OECD Green Growth Studies

Linking Renewable Energy to Rural Development



OECD

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BETTER POLICIES FOR BETTER LIVES

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Foreword

This publication is the final report of the OECD's two-year research project "The Production of Renewable Energy as a Regional Development Policy in Rural Areas". It presents the project's main findings, policy recommendations, and case studies.

The research project was carried between June 2010 and June 2012, when final results were presented at an international conference, in Paris. In 2009, member states gave the OECD a mandate to develop a Green Growth Strategy; this set in motion a wide range of OECD work on green growth and led the Rural Development Programme to assess the potential of renewable energy deployment to generate economic growth in low-population-density regions. The project, carried out with the assistance of the International Energy Agency, brings together a substantial body of empirical evidence and provides "food for thought" for national, sub-national and local governments dealing with a green-growth agenda. Accordingly, this report feeds into the OECD's Green Growth Studies.

The research capitalises on the body of knowledge created by the OECD's Rural Development Programme over the last decade. The Rural Development Programme involves a broad network of stakeholders worldwide. It is linked to the Territorial Development Policy Committee (TDPC) and its Working Party on Territorial Policy in Rural Areas. These bodies provide governments with a forum for discussing regional and rural development.

In particular, this report builds on the *The New Rural Paradigm: Policies and Governance*. Published in 2006, *The New Rural Paradigm* offers a new way to interpret rural economies based on holistic approaches to development and inclusive (multi-level) governance concerning policy design and implementation. In particular, *The New Rural Paradigm* recognises that rural regions have the potential to capitalise their existing assets, such as location, natural and cultural amenities, and social capital. The most defining characteristics of this shift are a focus on places rather than sectors and an emphasis on investments rather than subsidies. Within this framework, renewable energy represents just another option available to rural communities to promote economic growth.

This publication, which is based on the active participation of a large number of public bodies dealing with rural development issues, owes much to these networks and represents a new approach to peer reviewing in rural development issues.

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The report was co-ordinated and drafted by Raffaele Trapasso (Administrator) under the direction of Joaquim Oliveira Martins (Head, Regional Development Policy Division), William Tompson, and José Enrique Garcilazo (Heads of the Rural Development Programme). Adam Brown and Simon Mueller from the Renewable Energy Division at the IEA provided information, data and drafting for the part of the report assessing global trends. The case study authors included Betty-Ann Bryce (Oregon), John Bryden (North Karelia, Troms County, Region Zealand), Margo Cointreau (Scotland and Friesland), David Freshwater (Prince Edward Island), Carlos Icaza Lara (Extremadura), Raffaele Trapasso (Abruzzo, Puglia, Québec and Middle Norrland), Amanda Weinstein (Tennessee, Iowa and Maine-Vermont). Major assistance was provided by Lucero Perez (consultant).

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Table of contents

Acronyms and abbreviations 13

Executive summary 17

Part I **Synthesis and policy implications** 21

Introduction 23

What are the goals of this report? 24
How is the report structured? 25
Note 26

Chapter 1 **Trends in global renewable energy markets and national policies** 27

The boom in global renewable energy 28
Can renewable energy compete with conventional energy? 29
The outlook for renewable energy 29
The policy drivers of renewable energy 32
Notes 35
Bibliography 36

Chapter 2 **Overcoming the barriers to renewable energy deployment** 37

Economic barriers 38
Other structural barriers to renewable energy deployment 42
Getting the policy mix right nationally and regionally 42
Notes 45
Bibliography 46

Chapter 3 **Renewable energy and rural development: Making the link** 47

The nature of renewable energy investment in rural areas 48
The impact of renewable energy on rural development 50
Notes 66
Bibliography 69

Chapter 4 **The challenges of linking renewable energy to rural development** 71

Harmonising the drivers of renewable energy deployment 72
Balancing the pace of deployment with regional capacity 75
Dependence on the public sector 77
Competition with other land-based rural industries 78
The mismatch between renewable energy and transmission infrastructure policy 79
Assessing the impacts of renewable energy policy on regional economies 81
Avoiding public opposition 83
Notes 85
Bibliography 87

Chapter 5 **Putting renewable energy to work in rural areas** 89

Developing a "place-based" approach that combines renewable energy with rural development 91
Replacing uniform national renewable energy targets with a more tailored approach 91
Recognising the spillover effects of narrowly-defined renewable energy policies 92
Promoting linkages between renewable energy and rural industries 93
Using inclusive governance to ensure sustainable rural development and public acceptance 94
Conclusion: Policies to ensure that renewable energy deployment benefits rural areas 97
Notes 99
Bibliography 100

Part II **Case studies** 101

Overview 102
The international research network and the outline of case studies 102
Note 103

Chapter 6 **Prince Edward Island, Canada** 105

The context 107
Renewable energy policy on Prince Edward Island: Objectives, opportunities and challenges 110
Assessment of policy impacts on rural development 115
Main challenges 117
Notes 118
Bibliography 119

Chapter 7 **Québec, Canada** 121

The context 123
Renewable energy policy in Québec: Objectives, opportunities and challenges 127
Assessment of policy impacts on rural development 132
Main challenges 134
Notes 136
Bibliography 137

Chapter 8 **Region Zealand, Denmark** 139

The context 141
Renewable energy policy in Region Zealand: Objectives, opportunities and challenges 145
Assessment of policy impacts on rural development 150
Main challenges 151
Notes 152
Bibliography 153

Chapter 9 **North Karelia, Finland** 155

The context 157
Renewable energy policy in North Karelia: Objectives, opportunities and challenges 161
Assessment of policy impacts on rural development 166
Main challenges 168
Notes 169
Bibliography 171

Chapter 10 **Abruzzo, Italy** 173

The context 175
Renewable energy policy in Abruzzo: Objectives, opportunities and challenges 178
Assessment of policy impacts on rural development 184
Main challenges 185
Notes 186
Bibliography 187

Chapter 11 **Puglia, Italy** 189

The context 191
Renewable energy policy in Puglia: Objectives, opportunities and challenges 194
Assessment of policy impacts on rural development 199
Main challenges 201
Note 202
Bibliography 203

Chapter 12 **Friesland, The Netherlands** 205

The context 207
Renewable energy policy in Friesland: Objectives, opportunities and challenges 209
Assessment of policy impacts on rural development 216
Main challenges 217
Notes 218
Bibliography 219

Chapter 13 **Troms County, Norway** 221

The context 223
Renewable energy policy in Troms County: Objectives, opportunities and challenges 227
Assessment of policy impacts on rural development 232
Main challenges 234
Notes 235
Bibliography 236

Chapter 14 **Extremadura, Spain** 237

The context 239
Renewable energy policy in Extremadura: Objectives, opportunities and challenges 241
Assessment of policy impacts on rural development 247
Main challenges 248
Notes 249
Bibliography 250

Chapter 15 **Middle Norrland, Sweden** 251

The context 253
Renewable energy policy in Middle Norrland: Objectives, opportunities and challenges 256
Assessment of policy impacts on rural development 260
Main challenges 262
Notes 264
Bibliography 265

Chapter 16 **Scotland, United Kingdom** 267

The context 269
Renewable energy policy in Scotland: Objectives, opportunities and challenges 271
Assessment of policy impacts on rural development 275
Main challenges 277
Notes 279
Bibliography 280

Chapter 17 **Iowa, United States** 283

The context 285
Renewable energy policy in Iowa: Objectives, opportunities and challenges 288
Assessment of policy impacts on rural development 292
Main challenges 293
Notes 295
Bibliography 296

Chapter 18 **Maine and Vermont, United States** 299

The context 301
Renewable energy policy in Maine and Vermont: Objectives, opportunities and challenges 304
Assessment of policy impacts on rural development 309
Main challenges 310
Note 311
Bibliography 312

Chapter 19 **Wallowa County, Oregon, United States** 315

The context 317
Renewable energy policy in Wallowa County, Oregon: Objectives, opportunities and challenges 321
Assessment of policy impacts on rural development 326
Main challenges 327
Notes 328
Bibliography 329

Chapter 20 **Tennessee, United States** 333

The context 335
Renewable energy policy in Tennessee: Objectives, opportunities and challenges 338
Assessment of policy impacts on rural development 342
Main challenges 344
Notes 345
Bibliography 346

Tables

Table 2.1. Characteristics of electricity support mechanisms 40
Table 3.1. Innovations in renewable energy products, practices and policies in the case study regions 56
Table 3.2. Key dimensions of regional integration systems in the case study regions 61
Table 3.3. Key institutional factors for regional innovation in the case study regions 62
Table 3.4. Key regional policy instruments in the case study regions 63
Table 5.1. Failures and new institutional arrangements to put renewable energy to work 95

Table 6.1. Prince Edward Island: Demographic data 107
Table 6.2. Prince Edward Island: Main economic indicators 108
Table 6.3. Agriculture and fishing on Prince Edward Island, 2010 108
Table 7.1. Québec: Demographic data 123
Table 7.2. Québec: Main economic indicators 124
Table 7.3. Forestry and mining in Québec, 2010 125
Table 7.4. The production of energy in Québec 126
Table 8.1. Region Zealand: Demographic data 141
Table 8.2. Region Zealand: Main economic indicators 141
Table 9.1. North Karelia: Demographic data 157
Table 9.2. North Karelia: Main economic indicators 158
Table 9.3. Biomass energy in North Karelia in 2008 and targets for 2020 165
Table 10.1. Abruzzo: Demographic data 175
Table 10.2. Abruzzo: Main economic indicators 176
Table 11.1. Puglia: Demographic data 191
Table 11.2. Puglia: Main economic indicators 192
Table 11.3. Installed renewable energy capacity in Puglia and Italy, 2011 194
Table 12.1. Friesland: Demographic data 207
Table 12.2. Friesland: Main economic indicators 208
Table 12.3. Installed renewable energy capacity in Friesland and the Netherlands 209
Table 12.4. Synergies between rural development policy and renewable energy in the Netherlands 212
Table 13.1. Troms County: Demographic data 223
Table 13.2. Troms County: Main economic indicators 224
Table 13.3. Renewable energy in Troms County, installed capacity and production, 2010 226
Table 13.4. The potential for small hydro developments in Norway 230
Table 14.1. Extremadura: Demographic data 239
Table 14.2. Extremadura: Main economic indicators 240
Table 14.3. The production of renewable energy in Extremadura, 2007 and 2010 241
Table 15.1. Middle Norrland: Demographic data 253
Table 15.2. Middle Norrland: Main economic indicators 253
Table 16.1. Scotland: Demographic data 269
Table 16.2. Scotland: Main economic indicators 269
Table 17.1. Iowa: Demographic data 285
Table 17.2. Iowa: Main economic indicators 285
Table 17.3. Iowa's federal renewable energy incentives and regulations 289
Table 17.4. Iowa's renewable energy incentives and regulations 290
Table 17.5. Iowa's wind and solar facilities granted state and local subsidies, 2009 294
Table 18.1. Maine and Vermont: Demographic data 301
Table 18.2. Maine and Vermont: Main economic indicators 302
Table 18.3. Maine and Vermont's federal renewable energy incentives 306
Table 18.4. Maine's renewable energy incentives 307
Table 18.5. Vermont's renewable energy incentives 308
Table 19.1. Wallowa County and Oregon: Demographic data 317
Table 19.2. Oregon: Main economic indicators 318
Table 19.3. Wallowa County's employment growth, 2001-2009 319
Table 19.4. Oregon's electric power generation by primary energy source, MWs, 2009 320
Table 19.5. Total renewable energy investment in Oregon, excluding hydro-electric, 2010 322
Table 19.6. Oregon's incentives and policies for renewables and efficiency 323
Table 20.1. Tennessee: Demographic data 335

Table 20.2. Tennessee: Main economic indicators 336
Table 20.3. Tennessee's federal renewable energy incentives..... 340
Table 20.4. Tennessee's renewable energy incentives..... 341

Figures

Figure 1.1. Global trends in renewable power generation except hydro-electric, 2000-2010.....28
Figure 1.2. The sharp fall in the cost of solar PV modules, 1976-2011 30
Figure 1.3. IEA projections for share of renewable energy in power, heat and transport by 2035 ...32
Figure 2.1. Factors influencing renewable energy competitiveness and the role of policies 38
Figure II.1. The OECD regional case studies.....103
Figure 8.1. Region Zealand: Patent applications in renewable energy technologies.....143
Figure 8.2. Denmark's energy strategy 2050.....147
Figure 8.3. Installed wind energy in Denmark, 2000-2011 148
Figure 10.1. Unemployment rates in Abruzzo, compared with the average rate in Italy and in OECD regions 176
Figure 10.2. Renewable energy policy framework in Abruzzo.....180
Figure 11.1. Renewable energy policy framework in Puglia 195
Figure 15.1. Installed wind energy in Sweden, 2000-2011 258
Figure 15.2. Patents in renewable energy technologies in Sweden, 1975-2005.....259
Figure 15.3. Relative cost of conventional sources of energy in Sweden, 2011 262
Figure 17.1. Iowa's industry mix, 2010.....286
Figure 17.2. Iowa's primary energy consumption by fuel type, 2009.....287
Figure 18.1. Maine's industrial mix, 2010 302
Figure 18.2. Vermont's industrial mix, 2010 303
Figure 18.3. Maine and Vermont's primary energy consumption by fuel type, 2009.....304
Figure 20.1. Tennessee's industry mix, 2010.....337
Figure 20.2. Tennessee's primary energy consumption by fuel type, 2009 338

Acronyms and abbreviations

ACOA	Atlantic Canada Opportunities Agency
AWTS	Atlantic Wind Test Site
CAB	County Administrative Board (Sweden)
CAP	Common Agricultural Policy
CCC	Copenhagen Clean-tech Cluster
CCS	Carbon capture and storage
CHP	Combined heat and power
CO_2	Carbon dioxide
CSP	Concentrating solar power
DOE	United States Department of Energy
DTU	Technical University of Denmark
EAFRD	European Agricultural Fund for Rural Development
EEA	European Economic Area
EFTA	European Free Trade Association
ETS	Emissions Trading Scheme
EU	European Union
FIP	Feed-in premium
FIRE	Finance, insurance, and real estate
FIT	Feed-in tariffs
GC	Green Centre
GDP	Gross domestic product
GF	Growth Forum
Gt	Giga tonnes
GVA	Gross value added
GW	Gigawatt
GWh	Gigawatt-hour, 1 kilowatt-hour equals 109 watt-hours
ha	Hectare
ICT	Information and communications technology
IEA	International Energy Agency
In/km^2	Inhabitants per kilometre squared

IWAL	International Wind Academy, Lolland
J	Joule
kb	Kilobarrel
kV	Kilovolt
kWh	Kilowatt-hour, 1 kilowatt-hour equals 103 watt-hours
kWp	Kilowatt peak
kWth	Kilowatt thermal
l	Litre
LAG	Local action group
LCRs	Local content requirements
LEADER	Links between the Rural Economy and Development Actions (*Liaison Entre Actions de Développement de l'Économie Rurale*)
LHC	Lolland Hydrogen Community
m/s	Metres per second
M^3	Cubic metre
MAMROT	Ministry for Regional Affairs and Land Occupation (Quebec)
Ml	Million litres
MRC	Regional County Municipalities (Quebec)
mT	Million tonnes
Mtoe	Million tonnes of oil equivalent
MVA	Megavolt ampere
MW	Megawatt
MWh	Megawatt hour, 1 megawatt-hour equals 106 watt-hours
NOK	Norwegian Kroner
NREAP	National Renewable Energy Action Plan
NRP	New Rural Paradigm
O&P	Operation and maintenance
PEI	Prince Edward Island
PJ	Petajoule, 1 petajoule equals 1015 joules
PPA	Power purchase agreements
Ppm	Parts per million
PV	Photovoltaic
R&D	Research and development
RE	Renewable energy

REAP	Rural Energy for America Program
REC	Renewable energy certificate
RES	Renewable energy sources
RPS	Renewable Portfolio Standards
SEK	Swedish kroner
SME	Small and medium-sized enterprises
TGC	Tradable green certificates
TJ	Terajoule, 1 terajoule equals 1012 joules
toe	Tonne of oil equivalent
TWh	Terawatt-hour, 1 terawatt-hour equals 1012 watt-hours
USDA	United States Department of Agriculture
VAT	Value added tax
WD	Western Economic Diversification Canada
WEICan	Wind Energy Institute of Canada

Executive summary

Renewable energy (RE) is being championed in many places as a potentially significant new source of jobs and rural growth in OECD countries, and as a means of addressing environmental and energy security concerns. In most countries, governments have invested large amounts of public money to support RE development and are requiring significant quantities of RE to be sold by energy providers. But what are the economic impacts of these policies and investments? Can RE really help to develop rural economies? These are some of the questions explored by this report, which presents the results of a two-year study of the impact of RE on rural development. Drawing on case studies in 16 regions across Europe and North America, it finds that while RE indeed represents an opportunity for stimulating economic growth in host communities, it also requires a complex and flexible policy framework and a long-term strategy.

What does renewable energy offer rural areas?

The global deployment of RE has been expanding rapidly. For instance, the RE electricity sector grew by 26% between 2005 and 2010 globally and currently provides about 20% of the world's total power (including hydro-power). Rural areas attract a large portion of the investment in RE deployment. The case studies found that RE deployment can provide host communities with several benefits, including:

- **New revenue sources.** RE increases the tax base in rural communities, which can support better service provision. It can also generate extra income for landowners and land-based activities. For example, farmers and forest owners who integrate renewable energy production into their activities have diversified, increased and stabilised their income sources.
- **New job and business opportunities**, especially when a large number of actors is involved and when the RE activity is well integrated within the local economy. Although RE tends to have only a limited impact on local labour markets, it can create valuable jobs in regions where there are otherwise limited employment opportunities. While RE creates some direct jobs – such as in operating and maintaining equipment – most of the long-term jobs created are indirectly related to RE, and arise along the renewable energy supply chain (in manufacturing, specialised services and so on).
- **Innovations in products, practices and policies** in rural areas. In hosting RE, rural areas are the places where new technologies are tested, challenges first appear, and new policy approaches are trialled. Some form of innovation related to renewable energy was observed in every case study. The presence of a large number of actors in the RE industry enriches the "learning fabric" of the region. Small and medium-sized enterprises are active in finding business niches as well as clients and valuable suppliers. Even when the basic technology is imported from outside the region, local actors often adapt it to local needs and potential.

- **Capacity building and community empowerment**. As actors become more specialised and accumulate skills in the new industry, their capacity to learn and innovate is enhanced. Several rural regions have developed specific local institutions, organisations and authorities to deal with RE deployment and as a reaction to large-scale investment and top-down national policies. This dynamic has been observed both in regions where local communities fully support RE and in regions where the population is wary of the potential risks associated with RE deployment.
- **Affordable energy**. RE provides remote rural regions with the opportunity to produce their own energy (electricity and heat in particular), rather than importing conventional energy from outside. Being able to generate reliable and cheap energy can trigger economic development.

Key challenges: Putting renewable energy to work in rural areas

Renewable energy policy is expected to deliver in three areas: energy security, climate change mitigation and economic development (job creation). However, without the right policies this is not always the case and there can be significant trade-offs among these goals. For instance, large biomass heat and power plants can generate new employment opportunities in rural communities but may increase CO_2 emissions through land-use change and transportation of feedstock over relatively long distances. Similarly RE is in most instances a capital-intensive activity; the energy sector as a whole represents a small share of employment in regional economies. Small-scale installations typically source labour and equipment from international suppliers, thus limiting the community impact in terms of job creation.

On the other hand, a well-designed framework for regional policy could offer a real opportunity to reconcile policy trade-offs and identify potential complementarities among the objectives of energy security, climate change mitigation and job creation. This underlines the need for a shift in the approach to rural development in many OECD countries. This should place less emphasis on sectoral policy and subsidies in favour of policies that are place-based, grounded in local conditions and opportunities and that focus on the competitiveness of rural areas. Specific factors to bear in mind include:

- **Embed energy strategies in the local economic development strategy** so that they reflect local potentials and needs. Environmental and energy security arguments tend to be the main impetus for promoting renewable energy, and the local economic benefits tend to get overlooked.
- **Integrate RE within larger supply chains in rural economies**, such as agriculture, forestry, traditional manufacturing and green tourism.
- **Limit subsidies in both scope and duration**, and only use them to encourage RE projects that are close to being viable on the market. If subsidies are too high, they can attract rent-seeking investors, lead to high-cost energy that is only viable as long as high levels of subsidy are sustained, have a negative impact on land use and displace other activities such as agriculture and tourism.
- **Avoid imposing types of RE** on areas that are not suited to them. For example, wind power is only appropriate in certain places – more care is needed to identify those places rather than adopting policies that somewhat arbitrarily spread RE projects across national landscapes.

- **Focus on relatively mature technologies** such as heat from biomass, small scale hydro and wind. These proven technologies are not likely to experience big evolutions in technology that can leave new plants suddenly obsolete.
- **Create an integrated energy system** based on small grids able to support manufacturing activities. Policy should take into account backstop technologies for power sources that are intermittent, such as wind and solar. In several regions, the capacity to deploy RE is constrained by grid limitations yet there are no incentives to improve transmission infrastructure.
- **Recognise that RE competes with other sectors**, particularly for land. Poor siting can adversely affect local residents and disrupt tourism, which is typically a much larger source of income and employment.
- **Assess potential projects using investment criteria**, and not on the basis of short-term subsidy levels.
- **Ensure local public acceptance by ensuring clear benefits to local communities and engaging them in the process:** this is crucial as local opposition can slow construction and may make introducing future RE projects even more difficult.

There are no shortcuts to rural development. Policy makers should always take into account the overall cost of energy, and implement the least expensive energy solution that can also satisfy carbon emission reduction requirements. Only a coherent and integrated development strategy can promote growth and improve the environment.

Part I

Synthesis and policy implications

Introduction

Box 0.1. **What is a "rural region"?**

The OECD defines "rural" through a two-fold methodology. First of all, the OECD identifies two levels of geographic units within each member country. The higher level (Territorial level 2 [TL2]) consists of 362 larger regions while the lower level (Territorial level 3 [TL3]) is composed of 1 794 smaller regions. In most of the cases they correspond to administrative regions and TL3 are within TL2. This classification facilitates greater comparability of geographic units at the same territorial level.

The second step is to identify the different "geography" of each region. For instance, in the United Kingdom one could question the relevance of comparing the highly urbanised area of London to the rural region of the Shetland Islands, despite the fact that both regions belong at the same territorial level. Thus, the OECD has established a regional typology according to which TL3 regions have been classified as predominantly urban (PU), predominantly rural (PR) and intermediate (IN).

The OECD regional typology – calculated only for TL3 – is based on three criteria. The first criterion identifies rural communities according to population density. A community is defined as rural if its population density is below 150 inhabitants per square kilometre. The second criterion classifies regions according to the percentage of population living in rural communities. Thus, a TL3 region is classified as:

- Predominantly rural (rural or PR), if more than 50% of its population lives in rural communities.
- Predominantly urban (urban or PU), if less than 15% of the population lives in rural communities.
- Intermediate (IN), if the share of population living in rural communities is between 15% and 50%.

The third criterion is based on the size of the urban centres. Accordingly:

- A region that would be classified as rural on the basis of the general rule is classified as intermediate if it has an urban centre of more than 200 000 inhabitants representing no less than 25% of the regional population.
- A region that would be classified as intermediate on the basis of the general rule is classified as predominantly urban if it has an urban centre of more than 500 000 inhabitants representing no less than 25% of the regional population.

What are the goals of this report?

The deployment of renewable energy (RE, see Box 0.2 below for definitions) is increasingly being championed as a potentially significant source of job creation in OECD countries, as well as addressing concerns with energy security and climate change. In most OECD member countries, governments have invested large amounts of public money to support RE development. Many governments require energy providers to sell significant quantities of RE. A large part of this investment goes to rural regions, seen as ideal for siting RE instalments owing to the space-intensive nature of most RE technologies (Box 0.2).

Yet experience shows that the economic benefits of RE deployment for rural communities are not automatic: realising them requires care, thought and the right policy framework. This report aims to help policy makers link renewable energy deployment to regional development in rural areas. It also seeks to clarify what kind of opportunities and challenges rural communities should expect from RE. As the hosts of alternative energy installations, rural communities bear the related costs – it is only fair that they should also reap the benefits.

The study's findings are relevant for public and private stakeholders acting at international, national, and regional levels. Though based on a study of OECD regions, rural constituencies in both OECD and non-OECD countries can benefit from the findings. They also transcend the bounds of rural development policy, with important implications for national and international authorities dealing with energy policy and environmental policy.

Energy and environmental policies generally take a top-down approach in which objectives and interventions are designed at a national or supra-national level (as in the case of the European Union's strategy on climate change mitigation). However, their impact is often felt at the local level. The report finds that in many regions, poorly-designed renewable energy policy has often negatively affected the welfare of rural communities. Where this has happened, citizens have in some cases started opposing renewable energy deployment in their areas. This increases transaction costs and undermines the capacity of renewable energy policy to deliver energy and reduce carbon dioxide emissions.

The report can also help to inform international debate on environmental issues. In recent years, the promise of "green growth" has driven policy support for investment in green technologies, which are seen as a panacea for combining environmental sustainability with economic growth. While there is no doubt we need to find ways of spurring growth while addressing environmental challenges, there is a need for realism about some of the costs of the "green option", as well as the complexities of combining "green" with "growth". Ignoring or underestimating the negative impacts of some green policy instruments, or raising unrealistic expectations about their benefits, can ultimately make it harder to put the global economy on a greener development path. Ensuring that greener policies are also politically and economically sustainable is arguably of particular importance in the current economic context. Sluggish or negative growth and slack labour markets have made policy makers and electorates even more sensitive to the economic costs of various policy choices.

Box 0.2. **Which renewable energy technologies are included in this research?**

Renewable energy incorporates a broad portfolio of technologies, all at different stages of maturity and economic competitiveness under current market frameworks. Concerning electricity, a distinction is often made between large hydro-electric power (defined as larger than 10 megawatts) and other RE sources. This is because large hydro power is a very mature energy technology – in fact its share was higher than today during the early days of electrification in many power systems. Therefore the policy challenges associated with its deployment are different from those technologies that are still evolving, such as solar, wind and geothermal energy. Moreover, its important impact on land use and landscape means that building new large-scale hydro-plants tends to be a rare option in OECD countries. For these reasons, large hydro power is not included in the current report. However, small (<10MW) and micro hydro-power systems do form a part of some RE portfolios and can often fit well within rural communities and so are considered in this report.

How is the report structured?

The report is divided into two parts. Part I synthesizes the findings emerging from the research, and especially the 16 case studies. It is divided into five chapters:

- Chapter 1 assesses the global trends for renewable energy deployment, based on a contribution provided by the International Energy Agency.
- Chapter 2 discusses the barriers to RE deployment, particularly the economic barriers, and proposes ways of overcoming them
- Chapter 3 outlines numerous ideas for making the link between RE and rural development.
- Chapter 4 discusses key challenges observed in the case studies that are undermining attempts to link RE and rural development.
- Chapter 5 rounds up Part I with policy solutions and, in particular multi-level governance mechanisms, which could improve the links between renewable energy deployment and rural development.

Part II presents the 16 regional case studies: Prince Edward Island and Québec (Canada); Region Zealand (Denmark); North Karelia (Finland); Abruzzo and Puglia (Italy); Friesland (The Netherlands); Troms County (Norway); Extremadura (Spain); Middle Norrland (Sweden); Scotland (United Kingdom); Iowa, Maine/Vermont, Wallowa County, Oregon, and Tennessee (United States).[1] The case studies were designed and conducted following a common research framework to make comparison among them easier. Each case study summarises the socio-economic profile of each region, focusing on the energy sector, and then discusses the impact of renewable energy deployment on regional development. The analysis explores whether RE is well integrated within the regional economy; whether it has created business opportunities; whether it has given rise to rent-seeking behaviours; and, finally, whether the investment in RE is empowering local communities to build skills, innovation capacity and multi-level-governance mechanisms. The case studies provide recommendations for linking RE deployment to rural development policy, while also assessing missed opportunities and co-ordination failures.

Note

1. The RE deployments in Maine and Vermont are merged into a single case study due to the close resemblances of these two New England states in terms of renewable energy policy.

Chapter 1

Trends in global renewable energy markets and national policies[1]

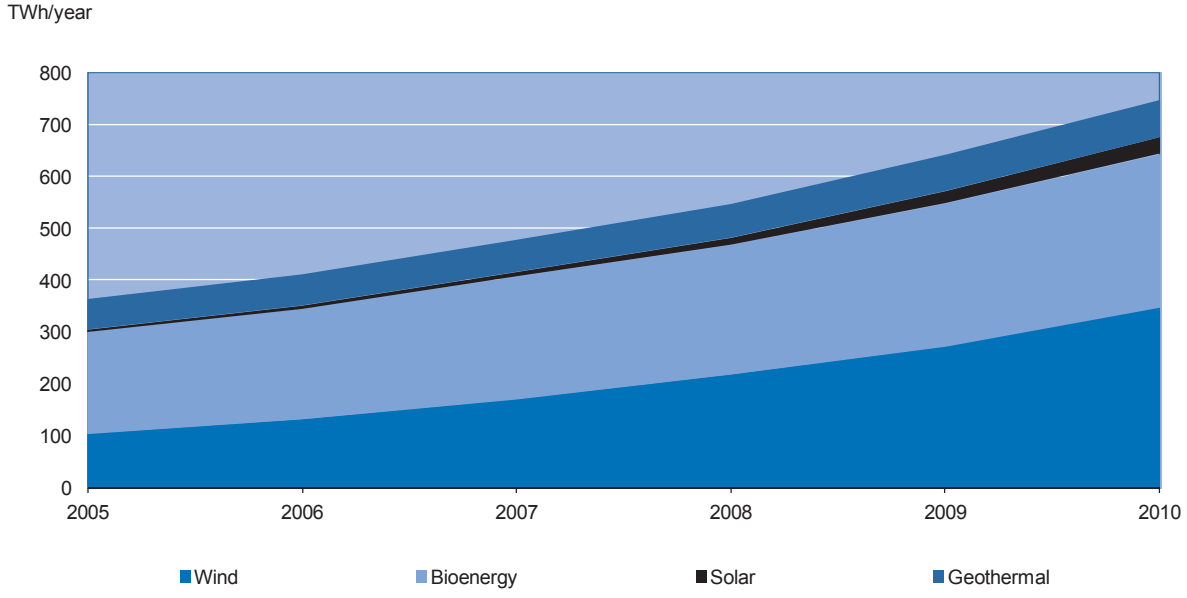
This chapter provides background information for the overall report. It assesses the trends of installed capacity, taking into account electricity, heating and cooling. It compares the cost of producing renewable energy to that of conventional fuels and discusses the current trends. The chapter presents an outlook on renewable energy deployment, based on IEA projections. Finally, it presents the drivers underpinning renewable energy across the globe.

The boom in global renewable energy

The renewable electricity sector is booming: it grew by 26% between 2005 and 2010. Today it provides about 20% of the world's power. Hydro-electric power generates 84% of the world's renewable electricity, while the other newer renewable electricity technologies have also grown rapidly, doubling their production between 2000 and 2010 (Figure 1.1). Wind has grown most rapidly in absolute terms. Solar photovoltaic has grown at a rate of 50%, and installed capacity reached about 70 GW globally by the end of 2011. Renewable energy (RE) for heating, cooling and transport fuels is also steadily growing. The production of heat from renewable sources grew by 6% between 2005 and 2009, with the use of biomass (e.g. wood) still the dominant technology, accounting for around 10% of global primary energy supply if one includes the use of "traditional" biomass, with low efficiency, for heating and cooking in developing and emerging economies. However more "modern" heating technologies – particularly solar, but also geothermal – have seen an overall growth rate of nearly 12% between 2005 and 2009. This growth was driven in large part by rapid increases in solar heating in China. The production and use of biofuels for transport have also been growing rapidly, providing 3% of road transport fuels globally (2% of all transport fuels) in 2009. Ethanol production and consumption are mainly concentrated in the United States and Brazil, while Europe principally produces and consumes biodiesel.

Progress in RE electricity penetration was initially concentrated in OECD countries, but the emphasis has shifted in recent years to the developing economies – particularly to China, India and Brazil – in response to their rapidly growing appetite for electricity.

Figure 1.1. **Global trends in renewable power generation except hydro-electric, 2000-2010**



Source: IEA (2011), *Deploying Renewables 2011: Best and Future Policy Practice*, OECD Publishing, Paris, *10.1787/9789264124912-en.*

These positive trends are linked to policy interventions that have tried to capitalise on the potential of RE to deliver on different key policy goals such as climate change mitigation, energy security and economic development. National and supra-national authorities have put in place a range of subsidies, grants and regulations to support RE deployment and experimentation, which have helped reduce the cost of RE. However, RE deployment still faces structural challenges that need to be tackled. These include their competitiveness with conventional source of energy in terms of price and reliability, avoid to become dependent on public support; providing investors with a stable policy environment; the highly complex policy environment; and public acceptability (discussed in Chapter 2).

Can renewable energy compete with conventional energy?

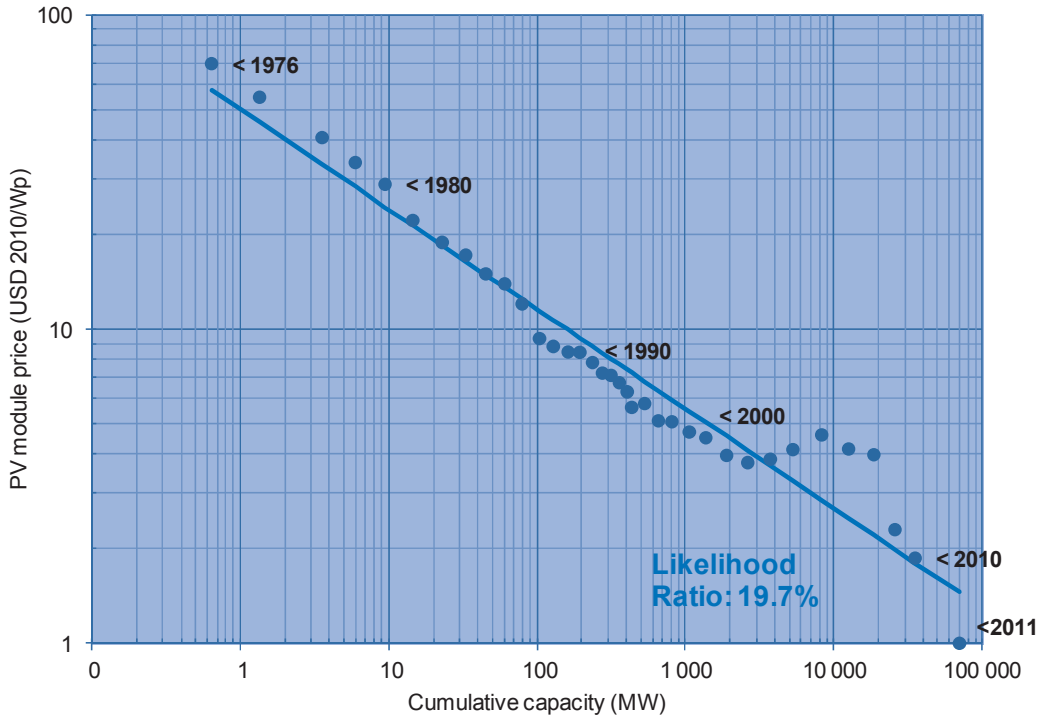
The costs of producing energy from renewable sources depend very much on location and the resources involved. In favourable circumstances (large solar irradiance, or good wind resources, for instance), renewable energy from hydro, wind and geothermal electricity can be cost-competitive with energy from fossil fuels, as can heat from biomass, geothermal and solar energy. As deployment levels rise, the costs of less mature renewable sources – such as wind and solar photovoltaic – are falling as experience and cumulative capacity grows. The capital cost of on-shore wind turbines has been halved over the last 30 years, while efficiency and reliability have increased. Wind energy is cost-competitive in an increasing number of cases. For example, wind projects in New Zealand (where mean annual wind speeds can be above 10 metres per second) are being developed in the absence of any government support. The cost of solar PV has also been falling very quickly over the last few years as demand has risen sharply, with costs declining by 19% with each doubling of global capacity (Figure 1.2). Electricity from PV is expected to be competitive with retail electricity prices in some regions within the next few years, especially where both solar radiation levels and the cost of generation from fossil sources are substantially higher – for example, in remote off-grid locations at low latitudes.

Nevertheless, RE production costs are generally still higher than for conventional energy systems. This gap is buffered by various forms of public financial support in most OECD countries. Support is provided to make investment in the technologies profitable. This is necessary within current pricing structures, which often fail to reflect the externalities associated with the environmental impacts of fossil fuels, for example, or where fossil fuel use is subsidised. Much will depend on what happens to fossil fuel prices.

The outlook for renewable energy

The share of renewables in the energy sector is bound to grow considerably. In Europe, this growth will largely be driven by policies adopted at supra-national level, especially the European Union's renewable energy sources directive, which requires each EU country to give renewable energy sources (RES) a 20% share in final consumption by 2020 (Box 1.1). This translates into a share of renewables in the power sector of 35% – a strong increase on current penetration levels. In the United States, by contrast, the impetus is coming largely from the state level: there is no federal target. State targets vary widely:

Figure 1.2. **The sharp fall in the cost of solar PV modules, 1976-2011**



Source: IEA (2011), *Deploying Renewables 2011: Best and Future Policy Practice*, OECD Publishing, Paris, *10.1787/9789264124912-en*.

- 29 states (and the District of Columbia) have mandatory Renewable Portfolio Standards (RPS);
- 8 states have renewable energy goals; and
- 18 states offer performance-based financial incentives, including feed-in tariffs (FITs) or tradable renewable energy credits (RECs) schemes.

Despite this very different policy framework, RE (including large hydro) accounted for about 10% of total power generation in the US in 2010, which is similar to the EU level. RPS targets should add about 4-6 GW of power every year from renewable energy between 2011 and 2020, independent of the federal incentive picture (see US case studies in Part II). However, if economic recovery proves difficult, deployment may fall below these levels.

Box 1.1. **The European Union's renewable energy targets**

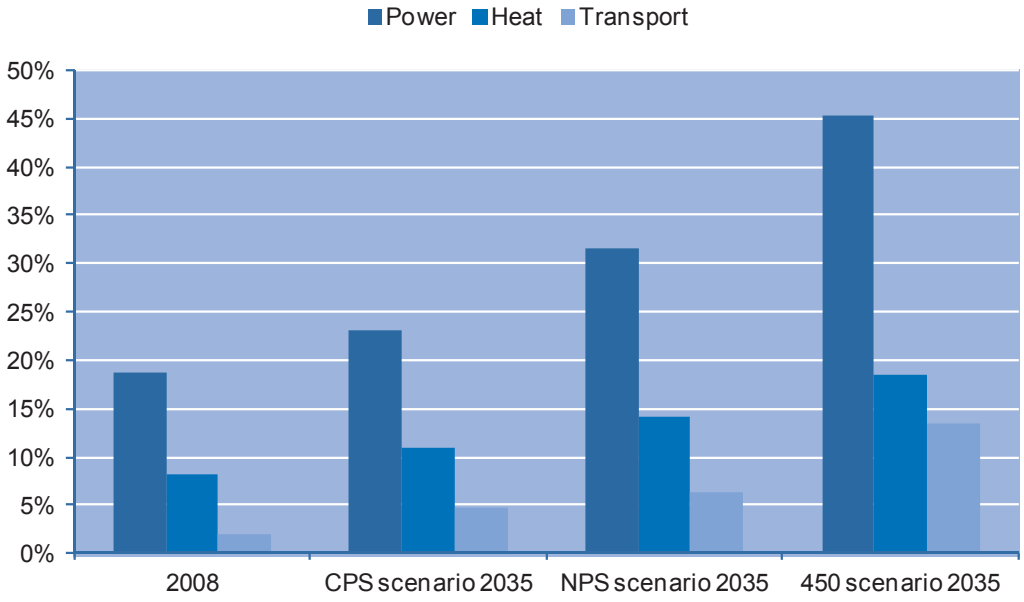
The EU's directive on the use of energy from renewable sources requires EU member states to reach an overall RE target of 20% of gross final energy consumption by 2020, with a sub-target of 10% for renewables in transport (EU, 2009). The share today is 8.5%. The overall target is divided among member states, so some states can have higher or lower shares. The directive requires member states to submit National Renewable Energy Action Plans (NREAPs) to the European Commission. These provide a detailed description of policy measures adopted by the member states to achieve their renewable targets in electricity, heating and cooling and transport by 2020.

According to the NREAPs, a total of 1.211 terawatt-hours (TWh) of electricity from renewables will be generated by 2020, of which 1.160 TWh will come from OECD-EU countries. In terms of installed capacity in the 27 countries of the European Union, the plans foresee a total installed capacity of 491 GW (of which 469 GW would come from OECD-EU countries). In OECD-EU countries, wind energy is expected to dominate the expansion in RE generation, and is likely to supply 478 TWh, while solar is expected to provide PV 82 TWh in 2020.

Source: EU (2009), "Directive 2009/28/EC of the European Parliament and of the Council on the Promotion of the Use of Energy from Renewable Sources and Amending and Subsequently Repealing Directives 2001/77/EC and 2003/30/EC", *Official Journal of the European Union*, 23 April.

RE plays an increasingly important role in projections for future global energy provision, particularly in scenarios which include measures to reduce carbon emissions from energy production. For example the IEA has modelled three such scenarios to 2035 (IEA, 2010). The first scenario, the Current Policies Scenario (CPS) assumes that only existing policies are in place. The second scenario, the New Policy Scenario (NPS) models the impact of promised but as yet unimplemented actions to fulfil countries' various pledges and other commitments to combat climate change.[2] The third scenario, the 450 Scenario, outlines an energy pathway that would limit the concentration of greenhouse gases in the atmosphere to 450 parts per million (ppm) of CO_2, which would be required for constraining further global warming. RE technologies feature in each scenario, but it is striking that the growth of the RE share under the CPS scenario is relatively modest, a fact which highlights the continued importance of climate-change policies in driving the growth of renewables (Figure 1.3). The more ambitious the effort to limit climate change, the greater the shift towards RE is likely to be.

Figure 1.3. **IEA projections for share of renewable energy in power, heat and transport by 2035**



Note: CPS = Current Policy Scenario; NPS = New Policies Scenario.

Source: Derived from IEA (2010), *Energy Technology Perspectives 2010: Scenarios and Strategies to 2050*, OECD Publishing, Paris, *10.1787/energy_tech-2010-en*.

The policy drivers of renewable energy

The growth in the deployment of RE has to a very great extent been policy-driven. Governments acting to encourage the deployment of RE technologies have typically cited three interlinked reasons:

- to improve energy security;
- to protect the climate and the wider environment from impacts of fossil fuels use; and
- to encourage economic development, particularly associated with land-based and marine industries (agriculture, forestry, etc.), or with manufacturing (Müller, Brown and Ölz, 2011).

In the sections which follow we consider the extent to which this is the case.

Energy security

Increasing the share of RE in a country or region's energy mix can improve energy security by providing greater diversity of supply, and, in many contexts, providing a less centralised and more modular supply that may be less prone to disruption. However, renewable sources have some associated security issues of their own. These include supply fluctuations due to diurnal and seasonal variations in wind and sunshine, or changes in hydro generation when precipitation levels are lower than expected. Such

factors should also be considered in any energy security appraisal, particularly when renewable sources provide a significant proportion of supply in any energy sector. In essence, RE sources can add to system security only when they are dispatchable and controllable, and any assessment of their impact on energy security in a given context must take account of the full range of technologies engaged and the ways in which they can interact.

Reducing greenhouse gas emissions and environmental impacts

Current global patterns of energy production and consumption are unsustainable. Continuing with business as usual will lead to unacceptable increases in global average temperature levels, with potentially catastrophic consequences.

RE technologies can play a key role in combating climate change. Studies indicate that RE technologies have life-cycle CO_2 emissions that are significantly lower than fossil-based technologies and comparable to those of nuclear generation (e.g. Cherubini *et al.*, 2009; NEEDS, 2009; POST, 2006). The life-cycle balance is also an important consideration for the other sectors, such as heat and transport.

IEA has assessed the contribution of RE technologies to reducing greenhouse gas emissions in the power sector (IEA, 2011a). They did so by comparing CO_2 savings from RE with a hypothetical situation in which no RE technologies (including hydro) are present in the power generation mix. To define a country's baseline, its renewable electricity share was replaced by the country's average non-renewable power-generating technology mix. Each conventional technology contributed to the replacement according to its share in the 2008 generation mix. The analysis was performed for 56 countries.[3] The results show that, for 2008 alone, RE technologies in the focus countries avoided the emission of 1.7 gigatonnes (Gt) of CO_2. This total is more than the aggregate power sector-related CO_2 emissions of the OECD Europe region in the same year (1.4 Gt CO_2). While these results in part reflect the exclusion of large hydro, which accounts for a very large share of power generation in many places (98% in Norway, for example), they underscore the role of conventional power generation in the emission of greenhouse gases. Most countries will find it extremely difficult, if not impossible, to achieve their climate change objectives without addressing emissions from the power sector.

Economic development

The deployment of RE technologies is frequently given high priority within a comprehensive strategy for more sustainable economic growth, sometimes summarised by the term "green growth" (OECD, 2011). RE technologies featured prominently in a number of countries' economic recovery packages in 2008/09, such as the United States. RE technologies provide new sources of natural capital, by allowing locations with good solar or wind resources, for example, to exploit these "new" assets to support their own energy needs. RE technologies may also allow countries to exploit RE resources with long-term export potential, by producing biofuels sustainably or by using high levels of solar radiation to generate exportable electricity via concentrating solar power (Brown *et al.*, 2011).

Job creation is another policy objective cited by governments as a reason for promoting RE. In its 2008 *Green Jobs* report, the United Nations Environment Programme (UNEP) concludes that "Compared to fossil-fuel power plants, renewable energy generates more jobs per unit of installed capacity, per unit of power generated and per dollar invested" (UNEP *et al.*, 2008).[4] Such claims are particularly appealing to policy

makers facing high and persistent unemployment. They should not, however, be taken at face value. Firstly, many of the jobs in RE sectors depend on a high and stable level of public subsidies to RE supply chains. Secondly, at an aggregate level, the critical question concerns not the creation of "green jobs" in specific sectors, but the aggregate employment impact of de-carbonising the economy: over the very long run, this impact should be zero, but in the short-to-medium term it will involve a good deal of both job destruction and job creation, and it may turn out to be negative in many places. For host communities, however, the more relevant concern is often the potential employment impact locally. In rural communities, even small-scale job creation can make a difference, and it is this prospect that has prompted many rural communities to embrace RE projects. RE has been particularly attractive to rural communities hit hard by rising fossil fuel prices and/or the decline of traditional sectors.

Potentially, at least, RE projects can offer rural host communities a range of economic benefits, including new investment, increased tax revenues and new jobs. They may stimulate the creation of new firms in the area and, in some cases, they may foster the emergence of new sectors that occupy niches in larger national or international supply chains. Where projects involve a significant degree of community ownership, local communities may directly capture a share of the resource and policy rents. In some circumstances, RE projects may also reduce the cost of heat or power, with concomitant benefits for local competitiveness. However, none of these benefits is a necessary or inevitable consequence of RE deployment. As will be seen later in this report, the benefits to rural host communities depend to a great extent on the way in which projects are designed and deployed. Issues like community ownership, appropriate design of public support instruments and the engagement of local stakeholders all loom large in the analysis that follows.

Notes

1. This chapter is largely based on information and data provided by the International Energy Agency (IEA, 2011a). The IEA is an autonomous body established in November 1974 within the framework of the OECD to implement an international energy programme. It carries out a comprehensive programme of energy co-operation among 26 of the OECD's 30 member countries. The basic aims of the IEA are: *i*) to maintain and improve systems for coping with oil supply disruptions; *ii*) to promote rational energy policies in a global context through co-operative relations with non-member countries, industry and international organisations; *iii*) to operate a permanent information system on the international oil market; *iv*) to improve the world's energy supply and demand structure by developing alternative energy sources and increasing the efficiency of energy use; *v*) to assist in the integration of environmental and energy policies. IEA member countries are: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, the Republic of Korea, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States. The European Commission also takes part in the work of the IEA.
2. *E.g.*, the pledges made at the Conference of Parties of the UN Framework Convention on Climate Change in Copenhagen (2010) and Cancun (2011).
3. A detailed methodology is presented in IEA (2011c).
4. It should be noted that energy is a capital-intensive sector with a very low use of labour and that the energy sector generally represents a very small share of employment at the national level.

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Chapter 2

Overcoming the barriers to renewable energy deployment

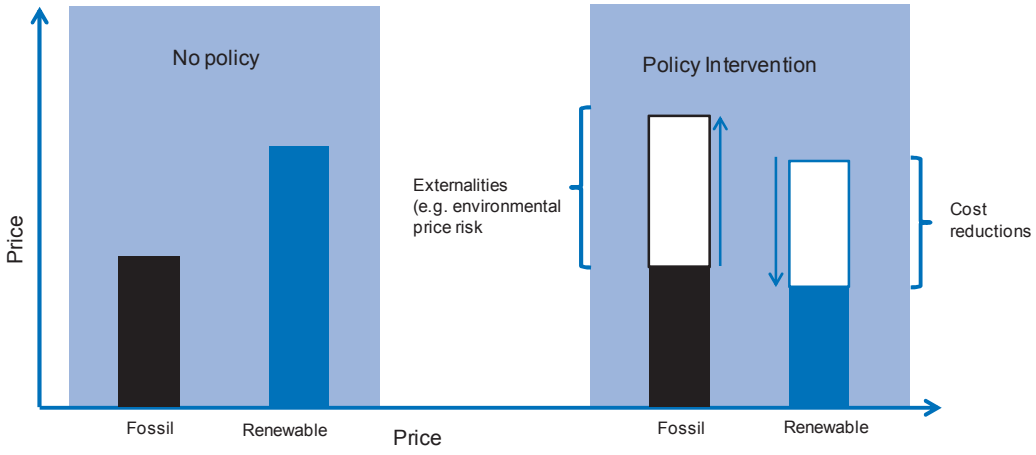
This chapter discusses how to overcome the main barriers to renewable energy deployment. It presents the main policies to deal with economic barriers, including investor security and high transaction costs. It also takes into account non-economic barriers such as lack of infrastructure and regulation, and ends with a discussion on the need for policy coherence within the renewable energy support framework.

Renewable energy (RE) technologies face several barriers that impede or even prevent their integration into an energy system primarily designed for the use of fossil fuels. Policy actions should remove these barriers if the share of RE in the energy supply mix is going to continue to rise. This chapter outlines the main barriers and puts forward some proposals for removing them.

Economic barriers

The key economic barrier to RE technologies is that they are not generally cost-competitive with conventional technologies under current pricing mechanisms (discussed in the section on "Can renewable energy compete with conventional energy?" in Chapter 1). The market expansion of RE technologies, however, has been accompanied by cost reductions in critical technologies, such as wind and, in part, solar PV, and such trends are set to continue. Where technologies are not yet competitive, short-term economic support such as through subsidies may be justified. This would help to use price to signal the environmental and energy security benefits of RE deployment when these are not reflected by current pricing mechanisms. Support is also justified to allow the newer RE technologies to mature enough to allow their cost to fall (Figure 2.1).

Figure 2.1. **Factors influencing renewable energy competitiveness and the role of policies**



Source: IEA (2011), *Deploying Renewables 2011: Best and Future Policy Practice*, OECD Publishing, Paris, *10.1787/9789264124912-en*.

Financial support policy options for the electricity sector

A number of policy options have been developed to address the economic barriers faced by RE technologies in the electricity market sector. These options include:

- **Feed-in tariffs (FITs).** These ensure the generator of renewable electricity is guaranteed a fixed purchase price per kWh for their electricity. The tariff is guaranteed at a fixed rate (sometimes indexed to inflation) over a long period, commonly 20 years. Although FITs were originally intended to be the only remuneration to generators, some more recent schemes instead offer a "feed-in premium" that is paid above the market price for electricity. Generators then have two sources of income: one from selling power directly on the market at the prevailing price, and an additional feed-in premium (FIP). To restrict the overall policy cost, some governments, including Spain,

the Netherlands, and Switzerland, have introduced annual caps on the amount of capacity that can benefit from FIT support in a certain time period, or have placed an annual limit on total expenditure.

- **Tradable green certificates (TGCs) or renewable energy certificates (RECs).** These systems are based on the idea of separating the actual power from its "greenness". The RE power is sold on the normal market but generators can also sell a certificate, representing a certain amount of renewable electricity, on a separate market established just for these certificates. Certificates are sold to large consumers or retailers of electricity who are obliged to buy a certain number of these certificates. Demand for certificates is ensured through quotas. The size of the quota obligation sets an upper bound for annual generation volume, because prices would drop sharply if there was to be an oversupply of certificates. TGC schemes can usually fine any entities who fail to buy sufficient certificates to meet their quota. In most cases, this penalty rate determines an upper bound for the value of certificates. In their original form, certificates did not differentiate by technology. Today some schemes encourage more expensive yet promising technologies by issuing more certificates for the same amount of electricity these technologies produce than to others (see Box 4.5).
- **Tenders.** These are used when a regulatory authority announces that it wishes to install a certain capacity of a given technology or suite of technologies. Project developers then apply to build the project and name the price at which they are willing to develop the project. Tenders commonly contain specific requirements (e.g. that manufacturing must be done locally, certain technological specifications, maximum price per unit of energy, etc.). The bidder with the lowest offer is selected to proceed with the project. Usually the parties sign a long-term contract (called a power purchasing agreement). Tenders are frequently used to meet government-set RE quotas in systems where there is no trading of certificates.
- **Tax incentives or credits.** These are particularly used in the United States to support RE technologies. An important prerequisite for this scheme to function is that tax credits can be traded. For example, if a wind farm operator generates USD 100 worth of tax deductions, the project owner can sell this deduction to companies, who can then deduct this amount from their taxes.
- **Direct cash grants/rebates.** These can be used to reduce investment costs and so improve returns for investors. The Section 1603 grant scheme works in the United States, for example, allows RE technology project developers to get back 30% of their investment costs in cash. This payment helps to make the technology more competitive. This measure was introduced after the market for tax credits (see previous bullet) collapsed due to the economic and financial crisis in 2009.

These mechanisms differ in the extent to which regulators can manage the rate and volume of RE deployment. They provide different opportunities to manage the prices paid to developers, and to control overall policy costs, and they provide different levels of security and certainty over the income that developers will receive. They also involve differing levels of bureaucracy, which make them more or less suited, for example, to small-scale deployment. The characteristics of the different systems are summarised in Table 2.1, and each is discussed in detail below.

Table 2.1. **Characteristics of electricity support mechanisms**

	FIT/FIP	TGC	Tender	Tax incentive	Capital grant
Deployment volume management	Difficult unless designed with capacity cap	Built-in but not technology specific	Good	None	Possible via cap on grant volumes
Price control	Very specific control possible; frequent reviews required	Price capped by buy-out fee and set by market; price floors can be introduced	Good	None	Possible by setting maximum grant levels
Investor security	High, some exposure to electricity market fluctuations for FIPs	Exposed to electricity and certificate market risks	High once concession is obtained, very low during bidding phase	High but susceptible to budget cuts	High but susceptible to budget cuts
Transaction costs/ complexity	Relatively simple if procedures streamlined and applicable to small developers	Complex, best for larger developers	Relatively straightforward but best for larger projects	Relatively simple as part of overall tax management	Relatively simple

Managing deployment volume

FIT systems can generate market distortions but are widely used and have proved effective at stimulating deployment and investment, since investors have a guaranteed income for the project lifetime. However, in most FIT systems, the market volume is unconstrained. This has proved problematic for a number of countries that have used FITs as a financial support instrument, particularly for solar PV. With fixed FIT tariffs and rapidly falling PV module prices, rates of return became highly attractive, leading to an explosion of capacity, and extremely high overall policy costs. The small and modular nature and short implementation schedules for PV reduced the extent to which regulators could foresee rapid deployment rates.

To avoid such situations, policies should be designed in a way that makes it possible to adapt tariffs to changes in system costs in a predictable way. For instance, by providing a clear schedule for regular review, by linking digression rates to deployment volumes, or by indexing support levels to globally-traded PV equipment prices, as far as transparent markets exist.

Such volume problems do not occur using the TGC, tendering and grant-based systems. These systems have built-in ways of controlling deployment volumes. For example, how the TGC cap is established can be controlled by tendering for set levels of capacity. The budget available for capital support can also be constrained. These systems also allow the overall rate of deployment to be managed, although, in the case of TGC schemes, the total volume, rather than levels of specific technologies, is influenced by the cap.

Ensuring investor security

Providing a secure environment for RE investors is particularly important in the early phases of market development. However, policy makers need to distinguish between risks arising from sub-optimal framework conditions on the one hand, and risks inherent to the sector on the other. The first type of risk needs to be mitigated as much as possible at all stages of market development. With increasing maturity of the RE market, stakeholders

should also be increasingly exposed to the second type of risk in order to ensure an efficient outcome. However, even in a mature market, effectiveness remains an equally important factor as efficiency.

Another important difference between FITs and TGCs is the risk exposure of RE generators. Under a classic FIT scheme, generators receive a fixed income for each unit of electricity and, therefore, are not exposed to market price fluctuations at all (except in some adapted versions, where a premium above the electricity rate is paid). In any case, FITs and FIPs do not expose generators to the price volatility of a certificate. Under a TGC scheme, generators are exposed to both electricity market and certificate market risk. Generators can mitigate this risk by securing long-term power purchase agreements (PPAs) covering the value of the electricity and certificates, but at some discount.[1] Investors may use conservative income values in preparing their investment cases, and so seek higher returns to mitigate these perceived higher risks. Tenders, when linked to secure PPAs at fixed or indexed power prices, provide a high level of security to developers and investors.

Another element of security relates to the longevity of the support schemes, which is important for building investor confidence that a viable overall market, not just a few projects, will be created. This is particularly important for the equipment supply industry. FITs and TGC schemes are usually promoted as long-running mechanisms that provide such security. The cost of a support scheme is usually funded by passing on the additional costs to all consumers. This arrangement insulates the project from public expenditure reviews and cuts.

Tenders, tax incentives and grant schemes offer less security in this sense, because they are usually of more limited duration. Tax breaks and capital grants are also dependent on public expenditure and budget uncertainties and are, therefore, vulnerable to cuts. These conditions are more likely to lead to stop-go patterns of deployment – not conducive to investment in the manufacturing facilities needed to support large-scale deployment. The US wind industry, which is principally stimulated by tax incentives, experiences these swings in deployment levels. Such boom-and-bust cycles can lead to spikes in equipment prices during a boom phase, because the high uncertainty prevents the development of a robust supply chain.

Transaction costs and complexity

The policy options in Table 2.1 also differ in their transaction costs and complexity. Under a FIT, the distribution grid operator is usually responsible for paying the generator. The contractual arrangements and procedures can be simplified. FITs are relatively easy to design at the central level, with limited information about the characteristics of local energy markets, and establish a low-risk environment that kick-starts markets and allows smaller players to come on board due to the relatively low bureaucracy that it is needed to handle them. With a TGC system, generators need to sell on both the certificate market and electricity power markets. The complexity and transaction costs associated with such systems are high and not as accessible as FITs to smaller investors. For similar reasons, tenders are best suited to larger-scale developers and investors, whereas tax-based incentives and grant schemes can be applied at different scales. TGC systems can however be adapted to make it easier for smaller generators, such as private households or small community projects, to take part. Guaranteed price floors, or giving for small-scale projects the option of selling certificates to government bodies are examples.

Other structural barriers to renewable energy deployment

There are a series of other barriers that are not related to the price of RE or to the form of incentives put in place. These include regulatory and policy uncertainty, institutional and administrative arrangements, and infrastructure designed with fossil fuels in mind that may be unsuited to more distributed energy supply or the high up-front capital demand of RE technologies:

- **Regulatory and policy uncertainty barriers:** Bad policy design, or discontinuity and/or insufficient transparency of policies and legislation.
- **Institutional and administrative barriers:** The lack of strong, dedicated institutions, lack of clear responsibilities and co-ordination among different sectors, and complicated, or non-transparent permitting procedures.
- **Infrastructure barriers:** These mainly centre on the flexibility of the energy system, e.g. the power grid, and its ability to integrate/absorb RE technologies efficiently and without risk of disruption and interruption.
- **Lack of awareness and skilled personnel:** Insufficient knowledge of the availability and performance of RE technologies as well as a lack of skilled workers.
- **Public acceptance and environmental barriers:** Linked to experience with planning regulations and public acceptance of RE technologies.

Even where the economic barriers have been addressed, the existence of these non-economic barriers can either prevent deployment altogether (no matter how high the willingness-to-pay) or lead to higher costs than necessary or distorted prices. The analysis of the effectiveness of policies carried out by the IEA (2011a) indicates that overcoming such barriers may be more important than deciding which financial support mechanism to use.

Getting the policy mix right nationally and regionally

An effective policy response would be to tackle the most significant of the non-financial barriers, while also putting appropriate financial support measures in place. In fact, tackling the non-financial barriers should reduce the need for financial support. This requires a balanced portfolio of measures that mutually reinforce each other, rather than interacting in a potentially undesirable way. Continual evaluation of policy interventions is also important, as a process of trial and error is inevitable when dealing with new sectors and new technologies like RE.

There is now a wealth of policy experience gained in the countries that have led the deployment of the technologies. In a recent analysis, the IEA (2011a) developed a number of quantitative policy indicators to help answer the following questions:

- Will national policies to stimulate growth in RE generation also lead to a sustainable energy future?
- Is a country paying a reasonable remuneration per unit of deployed RE technology?
- Is a country getting RE electricity generation in line with the remuneration that it allows for generators?

- Are the overall costs of support premiums in line with the technology's contribution to the country's electricity system?

The IEA developed a set of indicators to compare the effectiveness and cost effectiveness of policies developed for wind and for PV in OECD and BRICS[2] countries. The analysis indicates that there are some differences between the performances of the various financial support mechanisms. For example, FITs, for example, tend to be more cost effective than TGC schemes, although these differences are less important than the whole policy portfolio. The analysis identified a number of overarching principles for designing an effective RE policy portfolio:

- Provide a predictable and transparent RE policy framework, integrating RE policy into an overall energy strategy, taking a portfolio approach by focusing on technologies that will best meet policy needs in the short and long term, and backing the policy package with ambitious and credible targets.

- Take a dynamic approach to policy implementation, differentiating according to the current maturity of each individual RE technology (rather than using a technology-neutral approach), while closely monitoring national and global market trends and adjusting policies accordingly.

- Tackle non-economic barriers comprehensively, streamlining processes and procedures as far as possible.

- At an early stage, identify and address overall system integration issues (such as infrastructure and market design) that may become constraints as deployment levels rise.

The differences in deployment success between countries reflect the extent to which these principles have been applied. The experience with onshore wind developments, for example, demonstrates that those countries that have adhered to the principles outlined above have managed to induce a dynamic and stable market (Brown, *et al.* 2011). On the other hand, countries that lack a comprehensive and stable policy framework for RE deployment have seen boom-and-bust cycles in deployment and, accordingly, a less well-developed market, particularly in terms of the supply chain.

Another important policy principle is the need for close monitoring of market developments and adequate policy reaction. This is exemplified by developments in the solar PV market. In Germany, legislation required a regular policy review every two years (IEA, 2011a). In mid-2010, unscheduled tariff reductions were enacted following consultation with industry when markets were overheating. This approach avoided the problems experienced in Spain (see case study in Part II), where regulation was not flexible enough to respond to an overheating PV market in 2008/09, for instance. Experience shows that such retroactive changes to policies and support mechanisms can have long-lasting impacts on market confidence.

Finally, the success of policies depends on the objectives they are intended to meet. Consequently, setting realistic objectives is one important step in designing successful policies. If expectations are unrealistically high then it is no surprise when policies do not live up to them.

Ensuring policy coherence in the regions

Ultimately the objective of national policy is to achieve an appropriate balance among the three policy objectives of energy security, climate change mitigation and economic growth (Chapter 1). The current path emphasises expanding RE use through national policy support. But because different countries have different RE capabilities and different potential for RE to replace conventional energy there are clear differences in the extent to which RE has been adopted. In addition the level of subsidy has been a clear influence on RE deployment with countries providing larger incentives seeing faster adoption.

The impact of national policies can also vary significantly within countries. Ultimately every RE installation takes place in a specific region; regions can have widely diverging resource potential and relative costs between renewable and conventional energy. From a national perspective it may appear sufficient that an aggregate RE target is met irrespective of the particular mix of RE sources and their location. But in reality, how and where RE is produced and the price that users pay for it will have a major impact on economic activity.

The choice of national instruments and the level of support given to RE plays a large role in decisions about the size and type of RE installation. For example, while high FITs in place for long periods of time can stimulate rapid investment and rapid technological change, they can also lead to investments in places with limited resource potential, or to investments that may distort local economies by attracting too much land, labour and capital into the renewable sector, and thus causing damaging competition with other industries. Similarly the choice of instrument can bias investment to large *versus* small projects (Table 2.1).

Because RE policy is essentially decoupled from local market signals the resulting set of installations may not achieve local or national economic development objectives. This can happen because:

- too much or too little RE is produced in a given location;
- some types of RE are favoured over other types by national policy, even though some regions have clear strengths in the unfavoured alternatives; or
- relatively high priced RE sources are introduced in regions where conventional energy is inexpensive to provide, instead of in regions where conventional energy is expensive.

Because national strategies set the framework conditions for individual project decisions it is crucial to think about how the signals that policy provides influences action in different types of territory. This means that national policies not only have to be judged in terms of how well they reach aggregate goals for RE, but also in terms of how they alter regional economic development options. National mistakes in policy, such as the excessive investments in PV triggered by too high FITs, cause financial problems at the national level. But they leave an additional problem at the local level in the form of locked-in long-life investments that can limit future regional development options.

Notes

1. Quota obligations can exist in the absence of a certificate market. This is the case under some Renewable Portfolio Standards. In such cases, the party that is obliged to fulfil a certain quota can directly sign a PPA with a project developer. Examples even exist of using a FIT (paid by a party obliged to meet the quota obligation) to independent power producers (IPPs).
2. Brazil, China, India, Russia and South Africa.

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Chapter 3

Renewable energy and rural development: Making the link

This chapter focuses on the link between renewable energy and rural areas. It presents data showing that a significant share of the total investment in renewable energy takes place in rural regions. It discusses the numerous positive outcomes that are related to renewable energy deployment in a given rural region, such as the new source of revenues that support improved public services and the impact renewable energy has on fuel poverty in remote regions.

The nature of renewable energy investment in rural areas

Is investment in renewable energy (RE) a development opportunity for rural regions? This chapter discusses the patterns of RE investment in rural area, and its impacts on rural development. It is based primarily on the empirical evidence collected in case study regions (see Part II).

Rural areas attract a large part of overall investment in RE deployment. Installations have to be located where renewable sources of energy are available and possibly abundant, and also where there is space to host them. For all these reasons, low density areas – i.e. rural regions – are more likely to have these characteristics and so they are the most likely location for RE installations.[1]

In 2011, the global investment in RE was USD 211 billion (UNEP, 2011). Our analysis adds a spatial dimension to investment data to show that there is a close link between RE deployment and rural areas in terms of investment. The percentage of investment in new assets (mostly RE installations) that goes to rural areas varies according to the country. Box 3.1 explains our methodology and shows results for Australia, Canada, Germany and the US). Unfortunately, given the available data, it has not been possible to calculate an overall average for the total investment in RE that goes to rural areas. It is possible to affirm, however, that a large share of it percolates to rural communities, providing them with a range of new development opportunities.

Investment in RE sectors in rural areas comes from several sources, both public and private. For instance, the public sector is investing in demonstration projects, research and development (R&D), as well as in infrastructure to support RE deployment. This investment comes from all levels of government, from local to national. A large share of the overall investment comes from the private sector, which installs RE to take advantage of public incentives (FITs or green certificates, for instance). Several companies are also investing in R&D in rural areas. For instance, they are developing testing facilities to adapt installations to extreme climate conditions or to explore new technologies in places where it is possible to test the prototypes (see the case study about Québec or Region Zealand, for instance).

Precisely quantifying the RE investment in rural communities is a challenging exercise due to the number of different policies and projects in place. Data collected in field visits, however, provides some useful information:

- In Puglia, Italy, the regional government is in charge of co-ordinating a project co-funded by the European Commission and the national government to support the creation of an RE supply chain, including manufacturing and service sector, in Italy's southern regions (Puglia, Campania, Calabria, and Sicily). This Integrated Operating Programme for Energy (*Programma Operativo Integrato Energia*) aims to invest a total of EUR 1.6 billion in the south of Italy between 2007 and 2013.
- In Québec, the provincial government has invested heavily in RE industries, particularly in wind energy. It has a policy to promote a wind energy supply chain focusing on the development of manufacturing activities. The provincial policy focuses on Gaspésie, a predominantly rural region suffering from high unemployment. The total investment in RE is expected to total CAD 15.3 billion between the time the policy was launched in 2006, and its end in 2015.

Box 3.1. Measuring the share of renewable energy investment going to rural areas: A methodological note

We have calculated the share of RE investment going to rural areas using two sets of data: the amount of investment in RE at the TL2 (territorial level 2); and an index of rurality for each region, based on the OECD regional dataset.

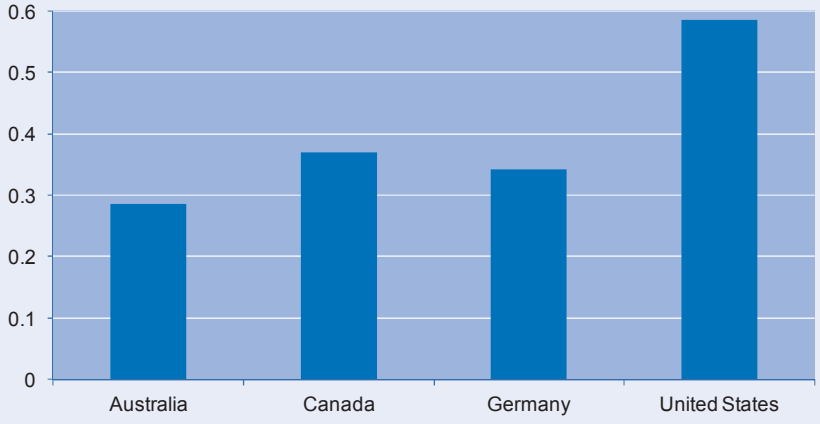
- Data on investment in RE in TL2 provide information about the amount of resources invested in new plants (*Installations and Asset Finance Investment*) at the regional level in 2011. They were provided by Bloomberg New Energy Finance.
- The index of rurality at TL2 is constructed using OECD data on rural communities (municipal level), and then taking the ratio between the population living in those rural communities and the total population of a given TL2 region.

The calculation of RE investment in rural areas links the amount of resources in a region with the rural index. The investment in rural areas in a given region is computed as the share of total investments in the region corresponding to the regional rural index. This is a rough approximation of the amount of resources going to rural areas. We believe, however, that this approximation underestimates the amount of resources going to rural areas, as the RE plants considered in the Bloomberg data set tend to be large-scale installations, and as such they are unlikely to be sited in urban areas.

The analysis, then proceed by aggregating the amount of investment in rural areas in each region of a given country, and calculating the country index as the ratio between the investment in rural areas and the total investment in that country. The outcome is a country average over regions, which indicates how much investment in RE goes to rural areas in each country

The match between the two data sets was possible only for a limited number of countries. In particular, the index was elaborated for Australia, Canada, Germany, and the United States. These countries offer a broad range of cases encompassing both highly urbanised regions and predominantly rural regions.

Percentage of renewable energy investment going to rural areas in selected OECD countries, 2010



Note: Australia and Canada, although being considered largely rural, are both strongly urbanised. As the localisation of installations is constrained by the grid, it is normal that in these countries RE tends to be deployed close to urban poles. This is not true in the United States where population and infrastructure is more scattered, and of course in Germany, where all regions, including rural areas, have a relatively high population density and good grid infrastructure.

Source: OECD Regional Statistics, *www.oecd.org/topicstatsportal/0,3398,en_2825_497132_1_1_1_1_1,00.html*; and Bloomberg New Energy Finance, *www.newenergyfinance.com/*.

- Extremadura, a historically underdeveloped region of Spain, received a total investment of EUR 1.4 billion in solar energy – PV and CSP – between 2008 and 2010.
- In Scotland RE investment totalled GBP 2.7 billion in 2009, and the region has just decided to deploy one of largest European on-shore wind farms in the Shetland Islands. It alone will involve an investment of GBP 650 million (in a community of 20 000 people).[2]
- In the United States, the American Recovery and Reinvestment Act of 2009 (ARRA), also called "Stimulus Package", allocated a total investment of USD 27.6 billion to RE sectors, between 2009 and 2019.[3] These funds have promoted demonstration projects and RE installations in all the American states involved in the research: Iowa, Maine, Oregon, Tennessee and Vermont.

To get an idea of the magnitude of RE investment compared with regional economies, consider that annual RE investment in Puglia between 2007 and 2013 is equal to 0.33% of the regional GDP (2009 values). In Québec, investment in RE represents 0.05% of GDP (also as of 2009). Finally, in Extremadura investment in RE in 2009 was equal to 2.7% of regional GDP.

The impact of renewable energy on rural development

Our research suggests that RE deployment can increase and stabilise rural incomes; contribute to the development of new products, new technologies, and new policy approaches, improving the overall innovation capacity in rural areas; empower local communities; and, finally, provide remote rural communities with cheaper sources of energy. These are discussed further below.

New sources of revenue to support key public services and infrastructure

RE deployment provides rural communities with new sources of revenues that can benefit public services and infrastructure. When an RE installation is developed in a rural area, the developer has to pay a series of taxes to the local community. Some of these taxes are paid as soon as RE is deployed; others are paid on a yearly basis and are related to business turnover. For instance, developers have to pay local governments for building permits, running their business in the area, etc. These local taxes represent a source of revenue for the host community and can have a dramatic impact on service delivery. In a similar vein, local authorities can decide themselves to install RE on public spaces, and take advantage of public subsidies for the production of alternative energy (Box 3.2). Finally, rural actors such as farmers can also produce RE to increase their incomes or diversify their core business.

We found much evidence of these dynamics in the international case studies (Part II). The most evident examples of taxes paid by developers to local governments come from the United States, where local communities are more dependent on local taxes to deliver public services. The presence of wind farms or PV fields in a community (municipality or county) has allowed the local government to invest more in the production of public goods and in the maintenance or improvement of infrastructure. There are also cases in Europe in which the presence of an RE developer in a rural community has had an impact on local public service delivery. In Extremadura (Spain), for instance, small municipalities hosting large PV fields or concentrating solar power (CSP) installations received a large amount of money upfront through building permits and changes in land

use (from agricultural to industrial land, for instance), as well as an annual income stream. These resources gave host communities the opportunity to build social housing, to attract new residents, and provide senior citizens with better services.

Box 3.2. **Local communities taking the initiative**

Many rural communities are themselves producing RE and taking advantage of available subsidies. For instance, in Abruzzo (Italy) a small mountain municipality of less than 1 000 inhabitants has installed PV panels on the top of the roof of the old school. The installation allowed the municipality to profit from Italy's very generous 2009/2010 FITs (*Terzo Conto Energia*) for PV electricity. Using these subsidies, the local government refurbished the school building and improve the school's overall quality and safety, also protecting it from closure. There are also examples of rural communities implementing large-scale RE deployment to generate a very large income. The Shetland Islands in the UK largely depend on the royalties paid by the oil companies that extract petroleum and natural gas from the North Sea. The royalties are used to produce key public services to ensure the sustainability of this remote community. However, realising that the oil and gas reserves will not last forever, the Shetland community has decided to invest in wind energy through a charitable trust. The Shetlands will host a large wind farm (around 120 turbines) that will generate a constant flow of electricity. By tapping into the UK's green certificates, the income should buffer the expected decline of the royalties paid by the oil industry.

Finally, there is a range of different ways in which rural landowners can link RE to their businesses. For instance, in several case study regions farmers were producing RE. This allowed them to diversify and stabilise their farming income, while offering additional long-term income possibly continuing after they retire. In some case study regions, landowners have played a central role in RE deployment:

- In the Netherlands during the 1980s, the central government decided to support the installations of wind turbines on farmland by providing FITs directly to farmers. This was to overcome the constraints related to land permits (farmers own their land) and improve the deployment of wind energy.
- In Extremadura (Spain) and Puglia (Italy), farmers deployed PV fields on their land to benefit from the high FITs. However, the way in which the national subsidies are designed does not allow farmers to take advantage of the electricity produced by their installations, which has to be entirely dispatched into the grid for them to be eligible to receive the premium price.[4]
- There are other technologies (and regulations) that allow farmers to use in a more flexible way the energy they produce. For instance, digesters (using agricultural residues as feedstock) can produce both electricity and heat (known as combined heat and power or CHP). In Puglia, farmers have to dispatch electricity onto the grid, but can keep the heat produced by their installations and use it in their production processes.[5]
- In Prince Edward Island (Canada), dairy farms can install small wind turbines and self-produce part of the energy they need. This reduces their energy costs.

- Forest owners can also benefit from RE. In Québec they can rent part of their land to wind installations. In Nordic Countries, and in particular in Middle Norrland (Sweden) and North Karelia (Finland), forest owners have been able to diversify their production by using forest residues as feedstock for district heating systems.

Jobs and business opportunities

Although RE is widely considered to be more labour intensive than conventional energy (Wei, *et al.* 2010), it remains a capital-intensive activity. The energy sector in general is capital intensive, and this holds true for solar, wind, and hydroelectric energy production. This is less true of biofuels, since these are the only renewable source that does not rely on a free energy source provided by nature. Even so, the creation of jobs involves large transaction costs and is certainly not automatic. We found only a limited impact of RE on local labour markets in terms of overall job creation (Box 3.3).[6] Although it was not possible to measure job multipliers in all case studies, due to the lack of recent data on regional trends, there are significant reasons why renewable energy policies should not be expected to have a large impact on overall employment.[7]

Box 3.3. **The impact of renewable energy on employment**

The number and the unit cost of new jobs created by investing in RE – i.e. the job multiplier associated with the investment – vary according to the activity. Energy generation is a capital-intensive activity with a low job multiplier and thus with a limited impact on the labour market. However, the jobs created are usually valuable and stable. The situation is completely different for RE installation construction, which typically has a far higher job multiplier and can generate up to 30 jobs for each USD million invested. However, construction is a short-term activity, so it does not affect the medium/long-term economic trajectory of rural communities in the same way. Manufacturing of RE parts also has high multipliers, and is a long-term activity (see table below). Regions able to increase their specialisation in manufacturing activities for renewable energy are thus likely to benefit from a large and lasting increase of their workforce.

Employment multiplier estimates for renewable energy

Province/region/state	Local
Generation (operation and maintenance) – 7-8 jobs for every USD 1 million in output	Generation (O&M) – 0.7-1 jobs for every USD 1 million in output
Construction of plant – 19-30 jobs for every USD 1 million of construction costs	Construction of plant – 12-15 jobs for every USD 1 million of construction costs
Manufacturing of electrical equipment – 16-24 jobs for every USD 1 million of output	Manufacturing of electrical equipment – 10-14 jobs for every USD 1 million of output

Source: Freshwater, D. (2010), "Green Power, Green Jobs", presentation at the launch seminar for the OECD project, *The Production of Renewable Energy as a Regional Development Policy in Rural Areas*, Montreal, 15 September, *www.oecd.org/dataoecd/31/1/46186430.pdf*.

Another important reason is that the energy sector in general usually represents only a small percentage of regional overall employment. This was evident in the case studies. For instance, in Tennessee, despite an impressive growth rate of 18.2%, the "clean jobs"

sector of the economy (as defined by The Pew Charitable Trusts, 2009) accounted for only 0.49% of Tennessee's employment in 2007, or 1 090 businesses and 15 507 jobs (The Pew Charitable Trusts, 2009). Hence, even if the renewable energy sector is able to replace the non-renewable sector, it will still account for a small percentage of overall employment.[8]

Nevertheless, RE can create some valuable job opportunities in rural areas. Some predominantly rural regions have benefited from the presence of valuable jobs in operation and maintenance activities (O&M). In a small rural community with less than 1 000 inhabitants in Extremadura, for instance, a large-scale (50 MW) CSP installation employs up to 40 people on open-ended contracts. In Gaspésie, Québec, workers in O&M for wind energy have annual salaries of up to CAD 80 000 per year – well above the regional average. This means that even if the few jobs created by RE in rural communities can have an important impact on the sustainability of communities. Finally, the analysis did not find any cases of RE displacing jobs in other activities – especially in the conventional energy industry – within local economies (Box 3.4).

Box 3.4. **Renewable energy deployment and job displacement in regional case studies**

Several researchers have raised the possibility that RE deployment can displace jobs – either directly from the conventional energy industry, or indirectly due to the higher cost of energy (Marsh and Miers, 2011; CEPOS, 2009; Calzata Àlvarez, *et al.* 2009). However, we did not observe this in the regional case studies. This may reflect several factors. First, where higher energy costs are diffused beyond the RE-producing region, it is likely that indirect employment destruction effects are similarly diffused and are spread across the economy as a whole.

Secondly, in many regions RE and conventional energy are evolving in parallel. These regions deploy a large quantity of wind or solar energy and yet produce the bulk of their electricity using conventional technologies. RE might thus displace some new job creation in conventional sectors (energy demand is rising, and if RE were not deployed, conventional production would rise) but without destroying existing jobs. In some regions specialised in the production of energy, such as the Shetland Islands, RE sectors suffer from competition with the oil industry, which absorbs a large number of workers and pays higher salaries.

Concerning the indirect displacement of jobs, there may be a lag between RE deployment, the increase of energy costs, and the impact on the productive fabric of a country or a region. Given that any increases in energy costs, such as in Italy and Spain, are relatively recent, it might be too early to detect any indirect impact on regional economies. However, it is also possible that energy-intensive businesses would react to an increase in energy costs by improving their energy efficiency. This was the case of a large company in Tromsø, Norway, producing ferrosilicon, which installed a CHP system to recover some of the energy used in the production process to reduce the consumption of electricity, in response to a sudden increase of energy prices due to the new national energy policy. Reducing energy consumption would reduce energy requirement, and then – indirectly – energy cost.

*Source*s: CEPOS (Center for Politiske Studier) (2009), "Wind Energy: The Case of Denmark", CEPOS, Copenhagen, *www.cepos.dk/fileadmin/user_upload/Arkiv/PDF/Wind_energy_-_the_case_of_Denmark.pdf*; Calzata Àlvarez, *et al.* (2009), "Study of the Effects on Employment of Public Aid to Renewable Energy Sources", *Procesos de Mercado*, Vol. 7, No. 1; Marsh, R. and Miers, T. (2011), "Worth the Candle? The Economic Impact of Renewable Energy Policy in Scotland and the UK", Executive Summary, *Verso Economics, www.versoeconomics.com/verso-0311B.pdf.*

The largest share of long-term job creation is not in energy generation itself, but along the RE supply-chain, in manufacturing, specialised services and also rural activities such as farming, forestry, etc. For instance, a large investment in RE can actually generate new manufacturing activities. This happens when local demand for RE installations is very large and companies producing such installations decide to locate production to the region to save on transportation costs or to access specific advantages (subsidies or grants) put in place by the RE policy. For instance, the large investment in wind energy made by the Québec government in Gaspésie prompted one of the world leaders in the production of wind turbines to start producing large pillars in the region. It also stimulated other businesses, thus creating more than 400 new jobs in the community. Linkages with manufacturing activities can also develop in sectors that are not directly related to RE, but still within the RE supply chain. This was evident in Extremadura, Spain. Although the large investment in PV and CSP did not trigger any new manufacturing activities, it did create business opportunities for the production of metal frameworks to support solar installations and of mirrors used by CSP installations. Some small businesses producing electric pylons were able to diversify into the new sector. Likewise, Extremadura attracted businesses in the galvanisation process, and several new firms opened. In general, the jobs created in these manufacturing activities that are connected to RE, but not directly involved in the production of RE installations, are not taken into account by statistical analyses of the impact of RE impact on employment.[9]

The RE impact on employment creation is larger when the energy process depends on a raw material, as in the case of biomass. Biomass encompasses a large series of products and by-products (Box 3.5). In general, the use of biomass as feedstock for the production of electricity, heating or biofuels requires the organisation of a specific productive process involving a large number of actors. Empirical evidence collected on field visits (in particular, Middle Norrland, Iowa, and North Karelia) demonstrates that biomass is likely to have a larger impact on local labour markets than other RE technologies, although there are important differences to take into account.

Large RE deployments driven by ambitious policy bioenergy targets can have a large impact on rural economies. For instance, Iowa (United States) has been the focal point of a federal policy to support the production of ethanol for fuel.[10] An increasing share of the state's corn (maize) production has been absorbed by the RE industry to extract corn starch (sugar) and produce ethanol. The policy has triggered higher prices for corn – while also stabilising local demand.[11] While the impact in terms of new employment in farming is relatively limited, the policy has created a large number of new jobs in the bio refineries. Today, Iowa is home to a specialised pool of labour in this sector, and local actors are experimenting in new technologies that can produce ethanol from a large range of other industrial and urban residues, thus reducing the impact on corn prices. A similar situation was also observed in Middle Norrland, Sweden, where the national government has been supporting district heating systems for 40 years. Nowadays, these systems use forest residues as the main feedstock, creating a diversification opportunity for forest businesses. New jobs have been created to collect, treat and transport forest residues to power plants.

Small-scale biomass deployments can also have an important role in stabilising rural jobs. For instance in North Karelia, Finland the forestry sector was able to take advantage of public incentives to improve the quality of timber while using the offcuts as feedstock for renewable heating to small rural communities. Some jobs were created to collect and treat the forest residues. Although the impact on job creation is not dramatic, the diversification has offered small forest owner co-operatives a new source of revenue.

Box 3.5. **Defining biomass**

Biomass is defined as all plant and plant-derived materials, including animal manure. Biomass that can be used for energy production is composed of a wide variety of agricultural and forestry resources, industrial processing residues, and municipal solid and urban wood residues (see table below). The agricultural resources include grain (used for biofuels production), animal manures and residues (biogas), and crop residues derived primarily from corn and small grains (e.g., wheat straw) (renewable fuels). A variety of regionally significant crops, such as cotton, sugarcane, rice, and fruit and nut orchards can also be a source of crop residues. Forest resources include residues produced during the harvesting of forest products, fuel wood, residues generated from forest product processing mills, and wood from cutting to reduce fire hazards and improve forest health. Municipal and urban wood residues are widely available and include garden and tree trimmings, land-clearing wood residues, wooden pallets, packaging materials, and construction and demolition debris.

Agricultural and forest resources for biomass energy

	Agricultural resources
Primary	Crop residues from major crops — corn stover, small grain straw, and others
	Grains (corn and soybeans) used for ethanol, biodiesel, and bio products
	Perennial grasses
	Perennial woody crops
Secondary	Animal manures
	Food/feed processing residues
Tertiary	Municipal solid waste (MSW) and post-consumer residues and landfill gases
	Forest resources
Primary	Logging residues from conventional harvest management and land clearing operations
	Removal of excess biomass (fuel treatments) from timberlands and other forestlands
	Fuel wood extracted from forestlands
Secondary	Primary wood processing mill residues
	Secondary wood processing mill residues
	Pulping liquors (black liquor)
Tertiary	Urban wood residues — construction and demolition debris, tree trimmings, packaging wastes and consumer durables

Source: USDA (US Department of Agriculture) and DOE (US Department of Energy) (2005), *Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The technical feasibility of a billion-ton annual supply*, April, USDA, Washington DC, available at *www1.eere.energy.gov/biomass/pdfs/final_billionton_vision_report2.pdf.*

Innovation and learning

Rural areas can play a key role in RE innovation. Rural areas are the place where RE installations are deployed, so they are also the places where new RE technologies are tested. RE deployment has triggered innovations in products, practices and policies in all the case study regions (Table 3.1).

Rural communities are also the places where challenges first appear and where new policy approaches to RE are tested. In this vein, regional institutions can promote innovation in policy making, providing feedback to central governments, or experimenting with new policy solutions that are more effective in linking RE deployment with regional development. This was evident in Puglia, Italy. The region is the Italian champion in solar energy. The regional government was able to fine tune its RE policy to reduce distortions and rent-seeking behaviours, providing the national government with an important reservoir of experience about policy challenges related to RE deployment.

Table 3.1. **Innovations in renewable energy products, practices and policies in the case study regions**

Region	Innovative products	Innovative practices and policies
Tennessee, US	Electric Vehicles, Cellulosic ethanol.	Collaboration between universities and national energy research centres.
Maine, US	Deep sea floating wind mills, tidal energy.	*Ex ante* evaluation of the impact of off-shore installations on maritime communities.
Vermont, US		Branding of electricity renewably sourced. Small-scale farm based biogas for decentralised electricity production ("cow power").
Iowa, US	Ethanol from maize, cellulosic ethanol.	Focused systemic research strategy
Wallowa County, Oregon, US	Small-scale energy integrated into existing activity.	Community based co-ordination approach – "energy has to have a job".
Québec, Canada	Low temperature turbine blades for wind installations.	*Bureau d'audiences publiques sur l'environnement* (BAPE) to protect the interest of rural communities vis-à-vis RE deployment.
Prince Edward Island, Canada	Smart RE energy systems and integration with optical fibre network by municipally owned energy company.	
Troms County, Norway	Low temperature turbine blades, tidal energy, extraction of heat from water and sewage.	
North Karelia, Finland	Wood-based biofuels, efficient wood burners, related machinery and equipment, CHP and district heating.	
Middle Norrland, Sweden,	Bioenergy from wood, with CHP and district heating. A "green highway" for transport between Sweden and Norway.	
Region Zealand, Denmark	Wind, wind installation maintenance, testing facilities; algae production for biofuels; straw-based bioenergy.	Local consortia to organise land use and to link demonstration processes to regional economies.
Friesland, Netherlands	Solar powered boats and related systems for battery control, etc; green gas based partly on cow manure.	Developing a niche opportunity (PV powered boat industry).
Extremadura, Spain	Mounts for solar installations.	
Puglia, Italy	Small wind generators; emerging policies to encourage small-scale decentralised renewable energy.	RE policy has been modified several times to reduce distortions and rent-seeking behaviours.
Abruzzo, Italy		Aesthetic principles are explicitly put in the guidelines for siting RE installations in rural landscapes.
Shetland Isles, Scotland	Hydrogen from wind; energy storage systems; tidal generators.	

Rural communities can and do engage in R&D related to RE. In Iowa and North Karelia, private and public research focuses on developing second and third generation biofuels. These regions demonstrate a combination of a major resource base, strong prior evidence of R&D success and large investments. In both cases the RE research is embedded in an existing science base that was already connected to industry. And, in both cases the research is seen as a long-term process to construct a system that would have multiple related products and processes. These rural communities aim at producing a breakthrough innovation that can dramatically affect local economies and that can be exported at the global scale.

Other rural regions have engaged in specific RE projects that may be able to provide novel extensions of existing technologies. For instance, Maine and Abruzzo are exploring the opportunities offered by off-shore deep-sea wind to develop their regional economies. In these cases the crucial missing piece is finding a cost-effective solution, as the concept is well understood. In these places a firm or group of firms may be able to make an engineering advance that can make the technology viable. In the same vein, some case study regions have created specific testing facilities where producers can verify the performance of their apparatuses. In this case, the best examples are Shetland Islands, UK, and Region Zealand (Denmark). In Shetland a group of researchers is experimenting with storage systems to lower the cost related to hydrogen. In Region Zealand, and in particular in the island of Lolland, the rural community has a vision to become an advanced testing site for RE technologies. Lolland is experimenting in approaches to operating and maintaining wind turbines and hydrogen-based storage systems. Rural communities have also promoted innovative ways to link RE to manufacturing. This is the case for Friesland, where the provincial government has supported small firms building PV powered boats in connection with a "Solar challenge for electric boats". Innovation is not focused on PV panels, but rather on how to integrate them into the structure of a boat in an efficient and inexpensive way. The idea it to produce a boat that, while competing in the solar challenge, can also be sold on the market (see the Dutch case study for further information on this).

In another group of case study regions, innovation has come up with new ways to connect RE to the local economy. Places like PEI (Canada) and Wallowa County in Oregon have integrated existing knowledge into their local economy and are currently reaping large benefits. In PEI, RE has helped to lower the cost of energy for rural dwellers. The Canadian province has a very limited manufacturing base, so producing (components for) wind installations was never an issue for the RE policy. The local energy authority has been able to identify a level of subsidies that supports the deployment of wind energy but does not trigger rent-seeking behaviour. Moreover, specific incentives have been designed to promote the installation of small-scale turbines on local farms to reduce their energy costs and allow the introduction of machinery to improve their productivity. In Wallowa County, small-scale installations are integrated by rural dwellers in their businesses, again with the aim of reducing energy costs, rather than promoting the regional specialisation in RE industries. Local business can be very innovative in identifying solutions that benefit their specific activity (e.g. solar energy to power a water treatment plant).

Networks and systems for innovation are able to connect RE with a broader productive framework (Box 3.6). Typically, regional innovation systems are based on a wide consensus between – and joint activities among – regional and local governments, enterprises, universities and/or research institutes, and users. They engage a wide number of people and interests, such as farmers, employees, enterprises, regional associations and

NGOs, local government, research and training institutes, and the general public. They have usually developed around a key regional specialisation; an industry in which the region is recognised as a national or international champion. Concerning RE, there are several regional innovation systems that were able to embed the energy sector in a broad supply-chain built around a regional core business. In these cases, innovation activities are coherent both with the core regional business and with regional and national energy policies.

Box 3.6. **What are regional innovation systems?**

Most innovation research now recognises that innovation is usually a co-learning process, involving many other actors other than a sole "inventor" or "entrepreneur". Specifically, innovation normally involves joint and mutually supporting activities for a range of producers of goods and services, consumers or users of the goods and services in question; universities and/or research institutes with specific relevant expertise; and government agencies (Freeman, 1987; Lundvall, 1992).

The case studies presented in this publication support the view that, at least for RE, regional innovation systems in rural regions involve producers and users, as well as universities, research institutes, and local government in a non-hierarchical way. As Foray (2004) points out "design and technology are not subordinate to science and R&D" and "knowledge is often a joint product" from both learning and doing (Foray, 2004). Along these lines, it is assumed that a regional innovation system can be said to exist if there are strong institutional links among regional authorities (councils and agencies), regional universities and research institutes, regional enterprises, and regional customers using the "product"(s) in question, all of whom share a common goal or intent. Often these links are supported at national and even supra-national levels.

A regional innovation system usually refers to a specific territory or region, but this does not necessarily imply a lack of inter-relationships with other regions, or with suppliers, customers and national or international levels of governance (Cooke, *et al*., 2005). Indeed the present research demonstrates how important such external linkages and influences can be for the regional innovation system.

Sources: Freeman, C (1987), *Technology Policy and Economic Performance: Lessons from Japan*, Pinter, London; Lundvall, B. (1992), *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, Pinter, London; Foray, D (2004), *The Economics of Knowledge*, MIT Press, Boston; Edquist, C (2004), "Final Remarks: Reflections on the Systems of Innovation Approach", *Science and Public Policy*, December, Vol. 36, No. 6; Cooke, P., N. Clifton and M. Oleaga (2005), "Social Capital, Firm Embeddedness and Regional Development", *Regional Studies*, Vol. 39, No. 8; Foray, D., P. David, and B. Hall (2009), "Smart Specialisation – The Concept", *Knowledge Economists Policy Brief*, No. 9, June, *http://ec.europa.eu/invest-in-research/pdf/download_en/kfg_policy_brief_no9.pdf*, accessed on 30 April 2011.

How do regions learn?

Rural regions can engage in complex learning processes that can have a dramatic impact on innovation capacity and then on the success of a given business activities. In particular, while rural regions only rarely produce learning related to R&D activities ("learning by searching") they have a fundamental role in the other dimensions of learning (by doing; by using; and – in particular – by interacting) (Box 3.7). In innovative regions, the innovation process involving a large number of actors spurs a common learning activity. A policy that can spur such a learning process may have a strong impact on the success of a given industry. For instance, the success of Denmark's wind industry

may depend on its capacity to involve a large number of actors (farmers and co-operatives) in the deployment of turbines and in their technological development (Kamp, *et al*. 2004).[12]

Box 3.7. **The types of learning involved in rural innovation for renewable energy**

Learning is a complex activity that can involve the action of a single actor or a multiple actors. It is possible to classify learning activities in the following four points:

- **Learning by searching.** Normally thought of as R&D or 'learning by studying', and the results are commonly in the form of articles, scoping studies, monographs, books, prototypes, etc.
- **Learning by doing.** Takes place at the manufacturing stage and increases production skills in individuals, organisational routines and manufacturing practices. Trial-and-error practical experience is gained. Rules of thumb are important. Generates mainly tacit knowledge.
- **Learning by using.** Diffusion and increased adoption of a product leads to improvements. Especially important with products that consist of complex, interdependent components. This makes it difficult to predict how they will act together, knowledge which requires active and prolonged use.
- **Learning by interacting.** Results from close producer-user contacts. The more complex the technology the more it is the case that producing firms cannot have or develop all the necessary skills and knowledge needed.

Sources: Andersen, E. and B. Lundvall (1988), "Small National Systems of Innovation Facing Technological Revolutions – An Analytical Framework", in C. Freeman and B.A. Lundvall (eds.), *Small Countries Facing the Technology Revolution*, Pinter, London; Boon, M (2008), *Why did Danish Entrepreneurs Take the Lead in the Wind Turbine Industry and not the Dutch? A Study on the Interaction between Evolution and Strategy of Two Communities in an Emerging Industry*, Master's Thesis, Erasmus University, Rotterdam; Kamp, L.M. (2002), *Learning in Wind Turbine Development: A Comparison between the Netherlands and Denmark*, PhD Thesis, University of Utrecht; Kamp, L.M. *et al.* (2004), "Notions on Learning Applied to Wind Turbine Development in the Netherlands and Denmark", *Energy Policy*, Vol. 32; Rosenberg, N. (1982), *Inside the Black Box: Technology and Economics*, Cambridge University Press, Cambridge.

There are two main ways in which RE can involve a large number of actors at the regional level: *i*) by connecting to existing – and successful – rural industries; or *ii*) by involving a large number of small and medium enterprises (SMEs). In both cases, the advantage is to have RE embedded in broad research networks that try to transform it into a viable business.[13] We observed such "embeddedness" in some case studies, especially where there was a significant share of local ownership of land and basic resources, as well as of the enterprises in the supply chain. This allowed the rural community to capture rents, profits and interest, which in many cases account for the majority of regional GDP contributed by the renewable energy system.

We have clustered the case studies into the two types of group described above:

- RE linked to a regional industry (usually forestry, agriculture, or manufacturing): There are several case studies in which research assets belonging to forestry or agriculture industries are connected to RE. In these case studies, RE is closer to being a viable business. For instance, in North Karelia (Finland) innovation for RE is occurring within the wood-based bioenergy supply chain. The region is one of the European champions in the forestry supply-chain, which involves hundreds of small forest owners, businesses in the pulp and paper industry, and even important manufacturing companies. The region is also home to important research institutions, including universities, and local governments tend to specifically support this industry. Another example is Iowa (United States) where innovation in RE focuses on the production of ethanol from sugar (mostly from corn starch, see above). Several research institutions and public authorities have been supporting agriculture to improve productivity.

- RE connected with a large number of SMEs that explore new opportunities for businesses. In other regions, although RE sectors do not link to specific industries, renewable energy has attracted the interest of local SMEs, which have started experimenting with new technological solutions for RE installations or new uses of RE technologies. This was especially true in those rural regions that have good human capital, diffused entrepreneurship and a history in the energy sector. In this case embeddedness is probably less evident, but equally important, as regional entrepreneurs foresee the possibility of developing business opportunities in a new sector and start investing in RE related activities. For instance, in Puglia and Extremadura an army of SMEs is investing in activities related to RE deployment. This depends on the availability of large public subsidies for RE, of which there was a sharp decline over 2011/12) as well as on the ability of small businesses to quickly reorganise their productive strategy to take advantage of new opportunities. SMEs in this sense may be quicker to produce innovation for the market than large companies. This was evident in Friesland, where there is a long tradition of canal transportation and recreation, boatbuilding, and related activities. The local government support to solar boating triggered a diagonal diversification in the local boat industry that was able to specialise in the production of PV powered boats.

The ingredients of innovative regions

We have identified certain characteristics that support RE-related innovation in rural regions (Table 3.2). Although there is no magic formula for a successful RE regional innovation system, the successful and emerging cases observed in this research have strengths in a number of dimensions, particularly regional legitimacy, regional and local policy support for RE, embeddedness, and cross-sectoral linkages.

Table 3.2. **Key dimensions of regional integration systems in the case study regions**

Dimension of RIS	Few/weak	Some/moderate	Many/strong
Regional-international linkages and activities	Vermont Abruzzo	Maine Québec	North Karelia Friesland
Regional-national linkages and activities	Friesland Abruzzo	Maine Vermont	Iowa North Karelia
Cross-sectoral linkages	Puglia Shetland Tennessee Abruzzo	Extremadura	North Karelia Iowa PEI Friesland
Industry-research linkages	Region Zealand	Tennessee Puglia Extremadura Abruzzo Troms County	N Karelia Maine
Regional embeddedness	Extremadura Puglia Shetland		North Karelia Middle Norrland Iowa PEI Vermont
Regional and local policy support for RE		Extremadura Puglia Québec Friesland Shetland Troms County Vermont	North Karelia Region Zealand Friesland Middle Norrland PEI Iowa Vermont Tennessee
Regional legitimacy	Extremadura Puglia	Shetland Friesland Vermont	North Karelia Middle Norrland PEI Iowa

Ingredients of supportive institutional frameworks

The emergence of regional integration systems around RE also depends on some key aspects of the regional institutional framework (Table 3.3). Regional public authorities must be free to act in various ways, including developing their own policies and responses to national and international policies and conditions for RE.[14] There are clear associations between these institutional characteristics and the dimensions of RE regional innovations systems discussed above. There are also important links to the regional policy elements. It is hard to start the process of "smart specialisation" which leads to an RE regional innovation system without strong regional and local government who are actively engaged with knowledge and learning institutions as well as relevant groups of enterprises. These are not "sufficient" conditions; they are necessary ones. They cannot occur in highly centralised countries where top-down policies prevail. The engagement and support of democratic local authorities also helps to ensure regional legitimacy, especially where a large number of SMEs, farmers, foresters, etc. can be involved in positive ways.

Table 3.3. **Key institutional factors for regional innovation in the case study regions**

Institutional factor	Notable case study examples
Strong regional/ local governments with wide powers and ability to act	Region Zealand, North Karelia, Troms County, Middle Norrland, PEI, Vermont, Maine, Iowa, Friesland
Local/ regional government ownership of power utilities	North Karelia, Middle Norrland, Troms County, Region Zealand, PEI
Presence of strong university/ research institutes	North Karelia, Middle Norrland, Troms County, PEI, Maine, Vermont, Iowa, Puglia, Extremadura, Abruzzo
Presence of education and training facilities with RE activities	Nearly all study regions, but in varying degrees
Co-operatives or community enterprises active in RE	Region Zealand, North Karelia, Shetland
Farmers and foresters notably active in RE supply chain	North Karelia, Iowa, Vermont, Region Zealand, Middle Norrland
Good external linkages with higher level political, research and enterprise	North Karelia, Iowa, Region Zealand, Friesland, Shetland
Strong links and common activities among different regional sectors	North Karelia, Iowa, PEI, Friesland
Strong legitimacy for RE activities	North Karelia, Region Zealand, Iowa, Vermont, PEI

The innovation platform involving all of these groups, and local and central government, has been critical in defining and linking the support for different elements of the innovation system. A platform is not a hierarchy dominated by one actor or interest, but a partnership which has a flat organisational form – a space for sharing ideas, knowledge, experience and perspectives. It provides a "sheltered environment for innovation" (Lester and Piore, 2004). In the case studies where regional innovation systems for renewable energy in rural contexts have existed, do exist or are in the making, it is possible to observe a range of different regional and national policy instruments which played an important part of the creation of the system. For example, early support was given for R&D, technology and investment, the regulatory framework was supportive, and the establishment of active innovation platforms created the space for consensus and legitimacy-building at regional levels. This both created a relatively open body of producers (and supply chain) and local users, which allowed for the learning-by-using process and hence rapid development of the technology, and a sound understanding of priorities. This in turn led to rapid cost reductions and so to a reduced need for investment and energy subsidies. However, in all cases where there was a significant existing or potential rural regional innovation system, early support was needed and given.

Ingredients of supportive policy for innovation

Some of the support to innovation is provided by national policy instruments and fiscal tools. For instance, carbon taxes in the Nordic countries provide incentives for RE deployment by raising the relative price of fossil fuels. In the same vein, the support for community ownership of land under the 2003 Scottish land reform (Bryden and Geisler, 2007), the national support for ethanol development in the United States, and the national rural and regional policy support for the timber and bioenergy clusters in Finland, have all played key roles in stimulating regional innovation platforms. The local secondary schools, colleges, universities and institutes, as well as professional organisations also play an important role in the development and renewal of relevant knowledge and skills, and these may be partly or wholly supported by national policies.[15]

However, it is clear that regional and local policies have also been important for the development of innovation systems around RE.

Table 3.4 gives an overview of the range of policy instruments that have been deployed by regional and local governments in the case study regions. Key areas of policy activity are innovation platforms, knowledge creation, and related research and competence development that address the market failures identified by Foray, *et al.* (2009). In addition, direct investment by local and regional authorities either in RE production and distribution companies and/or in combined heat and power (CHP) systems that use RE has been important in many cases. Other interesting policy approaches have been to create a specific brand. In the "Solar Challenge" in Friesland, the provincial government has created an international competition involving PV powered boats. The competition involves participants from many countries and has begun a process of local specialisation in solar boating that has triggered the creation of more than 30 small companies as well as research involvement by local schools and national universities. Regional branding was also important in Vermont, where the local energy company was able to create a specific brand for the electricity produced by dairy farms through bio digesters ("cow power") for which it receives a premium price.[16]

Table 3.4. **Key regional policy instruments in the case study regions**

Policy type	Presence in regions with significant or emerging regional innovation systems for RE	Presence in other regions
Regional targeted RE innovation activities	***	*
Municipal/regional government ownership of RE production facilities or energy utilities	***	*
Skills development – education and training investments	***	*
Investment in RE R&D facilities and activities	***	*
Marketing, branding and promotion of RE	***	*
Physical planning controls	**	**
Local taxation of energy/business/land	**	**
Influence of national policies (business, energy, environment, etc.)	***	*
Investment incentives for RE	*	*
Sustainability objectives	***	*

Key: * **weak**, in few or no cases; ** **moderate**, in most but not all cases; *** **strong**, in all or nearly all cases.

Capacity building and community empowerment

RE policy can build capacity in rural communities. In several case studies, RE policy has invested in capacity building at the local level to help rural communities deploying sustainable energy according to their needs and potentials. For instance, in Abruzzo and in the island of Lolland (Region Zealand, Denmark), municipalities are involved in the European network known as the "Covenant of Mayors" (see case study assessing

Abruzzo). This network is funded by the European Commission's Directorate-General for Energy to capitalise on local governments' ability to involve citizens and affecting citizens' behaviour. Municipalities participating in this network agree to set very ambitious targets for RE in their territory. They are expected to prepare an assessment of their energy needs and present an action plan in which RE gradually replaces conventional energy sources. In the case of Abruzzo, the regional and provincial governments provide rural municipalities with assistance, expertise (energy agents), and capacity building actions.[17] In the same vein the Scottish government supports rural communities engaging in RE deployment through the Community and Renewable Energy Scheme (CARES). The aim of this programme is to promote local ownership of RE projects. It employs local project officers around Scotland to help rural dwellers with the process of applying for funds and developing installations that fit their needs (see Box 5.3 for more on this).

RE policy has stimulated citizen engagement in several regional case studies. Several rural regions have developed specific institutions, organisms and authorities to deal with RE deployment as a reaction to large investment and national policies. This dynamic has been observed both in regions where local communities fully support RE deployment and in regions where populations oppose specific developments that are perceived as a threat to their well-being or key assets. In general, our field research reveals a new governance model in which citizens (individuals or small groups) are highly vocal and visible (through the Internet, for instance) and do not accept to devolve their decision power to the traditional institutions, including local governments.

Affordable and reliable energy for remote rural communities

RE can reduce the cost of energy in remote regions. RE provides remote rural regions with the opportunity to produce their own energy (electricity and heat in particular) rather than importing expensive conventional energy and relying on other regions. In the Shetland Islands, Scotland, for example, more than one-third (35%) of all households live in fuel poverty, meaning that households have to allocate more than 10% of their income to energy (including heat). Moreover, 13% of Shetland's household even suffer from extreme fuel poverty, meaning that they have to spend more than 20% of their overall income on energy (including heat). For this reason, the local population has a strong rationale to adopt RE, especially for heating, and Shetland is experimenting with innovative heating systems using small-scale wind installations (wind-to-heat project). Similar initiatives were assessed in Nordic regions such as North Karelia (Finland) and Middle Norrland (Sweden), where the use of renewable heating (district heating systems relying on forest residues) can lower local energy costs by 30%.

Providing a remote region with access to reliable and cheap energy can trigger economic development. There are several examples in Nordic regions (Tromsø, Middle Norrland) of where the availability of cheap and reliable energy was intertwined with an industrial policy to develop manufacturing. These regions were tapping their hydropower potential to attract companies active in energy-intensive activities, like smelting or pulp and paper production. Québec is currently implementing an ambitious policy (*Plan Nord*) to provide communities in the north of the province with RE, both to deal with low accessibility to energy and also to promote local development. Such policy interventions should create an integrated energy system based on small grids able to support manufacturing activities. At a lower scale, the Scottish government supports the creation of self-sufficient energy systems on small islands. In the case of the island of Eigg, for

instance, the completion of the electricity grid in 2007 has made a significant difference, freeing residents from dependence on diesel generators and providing them with a stable and affordable power supply. A reliable electricity supply has brought improvements in other areas, for example better treatment of drinking water. Improved home insulation and heating has also yielded benefits, making it more affordable to keep homes at a comfortable temperature. A wider economic impact has come from having a reliable and affordable electricity supply, which has enabled several new businesses to start up, including restaurants, shops, guest houses and self-catering accommodation (Ashden Awards Case Study, 2010).

Notes

1. Land intensity is particularly evident with wind installations. For instance, the largest areas with good wind resources in the United States lie in the sparsely populated Great Plains and in pockets along the mountain spines of the East and West Coasts. In China, the best wind resources are similarly located far away from the population centres. Even in the compact United Kingdom, the best resources are in relatively remote Cornwall, Wales, and Scotland (Ingram and Hong, 2011, *www.lincolninst.edu/pubs/dl/2036_1358_Alternative-Enegry-Sources-and-Land-Use-LP2010-ch05.pdf*).

2. To have an idea of the magnitude of RE investment compared with regional economies, it is possible to consider that, for instance, yearly investment in Puglia between 2007-2013 is equal to 0.33% of the regional GDP (2009 values). In Québec, investment in RE represents 0.05% of GDP (also as of 2009). Finally, in Extremadura investment in RE in 2009 was equal to 2.7% of regional GDP.

3. ARRA was designed to react to the late-2000s recession. ARRA's primary goal was to save and create jobs on the short run. Secondary objectives were to invest in infrastructure, education, health, and renewable energy. According to the United States' Congressional Budget Office (CBO) the total impact over 2009-2019 will amount to about USD 831 billion (CBO, May 2012, *www.cbo.gov/sites/default/files/cbofiles/attachments/ARRA_One-Col.pdf*). ARRA included direct spending in infrastructure, education, health, and energy, federal tax incentives, and expansion of unemployment benefits and other social welfare provisions.

4. While obliging small-scale producers to put all the electricity they produce on the grid helps to balance the grid, it could also negatively affect the development of "smart" grid systems, in which producers and users of electricity in the same area exchange electricity produced from different sources. Smart grids, however, would also affect the business of large energy operators.

5. One farmer in Puglia was using the heat produced by his digester to dry tomatoes in specific ovens.

6. Kammen *et al.* (2004) carried out an analysis of 13 independent reports and studies on the economic and employment impacts of the increased use of RE in Europe and the United States. Their result stress the potential of RE to generate employment in the US economy.

7. Lack of data is due to the fact that most of the investment in RE in the case study regions took place between 2008 and 2009. It is too early for the economic impact of these deployments to show up in official statistics. Moreover, it can be challenging to access detailed data about regional economies that consider linkages among sectors (e.g. which use input-output tables, or social accounting matrixes).

8. According to one study, "The economic benefits that derive from the renewable energy sector are hard to assess because the industry is difficult to measure as a clearly-defined sector. However, employment figures cited by those promoting

renewable energy are often greatly exaggerated, exceeding official employment figures covering the whole of the energy sector" (Marsh and Miers, 2011).

9. This is also true in Region Zealand, where the rural communities on the island of Lolland have been able to create new jobs in testing facilities (see the case study)

10. See case study for further details about the United States' focus on ethanol and its rationale.

11. Refineries can also use corn that would not be absorbed by traditional markets (food).

12. Kamp, *et al.* (2004) applied the innovation learning systems framework to the cases of wind power technology in Denmark and the Netherlands, both users of wind power for many years. The authors sought to explain the difference in performance of the Dutch and the Danish wind turbine innovation systems between 1973 and 2000, specifically examining differences in the relevant learning processes in the two cases. They found that: *i*) the major difference was in learning by interacting, which was much stronger in the Danish case, especially for small-scale subsystems. In Denmark, there was trust between those involved, a joint frame of meaning, tight links between producers, users and researchers, and the actors were at the same cognitive level. This was not the case in the Netherlands. *ii*) Learning by using was much stronger in the Danish case because in Denmark the users were keen on wind power, and investment subsidies were introduced early, leading to many turbines being built and installed. This also meant that learning by doing was stronger in Denmark than in the Netherlands. *iii)* The approach in the Netherlands was heavily dependent on R&D subsidies and was led by large companies and research institutes. This science and technology push approach was not successful.

13. Heanue and Jacobson (2008) describe network relationships, interactive learning, and knowledge bases as critical for establishing the notion of "embeddedness" in rural innovation. For instance, Midtun & Koefed (2005) analyse the development of innovation systems in wind energy in Finland, Sweden and Denmark. They stress both the linkages between local farmers and co-operatives, producers of windmills and parts, and users of windmills, as well as the political and social conditions at important phases in the innovation system.

14. This is clear from the work of Midttun & Koefoed (2005), who specifically deal with RIS around RE, as well as the general work on knowledge generation and smart specialisation of Foray (2005) and Foray *et al* (2009).

15. In some regions vocational educational training is linked to a specific regional policy for RE. It is the case of Québec, where the provincial government has created a community college in Gaspésie to create workers for the wind energy industry and in particular for dealing with operation and maintenance of the turbines.

16. In the case of Vermont it is important to note that consumers cannot be sure of actually receiving the electricity that was produced by dairy firms. Notwithstanding, due to the importance they assign to having dairy businesses providing fresh milk in the region, they are willing to pay a premium price for the electricity knowing that part of this premium will represent an extra income for organic dairy farms producing electricity.

17. The Covenant of Mayors has become the mainstream European movement involving local and regional authorities in the fight against climate change. The EU supports this movement to valorise the role local governments play in mitigating climate change. The assumption is that local governments can affect citizens' behaviour

though local regulation, and conciliate public and private interests by integrating sustainable energy issues into overall local development goals. The Covenant of Mayors is usually based on a voluntary commitment by signatories to meet and exceed the EU 20% CO_2 reduction objective through increased energy efficiency and development of renewable energy sources. The network does not provide any financial resources per se, but it forces municipalities to design an action plan for RE and energy efficiency, which increases their possibility to get financing when bidding for EU funds supporting renewables.

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Chapter 4

The challenges of linking renewable energy to rural development

This chapter focuses on the obstacles that undermine the potential of renewable energy, both in terms of deployed capacity and economic growth in rural areas. It identifies six key economic, environmental and governance challenges that undermine the potential of renewable energy in generating economic growth. These challenges also act as bottlenecks to green growth as they can affect the long-term implementation of a sustainable development agenda.

This chapter focuses on the challenges that are undermining the potential of renewable energy (RE), both in terms of deployed capacity and economic growth in rural areas. As mentioned earlier, RE is often presented as a panacea for key policy challenges related to energy security, environmental sustainability (climate change mitigation), and economic development, particularly job creation. The empirical evidence collected across case study regions, however, demonstrates that it is not easy to achieve these policy objectives through RE deployment. The reasons are several:

- It is difficult to harmonise all three policy objectives. This also depends on the complexity of the governance framework underpinning RE deployment, which is very clear when assessing regional and local trends.
- There is a trade-off between the pace and size of the investment and the capacity of regional communities to absorb it in a fashion that yields maximum local economic benefit.
- The majority of RE deployments assessed in the research would not be sustainable without large support from the public sector in the form of subsidies and incentives.
- In several cases, high public subsidies have affected relative prices at the local level and caused competition between RE installations and other (land-based) rural industries.
- RE is often deployed without an integrated approach that takes into account the energy infrastructure already in place and the overall regional energy framework.
- It is methodologically challenging to assess the quantitative economic benefits to rural regions of RE deployment, leaving policy makers without the figures they require for decision making.
- Large investment and lack of a territorial approach have triggered public opposition to RE installations in many rural communities. Citizens oppose RE deployment if they see installations as a threat to their well-being or to key economic activities in their area, rather than a benefit.

Thus, while governments may intend to stimulate economic growth through renewable energy expenditures, they may have the opposite effect if these factors are not properly addressed. This chapter outlines how each of these challenges can be overcome.

Harmonising the drivers of renewable energy deployment

As discussed above, RE policy is expected to deliver in three key areas: energy security, climate change mitigation, and economic development, especially job creation. The economic development driver of RE deployment gained momentum during the first phases of the current international financial crisis. A widely held assumption is that investment in RE will trickle down to other sectors, such as construction, manufacturing and services, thus creating new employment opportunities in countries and regions.

However, evidence collected in the case studies demonstrates that RE deployment can easily fail to deliver results in one or more of the three areas. For instance, large biomass heat and power plants can generate new employment opportunities in rural communities, but may have a negative CO_2 balance due to land-use change and transportation of feedstock over relatively long distance (Box 4.1).

Box 4.1. **Trade-offs of renewable energy production: Case study examples**

In Extremadura, a 16 MW biomass plant produces approximately 120 GWh of electricity a year that is sold to the local energy utility. The plant created around 300 jobs during its construction in 2008 and a total of 100 direct and indirect jobs (including O&M, and logistics) once fully operational in 2011. Such a large installation needs a large quantity of agricultural residues – mostly herbaceous material such as corn stover; and 30% ligneous material, mainly wood chips from oak, olive and fruit trees – that need to be collected over a territory of several hundred square kilometres. The emissions involved in transporting this material are such that the final balance of CO_2 emissions produced by the installation could actually be negative. Moreover, transporting the biomass generates pollution and also creates traffic congestion in an area that used to be very calm, causing disaffection among local citizens.

In the same vein, small-scale installations not properly integrated into the regional energy infrastructure (through smart grids, for instance) have a limited impact on energy security. This was observed in Puglia, where the large deployment of small-scale PV installations within an old transmission system – managed by the national system operator – does not allow the proper integration of RE within the regional energy framework, which still relies on large fossil-fuel power stations. Moreover, small-scale installations typically source labour and equipment from international suppliers, so the impact at the community level in terms of job creation is rather limited. In PEI, for instance, farmers use public incentives to install small-scale turbines produced in China. Moreover, if RE deployment causes an increase in energy costs, the overall impact on regional economies could be actually negative.

1. Similar problems have been observed in Iowa, where large ethanol refineries, despite their importance within the state economy for the impact they have on rural jobs and salaries, cause pollution and congestion problems for the hosting community (Selfa, *et al*., 2011).

2. The possibility that RE policy fails to achieve significant impacts in terms of energy security and reduction of carbon emissions was also recognised by Jaeger and Egelkraut (2011). In particular, it is possible to look at a several combinations of policy alternatives that achieve the same set of incremental gains with respect to energy efficiency and climate change mitigation, and compare the costs and cost-effectiveness of different policy solutions. According to this comparison, biofuels produced in the United States are found to be 14 to 31 times as costly as alternative policy solutions such as raising the gas tax or promoting energy efficiency improvements. In the United States, mandated corn ethanol production for 2025 reduces petroleum input use by 1.75%, and would have negligible net effects on CO_2 emissions; and although European Union's imports of Brazilian ethanol may look better given the high costs of other alternatives, this option is equivalent, at most, to a 1.20% reduction in EU gasoline consumption (Jaeger and Egelkraut, 2011).

The influence of the three drivers on RE policy also generates co-ordination problems and makes it difficult to identify a strategic approach to deployment. It is still unclear which kind of policy mix would best stimulate RE production in rural areas, while also optimising economic development and environmental objectives. This is mirrored by the complexity of the policy framework supporting RE deployment in regions and countries that participated in the research. RE policy usually encompasses a number of sectoral policies, such as energy and environmental policies, and more holistic ones, such as regional policy, and rural development policy. Policy approaches implemented in case studies vary according to the mix of these policies.

RE policy depends on a network of interactions among different public authorities, sectoral policies, and other actors, including the business community. For instance, while energy policy is often under the national jurisdictions, economic development, environmental sustainability, and land management (which are key components of the RE policy) involve different actors and sectoral policies (Box 4.2). This requires the creation of a governance system that can handle complexity.

In the majority of case studies, the national level dominates, defining the binding space within which the other levels can manoeuvre. In most regions, the governance of RE is still evolving towards a more participative model that helps deal with key issues related to the harmonisation of different policy objective. Hence, governance systems change over time and can develop innovative arrangements and positive solutions to typical governance failures.

Box 4.2. **Key responsibilities and interactions within the multi-level governance framework commanding renewable energy**

- The national level: is responsible for market regulation and support to RE technologies, both via supply regulation and subsidy allocation. In most case study regions, the regulatory framework for RE is under the jurisdiction of the central government, although in the EU context a major role is played by supra-national institutions, such as the European Parliament, European Council and European Commission. Main institutional players within the RE policy at the central level are the ministries of economy and other sectoral ministries dealing with agriculture, environment, industry and infrastructure. National stakeholders include energy agencies, large firms and organisations representing sectoral interests (particularly in agriculture and large firms producing energy).
- The regional level: in most case studies it is this level that translates general policy goals into more defined strategies. Regional governments define targets, specific policy instruments and territorial priorities. They also allocate financial resources among programmes, promote industrial clusters, partnerships and networks and support research and innovation projects, even through specific development agencies. This role is performed by regional departments that often mirror the sectoral specialisation seen at the national level. These regional bodies are in a better position to identify sectoral and territorial priorities in a way not available to national governments.
- The local level: this is where individual investment projects and initiatives are conceived and implemented. These initiatives can be promoted under the form of single company projects or integrated projects involving several partners (companies, co-operatives, local authorities, etc.). Local authorities provide formal approval for developing energy businesses (e.g. planning and building permits) and local centres/agencies give firms advice/training and support to set up public-private partnerships. Development agencies often operate at the local level, connecting projects with other initiatives of local development. This is often a crucial level to co-ordinate different sectoral policies.

Centralised approaches to RE deployment still tend to predominate, not least in setting key policy objectives. In general, the incentive schemes put in place to support RE come largely from the energy sector (at the central level), and the emphasis is on increasing the level of deployment rapidly. To achieve this, however, energy policy has to be "filtered" by other policy frameworks. The policy has to percolate through different levels and policy frameworks. And every tier adds complexity to the general policy target.

Multiple objectives driven by different policies – within a complex and evolving governance framework – can generate confusion about the general strategy that should be put in place. For instance, in some case studies, RE policy is considered as a "hard"

industrial policy, supporting mostly large-scale installations (Box 4.3). This was observed in Extremadura, where the regional government considered the deployment of RE as "an industrial revolution for the region".[1] Likewise, in Québec, the provincial government focused its efforts on creating an industrial supply-chain specialised in the production of wind installations. By considering RE deployment as a "top-down" industrial policy, there is the risk of failing to engage local actors (and their investment capacity), and, more importantly, a risk of considering RE as a stand-alone sector within rural economies.

In other regional case studies, RE policy takes a "soft" industrial approach, targeting framework conditions (skills, entrepreneurship, and innovation capacity, for instance). In this case, regional and rural actors play a key role in policy design and implementation through a more inclusive governance mechanism. This was observed in the Dutch province of Friesland. Although the province is involved in a large project aiming at connecting the energy sector with RE, a part of the provincial RE policy has focused on the creation of new market niches (PV powered boats) in which local entrepreneurs can invest. This policy is closer to the local level and able to take into account specific information about the real potential of the local community to engage in RE deployment.

Another approach is for RE deployment to be viewed as a regional development issue administered by a regional policy. Under this governance approach, rural development policy and other key policies such as agricultural policy are more connected with the RE sectors. The advantage of this is that RE policy has broader scope and is better co-ordinated with other sources of public investment. In this framework, the national level plays the role of regulator, while policy design and implementation is largely devolved to regional and local governments.[2] Local communities play a key role in supporting regional specialisation, and a very broad multi-level-governance scheme enhances citizen participation in key decisions concerning the use of natural resources in their territories. RE deployment can enhance the competitiveness of sectors and business that are already in place within rural communities. Examples of this approach have been assessed in Iowa, United States, and North Karelia, Finland.

Balancing the pace of deployment with regional capacity

The case studies reveal a trade-off between the pace of investment in RE and the capacity of rural economies to absorb it. Investment in RE is not only large, it is also taking place rapidly. Public authorities are eager to promote specialisation along the RE supply chain, particularly in manufacturing activities, to benefit from a "first mover advantage". However, the capacity of rural communities to take advantage of this dynamic is often constrained by their small local labour markets, "sticky" skills – which are difficult to adapt – and lack of intermediate institutions (see Box 5.1 in Chapter 5) to lower transaction costs and trigger collective action.[3] For this reason, rural areas often have to bring in workers from outside to fill temporary jobs and struggle to place local people in technical jobs.[4] The cases of Puglia and Extremadura support this argument. These regions massively expanded their PV capacity between 2008 and 2010. In both cases, this was supposed to trigger regional specialisation in the PV supply chain. The reasoning was that by generating a large demand for PV installations, regional supply would follow. However, the regional labour market did not have enough time to develop

Box 4.3. **Renewable energy as industrial policy**

Industrial policy loosely refers to a systematic effort by governments to expand the size of particular industries. Essentially it assumes that markets have failed to recognise the full potential contribution of firms in a particular industry to the economy. By this standard renewable energy policy can be seen as industrial policy. As one of the objectives of RE policy is to increase employment, it falls into the classic forms of industrial policy where governments support the development of specific firms to address high unemployment. Moreover, because RE has a specific territorial focus it combines aspects of industrial policy with regional policy.

Industrial policy has been roundly criticised as a misguided attempt to pick winners and as misallocating resources to uncompetitive regions (Loveridge, 1996; Malecki, n.d.; Noland and Pack, 2003). More recently there has been nuanced support for more refined versions of industrial policy that go beyond providing financial incentives to specific firms in particular sectors (Aiginger, 2007; Rodrik, 2004). The more recent approach suggests that industrial policy can be valuable if it leads to investments that increase productivity across the larger economy; if it introduces new knowledge that can increase the competitiveness of local firms; or if it reinforces an existing infant industry that has inherent capability but faces barriers to growth (Pack and Saggi, 2006).

Notably this shift in emphasis in industrial policy is consistent with the new rural paradigm recommendation that rural development policy move from a focus on subsidies to one on investments, and from sectoral policy to a more integrated approach (OECD, 2006). This suggests that if renewable energy policy is to be both an effective industrial policy and effective rural development policy it must involve more than just an effort to stimulate firms to produce renewable energy by providing large amounts of finance.

Sources: Aiginger, K. (2007), "Industrial Policy: A Dying Breed or a Re-emerging Phoenix", *Journal of Industry Competition and Trade*, Vol. 7; Loveridge, S. (1996), "On the Continuing Popularity of Industrial Recruitment", *Economic Development Quarterly*, Vol. 10, No. 2; Malecki, E. (n.d.) "Jockeying for Position: What It Means and Why It Matters to Regional Development Policy When Places Compete", *Regional Studies*, Vol. 38, No. 9; Noland, M. and H. Pack (2003), *Industrial Policy in an Era of Globalisation: Lessons from Asia*, Institute for International Economics, Washington, DC; Pack, H. and K. Saggi (2006), "The Case for Industrial Policy: A Critical Survey", *Policy Research Working Paper*, Series 3839, The World Bank, Washington, DC; Rodrik, D. (2004), "Industrial Policy for the Twenty-First Century", *CEPR Discussion Papers 4767*, CEPR Discussion Papers, London; OECD (2006), *The New Rural Paradigm: Policies and Governance*, OECD Publishing, Paris, *10.1787/9789264023918-en*.

the necessary skills and local SMEs have only marginally benefited from the new business opportunities. In Tennessee, the RE investment by the federal government as part of the stimulus package in response to the financial crisis (the American Recovery and Reinvestment Act, ARRA) financed demonstration projects in PV energy. However, it had a very limited impact on job creation, as the state labour market did not have the time to generate the local networks to connect investment in RE to its productive fabric. Finally, even if investment does trigger local specialisation along the RE supply chain, it can be challenging for these regions to benefit from a first movers advantage for two reasons: *i*) the technology is still maturing; and *ii*) new competitors, such as China, are investing massively in producing RE components. China produced a large share of the installations we visited in the case study regions.

Dependence on the public sector

High and long-lasting subsidies mean that in most places RE is heavily dependent on the public sector; this makes it difficult to produce alternative energy at low prices. At the end of the 2000s, several OECD countries introduced high subsidies/incentives for RE technologies, particularly PV and wind. This was justified by the many policy objectives that RE was expected to deliver, and especially by the promise of generating new employment opportunities. Evidence from case study regions, however, suggests that subsidies and incentives have often been too high and in place for too long. For instance, Italy and Spain's feed-in tariff schemes for PV energy have failed to harness the market incentives needed to ensure a viable and cost-effective introduction of RE into the countries' energy portfolio. On the contrary, the government's support mechanisms have in many respects subverted these incentives, resulting in massive expenditures that show little long-term promise for stimulating the economy or protecting the environment.[5]

Similarly, Québec has put in place a 10-year strategy (2006-2015) to promote wind energy and a related manufacturing supply-chain in the under-developed rural region of Gaspésie. The province has launched a series of calls for tender through its energy company (Hydro Québec), offering a premium price to developers to be paid by the energy company. Economic development motives were clearly at the forefront, as Hydro Québec already produces almost all of its power from renewable sources (large-scale hydro) and had no commercial incentive to move into wind in Gaspésie. To buttress this development objective, the province also introduced local content requirements (LCR) to facilitate the creation of local manufacturing activities (Box 4.4). While the policy has been able to create hundreds of manufacturing jobs in Gaspésie, the subsidised price paid to developers has been increasing and the potential export market for regional producers has been constrained by the fact that other Canadian provinces and the United States have put in place similar policy arrangements to stimulate manufacturing in their own regions. In any case, Gaspésie does not at present seem likely to emerge as a strong player on the world market for wind components, particularly given rising competition from China in this and other RE sectors. As a result, to keep the wind energy industry in good shape in Gaspésie, the province should continue to launch calls for tender for wind energy beyond 2015 – the date at which the support to wind energy should be phased out. There is little reason to believe that the reinvention of the Gaspésie economy over the last seven years will prove self-sustaining once public subsidies are withdrawn.

There are some cases in which direct incentives are not needed to promote alternative energy. In North Karelia, Finland, for instance, the public sector provides small forest owners with incentives for thinning their forest. This gives them the possibility to earn some income from their forest in the short term, while preserving the long-term quality of the forest resource and so the broad supply chain (and the thousands of jobs) that is related to it. It has also prompted forest owners to sell a large quantity of the thinned forest residues to small district heating systems. This is an example of an effective indirect subsidy to RE. Sweden has been supporting district heating systems over the last 40 years and, at the same time, has put in place a carbon tax and a specific tax on heating systems based on conventional fuels. In this context, there is no need to subsidise RE, as renewable heating (based on forest residues) is very competitive on the market and allows households to reduce their spending in energy. In Iowa subsidies to first-generation biofuels have been progressively reduced (and eventually will be phased out) by the federal government. Despite this phase-out, bio refineries are still producing ethanol from corn starch due to their increased productivity and the existence of federal regulations obliging the oil companies to mix ethanol in conventional fuels.

Box 4.4. **The pros and cons of using local content requirements to promote regional manufacturing activities**

LCRs are the most direct way to promote a local manufacturing industry. In the case of Gaspésie's wind sector, LCRs require the use of a certain percentage of locally-manufactured technology in domestic wind turbine projects. LCRs force wind companies to shift their manufacturing base to the country (or province), or to outsource components used in their products to domestic companies. However, unless the mandate is specifically targeted to domestically-owned companies it can encourage local manufacturing by any company, domestic or foreign (Lewis and Wiser, 2007).

LCRs are increasingly used in several countries, and especially by sub-national governments. Some countries have implemented adjustable local-content premiums in addition to feed-in tariffs. Turkey's Renewable Energy Law of 2010 offers bonus payments if the hardware components of renewable-energy technologies are produced in Turkey. In Italy, investors are entitled to an additional 10% bonus payment for solar components manufactured in the European Union. In the United States, the state of Washington provides an incentive to investors in solar PV generating plants which increases if consumers use locally-produced solar panels and inverters. If both solar inverters and modules are locally manufactured, the base incentive rate almost triples. Delaware, Florida and Texas provide similar bonus premiums for household solar applications (OECD, 2011).

LCRs need a large market in order to lure foreign firms to undertake the significant investments in local manufacturing. However, they can negatively affect the cost of RE and they distort international trade. For example, if the market is not sufficiently large or stable, or if the local content requirements are too stringent, then the advantages of attracting local manufacturing may be offset by the higher cost of wind equipment. Even where this is not the case, there remains a question about the viability of such manufacturing once the initial public subsidy that accompanies LCRs is phased out. Some concerns of this nature have already been raised in Brazil, where only one wind turbine manufacturer currently appears able to meet the local content requirements. The potential negative impact of LCRs on turbine costs has also been raised in Canada and China. These experiences suggest that local content requirements can have significant local impact, but should be applied, if at all, in a gradual fashion and only in markets with sufficient market potential (Lewis and Wiser, 2007). They should also be time-limited: the literature on infant industries suggests that sectors requiring prolonged support are unlikely ever to become viable on their own, and the longer public support is sustained, the greater the risk of creating a large, subsidy-consuming lobby. Turning to trade, measures aimed at increasing the domestic supply of technologies can affect trade flows in an adverse way. The trade-distorting impact of supply-side policies should be stronger the more they favour local suppliers over foreign competitors (OECD, 2011).

Sources: Lewis, J. and R. Wiser (2007), "Fostering a Renewable Energy Technology Industry: An International Comparison of Wind Industry Policy Support Mechanisms", *Energy Policy,* Vol. 35; OECD (2011), "Domestic Incentive Measures for Renewable Energy with Possible Trade Implications", Joint Working Party on Trade and Environment, COM/TAD/ENV/JWPTE(2011)46.

Competition with other land-based rural industries

Subsidies to RE often affect relative prices at regional level in unintended and sometimes undesirable ways, and can intensify competition for natural resources and other inputs. For instance, high public subsidies to RE deployment can have a negative impact on land use and displace agricultural activities. We observed this in several regions. In Puglia and Extremadura, high national incentives (FITs) for PV energy caused farmers to install PV fields on their agricultural land. The income generated by these installations (through FITs) was higher than from traditional uses, which also require

other inputs – labour and capital – and bear a higher risk. In Puglia, for instance, according to local stakeholders, a one-hectare PV field could generate up to EUR 5 000 a year under Italy's feed-in tariff system.[6] This large deployment of on-ground solar installations (mostly PV but also some CSP), not only affected the availability of agricultural land, it also absorbed a large share of the local water supply.[7] It should be said that the impact on agricultural land is not homogenous and tends to be higher where the productivity of land is lower and agricultural activities less intensive, and also where the presence of grid connections reduces the initial capital cost of the installations. In fact, due to the lack of grid connections, marginal agricultural land in remote areas cannot be used for the production of RE.

Some RE technologies can also compete with tourism activities. While wind turbines are compatible with farming activities, their impact on landscape can be intense. It is very difficult to assess the real impact of wind turbines on landscape in an objective way. To some people, wind turbines could be considered a symbol of sustainable development – to others they are a wound on the traditional rural landscape. Opponents believe that constructing large, towering metal structures creates an industrialised landscape in rural and natural areas, which some people consider to be detrimental. None of the case studies revealed clear damage caused by RE installations to tourism activities, but this could also depend on the relatively short time of the research and on the lack of precise information. One assessment of the impact of wind energy on tourism in some rural areas in Scotland found that wind energy deployment would have an impact, although relatively small, on local attractiveness for tourists (Riddington, *et al.* 2008).[8] Deployments might keep away those tourists looking for scenery and tranquillity causing a negative impact on both employment and gross value added in the tourism sector. This study suggests that there is a need to make clearer to the general public that in some "scenic/wilderness" areas they will not see large commercial wind farms. However, wind installations are highly sensitive to location and scenic areas often have the best wind for generating power.

In this context, high subsidies to wind energy would not be a good idea – they could unbalance the democratic debate among different local constituencies and could encourage wind installations to be deployed in areas with high landscape value and despite local opposition and the potential damage to tourism activities.

The crucial point here is not that land-use change should be prevented. Land, like other production factors, should be allowed to evolve to its highest-value uses. The problem is rather that strong, spatially-blind incentives can trigger changes of use that will not, in the long run, be economically desirable and that may nevertheless be impossible or extremely costly to reverse. Empirical evidence collected in the report cited above shows the importance of using aesthetic guidelines when siting wind installations (Riddington, *et al*. 2008). For instance, Abruzzo, Italy, has successfully promoted wind energy within a protected landscape by using such guidelines (see Box 5.3).

The mismatch between renewable energy and transmission infrastructure policy

An energy grid is a fundamental factor in the ability of a rural region to export, or distribute locally, renewable electricity (and biogas in gas grids). Often RE policy is narrowly focused on energy installations and does not take into account any upgrade of regional infrastructure that may be required to distribute the additional energy generated. The most striking example of this poorly-integrated regional approach is the lack of support to upgrade capacity and change the way energy transmission systems function. In

many cases, this can hamper RE deployment, even if the area is rich in renewable sources of energy.

In most cases, transmission and distribution infrastructure is only designed to convey electricity produced by a few large centralised power plants and cannot accommodate small-scale distributed generation. This has multiple effects on RE deployment in rural regions. In general, it favours the deployment of large RE installations over small and diffused plants. Moreover, an outdated grid makes it more expensive to install RE, and thus requires higher subsidies for developers. Regions already specialised in power generation may therefore enjoy an advantage when it comes to RE development due to their denser grids.[9]

RE in several case study regions was suffering from an inadequate grid and incentives for "smart" systems (in which producers and users of electricity in the same area exchange electricity produced from different sources). In Italy, for instance, there were 250 000 requests for connection from RE suppliers (a total of 196 GW) in April 2011. However, only 42 GW were already connected. About 22 000 requests for connection (140 GW) were for plants not yet authorised. This indicated the virtual saturation of the grid. While it is unlikely that all these applications will actually become installations, the system operator has to take them into account, and this affects the possibility of having actual new RE deployments. This national bottleneck, together with high incentives for RE, is mirrored by the creation of a market in Puglia for licences granted by the national system operator to connect to the grid. Moreover, there are no incentives to improve the grid or introduce smart distribution. The national company that might do this (ENEL) could actually see its businesses damaged by a transition to RE technologies and diffused generation. The situation is similar in countries/regions with natural gas distribution grid. In Friesland, for instance, the high concentration of cows provides good conditions for the large-scale production of biogas (also potentially reducing the negative impact on the environment of intensive livestock production). However the presence of a natural gas grid and the lack of specific infrastructure for collecting biogas undermine this opportunity.

A crucial issue is who bears the cost of transmission grid expansion. RE is already more expensive than conventional power in most situations. If the costs of connecting RE generation to the grid are borne by the generator, then renewable energy will be even less competitive. This will reduce the amount of RE produced. But if the costs are not at least partially borne by generators, then too much will be spent by system operators and utilities on building transmission capacity to connect high-cost power and the resulting high cost of energy will have adverse economic development effects across all regions.

Without sufficient grid capacity to transport electricity from rural regions to urban centres, many projects will struggle to find funding, as their revenue potential is limited to local demand. Maintaining the electricity grid is generally a shared responsibility, with nation-wide bodies overseeing the (high-voltage) transmission lines and regional bodies responsible for the (low-voltage) distribution networks. In Puglia and Scotland, the electricity grid cannot absorb any additional RE capacity, thereby stalling any expansion of RE supply without on-site storage (usually a costly option) or demand-side management. In some instances, rural areas may prefer to concentrate on meeting local demand before connecting to a grid. However, many rural areas have more RE resources than local consumption requires, while urban areas lack sufficient space and resources to meet their energy needs with RE. Orienting part of the incentives to improve transmission/transportation capacities in regions would facilitate the export of RE from

regions where is produced to regions where is consumed (Box 4.5). The above discussion also implies that RE will be easier to deploy in regions where the grid is already fairly dense and where there is already some specialisation in energy. These areas may also have a good local labour market with the necessary skills. These are important points for policy makers and private sector developers to bear in mind when framing public initiatives or making location decisions.

Box 4.5. **Tradable renewable energy**

When fed into the general grid, energy produced from renewable sources is indistinguishable from conventional energy. It is therefore very difficult for companies to claim that they are using electricity produced from renewable sources. Renewable energy certificates (REC) provide a means for companies to prove they are using renewable energy. This is very important in implementing regulations on the use of RE.

Another problem with RE, and electricity in general, is matching demand with supply in the grid. Given that it is expensive and often inefficient to store electricity, this requires a very flexible supply. In this context, it is difficult to trade RE, as it needs to be fed into the grid as soon as it is produced, and in many cases the quantity produced is not controllable as it depends on natural forces. The amount of electricity produced by wind power, for instance, depends on the power of the wind, which does not follow a completely predictable pattern.

In this scenario RECs represent a way to improve RE tradability. The energy produced is "virtually" stored in the certificate, which allows companies to prove their use of RE. This is basically a decentralised subsidy to RE producers, in the sense that it is the price generated in the market for REC which defines the size of the subsidy. This market, however, is geographically limited by a country's administrative boundaries, or the extent of the electricity grid. A series of fragmented and thin markets have been created. On the one hand, the fragmentation is linked with the need to match the certificate with the actual usage of electricity; on the other hand, a thin market is characterised by large price volatility, which introduces a high degree of uncertainty over the size of the subsidy.

Sources: Schmalensee, R. (2011), "Evaluating Policies to Increase the Generation of Electricity from Renewable Energy", *Working Papers 1108*, Massachusetts Institute of Technology, Center for Energy and Environmental Policy Research and Field, B. and Field, M. (2002), *Environmental Economics*, McGraw Hill, Toronto.

Assessing the impacts of renewable energy policy on regional economies

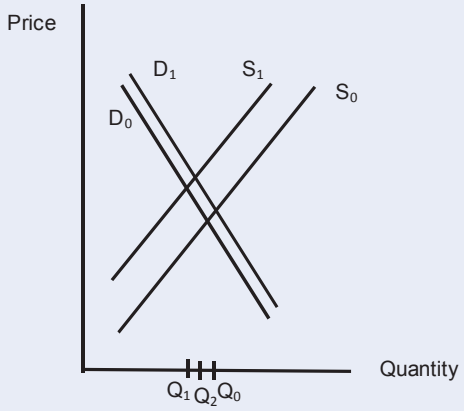
While CO_2 emissions and electricity generation can be calculated with relative precision, it is challenging to assess the impact of RE deployment on economic development. This was a problem in all the regional case studies. For instance, lack of specific data makes it difficult to calculate the net impact on jobs at the regional level. Data sets on employment trends in rural areas do not refer specifically to industrial specialisations related to RE production. Likewise, data sets on economic activities are still lacking an environmental or "green" dimension. This information gap means that public authorities can only assume that economic development will automatically result from RE deployment, but do not have specific facts to allow them to develop more nuanced and targeted policies. It also limits the ability to evaluate (and then adjust) policies once they have been implemented. In the same vein, the poor quality of data and forecasts, i.e. very high expectations in terms of jobs created by RE, can bias policy evaluation. In other words, good results may seem disappointing if *ex ante* expectations were unrealistic.

The expansion of relatively high-cost renewable energy projects is having important consequences for low income citizens. If the higher costs of RE are blended into market prices for energy, as is the case with feed-in tariffs, this raises the cost of energy across the board (Box 4.6). If government subsidises the production of RE with scarce tax revenue, then there is less money available for other policies. In either case the poor are more exposed, since they spend a larger share of their income on energy and are more dependent on support from government programmes. Both fuel poverty and reduced access to government assistance may reduce aggregate demand if the poor reduce their expenditures in response. Thus, while governments may intend to stimulate economic growth by RE expenditures, they may have the opposite effect if the modalities of deployment and the distributional consequences of RE policies are not properly addressed.

Box 4.6. **The macroeconomic impact of renewable energy**

If externalities are not taken into account, almost all sources of renewable energy are more expensive than their conventional counterparts. This means that until renewable energy prices fall or conventional energy prices increase, displacing conventional energy with renewable energy will increase the cost of using energy. To the extent that energy cannot be replaced by some other input at the margin this means that the cost of production of goods and services using energy must increase. In the figure below this is represented as a shift back in the aggregate supply curve from S_0 to S_1 and a corresponding decrease in output from Q_0 to Q_1, supposing aggregate demand does not shift.

Impact of renewable energy on supply and demand



But perhaps, as proponents suggest, renewable energy leads to a shift out of aggregate demand to D1 because of the effects of new technologies on income and employment. Then aggregate output becomes Q2. Q2 is drawn as being less than Q0 since the energy sector is only a small part of the aggregate economy, and demand for energy is a derived demand, which suggests it is in a society's interest to reduce the costs associated with producing energy. Consequently, the aggregate economic impact of renewable energy is likely to be higher prices and lower aggregate output and thereby reduced employment.

Avoiding public opposition

In a number of rural regions a top-down approach to RE is causing communities to oppose many large-scale installations – usually large-scale ones. This is holding back the rapid and wide scale deployment of alternative energy. The top-down approach tends to be driven by the argument that RE is a panacea for reducing climate change, increasing energy security (and sometimes national security),[10] and promoting growth (Wei, *et al.*, 2010; EWEA, 2009; European Photovoltaic Industry Association and Greenpeace, 2006). Central governments and supra-national organisations – including the European Commission, the OECD and the IEA – have also been supporting the rapid deployment of RE, in some cases with very ambitious targets for installed capacity. Accordingly, central governments have often favoured those solutions able to guarantee the maximum result (in terms of installed capacity) in the shortest time and at the lowest (transaction) cost. While the importance of RE to the world's energy future is difficult to dispute, we suggest that such an approach may, over time, engender resistance rather than support for RE; In other words, more haste may result in less speed.

For example, a consequence of this top-down approach is that, in many regions, RE is deployed by a few developers who build large-scale installations with limited say by host communities about the kinds of technology and installations that would fit their context best. This approach has prompted some rural communities to oppose RE, even in places where they previously supported it (e.g. see the case of Friesland in the Netherlands). In many cases local communities do not oppose the "green narrative", but rather the potential negative impact RE has on the amenities and assets they value or they use to generate revenue. For instance, in the Shetland Islands a vocal group of local people has been opposing for several years the idea of deploying a large-scale wind farm on the main island of the archipelago. These local opponents are not against the idea of RE; they oppose the idea of transforming their small territory into a place to produce a large quantity of (subsidised) RE to be exported to mainland Scotland and the rest of the United Kingdom. In the same vein, small communities in Norway oppose large-scale wind developments, which they feel do not fit their landscape, could keep tourists away, and do not fit their view of sustainable development.

Social acceptance tends to be easier to win in economically deprived regions suffering from the crisis of traditional rural industries – forestry, agriculture, fishery, mining, etc. Here out-migration by young people tends to be high, affecting the availability of key public services and the strength of intermediate institutions (Box 5.1). Such communities may welcome a higher level of government promoting investment in large-scale RE projects in their area. However, even here a top-down approach to RE could have only a marginal impact on regional development. In Gaspésie (Québec), for example, rural communities did not oppose the provincial policy to deploy a large number of wind turbines, despite the importance of their traditional landscape for tourism. The region was suffering from a crisis in the forestry and fishery sectors, which had caused regional unemployment to reach 25%. Likewise, in Extremadura, which is a historically fragile rural economy, small and remote rural communities have traded their agricultural land for vast CSP installations (see above). However, in most of such cases, large RE investment involves only a few developers directly, and does not stimulate a real development process in the regional economy, which remains dependent on the inflow of public resources to support the local supply. For example, where high preferential tariffs for RE generate large revenues, the plant owner may pay a small portion of the revenue, which can be a significant amount of money in the local context, to compensate the host

community for the use of their land. However, this is likely to be the extent of local "engagement". This leaves the renewable energy development entirely dependent on outside actors and reduces the potential of the investment to act as a spur to endogenous growth. Local actors, having little or no involvement in the development strategy, fail to look for investment opportunities along the renewable energy supply chain. Ultimately, this has a negative impact on the potential for triggering self-employment and entrepreneurship, which are pillars of regional development processes.

It is easy for supporters of RE projects to dismiss local opposition as mere "NIMBY-ism" ("not in my back yard"). Yet it would be a mistake to argue that because an investment (whether for RE or some other purpose) is necessary for society at large, the host community should simply accept any costs without concession or compensation. Where host communities are asked to accept real costs, they should be given a role in helping to identify ways to mitigate those costs as much as possible and to design appropriate compensation unavoidable costs. This means giving them a voice in the policy process.

Rural dwellers are demanding more active and direct participation in RE policy, particularly when it will directly and palpably affect their lives, their property values and, in some cases, the viability of their own economic activities. The growth in the Internet has given rural people a dramatically increased capacity to access information and the ability to become organised to play a more active role in the governance of RE deployment. They are less and less happy to delegate key decisions about their future to public authorities. Even in countries with relatively developed RE markets, like Germany, social opposition is emerging as a potential threat to future development. Currently, debates at the level of the *Länder* (German regions) are halting the construction of the "energy highways" proposed to transport large amounts of RE from the rural north to the urban south. Opposition is coming from different local constituencies (rural dwellers, farmers, and environmentalists) concerned about the impact of the power lines on health, landscape, and wildlife (Fröhlingsdorf, 2011). This regional opposition is distinct from the general popular support for Germany's ambitious renewable energy development goals. In this respect, Germany is by no means unique: broad public support for aspirational goals often sits alongside fierce local resistance to concrete projects. In this context, the governance responsibility for achieving renewable energy objectives falls largely on the shoulders of sub-national authorities charged with overseeing the deployment of renewable energy.

Notes

1. Between 2007 and 2011, the regional government concentrated environment, industry, and energy policies into a single *consejería* (regional ministry). This institutional arrangement allowed the regional government to speed up the authorisation process for RE installation, improve the grid, and invest in training to promote job creation at the regional level. The concentration of power and competences in a single governance "hub", however, might have deterred the co-ordination between energy and rural development (each under a different *consejería*). While effectively lowering transaction costs, this approach to RE deployment could have impoverished its impact on rural development by reducing the number of actors involved in policy implementation. In 2011, following regional elections and a radical change of the national approach to RE, the regional governance of RE was rearranged. Energy was integrated into a new *consejería* for agriculture, rural development, and environment, offering opportunities for public synergies and inter-sectoral interaction between these areas. The new *consejería* aims to improve biomass and small-scale installations, based on collective actions and direct engagement of local actors, especially in terms of investment. This contrasts with the old approach, in which investment was mostly coming from outside the region, and was concentrated in RE sectors highly subsidised by national policy.

2. The role of the central government is important in deciding what kind of financial incentives should support RE production. For instance, evidence from case studies shows that feed-in tariffs have been very effective in supporting the deployment of RE. This depends on a very high price paid by the electricity system operator to the generator of the RE electricity. However, in all the cases the price was poorly set (too high) and, together with lower costs of the technologies due to increasing experience, the production of RE either had an impact on the relative electricity cost or caused a public deficit. This forced the central government to reduce FITs, impinging upon the profitability of RE.

3. For instance, high transaction costs limit the potential for developing small-scale biomass plants, whose sustainability depend on a large number of well-organised rural actors (farmers, forest owners, etc.) providing the plant with a continual supply of residues.

4. It takes three to five years to train skilled workers in renewable energy activities, according Mr. Sauvé, Québec's Deputy Minister of Natural Resources and Fauna.

5. See also Frondel, *et al.* (2009) for a discussion of the negative impact of high public subsidies on RE deployment (PV installations) in Germany.

6. Between 2005 and 2010 (*Conto Energia* and *Secondo Conto Energia*), Italy's FIT scheme paid developed a premium price up to EUR 0.50 per kWh lasting 20 years to developers.

7. Early generations of CSP systems are intense in water use, which is used to carry the heat generated by mirrors, or in energy storage systems. So they are usually located on agricultural land that has good access to water.

8. This research suggests that a few very large wind farms are better than a large number of small farms. A number of medium size farms concentrated in a relatively small, contiguous area is also not desirable.

9. Extremadura's denser grid gives it an advantage when competing for RE quotas at the national level. The grid density in the region is explained by the presence of a nuclear power plant.

10. Especially in the Iowa, United States, the argument that producing ethanol is also a way to reduce the use of the Army to guarantee stability in oil producer countries was discussed several times.

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Chapter 5

Putting renewable energy to work in rural areas

This chapter concludes Part I of this report and provides policy recommendations. Introducing a "spatial dimension" to the renewable energy strategy is likely to improve policy outcomes. Policy interventions should trigger collective actions involving a large number of regional actors. Most importantly, renewable energy should not be considered as a stand-alone sector, but rather should be connected to the industrial base and key assets of rural regions.

The challenges described above point to the need for a shift in RE policy away from an emphasis on sectoral policy and subsidies, towards place-based policy grounded in local conditions, opportunities and the competitiveness of rural areas. Bottlenecks to "green growth" could be resolved by a policy approach that involves rural dwellers in key policy decisions, capitalises on local assets to produce RE, and links the production of sustainable energy to rural industries (Box 5.1). RE should not be considered as a stand-alone sector within rural economies but should rather be seen in the context of existing supply chains and skills. In general, this research suggests that there are no shortcuts to regional development in rural areas, and policy interventions should accept the complexity of RE policy and capitalise on the opportunity to involve a large number of local agents and stakeholders, feeding into legitimacy and local ownership of projects, instead of focusing interventions on local elites and small groups of developers. Some of these ideas are developed further in this concluding chapter.

Box 5.1. How the new rural paradigm could guide renewable energy policy in rural areas

To embrace the new rural policy challenges faced by many countries, innovative governance mechanisms have been developed to enhance co-ordination across sectors and levels of government, as well as between public, private and non-profit stakeholders. Moreover, new policy instruments with a significant territorial and place-based focus are being created to identify and capitalise on rural areas' competitiveness, local assets and knowledge, as well as to tap into diverse potentials for development. The OECD has described this evolution as a paradigm shift in rural development policies. The defining characteristics of this new rural paradigm are a focus on places rather than sectors and an emphasis on investments instead of national transfers and subsidies (table below; OECD, 2006).

In general, for RE to be an effective tool for rural development it has to be compatible with this new paradigm. This means projects have to be assessed using investment criteria, and not on the basis of short-term subsidy levels. Projects have to be integrated into the local milieu and not simply dropped into communities by national governments. Most importantly RE is only appropriate in certain places and more care has to be taken in identifying those places rather than adopting policies that somewhat arbitrarily spread RE projects across national landscapes. This approach implies complexity and the involvement of a large number of local, regional and national actors. This should not be considered as a problem, but as an opportunity to have a significant impact on a large number of key actors, thus improving the chances of creating long-term development.

The new rural paradigm for rural development

	Old approach	New approach
Objectives	Temporary compensating disparities; farm income	Competitiveness of rural areas: developing local assets and exploiting unused resources
Strategies	Sectoral	Comprehensive/context specific
Key target sector	Agriculture	Various sectors of rural economies (e.g. rural tourism, manufacturing, renewable energies, services)
Main tools	Subsidies	Investment in soft and hard infrastructure: education, employment, Innovation, transport
Actors	Central government	Different levels of government (National, regional, local) and local stakeholders (public, private)

Source: OECD (2006), *The New Rural Paradigm: Policies and Governance*, OECD Publishing, Paris, *10.1787/9789264023918-en*.

Developing a "place-based" approach that combines renewable energy with rural development

RE deployment is too often seen as a technology issue, rather than an economic development issue. In general, the aim of national policy is to speed up the implementation of RE to displace conventional energy, and to foster technological innovation to reduce the cost of this energy. While it is generally recognised that only certain sites are appropriate for RE projects, the main focus is on the quality of the resource; the associated costs of getting the energy to market are only a secondary consideration. In most places, economic development benefits are seen as positive but secondary by-products of environmental policies. There is nothing wrong with this: there is no logical reason why local economic development concerns should be given precedence in RE policies, and this report does not intend to suggest that they should. However, the research suggests that greater attention to the place-based character of RE projects would not only make it easier to realise the potential economic development benefits, it would also make them more sustainable and cheaper to implement.

Replacing uniform national renewable energy targets with a more tailored approach

National policies typically set uniform targets without much concern for the potential of different regions to achieve them. Once national (or EU) policy has been formed, there tends to be little flexibility in the goals and standards assigned to lower levels of government. Yet it is clear that not only do different regions have different capacities for producing renewable energy, they also vary in their availability of conventional energy. This means that some regions have a greater capacity to introduce renewables, while for others replacing low cost conventional (fossil) energy with more expensive renewable energy is much more difficult.

Assigning uniform RE targets may appear equitable, but in reality it imposes higher economic costs of adjustment on some than on others – this may mean higher aggregate costs than necessary. Where countries or regions have significant fossil fuel resources, the energy security motivation for introducing renewables is weaker and the economic cost of switching is relatively higher. New Zealand, for instance, has made a major shift to renewable resources, in part because of its high quality wind (particularly in the Tararua Ranges in the North Island), geothermal and other resources, but also because New Zealand has few fossil fuels (TE ARA, 2012).[1] Similarly, Denmark is a world leader in wind power, in part because it has no other indigenous energy sources. If the main objective for introducing renewables is to counter climate change, then it should not matter where reductions in fossil fuel use occur, only that they occur. In this case the least-economic cost of adaptation is achieved by asymmetric adjustments across regions, similar to the logic of a cap-and-trade regime.

Introducing a territorial approach to the implementation of RE may result in faster adaptation to the new energy paradigm, because those places most suited to its introduction have the strongest incentive to adapt. A territorial approach to RE can also reduce the aggregate economic cost of adjustment by concentrating fossil fuel use in those regions where it is locally available and RE capacity is weak. In other words, RE deployment should be tailored to fit the energy profile of territories and regions, in order to minimise associated cost and displacement effects.

Recognising the spillover effects of narrowly-defined renewable energy policies

At present RE has the biggest positive local economic impact where it displaces expensive imported conventional energy. This is most likely to be the case in more remote rural regions where there is a high-quality renewable source and expensive and constrained capacity to import energy. In this environment, shifting to a high percentage of renewables can reduce total energy costs. However, in this type of region, it is likely that the renewable energy is "locked in", because high cost for importing energy also imply high costs for exporting energy. Iceland is the perfect example. Electricity from renewables is cheap in Iceland and underpins a large aluminium sector (National Energy Authority and Ministries of Industry and Commerce, 2004). But electricity remains cheap because there is no way to export it.[2]

Large amounts of locked-in power can provide the engine for rural development. The Tromsø region in Norway has large hydro resources that are being supplemented with wind power to reduce seasonal power shortages. The high cost of building transmission capacity to the south makes electricity relatively cheap in Tromsø and this is an absolute advantage for economic development. A region further south in Norway, with better access to the grid, would have a much higher opportunity cost for using electricity locally that could limit the role of electricity as a driver of economic growth, although this access would offer RE producers a larger and potentially more profitable market.

Large-scale RE projects are almost always export-oriented and have limited connections to the host region.[3] Rural regions with excellent renewable capacity and reasonable proximity to urban centres may be able to generate export earnings from energy exports. If very little of the energy produced is used locally, there are few local linkages. Nevertheless, revenue from selling energy can be a significant contributor to the local economy if a reasonable share comes back to the region in the form of tax receipts, land rental charges or ownership dividends. Direct employment effects are likely to be limited at large export sites, because automation is used to control the cost of production.

Most importantly, governments at all levels must recognise that energy is a commodity that has value as an input and not as a final product. Moreover, for most consumers, be they households or firms, it is a fairly standardised commodity: in rare cases people can be convinced to pay more for energy produced in specific ways and this can create a niche market for a specific producer, but as renewable energy becomes more common this type of niche premium is less likely.

Using subsidies to stimulate innovation can lead to real costs for first-mover regions. Introducing high-cost energy into a region may provide some local benefit as long as subsidies are high, but the subsidies have to be ongoing to keep this type of producer operating. While the nation may gain some incremental knowledge from the plant that can be useful in driving down the cost of future production, the community with the old expensive technology is disadvantaged. When new technologies emerge there is no incentive at the national level to maintain subsidies for older technology and the community may see its local energy provider fail or its power costs rise.

The distributional consequences of RE adoption should not be ignored. As RE increases its share of the total energy supply, the average price of energy increases. For the poor, who spend a higher share of their income on energy this has a significant adverse consequence. For the rural poor, who tend to live in older housing

that is less energy efficient and are responsible for providing all their energy needs (heat transport and electricity), the consequences may be especially harsh (Solomon, 2012). In Germany, where fuel poverty has until recently been comparatively rare, it is estimated that 10-15% of the population now struggle to pay their energy bills.[4] Average retail electricity prices in early 2012 were estimated at more than 40% above the levels of 2005, sparking debate about the extent to which the "green transition" was responsible for the increase. As noted above, however, there are circumstances in which RE may play a role in reducing fuel poverty: in areas where conventional energy is relatively expensive and renewables can help bring down energy costs, the poor may benefit more than most from the switch.[5] These differences in the distributional impacts of RE deployment in different contexts also underscore the need for a place-based approach.

Promoting linkages between renewable energy and rural industries

Environmental arguments remain the main impetus for promoting renewable energy, but it has clear economic impacts. Indeed, as natural gas prices decline, the economic competitiveness of renewables weakens. This increases the importance of ensuring that RE policy causes the least possible harm to the economy while meeting environmental objectives. Like oil and coal deposits, the opportunities for developing RE vary by place. Those regions with high-quality resources may well have a real economic opportunity in exploiting them, but not all regions have this opportunity. And for the region to benefit from this development, the renewable energy strategy has to be embedded in the local economic development strategy. As stakeholders in Wallowa County, Oregon, told the OECD mission, "energy has to have a job". This means that it has to be priced so it allows firms in other sectors to remain competitive.

At present, there are few cases of RE being well integrated into rural development. In the local communities where RE represents a sound development opportunity, several things stand out:

- RE strategy is mainly driven by local concerns and not national policy. This means that the choice and scale of projects reflects local opportunities.
- The projects are mainly oriented towards serving local demand. While energy export opportunities may exist, communities recognise that energy exports are commodity markets where viability ultimately depends upon having the lowest delivered cost of power.
- More successful projects have limited reliance on subsidies to cover operating costs. High subsidies seem to attract rent-seeking investors, who calculate that they can recover their investment costs in a few years. After this, the fate of the plant is immaterial to them, but it still has consequences for the community.
- There is a focus on relatively mature technologies, such as heat from biomass, small scale hydropower and wind energy. These are proven technologies that are not likely to experience big jumps in technology that can make recently completed plants instantly obsolete.
- The local strategy recognises that RE competes with other sectors for inputs, particularly land. In general, most RE projects are visually unattractive, and poor siting can adversely affect local residents and disrupt tourism, which is typically a much larger source of income and employment than energy.

- Successful integration of RE into rural development seems to place little focus on direct employment benefits. The main aim is to provide reasonably priced energy and the limited employment opportunities are seen as a minor bonus. While creating even 10 new jobs is a noticeable accomplishment, these will not restore prosperity across the board. The real employment benefits are less direct and stem from finding ways to use RE to enhance the competitiveness of local enterprises.

Using inclusive governance to ensure sustainable rural development and public acceptance

The capacity to connect RE to rural economies depends largely on governance arrangements. The research found several examples of deployment supported by inclusive governance, even where the renewable energy policy was mostly top-down. The absence of a partnership approach to RE deployment has had three main negative consequences: *i*) little circulation of information and feedback between lower and higher governance tiers; *ii*) a dominance of large-scale RE projects which lack linkages with the local economy and rural activities; *iii*) poor integration along production chains and/or limited involvement of key regional/local actors (see Table 5.1 for more). However, several case studies and the literature indicate that governance systems are evolving to establish renewable energy discourses, build resourceful actor networks and negotiate commitment between different interests (Smith, 2007). In most cases, this policy "evolution" is led and carried out by intermediate institutions – such as co-operatives, local governments, and universities – whose role is to harmonise objectives among different stakeholders, while clarifying rules and enforcing control over policy performance (Box 5.2).

Intermediate institutions can disseminate clear and reliable information to the local community, put democratic mechanisms in place to allow rural people to influence key decisions about renewables, and co-ordinate activities. They can adapt national policy interventions to the characteristics of a local community. They can also help local communities capitalise on technologies that involve a large number of actors but that require co-ordination, facilitating the creation of regional innovation systems, as discussed in Box 3.6 (Chapter 3). Intermediate institutions play also a key role in promoting public acceptance of RE among local communities.

In general, the presence of intermediate institutions, such as cooperatives, greatly helps to reduce co-ordination costs related with RE investment in rural areas, since costs cannot be absorbed by a single private or public local operator (Table 5.2). They are particularly effective in RE sectors that require the involvement of a large number of co-ordinated actors, like biofuels, biogas and biomass in general. This characteristic allows policy makers to implement complex interventions – which deal with a new technology and involve a large number of actors – without requiring "policy shortcuts" (often associated with a top-down and sectoral approach) such as promoting large-scale deployment involving a limited number of actors. Such shortcuts initially appear to reduce complexity but tend to deliver poor policy outcomes, while distorting rural economies.

Box 5.2. **Intermediate institutions: What they are and how they can link rural development to renewable energy**

Intermediate institutions are bodies and rules operating in between national/regional governments and individuals/firms. They play an important role in solving market failures and promoting collective action. According to Porter (1994, 2003) these "institutions for collaboration" might be trade associations, entrepreneurial networks, standard-setting agencies, quality centres, technologic networks, etc. Arrighetti and Seravalli (1999) identified a broader range of institutions which encompasses sectoral organisations, local governments, local banks, consortia, associations, local development agencies, and even peripheral offices of national administrations. They contribute to regional competitiveness by connecting development opportunities and fostering collective action.

Several cases studies in our research found that intermediate institutions were playing a key role in linking renewable energy deployment with rural development. For instance in Middle Norrland (Sweden), and – at a different scale – Québec (Canada), forest co-operatives are crucial for embedding RE production within their core businesses. In Middle Norrland a co-operative (Skogsägarna Norrskog) of 13 000 small forest owners sells forest residues to the local CHP plant. The local power company – the CHP operator – has a long-term contract with the co-operatives. Several rules guarantee that suppliers maintain a high quality product and invest in R&D to improve biomass performance (see case study). This set-up means that in this region there is no need for incentives to promote RE. Forest owners have clearly identified RE as an opportunity for diversifying their business and stabilising their income. In the same vein, a smaller co-operative in Québec is trying to trigger the local consumption of forest residues to produce renewable heating as well as to promote the production of boilers and reduce fuel oil and coal use.

The role of intermediate institutions is also key for creating regional innovation systems as they connect and mediate among government authorities, research centres and businesses. In North Karelia, for example, there is a research system made up of a series of local bodies and organisations which work with the Regional Council on trans-European and Nordic collaboration projects. They provide scientific support to policy institutions and focus on innovations with high relevance for the use of RE: liquid fuel production through pyrolysis; diesel oil and ethanol production from cellulose; optimal logistic management for biomass flows and forest resources measurement through GPS systems. Likewise, Iowa provides another example of the pivotal role played by local research centres that are able to work in close collaboration with different producers along the supply chain to promote innovation and the more efficient use of biomass.

Table 5.1. **Failures and new institutional arrangements to put renewable energy to work**

Institutional and market failures	New institutional horizontal co-ordination
Lack of feedback mechanisms between hierarchies of national, regional and local government.	Co-operation among biomass producers to organise biomass collection, processing and transport (Iowa; North Karelia; Québec)
Poor circulation of information and exchange among governance levels: asymmetric information, large gaps in entrepreneurial initiatives, low capacity building at regional and local levels	Collaboration among research institutes, institutions and firms/agricultural production systems for technological innovation (Iowa; Tennessee; North Karelia; Puglia; Friesland)
Lack of integration in the regional production fabric. High transaction costs within the RE sector and between RE and rural activities (e.g. between RE and production of biomass by agricultural activities)	Strengthened vertical integration within cluster systems to connect core rural businesses to RE (North Karelia; Iowa; Region Zealand)

A key challenge for RE policy is to find forms of compensation for host communities that do not negatively affect the economic viability of RE developments or investment inflows. Benefits of renewables (wages, rent, interest and profit) need to be appropriately distributed among all groups contributing to their successful deployment. The make-up of these groups will vary by technology and scale of deployment; in general, it consists of investors, developers and host communities. This challenge is compounded by the difficulty in assigning value to the costs borne by local communities. The market costs are well understood and relatively straightforward, but other costs – changes to landscapes, nuisance (e.g. noise or shadow flicker), environmental impacts (e.g. wildlife and water quality, increased traffic congestion) and the potential for reduced property values – are more difficult to value (Hubert and Horbaty, 2012). For land-intensive renewable energy sources like large-scale solar and bio-energy, the potential for competition among land uses can also fuel public opposition. Landscape and land-use concerns are particularly strong in rural areas where local income is often tied to the land through agriculture and related industries, as well as tourism.

Public authorities can foster community acceptance in two ways: increasing understanding of renewable energy projects and ensuring local benefits; in both cases, they need to engage local (intermediate) institutions and adopt a territorial approach to RE. In an analysis of the social acceptance of wind farms, Huber and Horbaty (2012) highlight how "reducing the risk for future surprises, early and transparent communication can even strengthen projects and assist in building public support", concluding that "public consultation on projects cannot begin too soon". Public authorities – and, in particular, regional governments – can facilitate this upfront effort by requiring community consultation during the project development phase and streamlining permitting processes so that communities understand how they will be affected by renewable energy projects. What is more, regional and local authorities and institutions are well placed to understand how RE projects relate to cultural and regional specificities. Investors will also benefit by understanding the community's priorities from the outset, rather than investing in costly designs for inappropriate projects (Huber and Horbaty, 2012).

Communities will be more willing to accept some of the costs of renewable energy installations if they stand to gain from them, and if they can connect their activities to RE deployments (Box 5.2). In many cases, RE is considered as a stand-alone sector within local economies. The popular perception is that large utility companies and corporate investors are the main beneficiaries. The local content of value added is generally very small, being limited to land leases and wages, for example. It doesn't have to be this way however. The success of Denmark's wind industry depends on the direct involvement of farmers and local co-operatives. These constituencies heavily invested in wind energy deployment, easing the path for renewable energy development and making investment more politically secure (Kamp, 2002 & 2004; Midttun and Koefoed, 2005; Bryden, 2010).

Citizen participation can increase public acceptance of installations, allowing RE to be perceived as a key part of their local society and economy, enhancing linkages with existing intermediate institutions and having a positive impact on regional development. There is a strong link between the need to focus renewable energy development on accumulated competencies and gaining community acceptance. Public authorities at the regional and local level can ensure benefits by creating opportunities for communities to invest in – or directly contribute to – the production of RE. Creating such opportunities counteracts the popular perception that large utility companies and corporate investors are the main beneficiaries.

Box 5.3. Good practice examples of bottom-up approaches to renewable energy

There are some local experiences in which RE policy provides rural dwellers with specific policy tools to experiment with deployment and to gather direct benefits. For instance, the Scottish government is active in supporting bottom-up RE development through pioneering policy interventions. The Community and Renewable Energy Scheme (CARES) – overseen by Community Energy Scotland (CES) – supports community groups developing RE projects of up to 50 MW across rural Scotland. Through CARES, community trusts, charities and volunteers active at the very local level can get involved in RE. The policy supports them with loans and technical assistance provided by CES's development officers and network of experienced community groups. This policy has spurred over 1 000 RE projects, representing 163 MW of installed capacity. Another example of a positive institutional arrangement at the local level comes from rural Abruzzo. Here siting of RE installations always takes into account technical parameters – such as sun irradiation or wind speed – as well as aesthetic factors. This reflects the large extent of protected areas and natural parks, as well as the bottom-up approach taken by RE policy in this Italian region. The gradual introduction of wind turbines into the local landscape (over more than 20 years) has allowed local communities to get used to the technology, to support it and connect to it, building ownership and institutional capital in the process.

Small-scale, gradually-paced developments involving a large number of people tend to have a positive impact on rural economies. The research found small-scale and connected projects in almost every region that were providing rural communities with new and promising business opportunities. These projects depend on the active participation of a large number of rural actors (farmers, forest owners, SMEs, etc.), who have to deal with different processes and activities, increasing their skills and problem-solving capacities. They have also to create new institutions and businesses, thus building social capital that can have a long-term impact on rural development overall.

Surprisingly, these small-scale projects involving a large number of local actors were almost always marginalised by central government RE policies. Promoting developments that involve a large number of rural actors over a long period should be a primary goal for RE policy. Instead it is more oriented towards large RE deployments that involve a few developers and which aim to achieve dramatic short-term results.

Conclusion: Policies to ensure that renewable energy deployment benefits rural areas

- Avoid applying generic national criteria that ignore the suitability of local conditions and the opportunities for integrating RE into local productive fabric. Supporting RE deployment where capacity is low results in high cost and limited energy.
- Limit subsidies in scope and duration; use them only to induce RE projects that are close to being viable in the market. In general, RE is more expensive in the market than conventional energy, but there are regions where the cost disadvantage of certain renewables is relatively small, or non-existent. In these regions, where conventional energy is relatively expensive, it is much easier for RE to be competitive.
- Limit subsidies in value: If subsidies are too high, they tend to encourage RE projects that are designed to capture the maximum amount of subsidy. This sort of rent-seeking behaviour can lead to high-cost energy that is only viable as long as high levels of subsidy are sustained. They can also intensify competition for natural resources and

other input, have a negative impact on land use and displace agricultural activities, particularly if they are spatially blind. Moreover, the structural changes that occur may prove unsustainable as the subsidy is phased out, and yet may also be expensive to reverse.

- Ensure RE activities are embedded in the local economy. More jobs are created when RE is not a stand-alone activity but is integrated within larger supply-chains within rural economies, such as agriculture, forestry, traditional manufacturing and green tourism.
- Carefully assess the capacity of a given region to become a manufacturing pole specialised in RE sectors. There is no first-mover advantage in adopting technologies that are rapidly evolving. Newer technologies are almost certain to be more efficient and have lower cost per unit of output. When a technology becomes more mature, its unit costs are likely to be both lower and more stable over time, making investments less risky. Efforts to build local manufacturing capacity for future exports may drive up the cost of the installed local energy and still fail to generate future sales of components, because local firms have a high production costs and may quickly be overtaken by competitors who enter the market later.
- Tap into the opportunity represented by renewable energy for heating. Renewable heat is systematically ignored by RE policy, despite being the most competitive with conventional sources. The direct conversion of a renewable power source to heat involves a relatively cheap transformation, and in many cases it offsets a relatively high-cost fossil-fuel source.
- Ensure RE activities are integrated within an energy framework that facilitates dispatch and integration into the grid. Policy should take into account backstop technologies for intermittent power sources. RE should be linked to large hydropower or conventional sources to lower operating costs. RE deployment should also be linked to improvements of the transmission infrastructure. In several regions, the capacity to deploy RE is constrained by grid limitations; however, there are no incentives to improve transmission infrastructure. In regions where new capacity has to be created – such as electricity transmission lines, pipelines, rail lines – these add to the associated capital costs of a project. In more remote regions the cost of transport infrastructure may be several times larger than the cost of the RE project.
- Local public acceptance is crucial and can be secured by many of the above steps, and by ensuring the community sees net local benefits from the project, and is engaged in the process.

Notes

1. The good performance of wind energy in the Tararua Ranges in New Zealand is due to the exceptional quality of the wind resource. A large wind farm of 103 turbines, each with a 660-kilowatt generating capacity, works on 99 out of 100 days, and almost half the time at maximum capacity. The farm produces electricity equivalent to operating for 4 000 hours at maximum output each year. In Wales, Scotland or western Ireland the output is typically around 3 000 hours, and in Germany only 2 000 hours each (TE ARA, 2012, *www.teara.govt.nz/en/wind-and-solar-power/2*, accessed on June 2012).

2. This situation may change, as Iceland has started assessing the possibility of building the world's longest sub-sea electric cable to allow it to sell its geothermal and volcanic energy to Europe (AFP, 2011).

3. For instance, in the Shetland Isles, the construction of a large wind farm (the Viking project, see case study) will also finance the construction of a cable to connect the local grid to the UK's transmission network. In this case, this remote community is trying to capitalise on its good wind resource to export large quantities of electricity. There are also cases, such as Gaspésie in Québec, where the local production of electricity through wind installations may reduce the local demand for hydroelectricity, allowing the provincial energy company (Hydro-Québec) to sell more hydroelectricity to the United States at a higher price than the current domestic one.

4. Germany has no official definition of fuel poverty, but a number of indicators associated with it have been on the rise, and German energy suppliers report that up to 600 000 households experience power cut-offs every year as a result of non-payment of electricity bills; see *Handelsblatt*, 30 April 2012.

5. See, in particular, Snodin (2008), which is broadly favourable with respect to the potential for RE to reduce rural fuel poverty. However, Snodin's conclusions depend in large part on the impact of RE deployment on local socio-economic development. In any case, Snodin concludes that improving the housing stock is the most effective response to fuel poverty – i.e., the solution lies more on the demand side (energy efficiency) than the supply side (RE).

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Part II

Case studies

Overview

Part II of the report presents 16 case studies in which the renewable energy policy aims at promoting economic growth in rural areas. Case studies, although presenting difference, are presented in a uniform layout, for ease of comparison. They are based both on information collected through questionnaires sent to partner regions and field visits.

Each case study is divided into four main sections, which provide:

- An overview of rural trends in the case-study region (socio-economic trends).
- A brief assessment of the energy profile of the region, including renewable energy.
- An overview of the renewable energy in the region, which takes into account national and also supranational policy (if present).
- An evaluation of the impacts and results of the policy.

The international research network and the outline of case studies

The OECD, in co-operation with national and regional counterparts, conducted 16 case studies in 10 countries (Figure II.1) to assess the impact of RE deployment on rural communities. These took place in:

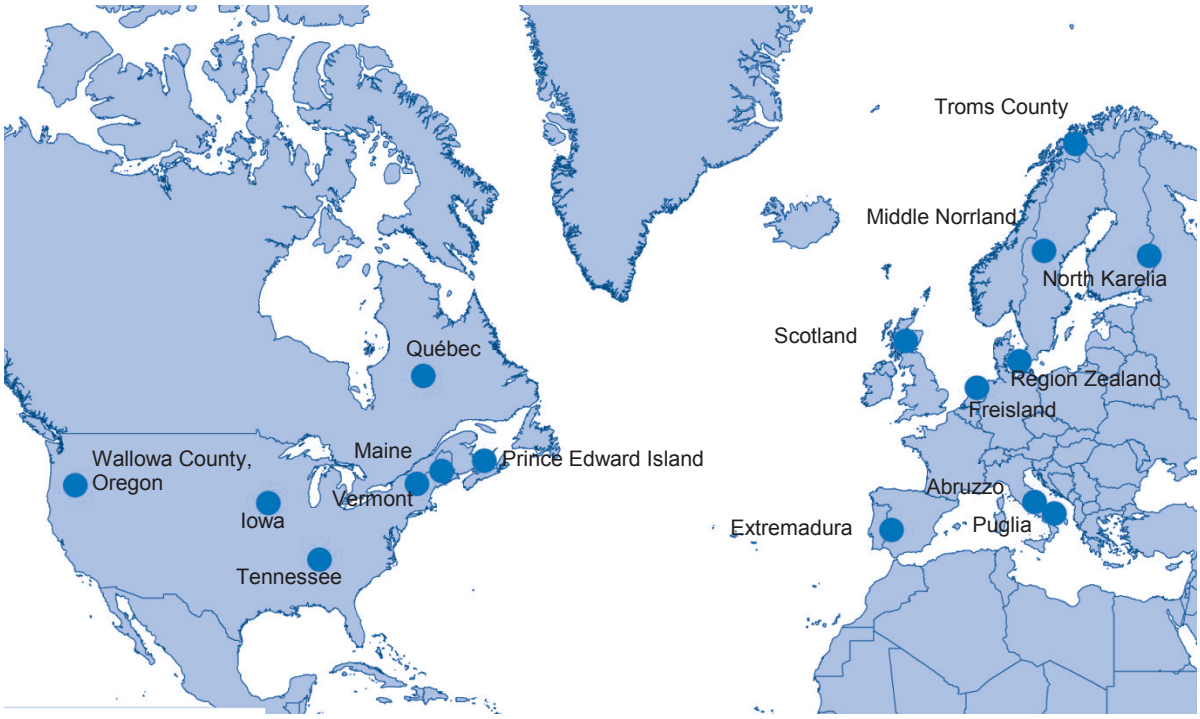
- Prince Edward Island and Québec (Canada)
- Region Zealand (Denmark)
- North Karelia (Finland)
- Abruzzo and Puglia (Italy)
- Friesland (The Netherlands)
- Troms County (Norway)
- Extremadura (Spain)
- Middle Norrland (Sweden)
- Scotland (United Kingdom)
- Iowa; Maine and Vermont; Wallowa County, Oregon; and Tennessee (United States)

These regional case studies were chosen by the OECD in close collaboration with national and regional authorities, aiming at a wide range of examples in terms of RE sectors and also degrees of rurality. The research focused on a broad range of RE technologies, although it omitted large-scale hydro installations (see Box 0.2 in the introduction).[1] The study also looked at the governance mechanisms, institutional settings and policies underpinning renewable energy deployment in these rural regions.

Representatives from case study regions acted as peer reviewers and experts within the process allowing the circulation of information, a better understanding of policy challenges, and providing recognition of regional best practices. In some cases, international co-operation went beyond initial expectations and common borders of peer reviewing activities: several partner regions signed bilateral co-operation agreements to exchange technologies and create business opportunities in renewable energy industries.

In spite of some important differences (degree of rurality, relevance of the energy sector, governance system in place), the structure of the case studies is the same. The first part discusses the degree of rurality of the region. The second section discusses the socio-economic trends and introduces the main challenges. The third part describes the regional industrial mix to assess the importance of the energy sector. Then the case study assesses the renewable energy policy, its results in terms of economic development, and the possibilities for improving the capacity of RE policy to deliver economic growth in the region. The analysis tries to assess whether renewable energy is well integrated in the regional economy, if it has generated business opportunities rather than rent-seeking behaviours (which are often an unintended result of subsidies), and if the investment in renewable energy is empowering local communities in terms of skills, innovation capacity, and multi-level-governance mechanisms.

Figure II.1. **The OECD regional case studies**



Note: This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

Source: National Statistical Offices and FAO Global for administrative boundaries.

Note

1. Large hydro is an established technology and thus does not present the same policy challenges as emerging RE technologies. Moreover, though undoubtedly both renewable and low-carbon, large hydro remains highly controversial in many quarters owing to its other environmental and socio-economic impacts.

Chapter 6

Prince Edward Island, Canada

Rural development and renewable energy (RE) on Prince Edward Island: Summary and conclusions

Main findings. *i*) Small, mainly rural territories can adopt innovative and effective renewable energy strategies that contribute to economic development. *ii*) Investment in renewables can be justified in terms of the power produced rather than any additional development impacts. *iii*) The publicly owned development model can stimulate investment in small economies with limited investment capital of their own. *iv*) Creating local investment opportunities and spreading RE benefits locally helps to maintain local support for RE deployment.

Renewable energy in Prince Edward Island: A summary. Renewable energy offers Prince Edward Island (PEI) a local source of power that is competitive with imported power. Because the island has no fossil fuel reserves and no opportunities for hydroelectric power, electricity has always been expensive. Electricity imports are constrained by the capacity of the two submarine cables linking PEI with New Brunswick. PEI has the best wind capacity of any province in Canada. In 2010, there were 89 utility-grade wind turbines installed over 6 wind farms in operation with a combined wind energy capacity of 164 megawatts and a potential annual production of more than 170 thousand MWh.

PEI created an effective mechanism for renewables development in the form of the PEI Energy Corporation. This publicly-owned development model allowed the province to quickly create a wind-based energy sector. Instead of having to attract external private investors, it was possible to use provincial resources to demonstrate the viability of the concept. The Energy Corporation has been extremely successful in fundamentally reordering the electricity sector on the island in a short period of time. The corporation and other provincial agencies have paid considerable attention to building a positive public image for wind power. To date, siting issues have not been a major problem on the island. This reflects in part the locations that have been selected. But it also reflects the policy of ensuring that local people see clear benefits in the form of a cost-effective domestic source of electricity and stable prices. In addition, efforts to stimulate small-scale generation on farms and in rural communities have given citizens a direct stake in wind energy, despite its higher cost per kilowatt hour compared with large installations. These and other actions, such as creating local investment opportunities and trying to distribute benefits (i.e. site rents) over a wider base, have reduced public complaints compared to other regions. Electricity costs in PEI remain high by North American standards, but they are now more predictable.

Future challenges. Wind energy satisfies 20% of total electricity demand on the island, creating a challenge for system integration. Wind power remains an intermittent resource, even with high capacity wind conditions. To maintain grid reliability as the wind power share increases, PEI has to find a way to better integrate its generation with generation in other provinces. Ironically, this may necessitate a major investment in new interprovincial transmission capacity, just as PEI becomes less reliant on imported power.

Both wind and tourism are priorities for the provincial government, but there seems to be little concern for how the two could affect each other. In particular, the provincial government does not seem to recognise the need to take into account the visual impact as well as wind conditions when siting turbines.

Finally, the focus on wind energy appears to have overshadowed other renewable energy opportunities. The first major investment in renewable in PEI was the Charlottetown district heating plant yet there seems to be limited interest in replacing oil used for heating with wood-fired furnaces and boilers. While wind is important, renewable energy for heat is the easiest substitution to make, especially in rural areas where biomass is locally available. In several instances we heard plans to replace oil heat with electric heating, even though this is an inefficient use of a high-value energy source. This suggests that biomass has been undervalued as a heat source.

The context

Prince Edward Island's socio-economic profile and performance

Prince Edward Island (PEI) is both the smallest and the most rural province in Canada. The province covers approximately 5 684 km2 and is home to about 142 000 people; just over 0.4% of all Canadians (Table 6.1). The average population density is relatively high – 25 in/km2 – even with roughly 55% of the population living in rural areas. There are only two cities in the province: the capital, Charlottetown, with a population of just under 35 000 people, and Summerside, with a population of about 15 000. The rest of the population resides in small towns and in the open countryside. Because the cities and towns are small, there is no significant urban-rural dichotomy. While farms dominate the landscape – about 45% of the territory – consolidation has reduced farm numbers to under 1 700, supporting about 5 000 individuals.

Table 6.1. **Prince Edward Island: Demographic data**

	PEI	Canada
Population (2010)	142 266	34 108 752
Population share (%)	0.42	100
Population density	25 in/km^2	4 in/km^2
Elderly dependency ratio (%)	22	18

Source: OECD Regional Database, http://dotstat/wbos/.

In recent decades PEI has experienced a falling birth rate, significant outmigration by islanders and limited inward migration**.** While the population has increased, it has been at a slower rate than the national average: between 1985 and 2010 the population of PEI increased by 11.5%, while Canada's population increased by 32%. Because the natural rate of growth is roughly zero, net inward migration largely accounts for any increases in population. The population is ageing rapidly, with the percentage of those over 65 increasing from 11% in 1971 to 15.6% in 2010.

The PEI economy remains more dependent on resource-based industries than most OECD regions**.** Agriculture, fishing and forestry account for about 8% of provincial gross domestic product (GDP), while tourism accounts for about 10%. PEI's GDP is the smallest of all the provinces. Table 6.2 shows that PEI has a significantly smaller output per head than Canada as a whole and is below the OECD average. Unemployment rates are higher than the Canadian average, but below the OECD average. Worker education levels are not much different than for Canada as a whole and better than the OECD average. Not surprisingly there are few patents due to low levels of formal research and development (R&D) on the island, which reflects its small population and lack of any large cities.

Table 6.2. **Prince Edward Island: Main economic indicators**

	PEI	Canada	OECD gap
GDP per capita – current USD PPP	22 163	31 728	90%
GDP share	0.29%		
Productivity – current USD PPP	44 238	62 198	81%
Unemployment rate (%)	10.4	6.9	4.1
Employment rate (%)	73.6	71.0	6.9
Long-term unemployment (%)	0	0.2	-2.4
Youth unemployment (%)	13.8	11.6	-1.5
Infrastructure (motorway density)	0	0.20	
Tertiary attainment	46.6%	45.5%	
Patents per million inhabitants	34.96	54.5	-34.6

Source: OECD Regional Database, *http://dotstat/wbos/.*

As in all OECD regions, the service sector dominates the provincial economy. Services now account for about 77% of provincial GDP, while manufacturing has steadily declined from almost 12% in 2004 to 9.4% in 2010 (PEI Finance and Municipal Affairs, 2011). The major components of the service sector are finance, insurance and real estate; public administration; health care; and education. The public sector plays a larger role in PEI than in some other provinces because it is the smallest province, resulting in basic provincial government functions and federal programmes being more significant factors. PEI has a very small internal market and until 1997, when the Confederation Bridge opened, had no direct land connection to the rest of Canada. Small size and remoteness contribute to a weak economy, because costs are inherently higher for most goods and services whether imported or locally produced.

PEI has the highest percentage of high-capacity agricultural land of any province. This, combined with a moderate climate, has made farming a key economic sector. Table 6.3 shows that farming and fishing directly account for 7.8% of GDP and a similarly large share of employment. Food and fish processing account for another 4.9% of GDP. In 2010 about 36% of the value of PEI exports came from farms, and another 26% from fishing or aquaculture.[1] Most tourist activity – beaches, sport fishing, water sports, golf and cycling – depends on the landscape, and there is also significant rural cultural tourism. Forestry is a declining industry even though a significant amount of the island is forested (about 50%). Industrial wood use (lumber mills and pulp and paper) has fallen significantly since 2004, although it has increased slightly in the most recent years. The majority of wood harvested is now used as fuel wood, either as logs or as chips, and the volume has been increasing slowly over time.

Table 6.3. **Agriculture and fishing on Prince Edward Island, 2010**

	Agriculture		Fishing and aquaculture	
	Absolute value	As a % of PEI total	Absolute value	As a % of PEI total
GDP	CAD 200.7 million	5.2%	CAD 101 million	2.6 %
Employment	3 300 people	4.7 %	2 800 people	4%

Source: PEI Finance and Municipal Affairs (2011), *Statistical Review 2010*, PEI Statistics Bureau, Department of Finance and Municipal Affairs, *www.gov.pe.ca/photos/original/fma_37asr2010.pdf.*

Prince Edward Island's renewable resources

Historically, PEI has relied on imported energy; other than wood used for fuel it had no significant indigenous energy sources prior to the establishment of wind farms. Liquid fuels are all imported, and, prior to the construction of submarine cables that allowed electricity to be brought from New Brunswick, PEI relied on diesel generators for electricity production. Electricity on the island is expensive since it is produced in a distant province, and the capacity of the connecting transmission line is constrained. Moreover, because the island is a small player in energy markets, it has no pricing power and has little choice but to accept quoted prices. These factors have played a large role in prompting PEI to become an early North American innovator in wind power. Wind conditions on much of the island are highly favourable and wind power was seen as both a way to increase energy security and to generate electricity at competitive prices. PEI has the best wind capacity of any province in Canada. This reflects both its island location in the Gulf of St Lawrence and its small size; the majority of the land mass is in close proximity to wind coming off the water. In 2010, there were 89 utility-grade wind turbines installed over 6 wind farms in operation with a combined wind energy capacity of 164 megawatts and a potential annual production of more than 170 thousand MWh. In addition, while the island is densely settled by Canadian standards, the capes where most large wind developments are sited have the greatest wind capacity and are the least populated parts of the province. This has helped to avoid significant impact on people. In addition, the small size of the province reduces the cost of constructing transmission capacity. In fact, the voltage of the lines constructed is relatively low (69 kV) and might be considered distribution size in larger provinces. The wind regime allows for a high turbine use rate, lowering the cost per kilowatt generated; combined with high prices for imported electricity, wind power is competitive at prevailing local market prices.

While some biomass resources have been developed, there is considerable potential to further expand their use**.** PEI has a moderate climate by Canadian standards, but winter is still relatively long and temperatures can be well below freezing for extended periods. As a result, heating is a major use of energy in the province and may account for up to half of total household energy consumption. Currently, over 80% of the energy used for home heating on the island comes from oil. This represents an increasing cost for households and a significant source of GHG emissions. Electric heat is currently cheaper, but in many locations neither local distribution lines nor household wiring are capable of supporting it. This makes it impractical to retrofit electric heat systems in older houses and communities. On the other hand, the installation of heat pumps, although requiring a substantial electricity input, does not require major rewiring. This form of heating has become a cost-effective solution for several residential, commercial and institutional facilities. Wind electricity can be used for this, but there is still the problem of a back-up power source. In some older homes in rural areas wood is either the primary or secondary source of heat, but it is typically burned in an inefficient manner either in open fireplaces or poorly designed wood stoves. Modern wood stoves or boilers fuelled by pellets or chips could provide a source of low carbon energy for many houses in the province with relatively minor modifications to the residence. With the decline in the forest industry on the island, competition for wood has been reduced. Thinning to improve the harvest quality of provincial forests will increase the supply of low-value wood. As a result, modern wood-based heating systems could offer a source of heat that is readily available, reliable, and involves a less complex retrofitting of homes.

There are already successful, large-scale examples of biofuel heat sources in PEI. Charlottetown has a district heating system that covers public and private buildings across a major part of the city (Box 6.1). In addition, Cavendish Farms operates the largest methane digester in North America to provide heat for its potato processing facility in New Anaan. The digester is fuelled by waste products from the processing operation. It provides 33% of the total heat needed every year to process potatoes and represents a 10 million litre reduction in boiler fuel per year. Without the digester, a significant percentage of the potato residues would be wasted. The opportunity to use it as livestock feed has diminished due to a decline in cattle numbers in recent years. Thus, the methane digester reduces pressure on waste disposal systems while also providing process heat.

Box 6.1. **Charlottetown's innovative heating system**

Between 1981 and 1985, three small district heating plants were built in Charlottetown: the first used solid waste to heat a hospital; the second and third one used wood chips to heat to several provincial buildings, including the University of Prince Edward Island. In 1995 the three plants were sold to a private investor that consolidated them into a single system and then extended it through central Charlottetown. The current system is about 45% fuelled by municipal waste, 45% by woodchips and 10% by oil. In addition to producing heat for about 125 buildings, the system also produces 1.2 MW of electricity from secondary heat. Most of this is used internally but surplus is sold to the grid.

Renewable energy policy on Prince Edward Island: Objectives, opportunities and challenges

The policy drivers: Why is Prince Edward Island implementing a renewable energy policy?

Renewable energy offers Prince Edward Island a local source of energy that is competitive with imported power. Because the island has no fossil fuel reserves and no opportunities for hydroelectric power, electricity has always been expensive. Producing electricity locally using diesel or oil powered generators is more expensive than importing electricity from other provinces. But imported power is not cheap due to high transmission costs and relatively high generation costs in other Atlantic provinces. Advances in wind turbine technology in Europe offered PEI the possibility to use its wind capacity to reduce imports and potentially begin to export surplus power. Unlike many other locations, the relatively low cost of electricity produced by wind compared to the cost of imported power makes wind viable with minimal subsidies.

A crucial driver for wind energy is the current capacity constraint on transmission to import electricity. Electricity imports are constrained by the 200 MW capacity of the two submarine cables linking PEI with New Brunswick. When the first wind investments were made, peak loads in PEI were approaching cable capacity. Now they are in excess of capacity and energy needs can only be met because of the investment in wind generation. Local wind power provides two important benefits despite its intermittent nature. First, it allows PEI to delay investing in a third submarine cable to meet growing demand, which avoids a major capital cost. Second, the load on the existing cables in non-peak periods is

reduced, extending the useful life of these cables, which also delays having to incur capital costs.

Electricity costs in PEI remain high by North American standards, but they are now more predictable. Wind power has not resulted in cheap electricity on the island, but it does provide more stable prices. In the past oil price shocks were quickly translated in electricity price shocks. A clear advantage of wind is that the cost of producing electricity is predictable since it mainly reflects capital costs that have already been incurred. While there are limits to the ability of the PEI grid to absorb additional wind generation, there is an opportunity to export power off the island. The West Cape facility was designed as a merchant (i.e. market-based) generation site, and although it has not yet met anticipated demand for green power, there is still the potential for wind power exports to offset some electricity imports.

The policy framework for renewable energy in Prince Edward Island's rural areas

The Constitution of Canada gives jurisdiction for energy to provincial governments, but federal and local governments also play a role**.** Canadian energy policy reflects the constitutional division of powers between the federal government and the provincial governments. Provinces control natural resources and hence manage the production of electricity, so the federal government must co-ordinate its energy policies with the province. In the case of PEI, the federal government plays a larger role in infrastructure provision than in other provinces because of the small size of its economy, which reduces its fiscal capacity. As part of the equalisation mandate in the Canadian Constitution, the federal government provides additional support to less wealthy provinces. For example, the Canadian government financed half the construction costs of the two submarine cables. Other stakeholders are local governments, such as counties and municipalities. The city of Summerside operates its own municipal electricity distribution company. Recently the company has invested in municipally-owned wind turbines and has arranged a power purchase agreement with a private wind farm. Local governments also manage spatial planning and zoning that can influence the location of installations.

The federal policy framework

The federal government of Canada has the power to make treaties with foreign countries in the field of energy. This has very important implications. For example, the Canadian government signed the Kyoto Protocol in 2002, although it withdrew from it in 2011, considering it as ineffective and as a potential burden to Canada's economic development. The federal government is currently involved in new negotiations begun in Durban at the end of 2011 to reduce global emission of carbon dioxide (CO_2). These negotiations involve the largest world economies, including the United States and China, which were not involved in the Kyoto Protocol. Canada also takes part in several international initiatives to promote RE deployment and plays an active role in several international networks and organisations.

The federal government has launched an energy strategy that supports the sustainable production of energy from both conventional and renewable sources. The government co-operates with provinces to reduce CO_2 emissions and promote RE through a series of programmes managed by Natural Resources Canada (NRC), including:

- EcoENERGY for Renewable Power: launched in April 2007 to encourage the generation of electricity from renewable energy sources such as wind, small-scale/low-impact hydro, biomass, photovoltaic and geothermal energy. This project, which ended in early 2011, created 104 RE projects scattered around Canada, with contribution agreements lasting until 2021. This represented a total investment of CAD 1.4 billion and approximately 4 500 MW of installed RE capacity.[2]
- The Decentralized Energy Production Initiative (DEPI): this promotes the integration and decentralisation of electricity production and distribution across Canada. This is also to cope with failures in electricity grids, given concerns over their age and reliability. DEPI deals with institutional barriers, poor reliability, and high system costs affecting the creation of a smart grid. It updates and develops standards such as codes and rules describing how to safely connect power technology.
- A project to promote carbon capture and storage technology (CSS) to improve sustainability in the conventional energy sector. Integrated CCS demonstration projects are co-funded by the federal government, provinces and private sector. The total Canadian investment in CCS projects is over CAD 7 billion (2011). Two of these large-scale demonstration projects, Shell Quest and the Enhance Alberta Trunk Line, will capture CO_2 from oil sands upgrades.

Canada's regional development agencies, which are federal ministries, are also active in promoting RE as a way to create economic opportunities. For instance, the Atlantic Canada Opportunities Agency (ACOA), which is active in New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island, has launched the "Atlantic Energy Gateway". Its aim is to improve the production of energy in Atlantic Canada, with a focus on renewable sources and promotion of energy exports by optimising and updating grid connections. Western Economic Diversification Canada (WD), the federal agency that covers British Columbia, Alberta, Saskatchewan, and Manitoba, cofounds initiatives across Western Canada to promote RE deployment, especially at a small scale. Finally, Canada Economic Development for Québec Regions (DEC) provides grants to support RE deployment linked to natural resources (forestry, in particular), mostly in Quebec's rural regions.

The Canadian government established the Atlantic Wind Test Site or AWTS (which later became the Wind Energy Institute of Canada or WEICan) at North Cape on PEI in 1980 as a national research centre. The location was chosen because of the high quality wind resources. The site has operated as a wind research centre and the national test location for large and small turbines. Although AWTS was a Government of Canada facility mainly conducting research funded by government agencies, it provided important support for PEI's wind development, and continues to do so as WEICan. It worked with a number of turbine manufactures to assess the potential of their products in the PEI environment, providing useful knowledge of turbine performance. It also gave PEI a strong local cadre of individuals with wind research experience that would not have been possible without the presence of a national test facility.

Provincial and local levels

The PEI provincial government has played a central role in fostering renewable energy in PEI since 1978. The province created the PEI Energy Corporation in 1978.[3] The corporation's charter includes promoting the development of all forms of energy on the island in an efficient and economic manner, providing financial support for the installation of energy systems, and co-ordinating the actions of all provincial government

programmes that affect energy systems. This broad mandate gives the PEI Energy Corporation a leading role in planning and structuring energy production and use on the island. In the absence of an indigenous energy industry, the government saw the corporation as a vital agent to introduce local capacity.

The first major provincial renewable energy investment in PEI by the corporation was the Charlottetown district heating plant (Box 6.1). This direct investment model was repeated when the Energy Corporation developed wind power at North Cape with eight turbines, adding eight more in 2003 to create the first utility-scale wind farm (10.56 MW) in Atlantic Canada. The corporation managed the development, arranged financing and installation, including new transmission capacity, and marketed the power to the island electricity provider for use on the island. The immediate effect was a displacement of imported power, reducing the load on the submarine cables at a minimal incremental cost. The project would not have been undertaken without these provincial resources, given the limited understanding of wind power at the time.

In 2006/07 the Energy Corporation installed an additional 30 MW of wind capacity at East Point. The two wind farms produce about 11.5% of the electricity consumed on the island. Importantly, the creation of the two farms showed that wind power was viable on the island and was competitive with imported power. This had an important demonstration effect. The local utility, Maritime Electric, developed the ability to integrate wind power into its mix of energy sources and islanders saw that public power from wind could be beneficial. The success of the two projects encouraged the city of Summerside to invest in its own 12 MW generation facility and attracted private developers to build additional capacity, including a 99 MW project that is intended to produce power to export at market prices.

The province is working to maintain public support for wind power. As wind power expands and becomes more visible it raises concerns among citizens. The two initial locations were at the tips of the island and relatively far from public view. They were publicly owned and sold their power to islanders, establishing a clear public benefit. In addition, the Energy Corporation allowed islanders to invest in the second wind farm at East Point through a series of "energy savings bonds" that gave residents a higher interest rate than bank bonds, a rate that was slightly above the corporation's alterative cost of funds. The bonds provided another form of "buy-in" for the public and increased the sense of local ownership of the project. The Energy Corporation and the provincial government have also supported community installations of small-scale turbines as another way to show that wind is valuable. Recently, a competition was held among small communities in PEI willing to invest in installing a small turbine to provide power for the refrigeration unit for the community hockey rink. Four communities were selected from about 30 applicants. The communities provide one-third of the cost while federal and provincial money covers the remainder. It is expected that the turbines will save the rinks about 36% of their electricity costs – a significant amount for such small communities (fewer than 500 residents). The competition provided direct benefits to the four selected communities and increased the awareness of wind power opportunities in other communities.

The provincial and Canadian governments have a programme that provides capital subsidies to farmers to install turbines for farm use, mainly to reduce cash costs of production. PEI also introduced a new agriculture strategy in 2009 – *Growing the Island Way* – which includes a renewable energy component co-ordinated with the Ministry Agriculture and Agri-Food Canada's Agri-Flexibility programme. Farmers can receive a

grant of up to CAD 50 000 to cover half the cost of installing small on-farm turbines. The province also allows small-capacity renewable energy generators (100 kW or less) to feed excess electricity into the grid via a net-metering agreement with the electrical utility, to offset their electricity consumption. This effectively values this power at the retail rate of CAD 0.12 per kilowatt hour for residential customers.

In 2011, the PEI Energy Commission began work on identifying a long-term strategy to reduce the cost of electricity on the island. The commission released a white paper in February 2012 that identifies four key issues for consideration:

- The role of imported power, including the Point Lepreau nuclear plant, in which Maritime Electric has an entitlement share, and other off-island generation sources.
- The role of increasing energy efficiency and other demand-side management approaches.
- The desirability of future capacity increases in wind power, especially merchant wind for export markets.
- The role that the government should play in producing electricity through the PEI Energy Corporations.

This is a timely study given important changes in the renewable energy sector. International agreements to put in place firm targets for carbon emissions appear to be less likely than a few years ago. Public finances are highly constrained and seem likely to remain so, and subsidies for renewables are shrinking.

Connecting renewable energy to rural development policy

Until recently, renewable energy deployment has not been seen as a specific rural development strategy. While the implications for rural areas have always been evident to the government, energy policy has been a larger issue than rural development. However, renewable energy is now one of four sectors identified as key drivers in the current provincial economic development strategy: *Island Prosperity: A Focus for Change* (Mayne, 2008). This recommends major investments in education and skills to improve the workforce and focuses on innovation as a driver of future growth. It also recommends improving basic infrastructure, including the electrical transmission and distribution grid. Significantly, it identifies renewable energy along with biosciences, information technology and tourism as key sectors deserving strong government support. The document also recognises that while wind energy will not be a significant source of jobs, it offers the benefits of more stable energy prices and the potential for significant export earnings. While the main focus is on wind, the strategy also identifies biofuels as an opportunity for improving agricultural productivity.

Renewables are a central component in the main development strategy for the province, and, perhaps as a consequence of that, have taken on a more visible role in the new rural development plan (the *Rural Action Plan,* PEI Fisheries, Aquaculture and Rural Development, 2010). The strategy identifies seven key goals, one of which is enhancing the primary sector. Along with increasing the competitiveness of agriculture and fisheries, this includes action plans to enhance wind energy, introduce new bioenergy crops and expand the use of biomass heat. The strategy contains a 10-point plan for expanding wind power and includes actions to increase power production, seek export markets, and maximise economic benefits. The plan explicitly recognises the need to improve efforts in land-use planning, ensure that leases for generation sites are fair and strengthen community support for wind power. These latter points suggest that, even in territories

where renewable energy is broadly supported for economic reasons, it is still important to ensure that the benefits from renewables are equitably distributed.

The impact of renewable energy on PEI agriculture remains uncertain**.** Increased on-farm production is facing challenges. Agriculture in PEI tends to specialise in the production of high-value commodities such as potatoes and milk. By contrast, crops for biofuel production are inherently low value because of the expensive conversion process to make the fuel – high prices for the crops would make the resulting fuel uncompetitive. Farmers thus have limited incentives to produce biofuel crops, unless they are an integral part of a crop rotation providing useful agronomic benefits. In the dairy industry, where methane gas digesters can be viable (see the Vermont case study), there is considerable scepticism among farmers. Previous efforts to introduce on-farm digesters failed because the technology was imperfect and the digesters were too complex to operate profitably. Moreover, the focus on wind both at the farm and provincial level may be crowding out other opportunities.

The tourism sector is another important part of the provincial economy. Unlike wind energy, tourism does provide a large number of jobs, albeit of a seasonal nature and for relatively low wages. Nevertheless, a large share of the current labour force has limited skills, so these jobs may well be crucial until workforce skills are enhanced. To date, large-scale wind facilities have been developed in relatively remote parts of the island, away from the major rural tourist sites. It is possible that the initial novelty of large-scale wind farms may have attracted more tourists. Now, however, wind turbines are ubiquitous and their presence is increasingly seen as disruptive. For a small, tourism-dependent province like PEI, balancing the positive aspects of wind energy with its potential negative effect on tourism is crucial. The 10-point plan for wind development in the *Rural Action Plan* implicitly addresses some of these issues but as wind power expands, including small-scale installations, the consequences for tourism may be significant.

Assessment of policy impacts on rural development

The Prince Edward Island case confirms that small, rather rural territories can adopt innovative and effective renewable energy strategies that contribute to economic development. The combination of a high quality wind resource and increasingly expensive imported power created both a motivation and an opportunity for change. Despite its small economy and fiscally-constrained government, it had the political authority to develop a renewable energy strategy that was tailored to its opportunities.

Many regions introduce renewables as an industrial strategy. The production of energy is seen as a means to develop manufacturing capacity in renewables that can serve external markets. In this model, subsides for installing generation capacity are justified by the fact that setting up an infant industry will more than repay the start-up costs from export sales. In some cases regions pay too much for generation capacity, especially if export markets fail to materialise. PEI recognised that investments in renewables had to be justified in terms of the actual power produced because they were unlikely to get any additional benefits. This may have made them more realistic about the levels of subsidy they should provide.

Stimulating local economies

Renewable energy policy has already significantly benefitted rural areas in PEI and will have a larger impact in the future. Because the vast majority of the island's energy, including electricity, was historically based on petroleum, the economy was more vulnerable to oil price shocks than regions where indigenous fossil fuels and hydro have a large presence. Not only did PEI have expensive power, but it also had volatile power prices. With the introduction of utility-scale wind farms, PEI has radically altered the local electricity market. For the first time indigenous power is contributing a major share of electricity on the island. Renewable energy provides PEI with power that has predictable costs, mainly because the majority of these costs are fixed at the time of construction. This provides a more stable pricing environment, delays the need for further investments in the submarine transmission capacity from New Brunswick and introduces wind farms as a competing land use, which can also have positive impacts. Firms can now have greater certainty over future costs, which allows for better planning and the ability to enter into long-term contracts.

There are some direct employment opportunities in installing and maintaining renewable energy generation and in specialised research on wind, but the opportunities are limited. The indirect benefits are significant however. PEI is a small market, so it has little potential to produce the technology or the components used for renewable energy production. PEI largely produces goods and services that compete on the basis of price. But as the cost of energy in PEI remains high, the efficient production of renewable energy reduces the operating costs of local firms, thereby increasing their competiveness. For example, PEI potatoes and potato products must compete with potatoes from other locations in North America. For Cavendish Farms (introduced above), installing a methane digester lowered costs in two important ways. First, it now purchases less fossil fuels for process heat, and second, it avoids having to pay to dispose of waste products in a landfill. This type of cost saving can also be important in the tourism sector. The North Winds Motel in Brackley is a small privately-owned motel in rural PEI. To reduce heating costs, a grain-fired boiler was installed. The boiler provides space heating and hot water and heat for a swimming pool and hot tub. Heating costs were greatly reduced, which makes operating costs lower and allows the motel to reduce room rates. Lower room rates help to attract tourists, and in turn more tourists generate benefits for the local economy. Similarly, stable electricity prices make it easier for firms to plan for future production and contract for future deliveries.

Stimulating innovation

PEI created an effective mechanism for change in the form of the PEI Energy Corporation. Without it, it is unlikely that PEI would be producing the current quantity of renewable energy. Modest efforts to produce wind-based electricity had existed on the island for a long time at the WEICAN site, confirming that wind was a viable source of power on PEI. But it was unlikely that private investors would have undertaken an investment the size of North Cape in the early 2000s. The technology was unproven in North America, a market for renewable electricity did not exist, and utility regulations at that time would have discouraged such a risky investment. By using a publicly-owned development model, instead of having to attract external private investors, the province was able to use its resources to demonstrate the viability of the concept. The development of renewable energy in PEI was possible because the Energy Corporation had the implicit guarantee of government funds and a mandate to make the investment. The Energy

Corporation has been extremely successful in a short period of time in fundamentally reordering the electricity sector on the island.

While PEI has established a clear record of innovation in wind turbine use, its ability to build upon this record is constrained. By being an early adopter, the provincial government was able to attract some research and development resources from Europe and the rest of Canada. This, combined with some geographic advantages for testing turbines, has allowed the province to develop a larger presence in the wind turbine industry than the size of the local market would suggest. To a considerable extent, the province has been able to lead the wind industry in Atlantic Canada. And, with Canadian government support, WEICan has had a lead role in domestic wind research. Now, however, Ontario, Québec and Alberta are investing large amounts of money in renewable energy development, as are a number of state governments in the United States. All of these offer much larger domestic markets than PEI, have far more resources to commit to supporting wind development, and most have more central locations that reduce transport costs for manufactured products.

Renewable energy has also been introduced in ways that provide benefits at the rural community, firm and household level. Small-scale wind turbines are being used to power community facilities and individual farms. While these are relatively inefficient ways to generate electricity, they are profitable for the owner due to public policies that provide capital subsidies for installation and high prices for any surplus electricity purchased from the rural community or farm. More recently, policy has been introduced to encourage the installation of wood-burning furnaces and boilers in public buildings in rural areas. Farms are also being encouraged to adopt methane digesters and produce energy crops, while low value wood from the thinning of stands can be chipped or pelleted to provide a low-cost source of fuel.

Main challenges

To date, public support for renewable energy has been high and siting has not been a major issue on the island. This is partly because installations have been sited in remote rural areas away from major tourism attractions. In addition, almost all the investments in renewable electricity have been conducted by a not-for-profit entity with a clear public purpose. This helps reduce community concerns about potential exploitation by the developer. Moreover, the power produced has been used on the island and considerable effort has been made to show how this benefits citizens. Now, however, wind turbines are increasingly being seen as disruptive. For a small, tourism-dependent province like PEI, balancing the positive aspects of wind energy against its potential negative effect on tourism is crucial.

Being a small and autonomous region allowed PEI to make rapid initial strides in developing wind power, but these same conditions may now limit further expansion. With increased wind output, PEI faces a significant challenge in system integration. Wind energy now accounts for over 20% of total electricity supply on the island, and in low load periods can serve the entire demand. However, wind power remains an intermittent resource despite the island's high capacity wind conditions. This poses a challenge for PEI, where wind is the only meaningful indigenous source of generation capacity. To maintain grid reliability as wind power increases, PEI has to find a way to better integrate its generation with generation in other provinces. This may necessitate a major investment in new interprovincial transmission capacity, just as PEI becomes less reliant on imported power. Increased power exports from PEI may be needed in order to balance

generation in New Brunswick if integration takes place. If PEI´s wind power is a relatively cheap source of electricity for the Atlantic region, then optimising the regional grid may require more wind electricity than PEI can normally consume. In turn, this could allow PEI to lower the cost of electricity in periods when wind is not available.

However, rapidly falling natural gas prices in North America have implications for the future development of wind-based electricity. Until recently, it was expected that further generation would serve export markets either in Atlantic Canada or in the northeastern US. But these markets now have potentially cheap gas-based generation opportunities. In the case of the US, a higher value of the Canadian dollar, combined with the need to build new transmission lines makes PEI's wind power relatively unattractive. Expanded wind generation capacity on the island requires additional off-island transmission capacity, but without subsidies to build a new submarine cable, the cost of delivering electricity to Atlantic Canada will be high.

A final challenge is that the focus on wind energy and the success in implementation appear to have overshadowed other renewable energy opportunities. The first major investment in renewables in PEI was the Charlottetown district heating plant. But there seems to be a limited interest in replacing oil used for heating with wood-fired furnaces and boilers. However, renewable energy for heat is the easiest substitution to make, especially in rural areas where biomass is locally available.

Notes

1. This includes food and fish processing based on local raw products.
2. Information available at *www.ecoaction.gc.ca/ecoenergy-ecoenergie/retrofithomes-renovationmaisons-eng.cfm*.
3. Canada's energy markets are largely regulated by the provinces, which mostly have their own indigenous electricity generation capacity. This gives them considerable control over prices, the construction of generation and transmission capacity, and conditions of service. For example, Québec has long used Hydro Québec as an economic development agent and establishes pricing and service conditions that result in low electricity prices throughout the province. However, other than wind the PEI government has limited capacity to influence energy prices and availability. The main provider of electricity on PEI, Maritime Electric, is a subsidiary of an "out-of-province" corporation and generates no electricity on PEI except in emergency situations or when the cable capacity is exceeded and the wind is not blowing. Any addition to the submarine cable transmission capacity requires negotiations with both the Canadian federal government and another province. Thus, the PEI provincial government has to rely upon the decisions of others about electricity prices and availability.

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Chapter 7

Québec, Canada

Rural development and renewable energy (RE) in Québec: Summary and conclusions

Main findings. *i*) RE policy can create new manufacturing jobs in lagging rural communities, although this needs a large amount of public resources and there can be issues about the long term sustainability of the policy. *ii*) Local content requirements (LCRs) are a powerful tool to attract foreign investment in a specific region, but they increase the cost of RE. *iii*) Focusing efforts on a small number of "winners" within RE technologies can overlook other technologies that could develop better links to rural industries. *iv*) Deploying a few large-scale projects reduces policy complexity, but also reduces the number of rural dwellers and businesses benefiting. *v*) If it was to promote a large number of small-scale projects, RE could benefit a larger number of rural businesses and individuals.

Renewable energy in Québec: A summary. The energy sector is a pillar of Québec's regional competitiveness, and the province is also making investments to improve its specialisation in RE. Québec is Canada's largest electricity generator and one of the largest in North America. Hydroelectricity alone represents more than 40 000 megawatts (MW) of installed capacity, of which more than 810 MW are being produced by over 100 small hydro power plants of less than 50 MW. The high availability of cheap electricity has been a key factor in Québec's industrialisation, and the province exports electricity to other Canadian provinces and the United States. To capitalise on this specialisation, Québec is currently implementing an ambitious energy strategy that aims to increase the installed hydroelectric capacity further and to support other RE sectors. For instance, by 2015 wind energy is set to become the second source of electricity in the province, with a total capacity of 4 000 MW. Smaller-scale RE initiatives are also appearing in connection with existing rural industries, such as forestry, where biomass energy offers another promising rural development opportunity. This diversification of forestry owes much to the *Politique Nationale de la Ruralité* (PNR), Québec's rural policy, which has provided rural areas with public goods and institutions such as community developers, R&D and business centres to promote entrepreneurship and self-employment.

Québec's RE policy also aims to revive lagging rural economies by developing their manufacturing sector. The goal of the current deployment of wind energy is to create new jobs in rural communities affected by the decline of primary industries. Policy interventions started in 2002 for small hydro power plants and in 2003 for 1 000 MW of wind power, when the provincial government put in place a call for tenders. Based on this experience, Québec launched its 2006-2015 energy strategy, which is managed by the provincial Ministry of Natural Resources and Wildlife (MRNF). One of the goals is to develop a wind energy supply chain in Québec and especially in the Gaspésie Peninsula, where rural areas have been hit by the simultaneous decline of forestry, mining and fisheries. Policy interventions are implemented by Hydro-Québec (HQ), which is a public company producing, transporting, and distributing energy in North America. To attract foreign investment in rural areas and trigger local specialisation, calls for tenders contain Local Content Requirements (LCRs) which require developers to concentrate 60% of their costs in Québec, and a minimum of 30% of the wind turbine costs in Gaspésie. Due to the large demand for wind turbines and the size and reliability of public interventions, several plants to manufacture them have been opened in Gaspésie, creating hundreds of jobs.

Future challenges. One of Québec's strengths in RE for rural development is its broad and co-ordinated set of policy interventions. However, the future of its RE industry will depend on the next energy strategy, with the current one coming to an end in 2015. The Quebec-based wind energy industry will also have to develop its export capacity. Local specialisation focuses on low value-added, expensive-to-transport components, such as concrete towers and large blades. LCRs have been successful in attracting foreign investors, but these have become the sole suppliers of local projects. This has helped push up the price of wind turbines, affecting the price HQ has to pay for wind electricity to keep on attracting projects. The energy strategy also supports mostly wind power and overlooks other RE sectors. In general, MRNF's approach seems to favour large-scale over small-scale RE installations, and does not take full advantage of local public goods created by the PNR. Small developments would also allow local communities to invest their own capital in RE, thus stimulating entrepreneurship and self-employment.

The context

Québec's socio-economic profile and performance

Due to its vast territory, "rural" is a diverse concept in Québec. The province covers approximately 1.5 million km^2 and is home to 7.7 million people; about 23% of the population of Canada (Table 7.1). Average population density is very low but the bulk of the population is concentrated in urban centres in the south of the province: Montréal, Québec City, and Gatineau together are home to 80% of Québec's population. Despite this demographic concentration, there is no clear urban-rural dichotomy but rather a range of different degrees of rurality. Outside metropolitan areas, the rural character of the province varies dramatically and includes rural communities on the edge of large cities; rural communities in Regional County Municipalities (MRCs); and rural areas located in unincorporated remote regions, including first nations' territories. The OECD Rural Policy Review of Québec classifies rural Québec into four categories: *i*) peri-metropolitan areas, hosting 9% of Québec's rural population (and 2.2% of total population); *ii*) intermediate MRCs home to 21% of rural population (5.5% of overall population); *iii*) accessible and predominantly rural MRCs (home to 811 000 people); and, lastly, *iv*) remote and predominantly rural MRCs, which host 566 000 people (OECD, 2010).[1]

Table 7.1. **Québec: Demographic data**

2008 data, unless otherwise indicated

	Québec	Canada
Population (2008)	7 753 470	33 327 337
Population share	23.26 %	
Population density	5 in/km^2	4 in/km^2
Elderly dependency ratio (2011)	25.1%	23%

Sources: *OECD Regional Database*, *http://dotstat/wbos/*, and Institut de la statistique du Québec, *www.stat.gouv.qc.ca/*.

Rural areas play an important role in determining Québec's provincial demographic trends. According to the Ministry of Health and Social Services (MSSS), the share of the 65+ age cohort in Québec will rise from 12% in 1995 to 27% in 2030. A comparable rise in the elderly population took 45 years in Canada and 65-75 years in Germany, France and the United Kingdom. If one considers the two broad categories "urban" and "rural", there is not much difference in the concentration of elderly people. However, following the OECD classification of rural Québec, the variations among different types of rural areas can be important. Owing in part to depopulation, the share of elderly population in Québec's remote rural areas increased sharply from 10.7% in 1986 to almost 15% in 2006. The population belonging to the 0-14 age bracket dropped from 23% of total population in 1986 to 17% in 2006 in the same areas.

Québec is Canada's second biggest provincial economy, but it has been facing a relative decline of its competitiveness in relation to the rest of the country. Québec has the second highest gross domestic product (GDP) in Canada, after Ontario (Table 7.2). However, its importance within the national economy has been declining in relative terms. Québec's real GDP accounted for 20.5% of the Canadian total in 2006, down 2.9 percentage points from 1981, reflecting the province's slower average annual growth.

The annual growth rate was approximately 2% in Quebec, compared with 3.5% in the rest of Canada, between 1998 and 2008. Mirroring aggregate trends, Québec's GDP per capita is slightly lower than the national average and declining in relative terms, although negative trends are buffered by stagnant demographics. The gap with the national performance could reflect higher unemployment rates.

Table 7.2. **Québec: Main economic indicators**

2008 data, unless otherwise indicated

	Québec	Canada	OECD gap*
GDP per capita USD PPP	26 376	31 728	114%
GDP share	19.4%	100%	
Productivity USD PPP	52 647	62 198	96%
Unemployment rate	7.2%	6.9%	- 0.9%
Employment rate	72%	71%	- 5.3%
Long-term unemployment	0.47%	0.2%	-1.9%
Youth unemployment	12.5%	11.6%	-2.8%
Infrastructure (motorway density)	0.30	0.20	
Tertiary attainment	48.6%	45.5%	
Patent per million	95.7	54.5	-10.1

Note: * The OECD gap is a percentage which refers to the difference between the selected region and the average performance of OECD regions.

Source: *OECD Regional Database*.

Quebec's industrial mix tends to be place-specific. Québec's urban economies are the main setting for tertiary activities and, in the case of Montréal, new technologies in information and communications, biotechnology, and bio-pharmaceuticals (OECD, 2004). Peri-urban and accessible rural areas are home to manufacturing firms, which represent 13.5% of overall employment, the highest level within Canada (2010). The province's specialisation in manufacturing is a legacy from the past, when Québec was an ideal location for sectors such as textile or clothing. The workforce was less expensive than in the United States because of lower wages, but was equally skilled. More recently Québec has lost many of these firms because of its inability to compete with low-wage developing countries and the reduction of tariff barriers. Finally, predominantly rural areas depend mostly on natural resources, the pulp and mining industry, and aluminium smelters. There are communities in some remote areas whose existence is justified by the extraction and processing of natural resources, such as timber.

Land- and resource-based activities are very important for Quebec's economy, representing approximately 9% of the province's GDP. Agriculture contributes approximately 1.9% of provincial GDP. Because of climate and soil quality, primary agriculture is concentrated in the south of the province along the St. Lawrence River where the major urban centres are located. Dairy is an important specialisation of provincial agriculture: Québec has more dairy farms than any other Canadian province, although their number has been constantly declining over the last two decades. Rural tourism is another increasingly important sector – accounting for 40 000 jobs in the mid-2000s – especially along rivers, by lakes and in forest areas. Québec's forests account for 20% of the total Canadian forest and 2% of the world's forests. They cover an area of 761 000 km^2, equivalent in size to the territories of Norway and Sweden combined. This

large resource supports an important, yet declining, specialisation in forestry activities (including pulp and paper, wood products, and timber), which in 2011 employed more than 60 000 people, and contributed a total value added of CAD 7 billion (Table 7.3). Québec is also home to a primary mining industry, which is still employing more than 40 000 people and generating almost 3% of the province's GDP (Table 7.3).

Table 7.3. **Forestry and mining in Québec, 2010**

	Forestry		Mining	
	Absolute value	% of province total	Absolute value	% of province total
GDP	CAD 7 billion	2.8	CAD 7 billion	2.8
Number of jobs	60 883	1.8	43 053	1.3

Source: MRNF (2011), *http://mrnf.gouv.qc.ca/ministere/economique/index.jsp*.

Québec's energy resources

Québec is Canada's largest electricity generator and one of the largest electricity generators in North America. Energy production contributed 3.9% of provincial GDP in 2010 and accounts for more than 52 000 jobs (MRNF, 2011). Among all the regions participating in the OECD assessment, Québec has the strongest specialisation in the energy industry in the country – mainly hydroelectric.

Due to its vast number of lakes and rivers, Québec has large overall potential for hydroelectricity production; it represents more than 35 000 megawatts (MW) of installed capacity (Table 7.4). Dams are generally located in remote rural areas and in the north of the province. A significant share of provincial production is exported to other Canadian provinces and the United States. In 2009, total production – mostly from hydroelectricity – was 199.57 terawatt hours (TWh), of which 23.4 TWh were exported. Currently, the province is implementing a strategy to install approximately a further 7 500 MW by 2035 (Hydro Québec, 2011) and to diversify production in the RE sectors.[2]

Wind energy is another promising sector. Québec has 100 000 MW of wind energy potential within 25 kilometres of existing transmission lines. However, the residual availability of the transmission lines and the technical/economic integration of this wind capacity is a major hurdle. Nevertheless, wind energy is expected to become the second source of electricity in the province (1 057.2 MW as of 31 March 2012).

Québec has also considerable potential for biomass-based energy. For instance, *the Institut de Recherche en Économie Contemporaine* (IREC) estimates that the province could take advantage of its large area of marginal land (approximately 300 000 hectares) to produce energy crops, giving it an overall energy potential of 30 000 gigawatt hour GWh (IREC, 2011). Nevertheless, it is the province's vast forest that offers the largest biomass potential in terms of forest residues to produce renewable heating. According to the MNFR (2010), Québec's forest areas could provide woody biomass (residues) of up to 14.7 million cubic metres a year (mm3) (8.4 mm3 from public and 6.3 mm3 from private forests). Current production is small and concentrated in some rural areas where forests are private and local public buildings need cheap heating to reduce their fixed costs.

Table 7.4. **The production of energy in Québec**

Installed capacity

	Hydroelectricity		Thermal energy		Nuclear energy		Wind energy		Total	
Year	MW	%	MW	%	MW	%	MW	%	MW	%
2006	37063.4	91.24	2562.5	6.31	675	1.66	321.8	0.79	40622.6	100
2007	37512.1	91.31	2474.2	6.02	675	1.64	422.3	1.03	41083.5	100
2008	38286.4	91.21	2484.5	5.92	675	1.61	531.8	1.27	41977.6	100
2009	38513.7	90.96	2492.1	5.89	675	1.59	659.5	1.56	42340.3	100
2010	38503.9	91.24	2364.1	5.6	675	1.6	659.1	1.56	42202.1	100

Source: MRNF, *www.mrnf.gouv.qc.ca/energie/statistiques/statistiques-production-centrales.jsp*.

The province has good potential in shale gas, with an estimated quantity of 2-15 trillion cubic feet (TCF) of original gas in place (OGIP), mostly located in the south, along the St. Laurence River. However, popular support for fracking (i.e. hydraulic fracturing) in Québec is the lowest of all Canadian provinces; at 22%, it is less than half the 46% support reported in Alberta, and well below the national average of 31% (Van Praet, 2011). This resource is currently unexploited. Due to the vast availability of lakes and rivers, Québec displays a large overall potential in hydroelectricity production, and plans to install approx. 3 000 MW in the next 20 years (Hydro Québec, 2011). Wind energy is another promising sector. The province of Québec has 100 000 MW of wind energy potential within 25 kilometres of existing transmission lines, which is economically viable in the short and medium term. Québec has also considerable potential in biomass. For instance, IRÉC (2011) estimates that the province could take advantage of a large quantity of marginal land (approximately 300 000 hectares) and produce energy crops with an overall energy potential of 30 thousand GWh (IRÉC, 2011).

The main actor in Québec's energy framework is Hydro-Québec (HQ), the world's largest operator in the field of hydroelectricity, and the fourth largest utility in North America. HQ directly employs 23 677 people. It is an "arm's length" corporate entity, owned by Québec´s government. HQ has historically been a pillar of Quebec's development strategy. Since the 1960s, its mission has been to provide cheap electricity to all consumers and also to economic activities that require large amounts of power, such as aluminium smelters, pulp and paper mills, metal refining, etc. HQ sells electricity at a standard (low) rate for consumers but its rates for businesses depend on size. The average rate across the province is CAD 0.063 per kWh, regardless of the availability of transport and distribution infrastructure. HQ generates and distributes electricity within the province, to Ontario and to the United States. It plays a key role in RE deployment, as it purchases all the output produced by the privately-owned wind farms.

Québec is on the cutting edge of innovation in the field of energy and electricity. HQ generates both supply and demand for electricity innovation. In the 1960s, it built the first 735 kilo Volt (kV) transmission line in the world. This breakthrough technology significantly reduced energy losses during transmission and made it possible to build dams in the northern territories. HQ's research institute – IREQ – has obtained some 850 patents and published thousands of articles over the past four decades. The presence of HQ also justifies the specialisation of the Université du Québec system in energy and engineering issues. The École de technologie supérieure (ETS), which ranks first in Quebec and third in Canada for the total number of engineering diplomas awarded each year, has

developed a joint research programme with HQ. Besides promoting breakthrough innovations, Québec is particularly active in innovation transfer to specific industries and communities. Some centres for technological transfer (centres collégiaux de transfert de technologie, CCTT) are active in the energy industry. CCTTs are funded by both public and private resources. For example, the Service de recherche et d'expertise en transformation des produits forestiers, SEREX, is a CCTT active in the forestry industry and helps forestry producers to develop technologies for using forest residues as feedstock for renewable heating. Another energy-related CCTT is the Wind Energy TechnoCentre (TechnoCentre éolien, TCE), which promotes the creation of a wind industry supply-chain in Québec. TCE investigates the characteristics of Québec's wind resource and runs some specific programmes on deploying wind turbines in a cold climate. Since 2006, a community college (CEGEP) in Gaspésie has been hosting the "Québec centre for wind turbine maintenance training".[3] In Québec, wind turbine maintenance jobs are very attractive as they pay a salary of CAD 60-80 000 a year.

Renewable energy policy in Québec: Objectives, opportunities and challenges

The policy drivers: Why is Québec implementing a renewable energy policy?

Québec has turned to renewables, in particular wind power, in an effort to revive lagging rural economies and strengthen the competitiveness of its energy industry. Many rural jobs have been lost due to the decline in manufacturing in peri-urban and accessible rural areas. Also, predominantly rural economies are facing a crisis in some traditional resource-based industries. Communities depending on forestry, mining, and fisheries have been struggling because of the international competition in these markets or the mismanagement of the natural resource on which they depend. For these rural regions, RE deployment represents an investment opportunity that could alter their development path for the better. Since the mid-2000s, the MRNF (which is in charge of RE policy in Québec) has been trying to attract foreign investors to rural areas and promote the creation of small and medium enterprises (SMEs) in wind energy. The section which follows on the policy framework for RE at provincial and local levels describes how this policy has been successful for promoting wind power production and stimulating the local economy in the Gaspésie region.

Another goal of Québec's RE policy is to increase electricity exports. The energy produced by wind farms could be consumed locally in areas that are at the margins of the provincial grid, such as Gaspésie. This would free up some hydroelectricity (which is much cheaper to produce than wind energy) for HQ to sell on the North American market. However, market prices have been decreasing since the financial crisis in 2008. Nevertheless, HQ officials stress that they did not have a commercial motive for moving into wind: it would have been cheaper and easier still to expand hydro generation. The move to wind was directed by the government's industrial policy for Gaspésie. In addition, RE is also a popular "brand" and could introduce diversification into the electricity market, enhancing HQ's image, which capitalises on being one of the largest and more sustainable electricity producers in the North American market. As some US states that are committed to increasing reliance on RE do not count large hydro as a renewable source, wind energy may help HQ to enter their market.

The policy framework for renewable energy in Québec's rural areas

The Constitution of Canada gives jurisdiction for energy to provincial governments, but federal and local governments also play a role. The government of Québec owns most of the province's underground resources, and controls most of its electricity production. In Canada, each province has its own energy policy. Some utilities operate at the county level, and can be owned by local governments. This is not the case in Québec, where HQ is the sole actor distributing electricity. In general, local governments manage spatial planning and can influence the location of installations. Finally, local governments in Québec (MRCs and municipalities) participate in consultation processes co-ordinated by the provincial government.

The federal policy framework

The federal government has the power to make treaties with foreign countries in the field of energy. This has very important implications. For example, the Canadian government signed the Kyoto Protocol in 2002, although it withdrew from it in 2011. The federal government is currently involved in new negotiations to reduce global emissions of carbon dioxide (CO_2) begun in Durban at the end of 2011. These negotiations involve the world's largest economies, including the United States and China, which were not involved in the Kyoto Protocol. Canada is taking part in several international initiatives to promote RE deployment and plays an active role in several international networks and organisations.

The federal government has launched an energy strategy that supports the sustainable production of energy from both conventional and renewable sources. In this context, Natural Resources Canada (NRC), in co-operation with the provinces, manages a series of programmes to reduce CO_2 emissions and promote RE, including:

- Eco-energy for Renewable Power: launched in April 2007 to encourage the generation of electricity from renewable energy sources such as wind, small-scale/low-impact hydro, biomass, photovoltaic, and geothermal energy. This project, which ended in early 2011, created 104 RE projects scattered around Canada, including Québec, with contribution agreements lasting until 2021. This represented a total investment of CAD 1.4 billion and approximately 4 500 MW of installed RE capacity (Natural Resource Canada, 2011).
- The Decentralized Energy Production Initiative (DEPI): this promotes the integration and decentralisation of electricity production and distribution across Canada. This is also to cope with failures in electricity grids, given concerns over their age and reliability. DEPI deals with institutional barriers, poor reliability, and high system costs affecting the creation of a smart grid. It updates and develops standards; e.g. codes and rules describing how to safely connect power technology (Natural Resource Canada, 2011).
- A project to promote carbon capture and storage technology (CCS) to improve sustainability in the conventional energy sector. Integrated CCS demonstration projects are co-funded by the federal government, provinces, and private sector. The total Canadian investment in CCS projects is over CAD 7 billion (2011). Two of these large-scale demonstration projects, Shell Quest and the Enhance Alberta Trunk Line, will capture CO_2 from oil sands upgrades.

Canada's regional development agencies, which are federal ministries, are also active in promoting RE as a way to create economic opportunities. For instance, the Atlantic Canada Opportunities Agency (ACOA), active in New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island, has launched the "Atlantic Energy Gateway". Its aim is to improve the production of energy with a focus on renewable sources, and to promote energy exports by optimising and updating grid connections. Western Economic Diversification Canada (WD), the federal agency working in British Columbia, Alberta, Saskatchewan and Manitoba, cofounds initiatives to promote RE deployment, especially at a small scale. Finally, Canada Economic Development for Québec Regions (DEC) provides grants to support RE deployment linked to natural resources (forestry in particular), mostly in Quebec's rural regions.

Provincial and local levels

Quebec's first steps in its RE policy were to promote wind energy in the Gaspé Peninsula[4] as a remedy for the region's economic problems. In the late-1990s, the Gaspésie economy was threatened by simultaneous crises in the fisheries, mining, and forestry sectors. Wind power was prioritised here as the region has a good wind resource and wind energy is also a good match with hydroelectricity for grid-balance issues. The MRNF intervened to create a supportive business environment for RE deployment, creating business and research centres – such as the Wind Energy TechnoCentre – and community colleges to develop skills in Gaspésie. Energy policy interventions in Québec are implemented by Hydro-Québec (HQ). In 2003, HQ put out a first call for tenders for 1 000 MW of wind energy: a CAD 2 billion total investment over three years. The call for tenders required tenders to ensure financial liability, fair compensation to communities and landowners, relative proximity to the grid (as building one mile of line costs approximately CAD 1 million), and to ensure local content (Box 7.1). This required that between 40% and 60% of the developers' total cost be concentrated in Gaspésie, depending on the year they started. The average price for the first call for tenders for wind power was CAD 0.083 per kilowatt-hour (kWh) over 20 years. HQ launched a second call for tenders in 2005 to install 2 000 MW of wind energy with a total investment of CAD 5.5 billion. The second call for tenders also included LCRs. This time 60% of developers' total costs had to be concentrated in Québec, and a minimum of 30% of the wind turbine costs in the Gaspésie region. The average price paid by HQ was CAD 0.105 per kWh.

Gaspésie's specialisation in RE has also been supported by a local Action Concertée de Coopération Régionale de Développement (ACCORD). Launched in 2007, ACCORD mixes cluster policy and industrial policy to concentrate within Québec manufacturing activities producing components for wind turbines for export across North America. The local impact of this policy has been significant. For instance, in the administrative region of Gaspésie-Îles-de-la-Madeleine, the local unemployment rate for the mining and fishery industries had hit 20% in 2000. The impact of RE deployment in this administrative region caused the unemployment rate to fall to 12.4% by 2011 and the participation level to rise from 50.8% in 2000 to 55.2% in 2011.

Box 7.1. **The use of local content requirements for regional development**

LCRs are the most direct way to promote a local manufacturing industry. In the case of Gaspésie's wind sector, LCRs require the use of a certain percentage of locally manufactured technology in domestic wind turbine projects. LCRs force wind companies to shift their manufacturing base to the country (or province), or to outsource components used in their products to domestic companies. However, unless the mandate is specifically targeted to domestically-owned companies it can encourage local manufacturing by any company, domestic or foreign (Lewis and Wiser, 2007).

LCRs are increasingly used in several countries, and especially by sub-national governments. Some countries have implemented adjustable local-content premiums in addition to base feed-in tariffs. Turkey's Renewable Energy Law of 2010 offers bonus payments if the hardware components of renewable-energy technologies are produced in Turkey. In Italy, investors are entitled to an additional 10% bonus payment for solar components manufactured in the European Union. In the United States, the state of Washington provides an incentive to investors in solar PV generating plants which increases if consumers use locally-produced solar panels and inverters. If both solar inverters and modules are locally manufactured, the base incentive rate almost triples. Delaware, Florida and Texas provide similar bonus premiums for household solar applications (OECD, 2011).

LCRs need a large market in order to lure foreign firms to undertake the significant investments in local manufacturing. However, they can negatively affect the cost of RE and distort international trade. For example, if the market is not sufficiently sizable or stable, or if the local content requirements are too stringent, then the advantages of attracting local manufacturing may be offset by the higher cost of wind equipment. Even where this is not the case, there remains a question about the viability of such manufacturing once the initial public subsidy that accompanies LCRs is phased out. Some concerns of this nature have already been raised in Brazil, where only one wind turbine manufacturer currently appears able to meet the local content requirements. The potential negative impact of LCRs on turbine costs has also been raised in Canada and China. These experiences suggest that local content requirements can have significant local impact, but should generally be applied in a gradual, staged fashion and only in markets with sufficient market potential (Lewis and Wiser, 2007). Turning to trade, measures aimed at increasing the domestic supply of technologies can affect trade flows in an adverse way. The trade-distorting impact of supply-side policies should be stronger the greater they favour local suppliers over foreign competitors (OECD, 2011).

Source: Lewis, J. and R. Wiser (2007), "Wind: A Local Industry: Countries Have Adopted Different Policy Mechanisms to Encourage Local WT Manufacturing", *Refocus*, Vol. 8, No. 2, available at *www.sciencedirect.com/science/article/pii/S1471084607700483*; OECD (2011), "Domestic Incentive Measures for Renewable Energy with Possible Trade Implications", Joint Working Party on Trade and Environment, COM/TAD/ENV/JWPTE(2011)46.

Capitalising on the Gaspésie experience, Québec launched its 2006-2015 Energy Strategy, encompassing large hydro and RE. The main goal is to increase the quantity of energy the province can export within the North American market, especially the spot market. The total investment in hydro power will be CAD 25 billion, and the estimated net impact on the provincial labour market would be to create 70 000 new jobs created over a decade. The energy strategy aims to achieve 4 000 MW of installed wind energy capacity by 2015. Within this policy framework, HQ has already launched two calls for tender for a total of 3 000 MW. As before, HQ sets strict technical requirements (efficient production of electricity and proximity to the grid) as well as LCRs. The energy strategy also supports small community projects; HQ has designed a specific call for tender that offers local communities and first nations the possibility to deploy a total of 500 MW of renewable energy in their territories. Approximately 290 MW of such small-scale projects will be deployed between 2013 and 2015 and the average price paid through this call for

tender will be CAD 0.13 per kWh. Overall, the price HQ pays to wind energy producers has risen over the last decade.[5]

Québec is also trying to link RE deployment to economic development in local communities through its National Rural Policy (PNR) – one of the most advanced rural development policies in the OECD (OECD, 2010). The PNR is led by a non-sectoral ministry: the Ministry for Regional Affairs and Land Occupation (MAMROT). The PNR is implemented in municipalities with less than 10 000 inhabitants located below the 49th Parallel and covers a total of 2 million people. It is implemented at the MRC level; favours stability and strategic planning, being based on a seven-year contract between the MAMROT and MRC; and promotes framework conditions for endogenous development rather than a specific sector (e.g. agriculture). Québec is currently implementing the second PNR (2007-2014), which represents an investment of CAD 200 million. In this framework, RE sectors are seen as one option for rural development (MAMROT, 2011), and PNR identifies four main policy actions:

- Information: the policy must inform rural communities of their potential for RE production and the related challenges and opportunities.
- Support to local initiatives: the government policy is to provide financial and scientific support to rural communities and businesses.
- Accessibility: rural communities should have access to RE resources, especially biomass where forest owners should be encouraged to create co-operatives to collect forest residues to be used as feedstock.
- Access to market: RE produced in rural communities should be easily put on the market.[6]

Based on these recommendations, PNR has promoted the creation of local institutions and organisations to help communities to diversify their activities. For instance, in Matapedia, an MRC in the Gaspésie Peninsula, SEREX is helping a community of forest owners to create a local supply chain based on the production of renewable heating.

Another strategy, the *Plan Nord* (PN), aims to capitalise on the endowment of natural resources, including RE, in the north of Québec. The PN applies to areas north of the 49th Parallel, representing 72% of Québec's landmass – over one million square kilometres or twice the size of France. The PN's goal is to trigger public and private investment of CAD 80 billion by 2035 in six strategic sectors: mining, forests, bio-food, tourism, hunting and fishing, and energy, including RE (MNFR, 2011). Energy alone should attract a total investment of CAD 25 billion to develop 3 500 MW of installed capacity: i.e. 3 000 MW of hydroelectricity, 300 MW of wind power, and 200 MW from other renewable energy sources (MRNF, 2010). The government forecasts a total impact on the provincial labour market of 75 000 jobs (from energy and the spinoffs in terms of the industries that could be attracted). RE deployment could provide remote areas with abundant electricity, which could in turn attract energy-intensive activities such as mining, smelters, pulp and paper companies. Moreover, installing 300 MW of wind energy will sustain the provincial demand for the wind turbines made in Gaspésie, especially if one considers that the energy strategy ends in 2015, when the implementation of *Plan Nord* will only be beginning.

Assessment of policy impacts on rural development

Of all the case studies assessed by the OECD in this report, Québec's RE policy is the largest in terms of:

- **Investment.** It will see approximately CAD 20 billion (about EUR 15.3 billion) invested in RE by 2035 – excluding large hydro and federal investment.[7]
- **Installed capacity.** The policy aims to install more than 4 800 MW by 2035.
- **Impacts on rural labour markets.** The provincial government hopes to generate approximately 70 000 new jobs in the energy sector by 2016. According to the provincial government, the policy has already generated 1000 new jobs, half of them in manufacturing activities and mostly in Gaspésie.

Public support for the provincial RE policy is very high for several reasons, despite the scale of the wind farms planned. Firstly, the economic decline of some rural areas, such as Gaspésie, meant that locals recognised the need for new investment opportunities and welcomed RE developments. Wind energy deployment has been enough to trigger the location of manufacturing activities in the region, to attract foreign investment (Box 7.2) and create valuable jobs. Secondly, the RE policy is implemented by HQ, which enjoys a large reservoir of public trust and respect in Québec for its role in supporting provincial economic development over the past 40 years. Thirdly, the presence of institutions protecting the interests of local communities has provided trust and social capital to the process. For example, the *Bureau d'audiences publiques sur l'environnement* (BAPE) is a public independent evaluation body assisting the Ministry of Sustainable Development, Environment and Parks (MDDEP). BAPE's agents go to local communities and give citizens the opportunity to state their concerns and ask questions about specific RE developments, including the expected economic benefits. If local citizens oppose a project, BAPE collects information to send to the MDDEP to inform its final recommendation about the project's implementation.

Québec's RE policy is remarkable for its coherence, and the number of co-ordinated actions put in place by the MRNF and HQ. Since the beginning of the 2000s, for example, the provincial government has also implemented a series of actions to create manufacturing jobs related to wind energy in rural Québec. As a result, Gaspésie is now home to several manufacturing firms producing large components for wind installations such as towers and blades. These firms have created about 400 manufacturing jobs in the last four years. Yet the attempt to create a supply chain in the region is hindered by its dependence upon foreign investment and technology and, above all, on public subsidies. Regional specialisation mostly depends on large plants owned by foreign companies that located their production in Gaspésie to meet the LCRs (Box 7.1). So far, a small number of local SMEs have been able to becoming integrated into the wind energy supply-chain, but they are mostly providing ancillary activities rather than core technologies. This situation may depend on the large investment needed to enter this business and the fast pace of deployment, which did not give enough time to rural communities to respond. This trend has been observed in other case studies and demonstrates the trade-off between the pace/size of RE deployment and the capacity of local actors to participate actively.

Box 7.2. **Foreign investment in a rural area: The case of ENERCON in Matane**

As part of this research, the OECD delegation visited manufacturing facilities in the Gaspésie region. This included the ENERCON wind tower plant in the town of Matane. ENERCON, a German company, is the fifth largest producer of wind turbines in the world, and has recently invested over CAD 60 million to start producing concrete towers – up to 138 metres high – for wind installations in Gaspésie and eastern Canada. The plant has created 150 jobs in Matane. Current production is 2.5 towers per week, but the factory has a production capacity of up to 5 towers per week.

Representatives of ENERCON listed the factors that attracted the company to this rural part of Québec:

- The target of 4 000 MW to be deployed between 2006 and 2015. This figure was large enough to convince the company to open a plant producing towers which – although built in modules – are extremely costly to transport over long distances.
- The crystal-clear rules guiding the calls for tender in the province and the reliability of the public development strategy. The company stressed that the decision to invest in Gaspésie was taken after receiving good feedback about the first call for tender by companies that were involved in this process (i.e. General Electric, which was the first supplier of wind towers in Québec).
- LCRs that were flexible enough to allow developers and producers to design coherent investment strategies. To invest in the area, ENERCON needed enough time (1.5 years) to organise the production with a large-enough group of developers.
- The presence of good transportation infrastructure: Matane has a port, and good rail and road systems, which are a legacy of the forestry and fishery industries.
- The good interaction with local institutions. This includes: *i*) the local mayor, who went to Germany several times to meet with the company and offer his support to the process at the local level; and *ii*) Gaspésie's Local Development Centre, which is the public body dealing with economic development issues in the region and is related to the Québec Rural Policy.
- The good local business environment, especially: *i*) availability of workers locally: ENERCON values having its labour pool in the same area in which it is located, to strengthen the link between the plant and the host community; and *ii*) good local suppliers (SMEs) for basic (yet key) inputs and services.

Hosting manufacturing firms that are among the world leaders in the production of RE components is a big opportunity for rural dwellers and businesses, provided that they are ready to transition quickly to a new set of skills. The presence of the manufacturing firm triggers a radical change at the local level, and the presence of manufacturing jobs has a relevant impact on the well being of a large number of families and on the community overall. The establishment of a large plant also opens up opportunities for self-employment and entrepreneurship. Small firms can supply the large one and provide a series of ancillary products and services. Moreover, interacting with a global player affects their productivity and capacity to deliver. As ENERCON's representatives explained, local SMEs have to guarantee very strict standards of quality, respect tight deadlines, and maintain price competitiveness. This is an important learning opportunity which could stand them in good stead in the future.

Another important strategy has been the recognition that rural areas, especially if remote and natural resource-based, need a new set of skills and to improve entrepreneurship if they are to become attractive for investors. The provincial government has been active in Gaspésie since the end of the 1990s, re-training local people through a set of policies, including the PNR. According to representatives of the Québec government, transitioning local skills from natural-resource industries to secondary activities requires three to five years.

Re-training local workers, however, is not enough to attract investment. Public policies should also create new local institutions and rules that favour entrepreneurship and self-employment, which are usually low in resource-based communities. In fact, as observed in Matane, the presence of small suppliers is a necessary condition for attracting local investment (Box 7.2). In general, the lower the set of skills and entrepreneurship available in a rural community, the larger the public investment needed to attract external actors to the area.

Québec-based forestry has also benefited indirectly from the energy strategy, despite suffering from reduced international competitiveness. The OECD delegation visited a rural community in Matapedia that is trying to specialise in producing renewable heating using woody biomass as feedstock. One local co-operative of forest owners is trying to optimise the management of forest residues and produce boilers able to satisfy local demand. The co-operative was able to place one of its prototypes in the regional hospital. Local entrepreneurs have been marginally supported by the energy strategy. They have benefited from the local intermediate institutions put in place by PNR, such as rural agents (community developers) and a research centre specialised in forestry products (SEREX), which provides the co-operative with the technical knowledge to improve the performance of their locally-produced boilers.

Main challenges

Québec emphasises how renewable energy deployment can contribute to rural development. Rural areas, even remote ones, can host RE manufacturing activities. Attracting large manufacturing plants can trigger further specialisation and improve entrepreneurship within the local community. Local SMEs can accumulate enough skills to improve their position in the local supply chain over the long run. The challenge, however, is to ensure the long-term viability of such activities in the absence of open-ended public subsidies.

However, although Quebec's RE policy can be considered among the most advanced within the international network assessed by this research, it suffers from the same structural, challenges observed in other case studies. These include the following:

- Québec has created a large market for wind energy through public incentives and subsidised prices for wind electricity. The latter, however, is still far more expensive than hydroelectricity, and its marginal price is increasing over time (also due to LCRs). Thus, its long-term sustainability is in doubt.
- Public policy has chosen to focus on a small number of RE "winners" – wind energy and hydro power – in order to create a large enough market to attract international energy companies. However, this has meant that other RE sectors, such as renewable heating from woody biomass, have not received as much support, despite possibly having greater potential to create linkages with key existing industries in rural Québec.

- The preference for large-scale deployments is a common trait of RE policy highlighted in the case studies. The aim is to accelerate the pace of the investment while reducing the transaction costs of each intervention. However, involving only a few actors in the policy process may reduce its development impact.
- Despite its internal coherence, RE policy is poorly co-ordinated with other provincial policies, in particular with the rural policy (PNR). The lack of co-ordination with PNR could be due to the large difference in terms of economic resources at stake. For instance, the PNR represents an investment of CAD 200 million over 7 years, while the RE policy (2000-2015) is only worth about CAD 10 billion of public and private investment. Actors such as HQ are used to implement large-scale projects rather than small local actions. Relying more on intermediate institutions related to the PNR – e.g. research centres and rural agents – could improve the effectiveness of the RE policy and also its linkages with rural industries.

Notes

1. In Québec there are 86 MRCs (and 14 equivalent bodies), which are county-like administrative and geographic units. Each MRC is composed of a number of municipalities. The MRC's responsibility is to manage land use by creating a "land use scheme" and revise it every five years; establish a plan for waste management, fire protection and civil protection (police); see to the proper functioning of watercourses in its territory, especially those used for agricultural drainage; prepare the evaluation rolls for local municipalities; and sell buildings for property tax default. MRCs are also responsible for local development and have to name or create, and fund, a local development centre to support regional businesses. MRCs do not cover the entire territory of Québec. Local municipalities (and equivalent first nations territories) not belonging to an MRC fall into two categories: *i*) all Indian reserves; and *ii*) 14 cities and urban agglomerations which do not belong to an MRC because they exercise some or all of the powers which are normally those of an MRC (a city or agglomeration in some cases exercises only some of these powers because some MRC powers are delegated to a metropolitan community) (OECD, 2010).
2. Note that the OECD research "The Production of Renewable Energy as a Regional Development Policy for Rural Areas" does not consider large-scale hydroelectric power to be renewable energy. This is not linked to environmental considerations but rather to the large scale of the investment which is needed for such installations. The equipment supply side is much more mature than for other RE technologies like PV or wind, although it can create a significant number of construction jobs and can have substantial local development impacts, *e.g*. in Brazil.
3. The Gaspésie-based CEGEP is the only community college in Québec specialising in the wind industry. The majority of students are in their 20s, and they come from all over the province. CEGEP is a public body and Québec students pay very low tuition fees to attend. But the Gaspésie college is also attracting foreign students on the basis of international agreements. For instance CEGEP started collaborating with a training consortium in Germany. CEGEP enjoys a low drop-out rate and a high rate of placement of students in the labour market. CEGEP operates in close collaboration with firms and has a European certification: this reflects the fact that the majority of manufactures operating in the area come from Europe.
4. The Gaspé Peninsula is situated along the south shore of the Saint Lawrence River in Quebec. It has an area of 30 341 km^2 and a population of approximately 100 000.
5. A third call for tender was launched in 2009 intended for first nations or local community projects only; in order to control the costs of energy, the government imposed a price limit at CAD 0.125/kWh to allow the projects to come about while limiting the financial impact on the consumer.
6. Through this specific intervention, the provincial government could support the demand for renewable heat from woody biomass in Québec, and forestry in rural communities. This is important as in Québec rural people use electricity for heating due to its very low prices (CAD 0.07 per kW). This price does not mirror a market dynamic, but rather a policy decision to keep electricity prices low across the province, regardless of distance from power plants or the main grid.
7. This figure jumps to more than CAD 47 billion if new a new instalment of hydro-electricity is also included, i.e. the large new dams developed in the north of the province.

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Chapter 8

Region Zealand, Denmark

Rural development and renewable energy (RE) in Region Zealand: Summary and conclusions

Main findings. *i*) Bottom-up initiatives can link RE and local rural development. *ii*) One way rural regions can contribute to innovation in RE technologies is to provide testing facilities; *iii*) RE is not a panacea for regional development, but it can help local communities to retain some valuable jobs and contribute to the regional branding strategy. *iv*) Even in Denmark, despite the strong support for the national green agenda, there are issues about social acceptance of wind installations; this causes transaction costs to rise and necessitates time-consuming procedures to deploy RE.

Renewable energy in Region Zealand: A summary. Region Zealand is a diverse region which encompasses both peri-metropolitan and predominantly rural areas. Copenhagen, the national capital, is located in the north of Zealand Island, and its functional area extends over the northern part of Region Zealand's territory. In the southern part of the region there are no large urban areas and the population density drops to approximately 50 inhabitants per square kilometre. This case study concentrates on the island of Lolland, home to 46 000 people. It used to be a manufacturing and agricultural powerhouse due to its shipbuilding industry and intensive sugar beet production, supported by Common Agricultural Policy (CAP) subsidies. During the 1990s and 2000s both manufacturing and agriculture were challenged by international competition and a drastic reduction of EU subsidies to primary activities, forcing the rural part of the region into a structural economic downturn.

An aggressive national policy towards RE has created development opportunities in Region Zealand, particularly in Lolland. The region has attracted a large number of wind installations due to its wind resource, which – although relatively modest compared to other case studies – is one of the best in Denmark. It has also capitalised on the availability of land, which has become a scarce resource both for wind installations and the region's manufacturing and farming legacy. Local inhabitants have benefited from public subsidies (upfront capital and feed-in tariffs) as well as access to EU funds that buffered it from the decline of other regional activities. Region Zealand has benefited from the support of the central government and the ease of access by mayors and others involved in the project to key central government people.

At the end of the 1990s, Region Zealand was able to attract a wind generator plant that created 300 jobs. However, these jobs have since been lost due to strong international competition and an aggressive company internationalisation strategy. Since then, regional institutions (including public authorities and private businesses) have looked beyond the mere deployment of installations and have put RE at the centre of an ambitious, yet realistic, development strategy. Initiatives included the creation of a consortium in the island of Lolland, the Lolland Community Testing Facilities. The presence of these testing facilities has triggered new skills and activities specifically related to the operation and maintenance of RE, thus developing an important niche within the region. These facilities include not just wind power, but also pilot biomass and hydrogen storage facilities. These bottom-up initiatives have been further improved and integrated internationally by the regional Growth Forum (GF), a public-private body which implements economic development in the region.

Future challenges. Although the current results are promising, RE has not had a dramatic effect on the economic performance of the Region Zealand, which is still dealing with outmigration and sluggish productivity. The RE activities have not so far been able to replace the jobs that were lost after the shipbuilding industry crisis, nor the sharp reduction of agricultural subsidies. However, as in other case studies assessed by this research, the development of RE sectors in Region Zealand has been a way to shift a local community facing a structural economic downturn to a lower economic equilibrium, in which there are fewer jobs and probably fewer rural dwellers.

In Region Zealand and Denmark as a whole, RE sectors still depend on public subsidies. Although evaluating the performance of RE in terms of energy efficiency and overall economic efficiency goes beyond the scope of this study, it is interesting to note that, even in Region Zealand, RE would not be a viable alternative to conventional fuels without these large public incentives. Siting onshore wind turbines is becoming increasingly difficult, leading to the need for even higher-cost offshore installations. Despite some pilots of hydrogen-based storage, Denmark has not yet found a solution to the intermit nature of "wind electricity". Consequently, despite the availability of wind energy, Region Zealand has not been able to attract energy-intensive manufacturing which requires reliable energy supplies.

The context

Region Zealand's socio-economic profile and performance

Denmark's Region Zealand is one of the five Danish regional administrative units created in 2007 and covers most of the island of Region Zealand and several smaller islands, including Lolland and Falster. It has a total territory of 7 273 km^2. Region Zealand is home to approximately 820 000 people (Table 8.1). The region has a diverse pattern of settlement that ranges from peri-metropolitan to predominantly rural areas. This diversity arises because Copenhagen, the national capital, is located in the north of the island of Zealand and its functional area effectively encompasses part of Region Zealand. People living in this part of Region Zealand depend on Copenhagen economically. The centre of the region is home to a number of medium-sized cities, including the administrative regional capital, Sorø. The southern part of the region has the lowest population density, with approximately 50 inhabitants per km^2 in Lolland Island, for example. Lolland, which is the focus of this study, is a large plain with an average elevation of 25m above sea level and 46 000 inhabitants.

Table 8.1. **Region Zealand: Demographic data**

2007 data unless otherwise indicated

	Region Zealand	Denmark
Population (2009)	820 564	5 529 888
Population share	14.9%	100%
Population density	110	129
Elderly dependency ratio (2006 data)	0.25%	0.21%

Source: OECD Regional Database.

Although its labour market is strong, Region Zealand is one of Denmark's less competitive regions. The regional unemployment rate is below the national average, and employment rates are over 75%, which is a remarkable performance compared to the OECD average (Table 8.2). In spite of this, the regional contribution to national GDP has slightly declined, from 11.5% in 1995 to 10.5% in 2008. The regional share of GDP is lower than the share of national population living in the region, which indicates that the regional productivity rate is lower than the national average. Due to its weak economic performance, Region Zealand falls within the criteria for the EU Regional Employment and Competitiveness objective.[1]

Table 8.2. **Region Zealand: Main economic indicators**

2009 data, unless otherwise indicated

	Region Zealand	Denmark	OECD gap
GDP per capita USD PPP	23 825	32 723	3.13%
GDP share	11%		
Productivity USD PPP	48 817	64 967	44 513%
Unemployment rate (2010)	6.7%	7.4%	6.3%
Employment rate (%)	75.7	76.5	66.7%
Long-term unemployment rate (%)	0.4	0.5	2.4%
Youth unemployment rate (% - 2010)	15.3	13.8	15.3%
Infrastructure (motorway density)			0.64%
Tertiary attainment as % of labour force (2008)	28.3	37.8	26.0%
Patents per million (2007)	119.2	231.0	430.0%

Source: OECD Regional Database, http://dotstat/wbos/.

Along with the rest of Denmark, Region Zealand's population has become concentrated within city regions or within commuting distance of larger labour markets. Over the last 10 years, a large part of Zealand Island has become a part of the Copenhagen labour market and the population has concentrated in the north of the region. However, the economic crisis is now affecting this spatial pattern, and population growth stopped in 2009. This may be due to declining house prices in the capital area, increasing fuel prices and intense road congestion (Nordregio, 2010). Another important phenomenon related to the crisis is the increased level of migration of young adults to cities with educational possibilities, which affects the dependency ration in rural communities (Nordregio 2010).

The region is dominated by the service sector, with declining manufacturing and agricultural sectors. Region Zealand has specialised in education, social, and health services. These sectors alone provide more than 30% of the region's employment and 22% of gross value added. There are several hospitals and senior care homes in the region. These facilities capitalise on the region's proximity to the capital and its natural amenities. The region also has a relatively large education sector with two main universities (University College of Zealand and Roskilde University) with approximately 16 000 students between the two. Some areas within the region used to be important manufacturing powerhouses. For instance, Lolland Island used to specialise in shipbuilding. Local firms, however, were dependent on public subsidies and disappeared between the 1980s and 1990s following Denmark's accession to the EU and the economic crisis that hit Scandinavian countries. In the 1990s, the region's shipbuilding legacy fed into the production of wind turbines. For instance, Vestas, the Danish world leader in the wind energy industry, opened a plant in Lolland in 2006 to produce wind generator components, such as towers and blades. Since then the globalisation of the wind energy market and the need to reduce transportation costs has caused Vestas to delocalise these activities, with the loss of 300 jobs, reducing the importance of the wind energy industry at the regional level. Region Zealand's landscape has also been shaped by intensive agriculture. This sector used to specialise in the production of sugar beet, which benefited from large subsidies under the Common Agricultural Policy (CAP). EU subsidies to the sugar supply chain were drastically reduced in the early 2000s, and agriculture now employs less than 2% of the regional population. Farmers are increasingly focusing their activities towards the production of environmental services and aim to specialise in the production of biomass.

Region Zealand's energy resources

Region Zealand has specialised in the production of energy, driven by its proximity to the Copenhagen metropolitan region and the availability of land. The region is home to a multifaceted energy system based on a mix of conventional and renewable sources of energy. Region Zealand's renewable energy resources include wind, solar and biomass from agricultural activities. The region also benefits from solar irradiance, with a yearly average of 1 200 kilowatts hour per square meter (kWh/m^2). The region's specialisation in agriculture and livestock production offers good potential for energy production from biomass. Region Zealand has 18% of Denmark's total agricultural land, and 6% of its cattle and 11% of its pigs (Government of Region Zealand, 2011). The region's flat topology rules out hydropower.

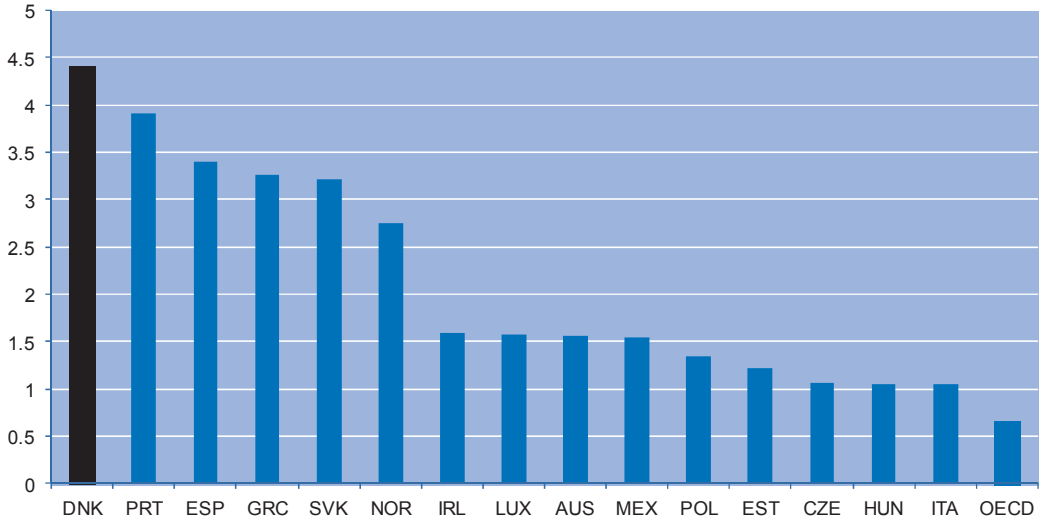
The region particularly specialises in wind energy, producing 1 542.6 GW a year, or 32% of the overall regional production, even though average wind speed is relatively low.[2] Approximately 620 GW are produced by offshore wind farms, which are increasingly important in the region. The large proportion of wind energy has created issues of intermittency. To deal with these, the regional energy company is improving the capacity and flexibility of the grid. For instance, several hydrogen fuel cell systems were installed in private houses in the island of Lolland to store energy produced by wind installations, thus balancing the grid.

Combined heat and power (CHP) plants (see below), or district heating systems, are also common, although less important than in other Nordic countries. This is a result of the lack of biomass – Denmark does not have the same forest resources as Sweden or Finland – and the presence of a natural gas grid servicing almost the entire territory.

The regional innovation system contributes to the national effort to improve the efficiency and effectiveness of RE, and to environmental sustainability in general**.** Denmark has the highest rate of innovation related to RE technologies in the OECD (Figure 8.1). The national innovation system is based on several key hubs (research centres and universities) that work closely with local communities, including businesses and public authorities. This involvement of a large number of actors within the innovation process can be considered a key factor in the country's success in developing the wind energy industry (Kemp, 2002). Region Zealand is embedded in the national research system and the region has important national innovation hubs. For instance, the Technical University of Denmark (DTU) Risø, in Roskilde (the regional capital) has become the main national laboratory for sustainable energy and a centre of expertise in wind energy. Region Zealand is also home to one of the first experiments in the field of industrial ecology, the Industrial Symbiosis Project (Box 8.1)

Figure 8.1. **Region Zealand: Patent applications in renewable energy technologies**

As a percentage of total Patent Co-operation Treaty patent applications, 2003-2008



Source: OECD (2012), *OECD Economic Surveys: Denmark 2012*, OECD Publishing, Paris, *10.1787/eco_surveys-dnk-2012-en*.

Box 8.1. **Kalundborg's Industrial Symbiosis Project**

The Industrial Symbiosis Project is a state-of-the-art experiment in the field of industrial ecology. Launched almost 30 years ago, the aim of the project was to reduce the environmental impact of manufacturing activities in the municipality of Kalundborg in Region Zealand. The basic idea is that companies can exchange each other's residues and by-products on a commercial basis. This has also created new business opportunities, energy savings and lower environmental impact. Kalundborg is now a world-renowned example of how innovative techniques can have a positive impact on environmental protection and economic development. Industrial Symbiosis has inspired eco-industrial parks around the globe, including the Styrian recycling network in Austria, Rotterdam Harbour, Industrial Complex in the Netherlands, Londonderry Industrial Park in New Hampshire, and Guigang Eco-Industrial Park in China (OECD, 2010).

Source: Government of Region Zealand (2011), response to OECD questionnaire.

Region Zealand has specialised in applied research within RE sectors, particularly in Lolland. The island has capitalised on the availability of land (a relatively scarce resource in Denmark, especially for wind installations) and manufacturing skills to build testing facilities for different RE sectors. The Lolland Community Testing Facilities (Lolland CTF) manages testing facilities on the island. The CTF was started in 1998, when local governments saw the potential of a green economy, particularly RE, and decided to raise taxes to build municipal utilities and testing facilities. These areas are equipped to host full-scale prototypes and provide developers with tailored services, including international visibility for their experiments due to the recognition the CTF has gained globally. Local governments sign a confidentiality agreement with companies to protect their intellectual property. The CTF is conducting applied research in three main areas:

- **Wind energy**. Lolland's testing fields allow producers to test full-scale wind energy prototypes. The presence of such facilities triggered the regional specialisation in operation and maintenance activities, which has become the main activity of the International Wind Academy Lolland (IWAL). IWAL focuses on innovative and non-intrusive testing techniques that do not damage the installations. Maintenance is a key business which, due to the increasing lifespan of wind turbines, can represent up to 40% of the overall cost of installations. IWAL co-operates with business academies in the region, and has launched training courses that attract pupils from all over the country and overseas.
- **Biomass.** The Green Centre (GC), founded 25 years ago on the island to help farmers innovate, is trialling techniques to cultivate algae on a large scale. Intensive agriculture could produce CO_2 and nitrogen that can be used in the production of algae. Potential uses for algae include purifying water by removing nitrate deposits from intensive farming and sewage treatment. It could also be used as a fertiliser as it contains CO_2. As with the wind testing facilities, an important feature of the GC is its proximity to the potential users of innovation, in this case farmer, and the ability to test research ideas directly in the field.
- **Hydrogen-based storage systems.** As explained above, these systems could facilitate the use of RE within the electricity grid. The Lolland Hydrogen Community (LHC), opened in 2007, is the European Union's first full-scale Hydrogen Community Demonstration facility for a residential fuel cell CHP plant (Iskov, 2009). The LHC is

located in the city of Nakskov, which produces approximately 500% more electricity from wind power than it consumes. It is seeking to store excess wind power locally in the form of hydrogen for use in residential and industrial facilities. Hydrogen is produced by using excess wind power to electrolyse water to produce hydrogen and oxygen. The oxygen is used in the municipal water treatment plant nearby to speed up its biological process. The hydrogen is stored in low-pressure (six bar) storage tanks which can fuel two proton exchange membrane (PEM) fuel cell micro CHP stations of 2 KW and 6.5 KW. Local citizens were invited to participate in the pilot project. Storage tanks were installed in five households, contributing to lower electricity costs. In 2012, the pilot project expanded 35 households.

Renewable energy policy in Region Zealand: Objectives, opportunities and challenges

The policy drivers: Why is Region Zealand implementing a renewable energy policy?

Region Zealand focuses on RE technology to contribute to its ambitious national plan to drastically reduce CO_2 emissions, and to create new employment opportunities in a region that suffers from outmigration and ageing. The region has experienced some severe economic shocks over the last two decades, as mentioned above. Today, it aims to capitalise on the legacy of its manufacturing and agriculture industries to develop a clean-tech cluster within the RE sector. This should create valuable new job opportunities for highly skilled people, who are currently migrating away, attracted by Denmark's main urban poles, especially Copenhagen.

The policy framework for renewable energy in Region Zealand's rural areas

Renewable energy policy is influenced by four different tiers of government, ranging from the European level to municipalities. In Denmark this is further affected by two peculiar characteristics. First, the national government is highly proactive in RE, and tends to influence policy choices at the European level. Second, power in Denmark is concentrated at the local level; intermediate governments, such as the Region Zealand regional government, play quite a limited role, mostly related to the design of regional development strategies based on local initiatives.

European level

It was not until 2005 that a mandatory and comprehensive energy policy was adopted at the EU level. Before then, EU Member States pursued intergovernmental initiatives motivated initially by energy security in the 1970s and subsequently by environmental concerns in the 1990s. In 1997, in reaction to the Kyoto Protocol, the EU introduced non-mandatory targets for Member States for the RE share in total energy consumption. In 2006, the European Commission issued the Green Paper: A European Strategy for Sustainable, Competitive and Secure Energy. This asked Member States to implement a European energy policy built on three core objectives: *i*) sustainability – to actively combat climate change by promoting renewable energy sources and energy efficiency; *ii*) competitiveness – to improve the efficiency of the European energy grid by creating a truly competitive internal energy market; and *iii*) security of supply – to better co-ordinate the EU's supply of and demand for energy within an international context. In 2007 this was translated into mandatory shares of RE production for Member States in the form of

the Renewable Energy Roadmap. This document set the overall mandatory goal of achieving 20% of RE in total energy consumption (10% of transport biofuels) by 2020, which has become part of the "Europe 2020" Strategy.

Denmark has played a key role within this framework, often anticipating the EU strategy and setting new standards for the EU (Andersen and Liefferink, 1997). The 2009 Renewable Energy Directive set individual targets for each Member State. Denmark's targets within the EU framework is to achieve 30% renewable energy by 2020 (Ministry of Energy, 2010); this was further enhanced by the Energy Strategy 2050 for Denmark (IEA, 2011).

The region's structural weakness compared to the rest of the country, especially in rural areas such as Lolland, makes Region Zealand eligible for EU structural funds. These funds, as well as the EU INTERREG programme and the CAP, provide Region Zealand with extra investment capacity which has been used to launch projects at the local level, especially in Lolland. These include the local Growth Forum (which receives a yearly contribution of EUR 10 million), as well as specific projects for the development of biomass and other renewables. INTERREG is also a source of financing for local projects because Region Zealand is part of the Oresund Region, which also encompasses the Capital Region of Denmark and Skåne County in Sweden. Finally, CAP support in Region Zealand is increasingly focusing on environmental services and the production of RE from agricultural biomass.

The EU also promotes a range of initiatives supporting RE deployment that directly involve local and regional governments. The EU Directorate-General for Energy has created a specific initiative, the Covenant of Mayors, to capitalise on the role local governments can play within the EU 2020 strategy[3]. The Covenant of Mayors has become the main European movement involving local and regional authorities in the fight against climate change. The assumption is that local governments can affect citizens' behaviour though local regulation, and reconcile public and private interests by integrating sustainable energy issues into overall local development goals. The Covenant of Mayors is usually based on a voluntary commitment by signatories to meet and exceed the EU 20% CO_2 reduction objective through increased energy efficiency and development of renewable energy sources. The network does not provide any direct financial resources, but it forces municipalities to design an action plan for RE and energy efficiency. This makes it easier for them to get support from EU funds for renewables. Region Zealand's municipalities are active members of this network.

National level

Denmark is an early adopter of RE due to its supportive conditions and strong political consensus (IEA, 2011). The evolution of Denmark's energy sector has been influenced by several factors:

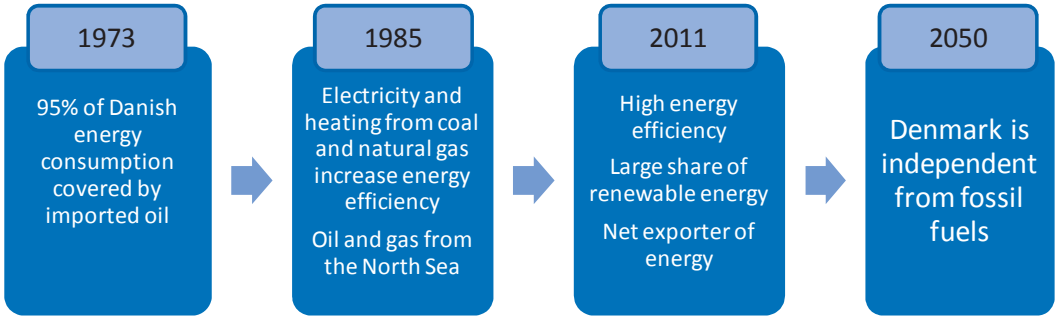
- The 1973 oil crisis negatively affected the national economy.
- Denmark's topology made it unsuitable for the development of hydro power.
- The Danes' aversion to nuclear power, which was banned in 1985, encouraged a search for alternatives.
- The absence of large centralised energy production, which pushed Denmark to create a multi-polar grid based on district heating systems.[4]

These factors prompted the country to specialise in renewable energy early on. The multi-polar grid established meant people were familiar with the concept of producing their energy locally. Many people were able to engage with wind energy at a very early stage of that technology, which is considered a key factor for successful wind energy (Kamp, Smits and Andriesse, 2004).

Besides reducing CO_2 emissions, national RE policy aims to achieve complete energy independence and contribute to the national specialisation in clean technology. Denmark has been able to dramatically reduce its consumption of fossil fuels. The positive trend is expected to continue over the next 10 years with fossil fuel consumption expected to decrease 33% by 2020, i.e. beyond the target agreed with the EU. The next long-term goal is to become independent of fossil fuel use by 2050 (Figure 8.2). In 2012, the government approved a new strategy, Our Future Energy (2011), to transform Denmark into a low-carbon society with a stable and affordable energy supply. This ambitious RE policy has given Denmark a positive international image as a leader in low-carbon technologies and spurred further specialisation in RE industries.[5]

Figure 8.2. **Denmark's energy strategy 2050**

Evolution of Denmark's energy profile

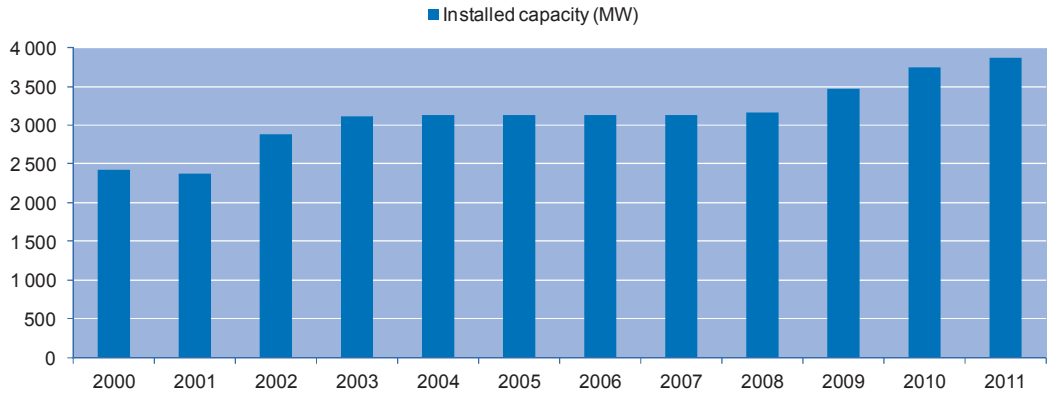


Source: Based on a presentation by Denmark Energy Agency.

Denmark has become the world leader in wind energy installations, although international competition has been dramatically increasing over the last three years. In 2008 the combined global market share of the two largest Danish wind turbine manufacturers, Vestas and Siemens, was just over 27% (Danish Energy Agency, 2009). This level of international competitiveness was enabled by the long-term strategy started by the national government in the 1980s. Denmark was the first European country to introduce large-scale subsidies for wind installations. Subsidies were granted in the form of capital costs (up to 30% in the initial phase) and feed-in tariffs (FITs). They were given mostly to local co-operatives to favour the involvement of a large number of local actors and spread the benefits related to the production of RE as widely as possible. Thanks to these incentives, Denmark had almost 2 500 MW of installed capacity of onshore wind energy in 2000 in spite of being a relatively small country (Figure 8.3).[6] Over recent years, however, Denmark has faced growing international competition. By 2011 the combined global market share of the two largest Danish producers had fallen to less than 20%

of global production, slightly more than the two largest Chinese companies combined, which only entered the ranking in 2009 (Recharge, 2012). Direct competition with Chinese producers will increase in the coming years. It is expected that China alone will account for 38% of global installations between 2011 and 2016, a trend that will favour its national producers (Reuters, 2011).

Figure 8.3. **Installed wind energy in Denmark, 2000-2011**



Source: Wind Power (2012), "Denmark", *Wind Turbines and Wind Farms Database*, *www.thewindpower.net/country_en_6_denmark.php*, accessed 11 April 2012.

Large-scale deployment of wind energy has required the creation of specific national organisations to protect local communities from the negative impacts of excessive deployment. Denmark has a very high density of large wind turbines: 9.8 per 100 km^2, compared with 0.49 in the UK and 5.5 in the Netherlands (Renewable UK, 2011). Onshore wind turbines are often highly visible, since they can be up to 125m tall, and their impact on the landscape has become significant. Although new wind turbines have been designed to minimise noise nuisance, the turbines can still be both seen and heard in their immediate surroundings, which restricts how close to residential neighbourhoods they can be built. Municipalities are obliged by regulations to consider the landscape when siting new turbines. The Danish Government has created a specific body, the Wind Secretariat, to assist local communities in the siting of turbines and with the overall planning process (Box 8.2). The national government has also put in place a regulation that requires wind turbine developers to compensate home owners near their installations for any decrease in property value. Another scheme extends the right to own shares of a wind turbine facility to anyone living within 4.5km. Wind turbine owners are also required to contribute to a fund that is shared with municipalities. This money can be used to inform the local population about climate-related issues and environmental projects. The Danish government is now also supporting offshore deployments, despite their higher cost.

Box 8.2. **The Wind Secretariat: Spatial planning and wind energy deployment**

The Wind Secretariat's work is part of a larger national framework supporting wind power deployment. It was created in 2008 following the introduction of higher public subsidies to RE to relaunch onshore wind installations. The national policy aims to install 1 300 MW of onshore and 500 MW of offshore turbines by 2020. This would add to the 4 500 turbines that are already in place. The challenge is to deploy new wind turbines in densely populated areas, optimising the cost of installations (wind resource and distance from the grid) without impinging upon landscape amenities, in order to retain a reasonable level of social acceptance among local communities.

The Wind Secretariat is playing an important role in this. Several installations have been in place for more than 30 years. It is possible to upgrade the current stock by reducing the overall number of turbines, as the new ones are much more efficient than the old ones. A Geographic information system (GIS)-based software for planning implemented by the Wind Secretariat will facilitate this task and optimise the use of land.

Source: Danish Ministry of Environment.

Regional and local levels

Regional and local bodies play an important role within Region Zealand's RE policy**.** In Denmark, a structural reform in 2007 substantially changed how regional development was governed. Five new regions and six Regional Growth Forums were created. The regions are responsible for preparing Regional Development Plans, while the Growth Forums aid in the design and implementation of policies for regional business development (Nordregio, 2010). Municipalities are also directly involved in RE deployment and development through their participation in the Covenant of Mayors. All 17 municipalities in Region Zealand participate in the Covenant of Mayors, which means that they are committed to going beyond EU targets for the reduction of CO_2 emissions. Municipalities are also involved in the management of testing facilities and provide developers with tailored services. Since 1998, they have been responsible for the spatial planning and siting of wind turbines.

Region Zealand has designed a regional development strategy which gives RE a pivotal role. The strategy supports the creation of new small and medium enterprises (SMEs) in RE sectors. It also aims to attract RE companies to the region, capitalising on access to EU seed money and existing regional RE development networks. As the regional government only has an advisory capacity and a limited budget of EUR 2 million per year, the strategy has to be implemented in close collaboration with other institutions active within Region Zealand, including municipalities, research institutions and the business community.

The implementation of the regional strategy is governed by the Growth Forum for Region Zealand (GF). The GF functions as a platform for regional development, and has become the most important regional body launching policy measures related to innovation and business development in Denmark. It brings together public authorities, research institutions, NGOs, and private businesses with the goal of identifying development opportunities for the regional economy. Its annual budget is approximately EUR 20 million, coming from EU funds, the administrative

regional budget and the private sector. The GF is part of the regional government and the regional development programme provides the main framework for its discussion. Within this framework, the GF prioritises investment and use of EU funds. Since its creation, the GF has supported RE technologies through several initiatives. The most relevant is the Energy Cluster Region Zealand, whose aim is to integrate the public sector, research bodies and private business within a single network. The GF benchmarks its policy initiatives with the Copenhagen Clean-tech Cluster (CCC), which is also a partner in some local initiatives. The GF has invested more than 30 million in 40 different projects since 2007.

Assessment of policy impacts on rural development

Stimulating local economies

A territorial approach to RE has created development opportunities in Region Zealand. The region initially attracted a large number of wind installations through its wind resource, which – although relatively modest compared to other regions internationally – is among the best in Denmark. Local inhabitants benefited from public subsidies (upfront capital and FITs), which buffered the decline of other regional activities, particularly farming and manufacturing. Although the current results of RE are deployment are promising, RE has not dramatically affected Region Zealand's economic performance, which is still dealing with low productivity and increasing unemployment (although the overall rate is still relatively low). The activities related to RE have not yet replaced the jobs that were lost during the shipbuilding and agricultural crisis. Although Vestas created 300 jobs in its Lolland plant, these were then lost when it abandoned the region in the 2000s following international competition and an aggressive company internationalisation strategy. However, as in other case studies assessed by this research, the development of RE sectors has served to shift a local community facing a structural economic downturn to a new lower economic equilibrium, in which there are fewer jobs and probably fewer rural dwellers.

Stimulating innovation

This regional case study demonstrates the importance of bottom-up initiatives for linking RE deployment to regional development. The region has been able to go beyond the mere deployment of installations and has put RE at the centre of an ambitious, yet realistic, development strategy. Learning from the Vestas experience, Region Zealand has redefined its competitive advantage to focus on providing testing facilities, specific skills and a supportive local population for its highly innovative RE research and development activities. Implementing this new strategy has required the direct involvement of local institutions and the business community. For instance, municipalities in Lolland chose to create local utilities and use their land resources to build testing facilities instead of attracting new RE installations and risking public opposition. This system has been improved by the regional GF, which has invested in creating denser networks of public and private actors. Region Zealand has also benefited from the "proximity" between local and central government and the short government "chain of command" that characterises Denmark. Although Lolland CTF is a regional initiative, it benefits from central government support. Mayors and institutions involved in the project have relatively easy access to key central government people and even ministries.

This is considered to be a key condition according to a local stakeholder met by the OECD delegation.

Main challenges

In both Region Zealand and Denmark as a whole, RE sectors are still dependent on public subsidies. Although evaluating the performance of RE in terms of energy and overall economic efficiency goes beyond the scope of this study, it is interesting to note that even in Region Zealand, RE would not be a viable alternative to conventional fuels without large public incentives. Denmark is the world leader in wind energy, but has to deal with very high energy costs and has not yet found a solution to the intermittency issue. This is equally true for Region Zealand, which has failed to attract energy-intensive manufacturing because of the unreliable nature of its renewable energy supplies.

Notes

1. The Regional Employment and Competitiveness objective aims to strengthen regional competitiveness and attractiveness and promote job creation. Four priorities have been identified: increasing the adaptability of workers and enterprises; enhancing access to employment and increasing participation in the labour market; reinforcing social inclusion and combating discrimination; and mobilising reforms in the fields of employment and inclusion. It is financed by the two EU structural funds: the European Regional Development Fund and the European Social Fund.

2. Zealand's average wind speed is 6 metres per second (m/s), with some peaks on the coast in the southern part of Lolland Island, where average annual speed reaches 8 m/s (Danish Wind Industry Association, 2012).

3. Europe 2020 is the EU's growth strategy for the next decade. It aims to turn the EU into a smart, sustainable and inclusive economy. These three priorities seek to help the EU and the Member States deliver high levels of employment, productivity and social cohesion. (European Commission, 2012)

4. District heating systems servicing local communities and run by municipally-owned utilities have contributed to the energy sector's development. Such district heating systems have been assessed across the Nordic countries. In Denmark, although they contribute to the efficiency of the energy system, they are more dependent on imported biomass, as the country does not have the large endowment of biomass (forest) that characterises Sweden or Finland. (Department of Energy and Climate Change, 2012)

5. The strategy strengthens existing policies in energy efficiency, renewable energy and other key sectors up to 2020. The strategy builds on the financial analysis carried out by the Climate Commission and acknowledges that the transition to fossil fuel independence will require investment, which may result in lower fuel costs in the long term but will often be more expensive than currently available fossil-fuel alternatives in the short term. In the transport sector, the strategy acknowledges that Denmark is dependent on international technological developments and therefore has to temper its ambitions at least in the medium term (IEA, 2011).

6. The government has announced a reduction in subsidies to future land-based wind turbines as their cost is expected to fall further, but subsidies to offshore turbines will be increased. The government also plans to review the energy tax and subsidy systems to raise incentives for switching from fossil fuels to RE in non-EU-ETS (Emissions Trading Scheme) sectors (OECD, 2012).

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Chapter 9

North Karelia, Finland

Rural development and renewable energy (RE) in North Karelia: Summary and conclusions

Main findings. *i*) It is possible to harmonise the drivers underpinning RE, especially when RE is part of a long-term development strategy linked to a key regional industry (forestry), includes a large part of the local community and involves a large number of small installations with limited impact on land use and landscape. *ii*) In remote regions, RE can be an efficient alternative to conventional fuels provided that production costs are properly managed. *iii*) Regional research bodies should focus on innovations that have an immediate or evident advantage for businesses. *iv*) Biomass is the RE sector that offers the most development opportunities in rural areas.

Renewable energy in North Karelia: A summary. North Karelia (NK) is a forerunner in the field of sustainable energy, which accounts for 63% of total regional energy use. This is much higher than the Finnish national average (28.5%), and that of the EU (less than 9%). Although the region is home to a large hydro installation (producing 900 GWh per year), wood-based energy accounts for 82% of renewable energy use. Being a remote region with extremely cold winters, NK requires a lot of heating, but energy is expensive to import. In these conditions, the region's vast wood reserves offer clear potential for fuel wood. In these circumstances, biomass-based RE can compete with conventional sources of energy in terms of both cost and efficiency. The use of wood chips for heating in NK has dramatically increased, from less than 100 000 m^3 in 2000 to almost 600 000 in 2010. Biomass is used in small and large district heating systems in towns. Some of the small district heating systems belong to forest owners, which reduces operating costs.

How is RE contributing to rural development? RE deployment has created effective development opportunities for local businesses while contributing to energy security, climate change mitigation and reduced heating costs. The large demand for biomass energy has benefited local business. Between 2004 and 2008, turnover and employment in the renewable energy sector grew by about 30%, which had a turnover of about EUR 200 million in 2010, and there are now 120 companies specialised in bioenergy. The sector is also improving the competitiveness of the region's huge forestry industry. Good sylvicultural practices require forest thinning – giving this thinned wood a market value encourages forest owners to manage their stands well. Thus, the production of woody biomass is highly complementary with producing high-value lumber. RE deployment involves a multitude of regional actors. There are 22 000 non-industrial forest owners in the region and many of them produce woody biomass. The co-operatives who dominate the forest industry play a key role in RE deployment, providing small forest owners with information on the most profitable way to collect and put biomass on the market, and reducing transaction costs and facilitating collective action. Some of these co-operatives have entered the business of district heating systems to take advantage of the woody biomass they produce. Regional district heating systems are often based on small-scale installations with a limited impact on the environment and landscape. This improves social acceptance in a region where landscape amenities are increasingly linked to a successful tourism industry. Furthermore, the technology they use is in line with the skills available in the region, which can easily absorb investment in this sector.

Future challenges. It is important to verify that policy frameworks imposed by other government levels do not undermine the success of biomass energy in NK. For example, the EU's renewable energy policy does not fully consider the specific circumstances of northern peripheral regions and is designed for more accessible regions closer to the grid (i.e. urban hubs). This policy approach tends to favour large scale installations operated by a relatively low number of developers. This is unlikely to be optimal for NK, where high subsidies triggered by EU policies are creating an incentive to adopt wind power. Wind installations, especially on a large scale, could reduce the public's currently strong support for RE. Although diversifying the RE portfolio is not a bad thing, policies should ensure that these alternative technologies do not undermine the success of woody biomass.

The context

North Karelia's socio-economic profile and performance

North Karelia (NK) is Finland's easternmost region and shares around a 296 km frontier with Russia. It is a predominantly rural region dominated by one main urban centre, Joensuu. NK has a population of 165 941 (2009) and an area of 21 585 km^2; its average population density is 7.7 inhabitants per square kilometre (Table 9.1). NK has about 2 200 lakes, of which Pielinen is Finland's sixth largest. The region includes 14 municipalities, five of which are towns. Joensuu is the administrative and economic capital of the region, providing specialised services to local industries, and also acting as a regional gateway. The regional population has been declining slowly; the death rate exceeds the birth rate, and there has been negative net migration for most of the past decade. However, in 2009 in-migration slightly exceeded outmigration, which is encouraging. As with other rural regions in Europe, the decline in birth rates means an increasing elderly dependency ratio. This is slightly higher for NK than for Finland as a whole.

Table 9.1. **North Karelia: Demographic data**

2008 data unless otherwise indicated

	Ita-Suomi *	Finland
Population	657 257	5 300 484
Population share (%)	12.40	
Population density (in/km^2)	8	16
Elderly dependency ratio (%)	30	26

Note: * Data displayed in this table refer to the Eastern Finland (Itä-Suomi) region, which is a TL2 according to the OECD regional typology, *www.oecd.org/document/62/0,3746,en_2649_34413_36878718_1_1_1_1,00.html.*

Source: OECD Regional Database.

NK's GDP per capita is 73% of the Finland national average (Table 9.2). However, over the last decade NK has increased its share of workers with tertiary education and improved its GDP performance. The working age population is more likely to achieve tertiary education than in the rest of the country, but unemployment rate is 4 percentage points above the national average. The employment rate is also lower than the national average. For these reasons, NK is a priority area for EU Structural Funds support – meeting the criteria to qualify for the EU's Regional Competiveness and Employment Objective – as well as for national funding.[1] The regional economy has been quite dynamic over the past decade, with strong growth in the leading mining, forestry, services and manufacturing sectors. However, with the main exception of mining and services, employment has declined even where there has been significant GDP growth.

Table 9.2. **North Karelia: Main economic indicators**

2008 data unless otherwise indicated

	Ita-Suomi*	Finland	OECD average (%)
GDP per capita USD PPP (2007)	23 579	31 336	96
GDP share USD PPP (% - 1995)	9.38		
Productivity USD PPP (2007)	57 855	64 833	106
Unemployment rate (%)	9	6.2	2.7
Employment rate (%)	63.9	72.5	-2.7
Long-term unemployment (%)	1.85	1.1	-0.5
Youth unemployment (%)	21.64	16.9	6.3
Infrastructure (motorway density - total motorway kilometres in a region relative to its population)	0.06	0.14	
Tertiary attainment (%)	48.3	38.1	
Patents per million inhabitants (2007)	71.1	203.7	

Note: * Data displayed in this table refer to the Eastern Finland (Itä-Suomi) region.

Source: OECD Regional Database, *http://dotstat/wbos/*.

NK's economy is dominated by forestry and its supply chain. Other important industries include food, plastic, metal, stone, manufacturing, mining, advanced services and tourism. Developing industries include film and gaming – the region is internationally known for its film production. North Karelia is home to a large forest that covers almost 90% of the territory. Moreover, the end of the Cold War allowed NK to take advantage of the forest resources over the Russian border. Local specialisation is so intense that NK is known as Europe's forest region and trees can be considered as a crop. The largest part of the forest resource is privately owned. Forestry is connected with important upstream and downstream activities. For instance, the region specialises in timber construction, and Eastern Finland produces most of the forest machines sold in Europe. *John Deere*, the world leader in forestry machinery, has its largest European plant in the NK region. Ponsse, a local company situated close to North Karelia, is another important forestry machinery producer. The forestry industry in NK also specialises in pulp (Enocell Mill, for instance, produces 500 000 tons of bleached softwood pulp per year) and biomass (the local champion in this field is Stora Enso Oyj, which employs 920 people in the region). Several successful companies such as *Kesla Oyj* (harvesting, transporting, chipping etc), *Pentin Paja Oy* (harvesting machines), *Konepaja Antti Ranta Oy* (specialist trailers) and *Outokummun Metalli* (harvesting equipment) are based in NK.[2] There are also firms specialised in the processing and use of ash collected from wood-fired power plants (e.g. FA Forest Ltd.). Finally, expertise in forest measurement and all other aspects of forest development is also concentrated in NK; several local companies export this expertise to other countries. The region is involved in several export promotion activities for forestry and bioenergy machinery, equipment and consultancy.

The presence of a large, managed, forest resource and various wood-based sectors has encouraged the specialisation of the regional economy into activities related to the use of woody biomass for energy. The regional council estimates that at least 120 companies are concentrated in the "bioenergy and renewable energy" sector, which had a turnover of about EUR 200 million in 2010. Between 2004

and 2010, turnover and employment in the RE sector (mostly woody biomass) grew by about 130% (turnover) and 60% (employment). Direct employment in this bioenergy cluster is about 1 300 man-years, and the regional multiplier for employment in the forest supply chain is estimated at 2.3.

The regional specialisation in the forest industry is symbiotically linked to a dense regional innovation network. Few OECD regions display such a clear link among local natural resource, business community, and research bodies. This represents a perfect framework within which to promote technological innovation in forestry. The regional research system is currently working in areas which could have a dramatic impact on RE: liquid fuel from pyrolysis (heating biomass in the absence of oxygen); diesel oil from cellulose; ethanol from cellulose; optimal logistics for biomass flows; measurement of forest resources using lasers; and transport and logistics equipment. Research is conducted by a series of bodies and organisations with headquarters in NK, which work well with the Regional Council and are closely involved with trans-European and Nordic collaboration projects. For example:

- The European Forest Institute (EFI) is a Joensuu-based international organisation producing information about European forests and forestry for policy makers in EFI member countries and the EU, although it does not belong to the EU's system of agencies. A total of 23 European states have signed the EFI convention, which created the organisation. In addition, EFI has 125 member organisations from 37 countries. EFI's vision is to be the leading institution conducting and advocating for forest research and facilitating forest research networking across Europe. It has a primary focus on the environment, particularly on climate change. EFI has recently started to assess renewable energy and produced a report on forest use for bioenergy in North Karelia (Northern Tosia, 2009). The aim was to test the development of biomass in a scenario where the use of bioenergy triples in volume at the global scale. This scenario would give Finland an opportunity for specialising in the new industry and would attract firms. It found that improved use of biomass would have large impacts on the labour market and positive effects in the region due to the reduced imports of fossil fuels.
- The Finnish Forest Research Institute (METLA) is a government research institute founded in 1917 under the Ministry of Agriculture and Forestry. It is the main forest research institution in Finland and one of the biggest in Europe, with a network of research units covering the entire country. METLA's duties are defined by statute to "promote, through research, the economical, ecological, and socially sustainable management and use of forests". METLA is currently working to create a GIS database to quantify and monitor the forest resource in both Finland and Europe. It is also exploring the risks associated with biomass use and storage. For example, storing biomass in the forest can alter biodiversity (piled wood can attract and concentrate insects) as well as soil fertility.
- The School of Forest Science is part of the University of Eastern Finland. It is active in several research projects, including health, environment, energy, and social issues. For example, one project is researching how to produce ethanol from wood (cellulose). Under the "sociology of bioenergy" research, the school aims to add a societal dimension in forestry. One example is a new project on the "good governance of the bioenergy sector in societies". This is showing that there is a misconception about biomass which may have an impact on its future

popularity among citizens. For example, many Finnish young people think that solar is more important than biomass in mitigating GHG emissions. The School of Forest Science has a PhD programme in bioenergy that attracts students from India, China and other important economies.

- The North Karelia University of Applied Sciences (NKUAS) is the easternmost university of applied sciences in Finland, and in the EU. Founded in 1992, it is an independent utility maintained by the City of Joensuu. The Centre for Natural Resources is one of the five multisectorial and interdisciplinary centres at NKUAS. Its mission is to promote development, business and entrepreneurship based on the sustainable use of natural resources and the bioeconomy. The centre offers education in three Bachelor-level programmes (rural industries, environmental technology, forestry) and in one Master's-level programme (environmental technology). The centre's research and development (R&D) activities are implemented through wide national and international networks and partnerships (universities, research institutions, advisory organisations, and SMEs). The goals are comprehensive development of knowledge and research to support regional entrepreneurship, and to provide skilful personnel. R&D activities are currently focused on developing decentralised energy, especially the small-scale use of biomass from forests, agriculture and municipal waste, explored a wide range of ongoing regional and international projects.

- The Joensuu-based National Forest Centre's main aim is to increase the use of biomass as a source of energy, especially ways to reduce the price of biomass and improve its energy efficiency. One focus is on improving logistics, since transporting logging residues (the most important generator of biomass) is very expensive. Transforming residues into woodchips is one improvement, but the competitiveness of woodchips depends on current subsidies for forest thinning. A radical solution to logistics and energy issues would be to liquefy the woody biomass.

North Karelia's energy resources

NK is a forerunner in the field of sustainable energy, especially wood energy. Renewable energy accounts for 63% of total energy use in NK, or about 6.55 TWh. This compares with 28.5% in Finland and less than 9% in the European Union. The region is home to a large hydroelectric installation, producing 900 GWh per year, yet wood-based energy alone accounts for 82% or some 5.4 TWh of total energy use in the region. The use of wood chips for heating in NK has dramatically increased over the last decade, from less than 100 000 m^3 in 2000 to almost 600 000 in 2010. The technical, economic and ecological potential of woodchips for the region has been calculated by the Finnish Forest Institute at 2 TWh a year.[3] This is linked to the good management of the natural resource. The annual forest growth (increment) is about 8.3 million m^3 and annual felling is currently between 4.2 and 5.4 million m^3. Wood used for energy is about 0.5 million m^3. This means that there is considerable potential to increase the biomass harvest from the forest both for board wood and for energy purposes, using thinning, off cuts, chipped branches, etc. There are also other potential sources of bio power available in the region from agriculture residues, animal manure, and sewage sludge.[4] Finally, due to the introduction of a favourable national wind power tariff for the

years 2011-2023, wind has become a potentially interesting resource. NK has set a target of producing 150 GWh a year from wind by 2020. Other potential sources are geothermal and solar energy (especially thermo solar).

Renewable energy policy in North Karelia: Objectives, opportunities and challenges

The policy drivers: Why is North Karelia implementing a renewable energy policy?

While environmental sustainability is an important driver, NK mostly deploys RE to deepen the forestry supply chain and improve energy security to reduce heating costs. NK is well known for its environmental assets. The region has been able to capitalise on its natural amenities by attracting a consistent volume of green tourists every year. This favours RE deployment. However, the economic driver is also very important. For instance, the intense specialisation in forest activities creates the perfect conditions – i.e. the presence of a consistent and reliable supply of biomass – to improve the use of RE. Businesses and research institutions have engaged in a common effort to enhance the connection between forestry and RE, and to increase the profitability of this new specialisation. Supply is not the only force at work; NK's households each spend on average around EUR 23 000 a year on oil for heating. To date, there are about 7 500 buildings in NK (about 10% of all buildings) heated mainly by fossil fuels, but the number is constantly decreasing. The local supply of biomass and the technology developed to use this feedstock – boilers and district heating systems – are proving to be effective in reducing heating costs to around EUR 16 000 a year per household. As a result, an increasing number of households are converting their boilers for biomass use, saving North Karelians EUR 2 million in primary energy costs. This money stays in the region, instead of being used to buy oil which comes outside the region. Moreover, NK is reducing its CO_2 emissions. According to the GHG inventory of NK, in 1990 emissions were 1.7 million tons of carbon dioxide (mT CO_2) equivalent in 1990, and 1.6 mT in 2007. At the same time, NK's annual average carbon footprint was much lower (9.6 CO_2 tons/person) than in Finland (14.6).

The policy framework for renewable energy in North Karelia's rural areas

The EU, national and regional policies all have an impact on NK, but the region has been able to adapt the various policy frameworks to its needs. This is common in EU regions, and has been observed several times during this research. NK, however, displays a specific capacity for adapting exogenous policies to its economic and environmental context. This may be explained by two characteristics of the local economy:

- Its specialisation in forestry, which is a sector that can be easily connected to climate change mitigation policies due to its important role in connection with carbon emissions.

- The presence of co-operatives that facilitate the implementation of interventions in RE deployment by reducing the transaction costs embedded in the use of biomass.

European policy

It was not until 2005 that a mandatory and comprehensive energy policy was adopted at the EU level. Before then, EU Member States pursued intergovernmental initiatives motivated initially by energy security in the 1970s and subsequently by environmental concerns in the 1990s. In 1997, in reaction to the Kyoto Protocol, the EU introduced non-mandatory targets for Member States for the RE share in total energy consumption. In 2006, the European Commission issued the Green Paper: A European Strategy for Sustainable, Competitive and Secure Energy. This asked Member States to implement a European energy policy built on three core objectives: *i*) sustainability – to actively combat climate change by promoting renewable energy sources and energy efficiency; *ii*) competitiveness – to improve the efficiency of the European energy grid by creating a truly competitive internal energy market; and *iii*) security of supply – to better co-ordinate the EU's supply of and demand for energy within an international context. In 2007 this was translated into mandatory shares of RE production for Member States in the form of the Renewable Energy Roadmap and further increased in 2009 in the EU's Directive on Electricity Production from Renewable Energy Sources (popularly known as the RES Directive). This set the overall mandatory goal of achieving 20% of RE in total energy consumption (10% of transport biofuels) by 2020, which has become part of the "Europe 2020" Strategy. This is implemented in Finland under the Finnish National Action Plan 2010, which has established a very ambitious target for 2020: 38% of energy will be produced by renewable sources, while energy efficiency will be improved by 20%.

EU programmes also promote RE sectors at the regional level. For instance, North Karelia is part of the EU INTERREG "CO2FREE project" which involves nine European regions acting together to promote and take action towards a world with less carbon emissions.[5] This interregional platform shares good practices in renewable energy, green ICT, ICT for energy efficiency, and sustainable transport.[6]

National policy

Finland has a multidimensional RE policy to secure energy supply at a competitive cost. The country has no domestic sources of oil or gas, so energy security is an important rationale for bio-energy development. Electricity supply based on local resources is a political priority because of weak local electricity grids. Finnish energy-intensive industries, including the very large forest sector, have been using combined heat and power (CHP) systems since the 1920s (Box 9.1). Therefore, RE policy started mainly as a regional and national development issue, which was also coherent with rural energy needs and the activities of the commercial forestry sector. Finally, the electricity market has been liberalised in Finland in accordance with EU policies, so energy policies are influenced by import prices and availability as well as relevant international agreements.

Box 9.1. **Evolution of renewable energy policy in Finland**

- Bioenergy produced by using wood residues has been used in the forest industry for combined heat and power (CHP) since the 1920s and 30s. The technology was adopted for district heating in the 1950s and 1960s and for commercial electricity production in the 1970s. Bioenergy was initially designed for industrial use, but it is increasingly used for municipal heating.
- Both, industrial use and municipal heating were anchored in public policies aimed to maintain a flexible and varied energy sector with an emphasis on increased self-reliance following the oil crisis of the 1970s.
- Since the 1970s, bioenergy production and CHP development have been closely linked with Districts Policy and have gained a great social and political legitimacy.
- In 1990, Finland became the first country to introduce a carbon tax, helping to support growth in the RE sector.
- Finnish RE policy became increasingly aligned with EU policy from the 1990s (Finland joined the EU in 1994).
- The Finnish National Action Plan 2010 was developed to implement the EU RES Directive, and sets ambitious RE targets for the nation (2009).

Source: Midttun, A., M.H. Gundersen and A.L. Koefoed (2003), "Greening of Nordic Electricity Industry: Policy Convergence and Diversity", The Norwegian School of Management BI, *Research Report* 6/2003, *http://web.bi.no/forskning/papers.nsf/0/1dd24cdf15fac796c1256e5c0033047e/$FILE/fr2003-06.pdf*.

Finland's energy policy is implemented through separately drawn-up energy policy documents, such as the Government's Energy Policy Programme and the objectives set in governmental negotiations. Alongside international commitments, special programmes like the 2008 National Climate and Energy Strategy and its supplementary programmes determine the lines to be followed. Within this framework, Finland promotes renewable energy through:

- Subsidies for investment and research projects in the field of sustainable energy generation.
- Premium feed-in tariffs for wind energy, biomass and biogas. The generators of these types of electricity sell it in the market and receive a variable bonus on top of the market price and equal to the difference between a target price and the market price.
- Reduced feed-in tariffs for hydropower, wind, biomass and biogas that fail to comply with the requirements of the premium feed-in tariff scheme.[7]

Finland also has subsidies that, although not specifically designed for RE, have affected its use. Biomass production is indirectly supported by national subsidies to improve forestry productivity. The Finnish government has a national grants scheme linked to building forest programmes, and the largest one is for bioenergy. This is a national grant offering a maximum of EUR 450 per ha, for up to 45 m^3 per ha. It should

be said that this grant poses some problems within the EU's competitions rules, although the EU seems to tolerate it. The grant targets small trees, scrub, etc. with no alternative uses and supports their removal from the forest for bioenergy. The grant is only for private forest owners; the rationale is to encourage small owners, often living in urban areas in the south of the country, to manage their forest land by thinning. Since it takes at least 50 years after planting before timber can be put on the market, the subsidy allows them to cash in part of the value of their asset in the medium term (after around 15 years) and also improves the quality of the final product.

National government has supported district heating systems to substitute fossil fuels with biomass. Finland's experience with district heating systems has been long and particularly relevant.[8] Finland was a pioneer in district heating, a system which pipes heat underground to houses, offices, public buildings and factories from a central furnace, typically run by a local authority or a co-operative. Originally, fossil fuels were used for district heating plants, but increasingly they use forestry biomass, as modern furnaces and equipment allow automatic stoking with wood pellets and chips. Boilers and pipelines are remotely controlled. Entrepreneurship in this area is increasing steadily; there are now about 500 district heating enterprises in Finland – a significant increase from about 30 plants in 1972. The use of forest biomass is environmentally sustainable (the ash is used to fertilise the forest), and also allows people to save money which would have been used to buy oil and other conventional fuels otherwise.

Finland's RE policy benefits from a tax on carbon dioxide introduced in 1990. The tax was introduced to reduce both the growth in energy consumption and harmful environmental impacts (Hiltunen, 2004). The carbon tax went through several iterations, but after the Nordic Energy Market opened in 1997 the rates were greatly increased and the CO_2 tax was transformed into a general tax on consumption of electricity rather than production (EEI, 2005). The electricity tax has different rates for industry and households. Households have to pay the full rate of about EUR 0.006/kWh, while industry and agricultural greenhouses pay about EUR 0.0025 (EEI, 2005). The tax is the same irrespective of the fuel used. There is a separate tax on heat generation, which is based solely on the carbon content of the fuel. It was introduced to compensate for the fact that exempting electricity-generating fuels from the carbon dioxide tax weakened the impact of economic environmental policy instruments (Hiltunen, 2004). Since January 2008, the rate has been EUR 20 per tonne of carbon dioxide produced; biofuel oil used in working machines or heating is exempt.[9] A lower electricity tax class for industry and a partial refund for energy-intensive industry are two additional measures aimed at ensuring the competitiveness of Finnish companies. Companies in the energy-intensive sector are refunded for electricity and fuel taxes exceeding 3.7% of its value added.

Regional and local policies

NK has its own strategy to help it become a fossil fuel-free region by 2030 and create business opportunities in the forestry supply chain (North Karelian Government, 2011a). The strategy is designed by the Regional Council (Box 9.2) and focuses on heat, electricity and transportation – the sectors in which the use of alternative energy is the lowest. The regional strategy aims at reducing dependence on oil and replacing it with RE (Table 9.3).

Box 9.2. **The North Karelia Regional Council**

The Regional Council is a federation of 14 municipalities and is responsible for energy policy. As in the other Nordic countries, Finland's intermediate governments have limited powers compared with the central level and the municipalities ("hourglass" governance). The Regional Council is a politically-guided body responsible for regional planning and general co-ordination of regional development programmes related to national and EU structural funds. The Regional Council has a pivotal role within NK: it co-operates with different administrative sectors, organisations, businesses and citizens. It also outlines regional development targets, key projects and measures through the regional planning system, consisting of the regional development plan, the regional strategic programme and the regional land use plan. The Regional Council is also in charge of international activities. The highest decision-making body in the regional administration is the Regional Council Assembly, which is elected by delegates from the member local municipalities. Executive functions are carried out by the Administrative Board, which is elected by the Assembly.

NK plans to host a large bio-refinery to produce liquid fuels from woody biomass. This would make it easier to export renewable energy at a larger scale by reducing transportation costs (which are relatively high for woodchips and pellets). The regional strategy considers manufacturing of heat, electricity, and transport fuels as a potential source of livelihoods in North Karelia. Forest-based products (especially woodchips, pellets, firewood, industrial by-products and biofuels), forest energy technology (machines and devices) and strong energy entrepreneurship could be the foundations for the ambitious targets of energy self-sufficiency and significant export of expertise and technology. The energy element is a key part of the forest biomass sector as a whole. The NK case illustrates how biomass can provide positive territorial and local benefits, a competitive energy source, and an engine for spin-off industries. Biomass is likely to have higher income and employment benefits than other energy sources where the main input is free (solar, wind, tidal) and/or where the benefits from these inputs are captured by external interests.

Table 9.3. **Biomass energy in North Karelia in 2008 and targets for 2020**

Biomass	Capacity (2008)	Target 2020	Use
Woodchips	554 GWh	2 000 GWh	Heat, power + fuel (2nd generation fuel)
Pellet	50 GWh	150 GWh	Heat, power
Firewood	350 GWh	400 GWh	Heat
Biogas	14 GWh	100 GWh	Heat, power + 25% for fuel
Industry by-products	1 305 GWh	1 500 GWh	Heat, power
Black liquor*	2 357 GWh	2 500 GWh	Heat, power

Note: * Black liquor is a recycled by-product formed during the pulping of wood in the paper-making industry. In this process, lignin in the wood is separated from cellulose. Black liquor is the combination of the lignin residue with water and the chemicals used for the extraction of the lignin. It is burned in a recovery boiler. The boiler produces steam and electricity and recovers the inorganic chemicals for recycling throughout the process (IEA, *www.iea.org/interenerstat_v2/meeting/products_final.pdf*).

Source: North Karelian Government (2011), *Climate and Energy Programme of North Karelia 2020*.

To implement its strategy, the Regional Council aims to capitalise on co-operatives of forest owners. NK, mirroring a national trend, is home to a large number of co-operatives (see Box 3 for an example). These co-operative organisations have a positive impact on social capital; they involve a large number of actors, produce common rules and build trust, thereby facilitating business interactions and reducing transaction costs. This is an important characteristic for allowing the region to take advantage of its biomass resources, providing the necessary organisation and co-ordination to collect biomass and organise its sustainable use at a reasonable cost.

Assessment of policy impacts on rural development

Stimulating local economies

This case study provides clear evidence that biomass has higher local income and employment benefits than other RE sources where the main input is free (e.g., solar, wind, tidal). It also demonstrates that it is possible to harmonise the key drivers underpinning RE deployment. RE deployment has created effective development opportunities for local businesses while contributing to energy security, climate change mitigation and reduced heating costs. The use of biomass is constantly increasing in NK: it was 70 000 cubic metres in 2000; 171 000 in 2005; and reached 561 000 in 2010. This large demand has also affected business. Between 2004 and 2008, turnover and employment in the renewable energy sector grew by about 30%, and there are now 120 companies specialised in bioenergy.

The key to success lies in the capacity of regional actors to organise the production of biomass at a very low marginal cost. NK represents an atypical example. The combination of cheap wood, very cold temperatures and high cost energy alternatives make the economics of RE and district heating systems particularly attractive. There are several other factors at play:

- The large number of people in NK that benefit from the use of biomass. The majority of the companies involved in the forestry sector are locally owned by co-operatives, private firms, individuals, and municipalities. For instance, there are 22 000 non-industrial forest owners and more than 5 000 people working in the forestry supply-chain. Thus, the profits and natural resource rents are largely recycled back into the local economy. A similar condition exists on the demand side of the market: biomass gives North Karelians the opportunity to reduce the cost of energy for heating. For forest owners there is an incentive to vertically integrate and use low value wood to produce high value heat. By owning district heating plants, the forest owners are able to capture revenue from the forest that might have been kept otherwise by a district heating plant owner.
- The co-operatives dominating the forestry industry are able to co-ordinate the actions of small producers, provide them with information and technical support to produce biomass at a reasonable cost, and, above all, reduce transaction costs by providing clear rules and operating in the name of a large number of members (Box 9.3). Other case study regions were not able to take advantage of their abundant biomass for RE because of the high costs involved in collecting, transporting and using it.
- The presence of a regional innovation system in which research institutions interact with businesses and provide them with cost-reducing technical solutions. These research bodies are working on innovations in the place and at the time it is needed, rather than on R&D that may have an impact on future RE developments. This does not

mean that their research objectives are small, but that they evolve in response to actual needs and with a clear focus on cost effectiveness.

- The forestry industry has strategic importance at the national level. Therefore, any subsidies to RE that negatively affect forest activities at the local level are immediately flagged by forest organisations and removed by policy makers.[10] This creates a sheltered environment for innovation (Lester and Piore, 2004).

Stimulating innovation

RE deployment is coherent with regional specialisation and is actually contributing to the competitiveness of the forestry industry. The region has a long track record of commercial and intellectual engagement with forestry and its upstream and downstream industries. This includes harvesting, forwarding and transportation machinery and equipment, wood fired stoves and boilers for heating, pulp and paper, and many related services. It is competitive in most of these products, having a leading export position in and beyond Europe. The business community, the regional government, the two local universities and two forest related research institutes work together on the development of forestry and related industries. And now RE is opening up more new business opportunities around the use of woody biomass.

The success of RE in NK depends also on capacity to engage in a learning process that can transform initial challenges into opportunities. Biomass use for RE was not an immediate success. It took time to penetrate the market and convince households to switch from oil to wood residues. For instance, low population density was an obstacle to the large-scale use of district heating systems, making a pipeline rather inefficient financially. However, the Eno Energy Co-operative (EEC) managed to solve this problem (Box 9.3).

Box 9.3. **A co-operative approach to problem solving**

The Eno Energy Cooperative was founded in 1999 with the aim of getting a better price for biomass produced by its members. It has 52 members (all forest owners), and a total forest area of 8 000 ha. To deal with low population densities, the co-operative focused on public buildings (usually close to each other), installing small boilers directly in the building. In a second stage, the co-operative built its own district heating system and installed its own woodchip boilers, collecting raw material within a 35 km radius of heating plants. These small networks can provide heat to nursing homes, schools, terraced houses, health centres etc. In a third stage, the co-operative agreed to provide heating through very short pipelines to single users. This was not very profitable but helped to improve market shares and the popularity of woody biomass among local households. Small boilers are fed with imported pellets because the co-operative does not yet have the volume to justify the pellet production. The total use of forest chips in 2010 was about 10 000 solid-m3. Today, EEC has 8 bio-boilers and a total capacity of 9.66 MW/h. The co-operative collects biomass to improve the quality of timber logs (by thinning, for instance), which remains the core business of members. The efficiency in the use of biomass is still improving. For instance, effective drying and preparing depends on the way in which the biomass is stored. Piles of branches should have a certain height (4-5 metres) and volume; they should also stay in the open air for a minimum of one year and a maximum of two. Co-operatives follow these basic rules to improve the performance of biomass in terms of energy production. Chipping and transporting is undertaken by self-employed operators. The evaluation of the biomass is done by experienced members; it would be too expensive to run efficiency tests on the entire production.

It is striking how well the public and private sectors are collaborating on an integrated strategy that incorporates all the dimensions of forest management and use. Where subsidies are in place, they appear to reinforce investment-oriented behaviour, rather than triggering rent-seeking behaviour.

Main challenges

The introduction of relatively high subsidies for wind energy could cause distortions in the region. Because Finland is a member of the EU, renewable energy policy operates at multiple levels. Local policy is both constrained and supported by EU and Finnish energy policy. Because EU renewable energy policy does not fully consider the specific circumstances of northern peripheral regions, it is unlikely to be optimal for NK. In particular, NK has no competitive advantage in any renewable sector other than biomass and is far from large potential markets for this production. Thus, RE in the region has largely focused on displacing imported energy, primarily heating fuel. But high subsidies for wind power, triggered by EU policies, are creating an incentive to adopt rent seeking behaviour, even though the market potential is limited. Incentives to this RE technology could cause distortions at the regional level for two main reasons. Firstly, the local wind resource is not remarkable, so installations will not operate at their full capacity. Secondly, the regional landscape is an important asset that supports a promising tourist industry. Wind installations, especially on a large scale, could reduce these assets and reduce the public's currently strong support for RE. Of course, deploying wind energy would diversify the local portfolio of RE technologies, but the policy should take into account how this sector interacts with others and with the rest of the regional economy.

Notes

1. This objective (formerly "Objective 2" in the previous EU programming period) covers all European regions that are not covered by the Convergence objective. With 16% of the EU's regional policy budget dedicated to this objective, its main aim is to create jobs by promoting competitiveness and making the concerned regions more attractive to businesses and investors. Possible projects include developing clean transport, supporting research centres, universities, small businesses and start-ups, providing training, and creating jobs. Funding is managed through either the ERDF or the ESF.

2. For instance, *Kesla Oyj* has 260 employees and a turnover of EUR 33.7 million (2010). The North Karelian *Anaika Wood Ltd Oy* is a successful producer of sawn and planed timber and glued and laminated wood for the building industry, and 95% of its products are exported. It has about 180 employees and a turnover of EUR 60 million. An innovative company called *Myzemes Ltd* specialises in environmental biotechnology, it is applying this technology to pulp waste to make new products.

3. In 2009, the use of woodchips for energy generated was 908 GWh in NK, and in 2008 forestry biomass contributed 954 GWh in the form of heat, power and second generation fuel, excluding industry by-products and black liquor (from pulp and paper manufacturing).

4. Dedicated biomass production from energy crops (annual area and production) – is about 4 000 hectares of cran-canary grasses and rye; municipal solid waste and organic wastes (locations and approximate tonnage) – Joensuu – 36 020 tonnes (2008) and the City of Outokumpu – 2 787 tonnes (2008); sewage sludge – 54 207 tonnes (2007) including centralised sewage sludge and households not included in the centralised sewage sludge system. Animal waste available for anaerobic digestion and animal manure – total availability is 978 800 m^3, but it does not seem to be used for energy at present.

5. INTERREG is designed to stimulate co-operation between Member States of the European Union at different levels. One of its main targets is to diminish the influence of national borders in favour of equal economic, social and cultural development of the whole territory of the European Union.

6. More information about this Interreg programme is available at *www.co2free-project.eu.*

7. Finland's feed-in tariff varies according to the technology. For instance, there is a subsidy of EUR 0.42/kWh for electricity producers who generate electricity using wind power, wood fuel or peat in a thermal power plant of less than 40 megavolt ampere (MVA); recycled fuels; biogas; wood chips; waste gas resulting from metallurgic processes or reaction heat resulting from chemical processes; or at a small hydroelectric power plant (less than 1 MVA). For electricity generated with wood chips, the subsidy is EUR 0.69/kWh, and for electricity produced with recycled fuels, EUR 0.25/kWh.

8. Midttun and Koefoed (2005) argue that Finnish bioenergy production and CHP development are closely integrated with district policy and "have, as such enjoyed great socio-political legitimacy". Further, the decentralised production base of CHP is also popular "as it alleviates the load on fairly weak local electricity grids".

9. For natural gas the rate is 50% lower, while the surcharge on peat is one quarter of the level that it would normally have under the tax code.

10. For example, the forest industry was concerned about the impact of incentives for thinning given to small forest owners. A large incentive would have encouraged the latter to sell their product as biomass logs, which could have been valuable for the other uses (timber, logs, pulp and paper production) putting them in competition with the industry. For this reason, the government limited the incentive and specified that trees with a diameter above 16 centimetres could not be thinned. This avoided any possible distortions to the core business of many Finnish rural regions.

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Chapter 10

Abruzzo, Italy

Rural development and renewable energy (RE) in Abruzzo: Summary and conclusions

Main findings. *i*) Taking aesthetic as well technical considerations into account when siting RE installations can help integrate them better into rural landscapes. *ii*) Linking RE deployment to tangible benefits for the hosting community, such as better public services, improves public support dramatically. *iii*) Without a framework of co-ordination to benefit from economies of scale, a large number of small initiatives do not necessarily have the same impact on the regional economy as fewer large-scale initiatives.

Renewable energy in Abruzzo: A summary. Rural Abruzzo has been particularly exposed to the international crisis due to its dependence on the public sector and external investment. Regional unemployment rates went from 5.3% in 2003 to approximately 9% in 2010 although some areas suffered more than others. The coast, with its large number of small businesses clustered in specialised industrial districts, has been relatively resilient. The rest of Abruzzo lies on the Apennine Chain and has much lower population densities. Large protected forest areas shape the landscape, business activities are relatively limited and local economies are much more dependent on public transfers and external investment in specific industrial sectors, both of which plummeted during the crisis. The situation was worsened by the earthquake that hit L'Aquila, the regional capital, in 2009. Although Abruzzo has not specialised in the energy sector, and regional emissions of CO_2 are in line with the national average, RE deployment has become a regional priority to take advantage of the large amount of public subsidies available for RE at the national and European level. These subsidies are directed to local communities to buffer the current lack of public resources and allow them to retain a good standard of public services, while also creating some job opportunities. Abruzzo's 305 municipalities are all subscribers to the Covenant of Mayors, the European network which aims to promote RE and energy efficiency initiatives at the municipal level.

How is RE contributing to rural development? The region's high degree of participation in the Covenant reflects the regional government's goal of an RE action plan in each municipality. An action plan allows municipalities to access European and national subsidies for RE deployment. As a result several municipalities have been able to deploy small-scale RE installations. This provides long-term revenue which can be reinvested to satisfy specific needs, such as refurbishing a local school or renovating senior residences. Because of the close involvement of local communities, and explicit regional rules to preserve the landscape, RE installations are usually scaled to fit the local landscape without causing a dramatic and sudden change. As a result, RE deployment has proceeded at a relatively slow (albeit constant) pace, reducing the "gold rush" dynamic observed in other case studies.

Future challenges. There are no specific controls over local projects to ensure they really do offset the consumption of conventional fuels and reduce CO_2 emissions. Subsidies have "institutionalised" rent-seeking behaviour for RE deployment; a number of small installations would make little sense without the current high level of public subsidies. If small deployments were co-ordinated by a regional strategy, this would create a large enough regional demand to stimulate entrepreneurship around the RE sector. This lack of co-ordination also reduces the possibility of the region taking advantage of its forests to produce woody biomass. Local communities alone cannot manage the high co-ordination costs required for this business. Finally, regional policy should be targeted on rural areas in the mountainous part of the region, which are suffering most from the reduction of central government funding. This would improve the link between RE deployment and local economies while also making the policy more efficient.

The context

Abruzzo's socio-economic profile and performance

Abruzzo is a predominately rural region in the middle of Italy, on the Adriatic coast. It covers 10 800 square kilometres and its population in 2010 was 1.3 million people; its population density is lower than the national average. Abruzzo has a very diverse landscape, ranging from coastal, where the bulk of the population and economic activities are located, to mountainous, where the regional capital L'Aquila is located. L'Aquila was seriously hit by an earthquake in 2009, which damaged the historical centre of the city and most of its socio-economic activities. Other regional urban centres are Pescara, Chieti, and Teramo.

Abruzzo's population is ageing faster than the national average (Table 10.1). The region's elderly dependency rate – the proportion of working-age population to those over working age – is already higher than the Italian average. A high rate can lead to problems, especially in finding resources for the health system and other public services, which are mainly financed by the working population.

Table 10.1. **Abruzzo: Demographic data**

2008 data unless otherwise indicated

	Abruzzo	Italy
Population	1 323 987	59 619 290
Population share	2.2%	
Population density (km^2)	117 in/km^2	198 in/km^2
Elderly dependency ratio	32%	31%

Source: *OECD Regional Database*, *http://dotstat/wbos/*.

In economic terms Abruzzo stands somewhere between the relatively affluent north of Italy and the impoverished south. For instance, while the region's gross domestic product (GDP) per head at current values in 2009 was 82% of the Italian average, it was 119.5% of that of the southern area (encompassing Puglia, Campania, Calabria and Sicily; Table 10.2). The region displays different local development patterns reflecting a combination of endogenous local development, and external investment from the centre. On the one hand, the coastal areas in the north of the region have been able to specialise in sectors in which Italy enjoys a global competitive advantage: the so called *made in Italy* brand.[1] Production is often organised in clusters of small and medium enterprises (SMEs). On the other hand, lagging territories, usually located in the mountainous area, have been supported by a national industrial policy which since the 1950s has been localising manufacturing activities in capital-intensive industries such as automotive, pharmaceuticals, and chemicals. This policy has been particularly successful in Abruzzo in attracting large firms to the region. More recently the region has also benefited from the European Union's Convergence policy, formerly Objective 2 (see Box 10.1 below).

Table 10.2. **Abruzzo: Main economic indicators**

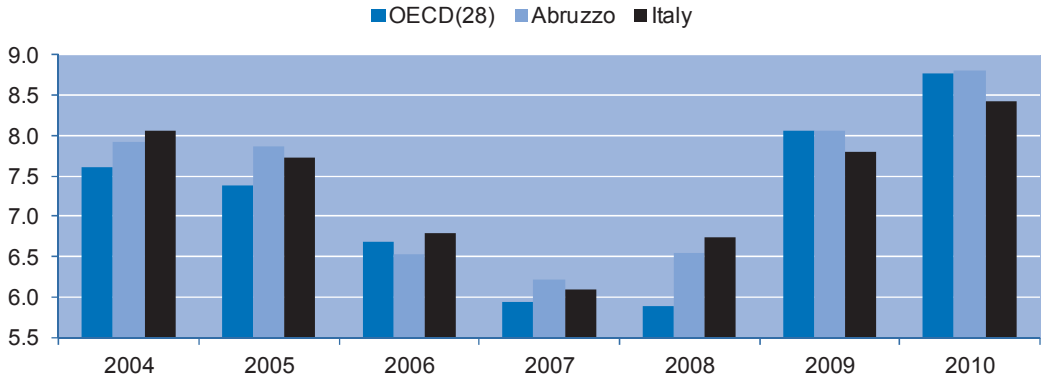
2008 data unless otherwise indicated

	Abruzzo	Italy	OECD gap
GDP per head in USD PPP (2007)	21 878.74	26 544.49	89%
Share of GDP (1995)	1.83%		
Productivity in USD PPP (2007)	57 382	64 783	105%
Unemployment rate	6.6%	6.9%	0.3%
Employment rate	59.7%	60.4%	-7.0%
Long-term unemployment	2.89%	3.2%	0.5%
Youth unemployment	19.61%	20.9%	4.3%
Infrastructure (motorway density) (2007)	0.27	0.11	
Tertiary education attainment (%)	19.7	17	
Patents per million inhabitants (2007)	31.9	46.1	

Source: OECD Regional Database, http://dotstat/wbos/.

Abruzzo is facing a challenging period in its economic history. GDP growth per head between 2000 and 2009 was 1.6%, lower than both the national average of 2.1% and the average for the south of Italy of 2.4%. Its regional unemployment rate has mirrored the national trend – it decreased until 2007, and subsequently increased until 2010 – but its performance has been worse than both Italy's and the OECD average (Figure 10.1).

Figure 10.1. **Unemployment rates in Abruzzo, compared with the average rate in Italy and in OECD regions**



Source: OECD Regional Database, http://dotstat/wbos.

The regional economy has a greater concentration of manufacturing than the national average. The manufacturing sector, which includes the construction industry, employed over 144 000 people in 2009, representing 40% of the workforce. Construction, in particular, employed almost 45 000 people (12.4% of the workforce). Textiles and clothing, as well as firms producing metal products and motor vehicles, each employed more than 4% of the workforce. There are also significant numbers employed in the food and plastic processing industries. Industrial infrastructure is spread throughout the region, but is concentrated in valleys close to the main urban poles: Val Pescara, Val Sangro,

Val Trigno, Val Vibrata and Conca del Fucino. Some of these areas host industrial districts (Box 10.1). In the service sector, commercial activities employ the largest share of workers, at 70 000 employees or 19% of the total. Business support activities, especially legal and technical services, employ 15%. Tourism is another important sector, contributing 12% of regional GDP in 2010.

Box 10.1. **Marshallian industrial districts**

An industrial district is "a socio-territorial entity which is characterised by the active presence of both a community of people and a group of firms in a naturally and historically bounded area" (Becattini, 1990). This community shares a system of values and common practices that spread into the district through the customs and the institutional structure, including markets, firms, professional schools, trade unions and employers' organisations.

In 1890, the economist Alfred Marshall documented the existence of a form of organisation of production based on the concentration of people and small- and medium-sized firms specialised in different parts of a production process in some districts of English industrial cities. In these "industrial districts", internal economies of scale were replaced by external economies related to the existence of skilled workers, specialised suppliers, and an informal system of knowledge diffusion.

The notion of the Marshallian industrial district was revived by Becattini (1975) to explain why the specialised local production systems of small and medium enterprises (SMEs) in the Italian region of Tuscany were so successful when the large firm production model of Turin and Milan was experiencing a serious crisis. Nowadays industrial districts are a widespread mode of production in many countries, and have become an instrument of analysis of economics and a focus of policy strategies.

Source: OECD (2009), *Rural Policy Reviews: Italy 2009*, OECD Publishing, Paris, *10.1787/9789264056237-en.*

The topography of the region represented an early obstacle to the exploitation of the land, but also preserved high-value landscape and natural resources – today, the region still has 230 000 ha of forest. Forests were put under special protection in 1922, when the first park area was created in Abruzzo. Since then, Abruzzo has become a place of parks, with 36% of regional territory under special protection. The regional topology and the special regime for forest areas have also influenced agriculture and the tourism industry. Intensive agriculture is limited to a few zones on the plains and has specialised in high-value sectors such as wine production, which has skyrocketed over the last decades. Agricultural production is organised in smallholdings which cover 660 000 ha overall. However, while the seaside areas are tourist destinations during summer, the mountainous area and the national and regional parks gain little advantage from tourism flows as relatively few tourists visit these areas. Nevertheless, the presence of many protected areas has probably encouraged the regional and local authorities to develop very specific skills in the protection of landscape amenities and biodiversity. This has also affected regional regulation, which is particularly strong on protecting natural resources. Such expertise and skills may create the basis for new economic opportunities in the future.

Although Abruzzo is home to world-class research facilities and several universities, they are weakly connected to the regional productive framework. For instance, the region is home to the *Laboratori Nazionali del Gran Sasso* (LNGS) which is a particle physics laboratory. The LNGS is situated beneath the Gran Sasso, the largest mountain in the

Apennine chain, between the towns of L'Aquila and Teramo. The underground facilities are located next to a freeway tunnel, the 10 km-long *Traforo del Gran Sasso*, which facilitates the logistics. The experimental chambers are buried beneath about 1.4 km of rock, protecting the experiments from cosmic rays. The LNGS was opened in the 1980s and since 2006 has been the world's largest underground particle physics laboratory. Abruzzo also hosts three main universities located in L'Aquila, Pescara and Teramo. It has been difficult to identify linkages among these research bodies, the manufacturing industry and the myriad of active SMEs in the region.

Abruzzo's energy resources

The region has a mix of conventional and renewable sources of energy, but none of them is particularly significant. Unlike most of the other case studies considered, Abruzzo has not specialised in the energy sector and regional production and consumption of energy is in line with the size of its population. Abruzzo has natural gas, producing approximately 22 million m^3 in 2005 (Regione Abruzzo, 2009). The local population, however, do not favour such developments, especially along the coast. Gas field development is also constrained by the large proportion of the region under protection. According to the Italian system operator, the region generated a total of 6 292 GWh of electricity out of a national total of 308 062 GWh, and consumed 6 344 GWh out of a national total of 309 884 GWh, in 2010. More than 60% of the region's electricity is produced in conventional power stations managed by national operators, although renewable energy sources contribute 2 400 GWh a year. The lion's share of this comes from large hydro-electric installations, due to the regional topography and the relative abundance of water. Together these generate more than 2 000 GWh. Other renewable sources are wind energy, which have an estimated potential of 532 GWh; and photovoltaic, whose potential is 40 GWh (Terna, 2010). In spite of the region's large forested area, woody biomass is not used to produce energy or heating. The region has not assessed the potential of biomass for the production of energy.

Renewable energy policy in Abruzzo: Objectives, opportunities and challenges

The policy drivers: Why is Abruzzo implementing a renewable energy policy?

Before the financial crisis, Abruzzo largely deployed renewable energy in response to national and European regulation. Although the region had pioneered wind energy in Italy in the 1980s, these early installations were mostly demonstration projects managed by the central government with little involvement of regional authorities and local investors. In the early part of the century, the region had a lower unemployment rate than Italy as a whole – 5.3% in 2003 – so there was little need to look for new investment opportunities. The situation changed when the financial crisis hit the regional economy in 2009/10, causing unemployment rates to increase to almost 9%, while reducing transfers from central government. The region started focusing on RE as a way to attract investment from the national government and the EU into local communities. This is especially true in the mountainous areas, which are historically more dependent on external investment and on the public sector in general.

Unlike other regions, Abruzzo's RE policy is not an industrial-style policy, aiming to create a supply chain in an RE sector, nor is it designed to mitigate local pollution. The main driver of the regional policy is to give small cash-strapped municipalities access to public subsidies for RE installations. This policy option is consistent with the lack of easily accessible alternative sources of energy (solar radiation and wind speed are not very high in the region) and with the intense protection of landscape amenities which characterises the region.

The policy framework for renewable energy in Abruzzo's rural areas

RE deployment in rural Abruzzo depends on a complex set of policies cutting across four tiers of government: the European Union (EU), national, regional and local government (Figure 10.2). The EU influences regional and local dynamics through its environmental and agricultural policies and its structural funds, particularly the European Fund for Regional Development (EFRD). Abruzzo is under the Regional Competitiveness and Employment objective of the EU (Box 10.2).

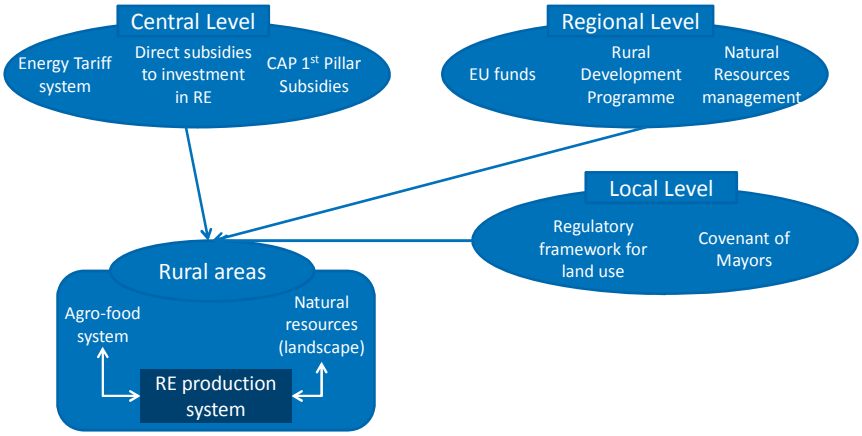
Box 10.2. **The EU's cohesion policy's competitive objective**

The Regional Competitiveness and Employment objective aims to strengthen regional competitiveness and attractiveness and promote job creation. Four priorities have been identified: increasing the adaptability of workers and enterprises; enhancing the access to employment and increasing participation in the labour market; reinforcing social inclusion and combating discrimination; and mobilising reforms in the fields of employment and inclusion. It is financed by the two EU structural funds. The EFRD and the national co-funding should funnel a total of EUR 47 million into the region between 2007 and 2013. The national government acts as an interface between regional governments and with the EU strategy and is also the key actor within the national energy policy, as it sets energy prices and defines the overall energy strategy.

Source: European Commission, Regional Policy – Inforegio, *http://ec.europa.eu/regional_policy/index_en.cfm*.

The regional government is responsible for implementing rural development policy, part of the so-called "second pillar" of the EU's Common Agricultural Policy (CAP). Finally, local governments – provinces and municipalities – have a particularly important role. As in other case studies, municipalities can influence RE deployment as they control land use and zoning (building permits and siting of installations). In Abruzzo, local governments also have a prominent role due to their participation in the "Covenant of Mayors", the mainstream European movement involving local and regional authorities in the fight against climate change (see below).

Figure 10.2. **Renewable energy policy framework in Abruzzo**



Source: Abruzzo Government (2011), response to OECD questionnaire.

European policy

It was not until 2005 that a mandatory and comprehensive energy policy was adopted at the EU level. Before then, EU Member States pursued intergovernmental initiatives motivated initially by energy security in the 1970s and subsequently by environmental concerns in the 1990s. In 1997, in reaction to the Kyoto Protocol, the EU introduced non-mandatory targets for the RE share of total energy consumption for Member States. In 2006, the European Commission issued the Green Paper: *A European Strategy for Sustainable, Competitive and Secure Energy*. This asked Member States to implement a European energy policy built on three core objectives: *i*) sustainability – to actively combat climate change by promoting renewable energy sources and energy efficiency; *ii*) competitiveness – to improve the efficiency of the European energy grid by creating a truly competitive internal energy market; and *iii*) security of supply – to better co-ordinate the EU's supply of and demand for energy within an international context. In 2007 this was translated into mandatory shares of RE production for Member States in the form of the Renewable Energy Roadmap; these were further increased in 2009 in the EU's *Directive on Electricity Production from Renewable Energy Sources* (popularly known as the RES Directive). This set the overall mandatory goal of achieving 20% of RE in total energy consumption (10% of transport biofuels) by 2020, which has become part of the "Europe 2020" Strategy. Italy's national target for renewable energy is set at 17% of its gross final energy consumption for 2020 (from 5.2% in 2005). In the new set of rules, the EU also highlights the potential of RE to reduce energy dependence and promote economic development, especially regional development.

The EU promotes a range of initiatives supporting RE deployment that directly involve local and regional governments. The EU Directorate-General for Energy has created a specific initiative, the Covenant of Mayors, to give value to the role of local governments within the EU 2020 strategy to mitigate climate change. The assumption is that local governments can affect citizens' behaviour through local regulation, and reconcile public and private interests by integrating sustainable energy issues into overall local development goals. The Covenant of Mayors is usually based on a voluntary

commitment by signatories to meet and exceed the EU's 20% CO_2 reduction objective through increased energy efficiency and the development of renewable energy sources. The network does not provide any actual financial resources, but it obliges municipalities to design an action plan for RE and energy efficiency. This makes it easier for them to get financing when bidding for EU funds supporting renewables. Abruzzo is very active in this network.

Besides local initiatives, the EU also promotes international/interregional co-operation in the field of RE. For instance, the EU is supporting a programme to deploy offshore wind in the Adriatic Basin. This project, called POWERED, is worth approximately EUR 4.5 million. POWERED aims to define a set of strategies and shared methods for developing offshore wind energy in all the countries overlooking the Adriatic Sea. Offshore wind power could allow a rapid increase of installations, by reducing the problems related to landscape that are frequently the main obstacles to the creation of wind farms in densely populated areas or those with a high historical or landscape value. It involves all the regional (and national) governments in this area, providing them with funds to assess the quality of the wind resource, the potential impact of wind installations, and the feasibility of deploying prototypes. Abruzzo is the co-ordinator of this international network.[2]

National policy

In Italy, national government has exclusive jurisdiction over environmental issues and shares responsibility for energy policy with regional governments. Moreover, the national government must implement EU directives aimed at improving environmental performance (such as its climate change mitigation strategy) and increasing RE consumption. It also co-funds the EU's Cohesion Policy and co-ordinates the "first pillar" of the CAP, which includes farm income support for several energy crops. Until 2010, the national government lacked an integrated approach to RE, supporting deployment merely to fulfil EU mandates rather than to implement a true paradigm shift in the national energy model. However, the situation has now changed since the instability in North Africa in 2011 – which affected countries supplying fossil fuels to Italy – and a national referendum that rejected nuclear energy development. In this new context, the national government has had to reconsider its strategic approach to renewables and has started promoting a true integration of RE within the national energy framework.

The national focus has been mainly on wind and solar power, while heating and cooling technologies have had less support. This bias is reflected in the wind energy trends. At the end of 2009, the country's wind generation capacity had increased almost 30% on the 2008 figure, to 4 850 MW. The regions which added the most new capacity were Sicily, Puglia and Calabria, followed by Campania and Sardinia. Some developments are also taking place in central and northern Italy, in regions such as Liguria, Piedmont, Veneto, Emilia Romagna and Tuscany.

Italy started offering concrete support to RE deployment in 1999 through the gradual liberalisation of the electricity market, which also split production, distribution, and transmission into different activities. The reform granted priority grid access to electricity produced by renewable means and introduced a quota system. Early incentives were designed to support large-scale wind installations: in 2004, Italy introduced tradable green certificates. In 2005, in response to an EU directive, Italy enacted a feed-in-tariff (FIT) system specifically designed to support photovoltaic (PV) installations. In some parts of Italy, particularly in the south, FITs have generated a speculative bubble in

PV installations that has made Italy one of the largest markets for PV in the OECD; the tariffs have since been modified (Box 10.3). In Abruzzo, PV installation has been limited due to the fact that, unlike other regions (see the Puglia case study) the region has not implemented any specific measures to facilitate or speed up the authorisation process, which has to go through several administrative steps starting with local governments that manage land use.

Box 10.3. **Feed-in tariffs and the PV "bubble"**

Since the biennium 2005-2006, in response to an EU directive, Italy has supported PV energy and other selected RE technologies with a premium feed-in tariff (FIT) scheme: *conto energia*. FITs originally supported both small off-grid PV installations of up to 20 kW, and larger grid-connected PV installations of up to 1 MW, providing operators investing in RE with a bonus on top of the market electricity price for a period of 20 years. Although Italy's FIT focuses on solar energy, other small-scale renewable energy power plants (<200 kW for wind power; 1 MW for other sources) can also choose FITs, which are available for 15 years. These are worth between EUR 180 and EUR 300 per MWh, depending on the fuel source (IEA, 2009). In theory, the premium paid to developers was to compensate for the cost of RE installations and the transaction costs arising from the lack of certainty around the authorisation process, which was managed by regional governments. The availability of FITs, especially in their early version, spurred explosive growth in PV installation (Gazheli and Di Corato, 2011). For instance, the number of PV installations in 2007 was 7 647 with an overall capacity of 87 MW, but by the end of 2010, the number of installations had reached 155 977, and the total capacity was 3 469 MW.

This speculative bubble raised the prospect of very large PV deployments generating huge long-term rents for investors and correspondingly high energy costs for consumers, who are the ones financing FIT. In response, FITs were fine tuned in 2008 in an effort to better reflect the marginal cost of RE and to reduce their impact on the overall cost of electricity. In 2011, the incentives were redesigned once again to control costs and better integrate RE deployment into the national energy framework. Italy has announced gradual reductions in FITs for PV installations with the intent of capping subsidies to developers by the end of 2016 (IEA, 2011). In the course of 2011, tariffs were reduced by between 8% and 10% for small plants and between 14% and 20% for large plants. However, an additional tariff bonus can be obtained where energy efficiency interventions are implemented, making it possible to obtain an increase of up to 30% of the original tariff. As of 1 January 2013 the FIT will only be granted to electricity injected into the grid. Specific, lower, incentives will be available for off-grid production of solar energy.

Sources: GSE; IEA (2009), *Country Profiles: Italy*, IEA, Paris; IEA (2011), *World Energy Outlook*, IEA, Paris; Gazheli, R., L. Di Corato (2011), "Land-use Change and Solar Energy Production: A Real Option Approach", *Working Papers*, Fondazione Eni Enrico Mattei.

Support for biomass comes through the CAP, managed by national government. The CAP has evolved from a programme which was merely supporting farm incomes to one aimed at shaping farm activities and it has now put a focus on the production of biomass for energy. The first pillar provides incentives to produce specific energy crops – perennial crops – with the aim of diversifying crops cultures and promoting the "commoditisation" of biomass. Italy has fallen behind with respect to EU targets and needs to make up ground in this area relatively quickly. To do so, in 2011, the central government has set ambitious objectives for the use of biomass to produce electricity, biogas, biofuels and heating and cooling. In particular, the national government aims to increase the use of biomass for energy production from 4 million metric tons in 2010 to 10 million metric tons in 2015. The national government will assign each region a specific and mandatory target to increase the production, collection and use of renewable

energy. However, such a sharp increase in biomass production could create problems for regions as many of them do not have policies, markets or production chains supporting biomass use. Part of the problem is that the incentives are designed to support single production units rather than the creation of integrated supply chains. This is particularly true in Abruzzo. Although its large forested area means it has large potential for biomass production, on the other hand it has no strategy in place to take advantage of this resource, nor the capacity to do so.

National RE policy cuts across several ministries, which adds complexity to the development of a coherent energy strategy. The main institutional actors involved are the Ministry of the Economy, the Ministry of Economic Development, the Ministry of Agriculture, Forestry and Food, and the Ministry of the Environment. The interaction among these institutional bodies is complex; in general, each ministry has implemented its own agenda, often influenced by specific constituencies or lobbies. This lack of a co-ordinated approach to RE at the centre has made the role of regional government particularly important.

Regional and local policy

At the regional level, several different policies support RE deployment. Regional levels have co-ordinated different policies and resources related to RE. Abruzzo, for instance, is responsible for managing funds related to CAP Pillar 2 and ERDF (within the Regional Competitiveness and Employment Objective – see Box 2), which are allocated through programming documents defined at the regional level. Abruzzo's regional government shares responsibility with the national government for energy policies.

The main feature of Abruzzo's RE policy is its "granularity": its main aim being to support a large number of small local initiatives. Based on the assumption that a large number of small installations can have the same impact of few large RE projects on the regional economy and on overall CO_2 emissions, Abruzzo's RE policy is based on small initiatives promoted by municipalities. Intermediate governments, such as the provinces, provide municipalities with technical support and funding to help them to deal with the complexity related to RE. For instance, the province of Pescara supports local governments by providing them with energy managers with the technical skills to design and implement local interventions.

European structural funds have been used to enhance the role of local governments within the RE policy. In 2010 the regional government decided to push all 305 of its municipalities into the Covenant of Mayors network (described earlier) and involve provincial governments (L'Aquila, Teramo, Chieti, and Pescara) and the Italian association of municipalities (ANCI) as co-ordinators. The provinces received EUR 300 000 from the regional government to support municipalities in preparing their Emission Balance Inventories (EIB) – to assess the carbon emissions at the local level – and Sustainable Energy Action Plans (SEAP) – to list possible interventions to improve energy efficiency. These action plans should facilitate the funding of local initiatives. For example, the regional government has allocated EUR 35 million from EDRF 2007-2013 to support the implementation of the Covenant of Mayors in the region. A share of these funds (approximately EUR 15 million) has been specifically allocated to support initiatives in small municipalities, with populations of up to 15 000. Within this policy framework, the remit of rural municipalities goes far beyond merely authorising schemes. Since 2009 the Covenant of Mayors framework has also been used for educational activities, through the *Energiochi* (playing with energy) initiative which encourages

schoolchildren to visit regional RE installations to learn about environmental sustainability and energy security.

Another feature of Abruzzo's RE policy is its focus on the protection of its landscape and natural assets. Abruzzo has developed a full set of regional rules ensuring the siting of RE installations not only takes into account their efficiency in terms of energy production, but also their impact on the landscape. The regional government has produced detailed guidelines that prevent protected areas from being able to host RE installations, in particular wind turbines. These policies have drastically reduced access to subsidies in scenic areas, even if they are not formally protected.

Assessment of policy impacts on rural development

Stimulating local economies

Abruzzo's focus on small installations means that small rural municipalities have been able to link RE to the delivery of key services and create new investment opportunities for local SMEs. For example, the municipality of Ancarano, a small rural town with a population of approximately 2 000, was able to place 360 square metres of PV panels on the roof of the old school; a project requiring an overall investment of EUR 250 000. The FIT received for the electricity produced was used to guarantee a loan to refurbish the school, benefitting 140 local children and allowing the community to keep its school, which was under threat from the national Ministry of Education's plan to rationalise the school system. In general, the large number of small interventions triggered by the Covenant of Mayors approach has created business opportunities for self-employed installers of renewable energy, although data on the overall employment impact are not available.

Abruzzo's bottom-up approach means local governments deploy small-scale installations with the support of the local community; citizens have a say in the siting and the sizing of the facilities (Box 10.4).

Box 10.4. **A gradual and participatory approach to building public support**

Tocco di Casauria is a town of 2 700 people in the mountainous part of the province of Pescara. The town was home to some early wind power demonstration projects in the 1980s. This experience showed the community the impact of wind energy on their day-to-day life, and also allowed the municipality to benefit from some extra funds deriving from the installation. At the end of the 1990s, two new turbines were installed with an overall installed capacity of 400 kW. In 2006 and 2009 more wind turbines were added, reaching a total installed capacity of 3.2 MW, based on wind turbines of 800 kW each. After the installation, the area was completely refurbished and trees that had been removed were replanted close to the wind turbines. As in other cases, the local community is now benefitting from public subsidies available for the production of RE, which has an impact on the local availability of public services such as schools and facilities for older people.

Tocco's experience demonstrates that it is possible to get a local community to support wind installations, provided that the intervention is done on a long-term basis (which allows locals to evaluate the impact and get used to the novelty) and without deploying large-size turbines which, although attracting more subsidies, could impinge upon other economic activities, such as tourism. RE is thus not considered "invasive" but rather as providing local communities with tangible advantages (better public services, in the case of Tocco) without compromising their basic values.

Main challenges

Abruzzo's decision to put local government on the front line of RE deployment has a number of drawbacks, as well as advantages. First, due to the absence of a guiding strategy, it is not clear who decides whether local projects actually make sense in terms of climate change mitigation and energy security. Second, public subsidies have become the only driver for RE deployment in the region. This is partly mitigated by the fact that benefits tend to be shared with local communities, but it triggers the same sort of rent-seeking behaviours that have been observed in regions promoting large-scale developments. Third, small deployments should be co-ordinated by a regional strategy to create enough regional demand to stimulate RE entrepreneurship. Without impinging upon the current system which allows municipalities to decide on the scale of installations, regional co-ordination could at least collect information about the overall demand for specific goods and services from the many local projects. Finally, wider co-ordination is certainly needed to take advantage of biomass as an energy source: this requires a number of different municipalities to work together. Because of strict regulations protecting forest areas, no single community could afford the cost of collecting biomass, considering the presence of an extended natural gas grid which already provide a cheap source of energy even to remote areas.[3] As a result, Abruzzo is not taking advantage of the most abundant and readily available renewable energy resource within its territory: the forest.

Abruzzo's RE policy also lacks a proper rural focus. While intended to support the communities suffering most from the reduction of public resources and external investment, the RE policy is implemented uniformly across the region. Though some resources are set aside for small communities, on its own this does not guarantee that mountainous rural municipalities have real access to public support. The policy could still misallocate resources by giving them to small municipalities which effectively belong to larger urban systems in the coast area. Introducing other conditions, such as the degree of rurality of local communities, could be a way to optimise the link between RE deployment and availability of public resources, as the policy intended.

Notes

1. This definition usually encompasses textiles, clothing and leather products. It can be also extended to machinery tools needed for the production of these items as well as to the agro-food industry, including wine.
2. For more see *www.powered-ipa.it/the-powered-project/*.
3. Italy has a very restrictive regime for activities within national parks; the economic activities that can be located within protected areas are very limited and biomass can only be harvested to protect the forest resource from fire and clean up roads.

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Chapter 11

Puglia, Italy

Rural development and renewable energy (RE) in Puglia: Summary and conclusions

Main findings. *i*) Puglia's government has been able to learn by doing. Regional policy has been fine-tuned several times to reduce any negative impacts on rural economies. *ii*) It is very hard for a regional policy to promote local supply chains in wind or PV energy in the face of international competition. *iii*) To harmonise the three drivers underpinning RE policy, the regional strategy should be designed to deal with a high degree of complexity and avoid attempts to find shortcuts (such as focusing on a single technology). *iv*) The potential to develop biomass supply chains remains untapped due to the large number of local actors involved (high transaction costs) and the level of co-ordination among different sectoral policies required.

Renewable energy in Puglia: A summary. Puglia is the leading region in Italy in renewable energy (RE) production. In 2011 its total installed capacity was 1.3 GW for wind, almost 1 GW for photovoltaic energy (PV) and 0.14 GW for biomass and waste energy. These are respectively 21%, 17% and 9% of the national totals. Puglia also has good potential for making renewable energy from agricultural residues. Since the early 1990s, the region has been a net exporter of electricity to the rest of the country and its regional labour market is well endowed with specific skills in energy production. Puglia's universities and national research centres also specialise in energy and the region has specific demonstration processes launched by the national government in the field of concentrated solar power (CSP).

The primary force driving deployment in Puglia has been the regional RE strategy. The regional RE strategy has evolved over time. Initially, it mainly implemented the national RE strategy. National incentives, which took the form of green certificates and tax credits, were most attractive for large-scale wind power, which Puglia promoted in the mountainous north of the region. When Italy introduced feed-in tariffs (FITs) for PV installations in 2007, Puglia took the opportunity to design its own regional renewable energy strategy (PEAR), which focused on linking RE deployment and economic development. In 2008 it radically simplified the authorisation process for RE projects. In 2010, however, the Supreme Court overturned this policy due to a conflict in competencies with the central government. At the same time, Italy changed its approach to RE to better integrate renewables within the national energy strategy. With the impact of large RE deployments on agricultural land and landscape amenities becoming increasingly apparent, policy was adjusted to improve the link among RE, existing regional industries and networks of SMEs, and agriculture. Its primary aim is now the construction of small biomass plants integrated within localised supply-chains.

How is RE contributing to rural development? RE deployment in rural Puglia has contributed to rural development, though not on the scale anticipated, and not without generating distortions in the rural economy. High national FITs and a large number of uncoordinated policies offering subsidies mean that developers, farmers and firms can receive multiple layers of support by designing a project that fits criteria for multiple subsidies; this can lead to large deadweight losses. Public subsidies have triggered speculation in the PV sector, which has displaced agricultural activities and affected the landscape. Subsidies – and the way they are structured – have also favoured the creation of independent, distributed energy suppliers that feed electricity into a grid that is poorly prepared to absorb it. Major grid management issues are already arising, and further RE deployment is seriously threatened by the lack of distribution infrastructure. Nevertheless, Puglia also offers a good example of how small-scale power projects can add to local employment. Although each project adds only a small number of jobs, there are multiple projects and in a rural area, even a modest increase in the number of jobs leads to a meaningful percentage increase in overall employment. Small-scale power also seems to offer more opportunities for employment in related industries, such as service providers and manufacturing, although these activities are often outside the scope of regional RE policies and are exposed to global competition.

Future challenges. A series of policy strategy improvements could positively affect RE deployment in Puglia and strengthen its links with rural development. Overall, adding RE as a new source of income and employment in rural areas should provide diversification benefits at the community level, not just at the firm level. The recent evolution of the regional RE strategy (including the regional plan for energy and the environment, PEAR), which focuses on small-scale production and local supply chains, would benefit from promoting collective action and co-operation among rural actors, rather than considering RE as a standalone industry within rural economies. For instance, Puglia has large potential for bioenergy from agricultural residues such as prunings from olive trees. Currently, this resource is not being used for energy production, mostly due to a lack of co-ordination among farmers. Puglia could capitalise on its experience in small-scale farming co-operatives to make the best of the available biomass.

The context

Puglia's socio-economic profile and performance

Puglia is a densely populated region with a complex mix of urban and rural landscapes. Located in the south-east of Italy, Puglia has a population of 4 million and a territory of approximately 19 000 km^2. Its average population density is 210 inhabitants per km^2 (Table 11.1), above both the national average and the threshold of 150 inhabitants per km^2 which the OECD uses to define rural areas. However, Puglia includes both densely populated areas – like the cities of Foggia, Bari, Brindisi, Taranto and Lecce – and a large number of small towns, mostly located on the fertile plains (the *Tavoliere delle Puglia*); as well as remote rural communities in the mountainous areas in the region's north and centre (*Appennino Dauno* and *Gargano*).

Table 11.1. **Puglia: Demographic data**

	Puglia	Italy
Population	4 076 546	59 619 290
Population share (%)	6.84	
Population density (inh./km^2)	210	189
Elderly dependency ratio (%)	27	31

Source: *OECD Regional Database*, *http://dotstat/wbos.*

Although Puglia's economy lags behind the Italian and EU averages, recent trends are encouraging. GDP per head is below the national average and unemployment rates are higher, especially for young people (Table 11.2). Under the EU's Cohesion Policy, Puglia is classified as an "Objective 1" or "convergence" region, meaning that its GDP per head is less than 75% of the EU average (Box 11.1). It has lower levels of infrastructure, human capital and innovation capacity than are typical for Italy or the OECD area as a whole (OECD, 2009*a*). The outmigration of educated young people has been an issue for a long time in this part of Italy and has increased over the last decade, particularly since the onset of the financial crisis in 2008. However, Puglia seems to be weathering the crisis better than most of Italy. For instance, regional employment increased by 1.9% in the first half of 2011 compared to a national increase of 0.4% (Puglia Government, 2011). This resilience is driven by an increase in service activities and self-employment. The latter increased by 6.8% in the first half of 2011 alone. Puglia has improved its capacity to tap into its regional assets – such as its landscape and culture – and a dense network of universities has improved its human capital. These factors may have had a positive impact on Puglia's industrial mix.

Box 11.1. **The cohesion policy of the European Union: Convergence objective**

The "convergence objective" is one of the three priority objectives of the EU's Cohesion Policy for 2007-2013. It closely mirrors former "Objective 1" funding. It aims to help the least developed Member States and regions to close the income gap with the EU average more rapidly by improving conditions for growth and employment.

The main fields of action are infrastructure (transport, environment, energy), employment (training), innovation (research and development), information and communication technologies and the efficiency of public administrations and public services. Funding comes from the European Regional Development Fund (ERDF), the European Social Fund (ESF) and the Cohesion Fund.

For the 2007-2013 programming period, the convergence objective covers: regions with *per capita* GDP below 75% of the EU average (Structural Funds); regions whose *per capita* GDP which has risen above 75% of the EU average due to EU enlargement; Member States with *per capita* gross national income which is less than 90% of the EU average (Cohesion Fund); and geographically peripheral regions (in order to compensate for excess costs due to their remote location).

Source: European Commission, Regional Policy – Inforegio, *http://ec.europa.eu/regional_policy/index_en.cfm*.

Table 11.2. **Puglia: Main economic indicators**

	Puglia	Italy	OECD gap
GDP *per capita* USD PPP	17 151	25 846	69%
GDP share USD PPP	69 860	1 576 087	
GDP per worker USD PPP	54 429	67 871	99%
Unemployment rate (%)	11.6	6.9	
Employment rate (%)	47.1	60.4	
Long-term unemployment (%)	5.88	3.2	
Youth unemployment (%)	31.58	20.9	
Infrastructure (motorway density)	0.08	0.11	150%
Tertiary education attainment (%)	16.5	17	57%
Patents per million inhabitants	13.8	46.1	

Source: *OECD Regional Database*.

Once a manufacturing powerhouse for the south of Italy, Puglia has specialised in tertiary activities over the past two decades. The service sector accounts for more than 30% of employment and more than 50% of regional firms (2009). In particular, trade has become more important. Puglia is Italy's gateway to the Eastern Mediterranean, with the port of Taranto playing an important role. The port is home to the remains of a large regional heavy industry area created by Italy's industrial policy between the 1950s and the early 1970s. Today, the area hosts only a small fraction of what used to be one of the key steel-producing areas in Italy. Another important industrial area is in the province of Brindisi which has mostly specialised in petrochemicals. These days the most important feature of Puglia's manufacturing is the role played by its small and medium enterprises (SMEs). The region is home to a large number of manufacturing SMEs specialised in medium- and low-tech sectors and organised into very dense and localised networks – so-called "Marshallian industrial districts" (see Box 10.2 in the Abruzzo case study). Puglia is the only region in the Italian Mezzogiorno where local agents have

successfully implemented the industrial district model. This allows its SMEs to be internationally competitive: Puglia-based industrial districts can compete at the global scale in food processing, footwear, textiles and clothing, and wood and furniture. Many of these clusters of firms are located in easily accessible rural areas close to large urban centres.

The region has strongly specialised in industries that make intensive use of the land, including the landscape. The *Tavoliere delle Puglia* is the second-largest plain in Italy and its fertile agricultural land has historically made Puglia an important farming region. Agriculture is highly productive in most of the region, which is one of the national champions in the production of vegetables, wine and olive oil. However, many other areas of Puglia have only limited access to water, constraining agricultural development. The region has no rivers and its agriculture relies on ground water, which represents an environmental issue. Farming has benefited from EU policies to support local food and the cultural heritage embedded in agricultural products. A large number of the region's crops and agricultural products enjoy EU certification as protected products. Production of oil and wine is often managed by cooperatives grouping small farms, which represent an important asset within the regional primary sector. Tourism is another regional specialisation that relies on the landscape. Over the last decade, the region has become a major tourist destination in the Mediterranean area, thanks to a good mix of cultural and natural amenities. Entrepreneurship and regional policies have also played an important role. Tourism is intertwined with farming, thanks in part to regional, national and EU policies aimed at promoting "agri-tourism" (OECD, 2009a).

Puglia is home to regional and national research and development centres which specialise in energy, such as Tecnopolis-CSATA near Bari, which was the first technological park created in Italy; the Centre for Research and New Materials (*Cittadella della ricerca*) linked to ENEA (the national agency for new technologies, energy and sustainable economic development) near Brindisi and the recently created DiTNE (National District for Energy Technologies). The region aims to consolidate scientific research and training with the objective of connecting research activities with the regional productive fabric. DiTNE, for instance, is working to promote a market for sustainable construction in the region and is a pillar of the region's energy conservation and energy efficiency strategy. Puglia is also home to demonstration projects implementing concentrated solar power (CSP) technology. Puglia's universities were created to support the region's specialisation in heavy industry and they continue to contribute to the pool of skilled labour in the field of energy and electricity production. For instance, the polytechnic in Bari has specific programmes for electric and electronic engineers.

Puglia energy resources

Puglia has specialised in producing electricity both from traditional and renewable sources. With a total production of 34 786 GWh and regional demand of only 17 394 GWh (2010), Puglia is a net exporter of electricity to the rest of the country. More than 90% of the electricity is produced in conventional power stations: Puglia does not have any hydroelectric installations due to its lack of rivers or lakes and nuclear power has been banned in Italy since 1986. Puglia, and in particular the province of Brindisi, is home to Italy's largest coal plants. One of them, the Federico II, has a total installed capacity of 2 640 MW. In spite of the presence of these large power plants, the region's energy sector suffers from distribution bottlenecks, with a regional grid density of 64 m/km^2 compared to a national average of 73. Italy manages its grid in a centralised

way. Transmission is controlled by TERNA, a quasi-public company, which operates as a monopoly nationwide. Improvements in the grid are limited and not supported by any national strategy.

The region's renewable energy resources are more abundant. In 2005, Puglia began specialising in the production of energy from renewable sources and now outperforms the other Italian regions in its installed RE capacity (Table 11.3). Solar radiation is above the national average in a large part of Puglia's territory. Overall, it has a yearly sun irradiation of approximately 1 679 KWh/m^2, which means that the region has a first class sun resource. Its wind resource is also good, although much more spatially sensitive than sunlight. In the north of Puglia there are areas where the wind speed averages 6-7 metres per second (m/s).

Wind farms are scattered around the region, particularly in the northern mountainous area in the province of Foggia. Installations almost doubled between 2008 and 2009, and the slowdown due to the financial crisis seems to be over. In 2011, the region had a capacity of 1 293 MW and more than 2 000 GWh of electricity was generated from wind in 2010. However, it is in photovoltaic (PV) energy that Puglia has raced ahead. As well as its good sun irradiance, Puglia's radical simplification of the authorisation process for installing PVs has magnified the impact of high national feed-in tariffs (FITs). Between 2009 and 2010 Puglia deployed approximately 470 MW of PV capacity, going from 215 to 683 MW. By 2010 it had the most installed photovoltaic capacity of any Italian region, with a total of more than 2 200 MW, generating 400 GWh of electricity.

Finally, the region's specialisation in agriculture could provide substantial residues for biomass that could be used as feedstock for the production of energy. According to the regional energy plan, Puglia has an overall potential of 24 867 terajoules (TJ) in dry biomass; and an overall potential of 964 TJ if one considers animal wastes (Pellerano, *et al.* 2007). However, despite of its potential, biomass is still marginal within the regional energy profile. The Regional Programme for Energy and Environment (PEAR) has a specific focus on the local supply chain for biomass production, but despite a few small installations since 2010, total capacity was still just 139 MW in 2011 (Table 11.3).

Table 11.3. **Installed renewable energy capacity in Puglia and Italy, 2011**

	Wind energy	PV	Hydro	Geothermal	Biomass and waste
Puglia (MW)	1 293.01	991.8	0	0	139
Italy (MW)	6 084.24	5 833.36	21 558.20	884.9	1 545.4
% of national capacity	21	17	-	-	9

Source: GSE (*Gestore Servici Energetici*) (2010), *Rapporto Statistico 2010: Impianti a fonti rinnovabli*, GSE, Italy.

Renewable energy policy in Puglia: Objectives, opportunities and challenges

The policy drivers: Why is Puglia implementing a renewable energy policy?

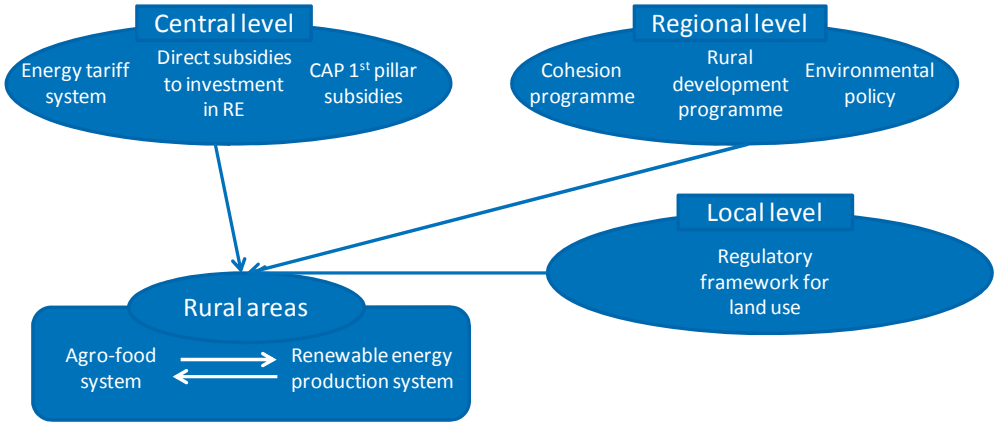
Puglia is deploying RE to lower CO_2 emissions and create development opportunities in a promising industry. The initial driver of the regional policy was the reduction of greenhouse gases. Pugila's CO_2 emissions are second only to Lombardy's, the most industrialised region in Italy, and reducing emissions has topped the regional government's agenda since 2005. Economic growth has been another goal. When

investment in RE deployment became intense at the end of 2007, the regional government tried to capitalise on the booming industry to create jobs and increase productivity.

The policy framework for renewable energy in Puglia's rural areas

RE deployment in rural Puglia depends on a complex set of policies cutting across four tiers of government: the European Union (EU), national, regional and local government (Figure 11.1). The EU influences regional and local dynamics through its environmental and agricultural policies, and its cohesion funds (Box 11.1). The national government acts as an interface between regional governments and EU strategy and also sets energy tariffs and defines the overall energy strategy. The regional government implements the EU cohesion policy and also has responsibility for implementing rural development policy, part of the so-called "second pillar" of the EU's Common Agricultural Policy (CAP). Puglia is the only Italian region that has developed a regional energy strategy, which it has been implementing since 2007 through the Regional Programme for Energy and Environment (PEAR). In 2008, the regional government created a fast-track approval system to simplify the authorisation process for RE installations. Finally, municipalities can also influence RE deployment, as they control land use and zoning (building permits and siting of installations).

Figure 11.1. **Renewable energy policy framework in Puglia**



Source: Puglia Government (2011), response to OECD questionnaire.

European policy

It was not until 2005 that a mandatory and comprehensive energy policy was adopted at the EU level. Before then, EU Member States pursued intergovernmental initiatives motivated initially by energy security in the 1970s and subsequently by environmental concerns in the 1990s. In 1997, in reaction to the Kyoto Protocol, the EU introduced non-mandatory targets for the RE share of total energy consumption for Member States. In 2006, the European Commission issued the Green Paper: *A European Strategy for Sustainable, Competitive and Secure Energy*. This asked Member States to implement a European energy policy built on three core objectives: *i*) sustainability – to actively combat climate change by promoting renewable energy sources and energy efficiency; *ii*) competitiveness – to improve the efficiency of the European energy grid by creating a truly competitive internal energy market; and *iii*) security of supply – to better co-ordinate the EU's supply of and demand for energy within an international context. In 2007 this

was translated into mandatory shares of RE production for Member States in the form of the Renewable Energy Roadmap; these were further increased in 2009 in the EU's *Directive on Electricity Production from Renewable Energy Sources* (popularly known as the RES Directive). This set the overall mandatory goal of achieving 20% of RE in total energy consumption (10% of transport biofuels) by 2020, which has become part of the "Europe 2020" Strategy. Italy's national target for renewable energy is set at 17% of its gross final energy consumption for 2020 (from 5.2% in 2005). In the new set of rules, the EU also highlights the potential of RE to reduce energy dependence and promote economic development, especially regional development.

The EU's cohesion policy and the CAP also support RE production. For instance, the cohesion policy has supported initiatives at the regional level through the European Regional Development Fund (ERDF) and the European Social Fund (ESF). The greater proportion of this investment has been allocated to regions within the "convergence objective", including Puglia. For instance, Puglia has received a total allocation from the ERDF of EUR 210 million to support solar energy, biomass and energy efficiency initiatives co-funded by the national government. The CAP is another source of funding for RE as it supports energy crops, particularly perennials. Its rural development policy can also be used to support demonstration projects and research and development (R&D).

National policy

In Italy, the central government has exclusive jurisdiction over environmental issues and shares responsibility for energy policy with regional governments. Moreover, the central government must implement EU directives aimed at improving environmental performance (such as its climate change mitigation strategy) and increasing the consumption of RE. National RE policy cuts across several ministries, which adds complexity to the development of a coherent energy strategy. The main institutional actors involved are the Ministry of the Economy, the Ministry of Economic Development, the Ministry of Agriculture, Forestry and Food, and the Ministry of the Environment. The interaction among these institutional bodies is complex; in general, each ministry has implemented its own agenda, often influenced by specific constituencies or lobbies. This lack of a co-ordinated approach to RE at the centre has made the role of regional government particularly important.

The central government also co-funds the Cohesion Policy and co-ordinates the "first pillar" of the CAP, which includes farm income support for several energy crops. Until 2010, the central government lacked an integrated approach to RE, supporting deployment merely to fulfil EU mandates rather than to implement a true paradigm shift in the national energy model. The situation has changed due to instability in North Africa in 2011, which affected countries supplying fossil fuels to Italy; and a national referendum that rejected nuclear energy development. In this new context, the national government has had to reconsider its strategic approach to renewables and has started promoting a true integration of RE within the national energy framework.

The national focus has been mainly on wind and solar power, while heating and cooling technologies have had less support. This bias is reflected in the wind energy trends. At the end of 2009, the country's wind generation capacity had increased almost 30% on the 2008 figure, to 4 850 MW. The regions which added the most new capacity were Sicily, Puglia and Calabria, followed by Campania and Sardinia. Some developments are also taking place in central and northern Italy, in regions such as Liguria, Piedmont, Veneto, Emilia Romagna and Tuscany.

Italy started offering concrete support to RE deployment in 1999 through the gradual liberalisation of the electricity market, which also split production, distribution, and transmission into different activities. The reform granted priority grid access to electricity produced by renewable means and introduced a quota system. Early incentives were designed to support large-scale wind installations: in 2004, Italy introduced tradable green certificates. In 2005, in response to an EU directive, Italy enacted a feed-in tariff (FIT) system specifically designed to support photovoltaic (PV) installations. Puglia's pioneering initiative to create a fast-track for PV authorisation, combined with the plummeting cost of PV panels, meant the FITs generated a speculative bubble in PV installations that has made Italy one of the largest markets for PV in the OECD (Solar Server, 2011). FIT incentives have since been modified to control costs and better integrate RE deployment in the national energy framework (Box 11.2).

Box 11.2. **Feed-in tariffs and the PV "bubble"**

Since the biennium 2005-2006, in response to an EU directive, Italy has supported PV energy and other selected RE technologies with a premium feed-in tariff (FIT) scheme: *conto energia*. FITs originally supported both small off-grid PV installations of up to 20 kW, and larger grid-connected PV installations of up to 1 MW, providing operators investing in RE with a bonus on top of the market electricity price for a period of 20 years. Although Italy's FIT focuses on solar energy, other small-scale renewable energy power plants (<200 kW for wind power; 1 MW for other sources) can also choose FITs, which are available for 15 years. These are worth between EUR 180 and EUR 300 per MWh, depending on the fuel source (IEA, 2009). In theory, the premium paid to developers was to compensate for the cost of RE installations and the transaction costs arising from the lack of certainty around the authorisation process, which was managed by regional governments. The availability of FITs, especially in their early version, spurred explosive growth in PV installation (Gazheli and Di Corato, 2011). For instance, the number of PV installations in 2007 was 7 647 with an overall capacity of 87 MW, but by the end of 2010, the number of installations had reached 155 977, and the total capacity was 3 469 MW.

This speculative bubble raised the prospect of very large PV deployments generating huge long-term rents for investors and correspondingly high energy costs for consumers. In response, FITs were fine tuned in 2008 in an effort to better reflect the marginal cost of RE and to reduce their impact on the overall cost of electricity. In 2011, the incentives were redesigned once again to control costs and better integrate RE deployment into the national energy framework. Italy has announced gradual reductions in FITs for PV installations with the intent of capping subsidies to developers by the end of 2016 (IEA, 2011). In the course of 2011, tariffs were reduced by between 8% and 10% for small plants and between 14% and 20% for large plants (IEA news). However, an additional tariff bonus can be obtained where energy efficiency interventions are implemented, making it possible to obtain an increase of up to 30% of the original tariff. As of 1 January 2013 the FIT will only be granted to electricity injected into the grid. Specific, lower, incentives will be available for off-grid production of solar energy.

Sources: GSE; IEA (2009), *Country Profiles: Italy*, IEA, Paris; IEA (2011), *World Energy Outlook*, IEA, Paris; Gazheli, R., L. Di Corato (2011), "Land-use Change and Solar Energy Production: A Real Option Approach", *Working Papers*, Fondazione Eni Enrico Mattei.

Support for biomass comes through the CAP, which is managed by the central government and regional government. The CAP has evolved from a programme which was merely supporting farm incomes to one aimed at shaping farm activities; it is now focusing on the production of biomass. The first pillar provides incentives to produce specific energy crops – perennial crops – with the aim of diversifying cropping and promoting the "commoditisation" of biomass. However, its incentives are still designed to support single production units rather than the creation of integrated supply chains. There are not instruments that can incentivise farmers to coordinate their action in producing or collecting biomass related to their primary activities. Italy has fallen behind EU targets for biomass production and needs to make up ground in this area relatively quickly. To do so, the central government has set ambitious objectives for the use of biomass to produce electricity, biogas, biofuels and heating and cooling, in 2011. In particular, the national government aims to increase the use of biomass for energy production from 4 million metric tons in 2010 to 10 million metric tons in 2015. The national government will assign each region a specific and mandatory target to increase the production, collection and use of biomass for the production of renewable energy. However, such a sharp increase in biomass production could create problems, as many regions do not have policies, markets or production chains supporting biomass use.

Regional and local policy

Puglia's regional government shares responsibility for energy with the central government. A number of different policies support RE deployment at the regional level. For instance, the regional government is responsible for implementing the EU Cohesion Policy and the second pillar of the CAP (rural development), both of which affect RE deployment at the regional level. One such project being implemented in Puglia is to promote RE production and energy efficiency in the Italian Mezzogiorno. This EUR 1.5 billion programme (the Interregional Operating Programme for Energy) aims to generate manufacturing supply chains linked to RE production. And he CAP's Rural Development Programme is financing the construction of small biomass digesters (up to 1 MW), which use agriculture residues or energy crops as feedstock. Specific support is devoted to training activities in collaboration with local universities.

To organise the various policy frameworks and take advantage of different RE sources, in 2007 the regional government enacted the Regional Environmental Energy Plan (PEAR, making Puglia the first region in Italy to take such an approach. This involved a detailed evaluation of the potential of different RE technologies in the region and set a series of general objectives for RE deployment, including objectives related to agriculture residues to be used as feedstock. While the PEAR lists all RE sectors that could be developed in Puglia, the focus has mostly been on wind energy and PV, particularly the latter. It set a list of specific targets for renewables: 400 MW of PV capacity and 4 000 MW of wind capacity to be installed by 2016. It is more complex to deploy RE technologies linked to the use of biomass, such as agriculture residues, due to the larger number of actors and intricate supply chains involved; yet the impact on rural development is likely to be larger. Concerning agriculture and biomass, the PEAR considered both the demand and supply side. On the demand side, the main issue is the reduction of farm production costs, although the plan does not specify any clear guidelines. On the supply side, the PEAR recommends the use of small- and medium-scale distributed facilities for biomass production, especially in agricultural areas, closely linked with local farm production.

The region's municipalities are involved in many decisions about the siting of RE plants. For example, they can give permission for wind farms based on the municipality's spatial plan. This plan, in turn, should follow regional criteria, which excludes protected areas, urban areas, high value landscape areas and so on and gives guidelines in term of plant density, territorial distribution, and availability of infrastructure such as roads and electricity networks.

Puglia's pioneering role in RE deployment should be recognised. While RE policy has been far from perfect in the region, the authorities have proved able to organise local resources to tap into innovative development opportunities. PEAR represents a good approach, involving a comprehensive assessment of regional RE potential leading to policy design. The regional RE strategy has evolved through a process of "learning by doing" in which the authorities are constantly trying to minimise distortions and maximise the benefits related to RE deployment. For example, when local communities expressed their opposition to large wind farms in mountainous areas or PV installations on valuable agricultural land, the regional government changed its approach and favoured a more sustainable pattern. This capacity to adapt demonstrates flexibility and the ability to discuss issues openly. This is critical in a policy domain like RE, which is relatively new and where no established understanding of "best practice" yet exists. This approach has underpinned the social acceptance of RE by the regional population in spite of extensive deployment. It is also aided by the fact that regional interventions aim to maximise benefits for host communities rather than for individual investors.

Assessment of policy impacts on rural development

While RE has created economic opportunities and jobs in a number of rural communities in Puglia, the overall impact on rural development seems to be limited. Although Puglia was the first region in Italy to design a strategy to deploy RE, and also the first to explicitly link the production of RE to regional economic development, policy implementation suffers from a sectoral approach. For instance, rural development policy is still disconnected from the PEAR and incentives are still designed for individual farmers, rather than rural communities. A more inclusive, integrated approach to policy, engaging a wider range of rural actors, would probably make it easier to address the co-ordination issues involved in more complicated deployments such as biomass development.

When evaluating the impact of RE policy on rural Puglia, one has to bear in mind that RE deployment in Italy has been supported by a set of strong public incentives, such as FITs and Green Certificates, but in the absence of a co-ordinated national strategy. These transformed RE into a promising speculative investment opportunity. Combined with Puglia's simplified authorisation process for PV installations, deployment boomed, revealing the flaws in the RE policy framework, such as the high subsidies and a lack of a monitoring activity able to provide feedback to policy makers. Developers make their investment decisions largely on the basis of what subsidies are available. Sometimes the interest of developers is linked to that of farmers and rural communities, but this is far from always the case. This approach caused a conflict between the regional and the national level, which has been resolved in 2010 by the Supreme Court of Italy that stated that energy policy is under the exclusive jurisdiction of the central government. This decision restricted dramatically the scope of the regional energy strategy.

Another weakness of the regional strategy is that it involves only a limited number of key regional institutions, private and public. The impression is that the regional government has centralised the governance of RE deployment leaving little room for other regional players. For instance, chambers of commerce, provincial governments, trade unions and other key intermediate institutions, particularly those representing rural interests, are not directly involved in steering and implementing the policy. This is true also for agricultural cooperatives, which could represent a powerful actor within RE policy, for their capacity to organise collective action and reducing the cost of collecting biomass, for instance.

Stimulating local economies[1]

The impact of RE production on rural economies has not lived up to expectations. This may reflect the fact that initial expectations were too high, especially in terms of direct employment generated by RE deployment. The regional government has no targets for job creation, but one of the pillars underpinning the regional narrative on RE deployment was about its potential for generating employment. Part of the issue is that the first wave of RE deployment mostly consisted of large-scale projects that relied on imported technologies and skills. Consequently, the economic impact was diffused far beyond the borders of the region and deployment was disconnected from local skills that could contribute to the RE supply chain. Puglia's experience demonstrates the existence of a trade-off between the pace of the deployment and creating the conditions, such as having the right skills in place, to enable the regional economy to capitalise on the investment.

Some positive impacts of RE can nevertheless be identified at the local level, including an increase in investment in the region; in tax revenues for rural communities (especially remote ones); in self-employment opportunities and in diversified outputs for existing businesses. Puglia's SMEs have taken advantage of these new opportunities and entered the RE business by producing, installing and operating RE technology, as well as developing new products to better control and manage it – by, for instance, manufacturing and installing small wind turbines, or inverters and components for PV systems.

The royalties and local taxes paid by developers to rural (and often remote) communities is another benefit. The deployment of an RE installation represents a large investment for a rural community, which can benefit from the taxes paid by developers. Although in Italy, local taxes are a small share of total taxation, a large investment can make a big difference for a rural community. Remote communities hosting wind farms in the mountainous areas of Puglia have used royalties and other taxes to maintain or increase the quality of basic services, such as schools, senior residences and social housing.

The regional innovation system is also benefitting from the large RE deployment. As discussed above, Puglia features national research centres in the field of energy and RE, and it is also home to demonstration projects. The specialisation in energy production was already present at the regional level, and the specialisation in RE technologies offers the possibility of integrating these competences more with the business community and acting on the frontier of a new industry, especially in PV technologies.

Finally, RE deployment has positively affected rural communities' capacity to integrate sectoral policies. In some cases, the lack of co-ordination among different policies supporting RE deployment was mitigated by the capacity of local communities to integrate different strategies and policy tools. Local actors (including local governments)

have learned how to do this over time through a process of learning by doing. This capacity to use different policies in a co-ordinated fashion could be used to capitalise on the potential in the biomass market, whose development depends on actors finding the right organisation at local level. The most typical case is that of use of by-products from agriculture, where local governance will be crucial to provide and process the by-products to generate energy.

Main challenges

Poor co-ordination of national and regional agendas has contributed to problems in some areas. For instance, the combination of relatively high FITs for PV energy set by the national government, with a hugely simplified regional authorisation process in Puglia, created the conditions for a very large (and largely unexpected) deployment of PV installations. This raised the cost of the RE policy in Italy, and forced the national government to redesign incentives, creating uncertainty on the national market and impinging upon the coherent deployment of RE all over the country. Puglia faces several other specific challenges:

- **Use of land and landscape.** Large-scale PV deployment has used valuable agricultural land: 3 375 hectares were devoted to PV installations by the end of 2011 (GSE, 2011). PV fields of up to 1 MW were eligible for the incentives and the simplified authorisation process. In some cases developers were putting in separate applications for adjacent PV fields, and with this *escamotage* they were able to go above the fixed limit of 1 MW. Both PV fields and large wind farms have "redesigned" part of the rural landscape in Puglia, potentially undermining sectors such as tourism which depend on the local landscape. This situation has changed since Puglia became one of the first regions to adopt landscape guidelines.
- **Grid management.** High subsidies and the way they are structured have encouraged uncoordinated energy providers to feed electricity into a grid that is poorly prepared to absorb it. As the number of projects increases it is likely that major grid management issues will develop.
- **Uncoordinated policies can also offer multiple independent subsidies.** Firms can receive multiple layers of support by designing a project that fits criteria for multiple subsidies; it may be the case that such overlapping subsidies are leading to large deadweight losses. This means that developers would need far less subsidies to realise their investment.
- **Social acceptance.** The rapid and large-scale deployment of RE at the outset led to some local opposition to RE in Puglia. For example, the first wind farm installed in the *Appennino Dauno* won architectural awards for its design but also led to a major dispute with the local population, who did not see it as in line with their culture and economy. As with grid management issues, social acceptance becomes more pressing as the level of RE deployment increases. When the scale and pace of deployment are seen as inconsistent with the region's economic and social fabric, local actors and groups oppose projects which increases the time and cost of deploying RE. Public support for RE could be improved if there were more opportunities for individuals and communities to enter the sector directly, or to benefit from it indirectly.

Despite being designed to take into account different potential linkages between RE and other regional industries, Puglia's RE policy has largely been implemented as a standalone sectoral policy. Rural development has not really been integrated into the

framework. A holistic approach to policy design should be mirrored by an equally holistic and comprehensive approach to implementation. Improved co-ordination seems to be crucial in order to identify real interdependencies between different policies. This could perhaps occur through the creation of a specific committee or interdepartmental structure, which is accessible to key rural constituencies. The regional Department for Environment, for example, could integrate different policy interventions, but it currently lacks the strength or legitimacy to do so.

Overall, Puglia's case shows that there is no shortcut to rural development and that even large investments need to be integrated into a complex action framework if results are to be sustainable.

Note

1. Due to the lack of data on RE impact on regional employment, this report focuses mainly on empirical evidence collected during field visits.

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Chapter 12

Friesland, The Netherlands

Rural development and renewable energy (RE) in Friesland: Summary and conclusions

Main findings. *i*) Friesland's government has linked RE to concrete business opportunities in manufacturing and tourism through a series of small, targeted, and relatively inexpensive policy interventions. *ii*) The region's specialisation in energy production (the Energy Valley Initiative) is aiding large-scale RE deployment in Friesland through building expertise and infrastructure. However, this large-scale approach risks locking-in fossil fuel-dependent technologies and bypassing rural development opportunities. *iii*) Friesland's dairy sector has an opportunity to produce bioenergy from the large volumes of potentially ecologically harmful animal waste, but short-sighted regulations are limiting diary farmers' capacity to realise this opportunity. *iv*) A failure to build public support is undermining the long-term deployment of RE technologies, such as wind.

Renewable energy in Friesland: A summary. Friesland's RE policy is one response to the challenges posed by an ageing population, the unsustainability of the agriculture sector, poor economic competitiveness and the need for more high-skilled employment. The Friesland government has developed a three-pronged economic agenda based on energy, water and recreation. The two primary targets are dairy farmers, who have the potential to produce biogas from their animal manure (despite a national regulation on feedstock that limits development), and local boat builders, who have been encouraged to develop solar-powered electric boats to navigate the province's numerous canals and waterways. This approach is bearing some fruit. For instance, supporting PV-powered boats through a bi-annual competition has favoured the creation of a cluster of 35 SMEs producing electric engines, batteries and battery management systems. Moreover, the direct involvement of local schools in the competition is a way to engage and train young people and link them to the business community.

Friesland could capitalise on Noord-Nederland's specialisation in energy (mostly natural gas) to promote RE, but there are issues to consider. The business community and provincial governments launched the EUR 23.5 billion Energy Valley Initiative to deepen the regional specialisation in energy – both conventional and renewable – by focusing on three areas: gas exploration, transport and storage; large-scale power production with carbon capture and storage (CCS); and decentralisation through large-scale wind energy, green gas and smart grids. As found in other OECD regions, creating a link between conventional energy and RE may facilitate large investment and attract specialised skills and know-how. In the case of Friesland, it also promotes RE at a larger territorial scale than the province. Yet there are challenges. The most relevant is the danger that applying an old paradigm (conventional energy) to a new one (RE) will lock-in fossil fuel based technologies. It might be preferable to develop a new strategy specifically adapted to RE and able to capitalise on local identities and local production in rural areas. Large investment, in fact, may overlook potential links between rural SMEs and RE production, while favouring large installations which have weak links to the local communities.

The local development of wind farms and a fledgling turbine production industry in Friesland are being undermined by weak policies for building the social acceptance of wind power. This experience with wind energy illustrates that there are no short-cuts to RE deployment: if policies do not bring all stakeholders on board, RE implementation can fail.

Future challenges. Friesland could capitalise on the success of its bottom-up initiatives by integrating them into a broader strategy. The province's experience demonstrates that it is possible to create business opportunities through RE. Small, targeted, public investment and involvement of key stakeholders are key elements for this success. This model, however, also has limits. For instance, it requires the public sector to select business opportunities and engage in a complex, time-consuming action to facilitate local processes. If the province wants to maintain this approach, and co-ordinate it with Energy Valley's large-scale interventions, it should enhance efforts to connect sectoral initiatives within a broader strategy that includes public consultation. The aim would be to trigger a self-reinforcing mechanism in which rural dwellers can exchange ideas and implement activities with less direct public sector involvement.

The context

Friesland's socio-economic profile and performance

Friesland is one of three provinces of the Noord-Nederland (North Netherlands) region, along with Groningen and Drenthe. The Wadden and North seas form its northern and western borders and a 32-km dyke, the *Afsluitdijk*, connects Friesland to the province of Noord-Holland, which includes Amsterdam. Its topography is distinguished by plentiful canals and waterways and by the virtual absence of any hills. Friesland boasts high-quality landscapes and many lakes; it was designated "the most beautiful province in the Netherlands" by the Dutch Society on Cultural Landscape (*Vereniging Nederlands Cultuurlandschap*) in 2010.

By Dutch standards, Friesland is a rural region and is challenged by its ageing population. With a population density of 143 inhabitants per square kilometre, Noord-Nederland is rather sparsely settled compared to the national average of 395 (Table 12.1).[1] One-third of Friesland's 640 000 residents live in the provincial capital and largest city, Leeuwarden. Though Friesland's total population is growing, the number of working-age inhabitants fell slightly between 2005 and 2009 and today make up a smaller share of the population than in 2000. Conversely, the population aged over 65 years grew by 14% over the same period, rising from 14% to 16% of the total (*OECD Regional Database*).

Table 12.1. **Friesland: Demographic data**

2008 data, unless otherwise indicated

	Noord-Nederland	The Netherlands
Population	1 704 783	16 405 399
Population share	10.39 %	
Population density	143 in/km^2	395 in/km^2
Elderly dependency ratio	24%	22%

Source: OECD Regional Database, http://dotstat/wbos/.

The Noord-Nederland region as a whole exhibits a relatively strong economic performance and is striving to increase and diversify its production of higher value added goods and services. The region had 3.5% unemployment in 2008 compared to 2.9% nationally, while GDP *per capita* was 95% of the national level (Table 12.2). Compared to other rural regions, Noord-Nederland is well positioned and benefits from high levels of public service delivery and educational attainment, as well as close connections to urban centres. Overall, the Netherlands has experienced some de-urbanisation of its economic activity, with intermediate areas' growth rates on a par with urban regions. However, growth in rural municipalities is weaker (OECD, 2008). Under the EU's Cohesion Strategy, Noord-Nederland was classified as an Objective 2 region and has received funding – EUR 356 million over 2000-2006 and EUR 373 million over 2007-2013 – to boost regional competitiveness and employment by becoming a knowledge economy (Enzing and Bodewes, 2008; European Commission, 2007).[2]

Table 12.2. **Friesland: Main economic indicators**

2008 data, unless otherwise indicated

	Noord-Nederland	The Netherlands
GDP per capita USD PPP (2007)	31 096	32 697
GDP share (2007)	9.89%	
Productivity USD PPP (2007)	62 376	61 777
Unemployment rate	3.5%	2.9%
Employment rate	75.6%	77.4%
Long-term unemployment	1.2%	1.0%
Youth unemployment	6.68%	5.5%
Infrastructure (motorway density)	0.08	0.11
Tertiary attainment	29.6%	33.8%
Patents per million inhabitants (2007)	50.7	208.9

Note: Friesland is a TL3 region (while the majority of case studies in this report are TL2). For this reason it is not possible to compare the regional performance with the OECD average.

Source: *OECD Regional Database*, *http://dotstat/wbos/.*

The regional industrial mix

The Noord-Nederland regional economy has three main specialisations tied to natural resources: energy, dairy and water technology. The specialisation in energy accounts for roughly 30 000 jobs spread across around 400 companies and includes Europe's largest onshore gas resources. These resources are currently exploited by the Dutch Gas Union, Gasunie.[3] For centuries, Friesland's economy has featured a large dairy sector; today 90% of Friesland's farms are dedicated to livestock production. The Friesian cow, known around the world as one of the best breeds for milk production, allows the province to contribute 13% of all milk production in the Netherlands. In line with the OECD trend, the dairy sector's share of employment and output has declined, though it is still significant in Friesland, both economically and socially. The province's specialisation in water technology has evolved over years of managing and treating its vast water resources. Approximately 50% of new companies in the Netherland's water technology sector are located in or around Leeuwarden.

Despite having no university, Friesland boasts a budding and diverse innovation system which attracts researchers and entrepreneurs and reflects its regional specialisations. The province has supported the creation of innovation clusters in water technology, dairy and energy – all sectors that draw on Friesland's natural and human resources. For example:

- The Wetsus Centre hosts academics working on water technology projects conceptualised by private companies. These projects include initiatives on "blue energy" and harvesting water from the air.[4] They are currently working with 38 researchers from around the globe and over 90 companies from across Europe. The centre receives 50% of its funding from the provincial government.

- The Friesland Dairy Campus aims to find solutions to emerging challenges in the dairy sector in three main areas: globalisation, sustainability, and animal welfare. The Dairy Campus hosts the first biogas facility in the province. Locating the project on a research campus provided a neutral testing ground for this technology and has highlighted some of the challenges for further biogas development in Friesland (see Box 12.1).
- The Friesland Solar Challenge, a biannual race for solar-powered boats, has catalysed another important innovation system. The success of the event, which has been designed and sponsored by the provincial government, has encouraged the creation of an electric boating manufacturing sector. While the market is still tiny, these companies are developing new products and battery management systems that are being used in electric boats and cars throughout the Netherlands and also abroad.
- Innovation in RE technologies in Friesland is also supported by the provincial (EU funded) Action Programme (*Fryslân Fernift*) with a budget of approximately EUR 1.1 million in 2011/12.

Friesland's energy resources

Energy security is generally not a concern for the Netherlands, which is a significant producer of natural gas and boasts a large oil-refining industry. The Netherlands is a net energy exporter. Nationally, over 99.95% of the total market has access to the electricity grid and over 95% to the gas grid, with an additional 4% on district heating. The main sources of RE in Friesland are biogas, and solar energy (Table 12.3). A smaller portion of RE is produced by blue energy. Provincial goals for 2015 are for an energy mix comprising 15% biogas; 50 MW solar and 2 petajoules (PJ) wind energy, as well as to develop pilot projects in waste heat and blue energy.

Table 12.3. **Installed renewable energy capacity in Friesland and the Netherlands**

	Wind (MW)	Solar (MW)	Biogas(TJ)
Netherlands	2 222	68	11 921
Data year	2009	2009	2009
Friesland	156.307	3	57.2
Data year	2011 data	2010 data	2010 data, m^3
Friesland share	7%	4%	

Source: Netherlands Central Statistics Bureau.

Renewable energy policy in Friesland: Objectives, opportunities and challenges

The policy drivers: Why is Friesland implementing a renewable energy policy?

Energy security is not an issue for Friesland, but the province wants to eliminate its reliance on fossil fuels and to use RE as a means of economic development. The provincial government's approach to economic development has evolved over the last decade through three phases: from infrastructure development to productivity and now innovation. Financial and other support for RE is concentrated in areas where the authorities see potential joint benefits from harnessing the province's abundant energy, water and recreation resources. The governance structure supports this integrated

approach. A provincial government reshuffle in early 2011 gave Friesland the opportunity to implement a more integrated approach to economic development by creating the Department of Economics, Innovation and Knowledge. So far, the provincial government has been successful in stimulating new initiatives at the local level.

The policy framework for renewable energy in Friesland's rural areas

Friesland's RE activities are influenced by a multi-layered governance structure with authority concentrated at the national and provincial/municipal levels; Dutch regions are mere statistical entities. The national government has primary authority over energy issues, including regulating transmission and distribution, grid management, taxes and subsidies. The national government can also overrule local and provincial decisions on large-scale energy projects, e.g. the placement of power lines. National RE policies are primarily overseen by the ministries of economic affairs, agriculture and innovation; infrastructure and the environment; and finance. Provinces are responsible for the spatial integration of energy projects; authorising and granting licenses; leading by example via provincial investments in RE and efficiency; and leveraging their role as energy producers and/or network companies. Municipalities also play a role, with responsibility for land use and planning (authorisation process).

European level

It was not until 2005 that a mandatory and comprehensive energy policy was adopted at the EU level. Before then, EU Member States pursued intergovernmental initiatives motivated initially by energy security in the 1970s and subsequently by environmental concerns in the 1990s. In 1997, in reaction to the Kyoto Protocol, the EU introduced non-mandatory targets for Member States for the RE share in total energy consumption. In 2006, the European Commission issued the Green Paper: *A European Strategy for Sustainable, Competitive and Secure Energy*. This asked Member States to implement a European energy policy built on three core objectives: *i*) sustainability – to actively combat climate change by promoting renewable energy sources and energy efficiency; *ii*) competitiveness – to improve the efficiency of the European energy grid by creating a truly competitive internal energy market; and *iii*) security of supply – to better co-ordinate the EU's supply of and demand for energy within an international context. In 2007 this was translated into mandatory shares of RE production for Member States in the form of the *Renewable Energy Roadmap* (2007). This document set the overall mandatory goal of achieving 20% of RE in total energy consumption (10% of transport biofuels) by 2020, which has become part of the "Europe 2020" Strategy. The 2009 Renewable Energy Directive set individual targets for each Member State.

The European Cohesion Strategy and the Common Agricultural Policy (CAP) also support RE production. As mentioned above, Noord-Nederland is classified as an Objective 2 region under the Cohesion Strategy and has received funding to support its transition to a knowledge economy. Many of these efforts are related to RE. Under the CAP, the EU's 2008 Rural Development Plan "health check" led to the boosting of existing funds by an additional EUR 146 million for the region to tackle six challenges; 19% of these funds will go to renewable energy. The province aims to focus these efforts on agriculture-based RE, such as biogas (Friesland Government, 2011a; Ministry of Agriculture, Nature and Food Quality, 2009). The Leader Program, one axis of the EU's Rural Development Program, has also contributed to Friesland's RE activities in rural areas, funding around 2 000 projects between 2007 and 2013 to the tune of EUR 800 million (though not limited to RE projects).

National policy

National RE policy reflects both EU mandates and the particular character of the Netherlands' energy sector. In accordance with the EU's 2009 Renewable Energy Directive described above, the Netherlands' Government aims by 2020 to reduce GHG emissions by 20% below 1990 levels and for 14% of energy consumed to come from RE, including 10% in transport. These targets are lower than for other EU countries, as the Netherlands has less technical potential for RE; i.e. smaller resources in terms of renewable energy sources (based on current technologies). Nevertheless, the country has two comparative advantages in RE:

- The strong interconnections among Northern European countries, which means that the variable supply typical of wind and solar energy can be absorbed by a larger consumer base.
- Significant biogas potential – as much as 3 billion m^3 a year nationally – with especially large potential in Friesland due to its dairy industry.

The Government Co-ordination Scheme (*Rijkscoördinatieregeling* – RCR) aims to promote RE by speeding up the licensing process for large-scale energy infrastructure and RE.[5] However, the Netherlands' highly urbanised landscape limits the prospects for expanding the grid, because power lines have to be a certain distance from households. In this context, national RE policy is seeking to establish a balance between large- and small-scale installations, benefitting from the former's "economies of scale" and the latter's minimal impacts on aesthetics and landscape.

The Netherlands was an early adopter of subsidies that focus on the marginal cost of RE. In 2003, the first production-support incentive was introduced, the *milieukwaliteit van elektriciteitsproductie* (MEP), a type of feed-in tariff. It provided a premium for renewable energy based on the difference between the market price for electricity and the cost of production from the technology being used. Producers received the same price over the 10 years of their contract; however the subsidy level was adjusted each year for new recipients to reflect changes in the cost of production. Later subsidies maintained this basic form with some changes. For instance, the subsequent SDE (Sustainable Energy Production subsidy – *Stimuleringsregeling Duurzame Energieproductie*) also guarantees a fixed price for producers, up to a certain level. If the market price reaches the subsidy level, producers receive no other government subsidy (Beckman and Haje, 2011). In addition, the capacity and expenditure of the scheme is capped by technology (IEA, 2008). Funding for the SDE peaked in 2009 at EUR 9.2 billion, compared to EUR 1.5 billion for both 2008 and 2011, and EUR 2.1 billion in 2010.

There is considerable overlap between RE and rural development in the Netherlands, highlighting the RE potential in rural areas. The Netherlands' Rural Development Strategy (NRDS), also referred to as Rural Development Programme II (2007-2013) (European Commission, 2007c), includes several initiatives for realising the RE potential in rural areas (Table 12.4). It has a budget of EUR 2.2 billion. Despite being a national programme, NRDS is administered via block grants awarded to the provinces based on a policy agreement negotiated by both national and provincial governments. Provinces also provide co-financing for initiatives. This allows provinces to influence the implementation of NRDS and integrate it with regional priorities. However, national budget allocations are still tied to sectoral ministries, which may limit this integrated approach during implementation (OECD, 2008).

Table 12.4. **Synergies between rural development policy and renewable energy in the Netherlands**

Axis of the strategy	Measure within the axis	Synergy with renewable energy policy
1	111. Vocational training and extension	∞ Specific measure for dissemination of knowledge, e.g. demonstration projects for renewable energy ∞ Target: 700 applications related to renewable energy
	121. Modernisation of agricultural holdings	∞ Specific support for sustainable development of agriculture to meet new challenges, such as renewable energy ∞ Target: 50 farm holdings supported for biogas production using organic waste, 100 farms supported for processing biomass
	124. Co-operation for innovation	∞ Specific support for innovative activities like renewable energy ∞ Target: 5 co-operative groups supported for processing agricultural and forest biomass for renewable energy, 5 groups supported for innovative operations to address climate change mitigation, 5 groups supported for innovative actions on renewable energy
	214. Agri-environment payments	∞ Potential synergy as support for maintaining landscape elements (like hedges, tree rows etc) could be beneficial for renewable energy.
	221. Initial afforestation of agric. land	∞ Potential synergy in influencing afforestation using species suitable as 2nd generation bioenergy crops.
3	311. Diversification into non-agricultural activities	∞ Sub-measure B supports the diversification of non-agricultural activities and targets the generation of renewable energy ∞ Target: 10 beneficiaries supported for installation/infrastructure for renewable energy using biomass and other renewable energy sources, 15 beneficiaries supported for production of biogas using organic waste, 15 beneficiaries supported for processing biomass for renewable energy
	321. Basic rural services	∞ Sub-measure B supports the facilitation of renewable energy. ∞ Priority will be given to renewable energy from local biomass and rest products. ∞ Supports knowledge exchange and co-operation for renewable energy chains, as well as the organisation of the logistics of biomass energy and the distribution of renewable energy.

Source: Friesland Government (2011), response to OECD questionnaire.

However, poor co-ordination of natural regulations and local policies is hindering the development of RE in some areas. This is illustrated well by the development of bioenergy in Friesland, with efforts to capitalise on the heating potential of biogas currently being thwarted by a lack of policy coherence (Box 12.1). Furthermore, local development of wind farms and a fledgling turbine production industry are being undermined by weak policies for building the social acceptance of wind power. The Friesland region has abundant wind resources, and a long history of using wind energy. Initially, turbines powered water pumps, which are crucial for irrigation of the agricultural sector, and later for small farm-based electricity production. Following this period of small-scale production – and local job creation at three manufacturing companies – a national strategy promoted large-scale wind deployment through farmers. By 2001 Friesland was the second-ranking province in the Netherlands in terms of installed wind capacity, with 69 MW, and it had set the second highest targets (200 MW) for 2010. Targeting farmers simplified the authorisation process, as farmers owned their land and were usually well connected to their communities (Breukers, 2006). This strategy worked well up to the mid-2000s, when the non-farming rural population began opposing new developments, seeing incentives going only to land owners (farmers) with no compensation for any negative impacts. This also reflected a broader economic shift

– from farming to tourism – which increased the value of the landscape and led to a hiatus in the deployment of wind energy. Today, Friesland no longer places wind turbines in its open landscape and has limited future developments to border areas. This radical change in the policy will impinge upon wind energy deployment.

Box 12.1. **Biogas: thwarted potential**

The Netherlands has a national problem with nutrient management due to its significant and intensive livestock industry. High concentrations of animal waste upset the nutrient balance in the soil and pollute water. The Dutch government has highlighted the potential of biogas for making a key contribution to its RE agenda. Converting cow manure into methane biogas instead of letting it decompose reduces greenhouse gases. An air-tight tank transforms biomass waste into methane through fermentation using a digestate (solid material remaining after the anaerobic digestion of a biodegradable feedstock), producing renewable energy that can be used for heating, electricity, and many other operations. The process leaves behind a drier version of the feedstock. Farmers hope to use this as fertiliser, a practice that greatly improves the overall economics of biogas production. Yet current rules are limiting the types of digestate (the mix of elements) that can be used as fertiliser and increasing production costs for farmers. Since 2004, a "positive list" designed at the EU level has decreed that only digestate composed of at least 50% manure and a product from the "positive list" can be used as fertiliser. All other digestates are considered to be waste and must be disposed of, but their disposal is expensive. Moreover, this approach has affected the price of the commodities on the "positive list" and has made biogas production financially unattractive in many cases. Within the EU, there is significant variability over what is considered an appropriate co-product for fermentation.

Regional and local policy

Friesland's financial support for RE is relatively small and targets the link between RE and economic development. The provincial budget for stimulating RE via co-financing was EUR 4.2 million in 2010 and will be EUR 1.6 million in 2012. The Friesland approach focuses on the region's existing economic strengths: natural gas production, agriculture (bioenergy) and boat manufacturing (Box 12.2). The targeted support to these areas demonstrates an innovative and collaborative approach, working with private businesses and other layers of government. By emphasising Friesland's comparative advantages, the province hopes to attract labour, business and potential investors. This "place-based approach" highlights that the province's long-term energy vision is rooted in local history and supported by local institutions, rather than being a short-term policy to take advantage of national and European subsidies.

Box 12.2. **Sun, boats and business**

The Friesland government is collaborating with small local businesses to create a specialised supply chain for the electric boating industry. The province's extensive waterway system, which connects 99% of farms, means that electric boats could become a key form of transport. The province already boasts a thriving boat-building sector, representing 25% of yacht building in the Netherlands (which nationally represents 1 500-1 600 jobs and an annual turnover of EUR 800 million). Linked to this is a growing electric boat building sector, including companies specialised in solar-powered boats, electric motors, batteries, battery management, and charging infrastructure. The provincial policy focuses on this emerging market and sees it as a pillar of its sustainability agenda. Policy interventions are designed in close collaboration with small businesses through a public-private body, the Electric and Hybrid Boat Foundation (*Elektrisch en Hybride Varen*). This foundation acts in three areas: *i*) informing consumers; *ii*) developing infrastructure, such as recharging stations on canals, and regulations that favour electric boats on the many canals and waterways; and *iii*) developing a quality standard for electric boats which distinguishes the safety, power capacity and distance of Friesland production.

A key component of the electric boating strategy is the Frislân Solar Challenge launched in 2008. This 6-day, 200 km boating race, held every two years, was inspired by the 11-City Speed Skating Race (*Elf Steden Tocht*), which began in 1909 and weaves through the waterways connecting the province's 11 main cities. Participants in the Solar Challenge can range from well-funded PV producers to students working on a very limited budget (the last edition attracted around 50 participants from all over the world). Although it has yet to foster a flourishing PV-powered boating market, the Friesland Solar Challenge has increased economic opportunities for existing companies along several supply chains. The boat that won the last race was built by a small local company that now sells battery management systems that can be used in electric boats and electric cars. The Solar Challenge is also boosting the tourism industry. Competitors and visitors to the race spend on average EUR 5 million in the province. Lastly, the race functions as a career fair, creating a unique opportunity for engineers to showcase their skills, and has already led to some recruiting by the main private sponsors of the event.

The long-term collaborative efforts in solar-powered boats and related improvements of electric engines, batteries and battery management systems have led to 35 SMEs being established (from only one less than a decade ago), a globally recognised bi-annual solar boating competition, engagement of young people, and significant partnerships among government, business, school and universities. Approximately 250 electric boats have been purchased by Frisians taking advantage of provincial subsidies – a total budget of EUR 300 000, which covered 20% of the cost of a motor retrofit or new boat.

Friesland's rural policy has progressed from a focus on staving off decline to supporting economic development, including in the RE sector. The evolution of the policy has been inspired by the European Union's LEADER programme, which aims to improve the quality of life in rural areas and add economic value to natural and cultural resources, and capitalises on diversity of rural economies. The target is to diversify rural economies and promote the environmental sustainability of rural businesses, in particular the SMEs that account for 80% of Frisian enterprises. Within this strategy the Network Towns and Villages Project aims to link individuals and SMEs together so they can jointly overcome obstacles for achieving the province's energy goals. The demand for RE LEADER projects is also coming from those rural communities which have a sustainability agenda. For example, Vlieland, a tourist island off the northern coast of Friesland, aims to be energy independent by 2020. Besides the environmental benefits, this strategy could attract green tourism from northern Europe. Vlieland municipality wants to avoid large installations; while wind turbines could solve the problem of energy supply, they could also upset the local community and reduce the area's natural

attractiveness. The alternative is a series of small interventions, including energy efficiency and the diffuse production of energy and heat using locally generated and managed biomass.

Another innovative policy is the goal for the all the province's farms to become net energy producers to help achieve the ambition of satisfying 15% of gas consumption using biogas by 2015 and 20% by 2020. Biogas is seen as an opportunity for the province's numerous dairy farmers to stabilise income and find innovative ways to manage waste (manure, in particular), which is a serious source of pollution in Friesland. However, there are technological barriers to take into account, as farmers must learn how to operate digesters. There are also high transaction costs for a single small producer of biogas to sell the output. To overcome these problems, the provincial government is assessing the option of building a special pipeline to collect biogas produced by several farms. Once stored, biogas would be upgraded to natural gas standards and sold to the gas utility. This process would increase the efficiency of the energy conversion from 38% to 96% and dramatically lower transaction costs in the market. The pipeline could be considered as a gas field. There are currently eight biogas producers in the region and a total of 10 have expressed serious interest in supplying the pipeline should it move forward.

The Friesland government has adopted the "Friends Approach" whereby it invests in frontrunners (innovators among business and local governments), supports them by stretching the limits of regulations, if needed, to overcome potential administrative barriers, and involves local stakeholder (citizens and businesses) in evaluating the policy impacts. The Friends Approach has inspired new collaboration with the private sector, while sparing the government the challenge of picking a particular technology or product to invest in. Thus, for instance, the Wetsus Centre for innovation in water technology and the Dairy Campus are supported by the public sector partly because they are also supported by private businesses. They attract companies and entrepreneurs interested in developing products and services that can contribute to the province's RE and economic development goals. By letting researchers and investors steer and partly fund the research agenda, the need for government funding is reduced.

Despite the absence of a regional government, the provinces that compose the Noord-Nederland region (Friesland, Groningen and Drenthe provinces) have joined forces to move towards a green economy at the regional level through the Energy Valley Initiative. The Energy Valley Initiative, a public-private initiative established in 2007, aims to create a world-class cluster of energy expertise in the Noord-Nederland region. Noord-Nederland is home to a large number of activities related to petroleum and natural gas, has large potential for alternative forms of energy, and enjoys a high concentration of energy expertise and businesses. The Energy Valley Initiative aims to capitalise on this and create an "energy cluster" which connects all the different regional actors active in the energy industry. The strategy focuses on three main areas: gas exploration, transport and storage; large-scale power production with carbon capture and storage (CCS); and decentralisation through large-scale wind energy, green gas and smart grids (Energy Valley Foundation, 2010). Activities range from raising public awareness to developing wind testing facilities and focus on a wide range of energy sources, from coal to renewables (Friesland Government, 2011a). Energy Valley also seeks to improve regional human capital. Projects include an Energy Academy being developed by the University of Groningen and the Hanze University of Applied Sciences. There are also plans to establish a knowledge centre focusing on green gas at Wageningen University's Dairy Campus in Friesland. While the Energy Valley Foundation estimated the initiative would

require a total investment of EUR 23.5 billion between 2008 and 2012, and could generate about 10 000 jobs, mainly in Groningen (Friesland Government, 2011a), its actual impact on local development has not lived up to its potential (see discussion below).

Assessment of policy impacts on rural development

Small versus *large scale interventions*

The Friesland provincial government has linked RE to concrete business opportunities in manufacturing and tourism through a series of small, targeted, and relatively inexpensive policy interventions. The province was able to see the potential of the electric boating industry and create a series of collective goods (e.g. the "solar challenge") to promote regional specialisation. The province's policy of engaging closely with local researchers and entrepreneurs has allowed financial and business development support to be administered in a collaborative manner. The bottom-up approach has enhanced backward and forward linkages between Friesland businesses and the "broad" RE supply chain. A good example of this is the electric boating industry (Box 12.2), which has hugely benefited from public intervention (support from the provincial government, in particular). This bottom-up approach contrasts with the top-down support for RE, often in the form of production-based subsidies (e.g. feed-in tariffs), which is also present in Friesland, and is common in case studies. These interventions would not have been possible without redesigning the government and governance structure underpinning RE policy. The administrative reshuffle has improved resource co-ordination made interventions more flexible, and has helped the province embrace a new phase in both its economic and rural development policies.

The impact on local development of larger policy initiatives like the Energy Valley is less evident and could be improved by taking into account small businesses and rural welfare. The Energy Valley experience raises three main challenges:

- Preventing the leading role given to conventional energy from undermining the province's new RE and environmental sustainability paradigm.
- Involving small businesses. The Energy Valley approach looks like an industrial policy aiming to improve regional specialisation in the energy industry through direct investment in infrastructure, support to large business, and human capital (R&D and skills). Due to the scale of investment, regional specialisation will certainly increase. Yet the experience of the electric boating industry illustrates that local specialisation in RE can also be improved by taking into account industries that are not vertically connected to the energy sector and including SMEs in the cluster strategy, given their importance in the regional economy. Frisian SMEs could become suppliers of larger companies involved in Energy Valley activities. In addition, small-scale projects generally don't solicit widespread interest among large companies; SMEs could focus their attention on these.
- Broadening the focus on rural development. Energy Valley could have promoted short supply chains of feedstock, which could include diary producers. Instead it will develop infrastructure to accommodate biomass imports on cargo ships to ensure supply for the three new bioenergy plants in Groningen (Energy Valley Foundation, 2010).

The importance of coherent policies

The transition away from fossil fuels is being limited by a lack of policy coherence across levels of governments and among sectoral ministries. Short-sighted regulations are limiting dairy producers' capacity to produce biogas, despite the ecological opportunities it offers to produce green energy and reduce pollution.

Friesland also underscores how gaining public support for new technologies should be a long-term, far-reaching aspect of RE policy. Concentrating the financial benefits of wind power generation on farmers without compensating other rural dwellers for the negative impacts of this activity has triggered a surge of public opposition, which is currently limiting local development of wind farms and a fledgling turbine production industry, despite the province's significant wind resources. This loss of public support has prevented the province from capitalising on new efficiencies in turbine technology.

In addition, the desire to protect the region's landscape is also challenging RE development, particularly wind farms and large-scale biomass production. There is a fear that growth in the biogas sector will lead to land-use changes, as more farmland will be needed for growing corn, a popular co-fermentation product (Friesland Government, 2011a). Additional land will also be needed for a pipeline. Landscape protection was also a motivating factor in the development of the provincial spatial planning law, which has limited wind turbine development to 400 MW in the north-western part of the province, and to turbines that have a maximum axel length of 100 m (Friesland Government, 2011a).

Finally, grid capacity is also limiting RE development in Friesland. Expanding it will be difficult as both electricity and gas grids are reaching their maximum capacity for absorbing RE (Friesland Government, 2011a). As already mentioned, the Netherlands is a densely populated country and it is difficult to imagine a densification of the electric grid that does not impinge upon urban forms.

Main challenges

Friesland could capitalise on the success of its bottom-up initiatives by integrating them into a broader strategy. The province's experience demonstrates that it is possible to link RE with business opportunities. Small, targeted, public investment and involvement of key stakeholders are key elements for this success. This model, however, also has limits. For instance, it requires the public sector to select business opportunities and engage in a complex, time-consuming action to facilitate local processes. If the province wants to maintain this approach, and co-ordinate it with Energy Valley's large-scale interventions, it should enhance efforts to connect sectoral initiatives within a broader strategy that includes public consultation. The aim would be to trigger a self-reinforcing mechanism in which rural dwellers can exchange ideas and implement activities with less direct public sector involvement.

Notes

1. Some data for Friesland's socio-economic profile and economic performance are for the entire Noord Nederland region. While provincial data are available from the government, they cannot be compared to other case study regions as the data are not harmonised. When appropriate and feasible, provincial data are also been included.

2. Objective 2 regions face structural difficulties and receive assistance from the European Union to help with their economic and social development. They fall into one of four categories: areas undergoing socio-economic change in the industrial and service sectors, declining rural areas, urban areas in difficulty and depressed areas dependent on fisheries.

3. Gasunie is the state-owned company that owns and operates the gas network in the Netherlands, part of Germany and the gas pipeline connecting the Netherlands and the UK. Until 2005, it was a public-private partnership with Royal Dutch Shell and Exxon each having a 25% stake. This ownership structure prevails for GasTerra, the trading company that was created in 2005 when Gasunie became 100% state-owned.

4. Blue energy is a system for generating power by mixing salt seawater with fresh water, *http://c2cislands.org/sjablonen/1/infotype/webpage/view.asp?objectID=1225*. Concerning the technology to harvest water from air, the Westus centre has developed "rainmakers". The rainmaker concept is a system whereby a stand-alone wind turbine is placed in regions lacking rains. This system is especially suited for such environments if also devoid of briny, brackish or polluted water bodies. The system's wind turbine does not drive a generator to produce electricity, as is commonly the case. Instead it drives a heat pump which is directly powered by the wind turbine. With the heat pump the water vapour in the air is condensed and collected for domestic or irrigation purposes.

5. "Large-scale" is defined as wind projects over 100 MW and other RE projects over 50 MW.

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Chapter 13

Troms County, Norway

Rural development and renewable energy (RE) in Troms County: Summary and conclusions

Main findings. *i*) In Norway, incentives to RE mostly target R&D and demonstration projects; this supports a variety of RE sectors and has avoided a "gold rush" to adopt a single technology. *ii*) Troms County's experience lends weight to the idea that, to be successful, RE deployment should provide rural communities with tangible benefits. *iii*) If RE was used to provide rural communities with cheap and reliable energy this could attract energy-intensive manufacturing to remote areas.

Renewable energy in Troms County: A summary. The economic and environmental drivers for RE are relatively "weak" in this region; RE deployment is more linked to the need for additional energy, especially in small rural communities. Mirroring a national trend, Troms County is experimenting with different RE technologies instead of picking a single "winner". The region is already specialised in the production of energy (hydro power) and is home to a network of research institutions, including a large university. These characteristics have encouraged several demonstration projects linked to different RE technologies in Troms County. The latest development is a combination of small-scale hydroelectric generation and wind turbines. Being less sensitive to freezing temperatures, wind energy buffers small-scale hydro, facilitating its deployment in rural communities. Other RE projects link water management to electricity generation, as in the case of Tromsø, the county's administrative capital. The city is also home to a district heating system which uses locally-source woody biomass as feedstock. In 2012 Norway introduced a renewable energy certificate programme to support renewable energy. This could change the RE adoption dynamic.

How is RE contributing to rural development? Energy has been one factor for economic development in rural Norway, but recent policies have reduced the appeal of RE deployment in rural communities such as Troms County. In the 20th century hydro-electricity was deliberately intertwined with regional development, with legislation requiring developers to site industrial plants close to a source of hydro-electric power, typically in the remote mountain and fjord regions. Most often this was used for the metals industry looking for cheap electricity. Troms County was no exception, and several energy-intensive manufacturing companies are still located in this region. Since 1991, however, due to the reform of Norway's energy market and the creation of the regional market (Nord Pool), electricity prices have been levelled out across the country, meaning that local people no longer see a clear link between local RE facilities and cheap electricity. At the same time, Norway has developed a very ambitious plan to reduce CO_2 emissions. These "exogenous" conditions have affected rural regions. Despite the climate change mitigation policy, many local communities are not eager to trade their landscape amenities for wind farms or small hydro installations. The situation is slightly better in smaller rural communities facing depopulation and ageing, where RE is seen as a way to have a more distributed energy system to attract new economic activities.

Future challenges. Reduced benefits for local communities translate into low public acceptance for RE and time-consuming procedures for RE deployment. This dynamic is evident in wind energy. The best wind resource in Norway, especially in the north, is along the sea shore. In Troms County, for instance, wind speed is 8m/s and without icing problems; the total production of wind energy could be 4.5 TWh a year. Based on this, the central government selected several sites for wind farms. However, as the production of RE does not represent a concrete advantage for the host communities, they oppose it. Wind installations are considered harmful to landscape amenities, which support an increasingly important tourism industry, and there is a general perception that negative externalities are not being compensated for. As a result, it can take up to 10 years to deploy wind farms in Troms County.

A series of policy improvements could positively affect RE deployment in Troms County and strengthen its link with rural development. First, rural communities might be more supportive if hosting an installation would provide them with a competitive advantage, such as lower energy prices for businesses. This would mirror their past experience with large-scale hydro-electric and compensate them for the use of their natural resources, such as landscapes. Second, the central government could consult at both regional and local levels when setting RE objectives and siting installations. The implementation of the 2009 EU Renewable Energy Directive will provide an opportunity for regions to become involved in a national RE strategy. It will be important to address both the social concerns around wind, bioenergy plants and transmission lines by engaging fully with local and regional actors.

The context

Troms County's socio-economic profile and performance

Troms County is a predominantly rural region, but with a network of urban centres.[1] It lies between 68 and 70° north, approximately 350km above the Arctic Circle. It is slightly smaller than Belgium (25 848 km^2) and has a total population of 157 500 – population density is very low, at six inhabitants per square kilometre (Table 13.1). The county borders both Sweden and Finland, and has a 1 800 km-long coastline. Some of Norway's largest islands are found in Troms County, and the historical importance of fisheries and agriculture has contributed to a dispersed settlement pattern. The county has 25 municipalities within which three different cultures meet: Norwegian, the indigenous *Sámi* peoples and the Kven – descendants of Finnish immigrants. Approximately two-thirds of the county's population live in the urban municipalities of Tromsø, Harstad and Lenvik. Although the population overall has been growing in the last decade, partly due to net inward migration, it has been declining in most of the smaller municipalities and rural areas due to outmigration by young adults, especially young women, to the region's largest cities. This has resulted in a surplus of men and an ageing population in the rural areas.

Table 13.1. **Troms County: Demographic data**

2008 data unless otherwise indicated

	Nord-Norge*	Norway
Population	462 731	4 768 211
Population share	9.7%	
Population density (inh/km^2)	4	15
Elderly dependency ratio (2006)	24%	23%

Note: * Data in this table refer to the region Nord-Norge, a TL2 according to the OECD regional typology (OECD, 2006).

Source: *OECD Regional Database*, *http://dotstat/wbos/*.

Regional GDP is below the national average (which is nevertheless the highest in the OECD), but even so Troms County enjoys high labour force participation rates, very low unemployment rates, and an increasingly diversifying economy (Table 13.2). While Troms County's GDP *per capita* is some 24% lower than the national average, it is comparable with the three northernmost counties, and remains high for an Arctic region. The regional economy was historically based on the area's natural resources, especially fisheries and agriculture. Along with a general decline in primary sector employment, the period following the Second World War has witnessed a rapid modernisation of the economy. Building and construction, mineral extraction, shipyards, energy, telecommunications,[2] information technologies, oil and gas, education and research, and the strong expansion of public services (health, education, utilities, culture) across all municipalities are now central to the region's economy. Within the service sector banking, business services, education and training, environmental engineering, financial services, research and development, tourism and trade are all important. As the biggest town in the north of the country, Tromsø has the largest hospital serving the region, the

University Hospital of North Norway, which employs over 6 000 people. The University of Tromsø has over 9 000 students and some 2 500 employees.

Table 13.2. **Troms County: Main economic indicators**

2008 data unless otherwise indicated

	Nord-Norge*	Norway	OECD gap
GDP *per capita* – current USD PPP	34 117.4	40 400	139%
GDP share (1995)	8.29%		
Productivity (2007) – current USD PPP	69 519.04	74 520.6	127%
Unemployment rate	2.8%	2.6%	-3.5%
Employment rate	77%	79.5%	10.3%
Long-term unemployment rate	0.32%	0.3%	-2.1%
Youth unemployment rate	7.8%	7.8%	-7.5%
Infrastructure (motorway density)	0	0.05	
Tertiary attainment	36%	36.6%	
Patents per million inhabitants (2007)	20.4	120.2	

Note: * Data in this table refer to the region Nord-Norge, a TL2 according to the OECD regional typology.

Source: *OECD Regional Database*, *http://dotstat/wbos/.*

Despite the weakening links with the primary sector, natural resources and landscape are still important for the regional economy. Since Troms County has only 1% of its surface area classed as cultivable land, agriculture is a relatively minor part of land use. It is mainly located around the coast and was traditionally combined with fishing to form a key part of rural livelihoods. Troms County is at the northern limits of agricultural production possibilities, but the Gulf Stream enables some seasonal farming around the coasts and fjords, while the *Sámi* people also carry out traditional reindeer herding. Regionally-orientated agricultural policies have helped to maintain agriculture in the north. The county has significant forest cover: 808 000 hectares, of which 57% is deemed to be productive. Other important sectors are mining, quarrying and tourism. The latter is based on the region's dramatic landscape and its proximity to the Arctic Circle.

Another important part of the regional economy is energy-intensive manufacturing, attracted to the region by the availability of cheap hydro-electricity. Troms County has been producing hydro power for 150 years. Up to the 1990s the production of energy was intertwined with energy intensive manufacturing activities. Territorial contiguity between hydro power and manufacturing plants was meant to provide the latter with cheap electricity and a competitive advantage on the international market, while promoting rural development in the north of Norway. The legacy of this policy is still evident in Troms County. A good example is the locally-owned company Finnfjord AS, which has one of the 10 largest ferrosilicon plants in the world and supplies 15% of European demand (Box 13.1). Finnfjord has a annual turnover of EUR 100 million and employs 120 people. Ferrosilicon is used in cars, concrete strengthening for buildings, energy, infrastructure, transport, and steel recycling. The raw materials for the ferrosilicon are hydro-electric power, quartzite (from the neighbouring county of Finnmark), coal/coke, iron ore (from Sweden and Russia) and electrode paste (from Eastern Europe).

Box 13.1. Staying globally competitive thanks to renewable energy and efficiency measures: The case of Finnfjord

At the end of a 40-year contract for hydro-electricity with the regional utility in the early 2000s, Finnfjord was facing a price increase of 60%. At the same time, environmental legislation was demanding tighter control over emissions, and Finnfjord was facing growing competition from China, which produces about 75% of the world's ferrosilicon. The main issue for the company was how to maintain a competitive edge over China, given the tight environmental controls in Norway and Europe and the increasing cost of power. They achieved this through progressive energy recovery and recycling. At the same time, the Government of China introduced an export tax on ferrosilicon exports, leading to increased world prices. In addition, China adopted some pollution control measures in 2007 – the 11th Chinese Plan demands a 20% reduction in energy consumption. Finnfjord felt that from the point of view of the environment and climate mitigation, it is better to use Norway's hydro power to produce ferrosilicon than to export hydro power and import ferrosilicon from a less environmentally-friendly source. As a result of the energy savings and increased prices, Finnfjord has continued to increase production capacity and productivity while reducing power consumption by 10%. At the same time, they have improved their process understanding and raw material selection.

These changes have allowed Finnfjord to reduce its CO_2 emissions to 3 500 kg per metric tonne. Compared with 13 500 kg per metric tonne in China. However, half of the energy used is wasted, one-third is chemically bounded in the product, cooling water, and auxiliary processes. Efficiency is 32%. Although the company claims that this is already the best in the world, they now plan to improve it further through energy recovery. In the first stage they will recover electrical power re-using the heat generated by the production, equivalent to 220 thousand tons of CO_2, which will increase efficiency from 32% from 48%. They are co-operating with Innovation Norway and Enova (see later) to achieve this through a project valued at 700 million Norwegian kroner (NOK); of which Innovation Norway and Enova have invested a total of 200-300m NOK in state grants. This will further reduce power consumption, saving the company an estimated 340 GWh every year. They plan to use the excess heat to dry wood for pallet production, saving wood as well as recycling process energy. In the third phase of CO_2 cleaning, they will pre-heat coal for a thermal power plant, eventually increasing energy efficiency to 75%.

Oil and gas may become the leading industries in Troms County in the near future. Troms County plans to become the gateway to the new oil and gas fields in the Arctic region. These untapped resources amount to 90 billion barrels of oil, up to 50 trillion cubic metres of natural gas and 44 billion barrels of natural gas liquids. That is about 13% of the world's technically recoverable oil, and up to 30% of its gas — most of it offshore (Schiermeier, 2012). Tromsø, the regional capital, is already attracting branches of oil and gas companies from all over the world.

Troms County's regional innovation system mirrors the diversification in its economy; it is specialising in climate change and environmental issues, including RE. Troms County has the most northerly university in Norway (University of Tromsø), as well as a number of research institutes partly or wholly engaged in renewable energy or related research. In particular, the national research institute NORUT (Northern Research Institute) has a major presence in Troms County, with a technological and social science capacity, and 130 employees of which 40 are PhDs. NORUT conducts technological research in cold climate material and construction related to renewables, local energy provision, and wind power (cold climate tolerances, e.g. for blades), as well as solar energy technology including silicon casting, energy storage and low energy housing, distributed energy systems and smart grids. Its social science activities include research on resource management, climate change issues, clusters networks and innovation systems. NORUT is currently co-operating with the university to launch a joint research centre, ISES, which will focus on sustainable energy. The

university specialises in issues important to the Arctic region, including climate change, exploitation of Arctic resources, and environmental threats. Troms County recommended the Energy Lab Dyrøy as a pilot project in the 2001 county council "Action Plan for Climate and Energy in Troms". The energy lab is intended to strengthen the RE industry's innovation capability in small-scale production, energy efficiency, energy management and energy conservation.

Troms County's energy resources

Troms County produces hydro power, imports fossil fuels, and has good potential in several RE sectors. As in the rest of the country, the county has specialised in large-scale hydro-electric power, prompted by the excellent water resources and a national policy that supports rural development through the availability of energy. Troms County is normally a net exporter of hydro-electricity. The county's maximum production capacity of hydro power was 558 MW in 2009 (Statistics Norway, 2012). This is about 2% of the total for Norway, which produces some 126 077 GWh annually from hydro-electric plants and has net exports of about 9 000 GWh. However, regional production can change according to the weather, as ice reduces the productivity of hydro-electric plants. Transportation losses and grid availability are other limits to regional energy export. The system was designed to support a localised large consumption of energy, not to transport electricity towards large urban poles in the south of the country. Moreover, the electricity grid runs mostly north-south with a few interconnections with adjacent Norwegian regions, northern Sweden and northern Finland.

Troms County is a net importer of fossil fuels; liquid fuels are used for heating and sea, road, and air transportation. Finally, Troms County has significant resources for RE production, both actual and potential (Table 13.3). For instance, there is abundant wind along the seashore. Wind speed here averages 8 metres per second (m/s) and there are only limited freezing problems due to the relatively warm water. The total production of wind energy in the county could rise to 4.5 TWh a year. The large forest could also become a major provider of woody biomass. However, there is a growing gap between the volume of annual tree felling and the annual increase in timber growth (around 300 cubic metres of cutting). This means that there timber is a significantly underused resource, which may also be deteriorating. There is also potential for new forms of renewable energy, such as tidal and wave energy. In particular, the topology of the region and abundant water resources may favour the development of small-scale hydroelectricity plants.

Table 13.3. **Renewable energy in Troms County, installed capacity and production, 2010**

	Troms County	Norway	Troms County as a % of Norway
Hydro	558 MW capacity, producing 2.1 TWh per annum	30 000 MW capacity 121.8 TWh production	Just under 2% of both capacity and production.
Wind	1.5 MW capacity (1 wind farm in 2011) New licences granted in 2008 for Kvitfjell and Faaken, total 260 MW	381.5 MW capacity New licences granted in 2008 for 1400 MW	0.4% of capacity in 2011, but obtained 18.5% of total capacity in licences granted in 2008.
Biomass	375 GWh, of which 62 GWh in district heating plants using bioenergy (mainly wood)	14 TWh of which 4.3 TWh in district heating plants	2.7% of Norway total*

Note: * Assuming that the Norwegian figure includes firewood used in homes, as the Troms County figure does.

Source: Background report provided by the local government, unpublished.

Renewable energy policy in Troms County: Objectives, opportunities and challenges

The policy drivers: Why is Troms County implementing a renewable energy policy?

In Troms County, RE is seen as a way to reshape the regional energy framework and create new opportunities for economic diversification and development. Unlike other regional case studies, the "green narrative" that usually supports widespread RE deployment is much weaker in Troms County. This might be a result of the good performance of the regional economy, especially the high activity rate coupled with the low unemployment rate. In addition, locals tend to have a different perception of climate change, which is considered as an opportunity to improve business activities in the Arctic region. Therefore, as the economic and environmental drivers are relatively "weak" in this region, RE deployment is more linked to the need for additional energy, especially in county's small rural communities. As with past experience with large-scale hydro, local stakeholders focus on attracting business through energy availability. Moreover, RE should allow them to produce energy in smaller installations than large-hydro plants. The plan is to couple small-scale hydro plants – which are sensitive to icing – with wind power to assure a reliable production of energy. Distributed energy production should also promote improvements to the grid, increasing the interconnections with adjacent regions in the north (including neighbouring regions in Sweden and Finland), opening up new business opportunities in those areas affected by slow but constant depopulation and ageing (Box 13.2).

Box 13.2. **A small municipality's plan to deploy renewable energy in Troms County**

The OECD delegation met with representatives from the Storfjord Municipality in Troms County. Home to approximately 1 800 people, this seems to be the most proactive municipality in the region when it comes to using RE to generate local employment. Taking advantage of new powers granted to local levels by central government for promoting RE deployment (see below), the Storfjord municipality has already developed a local plan for small-scale hydro-electric development, steering projects into suitable sites which do not conflict with tourism or the environment. They are also thinking about exporting energy to Sweden, and building a power transmission line and a railway to transport processed minerals from Sweden in winter (when the North Baltic is frozen).

The evolution of multi-level governance in Norway gives local governments more power to deal with relevant issues, including RE (OECD, 2008). The devolution process which started in the mid-2000s is still underway: local governments tend to be "policy takers" rather than "policy makers". This is especially true for complex issues such as RE. For instance, the regional decision to couple small hydro with wind mirrors a national trend: the Norwegian government considers that wind energy – onshore, offshore, and deep water – is the best option to increase Norway's electricity export potential. Likewise, regional strategies to reduce carbon footprints – which are tightly linked to RE deployment – are "inspired" by the centre (and supra-national levels), rather than by a local desire to reduce CO_2 emissions. This dynamic depends on the relatively centralised governance characteristic of Norway (although there is a trend to decentralise power), particularly in the energy sector.

The policy framework for renewable energy in Troms County's rural areas

Norway's RE policy is influenced by supra-national strategies, as well as national and local policies. Despite not being an EU member country, Norway is part of the European Free Trade Association (EFTA), and the European Economic Area (EEA).[3] As we explain below, this means that the country has to implement EU policy strategies for climate change mitigation and energy. The national energy policy promotes RE to enhance the country's export capacity, while the country's regional development policy considers RE as a growth opportunity for local communities, especially in the north. Finally, counties and municipalities implement national policy at the local level through their spatial planning remit and construction permits.

European policy

Since 1994, Norway's participation in the EU internal market, as well as its involvement in related EU policy areas, has been regulated by the EEA Agreement. This agreement obliges Norway to follow regulations related to the EU's internal energy market. After a process of consultation and negotiation among the three EFTA-EEA countries and the European Commission (EC), EU acts can be transposed into national legislation. The EFTA Energy Working Group has met with the EC to discuss the EU's Renewable Energy Sources (RES) Directive on several occasions, and is currently discussing the implementation of the directive within the framework of the EEA Agreement (Box 13.3). When agreement is reached, Norway will prepare an action plan, which will be a good opportunity to reflect on national and county strategies for regional development, climate change, energy security and environmental considerations and actors. At present, Norway has set itself an ambitious target to reduce global greenhouse gas emissions by 30% of its 1990 levels by 2020, and to become carbon-neutral by 2050. Meeting the 2020 target will be challenging, because both the country's electricity supply and energy use in buildings are already essentially carbon-free (IEA, 2011).

Box 13.3. **The EU's renewable energy strategy**

It was not until 2005 that a mandatory and comprehensive energy policy was adopted at the EU level. Before then, EU Member States pursued intergovernmental initiatives motivated initially by energy security in the 1970s and subsequently by environmental concerns in the 1990s. In 1997, in reaction to the Kyoto Protocol, the EU introduced non-mandatory targets for the RE share of total energy consumption for Member States. In 2006, the European Commission issued the Green Paper: A European Strategy for Sustainable, Competitive and Secure Energy. This asked Member States to implement a European energy policy built on three core objectives: *i*) sustainability – to actively combat climate change by promoting renewable energy sources and energy efficiency; *ii*) competitiveness – to improve the efficiency of the European energy grid by creating a truly competitive internal energy market; and *iii*) security of supply – to better co-ordinate the EU's supply of and demand for energy within an international context. In 2007 this was translated into mandatory shares of RE production for Member States in the form of the Renewable Energy Roadmap; these were further increased in 2009 in the EU's Directive on Electricity Production from Renewable Energy Sources (popularly known as the RES Directive). This set the overall mandatory goal of achieving 20% of RE in total energy consumption (10% of transport biofuels) by 2020, which has become part of the "Europe 2020" Strategy.

National policy

In Norway, RE deployment falls under several policy frameworks, including energy and regional development. The governance of renewable energy policy is dominated by the Ministry of Petroleum and Energy. The Ministry of Environment is also involved, being responsible for climate policy and relevant physical planning issues at the national level. The ministries of local government, regional development, and agriculture have a limited role, except through Innovation Norway (described below), which is a regional development instrument.

The liberalisation and development of the Nordic energy market and the need to find further ways of reducing CO_2 emissions are the primary drivers of Norway's RE policy, followed by job creation. The liberalisation of the energy market started in 1991 and has had a profound impact on national energy policy, including RE. Norway, Sweden, Denmark and Finland created the Nord Pool in 2001 to integrate their energy systems and compete on the European market. Under this framework, Norway has started co-operating with Sweden to support RE though a common renewable energy certificates (REC) scheme, launched in 2012. The creation of the Nord Pool was coupled with a specific policy to reduce carbon emissions in the energy sector.

The Norwegian government established ENOVA in 2001 to stimulate non-hydro renewable energy production. ENOVA administers a series of programmes and support schemes (in the form of investment aid) covering wind power, tidal power, district heating, and energy efficiency in industry and buildings. ENOVA was contracted by the Norwegian Ministry of Petroleum and Energy to generate projects totalling 18 TWh by 2011. By 2010 their projects amounted to 13.8 TWh, of which 5.1 TWh has been completed (so they are below their target). Large investment in climate change mitigation technologies allows ENOVA to support several RE sectors. Since the parliament's 2008 Climate Agreement, public spending on climate change mitigation has increased substantially. Public funding for research, development and deployment of clean energy more than tripled between 2007 and 2009. This increased ENOVA's investment capacity to promote energy efficiency and renewable energy by NOK 1.2 billion (approximately USD 190 million, or EUR 140 million) between 2008 and 2009 (IEA, 2011). ENOVA has been supporting a series of full-scale demonstration projects: tidal power projects (Hydro Tidal and Kinetic Energy), the world's first floating wind turbine (Hywind) and the world's first salt-power (osmosis) plant. ENOVA has also supported the world's largest off-shore wind installation, Sway. ENOVA has a programme to promote photovoltaic energy, due to the country's manufacturing specialisation in this sector (Box 13.4). These demonstration projects, mostly located in rural areas, make Norway one of the pilot countries for RE technologies.

Box 13.4. **Norway's solar energy manufacturing industry**

The Norwegian multinational REC, founded in 1996, is a world leader in the vertically integrated solar energy industry. REC is one of the world's largest producers of polysilicon and wafers for solar applications and a rapidly-growing manufacturer of solar cells and modules. In 2010 its worldwide revenues were close to NOK 14 billion. REC's production fell in 2011 as a result of the economic crisis and falling solar cell demand and prices. However, it is still producing in three rural regions including Narvik, just south of Troms County, despite the recent shut down of one plant in Trondheim.

Large-scale hydro-electricity is already well developed and building more large hydro plants will be expensive in terms of money, landscape and natural resources. Of the different RE technologies available, Norway considers small hydro and wind energy the most promising since both water and wind are abundant. However, small-scale hydro-electric plants are particularly sensitive to cold and icing, which dramatically reduces their productivity. A solution is to couple small hydro with wind energy, which is more resilient to the cold. Small-scale hydro potential has recently been mapped for the whole of Norway. The potential is overwhelmingly strong in rural regions, particularly those in the west and north. A recent GIS assessment of small hydro suggests a potential of 25 TWh nationally with an investment cost of less than NOK 3 per kWh (Juliussen, 2007).

Small-scale hydro is supported by a specific national programme in which the state participates directly in the initial investment and shares the profits with landowners. This operates through the state-owned energy company Statkraft, which co-operates with landowners through a business model called *Småkraft*. In this interesting business model, Statfkraft develops the project and splits the profits 50-50 with landowners who host the RE installation. Statkraft has about 200 such co-operation agreements and 10 projects are up and running. Table 13.4 shows the current and potential situation with *Småkraft* small-scale hydro plants and related waterfall agreements Norway.

Table 13.4. **The potential for small hydro developments in Norway**

Total existing large and small-scale hydro installed capacity	122.7TWh
Estimated remaining potential for hydro	37 TWh
Potential for small-scale hydro (at investment cost of <NOK3 per kWh)	25 TWh
Småkraft agreements in operation end 2010	285 GWh
Småkraft sites under construction	114 GWh
All Småkraft waterfall agreements	2.3 TWh

Source: Criscione, V. (2011), "Exploiting Norway's Hydropower Potential", *www.mypaper.se/show/findexa/show.asp?pid=345154792164355&page=23*.

District heating is another expanding technology and a very promising option for creating a localised demand for biomass. The consumption of district heating in Norway was 4.3 TWh in 2010, an increase of 31% from 2009. High investments in 2009 and 2010, partly supported by ENOVA's schemes, have led to expectations of further growth in district heat consumption in the coming years. However, although district heat consumption is increasing, it only accounts for 1.6% of the net domestic consumption of energy. About half of the resources used for district heating in Norway are forest biomass and municipal waste, which are supplemented by gas, oil, hydro power and waste heat. The price of district heating in Norway was 65.1 øre/kWh in 2010, excluding VAT.[4] This was an increase of 13% over the year before. High prices and increased sales significantly increased sales income from district heating in 2010 (by 46% over 2009 levels, totalling NOK 2.7 billion). As we have seen in other case studies, supporting district heating is a good policy to create a stable and large demand for woody biomass, which also reduces the need for public subsidies for gathering and treating biomass as a part of timber management practices.

Efforts to develop RE technologies are coupled with investment in upgrading the grid. Norway joined the North Seas Countries' Offshore Grid Initiative in 2010, which involves nine other northern European countries. The initiative is part of the EU's "supergrid" proposals linking the energy markets. Norway's hydro-power is seen as a giant battery for this system. However, this investment in empowering the grid will probably increase future electricity prices in Norway.

Finally, the national government also has a specific focus on job creation through RE. For example, government and industry together established the non-profit organisation INTPOW in 2009. INTPOW is intended to strengthen longer-term value creation and employment in the energy sector through the internationalisation of Norwegian technology. Ministries of local government and regional development and agriculture contribute to the national RE policy through Innovation Norway (IN), the government's most important agency for innovation and the development of enterprise and industry. IN has an office in each county, which works closely with the county and municipal authorities. It provides advice, financing, promotional, competence building, and networking services.[5] One area where IN is active is in promoting bioenergy for heating. The goal of this scheme, launched in 2009, is to increase the production of bioenergy by 14 TWh by 2020 in order to stimulate job creation. The bioenergy scheme for 2011 has a budget NOK 45 million. The scheme is available to farmers and forest owners and provides support to installations. In 2009/10, the scheme financed a total of 16 projects (2 of which focus on the production of woodchips). IN has also a large plan to improve the grid in the rural north of Norway. The agency will invest NOK 20 billion to improve maintenance, transmission and distribution and link the national system to the north of Sweden and the north of Finland.

Regional and local policy

Local governments are becoming increasingly important in the national governance mechanism; nevertheless, the influence of national policy decisions on RE deployment in Troms County is stronger than in other case studies. Counties and municipalities are involved in many decisions about the location of RE plants, as well as about regional and local development. Innovation Norway works closely with the county authorities on rural development priorities, clusters, etc. Both municipalities and counties, especially those with resource revenues, also invest their own resources, and in some cases the investment is related to renewable energy. For example, in Troms County, Dyrøy, Storfjord and Tromsø municipalities are all involved in renewable energy initiatives.

Counties and municipalities are also involved in the energy sector by running local energy utilities. As we have also seen in some of the other case studies, an energy company active at the local level and owned by local public authorities can be a good way to link RE deployment to local economies. As already observed in other regions (Sweden, Denmark and Québec) local utilities often have a specific focus on developing the region ("putting money back into the community"), investing in local culture, leisure activities and other public services. This is also the case in Troms County (Box 13.5). Tromsø Kraft, for instance, invests in the region providing local dwellers with services and better energy infrastructure in spite of the very high tax on the energy sector that characterises Norway (53%, and up to 70% in the oil industry).

Box 13.5. A locally-owned utility: The case of Tromsø Kraft

The OECD delegation met with representatives of Tromsø Kraft (TK), the regional utility in Troms County. TK is an energy company based in Troms County and owned by local municipalities. Established in 1898, TK employs 450 people and is the largest utility in the north of Norway. According to local stakeholders, despite its remote location, TK is able to compete on the international market. TK, like other regional utilities met during this research, stresses that the local availability of reliable energy sources is an important factor in attracting firms to the region.

TK is active in four energy areas: energy production; end-user sales (through another company also in Sweden and Finland); contractor enterprise; and energy supply.

- Annual production of energy is 1.1 TWh (2% of national capacity) from 12 large hydro plants owned and operated by TK. The company operates four power plants with an average annual production of 2.1 TWh. TK also aims to develop the largest wind power plant in North Norway (the Fakken Vindpark).
- Distribution: TK is the largest power line owner in North Norway, with a total of 9 000 km. TK serves 7 000 customers with a total of 2 500 GWh.
- Contractor enterprise: TK provides customers with ancillary services such as telecommunication (broad band Internet – as in the Swedish case). It is the leading contractor in North Norway.
- Energy supply: besides electricity, TK also produces heating using approximately 10 000 metric tons of wood chippings. The University of Tromsø, the hospital, the Research Park and a local school are TK's largest customers.

TK has recently diversified its activities into media and cultural services. The company owns the largest cultural magazine in Sweden (*Voltaire*) and an Internet bookstore. This is a relatively small business (approximately EUR 300 000 in 2010) but with good potential for growth.

The city of Tromsø has been able to develop an innovative system to produce energy through water management. The water and sewage department of Tromsø Municipality has undertaken a number of innovative projects to reduce its own energy demands, and aims to be energy neutral in 2014, which implies producing more than 7 GWh of energy themselves. The city is currently extracting energy from the fall of water between the source and the urban settlements, and also by using heat pumps to remove heat from sewage. For example the Stradveien district heating scheme in Tromsø delivers heating and warm water to 1 200 apartments, and also to an industrial and commercial area of 30 000 square metres. It has an annual energy capacity of 13.5 GWh, and 60% of this is extracted from sewage. Representatives from the city estimate that another 3-4 GWh could be produced, which could rise to 7-8 GWh within 20-25 years when the next step in sewage treatment is taken.

Assessment of policy impacts on rural development

Stimulating local economies

Neither Norway nor Troms County has seen a "gold-rush" to adopt RE. The region lacks the "green narrative", present in many regions and countries, which sees RE as the panacea for rural development. Despite Norway's ambitious overall targets for installed RE capacity, policies support several technologies, rather than focusing on a single "winner". Subsidies to RE are mostly targeted to demonstration projects rather than

producers, and it was only in 2012 that Norway introduced a REC programme (shared with Sweden) to support wind energy. Yet, even the availability of incentives is not causing the explosive uptake observed elsewhere. For instance, Troms County has just started the spatial planning process for siting wind energy, and is taking a cautious approach because local communities and industries are suspicious of wind installations, fearing a negative impact on the landscape on and the growing tourist industry.

Norway has a tradition of sharing the benefits from natural resources with local communities. The high level of public ownership in the power industry, and the presence of locally-owned utilities, such as Tromsø Kraft in Troms County, underline the principle that natural resources belong to the people, and that local communities should share in the benefits from their exploitation. This is a notion firmly embedded in Norwegian culture (Senghass, 1985; Brox, 2006; Aspen, 2011). This means that rent-seeking has been less of a problem in Norway than in other countries. However, recent events are reducing the scope for RE in rural Norway to be linked with rural development.

Traditionally, hydro-power has been associated with rural industrialisation in Norway. The Concession Acts of 1906-9 required that energy plants be combined with energy-intensive manufacturing, and assured the reversion of hydro dams and plants to the state after 60-80 years (Lange, 1977). Besides cheap energy, hydro plants generate local taxes that benefit regional communities, enhancing the link between local resources and local communities. However, the 1991 liberalisation of the electricity market, the creation of Nord Pool in 2001, and the European Union rules have reduced the possibility to differentiate energy prices at the local level, and levelled out transmission charges across the country. So what had been a major driver to produce hydro power in rural areas – attracting energy intensive firms – cannot be replicated by RE sectors, and their role within rural economy is still unclear. Although liberalisation apparently involved some efficiency gains in the energy industry, it might also act against regional development interests and efforts, especially in the remoter and more peripheral areas.[6]

Where benefits for local communities from RE are low, this can lead to low public acceptance and time-consuming procedures for agreeing on RE deployment. This is evident in wind energy (Aspen, 2011). The central government had been planning to capitalise on the good wind resource in the north of the country by increasing production of wind energy in these areas. It had selected several sites for locating wind farms. However, as the production of RE does not represent a concrete advantage for the hosting communities, and as there is a general perception that negative externalities are not being compensated for by the RE policy, they have tended to oppose them. It can therefore take up to 10 years to deploy wind farms in rural Norway, undermining the national strategy to couple wind energy with small hydro. Wind is not the only sector to suffer from low public acceptance, and neither is it only the "top down" approaches that are unsuccessful. For instance, Troms Kraft Varme AS, which is the District Heating subsidiary of Troms Kraft AS, is unable to finalise a project – for which it holds a concession – to develop and build a remote heating pipeline on the entire island of Tromsø (with long term demand potential of 120 GWh) due to local opposition to siting a wood-based biofuel plant close to the urban centre. This mirrors opposition to plants producing energy from waste resources through recycling. Again, this is linked to the fact that local communities do not perceive substantial benefits coming from RE production.

Stimulating innovation

Norway is successfully promoting new and innovative RE technologies, reducing the risk of being stuck with an inefficient RE sector. Its activities could make it a major player in offshore wind, tidal energy, adaptation of RE technology to Arctic conditions, and in low energy wood housing and building design. It is currently a leader in salt-fresh water osmotic energy, and this could also have long term potential. Its supply chain activities in silicon wafers and related technologies are also globally important and seem likely to remain major players in the future.

Main challenges

The Troms County case study highlights the importance of ensuring that RE deployment provides rural communities with tangible benefits. Current drivers of Norway's RE policy, i.e. climate change mitigation and liberalisation of the national energy market, which ends long-term supply contracts to energy-intensive firms, do not engage local communities, and may actually erode regional competitive advantages linked to the availability of cheap (hydro) energy for manufacturing activities. Higher prices for energy will generate larger rents for hydro-power owners and higher taxes and fees for municipalities and counties, but it is difficult to understand the net impact for rural communities. If RE deployment was better linked to local dynamics and if there was compensation available for possible negative impacts, this could increase public support for RE.

Notes

1. In this report Troms County is used to identify the county and Tromsø to identify its major city and administrative capital.
2. For example, the National Centre for Telemedicine is based in Tromsø.
3. The European Free Trade Association (EFTA) was founded in 1960 to promote free trade in Western Europe. Many of its former members are now part of the European Union and current membership is reduced to Iceland, Liechtenstein, Switzerland and Norway. Through EFTA, Norway is also part of the European Economic Area (EEA) – established in 1994 – and can participate in the EU's Internal Market without a conventional EU membership. In exchange, Norway is obliged to adopt all EU legislation related to the single market, except laws on agriculture and fisheries.
4. Øre is the centesimal subdivision of the Norwegian Krone.
5. IN plays a similar role to CAP Pillar II in EU countries.
6. However, new rules in the energy market that equalise the price of energy across the country will increase profits for hydropower companies, which have low electricity production costs. These profits may further increase if the price of emission permits also increases. Since 88% of Norway's hydropower capacity is owned by the state or local authorities, this would mean more money for the authorities' budgets.

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Chapter 14

Extremadura, Spain

Rural development and renewable energy (RE) in Extremadura: Summary and conclusions

Main findings. *i*) Predominantly rural regions can engage in ambitious RE deployment plans. *ii*) RE development can bring some benefits in terms of revenues for local communities and employment creation, but there is a risk of generating very high expectations. *iii*) The focus on large-scale RE deployment projects (i.e. attracting investment) should not undermine small-scale projects involving close co-operation with local communities.

Renewable energy in Extremadura: A summary. RE is booming in Extremadura and is benefiting regional development. Large-scale solar energy installations have the lion's share of RE deployment. These include some of the biggest photovoltaic (PV) parks in Europe. With feed-in tariffs (FITs) offering high and stable revenues over 20 years in a moment of crisis, large construction companies and foreign investors deployed a total of around 4 000 MW of PV all over the country in two years – ten times more than expected. Extremadura was a key player. Between 2007 and 2008, the region's PV capacity soared from 56 MW to almost 400 MW. Now the PV boom is dying down, the focus has shifted to Concentrating Solar Power (CSP). The large deployment of RE is affecting the regional energy mix. RE represented 5.7% of all electricity produced in Extremadura in 2010, but this figure is expected to rise to 20% in 2015. These percentages can be better understood by considering that Extremadura was already highly specialised in the production of electricity, being home to one of the largest nuclear plants in Spain and several hydroelectric installations. The rapid expansion of RE in Extremadura has been supported by three main elements: *i*) the presence of natural resources, such as abundant sun irradiance, land and water; *ii*) highly profitable national feed-in tariffs in 2008 and 2009; *iii*) a dense electricity grid, which facilitates the connection of RE installations to the network.

How is RE contributing to rural development? Extremadura is a good example of the benefits and challenges of rapid and large-scale deployment of RE in rural areas. The new sector generated a lot of expectations in terms of rural development at a time when rural areas were suffering the worst part of the economic crisis. The direct impact of RE deployment on jobs is relatively low, but even so the impact is pronounced in small rural municipalities with high unemployment and few income sources. The deployment of installations has generated a large number of temporary jobs in the construction sector, although long-term jobs in maintenance and manufacturing activities are relatively few. Some companies have been able to specialise in production connected to the RE supply chain, such as metal support structures for PV and CSP panels. These firms are also located in rural areas and generate stable and valuable jobs based on existing skills and competencies.

The explosive deployment of PV has challenged the region´s capacity to fully absorb the benefits of this sector and to build the required skills and competences fast enough to trigger endogenous development. This caused some frustration, with a portion of workers (especially the higher skilled) initially being brought in from other regions. A more gradual development of RE in the region would have allowed for better adaptation by local human, industrial and institutional framework to the requirements of the new industry. The massive investment in PV and, more recently, in CSP, might also have hindered the deployment of other RE technologies likely to have a larger impact on local labour markets, such as biomass (which is connected to primary activities). This was also because FITs for solar power were far more favourable than for some other renewables. To control the unforeseen expansion of some RE like PV, and to control the tariff deficit, the government made different changes in the national regulation (e.g. establishing maximum yearly quotas that can benefit from FITs) in 2009. Finally, in early 2012, the government decided to temporally cancel the FITs system for future RE initiatives. There are uncertainties about the length of this recent measure and the way in which it will affect the expansion and future development of RE in Extremadura.

Future challenges. The regional government is now trying to promote small-scale RE and biomass. Small-scale projects may have a larger impact on local labour markets, require less financial investment and use smaller quantities of land and water. However, they also have higher transaction costs and suffer from poor co-ordination among RE and rural and agricultural policies. Better policy integration could trigger RE development in rural areas at a pace that is compatible with Extremadura's resources and capabilities. It would also be crucial to develop a streamlined permitting procedure for small projects (currently a 1 MW plant must follow the same procedure as a 50 MW plant).

The context

Extremadura's socio-economic profile and performance

Extremadura is in southwest Spain near the Portuguese border, and is one of the country's 17 autonomous communities.[1] The region is made up of two provinces, Badajoz and Cáceres. This predominantly rural region has a territory 41 634 km^2 and a population of over 1.1 million. The population density (about 26 inhabitants per square km) is very low compared with the national average in Spain (91 in/km^2; see Table 14.1). The region has a dispersed population pattern: out of its 385 municipalities, only three have more than 50 000 inhabitants (Badajoz, Cáceres, and Mérida), while 199 have less than 1 000 inhabitants. The population has largely remained the same size since 1920 mostly due to the balance between the birth rate and the high emigration rate (especially of young people) to more prosperous regions.[2] For example, between 2002 and 2008 the region lost approximately 12 000 people through outmigration. Extremadura is dissected from east to west by two major river basins, the Tajo in the north and the Guadiana in the south (the two largest rivers in Spain). The local network of marshes and water reservoirs has a capacity of 19 639 cubic hectometres and underpins much of Extremadura's energy and agricultural production. A large part of the region is under the *Dehesa* agro-forestry environment and production system, dominated by cork oak, holm oak and pastures. This system combines the extensive use of crops, livestock, and sylviculture with a diverse and well preserved wildlife habitat. The region has 167 natural protected areas which together cover one-third of the region's land mass.

Table 14.1. **Extremadura: Demographic data**

	Extremadura	Spain
Population (2011)	1 075 800	45 908 100
Population share (2011)	2.34%	
Population density (in/ km^2)	26	91
Elderly dependency ratio (2008)	28%	25%

Sources: *OECD Regional Database*; Spanish National Institute of Statistics (INE).

Extremadura's economy lags behind Spain's and the EU's, though the gap is closing slightly. Extremadura has been the region with the lowest GDP per capita in Spain since the mid-20th century. The GDP per capita gap has narrowed in recent years (from 64.1% of the national average in 1995 to 70.2% in 2010) (Table 14.2), and Extremadura was the Spanish region with the highest GDP growth between 2000 and 2009. In the same period it also had the highest increase in the number of opening companies (Junta de Extremadura, 2010a). This development was supported by funding from the EU´s cohesion policy (Extremadura is classified as an "Objective 1" region), and by a modernisation and diversification of the regional productive system, described below (Junta de Extremadura, 2010b). However, unemployment, and long-term unemployment, remain extremely high, especially for young people and women. Employment rates are also lower than the national average. Finally, the gap with the national average is also felt in terms of the region's lower infrastructure density, human capital and innovation capacity. The economic crisis has hit this region especially badly, resulting in a worsening of unemployment between 2008 and 2011.

Table 14.2. **Extremadura: Main economic indicators**

	Extremadura	Spain	OECD gap
GDP *per capita USD PPP*			
1995	7 283	11 354	
2007	16 266	23 478	68%
2010	16 014	22 819	
GDP per worker USD PPP 2007	43 526	54 286	80%
Employment rate (2011)	51.9%	58.5%	
Unemployment rate			
2008	15.2%	11.4%	8.9%
2011	25.2%	21.8%	
Unemployment rate (2011) Women	28.5%	22.3%	
Long-term unemployment (2011)	11.3%	10.4%	
Youth unemployment (2011)	50.9%	46.4%	
Infrastructure (motorway density – area) (2008)	15.4	26.7	
Tertiary education attainment (2008)	26.9%	32.8%	

Sources: OECD Regional Database; Spanish National Statistics Institute (INE).

The regional industrial mix

The regional productive structure is focused on land-based activities and the public sector. Although the importance of agriculture within Extremadura's economy has declined over the last two decades, it is still twice the national average in terms of employment (9.8% of the workers in Extremadura worked in the primary sector in 2011, in contrast with 4.2% in Spain). The region has about 70 000 farms, over 50% of which are devoted to tree crops (especially olives). Grain production and livestock are also important, especially sheep and pigs. Extremadura leads the Spanish production of high quality Iberian ham and is the third largest region for olive oil production (after Andalucía and Castilla la Mancha). However, employment opportunities in the agricultural sector have dropped significantly (13.5% of regional employees worked in agriculture in 2005 compared to 9.8% in 2011). The relative weight of the public sector in the labour market is also high, covering 26% of all jobs. The services sector is less developed than in the rest of Spain. However, Extremadura's recent emphasis on long-term, entrepreneurial empowerment and human capital improvements has created an entrepreneurial rural economy with a more solid configuration than other rural areas in Spain (OECD, 2007). The number of enterprises per 1 000 inhabitants increased from 9.5 in 1986 to 67 in 2008 (Junta de Extremadura, 2010b).

Extremadura's energy resources

While the number and diversity of industries has rapidly increased, energy is positioned as the leading industrial sector in the region. The economic weight of regional manufacturing is relatively small (5.5% of the regional GDP compared to 12.5% in Spain) and its composition is polarised, with a large concentration in the energy subsector. There is a relatively small industry linked to the exploitation of natural resources (mainly agro-industry, cork, and ornamental stone). Extremadura has one of the largest nuclear plants in Spain, Almaraz, with 2 018 MW of installed capacity (26% of Spain's total nuclear installed capacity). The region is also one of the main national contributors to hydroelectricity production: 2 292 MW (13% of Spain's total installed hydroelectric capacity). Extremadura has a good endowment of renewable sources of

energy including sun, biomass and hydropower. These natural conditions, and the existence of a dense electricity grid, have favoured a recent expansion of renewable energy (Table 14.3). Extremadura is a net exporter of electricity to the Spanish market, being the region with the highest positive energy trade balance. In 2010, roughly 75% of the energy produced was exported to other Spanish regions (particularly Madrid and Andalucía).

Table 14.3. **The production of renewable energy in Extremadura, 2007 and 2010**

	Installed capacity (MW) 2010	Share (%)	Installed capacity (MW) and regional share 2007
Nuclear	2 018	40.7	1 957 (47%)
Hydroelectricity	2 292	46.2	2 148 (51.6%)
PV	374	7.5	38 (0.9%)
Concentrating Solar Power (CSP)	250	5	
Small hydro	20	0.4	17 (0.4%)
Biomass	15*	0.3	1 (0.02%)
Total	4 969	100	4 161 (100%)

Source: Spanish Electricity Network; Regional government of Extremadura.

Most of Extremadura lies within the area of highest sun irradiance in Spain, with an estimated yearly sun irradiation of 1 700-1 800 kWh per square metre of horizontal area (MITC, 2011). The abundant sun and large areas of land have facilitated the development of PV (374 MW of installed capacity in 2010) and CSP (250 MW), making Extremadura one of the best Spanish regions for solar energy production. The region comprises 10% of the country's total PV installed capacity and 36.7% of the total CSP installed capacity. The installation of solar panels on roofs is still in the early stages, but there could be good potential given the region's vast solar radiation. The development of biomass started recently (15 MW in 2010) also has good potential. Research calculates that 6 million tons per year (1.3 ton oil equivalent) of agricultural, forestry, livestock and agro-industrial waste could potentially be available for thermal and electrical use, which could generate 8 576 GWh/year (IDAE, 2011). Finally, wind energy could generate 42-46 TWh (MITC, 2011).

Renewable energy policy in Extremadura: Objectives, opportunities and challenges

The policy drivers: Why is Extremadura implementing a renewable energy policy?

Extremadura is focusing on RE to promote job creation and rural development. The economic situation in the region has been challenging, particularly in the small municipalities. The shrinking role of agriculture, along with the increasing depopulation of rural areas, has left the region´s smaller municipalities with a challenging budgetary situation. Moreover, the economic crisis has worsened the situation. Thus, regional government and representatives from trade unions and employers associations have signed the *Agreement for Sustainable Energy Development of Extremadura 2010-2020* (discussed further below) to capitalise on the investment in RE. In particular, signatories consider that renewable energy has strong potential for investment and job creation in Extremadura. In addition, RE is seen as an opportunity for the regional economy to become specialised in a promising, modern and sustainable industry.

The policy framework for renewable energy in Extremadura's rural areas

The Spanish energy sector is regulated at the national level, but sub-national authorities have significant responsibilities for implementation. The 17 Spanish Autonomous Communities can decide how and where energy is produced within their territory. They also control the administrative procedures and provisions for managing environmental impact and land use. Local governments also have an influence in the process, as they are responsible for issuing the land use permits and charge local taxes to RE companies. Spain also has some electricity companies operating at the regional level. Finally, the European Union influences national and regional dynamics through its financial resources and environmental, cohesion and agricultural policies.

European policy

It was not until 2005 that a mandatory and comprehensive energy policy was adopted at the EU level. Before then, EU Member States pursued intergovernmental initiatives motivated initially by energy security in the 1970s and subsequently by environmental concerns in the 1990s. In 1997, in reaction to the Kyoto Protocol, the EU introduced non-mandatory targets for Member States for the RE share in total energy consumption. In 2006, the European Commission issued the Green Paper: A European Strategy for Sustainable, Competitive and Secure Energy. This asked Member States to implement a European energy policy built on three core objectives: *i*) sustainability – to actively combat climate change by promoting renewable energy sources and energy efficiency; *ii*) competitiveness – to improve the efficiency of the European energy grid by creating a truly competitive internal energy market; and *iii*) security of supply – to better co-ordinate the EU's supply of and demand for energy within an international context. In 2007 this was translated into mandatory shares of RE production for Member States in the form of the Renewable Energy Roadmap; these were further increased in 2009 in the EU's Directive on Electricity Production from Renewable Energy Sources (popularly known as the RES Directive). This set the overall mandatory goal of achieving 20% of RE in total energy consumption (10% of transport biofuels) by 2020, which has become part of the "Europe 2020" Strategy. The Spanish government has adopted this target under its National Law 2/2011. The *Spanish Renewable Energy Plan 2011-2020* sets concrete objectives for each of the energy sectors (electricity, heating and cooling industry, and transport sector) broken down for each RE technology.

The EU's Cohesion Policy and the Common Agricultural Policy (CAP) also support RE. Extremadura is under the EU's "convergence" objective and has been receiving funding through the European Regional Development Fund (ERDF) and the European Social Fund (ESF). Priority 4 (transport and energy) of the ERDF's operative programme for Extremadura 2007-2013 included promoting energy efficiency and the use of renewable energy For this period, Extremadura received EUR 8.4 million from the ERDF to support different types of RE and EUR 6.3 million to promote energy efficiency and cogeneration (both amounts to be complemented by cofounding from the national government). The CAP is another source of funding for RE. The European Agricultural Fund for Rural Development (EAFRD) – CAP Pillar 2 could also support RE development in rural Extremadura. A good example is the EU LEADER programme, under which Extremadura has 24 local action groups (LAG) and EUR 118.5 million assigned for 2007-2013. LAGs can set up projects to promote the economic diversification of rural economies through RE. So far, however, very few RE projects have been financed by the LAGs (see section on main challenges for more).

National policy

The promotion of renewable energy in Spain focuses on reducing energy dependence and achieving environmental sustainability. Spain has traditionally faced three main energy-related challenges: *i*) lack of energy efficiency, as energy consumption per unit of GDP is higher than the European average; *ii*) high dependence on foreign energy; and *iii*) high emissions of greenhouse gases (MITC-IDAE, 2010). To address these challenges, the Spanish energy policy in recent years has focused on four main pillars: promotion of market liberalisation and market transparency, development of energy infrastructure, promotion of energy efficiency, and promotion of renewable energy. Within this context, the national policy to promote RE has focused on reducing emissions and the energy deficit. RE deployment is also part of a broader national agenda aiming at energy efficiency (IDAE, 2010; MITC-IDAE, 2010).

Spain was an active and early promoter of renewable energy. Extensive legislation has supported the development of RE. The Electricity Sector Law 54/1997 established that 12% of primary energy demand had to be met using renewable sources by 2010. In 2005 two new objectives were established: 5.83% of conventional fuels consumption by the transport sector should be satisfied using biofuels, and a minimum of 29.4% of gross electricity demand had to be covered by renewable sources by 2010. Finally, Spain assumed the European targets that supported the use of energy from renewable sources (European Directive 2009/28/EC) with the adoption of the 2011-2020 Renewable Energies Plan and other national laws to promote energy efficiency and a sustainable economy (IDAE, 2010).

RE growth in recent years has mostly focused on wind and sun. In terms of primary energy consumption, RE has gone from producing of 6.3% national energy in 2004 to 11.3% in 2010. In terms of electricity generation, RE contribution to gross final consumption of electricity increased from 18.5% in 2004 to 29.2% in 2010 (MITC-IDAE, 2010). As a result, Spain is the leading country in Europe and the second in the world in terms of installed solar thermal electric capacity; second in Europe and fourth in the world in terms of installed wind power; and second both in Europe and in the world in the photovoltaic sector (IDAE, 2010). Other forms of RE, such as biomass and biofuels, have still not reached their potential, while technologies like ocean wave energy and geothermal are still in the early stages of development. Research conducted in 2010 by the Trade Union Institute of Employment, Environment and Health in collaboration with the Institute for Energy Saving and Diversification (ISTAS-IDAE, 2010) calculated that the RE sector provided 70 000 direct jobs and 45 000 indirect jobs. Most of the employees worked in wind energy (50%), followed by PV (26%) and CSP (9%). More than 80% were permanent contracts.

Spain has used feed-in tariffs (FITs) to support the production of electricity from RE. The aim of FITs is to compensate for the marginal cost of producing renewable energy compared to conventional sources. To do so, the national operator(s) pay a bonus to the producers who feed electricity into the grid. This bonus is paid over a long period of time (usually 20 years) so that the producer of renewable energy can pay off the initial cost of the installation. Under this scheme, the cost is shared by consumers and conventional energy producers. While the introduction of a high feed-in tariff has been effective in supporting RE deployment, it has increased the cost of energy. So far, the Spanish government has been buffering an increase in electricity tariffs by asking electric companies to assume "temporarily" the "tariff deficit". The tariff deficit started in 2000, before the massive deployment of RE, when the government avoided raising the

electricity prices following the sudden increase in oil prices. FITs to renewable energy could have contributed to increase this "tariff deficit"[3] (IDAE, 2010).

The effects of FITs have been uneven and often unforeseen. FITs have varied according to the renewable source of energy. In this vein, between 2007 and 2008 Spain probably miscalculated the bonus for electricity producers from PV and fixed a high feed-in tariff. Along with the crisis in the construction industry, this caused many investors to finance the development of PV plants. In 2008 the government's objective was to reach 400 MW of PV, but by 2010 there were close to 3 500 MW of cumulative installed capacity.

Recent legal changes make the future development and expansion of RE in Spain uncertain. To control the unforeseen expansion of some RE sources like PV, and to control the tariff deficit, the government adjusted national regulations in 2009. For example, it has established maximum yearly quotas that can benefit from feed-in tariffs so as to reduce the amounts of feed-in tariffs. Finally, in January 2012, the government decided to temporally cancel the feed-in tariff system for future RE initiatives (*Real Decreto-ley* 1/2012),. This legislative measure will affect all types of RE. However, it will not affect FITs for existing or approved projects. There are uncertainties about how long this measure will last or how it will affect the expansion and development of RE in Spain.

Regional and local policy

The regional government has been an active promoter of RE. The regional strategy is aligned with the national government's strategy to expand renewable energy. As mentioned, RE is seen as an important source of new jobs and an opportunity to develop a promising, modern and sustainable industry in Extremadura. Between 2007 and 2011, the regional government concentrated into a single ministry *consejería* all the key issues related to RE deployment that were under the regional competence. This institutional arrangement allowed the regional government to speed up the authorisation process for RE installation. It also allowed it to invest in improving the grid through regional plans for upgrading municipal electricity networks, and to offer training for regional workers to match the demand from RE sectors (Box 14.1). However, this governance arrangement might have undermined the co-ordination between energy and rural development areas (since each is governed by a different *consejería*). In 2011, as a result of a change in regional government following regional elections, the *consejerias* were restructured. Energy is now integrated into the *Consejería* for Agriculture, Rural Development, Environment and Energy, offering opportunities for synergies and interactions among these closely-related areas.

RE deployment in the region involves key intermediate institutions including local governments, trade unions, and business organisations. Involving local private and social institutions in RE development has proven to be crucial for social acceptance and to better adapt RE development to the regional context. The regional government developed the *Agreement for Sustainable Energy Development of Extremadura 2010-2020* in consultation with various social actors, the region's political parties and the regional parliament. It was signed by the government, and the main representatives of trade unions and employers associations. As a consequence, RE development has good support from local public, private and social actors. The role played by some public and private "meso-institutions", such as the Regional Employment Office (SEXPE), the regional energy

agency, the Energy Cluster, and the Engineering University, has also been crucial in RE development (Box 14.1).

Box 14.1. **Institutions supporting renewable energy development**

The Extremadura Regional Employment Office (SEXPE). Adapting the local labour force to the new demands required by RE was a crucial challenge for Extremadura. SEXPE has a network of job centres all over the region that provide local communities with tailored training services through 210 development agents. Training is designed together with local governments, business representatives and trade unions. The SEXPE network has strongly supported the regional specialisation in RE with the aim of reducing high regional unemployment rates. SEXPE collaborates with other regional institutions like the Energy Agency of Extremadura and the Cluster of Energy in providing training in renewable energy areas.

The Energy Agency of Extremadura. The Energy Agency is a non-profit agency with public status. It was created in 2001 to support public authorities in making decisions about energy issues. It currently provides assistance and technical advice on energy to businesses, public institutions (such as small municipalities) and the general public. It provides technical RE training and professional courses (in collaboration with SEXPE) to professionals, workers (e.g. to manage agricultural residues) and operators in the maintenance services. The role of the agency is particularly important in biomass and solar energy. The agency has co-organised a forum to develop a network of people working in the field of biomass to exchange innovative business ideas (*www.formatebio.es*). Another project, "Retaler", involves Spain and Portugal and has conducted several research activities to study the potential of biomass. This project aims to create a network of collectors and producers of biomass. The agency is also trying to create a consortium of firms and set up a laboratory/test field and an international training centre in solar power, capitalising on Extremadura's current specialisation.

The Energy Cluster. The energy cluster is a private non-profit organisation of entrepreneurs founded with the support of the regional government. It aims to improve the competitiveness of the energy sector in Extremadura, promote the development of new projects and defend the interests of the sector (lobbying); promote collaboration among members (networking); and facilitate the internationalisation of smaller firms that are part of the cluster. It currently has more than 80 members, including most of the private and public energy firms operating in Extremadura (e.g. Iberdola, Endesa, and other large companies), the Energy Agency of Extremadura, universities and technology centres. It offers a meeting place where all those involved can co-operate. Eighty per cent of members are companies active in RE; the rest are firms related to conventional sources or nuclear energy. Public money covered its activities for two years, but now it is completely self-financed (by selling specific services, such as training).

University of Extremadura. The University of Extremadura plays a key role in providing specialised skills to the RE sector in the region. It has evolved from a community college offering a three-year course in engineering to a university with five-year training courses in several specialisations. These training courses are coherent with the regional industrial mix and support regional development in new industries, including RE. The university is trying to enhance its links with other regional organisations to strengthen co-ordination in R&D and investment.

The initial RE focus in the region has been large-scale solar energy, following the government decision to limit wind energy deployment in order to protect the landscape. Solar energy has been developed through large-scale facilities that took advantage of Extremadura's favourable natural conditions and national and regional support and incentives. Some of the largest solar installations in Europe are based in Extremadura, such as the 150 MW CSP EAFRD plant (Box 14.2). While the initial boom in solar energy has decreased, several approved projects still plan to build large scale facilities. In

contrast, regional regulations have hindered the development of wind energy in Extremadura. In 2005, the government enacted a regional law that required wind plants to create at least three local jobs indirectly related to the plant (e.g. component manufacturing) for each MW of installed power. As this regulation didn't exist in other Spanish regions, investors avoided Extremadura when siting wind farms. The law has since been modified to reduce the legal barriers and renew investors' interest. However, the most recent list of registered projects qualifying to receive the feed-in tariff (prior to the decree that temporarily cancelled the FIT) did not include any wind energy projects.

Today the policy focus has shifted to promoting biomass and small-scale solar installations given that large-scale PV and CSP are currently saturated. Extremadura has already developed some interesting and innovative small-scale RE initiatives (Box 14.2).

Box 14.2. **Innovative small-scale renewable energy projects in Extremadura**

Renting the roofs of public buildings

The municipality of Barcarrota (3 700 inhabitants) is experimenting with small-scale renewable energy projects in public buildings. It began with an assessment of energy efficiency potential in public buildings and outdoor lighting. The developer pays EUR 13 000-14 000 a year to rent the roof space to the public authority that owns the building. Under the current 20-year agreement, the first 10 years of rent are paid in advance, while the second half will be paid later. For this programme, the municipality made a special regulation governing the payment of property tax in public buildings by which companies pay only 25% of the regular property tax. The municipality allocates roofs through public tender, which states that the company should use advanced technology. Companies are also asked to maintain the installation and the building. This initiative has established PV panels on public buildings with a production of 7 143 KW and a total investment of EUR 450 000. The municipality intends to spread this initiative to another five public buildings (an additional 80 KW).

Combined system for biomass collection

A 3.34 MW bioenergy plant in Barcarrota has spurred the development of a biomass collection system in the municipality. Recognising the logistical hurdles for this collection, the municipality has called for bids to manage it. The company that owns the bioenergy plant eventually won the bid. Farmers can bring their agricultural residues to several collection points in the area.

The regional government intends to expand biomass energy further, taking advantage of the large volumes of agricultural, forestry, livestock and agro-industrial waste produced annually. Biomass initiatives could also have a larger impact on job creation. However, the relatively slow development of biomass in Extremadura (15 MW installed capacity in 2010) is a result of the difficulties in reaching long-term agreements between energy and biomass producers. Biomass power plants must ensure the long-term provision of feedstock, but long-term contracts between energy producers and biomass producers are difficult to reach. Banks also ask for long contracts (minimum 15 years) to grant loans to potential producers. Another bottleneck is the long administrative process for investors wanting to build biomass installations. Currently, the regional government is trying to negotiate special treatment for biomass under the new decree-law, introduced in 2012, that temporarily cancels FIT, in order to promote the expansion of this incipient sector in Extremadura. Finally, in the current context of budgetary restrictions, the regional government is focusing on small-scale projects, which require lower investment,

have a lower impact on land use, and a larger proportional impact on local labour markets.

Assessment of policy impacts on rural development

Stimulating local economies

As observed in other case-studies, the direct impact of RE deployment on long-term jobs is relatively low in Extremadura. Building installations has generated a large number of temporary construction jobs, while long-term jobs in maintenance and manufacturing are relatively few. Calculations by the Energy Agency of Extremadura estimate there were 4 509 workers (3 404 direct and 1 105 indirect jobs) in the RE industry in Extremadura in 2010 (Junta de Extremadura, 2011). A large proportion (close to 92%) of these jobs were in building new plants (especially CSP) and could therefore be considered temporary. Between 2010 and 2015, the regional government expects these employment figures to rise significantly, even though a high proportion will still be in constructing the plants.

However, even if employment figures are not very high when contrasted with the active population, RE plants have created jobs in small municipalities that traditionally had low employment. RE development is largely seen in these municipalities as an opportunity to diversify farmers' income sources. In addition, RE initiatives are spread across Extremadura (unlike nuclear energy that is concentrated in a particular place). Benefits may even reach other municipalities, especially if the hosting municipality is too small to provide the employees and services that a large-scale project requires (Box 14.2). In addition to employment, the RE boom has resulted in an injection of fiscal revenues for local governments. Investors have to pay the hosting municipality various land-use and permit related taxes. These advantages are clearly very attractive for small rural municipalities which may even use the new revenues for promoting other development initiatives (Box 14.2).

Some existing local companies have been able to specialise in servicing the RE supply chain, such as by building metal support structures and frameworks for PV and CSP panels. RE has revived other activities such as galvanisation, which had been badly affected by the crisis in the construction sector.[4] These companies offer permanent jobs in these rural areas. Local employment is also created in the management and maintenance of RE sites (cleaning solar modules, electricity maintenance, mechanical maintenance of sun trackers, technical consultancy and advice), and regional SMEs are becoming specialised in these niches. Activities in the RE supply chain could be further explored and promoted.

Box 14.3. **The benefits of renewable energy for small municipalities**

RE investors have to pay the hosting municipality: *i*) a lump-sum equal to between 2 and 5% of the initial investment to reclassify the use of land from agricultural to industrial (each municipality decides its own rate); *ii*) 2% of the initial investment for the construction permit; *iii*) an annual trade income tax if total turnaround is above EUR 600 000 a year; and, *iv*) property tax. Local municipalities can provide investors with fiscal advantages, such as exemption from the property tax for some years.

The case of Extresol solar thermal power plant is a good example of the impact of locating a large scale RE plant in a small municipality. Extresol comprises three 50 MW plants; two are already operating and the third is under construction). It is located in the municipality of Torre de Miguel Sesmero (1 280 inhabitants) The construction of the first Extresol plant employed 350 workers and the second employed 500 workers. Operating and maintaining both plants currently employs 100 people, with an additional 50 jobs expected from the third plant. The surrounding municipalities also benefited from additional jobs and service provision during construction, as Torre de Miguel was too small to offer the required services. Fiscal revenues earned from the reclassification of land use and working permits for the two first plants were inflated the annual municipal revenues 12-fold. In addition, the company will pay trade income and property taxes. The municipality has three main priorities for using the additional resources: *i*) to invest in infrastructure; *ii*) to support rural tourism as an income diversifying local development activity; and, *iii*) to fund social projects (e.g. a residence for the elderly).

The explosive deployment of RE has challenged the region´s capacity to absorb the benefits of this sector, due to its limited capacity to create new skills in such a short time. The rapid and intense process of deployment of PV during 2007/08, and of CSP in 2009/10 took the regional productive and institutional framework by surprise. The first wave of RE deployment mostly consisted of large-scale projects that relied partly on imported technologies and employees (especially the highly qualified). SEXPE started offering training and courses, but matching the skills offered with the competences required in the industry was difficult at the beginning. This situation started to change gradually with better planned training by public authorities and increasing support and involvement of other institutions, like the energy cluster and the energy agency of Extremadura. On the other hand, the first PV and CSP plants were located on valuable agricultural land with access to water. A subsequent regional law has regulated the use of agricultural land more strongly to avoid this situation.[5] An institutional challenge faced by small municipalities is that they are sometimes overwhelmed by the complex administrative processes and negotiations (including potential tax exemptions) required when dealing with large and powerful corporations.

Main challenges

It remains to be seen how the regional RE industry will evolve now that national feed-in-tariff incentives have been withdrawn. Extremadura is to host the first large-scale PV plant in Spain developed without feed-in-tariffs: a 250 MW installation (one of the largest in Europe) in the municipality of Talaván, which is expected to be fully operational in 2014. This shows that large-scale PV might be mature enough to continue evolving without public incentives. However, there are many concerns at the regional level about the effects this measure could have on developing the incipient biomass industry in the region. The development of PV, in fact, could impinge upon the possibility to capitalise on the huge biomass potential that is in the area.

Current budgetary restrictions mean it makes sense to focus public efforts on promoting small-scale initiatives, taking advantage of the acquired regional know-how in RE sectors. Such initiatives could be stimulated further using EU rural development funds (EAFRD – CAP Pillar 2). Extremadura´s LAGs, for example (which have EUR 118.5 million assigned for the period 2007-2013) could promote investment in small-scale plants and other projects related to RE or to SMEs supplying RE. The *Consejería* of Agriculture and Rural Development in the former regional government launched a series of calls for projects, but they did not attract any potential investors or LAGs. This might be a result of co-ordination failures between the *Consejería* of Agriculture and Rural Development and other key stake-holders involved in the field of RE. The new *Consejería* of Agriculture, Rural Development, Environment and Energy is a new institutional opportunity to improve the interaction among these areas. Finally, a streamlined permitting procedure will be needed for small-scale projects (under current regulations, a 1 MW plant must follow the same procedure as a 50 MW plant).

Notes

1. Political power in Spain involves a central government with devolved power for 17 autonomous communities. These regional governments are responsible for the administration of schools, universities, health, social services, culture, urban and rural development.

2 . Extremadura had 1.05 million inhabitants in 1920. The population reached a peak of 1.37 million in 1960. Since 1970 the population has fluctuated between 1 and 1.1 million inhabitants, with a slight but steady increase since 2002.

3. The impact of feed-in tariffs on final price is a complex topic that requires further investigation. For instance, a 2009 evaluation by the Association of Producers of Renewable Energy of Spain ("*Estudio del Impacto Macroeconómico de las Energías Renovables en España*") found no direct relationship between the evolution of the tariff deficit, the feed-in tariffs and the increased penetration of renewable energy in Spain. In fact, the increased production of electricity from renewable sources of energy should reduce the consumption of fossil fuels, and positively affect the national trade balance. However, many governments are tied to fossil-fuel providers by long-term contracts, so the benefits of renewable energy might be strongly delayed.

4. Hot dip galvanising is a metallurgical industrial process that protects iron and steel from corrosion.

5. For example, the construction of the PV "Dehesa solar" plant in Villar del Rey (1.6 MW) has involved the restoration of a slag heap from a nearby slate quarry.

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Chapter 15

Middle Norrland, Sweden

Rural development and renewable energy (RE) in Middle Norrland: Summary and conclusions

Main findings: *i*) Local communities can benefit from RE when it is strategically linked to rural industries. *ii*) Local utilities owned by municipalities play a key role in RE deployment, linking local resources to the energy business and reducing the cost of electricity. *iii*) There is a limited need for subsidies in the local energy system mainly thanks to the effective and profitable role of intermediate institutions such as co-operatives. *iv*) Ensuring that RE provides local communities with tangible benefits improves social acceptance.

Renewable energy in Middle Norrland: A summary. Middle Norrland is an energy-intensive rural region as large as Belgium, the Netherlands and Luxemburg put together. Hydropower, biomass, and wind dominate the regional energy profile. Hydropower is one of the pillars of the regional economy, contributing up to 70% of the region's 25 TWh of electricity generated every year. Further development of hydropower, however, is constrained by environmental regulations. The two counties which make up Middle Norrland have different RE priorities. Västernorrland aims to develop a cluster of firms active in bio-energy and technologies for exploiting forest residues and woody biomass to produce biofuels, while Jämtland's RE policy priority is to increase energy exports. Given the constraint on further development of hydropower installations, the county focuses on wind energy and biomass.

How is RE contributing to rural development? Regional specialisation in energy is mirrored by the presence of locally-owned utilities, which provide the Middle Norrland economy with cheap energy and ancillary services. For example, Jämtkraft, owned by the municipalities of Östersund, produces just under 1 200 GWh a year of renewable energy: 80% from hydro; 17% from combined heat and power (CHP); 3% from wind and less than 1% from biogas. The company supports local development by providing cheap electricity (20% cheaper than the national price), and manages the local district heating system, which generates heat from biomass (forest residues). The regional innovation strategy aims to develop the regional economy by supporting RE production. One example is the Processum Biorefinery Initiative, which has built a demonstration biorefinery which is the largest of its kind and the most profitable in Sweden. The plant directly employs 300 people, and challenges local businesses to provide innovative goods (equipment) and services. It also acts as a large bioenergy R&D facility, triggering patenting and the opportunity to test innovation on a large scale.

Future challenges. RE technologies not linked with rural businesses (e.g. wind) face the sorts of challenges observed in other case studies. In spite of local support for RE and the availability of public incentives, sensitivity over environmental issues in the region means there is local opposition to wind energy installations. However, Middle Norrland's endowment in wind is fair but not exceptional, and estimates of the impact of wind energy deployment on jobs are thought to be over-optimistic as they are based on the assumption that wind deployment will automatically generate manufacturing jobs in the region. Given this situation, and the fact that biomass energy is working well without the need for subsidies, there seems little justification for current efforts to increase wind turbines in the region. While wind energy is the focus of the national RE policy, imposing it on an area that doesn't necessarily need it is unhelpful.

The context

Middle Norrland's socio-economic profile and performance

Middle Norrland is a vast, predominantly rural region in the centre of Sweden. The region comprises two counties – Västernorrland and Jämtlands – which are administratively independent. Middle Norrland lies between the Baltic Sea and the Norwegian border and covers an area of 71 028 km^2; this is bigger than Belgium, the Netherlands and Luxemburg put together. However, this vast territory, which represents 17.3% of Sweden's land area, is home to only 4% of its population (Table 15.1). The population is concentrated in the region's main cities – Sundsvall (50 000 people) and Östersund (35 000) – while the rest of the territory is sparsely populated and covered by large boreal forests.

Table 15.1. **Middle Norrland: Demographic data**

	Middle Norrland	Sweden
Population (2009)	370 000	9 256 347
Population share (%- 2008)	4.03	
Population density (2009) (inh/km^2)	5	23
Elderly dependency ratio (% - 2008)	32	28

Source: OECD Regional Database, http://dotstat/wbos/.

Middle Norrland's contribution to the national economy has been declining over the last decade. The regional contribution to national gross domestic product (GDP) was 3.7% in 2008, compared with 4.4% in 1995. Demographic trends mirror economic performance, with the regional population also constantly declining (which also buffered the decline of GDP per capita). Foreign immigration is quite rare in this rural and relatively peripheral area – although increasing over the last years – and local youngsters tend to leave Middle Norrland for the larger urban centres in the south of the country. As a result, some of the region's more remote rural areas have seen a dramatic drop in their population. Since 2008, the international financial crisis has negatively affected regional employment, which fell by 6 300 people (3.6% of total employment) between 2008 and 2009. In Sweden overall, the total number of employed people decreased by 2.9% over the same period. Industries that have seen the largest reduction in jobs, both in Middle Norrland and in Sweden, are manufacturing and mining.

Table 15.2. **Middle Norrland: Main economic indicators**

	Middle Norrland	Sweden	OECD gap (%)
GDP per capita – current USD PPP	28 793	32 652	117
GDP share (1995)	3.57		
Productivity – current USD PPP	59 328.90	63 302.29	108
Unemployment rate (% - 2010)	10.2	8.4	0.8
Employment rate (% - 2009)	71.3	74.1	6.6
Long-term unemployment rate (% - 2009)	1.3	1.1	-1.8
Youth unemployment (% - 2010)	32.9	25.2	11.9
Infrastructure (motorway density)	0.4	0.20	
Tertiary attainment (% - 2008 data)	31.0	32.4	
Patents per million inhabitants (2006)	122.5	312.6	

Source: OECD Regional Database, http://dotstat/wbos/.

The regional industrial fabric has been evolving from heavy industry and primary activities towards a more diverse mix, although the new sectors tend to absorb fewer workers. Forestry is very important within the economy with forest covering 40 000 km^2, or 56% of Middle Norrland's total territory. However, the two counties forming the region (Västernorrland and Jämtland) are quite different in their industrial mix. Västernorrland, which borders the Baltic Sea, has been one of the main industrial poles in Sweden and is home to heavy industry, with a specialisation in pulp and paper. The high concentration of manufacturing has negatively affected the county's environmental quality. Jämtland, conversely, depends more on primary activities such as farming, and capitalises on its landscape and natural amenities to support a flourishing tourism industry. Tourism in Jämtland accounts for a turnover of about SEK 2.5 billion every year (approximately EUR 270 million) and creates 3 000 jobs every year (2010). Östersund, the county capital, is known as the winter city of Sweden.

Middle Norrland's energy resources

Regional manufacturing activities are backed by the local production of energy, which has become an important regional specialisation. Hydropower, biomass, and wind dominate the regional energy profile. Hydropower is one of the pillars of the regional economy. As in other Nordic case-studies, the abundant availability of cheap electricity was promoted by the industrialisation of the area. The first hydro plants in Middle Norrland were installed in the early 20th century. Today there are 92 plants, representing 5 500 MW of installed capacity. These contribute up to 70% of the region's 25 TWh of electricity generated every year. Approximately half of this power, 12.7 TWh, is exported within the Nord Pool (Box 15.1). Further development of hydropower, however, is constrained by environmental regulations. The large availability of hydropower favours the integration of other renewable sources of energy, such as wind energy, into the grid.

Box 15.1. **Nord Pool: The integrated electricity market in the Nordic countries**

Nord Pool Spot (*www.nordpoolspot.com*) is the largest market for electrical energy in the world, and provides a marketplace for producers, energy companies and large consumers in which they can buy or sell electricity. It offers both day-ahead and intraday markets to its participants. Nearly 340 companies from 18 countries trade on the exchange. The Nord Pool Spot group, which is owned by the Nordic transmission system operators, has offices in Oslo, Helsinki, Stockholm, Copenhagen, Tallinn and London. In 2010, the group had a turnover of 307 TWh – representing 74% of the total consumption of electricity in Nordic countries – and a value of EUR 18 billion. In addition, Nord Pool Spot owns 50% of the Danish gas exchange Nord Pool Gas A/S. In January 2010 Nord Pool Spot and NASDAQ OMX Commodities launched the UK power market N2EX. Nord Pool Spot's system price is the reference price for futures, forwards and options traded in the financial market. The system price is also the reference price for the Nordic OTC/bilateral wholesale market and it is used by distributors for quoting prices to end consumers.

Middle Norrland also has several sites where average wind speeds are 11 metres per second at 100 metres above the ground. This guarantees good conditions for the production of electricity. Another abundant renewable source of energy is biomass – including forest and crop residues – which displays an estimated overall potential of

12 TWh. The region has also estimated that municipal waste (including sewage sludge) could produce 0.12 TWh of energy per year. Finally, solar energy in the region could provide 800/900 kWh per m^2.

Regional specialisation in energy is mirrored by the presence of locally-owned utilities, which provide the Middle Norrland economy with cheap energy and ancillary services. One of these utilities is Jämtkraft, an Östersund based company that produces just under 1 200 GWh a year of renewable energy: 80% from hydro; 17% from combined heat and power (CHP); 3% from wind and less than 1% from biogas. Jämtkraft is a key business for the region, and is owned by the municipalities of Östersund (which holds 90% of the shares), Åre and Krokom. The company supports local development by providing cheap electricity (the local price – EUR 0.08 per kWh, excluding VAT – is 20% lower than the national price). Jämtkraft also manages the local district heating system and supplies heat to the municipalities of Östersund, Åre and Krokom through a 40 km pipeline. The 155 MW CHP plant was built in 2002 and is fed with forest residues to produce electricity and heating (via cogeneration of electricity and heat) for 10 000 households. Cogeneration enables the plant to run at 90% efficiency. The plant works at full capacity, and surplus heat is stored in a large water tower that works like a battery. The company also provides heating to agriculture (greenhouses) and offers heating pellets to customers living outside the district heating network. The company invests to improve the grid in sparsely populated areas and to improve export capacity. The grid will service a total of 80 000 people. Jämtkraft has invested SEK 20 000 (around EUR 2 200) per customer to secure the grid. There is a plan to bury power lines in order to increase their resilience and reduce the landscape impact (important for a tourist region). Jämtkraft also runs a fibre optic broadband network, coupled to the grid, called Jämtkraft Stadsnät. The 100 Mbit/s broadband allows the local population and visitors to access cable television, telephone, and the Internet. The company considers this as a public service, not a profitable business and the service was expressly requested by the municipalities that own the company.

The regional innovation strategy aims to develop the regional economy by supporting RE production. There are several examples in Middle Norrland in which local authorities support research and development (R&D) to create business opportunities within the RE supply chain. The most evident of these are the Processum Biorefinery Initiative in Örnsköldsvik (Box 15.2), and Sundsvall in the Västernorrland County, often referred to as the cradle of the Swedish chemical industry.

The regional innovation policy is also linked to large testing facilities. One such initiative is the Green Highway (GH). This flagship project is a large "laboratory" for sustainable transportation, which is the main target of Sweden's climate change mitigation strategy. The GH is financed partly by an EU INTERREG programme. The highway connects the Baltic Sea to the Atlantic and encompasses Sweden (Middle Norrland region, going through the cities of Sundsvall and Östersund) and Norway (Trondheim) and is specifically designed for "green vehicles". There are stations along the route for charging electric cars and renewable fuels. The GH also has testing facilities to assess the performance of green vehicles in cold weather. This is attracting automobile companies and related industries for their demonstration initiatives, and is having a positive impact on the regional economies along the route.

Box 15.2. **The biorefinery of the future**

The industrial pole based in Middle Norrland, once consisting of large companies, has been evolving into a constellation of small and medium businesses exposed to unstable demand and global competition. These businesses, together with regional authorities and research bodies (including the Mid Sweden University), have designed an innovation strategy – the Processum Biorefinery Initiative – to link existing expertise to a new set of chemical/energy projects based on woody biomass, a raw material readily available in the region. After carrying out extensive research on biofuels and other chemical products based on wood residues and energy crops (second generation biofuels), the Processum Initiative opened the Biorefinery of the Future as a demonstration project in 2010. Supported by a private investment of EUR 2.5 million per year and by public funds, the biorefinery is the largest of its kind and the most profitable in Sweden. It is already able to compete with similar companies in Norway, which have more experience in this industry. It produces black liquor, ethanol, advanced pelletized biomass through torrefied forest residues (green coal) and other bio-energy products. According to local stakeholders, the competitive advantage of the local plant is based on the environmental sustainability of its outputs compared with the oil industry, and also with other "green fuels" extracted from sugar cane and corn (first generation biofuels). The plant acts as the central component of a cluster policy. The plant directly employs 300 people, thus creating a pool of specialised workers in this innovative sector. It also challenges local businesses to provide innovative goods (equipment) and services in a timely and efficient way. The biorefinery is also a large R&D facility in the field of bio-energy, triggering patenting and the opportunity to test innovation on a large scale.

Renewable energy policy in Middle Norrland: Objectives, opportunities and challenges

The policy drivers: Why is Middle Norrland implementing a renewable energy policy?

Middle Norrland does not have a regional strategy for RE deployment; this is the responsibility of county governments and municipalities. While the two counties within the region have different priorities for their RE policies, environmental sustainability is a pillar of both:

- Västernorrland's RE policy aims at capitalising on its manufacturing legacy to develop a cluster of firms active in bio-energy – there is specific support to develop technologies for exploiting forest residues and woody biomass to produce biofuels.
- Jämtland's top RE policy priority is to increase energy exports. Given the constraint on further development of hydropower installations, the county focuses on wind energy and biomass to maximise the production of electricity while minimising the production costs by using a relatively mature technology.

The policy framework for renewable energy in Middle Norrland's rural areas

The Swedish governance model has often been characterised as an "hourglass", in which the national government and the municipal level hold the majority of powers, while the intermediate level (county) is relatively weak. This "classic" model combines a high degree of decentralisation for welfare services (equity), with a relative centralised framework for regional development and strategic planning (competitiveness). For instance, health is under the responsibility of directly-elected county councils, while regional development is managed by national agencies active at the county level (County

Administrative Boards or CABs), adapting national strategies to local needs. However, this model has been evolving in recent decades and Sweden is currently experimenting with new governance arrangements to provide local levels with more scope and competences. While this is also happening in Västernorrland and Jämtlands, local CABs are still in charge of RE policy.

In general, the national public entities involved in RE policy can be grouped into four categories, according to their specific task. Many of these bodies also have regional representations:

- Policy making is done by parliament, government, ministries, county administrations, county councils and local authorities.
- Funding policy implementation and innovation activities is the role of research funding institutes, the national agency for innovation systems (VINNOVA) and sectoral agencies.
- Implementing R&D is the task of universities and research institutes.
- Supporting commercialisation and entrepreneurship is the role of the agency for economic and regional growth – *Tillväxtverket*, ALMI, Innovation Bridge and incubators for small firms.

European policy

It was not until 2005 that a mandatory and comprehensive energy policy was adopted at the EU level. Before then, EU Member States pursued intergovernmental initiatives motivated initially by energy security in the 1970s and subsequently by environmental concerns in the 1990s. In 1997, in reaction to the Kyoto Protocol, the EU introduced non-mandatory targets for Member States for the RE share in total energy consumption. In 2006, the European Commission issued the Green Paper: *A European Strategy for Sustainable, Competitive and Secure Energy*. This asked Member States to implement a European energy policy built on three core objectives: *i*) sustainability – to actively combat climate change by promoting renewable energy sources and energy efficiency; *ii*) competitiveness – to improve the efficiency of the European energy grid by creating a truly competitive internal energy market; and *iii*) security of supply – to better co-ordinate the EU's supply of and demand for energy within an international context. In 2007 this was translated into mandatory shares of RE production for Member States in the form of the Renewable Energy Roadmap; these were further increased in 2009 in the EU's *Directive on Electricity Production from Renewable Energy Sources* (popularly known as the RES Directive). This set the overall mandatory goal of achieving 20% of RE in total energy consumption (10% of transport biofuels) by 2020, which has become part of the "Europe 2020" Strategy. Sweden has set a very ambitious target for 2020: 50% of energy to be produced from renewable sources (this compares with the national objective within the EU strategy of 49%), while improving energy efficiency by 20%).[1]

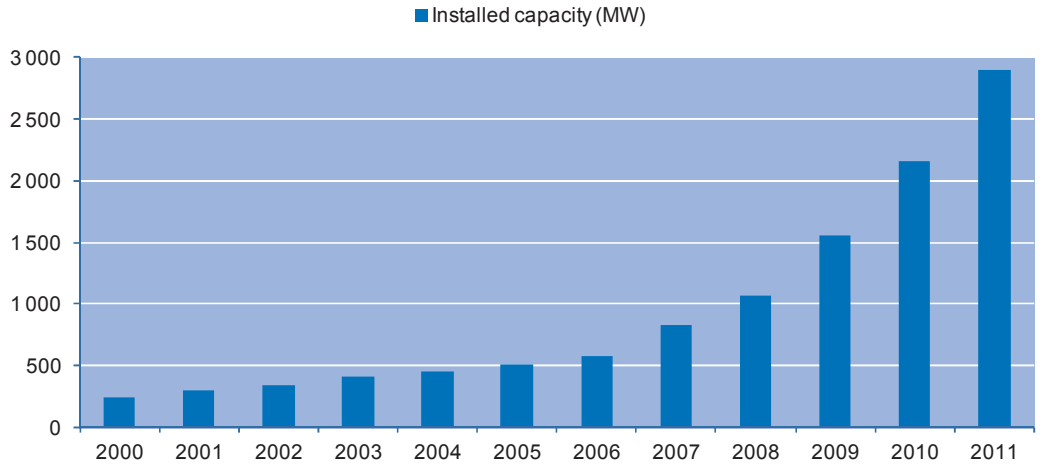
EU Structural Funds play an important role in Middle Norrland, helping to co-ordinate counties' RE initiatives. Middle Norrland falls under the EU's Competitiveness and Employment Objective framework. This allows the region to implement the Operational Programme Mid-North Sweden with a total budget allocation (including co-financing) of around EUR 353 million for the programming period.[2] The main goal of the Operational Programme is to create 1 400 new businesses a year and 4 500 new jobs during the programme period (2007-2013). Investment focuses on sustainable development within the existing manufacturing fabric and the energy sector.

Another important aspect of the programme is its focus on improving the accessibility and attractiveness of the region.[3] Both counties are subject to cross-border programmes under the EU's INTERREG Programme for supporting joint initiatives with regions in neighbouring countries.

National policy

Sweden's national RE policy aims to reduce CO_2 emissions and enhance its national competitive advantage in green technologies. Sweden is one of the leading International Energy Agency member countries using RE (IEA, 2011). Despite being an energy-intensive country, Sweden has been effective in limiting the share of fossil fuels in its primary energy supply (IEA, 2011). Energy use is generally efficient, largely owing to the wide use of electricity and district heat. Electricity is mostly generated by hydropower (46% in 2005), but wind energy is increasingly important in the country (Figure 15.1). RE deployment is supported by a quota and certificate system set up in 2003 and improved in 2006 (Ministry of Sustainable Development, 2006). The scheme promotes sustainable energy by offering RE producers a green certificate for every MWh of electricity produced, which they can sell for extra income. In 2012, Swedish green certificates will be extended to Norway to create the Nordic green power certificates, a common market for green certificates. Having a larger market for green certificates has allowed the Swedish government to define new targets for energy produced by renewable sources: 25 TWh by 2020 (Nordic Council of Ministers, 2009). The national support for RE is coherent with Sweden's focus on clean tech industries and the contribution of green technologies, including RE, to national exports. Sweden enjoys a "green brand" on the international market, which represents approximately half of its national gross domestic product (Reed and Saines, 2009).

Figure 15.1. **Installed wind energy in Sweden, 2000-2011**

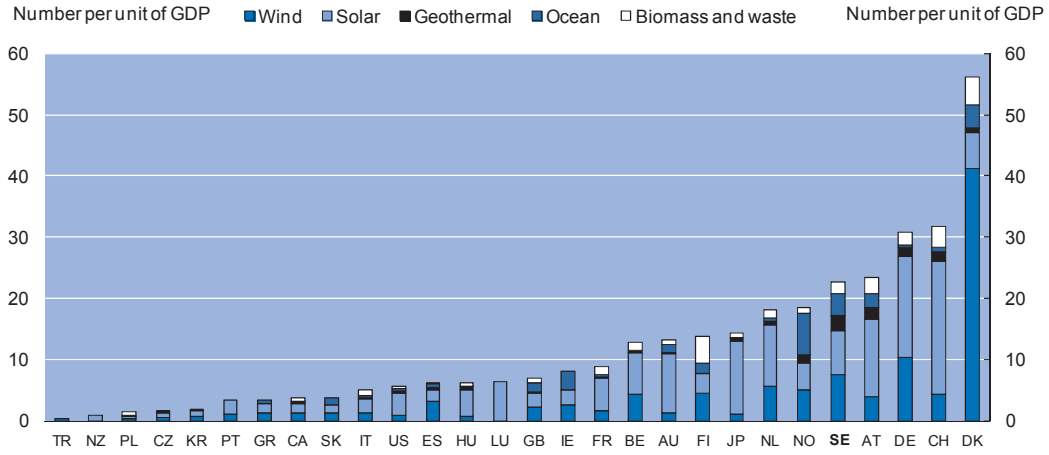


Source: The Wind Power (2012), *Wind Turbines and Wind Farms Database*, Sweden, *www.thewindpower.net/country_en_17_sweden.php*, accessed 11April 2012.

The national innovation strategy tries to link explicitly RE with business opportunities. Sweden is among the most innovative countries in the OECD for its RE technologies (Figure 15.2). However, national stakeholders consider that the

link between innovation capacity and business opportunities should be strengthened. To achieve this, the national innovation strategy implements a "triple helix model" to connect the public sector with businesses and research organisations. Funds are provided by Vinnova, which is the Sweden's innovation agency under the Ministry of Enterprise, Energy and Communications and the national contact agency for the EU Framework Programme for R&D. Vinnova has an annual budget of EUR 220 million to invest in new and existing projects and generally requires co-financing for all projects, which doubles the annual investments. Funding decisions are made following public calls for proposals under Vinnova's programmes. Investment decisions are based on expert assessments and suggestions from public, private and research programme councils. All programmes are continuously monitored and evaluated once they end. Regular impact analyses are also carried out in order to understand and learn from the long-term impacts of the projects.

Figure 15.2. **Patents in renewable energy technologies in Sweden, 1975-2005**



Source: OECD (2011), *OECD Economic Surveys: Sweden 2011*, OECD Publishing, Paris, *10.1787/eco_surveys-swe-2011-en.*

Sweden has been reducing its CO_2 emissions since the introduction of a carbon tax in 1991. Reductions have occurred mainly in the services and residential sectors, where the use of oil for heating has been largely replaced by district heating using biomass fuels. Sweden's carbon tax used to cover all sectors, but it was modified when the EU Emission Trading Scheme (ETS) was introduced to avoid double regulation (Box 15.3). Today, industries covered by the EU ETS are exempted from the carbon tax. Hence, all sectors are covered by a carbon price, but it varies greatly across firms and sectors, with some activities being fully exempted (OECD, 2011).

Box 15.3. **The EU Emissions Trading System (ETS)**

The EU ETS is the first and biggest international scheme for trading greenhouse gas emission allowances. It covers some 11 000 power stations and industrial plants in 30 countries. Launched in 2005, the EU ETS works under the "cap and trade" principle. This means there is a "cap", or limit, on the total amount of certain greenhouse gases that can be emitted by factories, power plants and other installations. Within this cap, companies receive emission allowances which they can sell to or buy from one another as needed. The limit on the total number of allowances ensures that they have a value. At the end of the year each company must surrender enough allowances to cover all its emissions, otherwise heavy fines are imposed. If a company reduces its emissions, it can keep the spare allowances to cover its future needs or sell them to another company that is short of allowances. The total number of allowances is reduced over time so that total emissions fall.

The ETS now operates in 30 countries (the 27 EU Member States plus Iceland, Liechtenstein and Norway). It covers CO_2 emissions from installations such as power stations, combustion plants, oil refineries and iron and steel works, as well as factories making cement, glass, lime, bricks, ceramics, pulp, paper and board. Emissions from installations in the scheme are falling as intended. The system will be modified in 2013, through a progressive move towards the auctioning of allowances.

Finally, Sweden's rural development policy is another source of support for RE, particularly for biofuels. The national policy to reduce CO_2 emissions is now focusing on transport, especially substitution of fossil fuels with biofuels. Within this context, rural policy plays an important role in supporting biofuel production in rural areas. It is also actively promoting small business in the field of RE in rural areas.

Regional and local policy

Counties deal with RE through their regional development strategies, while municipalities are responsible for planning and have direct control over energy production/distribution via their energy companies. In Sweden, counties have the mandate to prepare regional development programmes, development strategies and regional climate and energy strategies. In this framework, Jämtland County's Regional Development Strategy, introduced in 2009, has a specific focus on RE. While RE is mentioned as an opportunity for business development, the main focus is on improving the quantity of energy for export by promoting wind energy and biomass. Likewise, Västernorrland County's Development Strategy focuses on RE. Given the importance of manufacturing activities in the province, RE production is seen as an opportunity to promote manufacturing jobs and link manufacturing and forestry activities by promoting the production of bio-power. Municipalities are responsible for managing the land and issuing building permits. Some municipalities are also directly involved in the energy business as they own local utilities.

Assessment of policy impacts on rural development

Stimulating local economies

The Middle Norrland case study highlights that local communities can benefit from RE when this is strategically linked to rural industries. Local utilities owned by municipalities play a key role in RE deployment, linking local resources to the energy business. For example, the local utility in Östersund feeds its district heating system with forest residues (mostly sawmill, logging, and recovered wood) collected locally and provided by a co-operative (*Skogsägarna Norrskog*) of 13 000 small forest owners. The

power plant has a long-term contract with the co-operative and pays for biomass according to its "heat content" (the quantity of energy produced by a given quantity of residues). This guarantees that suppliers maintain a high quality product and invest in R&D to improve the performance of biomass. District heating absorbs the wood residues produced over a territory of approximately 500 square kilometres and has the potential to source more from a forest spanning over 1 million hectares (10 000 square kilometres). This has created a large and stable demand for woody biomass, giving the local forestry industry and small forest owners options for diversifying their business. More than 250 jobs have been created in biomass management and transportation. A share of residues (such as pine needles) is left in the forest to assure the fertility of the soil and the sustainability of the productive cycle. Moreover, forest harvesting is regulated by an annual cut limit to ensure local forestry remains sustainable and biomass production does not compete with timber production and other core businesses.

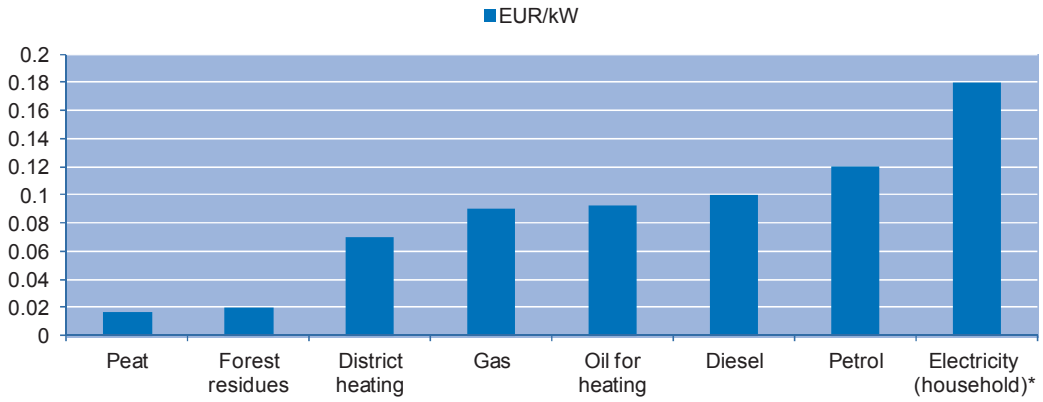
Likewise, Sundsvall's energy company produces heat from biomass and urban waste. It also collects waste heat from local companies, such as a large paper mills and a large sawmills. The local utility and manufacturing firms have developed a plan to produce bio-methane from residues from the municipal sewage system, a milk processing plant and from de-icing fluid from the local airport.[4]

There is a limited need for subsidies in the local energy system mainly thanks to the effective role of intermediate institutions. For example, the interaction between the district heating system (the local utility) and the forest owner co-operative requires no specific incentives for RE because it is economically efficient for the following reasons:

- Heat represents a large chunk of energy use in this region.
- The district heating system is managed by a local publicly-owned utility, whose main aim is to reduce energy costs for the regional community.
- Forest-owners have been constantly reducing the cost of collecting woody biomass while improving the quality of their output. In fact, after fuelling the Östersund-based district heating system for seven years, the co-operative has started selling wood residues to district heating plants in the south of the country, where Sweden's population is concentrated. Wood is shipped by train to the Stockholm area and sold at twice the local price. The higher price is triggering a process of specialisation and the co-operative is assessing the possibility of pelleting wood chips to further increase their value on the market and reduce transportation costs.
- The presence of the co-operative, which acts as an intermediate institution providing clear rules and common objectives to the business, reduces transaction costs and facilitates relations with the energy business.

There are several other advantages related to RE deployment in Middle Norrland. For example, RE reduces the cost of heating by more than 50% for locals (Figure 15.3). This depends on the district heating system – managed by a local utility whose aim is to reduce energy cost for the community – and on the good management of the forest resource. Incentives for the use of biomass are limited and "indirect". Sweden has historically supported district heating systems, which now represent a large market for biomass, and has also put in place a carbon tax which increases the cost of conventional fuels. RE deployment is also creating research opportunities for local businesses. This was observed in the case of Sundsvall's cluster specialising in the bio-methane business, and also in the business community which depends on the Green-Highway infrastructure (testing facility), both mentioned above.

Figure 15.3. **Relative cost of conventional sources of energy in Sweden, 2011**



Note: * Including tax, VAT and electricity certificates.

Source: Government of Sweden (2011), response to OECD questionnaire.

Main challenges

RE technologies not linked with rural businesses (e.g. wind) display the common challenges observed in other case studies. In spite of local support for RE and the availability of public incentives (green certificates provide approximately EUR 0.05/kWh), the sensitivity over environmental issues that characterise the region (and the country as a whole) means there is local opposition to wind energy installations. Wind farms are still relatively rare in the area. For instance, Jämtland hosts only 105 wind turbines, for a total 94 MW, even in areas that reach up to 8 m/s wind speeds. Another 500 wind turbines have the necessary permits to be built and a further 500 turbines are in the planning process. Local municipalities, which have full control over land use, are sometimes afraid of supporting large-scale projects that would potentially undermine political consensus as they must also consider local opinions in their decision making. Middle Norrland's population perceives wind energy to be in competition with landscape amenities: tourist businesses in Jämtland are sometimes suspicious about installations in their area as this could detract from the region's "uncontaminated" image on the national and international market, especially its unspoilt mountain areas. They are also afraid of the possible impact on traditional activities like reindeer herding, which is one of the main activities of the indigenous Sámi people. Perceived benefits are also limited both in terms of job creation (especially in a region with limited unemployment) and local revenue for the host community; which should be, but is not mandatory, around 0.2-0.5% of the total annual revenue of the installation.

Uncertain public support for wind energy dramatically increases transaction costs and requires the creation of specific public bodies to promote its deployment. In the Swedish legal system, even a single citizen can oppose projects that affect the landscape or natural amenities in his or her vicinity. Complaints can motivate Environmental Courts to take action. These are special courts for environment and water resources issues, regulated by the Environmental Code (Box 15.4). To reduce cumbersome bureaucracy, the region has created the Centre for Wind Power (WP) – co-funded by the EU – and the national government has appointed Wind Power Coordinators as interfaces with local communities and developers to promote wind energy deployment. WP engages local

communities in RE projects at a very early stage (planning), provides locals with information about the environmental impact of the project, and explains the economic benefits of the investment. Concerning this last point, WP's current estimates of job creation by wind energy deployment appear to be over-optimistic as they are based on the assumption that the deployment will create almost automatically manufacturing activities producing components for the wind installations: they estimate that deploying 1 000 new turbines in mid-Sweden in the next 10 years will create 9 000 new jobs during the construction phase and 450 exhaustively in the Middle Norrland region (O&M activities).

Box 15.4. **Sweden's Environmental Courts**

Environmental courts have legal jurisdiction over both land use and environmental issues. The courts have the power to review and rule on both the legality and merits of decisions made by regional boards and local authorities. Since May 2011, the Environmental Courts have become Land and Environment Courts and can make decisions on cases that arise from the application of the Act of Planning and Building, including review of local land-use plans and building permits.

There are five regional environmental courts in Sweden, connected to the five district courts of the civil justice system. There is one superior environmental court, the Environmental Court of Appeal, which is a division of the Court of Appeal in Stockholm. The environmental legal system also includes 20 regional boards and about 250 local environmental bodies. The decisions of the regional boards and local bodies can be appealed in the appropriate regional environmental court.

A hearing in the Environmental Court of Appeal is more like a general meeting than a court proceeding. Hearings are conducted in a relaxed atmosphere not typical of a court proceeding. Often the hearing takes place in a conference room and the testimony is taken informally at a conference table. The court normally travels to the site under dispute. The parties and the people living close to the site are allowed to give comments to the court. They are also allowed to represent themselves without lawyers. The court can require the responsible local, regional and central authorities and/or independent technical institutes to comment on a case.

Source: Bjällås, U. (2010), "Experiences of Sweden's Environmental Courts", *Journal of Court Innovation*, Vol. 3, No. 1, available at *www.pace.edu/school-of-law/sites/pace.edu.school-of-law/files/IJIEA/jciBjallas_Final%203-17_cropped.pdf*.

However, Middle Norrland's endowment of wind resource is fair but not exceptional, and WP's estimates of the economic impact of wind energy deployment, as already said, are over-optimistic. Given this situation, and the fact that biomass energy is working well without the need for subsidies, there seems little justification for the current efforts to increase wind turbines in the region. While wind energy is the focus of the national RE policy, imposing it on an area that doesn't necessarily need it is unhelpful.

Notes

1. The renewable targets are calculated as the share of renewable energy consumption to gross final energy consumption. Renewable consumption comprises the direct use of renewables (e.g. biofuels) plus the part of electricity and heat that is produced from renewables (e.g. wind, hydro), while final energy consumption is the energy used by households, industry, agriculture, and the service sector, including transport (EU, 2008).

2. Community investment in the programme through the European Regional Development Fund (ERDF) amounts to EUR 177 million, which represents approximately 9.3% of the total EU investment in Sweden under the Cohesion Policy framework for 2007-2013.

3. For more details of the programme see *http://ec.europa.eu/regional_policy/country/prordn/details_new.cfm?gv_PAY=SE&gv_reg=ALL&gv_PGM=1073&gv_defL=9&LAN=7*, accessed 25 May 2012.

4. Bio-methane is a promising business in Sweden. In 2010, bio-methane made up 11% (on an energy basis) of transport biofuels in Sweden, which in total provided 5.7% of transport demand. The 850 000 m^3 per year of biogas services around 200 vehicles.

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Chapter 16

Scotland, United Kingdom

Rural development and renewable energy (RE) in Scotland: Summary and conclusions

Main findings. *i*) Remote rural areas can contribute to renewable energy innovation, serving as test sites for experimental technology like tidal power, smart grids and energy storage systems. *ii*) Intermediate institutions in rural communities may play a key role in linking RE deployment with development. *iii*) Scotland illustrates the challenge of harmonising small-scale interventions with large-scale deployment. *iv*) Taking into account rural dwellers' preferences for specific RE technologies reduces the cost of deployment.

Renewable energy in Scotland: A summary. Scotland is a leading energy region, including for RE. In 2006, Scottish oil and gas companies exported a total of GBP 4.7 billion in goods and services, making energy the largest Scottish export sector. Capitalising on this specialisation and on its good endowment of RE sources, in 2010 Scotland had an installed capacity of 2.6 GW of wind, 1 MW of wave and tidal, and 257 MW of biomass and waste energy (2010). These are respectively 66%, 38% and 12% of the United Kingdom's total installed capacity. The energy industry is also intertwined with the Scottish innovation system which includes universities with award-winning programmes in the field of energy, and specific demonstration processes launched by the UK government in the field of wave and tidal energy.

The primary force driving RE deployment in Scotland has been the regional economic development strategy, which aims to transition to a low carbon economy. Scotland has considerable autonomy in energy and rural development policy and this has benefited its RE strategy. The Scottish government has set aggressive RE targets, including a target for community ownership of renewables, and aims to generate the equivalent of 30% of Scotland's energy demand through RE by 2020. This compares to the UK's national target of 20%. Over time, the RE policy has been increasingly linked to economic development opportunities through both top-down and bottom-up support measures. Key top-down initiatives are designed to create the infrastructure and environment to support innovation in high-potential technologies, most notably wave and tidal power. Bottom-up efforts like the community renewables policy enhance opportunities for rural development in terms of public service provision and capacity building. In remote rural areas lacking grids, renewable alternatives have been more cost-effective than conventional energy sources like diesel generators. Community renewable projects also create revenue-generating opportunities; to date, these projects generate an estimated GBP 2 million of revenue every year (for an average project lifespan of 20 years) for local communities; the community RE approach ensures that this additional revenue is invested locally.

Remote rural areas contribute to RE innovation, serving as test sites for experimental technology like tidal power, smart grids and energy storage that can enhance RE deployment. The often-cited disadvantages of remote rural areas, such as grid isolation and a smaller customer base, can be advantages for experimenting with RE. These characteristics allow for greater monitoring and control of energy use. New techniques can be tested and developed in this relatively controlled environment. Especially for small-scale installations, the close interaction between users and producers/developers facilitates innovation by testing the capacity of a given RE technology to assure the supply of energy, while reducing its cost. For instance, in the Shetland Islands, these features are complemented by an informed and supportive population.

Future challenges. Scotland aims to use RE to generate economic growth, but the focus on large-scale initiatives risks marginalising host communities and, as a result, reducing the potential impact of RE investment on rural development. RE in Scotland, as elsewhere, has sometimes been seen as a panacea for economic growth, rather than a way to provide cheap, low-carbon energy to local communities. This is mirrored by the governance of the RE policy. The Minister for Enterprise, Energy and Tourism plays a leading role in RE policy and oversees the economic development bodies, including the Highlands and Islands Enterprise (HIE), which focuses on rural areas. However, HIE bases its work on the Scottish Government Economic Strategy and the Scottish Economic Recovery Plan, rather than on the Rural Development Plan. The HIE and Scotland Enterprise also oversee the National Renewables Infrastructure Plan, which focuses on exploiting Scotland's offshore and marine RE potential (mostly found in rural areas). There are weak links between the large testing facilities and local communities. For instance, the advanced European Marine Energy Centre (EMEC) testing facility in Scotland is working as an R&D centre exploring new technologies: connecting it with small-scale, community-owned, initiatives could lead to significant improvements in the technology based on users' feedback.

The disconnect between large-scale RE deployment and rural development can aggravate public opposition even where there is potential for substantial community benefits. While large-scale RE deployment will inevitably affect rural landscapes and economies, more effort could be made to take into account local priorities. This is particularly true for rural areas, which may have specific preferences when it comes to RE. An emerging body of research shows that rural residents and workers have distinct preferences for what type of RE is desirable or acceptable. Understanding these preferences and incorporating them into decisions about economic development could make it cheaper and faster to install RE.

The context

Scotland's socio-economic profile and performance

Scotland has a clear rural character. Its international image is more strongly related to rural landscapes and culture than to its cities. Rural Scotland represents 75% of the entire territory. The average population density of 66 inhabitants per square kilometre (inh/km^2) is far below the 250 inh/km^2 for the United Kingdom (UK) as a whole (Table 16.1). However, population density also varies widely within Scotland, reflecting its rich and varied landscape. Scotland's topography can be divided into three regions – the sparsely populated highlands and islands in the north, which flow into the central lowlands where population is mainly concentrated, and finally to the rural Southern Uplands (*OECD Regional Database*).

Table 16.1. **Scotland: Demographic data**

2007 data unless otherwise indicated

	Scotland	United Kingdom
Population (2010)	5 222 100	62 261 892
Population share	8.38%	
Population density (inh/km2)	66	250
Elderly dependency ratio (2006 data)	3%	21%

Source: *OECD Regional Database*.

Scotland's economic performance is strong compared to the UK as a whole, despite slightly lower GDP per capita. Lower unemployment, higher tertiary education attainment and high productivity all point to the strength of Scotland's economy (Table 16.2). Overall, rural areas have strong economic performance, with growth above the OECD average. Scotland's rural areas tend to have higher levels of income, tertiary education, employment and safer and more liveable neighbourhoods than their urban counterparts. However, remote rural areas perform less well than Scotland as a whole, particularly in the periphery and islands. Such areas are under pressure from outmigration and ageing populations, market isolation, and poor service delivery including transport and energy. Housing shortages and fuel poverty are also more widespread in remote rural areas. Remote and accessible rural areas do share some characteristics: the services sector tends to be the largest employer; landscape is highly valued; and tourism and RE are seen as promising sectors for future economic development (OECD, 2008).

Table 16.2. **Scotland: Main economic indicators**

	Scotland	United Kingdom	OECD gap
GDP per capita USD PPP	29 096	30 145	116%
GDP share USD PPP	8.15%		
Productivity USD PPP	51 021	47 130	115%
Unemployment rate (2008)	4.7%	5.7%	-1.6%
Employment rate (2006)	72.2%	71.5%	
Long-term unemployment (2008 data)	0.97%	1.4%	-1.4%
Youth unemployment (2008)	13.02%	14.9%	-2.3%
Infrastructure (motorway density)	0.08	0.11	150%
Tertiary attainment (2008)	39.9%	34.6%	57%
Patents per million	86.9	90.2	

Source: *OECD Regional Database*.

Scotland's economy boasts strong conventional energy and manufacturing sectors. In 2006, Scottish oil and gas companies exported a total of GBP 4.7 billion in goods and services, making it the largest Scottish export sector (Scottish Government, 2011c). In terms of value added, electricity, gas and water supply represented GBP 2.6 billion in 2008, up from GBP 1.7 billion in 2000. Employment in the energy sector rose 10% between 2006 and 2007 to 40 700 jobs, i.e. 23% of all jobs in the sector across the UK. Overall, energy and water accounted for 2% of Scottish employment, the same level as agriculture and fishing. Manufacturing is another historical specialisation in Scotland. In 2010, manufacturing represented more than 170 000 jobs; 9% of the total Scottish workforce (National Statistics, 2011). Secondary activities are important contributors to the regional economy, despite the recent international crisis that has wiped out more than 30 000 manufacturing jobs and reduced gross value added (GVA): export-oriented manufacturing has lost between 10 and 20% GVA since the beginning of the crisis in 2008.

Land-based activities have played a key role in the diversification of Scotland's rural economies. The *OECD Rural Review of Scotland* (OECD, 2008) describes how a "second wave" of diversification is currently underway, featuring housing and entrepreneurial activity, following a first wave linked to farm households. Landscape is increasingly a key resource for this diversification, as illustrated by the central role played by tourism. In this context, it will be important to ensure that RE development does not negatively affect land, landscape and recreation. This is particularly true for remote rural areas where hotels and restaurants accounted for 13% of employment in 2009, compared to 7% in rural areas and 6% in the rest of Scotland (Scottish Government, 2011c).

Scotland's regional innovation system is linked to the regional specialisation in energy and targets high-potential RE sources, such as wave and tidal power. The sector benefits from state-of-the-art institutions like the European Marine Energy Centre (EMEC), a unique testing facility for wave and tidal RE that also offers support on regulatory issues, such as interconnection with the grid. This facility is contributing to the development of tidal power technologies: the Edinburgh-based Pelamis company, which tests its tidal turbines at EMEC, has moved on from seeking venture capital to a partnership with a major engineering firm (Marsh, 2011). Another initiative is the Saltire Prize, which seeks to accelerate the commercial development of marine energy by offering a GBP 10 million reward to the first team that can create a wave or tidal turbine that produces the most electricity (over the minimum of 100 GWh) over a continuous two-year period. Universities and corporations are also contributing to innovation with the universities of Strathclyde and Aberdeen winning recognition for distinguished RE engineering programmes and co-operation with companies.

The Shetland Islands case study

This Scotland case study focuses on the Shetland Islands, a remote and predominantly rural region in the North Sea. The Shetland Islands include over 100 islands and together have 2 702 km of coast. Flora and fauna are both diverse and admired; seabirds, marine life, and peat bogs are particularly treasured by locals and nature enthusiasts. The 22 000 inhabitants are sparsely spread throughout these islands, with about one-third of the population concentrated in the capital city, Lerwick. Average population density is very low: 15 inh./km^2.

The Shetland Islands' economy depends on energy and fishing, with a growing tourism sector. A breakdown of its GBP 800 million economic output in 2011 reveals that fisheries earn the most, at GBP 215 million, followed by oil and gas (GBP 68 million), the creative industry (GBP 29 million), tourism (GBP 18 million) and agriculture (GBP 14 million) (Angus, 2011). Shetland is home to one of the largest oil and liquefied gas terminals in Europe, the Sullom Voe Oil Terminal. Since it opened in 1978, direct and indirect jobs in the energy sector have contributed to the Shetland Islands' low unemployment rate: 1.4% compared to Scotland's overall 4 to 5%. However, these benefits are decreasing and given the finite nature of conventional energy resources, will not last forever. A deal for a new oil and gas project has been signed that could prolong current prosperity, but islanders recognise the need to find alternative sources of wealth. The tourism sector is growing, with visitor numbers increasing by 57% between 2000 and 2006. The islands have a particularly strong textile heritage and are known for their Shetland wool, but this sector is underperforming; knitwear accounts for only GBP 2 million. While agriculture presents an important financial contribution, 75% of this is from subsidies.

Scotland's energy resources

Scotland and the Shetland Islands are endowed with vast conventional and renewable energy resources. As mentioned, Scotland is a net exporter of energy due to its natural gas and oil reserves. Scotland is also home to the world's second largest energy hub: Aberdeen (behind Houston, USA). Despite its significant resources, production of conventional energy is falling; in 2010, total production of oil and gas was 5% lower than in 2009 at 2.3 million barrels of oil equivalent per day. The price volatility and limited nature of these resources make Scotland's vast RE resources more attractive. Scotland already produces 50% of existing UK wind and wave power; 40% of UK's offshore wind, wave and tidal power; 25% of Europe's wind and tidal power and 10% of Europe's wave power. Shetland, in particular, is one of the most promising areas in Scotland for deploying these technologies. The technical potential for electricity generation from wind and tides in Shetland has been estimated at over 7 000 GWh per year. Shetland has the most productive wind turbine in the world, which averages more than a 50% capacity factor.[1]

Renewable energy policy in Scotland: Objectives, opportunities and challenges

The policy drivers: Why is Scotland implementing a renewable energy policy?

Economic development and climate change mitigation are the primary drivers of Scotland's RE policies. Transitioning to a low-carbon economy is a strategic focus of the Scottish government, as laid out in the *Government Economic Strategy* (Scottish Government, 2011a). This high-level support complements UK and European efforts that target RE as a means to meet climate change, energy security, and economic development goals. The Scottish Government is firmly committed to supporting community involvement in RE, aiming to secure wider community benefits as it does so. In fact, community renewable energy schemes have been a priority since 2003 and to date the government has supported over 1 000 such schemes. The RE policy aims to ensure that all communities share in Scotland's next energy revolution, and take advantage of the opportunity to make money, save carbon and benefit from local economic regeneration. In 2011, the Scottish Government set a target for producing 500 MW of community and locally-owned renewable energy projects by 2020.

Significant heating needs and concern over fuel poverty are also motivating policy makers to promote RE, especially in remote rural areas. Most of Scotland's energy use is for heating, with many rural dwellers depending on the most expensive source of heat: fuel oil. For instance, the Shetland Islands rely on imported oil and waste gas for 93% of their energy production. This obviously affects energy prices. Rural areas in Scotland face higher prices for fuel due to limited gas grids which negatively affect competition. Higher prices lead to "fuel poverty": a household is in fuel poverty when the home cannot be heated to an acceptable standard at a reasonable cost. Fuel poverty is considered extreme when households must spend 20% or more of their income on fuel to maintain an adequate heating regime. Some 50% of remote rural residents are considered "fuel poor", 21% of whom are "extremely fuel poor" (Scottish Government, 2011c). In the Shetland Islands, a recent study conducted by the Unst Partnership found that 50% of islanders are "extremely fuel poor", spending more than 20% of household income on energy (mostly transport and heating). This is the result of both high heating demand due to the Shetland Islands' climate, and the high local cost of fuel.

The policy framework for renewable energy in Scotland's rural areas

RE policy must be co-ordinated between the EU, UK and Scottish governments, and policy co-ordination is central to meeting the objectives of each. Each of these administrative levels, and their RE policies, are outlined in the subsections below. In the UK, energy is a reserved matter for the UK Government, but to date the Scottish Government has been in control of the mechanisms to help deploy greater levels of RE. In particular, a mixture of reserved and devolved policies across a range of areas affect RE deployment, including subsidies, energy efficiency, oil and gas, carbon capture and storage, grid and transmission, consenting, and regulation of the energy markets. The importance of multi-level governance is accentuated by differences between the UK and Scottish governments' position on certain key issues. For example, Scotland is anti-nuclear and favours a biomass policy that gives preference to heat and small-scale projects, while the UK government is pro-nuclear and prefers to target biomass projects that can meet base load electricity demand. To this end, the Scottish government is actively seeking more devolved powers for energy, such as devolution of the Crown Estate (Box 16.1). Rural services are largely provided by local bodies, with the Scottish government providing the policy, financial and regulatory framework.

Box 16.1. **The sensitivities of the Crown Estate**

Crown land in Scotland is a historic estate with many elements dating back to the early days of the Scottish kingdom. It consists of varied interest ranging from ancient possessions such as Edinburgh and Stirling Castles, rights to gold and silver, the seabed, foreshore, rights and ultimate heir to ownerless property, treasure trove, oysters and whales. As noted, the Scottish Government is seeking more devolved powers with respect to the Crown Estate. The core of the sensitivity is the "seabed out to the 12 nautical mile territorial limit", which is technically under the control of the Crown. The Crown Estate leases offshore water; the revenues are paid to the UK Treasury, not the Scottish Government. The property rights and interests of the Crown Estate are a form of public land defined by Scots law, situated in Scotland but administered by a commercial property company based in London. In 2010 the Treasury Select Committee launched an inquiry into the administration and expenditure of the Crown Estate. The final report recommended a full review of the powers and functions of the Crown Estate and expressed concern of their monopoly position over the seabed.

Source: Wightman, A. (2010), *The Poor Had No Lawyers: Who Owns Scotland and How They Got It*, Birlinn Ltd.

European level

It was not until 2005 that a mandatory and comprehensive energy policy was adopted at the EU level. Before then, EU Member States pursued intergovernmental initiatives motivated initially by energy security in the 1970s and subsequently by environmental concerns in the 1990s. In 1997, in reaction to the Kyoto Protocol, the EU introduced non-mandatory targets for Member States for the RE share in total energy consumption. In 2006, the European Commission issued the *Green Paper: A European Strategy for Sustainable, Competitive and Secure Energy* (2006). This asked Member States to implement a European energy policy built on three core objectives: *i*) sustainability – to actively combat climate change by promoting renewable energy sources and energy efficiency; *ii*) competitiveness – to improve the efficiency of the European energy grid by creating a truly competitive internal energy market; *iii*) security of supply – to better co-ordinate the EU's supply of and demand for energy within an international context. In 2007 this was translated into mandatory shares of RE production for Member States in the form of the *Renewable Energy Roadmap* (2007). This document set the overall mandatory goal of achieving 20% of RE in total energy consumption (10% of transport biofuels) by 2020, which has become part of the "Europe 2020" Strategy. The 2009 Renewable Directive set individual targets for each Member State. For the UK, the government's goal is to use RE to supply 15% of energy consumed by 2020. In the new set of rules established by the directive the EU highlights RE's potential to reduce energy dependency and promote economic development (with a specific reference to regional development).

Both the European cohesion policy and the common agricultural policy (CAP) support RE production. For instance, the European cohesion policy (2007-2013) has been supporting regional initiatives through the European Fund for Regional Development (EFRD). Under the cohesion policy framework, Scotland is broken down into four regions, with the Shetland Islands forming part of the Highlands and Islands region. The Scottish programme has a budget of EUR 291 million budget (EUR 122 million from the EU) and is dedicated to making the region more competitive and innovative and also making the most of the natural and cultural heritage (European Commission, undated). The Scotland Rural Development Programme[2] receives EUR 680 million over the 2007-2013 period. The SRDP includes programmes targeting RE in rural areas, including land-based (farming and forestry) and non-land based (residents, business owners, etc.) projects.

United Kingdom

EU regulations, concern over climate change, and an ageing electricity supply mix have made increasing RE a priority for the UK government. There is a general push to increase electricity supply as almost all nuclear and coal-fired power plants in the UK will be retired by 2021, while efforts to build new nuclear plants have shown mixed results (IEA, 2006). These factors culminated in the UK taking a new policy direction in 2008/09. One new development was the creation of the Department of Energy and Climate Change, which took over the responsibility for energy and climate change policy from the Department for Business, Enterprise and Regulatory Reform, and from the Department for Environment, Food and Rural Affairs. The Office of the Gas and Electricity Markets (OFGEM) – the regulator of the electricity and gas markets that sets prices and administers RE certificates – was also restructured in 2009 to better support RE deployment, and the RE target was set at 15% by 2015 (OFGEM, 2009). In the new

framework, electricity producers were asked either to integrate a growing portion of RE into their supply mix by purchasing Renewable Obligation Certificates (ROCs), or else to pay a penalty. The price of ROCs was also altered, creating different incentive levels, or "bands", for different technologies. These are reviewed annually. UK's RE policy also supports new technologies to produce renewable heat and small-scale investment.

In 2010, the UK developed the world's first incentive to specifically target renewable heat and created a budget of GBP 860 million to support eligible producers. Targeting renewable heat is necessary because in the UK, and especially in Scotland, the majority of energy consumed is for heating. This is potentially significant for rural development as agriculture and forestry residues are a primary resource for renewable heat. Unfortunately, the introduction of the Renewable Heat Incentive was delayed the day before it was supposed to launch, deflating investor confidence (Macalister, 2011). The delay followed a notice from the EU concerning conflicts with EU state aid regulations. This highlighted the need for better policy co-ordination across the different levels of government. While the incentive scheme was eventually launched in November 2011, better policy co-ordination could have avoided this hiccup in UK RE policy.

Scotland and local involvement

Devolved powers in Scotland have been used to develop an ambitious RE agenda that goes beyond the UK's and takes advantage of Scotland's vast natural resources. The *1998 Scotland Act* granted greater autonomy to Scotland, including for energy and rural development. This expanded authority has been used to set more ambitious targets than set for the UK as a whole. Scotland's goals for 2020 are to use RE to generate the equivalent of 100% of Scotland's demand for electricity, and to meet 11% of the heating demand with renewables (Scottish Government, 2011a). Longer-term targets were laid out in the *2009 Scottish Climate Change Act* which came into effect in June 2010, including the goal of reducing GHG emissions by 80% by 2050. The Scottish Government also manages the implementation of the UK National Renewable Energy Action Plan[3] under the Scottish Renewables Action Plan (2009). Building on the UK's Renewable Heat Incentive, the Scottish Government has also created the Renewable Heat Action Plan. This focuses on building skills, providing consumer information, building Scottish supply chains, and leading by example.

As observed in other case studies, Scotland's RE policy tends to target large-scale projects, guided by central government. In this sense, the RE policy resembles an industrial policy, with large top-down investments in infrastructure, and the attempt to involve and reorient manufacturing activities. Measures include supply-side incentives, offering a subsidised price for large-scale production, and investments in key infrastructure. The policy, for instance, supports the EMEC and the National Renewable Infrastructure Plan, which will involve GBP 70 million of investment in the infrastructure needed for large-scale manufacturing, assembly, construction, operations, and maintenance of offshore RE technologies (Scottish Government, 2011a). These measures are embedded in the wider plan for transitioning to a low-carbon economy – *The Government Economic Strategy* (Scottish Government, 2011a).

What is peculiar to the Scottish RE policy, however, is that a part of its interventions at the local level capitalise on the presence of community groups – the backbone of rural development in Scotland. The Scottish Government is also active in supporting bottom-up RE development through pioneering policy interventions. For instance, the Community and Renewable Energy Scheme (CARES) – currently delivered on behalf of

the Scottish Government by Community Energy Scotland (CES) – supports community groups in developing RE projects of up to 50 MW. This policy has been set to capitalise on a broad range of organisations and groups (intermediate institutions) active in local communities across rural Scotland. Through CARES, community trusts, charities and volunteers active at the very local level can get involved in RE. The policy supports them with loans and technical assistance provided by CES's development officers and network of experienced community groups. This policy has spurred over 1 000 RE projects since 2009, representing 163 MW of installed capacity. For communities to participate they must own the land where the project will be installed; historically, such land ownership has been more widespread in rural areas.[4]

Intermediate institutions shape RE policy in rural Scotland. Scotland has one tier of local government, which is responsible for providing services such as education, public transport, and planning. Local governments can provide these services directly, or through agreement with local organisations and groups, including volunteers. This arrangement means that community organisations are more common than in other countries and their activities are more diverse. This system of local governance also influences RE policy. Local governments can grant planning permits for RE projects under 50 MW (still a remarkable size for a RE installation). Community groups can purchase, invest in or support these projects, and benefit from specific programme such as CARES.

In the Shetland Isles, it is community groups and charities that are linking energy to economic development. For instance, the Shetland Charitable Trust (SCT) is responsible for managing a special fund that pays for public services with revenue collected from the energy companies operating in and around Shetland.[5] This body is currently looking for a new "post-oil" development model and RE is considered as an investment opportunity for the future of the islands (Box 16.2). In particular, the SCT wants to replicate the mechanism regulating oil production for regulating RE: this means that wind energy should generate constant revenue over the long term. The SCT will then invest this revenue back into the community to provide public services and create employment. However, the current connection to the main grid servicing Shetland is already operating at its maximum capacity. Since the UK system does not provide incentives to off-grid installations, the Shetlands will need to be able to generate enough electricity to pay for the installation and a new interconnection to the main UK grid. This has been proposed, and recently given the go-ahead, through the controversial Viking Energy wind farm (Box 16.2).

Assessment of policy impacts on rural development

The Scottish government's efforts to bolster RE projects are producing results. Between 2007 and 2011, 42 renewable projects (over 50 MW) received consent from Scottish ministers, compared to 10 projects under the previous parliament. This is partly due to a streamlined administrative process, which has shortened the turnaround time on application to 9 months. In addition, the proportion of electricity consumption met by renewables between 2007 and 2009 increased by one-third, while the portion of Scotland's heat demand met by renewables between 2009 and 2010 doubled. This progress explains Scotland's large share in the UK's total RE production, discussed above.

Box 16.2. **The Viking Energy project**

The SCT has been promoting the creation of one of the largest wind farms in Europe on the Shetland's main island. SCT argued that given its excellent wind resource, the Shetlands would attract developers sooner or later and therefore it would be better to have the wind farm developed with the direct involvement, and under the control, of the local community. This would also guarantee long-term revenue, without the need to design a new development trajectory for the post-oil Shetland economy.

This vision is being implemented in the form of Viking Energy, a partnership between private investors – Viking Energy Limited and Scottish and Southern Energy – and the SCT. Viking Energy will involve 103 turbines to produce a total of 370 MW on Shetlands' central mainland. The wind farm is expected to last for 25 years, following a 5-year construction period, and will cost an estimated cost of GBP 566. It has been estimated that the SCT will receive an average annual income of more than GBP 20 million, with an initial investment of GBP 62 million.

However, the proposed large turbines would be visible from most of the island, affecting the natural landscape and prompting some local opposition to the Viking project. A 2010 survey showed that 60% of local people were for the project, while 40% were against it. Opponents organised themselves into a local group, Sustainable Shetland, to argue that the wider community's interests were not taken into account when designing the project. In particular, this group argues that the large-scale and corporate financial backing of the Viking project is out of sync with the niche-oriented, territorial approach which is increasingly supporting the regional economy. Sustainable Shetland is not opposed to wind farms or RE, they are opposed to the scale and siting of the current Viking proposal. They suggest scaling down RE production to just meet the needs of the island, and launching a development strategy that involves a large number of stakeholders and many different local sectors, including tourism. While providing an advice in this field goes beyond the scope of this report, it is interesting to see how RE deployment, even if conceived at the very local level, can affect the regional debate about economic development and negatively influence the regional endowment of social capital. Other more focused assessments of the Viking project conclude that a lack of mobilisation of social capital is indeed the biggest threat to realising the development goals in this local community. In particular, bridging the gap between competing visions, linking public and private efforts, and increasing local participation are all issues limiting the development of the rural web that should underpin this development (Kanemasu and Horlings, 2010).

Stimulating local economies

As well as providing clean power, RE policy also enhances public service provision and capacity building in rural communities. In rural Scotland, for example, improved access to energy has increased the provision of public services, such as longer operating hours for community or childcare centres. Renewable alternatives have proved more cost-effective than conventional sources in remote areas, creating a more stable environment for public services and business. For instance, the Unst Heritage Centre and Museum in the Shetlands uses a wind turbine to power electric heaters. This system has dramatically reduced the cost of heating and provided some revenue, allowing the museum to stay open longer in the season and promote a series of cultural initiatives for locals and tourists.[6] Another example is the 900 kW wind turbine installed in Westray, one of the Orkney Islands, where the local community reinvests the revenue it produces to develop the island's tourism potential. The isles of Eigg and Foula have both developed independent energy grids that have allowed for increased tourism and business start-ups. Overall, these small interventions generate an estimated GBP 2 million of revenue every year for local communities; they last on average 20 years. The community RE approach

ensures that this additional revenue is invested locally. For community groups, developing RE builds their capacity in private enterprise development and investment. Collaboration with other public/private or national/international institutions helps to build key connections and networks, as well as allowing for the important transfer of technical expertise from private developers to the community.

Stimulating innovation

Remote rural areas which contribute to RE innovation serve as test sites for experimental technology that can enhance RE deployment. What are often cited as disadvantages of remote rural areas, such as grid isolation and a smaller customer base, can be advantages for experimenting with RE. These characteristics allow for greater monitoring and control of energy use. In Shetland, these features are complemented by an informed and supportive population and there is interaction between users and producers/developers – a key element in innovation (Kamp *et al.*, 2004). This feature also attracts business. For example, the Pure Energy Centre (PEC), a private company, is developing new approaches to energy storage through hydrogen. It is training people from around the world in their development and use. Through training alone, the PEC has injected approximately GBP 65 000 into the local economy. When searching for a test site for its new tidal turbine, Nova Innovation decided to partner with the North Yell Development Council, which manages a port on North Yell, one of the Shetland Islands. This community-owned project will benefit from a supportive local government and close user-developer collaboration. A collaborative approach to innovation is also evidenced by the Scottish and Southern Energy smart grid project that aims to treble the amount of renewable power from wind within three years by developing an innovative energy storage system. Energy storage will be managed by centrally controlled "smart" water and storage heaters in 1 000 Shetland homes. Stabilising the grid with these heaters would allow up to 10 MW of extra wind power to be connected to the Shetland's current system. Through this project, small-scale wind farm entrepreneurs in Shetland will earn feed-in tariffs by supplying electricity to the smart grid.

Main challenges

Despite these promising rural initiatives, Scotland's RE policy does not take full advantage of the potential contribution of rural stakeholders. There is also a disconnect between RE and rural development policy. For instance, energy policy is planned by Scottish government ministers with advice from the Energy Advisory Board. This board is chaired by the First Minister of Scotland; its subgroups – including the Renewables Industry Advisory Group (RIAG) – are chaired by the Minister for Enterprise, Energy and Tourism. The Scottish Government also oversees the economic development bodies: Scottish Enterprise for lowland Scotland, and Highlands and Islands Enterprise (HIE), both of which work through networks of Local Enterprise Companies. HIE and Scotland Enterprise also oversee the National Renewables Infrastructure Plan focused on exploiting Scotland's offshore and marine RE potential, which is concentrated in rural areas. However, HIE bases its work on the Scottish Government Economic Strategy and the Scottish Economic Recovery Plan – not the Rural Development Plan. This disconnect between RE and rural development policy is also mirrored in the weak links between the large testing facilities promoted by the RE policy and rural communities. The EMEC, for instance, does not involve locals in its R&D activities, which are mostly focused on large scale production. Connecting it with community-owned initiatives, like the North Yell

project, could enable users' feedback to bring about significant improvements in the technology.

Understanding rural communities' preferences for RE, and incorporating them into decisions about economic development could make RE deployment cheaper and quicker. The engagement of local authorities to act in the community's interest does not always prevent local conflicts. This is the case for the Viking project, which attracted strong local opposition (Box 16.2). The need for public consultation on RE projects is greater as the scale of projects increases; late engagement can be costly for developers. Opposition to the Viking wind farm has contributed to the lengthy approval process for the project, which has only just been approved after almost a decade. While large-scale RE deployment will inevitably affect rural landscapes and economies, more effort could be made to take into account local priorities. This is particularly true for rural areas, which may have specific preferences when it comes to RE. In fact, an emerging body of research shows that rural residents and workers have clear views on what is desirable or acceptable in terms of RE deployment (Box 16.3).

Box 16.3. **Urban *versus* rural preferences for renewable energy**

An analysis of Scottish preferences for RE installations revealed distinct differences between rural and urban residents. They found that rural residents had a higher willingness to pay for RE, especially when it improves job opportunities in their area. This contrasts with urban residents who were more sensitive to the landscape impacts of RE. Commonalities were also identified: Scottish citizens generally support the expansion of renewable energy projects, with the most valued attribute being the reduction in air pollution. In addition, there was general support throughout the sample for large off-shore wind farm projects because of the absence of air pollution and relatively minor landscape impact. This was followed by small on-shore wind farm projects (Bergmann *et al*., 2010). Another relevant analysis looked at how one's view of what rural places are/should be, i.e. place of leisure and pristine nature vs. place of work, influences one's reaction to wind energy. It found that those who complain about wind turbines' flickering or noise tended to be outside the group who personally benefitted from wind turbines. It also found that the most vociferous complainers about these effects were people that felt excluded from the decision-making process (Pedersen *et al*., 2007).

The most apparent impact of these preferences is on the social acceptance of RE. Current UK RE targets require rural people to accept large levels of RE construction in their areas. For instance, Scotland, which is 75% predominantly rural according to the OECD classification, can contribute up to 50% of the UK's goal for RE generation laid out in their National Renewable Energy Action Plan, which charts a course to producing 15% of the UK's energy from RE by 2020. Without rural buy-in, it is possible that local opposition will be a formidable obstacle to future development. Following the "first generation" of recent RE development where large investors were better prepared to seize opportunities, some communities have expressed the opinion that large-scale investors are pocketing the profits rather than the local areas where the projects are installed. The perception by local communities that RE production only benefits outsiders can hamper social acceptance. In addition, as deployment levels rise, the availability of land for new projects decreases. If local populations don't see the benefit from RE projects they are more likely to oppose future ones.

Source: Bergmann, A., S. Colombo and N. Hanley (2008), "Rural versus Urban Preferences for Renewable Energy Developments", *Ecological Economics*, Vol. 65; Pedersen, E., L.R.-M. Hallberg and K.P. Waye (2007), "Living in the Vicinity of Wind Turbines – A Grounded Theory Study", *Qualitative Research in Psychology*, Vol. 4, No. 1-2.

Notes

1. The capacity factor is the portion of time that a variable RE source is actually producing energy. In this case, a 50% capacity factor means the turbine is spinning and generating electricity half of the time. Generally speaking, a capacity factor of 33% is considered world class.

2. The SRDP is a programme of economic, environmental and social measures, utilising European Agricultural Fund for Rural Development funding plus Scottish Government match funding. The programme is designed to support rural Scotland from 2007 to 2013. For more information consult *www.scotland.gov.uk/Topics/farmingrural/SRDP*.

3. The NREAP asks for the path and measures that will enable the UK to reach its target for 15% energy consumption in 2020 to be from renewable sources. (European Commission, 2009).

4. Community ownership of land is a predominately rural phenomenon in Scotland. Approximately 425 000 acres of land in Scotland are owned by community organisations. The increase in community ownership grew out of protracted landlord absenteeism and a desire to improve land use and promote development where previous landowners had neglected property or sold off valuable land or other assets. The *2003 Land Reform (Scotland) Act* extended the right to buy land to the "crofters" and the "community" (Community Land Ownership, Highlands & Islands Enterprise, 2010).

5. The Shetland Charitable Trust was established in the 1970s to manage funds received from the oil industry when they began operations at the Sullom Voe Terminal in Shetland. A board of 23 Shetland residents determines how the funds are spent. As both a trust and a charitable organisation, the potential activities that can be funded are limited, and must be in the interests of the Shetland community.

6. The Unst Museum benefits from the Wind2Heat policy. Created especially for this purpose, the Wind2Heat policy covers 17 projects, 12 of which are in Shetland. Through this initiative a cost-effective method of converting the available wind resource into valuable heat energy within community buildings is introduced.

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Chapter 17

Iowa, United States

Rural development and renewable energy (RE) in Iowa: Summary and conclusions

Main findings. *i*) RE generates more development opportunities when connected with rural sectors (e.g. agriculture). *ii*) Rural areas can be at the cutting edge of innovation in RE. *iii*) Producing RE through agricultural biomass requires intermediate institutions able to lower transaction costs and co-ordinate collective action. This also reduces the cost of RE. *iv*) While the production of energy crops has the advantage of reducing potential conflict between energy production and food production, it is currently economically unattractive for most farmers.

Renewable energy in Iowa: A summary. Despite outmigration and urbanisation, Iowa continues to be a largely rural state dominated by agriculture and associated industries, and is the largest producer of corn in the US. Its strengths in the RE sector are abundant land, specialisation in the intensive production of corn for energy, and a good wind resource, combined with its proximity to manufacturing centres and metropolitan areas with significant energy demand.

A mix of federal and state policies has supported RE in Iowa since the 1980s, motivated by a combination of concerns including energy independence, environmental impact, and – more recently – economic development. Iowa was the first state in the nation to pass a renewable energy portfolio standard in 1983. This early adoption has helped Iowa develop its wind energy supply chain, including its capacity in manufacturing branch plants and turbines. Iowa is now second only to Texas in wind generation capacity (approximately 3 700 MW), but is ranked first in terms of the share of electricity generation from wind, due to its higher capacity factor. These results have been achieved in spite of Iowa's limited energy infrastructure, as the state does not have a history of specialising in energy production. Policies such as the Iowa Power Fund, which was set up in 2007 to finance renewable energy projects (to the tune of USD 100 million over four years), have helped Iowa develop its biofuel and biotech industry. Iowa's corn industry was a natural fit with the production of corn-based ethanol, as well as cellulosic ethanol made from corn residues, and from new sources such as municipal waste.

How is RE contributing to rural development? Although there are economic benefits from Iowa's renewable energy policies, the employment effects are limited, as the energy sector is capital intensive and encompasses only a small share of the economy. That said, RE offers the region new business opportunities. Farmers earn extra revenues from selling agricultural residues to ethanol producers, and in some cases groups of farmers themselves have directly invested in ethanol production. Due to the large number of ethanol refineries in the state, Iowa has a specialised pool of workers, thus attracting still more ethanol producers and triggering a virtuous circle of further specialisation. This is in spite of the reduction of public subsidies to ethanol production. Good wind resource has also attracted investment and Iowa's farming landscape has become home to wind farms, which provide local communities and farmers with revenues from local taxes and royalties. Some of the wind-turbine component manufacturers have based themselves in rural communities, providing valuable jobs, although the number of jobs created state-wide is still relatively modest.

Future challenges. An integrated approach to RE should not focus merely on job creation; it should support the creation of functional linkages between RE and rural sectors and also take into account the need to lower energy costs. Iowa should focus on maximising all the economic benefits of its renewable energy industry, not just the employment benefits. Policy makers should ensure that the renewable energy industry has a comparative advantage by building on Iowa's strengths to diversify and strengthen the economy. For example it could focus on ethanol as a general feedstock for different uses, rather than the current narrow use as a biofuel. Rural policy could help farmers to further diversify their activity. Policy makers should continue to support wind energy with the aim of producing cheap energy. Policies could also focus on attracting wind manufacturing to the state, bearing in mind that intense international competition could challenge the sustainability of the wind sector. Any potential linkages between wind energy and the state's economy should therefore be identified and supported with public resources.

The context

Iowa's socio-economic profile and performance

Iowa is a US state of just over 3 million people, covering 146 000 km^2 of mostly rolling hills. Its main urban centres are medium-sized cities such as the state capital Des Moines, Cedar Rapids, Davenport and Sioux City, with other smaller cities scattered throughout the state. As with much of the Midwest, many of Iowa's non-metropolitan counties have experienced outmigration, but the state's population is still significantly more rural than the United States as a whole; approximately 43.5% of Iowans are rural dwellers compared to only 16.5% in the US (Table 17.1).

Table 17.1. **Iowa: Demographic data**

	Iowa	US
Population	3 007 856	307 006 550
Population share (%)	0.98	
Population density (km^2)	21	33
Percent rural (%)	43.5	16.5
Elderly dependency rate	0.22	0.19

Source: *OECD Regional Database*, *http://dotstat/wbos/;* and USDA Economic Research Service (ERS).

Iowa has a lower GDP per capita than the US average, lower productivity per worker and lower employment rates (Table 17.2). Its unemployment rate has remained consistently lower than the national average, even during the height of the recession. From 2008 to 2009, US employment rate declined by approximately 3% whereas employment in Iowa declined by 2%. Over the last decade, Iowa has seen both outmigration and urbanisation. The outmigration of educated young people is an important component of this trend, which has also contributed to a lower level of tertiary educational attainment in the state (Table 17.2). A less educated workforce will have a negative impact on growth and productivity. Innovation in science and technology – measured by patents per million inhabitants – is less than half the national average, and Iowa's GDP per head is also below the US average. Iowa's annual wages, though still lower, have been converging with the national average. Iowa ranks among the top 10 states for business due to its low cost of doing business driven by lower wages, energy costs, rental rates and taxes (Forbes, 2011; CNBC, 2011).

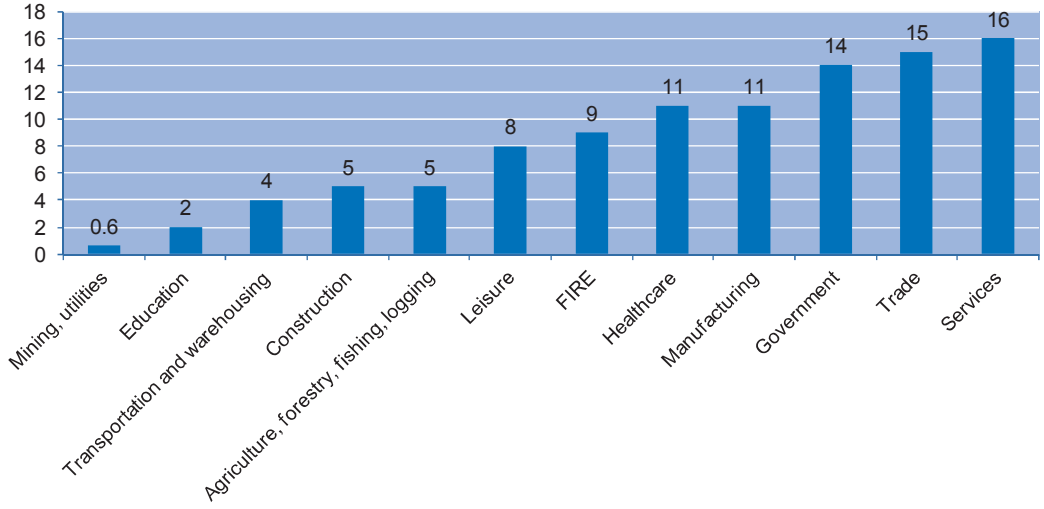
Table 17.2. **Iowa: Main economic indicators**

	Iowa	US	OECD gap
GDP *per capita* (2008) – current USD PPP	45 196	46 540	149%
GDP (2008) – millions current USD PPP	135 702	14 165 565	
GDP per worker	84 535	97 700	133%
Employment (people in full time employment)	1 605 277	144 989 525	
Poverty rate (%)	12.5	15.3	
Unemployment rate (%) 2009	6.0	9.3	-2.2
Employment rate (%) 2009	84.8	74.9	15.7
Youth unemployment (%)	8.0	12.9	-7.3
Infrastructure (motorway density)	0.47	0.3	
Tertiary education attainment (%) (2006)	22.1	24.3	
Patents per million inhabitants (2006)	73.9	175.2	

Source: *OECD Regional Database*, *http://dotstat/wbos/.*

Agriculture still dominates Iowa's economy. The state is consistently the top producer of corn in the US and a major producer of soybeans, hogs, oats, cattle, eggs, and dairy. Farming employs just over 85% of the land area in the state but less than 5% of the workforce, a share that has been steadily declining due in part to productivity gains. Iowa's prominence in agriculture has also led to a rise in other closely related sectors. For example, there are large meat production and processing plants (Tyson and Cargill) and other food processing manufacturers (ConAgra frozen foods and Kraft). Additionally, one of the largest employers in Iowa is Deere & Co, which specialises in manufacturing agricultural equipment. Because both agriculture and manufacturing have experienced significant employment losses, Iowa's employment growth has fallen behind the national average. Other than manufacturing, some of the largest employers in Iowa are retailers, "FIRE" (finance, insurance, and real estate), and healthcare. Education, FIRE, healthcare, and transportation have experienced the largest growth rates in Iowa over the last decade (Bureau of Economic Analysis). Business services, especially finance and insurance, have become important sectors in the state (Figure 17.1).

Figure 17.1. **Iowa's industry mix, 2010**



Source: US Bureau of Economic Analysis.

Iowa's energy resources

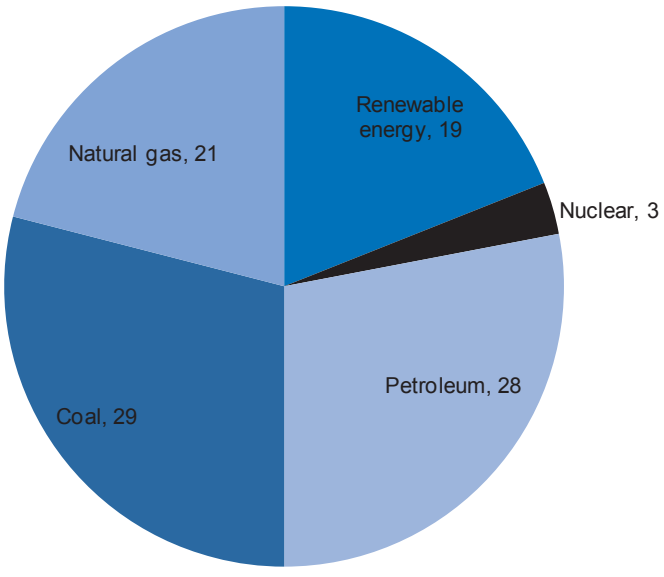
Iowa has limited fossil fuel resources, but good renewable energy potential. Its small population and large industrial sector means it has high energy consumption per head of population. The state has not historically been an energy producer so it does not have the installed infrastructure of other states. The state has coal and natural gas reserves, but low-sulphur coal is brought in by rail from Wyoming and natural gas via pipelines from Canada and the Texas-Oklahoma area. The proportion of energy from natural gas and nuclear power is substantially less than the US average and its share of energy from coal is more: approximately 72% of Iowa's electricity generation is from coal, compared to less than 45% for the US (Figure 17.2). Iowa's reliance on coal helps keep energy prices low, but increases its carbon emissions. Since 2000, carbon emissions from Iowa have increased from 79.5 to 85.1 million metric tons. Iowa has increased both its total carbon emissions and its emissions per head, falling from 22 to the 23 in the carbon emissions

rankings of US states (Environmental Protection Agency). In the Small Business Entrepreneurship Council's annual energy cost index, Iowa has the eighth lowest energy costs. These low costs are good for firms and residents, but provide less incentive to pursue more costly renewable energy strategies.

Fuel consumption in Iowa leans more towards renewable sources than the United States as a whole. Among the natural resources available in Iowa, biomass and wind have the most potential; its solar resources are rather limited. Iowa's chief comparative advantage in renewable energy production is the same resource that led to its comparative advantage in producing corn: its land. Renewable energy generation is generally land intensive. Iowa leads the nation not only in corn production but also ethanol production, accounting for one-quarter of the US supply. It started encouraging ethanol production in the 1970s to offset the first oil price shock; today nearly one-third of its corn is destined for ethanol production. Iowa's ethanol is currently transported by tanker, truck or rail to US fuel markets with requirements for motor gasoline blended with ethanol, as required by law, though a 2 900 km pipeline has been proposed (Energy Information Administration). Iowa also has good potential for producing other biomass crops that could be used in renewable energy generation, but high corn prices and high yields make the production of dedicated energy crops uneconomical in most of Iowa.

Iowa is the US state with the largest share of wind-generated electricity; it ranks second after Texas in terms of installed wind capacity with 3 675 MW, but has a higher capacity factor (Department of Energy). Iowa's early adoption of wind power has shaped its energy consumption profile. However, its limited transmission line capacity may restrict wind farm growth in the future because of the reduced market for its wind energy, although the "Green Power Express" (transmission lines) has been proposed by private business (ITC Holdings) to bring wind energy from states such as Iowa and North Dakota into heavily populated areas such as Chicago.

Figure 17.2. **Iowa's primary energy consumption by fuel type, 2009**



Source: US EIA State Energy Data.

Renewable energy policy in Iowa: Objectives, opportunities and challenges

The policy drivers: Why is Iowa implementing a renewable energy policy?

Iowa's RE policy has a strong focus on reducing carbon emissions, and on promoting economic growth and creating jobs. In 1983, the Iowa legislature enacted the country's first renewable energy standard, requiring its investor-owned utilities to purchase 105 MW of electricity from renewable sources. Although the utilities didn't comply until 1996, when ordered to by the Iowa Utilities Board, this renewable energy portfolio created a market for alternative energy that would not have existed otherwise. This early adoption of a renewable energy portfolio triggered the installation of wind energy and other alternative energy sources, allowing Iowa to tap into previously unused resources and slow the growth of carbon emissions. The ethanol industry has allowed Iowa to produce fuel locally that will lower carbon emissions while increasing the demand for its main crop, corn, adding local value, especially in rural areas.

The policy framework for renewable energy in Iowa's rural areas

RE deployment in rural Iowa depends on a complex set of policies cutting across state and national governments. Programmes at the national level tend to focus on financial incentives – including tax incentives, subsidies and loans – whereas state-level programmes tend to focus on establishing renewable energy standards that require utilities to purchase a certain portion of their energy from renewable sources. National financial incentives are used to encourage both research and development (R&D) and renewable energy programmes, including wind and solar farms and biofuel plants. The federal government also promotes the reduction of carbon emissions through energy efficiency: creating incentives to build with energy efficiency in mind and to update older buildings to become more energy efficient. Programmes aimed at increasing the supply of renewable energy and energy-efficient products would be less effective without a market for these products so the federal government has also established financial incentives for consumers to purchase energy efficient products through the Energy Star Program and other tax incentives, for example for solar panels.

National policy

Over time the US strategy for RE has gradually encompassed energy security and economic development as objectives. The Energy Policy Acts of 1992 and 2005, the Energy Independence and Security Act of 2007, the Emergency Economic Stabilization Act of 2008, and the American Recovery and Reinvestment Act of 2009 (ARRA) legislated financial assistance for renewable energy. The severity of the recent recession, coupled with growing concerns over climate change, created an opportunity for unprecedented national support and funding for renewable energy and energy conservation initiatives (Table 17.3). The ARRA alone included more than USD 70 billion in investments and tax credits for alternative energy related programmes. These investments are expected to move the US renewable energy market forward, enhancing its global competitiveness while creating jobs and promoting energy security.

Many of these renewable energy programmes would not be competitive without subsidies, raising concerns about their sustainability. In response, the US Department of Energy has created the SunShot programme in 2011, with the goal of making unsubsidised solar energy competitive on the electricity market by reducing related costs by 75% by 2020. Similarly, the 2012 federal budget proposes a 70% increase in the allocation of funds for renewable energy research and development, including USD 457 million for solar energy and USD 341 million for biofuels research and development. Such attempts to make the renewable energy sector competitive should make the industry, and the jobs that go with it, sustainable in the long run.

Because investments in biofuels also largely support the rural agricultural community, those subsidies also have the potential to increase farm income and therefore promote rural development (although see the discussion later in the case study on the opportunity cost of subsidies). The US Department of Agriculture's (USDA) Rural Energy for America Program (REAP, formerly the Renewable Energy Grant and Loan Program) provides funds to farmers and small businesses to purchase renewable energy systems or make current systems more efficient.

Table 17.3. **Iowa's federal renewable energy incentives and regulations**

	Financial incentives
Corporate deduction	Energy-Efficient Commercial Buildings Tax Deduction
Corporate depreciation	Modified Accelerated Cost-Recovery System (MACRS) + Bonus Depreciation (2008-2012)
Corporate exemption	Residential Energy Conservation Subsidy Exclusion (Corporate)
Corporate tax credit	Business Energy Investment Tax Credit (ITC) Energy-Efficient New Homes Tax Credit for Home Builders Renewable Electricity Production Tax Credit (PTC)
Federal grant programme	Tribal Energy Program Grant US Department of Treasury - Renewable Energy Grants USDA - High Energy Cost Grant Program USDA - Rural Energy for America Program (REAP) Grants
Federal loan programme	Clean Renewable Energy Bonds (CREBs) Energy-Efficient Mortgages Qualified Energy Conservation Bonds (QECBs) US Department of Energy - Loan Guarantee Program USDA - Rural Energy for America Program (REAP) Loan Guarantees
Industry recruitment/support	Energy-Efficient Appliance Manufacturing Tax Credit
Personal exemption	Residential Energy Conservation Subsidy Exclusion (Personal)
Personal tax credit	Residential Energy Efficiency Tax Credit
	Rules, regulations and policies
Appliance/equipment efficiency standards	Federal Appliance Standards
Energy standards for public buildings	Energy Goals and Standards for Federal Government
Green power purchasing	US Federal Government - Green Power Purchasing Goal
Interconnection	Interconnection Standards for Small Generators

Source: DSIRE (*Database of State Incentives for Renewables and Efficiency*), "Federal Incentives/Policies for Renewables & *Efficiency*", DSIRE website, *www.dsireusa.org/incentives/index.cfm?State=US&ee=1&re=1.*

State and local policy

In 2001 Iowa's governor set a voluntary goal for the state to produce 1 000 MW of electricity from renewable sources by 2010, encouraging the legislature to increase its existing renewable portfolio standards and energy incentive programmes (Table 17.4). In 2007, Iowa surpassed that goal in wind power alone; it currently has an installed wind capacity of approximately 4 000 MW. The most notable incentive programme is the Iowa Power Fund, established in 2007 to provide USD 100 million in funding over four years. So far the fund has invested more than USD 71.6 million in 50 different renewable energy projects, including the Fiberight project (Box 17.1). Iowa has made an extensive effort to develop its biofuel industries. In 2006, Iowa required that by 2020 25% of motor fuel was to come from gasoline mixed with renewable sources such as E10 (10% ethanol and 90% gasoline), E85 (85% ethanol and 15% gasoline), and biodiesel. A number of other renewable energy, energy efficiency, and carbon reduction goals have been set by Iowa's Office of Energy Independence and the Midwestern Governors Association. Iowa, along with six other governors and a Canadian premier, has joined the Midwestern Greenhouse Gas Reduction Accord, agreeing to reduce greenhouse gas emissions. Many of these goals would not be achievable without mandates or some type of financial incentive.

Table 17.4. **Iowa's renewable energy incentives and regulations**

Financial incentives	
Corporate exemption	Energy Replacement Generation Tax Exemption
Corporate tax credit	Renewable Energy Production Tax Credits (Corporate)
Performance-based incentive	Farmers Electric Cooperative (Kalona) - Renewable Energy Purchase Rate
Personal tax credit	Renewable Energy Production Tax Credit (Personal)
Property tax incentive	Local Option - Special Assessment of Wind Energy Devices
	Methane Gas Conversion Property Tax Exemption
	Property Tax Exemption for Renewable Energy Systems
Sales tax incentive	Wind and Solar Energy Equipment Exemption
State loan programme	Alternate Energy Revolving Loan Program
	Iowa Energy Bank
Utility grant programme	Farmers Electric Cooperative (Kalona) - Residential Efficiency Matching Grant Program
Utility loan programme	Alliant Energy Interstate Power and Light (Gas and Electric) - Low Interest Energy Efficiency Loan Program
	MidAmerican Energy (Gas and Electric) - Residential EnergyAdvantage Loan Program
Utility rebate programme	Residential Energy Efficiency Rebate (Offered by Several Cooperative Utilities)
	Rural Electric Cooperatives Energy Efficiency Rebate Programs (Offered by 12 Utilities)
	Alliant Energy Interstate Power and Light (Electric) - Business Energy Efficiency Rebate Programs
	Alliant Energy Interstate Power and Light (Electric) - Residential Energy Efficiency Rebate Programs
	Alliant Energy Interstate Power and Light (Gas and Electric) - Farm Equipment Energy Efficiency Incentives
	Alliant Energy Interstate Power and Light (Gas and Electric) - New Home Construction Incentives
	Alliant Energy Interstate Power and Light (Gas) - Business Energy Efficiency Rebate Programs
	Alliant Energy Interstate Power and Light (Gas) - Residential Energy Efficiency Rebate Programs
	Alliant Energy Interstate Power and Light - Business and Farm Renewable Energy Rebates
	Alliant Energy Interstate Power and Light - Residential Renewable Energy Rebates
	Ames Electric Department - Commercial Energy Efficiency Rebate Programs
	Ames Electric Department - Residential Energy Efficiency Rebate Programs
	Atmos Energy (Gas) - Residential Efficiency Program
	Black Hills Energy (Gas) - Commercial Energy Efficiency Rebate Programs
	Black Hills Energy (Gas) - Residential Energy Efficiency Rebate Programs
	Black Hills Energy (Gas) - Residential New Construction Rebate Program
	Cedar Falls Utilities - Commercial Energy Efficiency Rebate Program
	Cedar Falls Utilities - Residential Energy Efficiency Rebate Program
	Cedar Falls Utilities - Residential New Construction Program
	Farmers Electric Cooperative (Kalona) - Renewable Energy Rebates
	Farmers Electric Cooperative (Kalona) - Residential Energy Efficiency Rebate Program
	Indianola Municipal Utilities - Energy Efficiency Rebate Program
	Linn County Rural Electric Cooperative - Agricultural Energy Efficiency Rebate Program
	Linn County Rural Electric Cooperative - Commercial Energy Efficiency Rebate Program
	Linn County Rural Electric Cooperative - Residential Energy Efficiency Rebate Program
	Linn County Rural Electric Cooperative - Solar Water Heater Rebate Program
	MidAmerican Energy (Electric) - Commercial EnergyAdvantage Rebate Program
	MidAmerican Energy (Electric) - Residential Energy Efficiency Rebate Programs
	MidAmerican Energy (Gas and Electric) - Commercial New Construction Energy-Efficiency Program
	MidAmerican Energy (Gas) - Commercial EnergyAdvantage Rebate Program
	MidAmerican Energy (Gas) - Residential Energy Efficiency Rebate Programs
	Missouri River Energy Service Member Utilities - Commercial and Industrial Efficiency Rebates
	Missouri River Energy Service Member Utilities - Residential Energy Efficiency Rebates
	Muscatine Power and Water - Commercial and Industrial Energy Efficiency Rebates
	Muscatine Power and Water - Residential Energy Efficiency Rebates
	Waverly Light & Power - Residential Energy Efficiency Rebates
	Waverly Light & Power - Residential Solar Thermal Rebates
Rules, regulations and policies	
Building energy code	Iowa Building Energy Codes
Contractor licensing	City of Dubuque - Solar Thermal Licensing Requirement
Energy efficiency resource standard	Energy Efficiency Standard
Energy standards for public buildings	Energy Efficiency in State Facilities
Generation disclosure	Fuel Mix and Emissions Disclosure
Interconnection	Interconnection Standards
Mandatory utility green power option	Mandatory Utility Green Power Option
Net metering	Iowa - Net Metering
Renewables portfolio standard	Alternative Energy Law (AEL)

Source: DSIRE (Database of State Incentives for Renewables and Efficiency), "Iowa Incentives/Policies for Renewables and Efficiency", DSIRE website, *www.dsireusa.org/incentives/index.cfm?getRE=1?re=undefined&ee=1&spv=0&st=0&srp=1&state=IA.*

State resources are now focusing on second generation biofuels, to enable farmers to benefit from ethanol production without suffering from price distortions. Public subsidies in Iowa have supported specialisation in the production of ethanol to a point where the state has become attractive to biofuel businesses. While high subsidies for ethanol have created distortions, they have also enabled the state to trigger a progressively specialisation in this industry. When subsidies were reduced, starting in 2008, inefficient ethanol refineries left the business, and were replaced by more efficient installations. The current level of subsidies, and the infrastructure and skills available in the state, have attracted businesses producing cellulosic ethanol (from residues such as corn leaves and stalks) instead of corn as feedstock (Box 17.1).

Box 17.1. **The case of Fiberight: Testing an urban technology in a specialised rural area**

Federal funding and regional specialisation in the ethanol industry have attracted a Maryland-based company, Fiberight, to Iowa to test a technology that could serve large urban areas, if proved efficient. The USDA recently awarded USD 25 million in guaranteed loans to a Maryland based company, Fiberight, to convert a small demonstration-scale ethanol facility into a commercial-scale plant. This comes on top of approximately USD 2.9 million the company previously received from the Iowa Power Fund. Every day the plant will use 350 metric tons of municipal waste and waste from a nearby paper plant to produce 6 million gallons (22.7 million litres) of ethanol a year (with plans to increase that to as much as 10 million gallons a year). The plant is ideally located by the paper plant and near Cedar Rapids, which supplies a sufficient amount of municipal waste every day. Thus, in terms of environmental benefits, Fiberight not only produces ethanol from a renewable source, it also addresses the issue of waste disposal. Moreover, on the basis of improved environmental sustainability, the cellulosic ethanol plant is more environmentally sustainable than a corn- based plant.

In terms of economic benefits, Fiberight will charge a lower tipping fee less than the local municipal waste disposal facility. Other than the cost of transportation, there is no cost for the waste from the paper plant. Despite low input costs, even if the plant achieves its goal of producing ethanol at a cost of USD 1.65 per gallon, this would still be higher than the cost of producing corn-based ethanol, which is between USD 1.10 and USD 1.40 per gallon, depending on the cost of corn. Approximately 20-30 workers will be required to retrofit the existing plant. The facility is expected to be fully operational by the third quarter of 2012 and will employ 28 people.

IMPLAN studies produced by USDA for this research suggest that total operating industry output for the state of Iowa, including direct, indirect, and induced outputs, will be approximately USD 45 million and 106 jobs (using a multiplier of 1.41 and an employment multiplier of 9.64). The total construction output for the state including direct, indirect, and induced output will be approximately USD 40 million and 222 jobs (using a multiplier of 1.49 and an employment multiplier of 1.91) (USDA's background report, unpublished).

Most state subsidies are being channelled into demonstration projects using agricultural residues such as corn stovers (leaves and stalks) to produce ethanol. These projects have several challenges to overcome. First, agricultural residues have less sugar content than corn, hence are less efficient in terms of ethanol production. Second, farmers have to use extra labour to collect residues and prepare them for the RE producer, increasing their price and making them less economic to use as a feedstock. Third, there is debate among farmers about the long-term sustainability of using agricultural residues as they would otherwise be left in the fields to maintain soil fertility. Iowa's experience has shown, however, that developers might be able to deal with some of these issues. One of the main examples is the plant belonging to the POET Project Liberty (Box 17.2). It is

worth noting that the success of these initiatives depends on the close co-operation between farmers and producers of ethanol.

Box 17.2. **POET Project Liberty: Developing second generation biofuels**

The POET ethanol plant in Emmetsburg is the largest installation in the state developing technologies to transform cellulosic material into ethanol. The POET project has received approximately USD 14.75 million in state funding. At the federal level, the Department of Energy (DOE) also provided approximately USD 100 million in funding through a programme to promote commercial-scale cellulosic ethanol plants. POET also benefits from a USD 200 million federal loan guarantee. The project will be located alongside an existing corn starch ethanol facility in Emmetsburg and will employ 35 to 45 individuals.

Once operational, the POET Project Liberty plant plans to produce 25 million gallons (94.6 million litres) of cellulosic ethanol a year from approximately 300 000 metric tons of corn cobs and corn stover. POET is dependent on continued federal funding to encourage farmers to provide corn stover; Biomass Crop Assistance Program (BCAP) incentivises this by providing a dollar for dollar match of up to USD 45 per ton to farmers for harvesting biomass. Even so, POET still has significant hurdles to overcome simply to acquire enough corn stover; it takes 700 bone-dry tons from approximately 400 000-500 000 acres to supply the plant. IMPLAN studies suggest that total operating industry output for the state including direct, indirect, and induced outputs to be approximately USD 98 million and 168 jobs (using a multiplier of 1.22 and an employment multiplier of 3.73). The total construction output for the state is approximately USD 478 million and 2 647 jobs (using a multiplier of 1.49 and an employment multiplier of 1.91). Although POET has been able to reduce the cost of production by 40% in two years, the industry needs to make further efficiency gains if it is to be competitive without government support.

Assessment of policy impacts on rural development

Stimulating local economies

Although Iowa's renewable energy policies seem to provide environmental benefits and increased energy security, the employment effects of these policies in rural areas are less promising. Iowa has aligned its RE policy with a set of federal incentives promoting biofuels. Although financial incentives for the production of ethanol have been decreasing over the last decade, there is still a strong support at the federal level for this technology.[1] The state's specialisation in ethanol production has had a positive impact on farm revenue and has stimulated regional innovation. However, the number of jobs created has been relatively limited.

Iowa's specialisation in ethanol has created some agglomeration dynamics, which policy makers would like to replicate also in the wind energy industry. Due to the large number of ethanol refineries in the state (some of them owned by group of local farmers), Iowa has a specialised pool of workers, thus attracting still more ethanol producers and triggering a virtuous circle of further specialisation. This is in spite of the reduction of public subsidies to ethanol production. Ethanol has become an important specialisation in the state and is well integrated with farming activities. Policy makers have been trying to replicate this dynamic with wind energy. Good wind resource has also attracted investment and Iowa's farming landscape has become home to wind farms, which provide local communities and farmers with revenues from local taxes and royalties.

Some of the wind-turbine component manufacturers have based themselves in rural communities, providing valuable jobs, although the number of jobs created state-wide is still relatively modest

The low impact on job creation reflects the fact that energy makes up a very small portion of employment in the economy as a whole, and the RE sector is even smaller.[2] Despite an impressive growth rate of 26.1% in the "clean jobs" sector of the economy – compared to an overall growth rate of 3.6% in Iowa from 1998 to 2007 – the sector accounted for only 0.43% of Iowa's employment in 2007 (Pew Charitable Trusts, 2009). This constituted 729 businesses and 7 702 jobs, out of over 1.8 million in the overall state economy. Even if the renewable energy sector was to completely replace the conventional energy sector, it would still only represent a small percentage of overall employment, too small to expect it to have very significant impacts on unemployment and growth. For instance, once fully operational, POET and Fiberight will employ approximately 40 and 25 employees respectively; and some of these employees may be hired from out of state. Similarly, many of the net effects of the construction of these facilities may have been overstated by input-output analysis, especially locally, because work crews living elsewhere may be brought in to build the facility, but spend the income in their home region. Corn stover production is unlikely to create much additional employment, just more work for farmers, although there may be jobs for people going into farms to collect it. On the other hand, the increased income for local farmers is important to local economic development.

Ethanol as a fuel may just be the start; the product may become a general feedstock with many uses. This would make the success of the biomass industry less dependent on oil prices while diversifying the economy. For instance, although the Fiberight plant may not be a large job creator, it does have additional benefits to the local economy by avoiding the cost of a new landfill. Those savings can then be put back into the economy or can be used to lower taxes.

Main challenges

Even a small number of jobs can boost small rural communities, but these jobs will only have a lasting impact if they are sustainable. To make renewable energy jobs sustainable, the ethanol industry needs to become competitive without government subsidies. Iowa has significant strengths in the production of ethanol from corn stover and biomass in general, which is also increasing the demand for corn-based products.[3] Making the production cost of cellulosic ethanol competitive with corn-based ethanol and oil prices will be a significant challenge. Not only is the market for cellulosic ethanol limited by price, the market for ethanol in general is limited, although an expanded export market for ethanol could alleviate some of these issues. A national limit on grain-based ethanol, for example, could widen the market for cellulosic ethanol.

Federal and state policies should also take into account public acceptance of ethanol refineries. Community perceptions of ethanol production installations tend to be negative. Community-level surveys, individual and focus group interviews in Iowa found that community members believe that ethanol plants have brought only modest economic benefits to their community (Selfa *et al.,* 2010). Residents were concerned about increased traffic and water competition generated by the local ethanol plants. They did express widespread concern about the viability of the ethanol industry and the devastating impact that a future decline would have on communities. Public policies should take these

social vulnerabilities into account before they become an issue impinging upon the deployment of RE, as rural dwellers may start voting against RE options.

More generally, Iowa needs to pursue sectors in which it has a comparative advantage and to develop the link between RE and rural industries. Compared to other US states, Iowa has a comparative advantage in both biomass and wind. Diversifying the economy by building upon these strengths will help ensure economic growth is sustainable. Because Iowa was an early adopter of wind energy, it has developed some manufacturing capacity, including branch plants and turbine manufacturers, although it still must compete with Chinese manufacturers. The recent state investments and emphasis on biofuel and biotech potential also play to Iowa's strengths, but arguably even more important economically is Iowa State University's efforts to turn ethanol production in something similar to the oil industry, by producing not only ethanol but also a series of by-products.

On the other hand, the opportunity costs of subsidies should also be at least briefly considered in an analysis of the economic impacts of renewable energy policies. The subsidy per permanent employee for POET and Fiberight is approximately USD 2.5 million and USD 1 million per worker respectively. Table 17.5 below shows the subsidy per worker for other wind and solar firms in Iowa in 2009. These funds could instead be used to lower taxes or for other economic development programmes that are more labour-intensive. Weatherisation programmes to increase the energy efficiency of homes and buildings may be more labour intensive while reducing energy costs for firms and residents.

Table 17.5. **Iowa's wind and solar facilities granted state and local subsidies, 2009**

Company	City	Workers	Investment (USD)	Subsidies (USD)	Investment per worker (USD)	Subsidy per worker (USD)
Acciona Windpower	West Branch	130	23 000 000	4 850 000	176 923	37 308
Clipper Windpower	Cedar Rapids	250	50 000 000	3 150 000	200 000	12 600
Siemens Power Generation	Fort Madison	380	43 000 000	12 500 000	113 158	32 895
TPI Composites	Newton	330	56 000 000	6 600 000	169 697	20 000
Trinity Structural Towers	Newton	140	21 000 000	1 280 000	150 000	9 143

Source: Matera (2009), "High Road or Low Road? Job Quality in the New Green Economy", *Good Jobs First*, Washington, DC, *www.goodjobsfirst.org/sites/default/files/docs/pdf/gjfgreenjobsrpt.pdf.*

Notes

1. For instance, through air quality regulations and also by promoting a mix of ethanol and conventional fuels.
2. The largest share of clean jobs is not in energy generation but in conservation (The Pew Charitable Trusts, 2009).
3. Although demand for corn as fuel will also compete with demand for corn as food, affecting food prices.

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Chapter 18

Maine and Vermont, United States

Rural development and renewable energy (RE) in Maine and Vermont: Summary and conclusions

Main findings: *i*) Rural dwellers may be willing to pay a temporary premium price for RE if it will enhance key local businesses, such as dairy firms in Vermont. *ii*) RE policy can encourage collaboration across the public sector, research organisations, NGOs and businesses in rural areas for engaging in ambitious projects based on existing strengths. For example, Maine's DeepCWind project might restore – at least in part – the competitiveness of the shipbuilding sector. *iii*) Policies supporting RE should be better co-ordinated in order to avoid duplications. *iv*) Reducing the overall cost of energy should be always a clear target of RE policy.

Renewable energy in Maine and Vermont: A summary. Maine and Vermont are rural states in New England, a region with a clear identity built upon its landscape and maritime history. In both states, the population supports environmentally-friendly policies and is very conservative about the use of landscape amenities and natural resources. Maine and Vermont have comparatively large leisure and tourism sectors, based on the natural and cultural amenities these states offer. For example, the mountains in Vermont are a popular skiing destination for many tourists and Maine's coast is highly valued by locals and tourists.

Maine and Vermont have high energy costs and no fossil fuel resources, which have led to the early development of renewable energy, including hydroelectric energy generation. Vermont has also developed its nuclear energy sector which now supplies approximately 71% of its electricity needs, the rest coming from hydroelectric and other RE sources. Approximately 52% of Maine's electricity generation comes from hydroelectric and other RE sources. Both Maine and Vermont are largely forested, but their forest resources are only marginally used to produce biomass and both states rely heavily on heating oil in the winter months. Neither state has done much to tap their wind resources although renewable energy policies are now in place to expand their wind energy production.

Maine and Vermont's renewable energy policies are mainly supported by a complex mix of state and federal funds. Maine has a renewable energy portfolio standard requiring 40% of energy generation to come from renewable sources by 2017 while Vermont has no renewable portfolio standard, but has adopted a voluntary renewable energy goal of producing 25% of its energy from renewable resources. The two states implement different approaches to RE deployment: Maine is more focused on large-scale initiatives, while Vermont is more active in supporting small-scale ones.

How is RE contributing to rural development? Both states' renewable energy generation policies have had only a limited effect on employment so far because the energy sector is capital intensive and makes up only a small share of the economy. Maine's renewable energy policies and associated funding have been largely focused on wind energy generation and developing projects such as the DeepCWind Consortium which plans to increase Maine's wind generation capacity while building its manufacturing industry and research and development sectors. This is unlikely to directly create rural jobs, but by ensuring that rural communities affected by its offshore wind farms share some of the financial benefits, the rural economy should benefit. Vermont has chosen instead to focus its renewable energy policies on small-scale energy generation, such as its "Cow Power" biogas digester for dairy farms, and on energy efficiency which have a more direct impact on the rural economy.

Future challenges. The current renewable energy policies in Maine and Vermont have significant environmental and economic potential, but could still be improved. To be sustainable, the RE industry needs to be competitive in meeting all energy demands. Both states will need to continue to innovate, especially in the area of biogas digesters and offshore wind facilities, to increase efficiency and lower production costs. Policy makers need to consider whether existing subsidies for electricity generation could be better spent on weatherisation programmes which cut energy costs overall rather than increase them, and which potentially create more jobs. Maine and Vermont's renewable energy policies also need to do more to address energy demands related to heating as both states are heavily forested yet remain dependent on imported heating oil.

The context

Maine and Vermont's socio-economic profile and performance

Maine and Vermont are predominantly rural areas with low population density. The two states are both significantly more rural and less densely populated than the US average (Table 18.1), with Vermont being the least populated state in the US. Vermont is also one of the smallest states with only 23 960 km^2 of land. Maine covers more than 90 650 km^2. Maine's residents are located mostly along its Atlantic Ocean border. The largest city, Portland, contains a metropolitan area with over 500 000 people and is also located on the Atlantic coast. The rest of the state has low rolling mountains covered in trees (90% forested). Vermont is also largely forested (77%) but has slightly more rugged terrain, with the Green Mountains running the length of the state. It is the only state in New England that does not border the Atlantic Ocean. However, its largest city, Burlington (with a metropolitan area population of over 200 000) is also located on a body of water, Lake Champlain. Maine and Vermont maintain a strong cultural identity typified by the New England region that is inextricably linked to its landscape and history. In line with the national trend, both states have experienced outmigration from their rural areas. However, while Vermont's population has declined overall, in Maine the population has been concentrating in main urban areas.

Table 18.1. **Maine and Vermont: Demographic data**

	Maine	Vermont	US
Population	1 319 910	621 049	307 006 550
Population share (%)	0.43	0.20	
Population density per km^2	16	26	33
Percent rural (%)	41.6	66.2	16.5
Elderly dependency rate	0.22	0.20	0.19

Source: *OECD Regional Database* and ERS.

Despite stable employment trends and good educational attainments, both Maine and Vermont's economic performance has been sluggish over the last decade. The two states recorded a GDP per capita growth rate of 1.89% and 2.07% respectively. These are below the average pace of growth of similar states (2.12%) in the US. Maine and Vermont rank relatively low in the "best states for business" ranking (Forbes, 2011; CNBC, 2011), primarily driven by high costs of living and high business costs such as wages, energy costs, rental rates, and taxes. Nevertheless, their poverty and unemployment rates are lower than the national average (Table 18.2), and both states have weathered the effects of the recent recession better than the US as a whole. From 2008 to 2009 employment in the US declined by 3%, whereas in Maine and Vermont it declined by only 2.6% and 2.2% respectively, though Maine has had a slower recovery than Vermont (Bureau of Economic Analysis). One of Vermont's strengths is the presence of a high-skilled labour force: Vermont ranked eighth among US states. One factor behind Vermont's high educational attainment is the presence of the state's largest employer, the University of Vermont. Maine, on the other hand has one of the lowest educational attainments in the New England region, is positioned around the US average and ranked only 23 among the states.

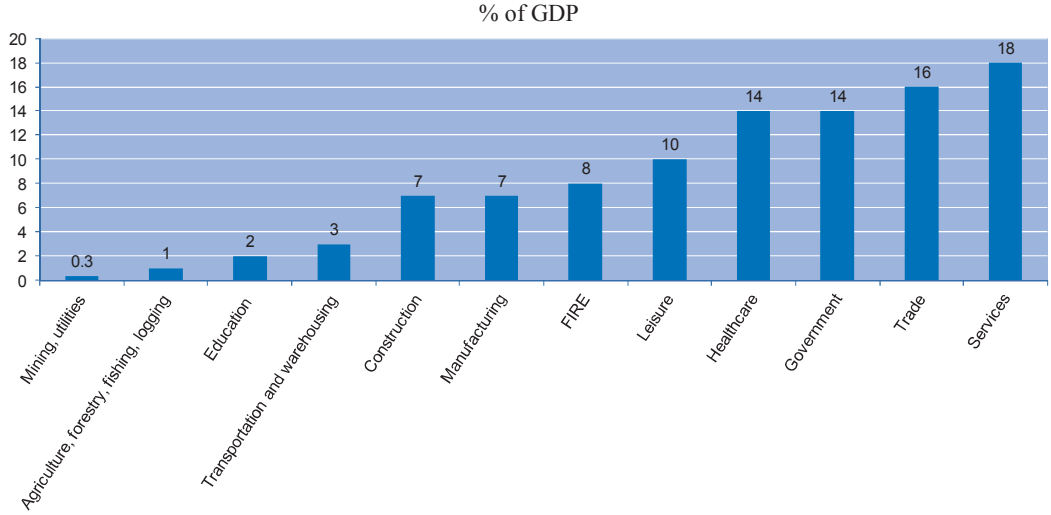
Table 18.2. **Maine and Vermont: Main economic indicators**

	Maine	Vermont	US	OECD gap Maine	OECD gap Vermont
GDP *per capita* (2008) –current USD PPP	37 667	40 966	46 540	124%	135%
GDP (2008) – millions current USD PPP	49 709	25 442	14 165 565		
GDP per worker (2007) – current USD PPP	66 539	67 732	81 139	121%	123%
Employment (people on a full time	647 465	334 942	144 989 525		
Poverty rate (%)	13.1	12.4	15.3		
Unemployment rate (%) 2009	8.1	6.9	9.3		
Employment rate (%) 2009	78.8	83.6	74.9		
Youth unemployment (%)	12.3	10.0	12.9		
Infrastructure (motorway density)	8.12	23.25	9.96		
Tertiary education attainment (2006)	23.7	29.3	24.3	-2.3%	+3.6
Patents per million inhabitants (2006)	80.1	142.3	175.2	-5.1	+51.3

Source: *OECD Regional Database*.

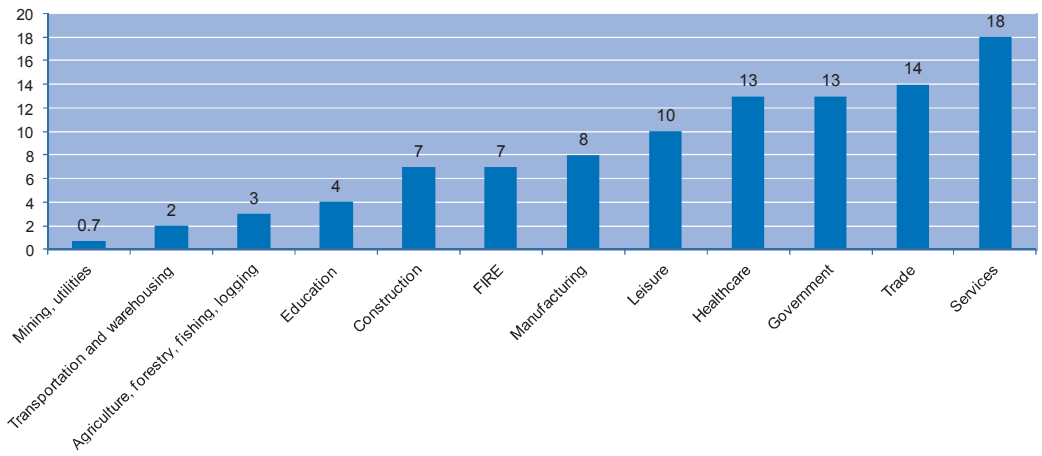
Maine and Vermont's low growth in recent years reflects a declining manufacturing sector and a lower share of surging services industries. For instance, since 1994 Maine's manufacturing employment has declined by 40%, and the state has lost more than 13% of its factories since 2001. Between 2009 and 2011, 141 factories have closed and 8 600 workers have lost their jobs in the manufacturing sector (Office of Congressman Michael H. Michaud, 2011). Vermont lost its flourishing mineral industry in the 1990s and replaced it with the branch operations of multinational corporations such as General Electric and IBM (which is one of the largest employers in the state). As a result, the state economy is tied to trends outside Vermont (McGrory Klyza and Trombulak, 1999). The reduction in manufacturing employment has been buffered to an extent by the rise of the service sector, but less so than in the rest of New England and the US as a whole. For instance, Maine and Vermont have a lower share of the service sector and particularly the high-performance "FIRE" sector (finance, insurance, and real estate) than either New England or the rest of the US. However, Maine and Vermont have taken advantage of their unique natural and cultural resources. Both states' economies have significant leisure and hospitality sectors, largely down to the tourism industry. In Vermont, skiing and hotels make up the largest portion.

Figure 18.1. **Maine's industrial mix, 2010**



Source: US Bureau of Economic Analysis.

Figure 18.2. **Vermont's industrial mix, 2010**



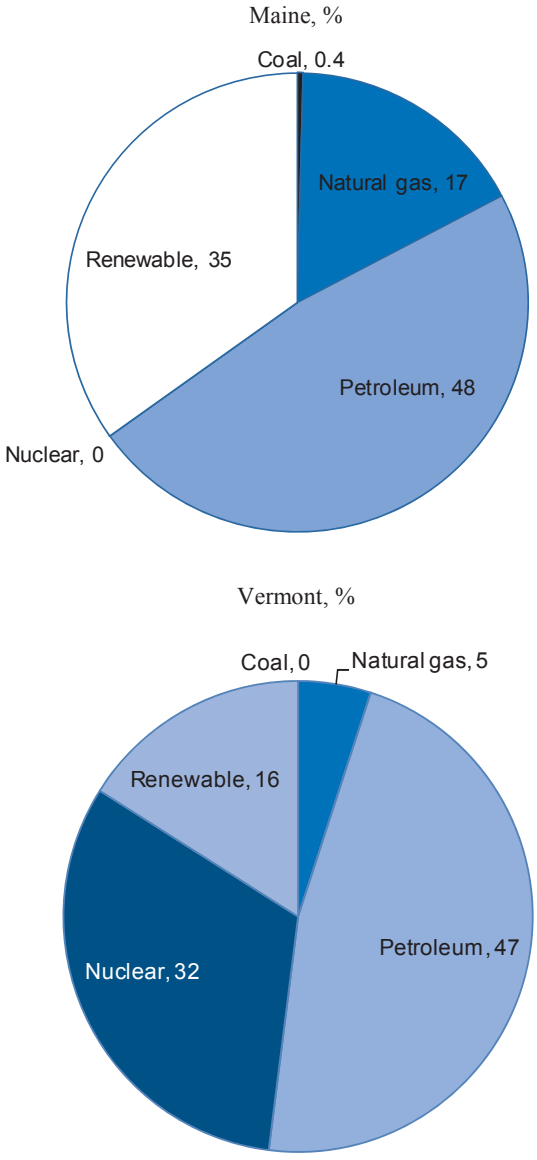
Source: US Bureau of Economic Analysis.

Maine and Vermont's energy resources

Neither Maine nor Vermont have any fossil fuel resources and therefore have had to rely on imports or developing alternative energy sources. They import all of their petroleum, natural gas, and coal from outside the region. Maine receives petroleum from abroad through its ports, and Vermont imports from Canada. Natural gas is imported to both states via a pipeline from Canada. Maine imports a small amount of coal while Vermont is one of only two states in the US with no coal-fired power plant. Vermont has also developed its nuclear energy sector which now supplies approximately 71% of its electricity needs, the largest in the nation. Because of this lack of fossil fuel resources, alternative energy resources in both states have become increasingly important (Figure 18.3).

The presence of a wide range of natural resources represents an important potential for renewable energy (RE). Apart from nuclear, the rest of Vermont's electricity generation comes from hydroelectric and other renewable energy sources, while approximately 52% of Maine's electricity generation comes from hydroelectric and other renewable energy. Maine and Vermont have biomass potential, mostly from their timber resources. Maine has the highest capacity for wood-fired generation of any state in the US. Vermont's Connecticut River and Lake Champlain offer hydroelectric energy potential, as do Maine's rivers. Wind energy is also a good resource. Vermont has good wind energy density along the mountains running down the centre of the state, and Maine's Atlantic coast has one of the best wind resources in the nation with a wind energy density (measured at 50 metres) of 600-800 W per square metre (National Renewable Energy Laboratory). So far, however, this wind energy potential is only marginally exploited: Maine has approximately 326 megawatts (MW) of installed wind energy capacity and Vermont has just 6 MW.

Figure 18.3. **Maine and Vermont's primary energy consumption by fuel type, 2009**



Source: US EIA State Energy Data.

Renewable energy policy in Maine and Vermont: Objectives, opportunities and challenges

The policy drivers: Why are Maine and Vermont implementing a renewable energy policy?

Maine and Vermont are deploying RE to improve their environmental sustainability and energy security. In both states environmental protection is a popular issue and voters tend to support policy initiatives that promote it (List and Sturm, 2004). In this context the two states have developed policies linking RE deployment to the reduction of carbon

emissions. For instance, Maine adopted legislation in 2006 to increase new renewable energy by 10% by 2017 and 2 000 MW of installed wind energy capacity by 2015, and modified its RE portfolio standard (RPS) accordingly. RPS requires electric utilities and other retail electric providers to supply a specified minimum amount of customer load with electricity from eligible renewable energy sources. Vermont has no renewable energy portfolio standard, but has adopted a voluntary renewable energy portfolio goal of producing 25% of the energy consumed in the state from renewable sources. To give utility customers an incentive to conserve energy and invest in renewable energy, Maine and Vermont utilities are also required offering net metering to all customers owning RE facilities, so they can receive retail credit for the electricity they generate. Maine and Vermont's dependence on imported fossil fuels and high energy costs are other factors supporting RE deployment. For instance, a significant portion of homes in Maine and Vermont (about 80% in Maine and 60% in Vermont) use fuel oil for heating, making them quite vulnerable to shortages and price spikes in the cold winter months (Energy Information Administration). Maine and Vermont's limited access to low-cost fossil fuels (the Small Business and Entrepreneurship's annual energy cost index ranked Maine and Vermont 41 and 43 respectively in terms of energy costs) puts upward pressure on energy prices year round. These high energy costs affect the costs of living for residents and the costs of business for firms. Mounting opposition to nuclear in Vermont also reduces the possibility of using nuclear power to reduce overall energy costs.

The policy framework for renewable energy in Maine and Vermont's rural areas

RE deployment in rural Maine and Vermont depends on a complex set of policies cutting across state and national governments. RE programmes at the national level tend to focus on financial incentives, such as tax incentives, subsidies, and loans as a way of reducing carbon emissions, whereas state level programmes tend to focus on establishing renewable energy standards requiring utilities to purchase a certain portion of their energy from renewable sources. At the national level, financial incentives are used to encourage the research and development of renewable energy programmes, including wind and solar farms and biofuel plants The federal government also provides incentives for the reduction of carbon emissions through energy efficiency. These include the reduction of total energy consumption by promoting energy-efficient new buildings and the updating of older buildings to become more energy efficient through weatherisation programmes. The federal government has also established financial incentives for consumers to purchase energy-efficient products through the Energy Star Programme or tax incentives to purchase solar panels.

US policy

The US strategy supporting RE deployment has evolved over time, gradually encompassing energy security and economic development objectives. The most recent federal financial assistance for renewable energy is through the Energy Policy Acts of 1992 and 2005, the Energy Independence and Security Act of 2007, the Emergency Economic Stabilization Act of 2008, and the American Recovery and Reinvestment Act of 2009. The severity of the recent recession coupled with growing concerns over climate change created an opportunity for unprecedented national support and funding for renewable energy and energy conservation initiatives. The American Recovery and Reinvestment Act of 2009 alone included more than USD 70 billion in investments and

tax credits for alternative energy related programmes. These investments are expected to move the US renewable energy market forward, enhancing its global competitiveness while creating jobs and promoting energy security.

Many of these renewable energy programmes would not be competitive without these subsidies, raising concerns about how sustainable these initiatives are. In response, the US Department of Energy created the SunShot programme with the goal of making unsubsidised solar energy competitive on the electricity market by reducing its cost by 75% by 2020. Similarly, the 2012 federal budget proposes a 70% increase in the allocation of funds for renewable energy research and development (R&D) with USD 457 million for solar energy and USD 341 million for biofuels research. Investments in innovations for making the renewable energy sector competitive will, it is hoped, make the industry and the jobs that go with it sustainable in the long run. Because investments in biofuels also largely support rural communities, those subsidies also included a rural development goal. Biofuels subsidies have the potential to increase farm income and general rural economic development. The Rural Energy for America Programme (formerly the Renewable Energy Grant and Loan Programme) under the USDA provides funds to farmers and small businesses to purchase renewable energy systems or make current systems more efficient. Table 18.3 summarises the renewable energy incentives put in place at the federal level.

Table 18.3. **Maine and Vermont's federal renewable energy incentives**

	Financial incentives
Corporate deduction	Energy-Efficient Commercial Buildings Tax Deduction
Corporate depreciation	Modified Accelerated Cost-Recovery System (MACRC) + Bonus Depreciation (2008-2012)
Corporate exemption	Residential Energy Conservation Subsidy Exclusion (Corporate)
Corporate tax credit	Business Energy Investment Tax Credit (ITC) Energy-Efficient New Homes Tax Credit for Home Builders Renewable Electricity Production Tax Credit (PTC)
Federal grant programme	Tribal Energy Programme Grant US Department of Treasury – Renewable Energy Grants USDA – High Energy Cost Grant Programme USDA – Rural Energy for America Programme (REAP) Grants
Federal loan programme	Clean Renewable Energy Bonds (CREBs) Energy-Efficient Mortgages Qualified Energy Conservation Bonds (QECBs) US Department of Energy – Loan Guarantee Programme USDA – Rural Energy for America Programme (REAP) Loan Guarantees
Industry recruitment/support	Energy-Efficient Appliance Manufacturing Tax Credit
Personal exemption	Residential Energy Conservation Subsidy Exclusion (Personal)
Personal tax credit	Residential Energy Efficiency Tax Credit Residential Renewable Energy Tax Credit
	Rules, regulations & policies
Appliance/equipment efficiency standards	Federal Appliance Standards
Energy standards for public buildings	Energy Goals and Standards for Federal Government
Green power purchasing	U.S. Federal Government - Green Power Purchasing Goal
Interconnection	Interconnection Standards for Small Generators

Source: DSIRE (Database of State Incentives for Renewables and Efficiency), "Federal Incentives/Policies for Renewables & Efficiency", DSIRE website, *www.dsireusa.org/incentives/index.cfm?State=US&ee=1&re=1.*

The state and the local policy

Maine generally supports renewable energy through its renewable energy goal while Vermont uses a renewable energy portfolio standard. The two states have established some financial incentives such as tax incentives to promote renewable energy development, but funding has generally been limited. Tables 18.4 and 18.5 below show the regulatory and financial incentives each state has established to promote renewable energy development. Maine's Public Benefit Fund is a voluntary programme for utility customers to donate money toward renewable energy projects in Maine. Vermont's Clean Energy Development Fund was established in 2005 to fund renewable energy projects from money received from the state's nuclear power plant (between USD 3 and USD 7 million annually). The fund was expanded recently with USD 22 million in funding from the American Recovery and Reinvestment Act State Energy Programme. The focus of renewable energy programmes in Maine and Vermont has been on electrical energy generation and not on heating. Maine and Vermont are counting on the renewable energy portfolio standards of other states to provide an export market for some of this electricity.

Table 18.4. **Maine's renewable energy incentives**

Financial incentives	
Local loan programme	New Generation Energy – Community Food Service Efficiency Lending Program New Generation Energy – Community Solar Lending Program Seacoast Energy Initiative – Energy Efficiency Loan Program
PACE financing	Local Option - Property Assessed Clean Energy Maine PACE Loans
Performance-based incentive	Community Based Renewable Energy Production Incentive (Pilot Program)
Sales tax incentive	Sales and Use Tax Refund for Qualified Community Wind Generators
State grant programme	Voluntary Renewable Resources Grants
State loan programme	Efficiency Maine – Small Business Low-Interest Loan Program
State rebate programme	Efficiency Maine – Business (Non-Residential) Program
Rules, regulations & policies	
Building energy code	Maine Model Building Energy Code
Contractor licensing	Solar Hot Water Contractor Licensing
Energy efficiency resource standard	Energy Efficiency Targets
Energy standards for public buildings	Energy-Efficient Building Standards for State Facilities
Generation disclosure	Fuel Mix and Emissions Disclosure
Green power purchasing	Maine – Green Power Purchasing
Interconnection	Interconnection Standards
Mandatory utility green power option	Mandatory Utility Green Power Option
Net metering	Maine – Net Energy Billing
Public benefits fund	Efficiency Maine Trust Efficiency Maine Trust – Renewable Resource Fund
Renewables portfolio standard	Renewables Portfolio Standard
Solar/wind access policy	Solar Easements Solar Rights
Solar/wind permitting standards	Maine Model Wind Energy Facility Ordinance

Source: DSIRE (*Database of State Incentives for Renewables and Efficiency*), "Maine Incentives/Policies for Renewables & Efficiency", DSIRE website, *www.dsireusa.org/incentives/index.cfm?State=ME&ee=1&re=1*.

Table 18.5. **Vermont's renewable energy incentives**

Financial incentives	
Corporate tax credit	Business Tax Credit for Solar
Local loan programme	New Generation Energy – Community Food Service Efficiency Lending Program New Generation Energy – Community Solar Lending Program
PACE financing	Local Option - Property Assessed Clean Energy
Performance-based incentive	CVPS - Biomass Electricity Production Incentive Green Mountain Power – Solar GMP Vermont Standard Offer for Qualifying SPEED Resources
Property tax incentive	Local Option - Property Tax Exemption
Sales tax incentive	Renewable Energy Systems Sales Tax Exemption
State loan programme	Vermont Economic Development Authority and Efficiency Vermont - Business Energy Conservation Loan Program
State rebate programme	Efficiency Vermont – Agricultural Lighting & Equipment Rebate Program Efficiency Vermont – Commercial Lighting and LED Lighting Incentives Efficiency Vermont – Compressed Air Systems Efficiency Vermont – Home Performance with ENERGY STAR (Existing Residential) Efficiency Vermont – HVAC Equipment Rebate Program Efficiency Vermont – Incentives for Integrated Design and High Efficiency Equipment Efficiency Vermont – Multifamily Apartment Rebate Program Efficiency Vermont – Small Commercial Refrigeration Incentive Efficiency Vermont – Vermont ENERGY STAR Homes (New Construction) Vermont Small-Scale Renewable Energy Incentive Program
Utility grant programme	CVPS – Biomass Grants
Utility loan programme	Vermont Gas – Residential Energy Efficiency Loan and Rebate Program
Utility rebate programme	Burlington Electric Department – Commercial Energy Efficiency Rebate Program Burlington Electric Department – Multi-Family Rental Energy Efficiency Rebate Program Burlington Electric Department – Residential Energy Efficiency Rebate Program Vermont Gas – Commercial Energy Efficiency Program Vermont Gas – Residential Energy Efficiency Program
Rules, regulations & policies	
Appliance/equipment efficiency standards	Energy Efficiency Standards for Appliances
Building energy code	Vermont Building Energy Standards
Energy efficiency resource standard	Energy Reduction Goals
Interconnection	Interconnection Standards
Line extension analysis	Line Extension Alternatives
Net metering	Vermont – Net Metering
Public benefits fund	Clean Energy Development Fund (CEDF) Efficiency Vermont
Renewables portfolio standard	Sustainably Priced Energy Enterprise Development (SPEED) Goals
Solar/wind access policy	Renewable Energy Rights

Source: DSIRE (*Database of State Incentives for Renewables and Efficiency*), "Vermont Incentives/Policies for Renewables & Efficiency", DSIRE website, *www.dsireusa.org/incentives/index.cfm?getRE=1?re=undefined&ee=1&spv=0&st=0&srp=1&state=VT.*

Maine's wind resource is located along the coast. Local inhabitants are against wind installations due to their impact on the landscape, and turbines must be deployed over the horizon; i.e. more than 20 miles from the shore, in deep waters. The DeepCWind Consortium is a partnership between university, government, non-profit, and private organisations aiming to lower the cost of deploying offshore wind. The consortium was awarded USD 8 million from the Department of Energy (DOE) to develop the first floating wind turbines. The development of this innovative new product will require significant research and development and the wind turbines should be built in partnership the state's currently declining shipbuilding industry. Maine hopes to become the leader in

the manufacture of floating turbines. The success of this strategy will depend on whether other areas adopt similar policies that create a market for floating turbines. The consortium will have to ensure its floating wind farm can compete with low gas prices. Its goal is to produce wind at a cost of USD 0.10 per kWh in order to make it competitive in the energy market. As well as the turbines themselves, the consortium also plans to export some of the electricity it generates to other New England states with RE portfolio standards. A prototype with a 25 MW capacity is planned by 2017 and eventually there will be a 100 turbine farm generating 500 MW approximately 20 miles offshore by 2020. The full plan is for a collection of floating wind farms with a generating capacity of 5 000 MW by 2030. The DeepCWind Consortium will help Maine reach its goal of installing 3 000 MW of wind power by 2020. They estimate the entire project will cost USD 20 billion and lead to 15 000 permanent jobs. The project should also take an innovative approach towards natural resources to guarantee that rural communities are properly rewarded by wind energy developers. For instance, it is assessing how the siting of offshore wind farms would affect those rural communities that are currently the main users of the areas, such as fishermen and tourist businesses. The aim is to guarantee that these communities can access financial benefits from the production of renewable energy.

Vermont uses a mixture of federal and state funding to reduce fossil fuel energy consumption. The Vermont Clean Energy Development Fund has funded a variety of smaller-scale renewable energy and energy efficiency projects throughout the state. For instance, the "Cow Power" programme has enabled dairy farms in Vermont to install biogas digesters which use manure to produce energy which can be fed back into the system. The cost of production is approximately 16 cents/kWh. Electricity customers may then sign up to pay the additional energy costs (approximately 4 cents/kWh) for a certain percentage of their energy to be produced from these biogas digesters.[1] The Cow Power programme has generated USD 1.8 million per year for Vermont farms. About eight participating farms now have the potential to remove 24 000 metric tons of carbon dioxide per year. State and federal funds were also used to implement an energy efficiency project, a reverse osmosis system (a sort of filter), on a small maple syrup farm. In Ferrisburgh, renewable energy funds and tax credits helped finance a 1.1 MW photovoltaic site. Vermont also has a Sustainably Priced Energy Development Program implementing a feed-in tariff that pays above the market price for solar and other renewable energy production.

Assessment of policy impacts on rural development

Stimulating local economies

Although Maine and Vermont's renewable energy policies provide environmental benefits for the two states, the employment effects on rural areas are less promising. The marginal cost of carbon emission reductions could be increasing in the future, especially if nuclear energy is phased out in Vermont due to increasing public opposition. The link between RE deployment and rural development is complex and there are significant reasons why RE policies may not have much of an impact on employment in rural areas. The energy sector in general is more capital than labour-intensive, and this also goes for wind energy and other renewable energy. As a result, the energy sector makes up a very small portion of employment in the economy as a whole and the renewable energy sector is even smaller. The largest share of clean jobs is not in energy generation but in conservation (Pew Charitable Trusts, 2009). The "clean jobs" sector of the economy (as defined by the Pew Charitable Trusts, 2009) grew at an impressive rate of 22.7%

compared to the overall growth rate of 3.3% in Maine from 1998 to 2007, but even so the sector accounted for only 0.85% of Maine's employment in 2007. This constituted 725 businesses and 6 000 jobs out of over 700 000 jobs in the overall state economy in 2007. Similarly, Vermont's clean job sector grew at a rate of approximately 15.3% compared to an overall growth rate of 7.4% but still only amounts to 0.59% of total employment, with 311 firms and 2 161 jobs out of a total of more than 360 000 jobs in 2007. Even if renewable energy was able to completely replace the non-renewable energy sector, it would still be a small percentage of overall employment, too small to expect it to have a very significant impact on unemployment and growth. Investing in the research and development of the renewable energy sector is significantly more labour intensive and can help drive innovation to make the industry become more competitive.

However, the impact on small rural communities may not just be through jobs. The DeepCWind project will not greatly affect employment in rural areas: offshore wind farms in general don't have large employment requirements. However, its impact depends on the way RE can become a source of financing for those rural communities that may be affected by the deployment of the wind farms. Vermont's energy generation systems do not increase employment on farms, but programmes such as "Cow-Power" do increase farm income which can be important for rural development. The local utility company played a key role in establishing a symbiosis between RE production and dairy farms, which allowed it to "brand" its electricity and sell it at a premium price on the local market. On the other hand this has had the negative impact of increasing electricity prices. Instead RE should aim at lowering overall energy prices. Energy efficiency programmes like weatherisation may do more to provide jobs due to higher labour intensity. Any jobs created will only have a lasting real impact if they are economically sustainable and for this, the industry needs to become competitive without government subsidies. At the moment, the small-scale solar and Cow Power projects are not competitive and will have a difficult time competing against Vermont's existing lower-cost renewable energy.

Main challenges

There is significant environmental and economic potential in Maine and Vermont's current renewable energy policies, but they could still be improved. Promising areas such as research and development, instrument manufacturing, and energy conservation and management are generally more labour intensive than other energy sectors. To be sustainable, the RE industry needs to be competitive in meeting all energy demands at a relatively low price. Innovations are still needed, especially in biogas digesters and photovoltaics, to increase efficiency and lower production costs. Building upon existing strengths will also help ensure economic growth is sustainable. For example, NRG Systems in Vermont has manufactured devices for wind turbines since 1980 and currently employs 115 people building on Vermont's manufacturing history. The DeepCWind Consortium plans to build on Maine's maritime history and shipbuilding firms, although as with any new technology there is substantial risk associated with such a programme.

The opportunity costs of subsidies should be at least briefly considered in any analysis of the economic impacts of renewable energy policies. These funds could also be used to lower taxes or for other economic development programmes that are more labour-intensive, such as weatherisation programmes, which can also reduce energy costs for firms and residents. Moreover, while there is a clear focus on electricity production, neither state's renewable energy policies sufficiently addresses energy demands in terms

of heating by using the abundant biomass, for instance. Maine and Vermont are both heavily dependent on heating oil and both have a substantial amount of forested area that could be sustainably harvested to provide a renewable source for heating in the winter. Currently, the forest is not a source of biomass, as local populations favour the "existence value" (or quasi-existence value) of it over the "use value"; in other words they place a higher value on an intact forest ecosystem than on the potential it offers for energy generation (Amjath Babu and Suryaprakash, 2004). Finally, there is room for coordinating state and national's interventions in the field of RE. This would reduce costs and also improve the impact of policies.

Note

1. This willingness of local consumers to pay a premium price for RE is – at least in part – related to the importance dairy farms have for people in Vermont. According to several local stakeholders, locals consider organic food – including fresh milk – very important and they recognise the need to pay a higher price to protect the local supply chain.

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Chapter 19

Wallowa County, Oregon, United States

Rural development and renewable energy (RE) in Wallowa County, Oregon: Summary and conclusions

Main findings. *i*) Locally designed RE policy supporting small-scale intervention enables rural communities to explore new economic development opportunities; *ii*) RE deployment can complement existing rural business, such as forestry, and promote the sustainable use of natural resources. *iii*) At the local level modest subsidies can focus attention on those RE projects that are best suited to local conditions and most likely to be commercially viable. *iv*) RE policy can play a role in creating rural institutions (governments, NGOs, business networks) able to transfer knowledge from one rural community to another, to replicate good policy approaches.

Renewable energy in Wallowa County, Oregon: A summary. Oregon covers a vast territory that is well endowed with natural resources, supporting early specialisation in the energy sector. It spans approximately 259 000km^2, almost half of which is heavily forested. The state is predominantly rural, though decreasingly so as growth is mainly in more urban regions, particularly in the Willamette Valley. Its good hydropower potential, particularly the Columbia River, and popular support for environmentally friendly policies has meant it specialised early on in the production of renewable energy. Hydropower produces 60% of the energy in the state and low energy prices have attracted energy-intensive manufacturing and also supported electricity exports. However, environmental and economic constraints mean that large-scale hydropower cannot be expanded. Wind and solar energy are now the fastest growing sources of power generation in the state. The state government has actively supported RE through legislation, targets and a number of incentive programmes. Most of this support has tended to favour large projects, but the recent elimination of Business Energy Tax Credits (BETC) has signalled a switch towards smaller-scale projects. Similarly the 2007 renewable portfolio standard has mandated that a proportion of energy must come from community-based small renewable energy providers.

How is RE contributing to rural development? This case study has a specific focus on Wallowa County, which is a predominantly rural region at the eastern edge of the state. Until recently, the state's aggressive support for RE has not had much impact on these types of regions with small economies, limited local demand, weak export potential and unable to support large developments. Renewable energy policy in Wallowa County has aimed more at employment creation and has had to be closely coupled with existing rural industries, in this case forestry and agriculture. Timber harvesting and thinning can be combined with biomass development for heating, while small- and micro-scale hydro can be introduced into existing irrigation channels. Such micro-scale activities reduce costs for existing enterprises and can provide additional employment – as the common phrase goes, "energy has to have a job".

Wallowa County formed its own not-for-profit organisation, Wallowa Resources, to support the transition to a new economy and to create local capacity to take advantage of RE opportunities. Supported by schemes such as the Rural Energy for America Program (REAP), the community has invested in small-scale projects which, overall, have made a noticeable impact on the total energy supply. By the end of 2011, more than 10 140 MWh of renewable electricity was generated in Wallowa County, enough to power 27% of the county's households, or about 840 homes, and worth 2% of the county's GDP. Around 65% of the energy dollars generated by such schemes have remained in the county through local ownership and investment.

Future challenges. The reduced funding for programmes like REAP could have a profound effect on small-scale initiatives. Future community-based initiatives will need to be sustainable in the long term without public subsidy. The residents of small communities like Wallowa County will have to act collectively to co-ordinate their initiatives and ensure they contribute directly to economic growth as the potential for energy export is weak. They may need new institutions to help them make the link between RE opportunities and their existing resources and economic activities and to build the capacity they need to take advantage of them.

The context

Oregon and Wallowa County's socio-economic profile and performance

Oregon has a strong rural character**.** It covers almost around 259 000 km^2 and is heavily forested. The precise degree of rurality of the state varies depending on how it is measured; there are a number of ways to define rural and urban areas in the United States, including one methodology specific to Oregon (Crandall and Weber, 2005). Under the census system (which defines a place with 2 500 or more as urban and the rest rural) 99% of the land in Oregon is rural and this area is home to 31% of the inhabitants. The OMB[1] and ERS[2] system (based to some extent on census tracts and commuting patterns) better reflects the connections between rural and urban areas. In the county-based OMB approach the "non-core" counties have 38% of the land and 4% of the population while the tract-based ERS system counts 68% of the land and 10% of the population as rural. Thus, under the OMB and ERS approach "roughly 15% of the land area and three-fourths of the population lives in metropolitan areas" (Weber, 2005). The Oregon-specific geographic classification was created to reflect the diversity of rural areas, an aspect not well handled by the other systems (Crandall and Weber, 2005). In this latter approach, an urban community is one with 50 000 or more inhabitants and the surrounding area within 10 miles (16 kilometres) of these cities, and rural areas are those areas at least 30 miles (48 km) by road from an urban community.

Oregon has experienced pronounced demographic changes over the last 30 years, which have had a profound impact on rural areas. The state population grew from 2.1 to 3.7 million between 1970 and 2006 (Johnson, 2008). Its growth of 85.5% between 1969 and 2009 was well above the national increase of 52.5%. The percentage of population aged 65 and older rose from 10.8% in 1970 to 12.9% in 2006. In contrast, the percentage under 35 years old fell from 57.1% in 1970 to 47.8% in 2006. Wallowa County, the region at the heart of this case study, is characterised by remoteness, low population and a historic economic dependence on wood products, agriculture, and amenity-driven migration (Abrams and Gosnell, 2012). The county has a density of 0.86 people per km^2 compared to 39.9 for the state of Oregon as a whole, making it one of the most sparsely populated areas in the United States (Williams and Williams, 2011). Further, the county is grappling with the same demographic changes faced by rural areas in other OECD countries although this phenomenon is to some extent masked by its stable population. Wallowa County's annual population growth rate averaged -0.52% from 2000-2009, less than the state average. Between 1969 and 2009 the county grew just 10%, well below the rate for Oregon as a whole. Nevertheless, acute demographic changes are evident, specifically increased out-migration of young adults and increased in-migration of retirees and second home owners.

Table 19.1. **Wallowa County and Oregon: Demographic data**

	Wallowa County	Oregon	United States
Population, 2010	7 008	3 831 074	308 745 538
Population share (%)		.18%	
Percent rural (%)			16.5
Elderly dependency rate, 2008		0.20	0.19

Source: *OECD Regional Database*; US Census Bureau, 2010.

Wallowa County is a predominantly rural area whose economy has long been dependent on natural resources. In Oregon an increasing share of the state population and economic activity is located in the larger cities: Portland, Eugene and Salem, and along the Willamette Valley. The eastern part of the state is experiencing much slower growth and Wallowa County, located in the north-east corner of Oregon, is one of the slowest growing and most remote counties. It covers 8 148 km^2, 58% of which are owned by the federal government; most of the non-agricultural land in Wallowa County is federally owned. Federal land traditionally provides a diversity of benefits, from forest products to grazing, recreation and food. While rural Oregon has historically depended upon timber and agriculture there has been a major reduction in timber harvesting, initially reflecting environmental restrictions and more recently a decline in demand. The timber industry has provided some of county's highest paid employment opportunities and 80-90% of the manufacturing jobs. Over recent years, the declining timber and agriculture sectors combined with the increasing focus on public land preservation have decreased the opportunities to derive economic benefits from public lands in the county (Christoffersen, 2005).[3] As a result, the county went from being one the state's 10 leading counties in terms of average wages to one the bottom five counties by 2006 (Renewable Energy Solutions and Wallowa Resources Community Solutions Inc., 2008). Further, while across the state there was a notable improvement in the value of agricultural production to approximately USD 4.4 billion in 2010, up 7% from 2009, this improvement is less visible in Wallowa County. Around 18 000 ha of the county's 240 000 ha of non-industrial private land is "agriculturally marginal" due to poor soils, steep topography, high elevation and a generally arid climate. According to the Bureau of Economic Analysis, 4 606 jobs were created in the county in 2009; 12 sectors accounted for 45% (2 085) of these jobs. These sectors are classified under the Regional Economic Analysis Project as the "leading"[4] industries in the county (Table 19.3).

Table 19.2. **Oregon: Main economic indicators**

2008 data, unless otherwise indicated

	Oregon	United States	OECD gap (%)
GDP per capita	35 360	37 993	144
GDP share (%-1995)	1.15%		
Productivity	76 445	81 139	140
Unemployment rate (%)	6.4	5.3	0.1
Employment rate (%)	71.8	72.2	66.7
Youth unemployment rate (%)	12.15	11.9	-3.2
Infrastructure (motorway density)	0.37	0.30	
Tertiary attainment as % of labour force (2008)	28.3	37.8	26.0
Patents per million population (2007)	172.1	131.8	430.0

Source: *OECD Regional Database*.

Table 19.3. **Wallowa County's employment growth, 2001-2009**

Major industry	Employ-ment	% of total	Growth rate	Employ-ment	% of total	Growth rate	Share-Shift
	2001		2001-2009			2009	
Unreported	36	0.83	18.65	107	2.32	-0.93	0.03
Mining	12	0.28	8.24	20	0.43	25	0.1
Health care & social assistance	207	4.78	6.65	341	7.4	9.29	0.79
Real estate & rental & leasing	217	5.01	5.68	323	7.01	-0.62	0.13
Professional & technical services	175	4.04	2.92	219	4.75	0.46	0.14
Arts, entertainment & recreation	100	2.31	2.59	121	2.63	0	0.06
Accommodation & food services	319	7.36	1.3	349	7.58	-1.41	0.08
Finance & insurance	117	2.7	1.29	129	2.8	5.74	0.22
Other services, except public administration	237	5.47	1.23	261	5.67	-0.76	0.09
Forestry, fishing & related activities	203	4.68	0.91	215	4.67	0.47	0.13
Leading industries total	1 623	37.44	3.21	2 085	45.27	1.56	1.77
Total employment	4 335	100	0.78	4 606	100	-2.42	0

Notes:

Employment: The employment estimates compiled by the Bureau of Economic Analysis (BEA) measure the number of full- and part-time employees, plus the number of proprietors of unincorporated businesses. People holding more than one job are counted in the employment estimates for each job they hold. This means BEA employment estimates represent a job count, not a count of the number of people employed. Also, BEA employment estimates are by place of work, rather than by place of residence. Therefore, the jobs held by residents outside of Wallowa County who commute to work in Wallowa County are included in the employment (or job) count for Wallowa County.

Major industry: The industry categories correspond with the general sector-level categories of economic activity of the 2002 NAICS (North American Industry Classification System), see *www.census.gov/epcd/www/naics.html*.

Unreported: For some counties an industry category labelled "Unreported" may appear. It is not uncommon, especially for smaller counties, to encounter suppressed data for selected industries. Data are suppressed to avoid disclosure of confidential information regarding individual firms. Even though the concern for confidentiality may relate to only one industry, data for at least two must be suppressed as summing over the reported data and subtracting from the total yields data for the suppressed category. The REAP program that compiles this table performs this computation when suppressed data are encountered, and reports them in the "Unreported" category. For consistency, the program also contrives a corresponding "Unreported" industry category for the nation at large. Often data for the "Mining", "Manufacturing", or the "Wholesale Trade" industry categories are suppressed, and you will find that their data are combined and designated as "Unreported" in the table.

Percent of total: The percent share of total employment for each major industry category.

2001-2009 share shift: This records the difference between each industry share of total employment between 2001 and 2009. Industries that experienced growth above the overall average over this interval will realise a positive shift, while those industries whose growth was less than the total will realise a negative one.

Growth rate: Growth rate refers to simple percentage changes over the previous year. Average annual growth rates are simply the average of the percent changes year-on-year over the periods 2001-2009 and 2008-2009.

Source: Bureau of Economic Analysis (BEA), Regional Economic Analysis Project, *http://oregon.reaproject.org/*.

Oregon's energy resources

Oregon is rich in potential renewable energy resources: solar, wind, geothermal, hydroelectric, biomass (wood and organic solid waste), wave and tidal energy. The Columbia River in the north and several smaller waterways flowing from the Cascade Mountains give Oregon some of the highest hydroelectric power potential in the United States.[5] In 2011, 78% of Oregon's generation came from renewables, including hydro, behind only Idaho with 93% and Washington with 82% (EIA, 2012). Oregon has specialised in the production of hydropower. Approximately 60% of its energy is produced by hydroelectricity installations along the state's main water resources. About 30% of the state's electricity is produced from imported natural gas while wind and wood combined provide another 7% of electricity. Only Washington produces more hydroelectric power than Oregon. As a result, Oregon has relatively affordable electricity prices (23% below the national average), which has attracted energy-intensive manufacturing to the state. It also exports energy. Major transmission lines connect Oregon's electricity grid to California and Washington State, allowing for large interstate energy transfers. The state does not have a gas grid so rural schools, hospitals and manufacturers rely on expensive oil or propane for their heating needs. This represents a good opportunity for RE sources such as solar, wind, and biomass (Table 19.4).

Table 19.4. **Oregon electric power generation by primary energy source, MWs, 2009**

	1999	Percentage of power generated	2009	Percentage of power generated
Total megawatt hours	56 848 347	100	56 690 856	100
Coal	3 722 644	6.5	3 196 902	5.6
Petroleum	8 029	*	7 955	*
Natural gas	6 880 440	12.1	16 133 451	28.5
Nuclear	Data not available		Data not available	
Hydroelectric	45 639 050	80.3	33 033 513	58.3
Other renewables	598 184	1.1	4 272 427	7.5

Note: * Percentage of power from petroleum is less than 0.5%.

Source: US EIA (Energy Information Administration) (2012), "Renewable Utility Scale Electricity Production Differs by Fuel Among States", *Today in Energy*, *www.eia.gov/todayinenergy/detail.cfm?id=6110*; Williams, R. and P. Williams (2011), "The Economic Impact of Renewable Energy Projects in Rural Areas: Northwest Region: Oregon", report for USDA Rural Development by Driven Engineering, Inc., 15 August.

Wind and solar energy are the fastest growing sources of electric power generation in Oregon. In 2011 capital investment in wind, solar and geothermal energy in the state topped USD 5.4 billon (Renewable Northwest Project, 2011). Of this, USD 4.5 billon went to wind project development, alongside USD 140 million invested in residential and commercial solar photovoltaic (PV) development and USD 600 million in solar manufacturing plants. The state's active RE policy has attracted manufacturing activities. A combination of stackable federal and state incentives explains much of this rapid growth. Oregon is a leading US solar manufacturing cluster with one of the country's largest solar manufacturing facilities in Hillsboro. The state is also home to the North American corporate headquarters of Iberdrola and Vestas. In addition, one of the biggest wind farms in the world is under construction at Shepherd's Flat, a rural part of the state in Morrow and Gilliam counties in north-central Oregon. This large wind farm will cover 30 square miles and, with a total capacity of 845 megawatts (MW), is expected to generate enough electricity to power 235 000 US homes. Besides attracting

capital investment (Table 19.5), renewable energy projects generate property tax revenue. The Oregon legislature, however, recently decided to eliminate the Business Energy Tax Credits (BETC),[6] signalling a change of approach in the state's RE policy. Oregon now intends to support small-scale community-based projects. The rationale is probably to improve the linkage between RE and the generation of revenue for small communities. This certainly benefits rural regions such as Wallowa County.

Renewable energy policy in Wallowa County, Oregon: Objectives, opportunities and challenges

The policy drivers: Why is Oregon, implementing a renewable energy policy?

Oregon has long taken an aggressive approach to supporting renewable energy. In 1975, the Oregon legislature declared that future generations should not be left a legacy of vanished or depleted energy resources. Oregon charted a course in energy efficiency that put it at the forefront in the United States. The mandate to push forward on renewable energy comes from the legislative and executive branch of the Oregon government, spurred on by popular support for environmentally-friendly policy initiatives.

The policy framework for renewable energy in Wallowa County and Oregon's rural areas

US policy

In the United States, investment in, and the use of, renewable energy has been encouraged with a range of state and federal government incentives. The federal government is supporting renewable energy through a mix of tax credits, rebates and support for research and development (R&D). The US strategy supporting RE deployment has evolved over time, gradually encompassing energy security and economic development objectives. The Energy Policy Acts of 1992 and 2005, the Energy Independence and Security Act of 2007, the Emergency Economic Stabilization Act of 2008, and the American Recovery and Reinvestment Act of 2009 (ARRA) legislated financial assistance for renewable energy. The severity of the recent recession, coupled with growing concerns over climate change, created an opportunity for unprecedented national support and funding for renewable energy and energy conservation. The ARRA alone included more than USD 70 billion in investments and tax credits for alternative energy-related programmes. These investments are expected to move the US renewable energy market forward, enhancing its global competitiveness, while creating jobs and promoting energy security.

Many of these renewable energy programmes would not be competitive without these subsidies, raising concerns about their sustainability. In response, the US Department of Energy has created the SunShot programme, with the goal of making unsubsidised solar energy competitive on the electricity market by reducing costs by 75% by 2020. Similarly, the 2012 federal budget proposes a 70% increase in the allocation of funds for renewable energy R&D, with USD 457 million for solar energy and USD 341 million for biofuels. Such investment in innovations aimed at making renewables competitive will, it is hoped, make the industry and the jobs that go with it sustainable in the long run. Because investments in biofuels also largely support rural communities, those subsidies

also aim at promoting rural development. Biofuel subsidies, for example, have the potential to increase farm income and to promote rural development.

The US Department of Agriculture's (USDA) Rural Energy for America Program (REAP, formerly the Renewable Energy Grant and Loan Program) provides funds to farmers and small businesses to purchase renewable energy systems or make current systems more efficient. The aim of REAP is to tap into the entrepreneurial spirit of rural America; it invests mostly in distributed generation, *i.e* projects that produce renewable energy for use on site. The REAP programme funded 36 projects in Oregon in 2011 from grants totalling USD 1.29 million. The funds were often combined other programmes and incentives from the Oregon Department of Energy and Energy Trust of Oregon. Most of the projects funded were for less than USD 20 000 and they targeted farms, ranches, orchards and other rural businesses. The projects ranged from irrigation improvements and lighting retrofits to solar systems and wind arrays.

Table 19.5. **Total renewable energy investment in Oregon, excluding hydro-electric, 2010**

Technology	Investment (USD)
Wind	4 509 968 594
Solar manufacturing	632 000 000
Solar development	143 531 794
Geothermal	121 152 545
Total	5 406 652 933

Source: Renewable Northwest Project (n.d.), *Total Renewable Energy Investment in Oregon*, Renewable Northwest Project, Portland, Oregon, *http://rnp.org/sites/default/files/pdfs/OR_5_billion_2-page_11Mar23.pdf.*

State policy

Portland was the first city in the country to use renewable energy through installed solar arrays. These were soon followed by net metering, encouraging small-scale renewable energy projects that could be connected to the grid, and legislation setting out strict renewable energy production targets. The 2007 legislature created a renewable portfolio standard (RPS) requiring the largest utilities in Oregon to supply 25% of their retail sales of electricity from renewable energy by 2025. It also mandated that at least 8% of Oregon's power should come from community-based renewable energy providers with a generating capacity of 20 MW or less. The report *Freeing the Grid* considered Oregon to be among the best states for regulations encouraging distributed renewable energy. It gave Oregon an "A" for net metering and a "B" for interconnection (Network for new energy choices, 2009).

Public support for environmentally-friendly policy initiatives means that there is effectively a ban on new coal-fired power plants as well as a requirement that gasoline be mixed with renewable fuels. Utilities are allowed to "decouple" revenue from the actual sale of electricity and natural gas. In 2011 the governor convened a taskforce to identify the types of initiatives that the state could take forward in the next ten years to reduce dependence on carbon-intensive fuels and foreign oil, develop home-grown renewable energy resources, mitigate greenhouse gas emissions, improve energy efficiency and create rewarding local jobs, and boost the state's economy through investment and innovation. Table 19.6 lists Oregon's renewable energy incentive schemes.

Table 19.6. **Oregon's incentives and policies for renewables and efficiency**

Corporate tax credit	Biomass producer or collector tax credit
Green building incentive	City of Ashland – green building incentive
Industry recruitment/ support	Tax credit for RE equipment manufacturers
Non-profit grant programme	BEF – Solar 4R Schools
PACE financing	Local option – Improvement Districts
Performance based incentive	EWEB - Solar Electric Program
	Oregon Pilot Solar Volumetric Incentive Rates & Payments Program
Personal tax credit	Residential energy tax credit
Property tax incentive	Renewable energy systems exemptions
State Grant Program	Clean Energy Works Oregon
	GreenStreet Lending Program
	Small-Scale Lending Program
Utility Loan Program	Ashland Electric Utility - Bright Way to Heat Water Loan
	Ashland Electric Utility - Commercial Conservation Loan Program
	Ashland Electric Utility - Residential Energy Efficiency Loan Program
	Douglas Electric Cooperative - Residential Energy Efficiency Loans
	EPUD - Residential Energy Efficiency Loan Programs
	EPUD - Solar Water Heater Loan
	EWEB (Gas & Electric) - Residential Energy Efficiency Loan Programs
	EWEB - Energy Management Services Loan
	EWEB - Residential Solar Water Heating Loan Program
	Lane Electric Cooperative - Residential Energy Efficiency Loan Programs
	McMinnville Water & Light - Conservation Service Loan Program
	Salem Electric - Low-Interest Loan Program
	Springfield Utility Board - Residential Energy Efficiency Loan Program
	Tillamook County PUD - Residential Energy Efficiency Loan Program
State Rebate Program	Energy Trust - Business Energy Efficiency Rebate for Existing Buildings
	Energy Trust - Business Energy Efficiency Rebate for New Buildings
	Energy Trust - Community Wind Incentive Program
	Energy Trust - Home Energy Solutions for Existing Homes
	Energy Trust - Industrial Production Efficiency Program
	Energy Trust - Multifamily Home Energy Solutions Program
	Energy Trust - New Homes Incentive Program
	Energy Trust - Residential Energy Star Appliance Rebate Program
	Energy Trust - Small Wind Incentive Program
	Energy Trust - Solar Electric Buy-Down Program
	Energy Trust - Solar Water Heating Buy-Down Program
	State Home Oil Weatherization (SHOW) Program
Utility Grant Program	Lane Electric Cooperative - Residential and Commercial Weatherization Grant Program
Utility Rebate Program	Central Electric Cooperative - Non-Residential Lighting Rebate
	Central Electric Cooperative - Residential Energy Efficiency Rebate Programs
	Central Lincoln People's Utility District - Residential Energy Efficiency Rebate Programs
	Columbia River PUD - Commercial Energy Efficiency Rebate Programs
	Columbia River PUD - Residential Energy Efficiency Rebate Programs
	Consumers Power, Inc - Residential Energy Efficiency Rebate Program
	Consumers Power, Inc. - New Homes Energy Efficiency Program
	Consumers Power, Inc. - Solar Energy System Rebate
	Douglas Electric Cooperative - Residential Energy Efficiency Rebate Program
	EPUD - Commercial and Industrial Energy Efficiency Rebate Program
	EPUD - Residential Energy Efficiency Rebate Program
	EPUD - Solar Water Heater Rebate
	EWEB (Gas & Electric) - New Facilities Energy Efficiency Rebate Program
	EWEB (Gas & Electric) - Residential Energy Efficiency Rebate Programs
	EWEB - Energy Management Services Rebate
	EWEB - Residential Solar Water Heating Rebate
	EWEB - Solar Electric Program (Rebate)
	EWEB – Existing Facilities Energy Efficiency Rebate Program
	Forest Grove Light & Power - Energy Efficiency Rebate Programs
	Idaho Power - Commercial Custom Efficiency Program
	Idaho Power - Easy Upgrades for Simple Retrofits Rebate Program
	Idaho Power - Irrigation Efficiency Rewards Rebate Program
	Idaho Power - New Building Efficiency Program

Table 19.6. **Oregon's incentives and policies for renewables and efficiency** (*cont.*)

Utility Rebate Program	Idaho Power - Residential Energy Efficiency Rebate Programs Lane Electric Cooperative - Manufactured Homes Rebate Program Lane Electric Cooperative - Residential Efficiency Rebate Program McMinnville Water & Light - Commercial Energy Efficiency Rebate Programs McMinnville Water and Light - Residential Energy Efficiency Rebate Program Midstate Electric Cooperative - Commercial and Industrial Energy Efficiency Rebate Program Midstate Electric Cooperative - Residential Conservation Rebates Monmouth Power & Light - Residential Energy Efficiency Program OTEC - Agricultural Energy Efficiency Rebate Programs OTEC - Commercial Lighting Retrofit Rebate Program OTEC - Residential Energy Efficiency Rebate Program OTEC - Residential Photovoltaic Rebate Program Portland General Electric - Heat Pump Rebate Program Salem Electric - Photovoltaic Rebate Program Salem Electric - Residential, Commercial, and Industrial Efficiency Rebate Program Salem Electric - Solar Water Heater Rebate Springfield Utility Board - Energy Savings Plan Program Springfield Utility Board - Energy Smart Lighting Program Springfield Utility Board - Residential Energy Efficiency Rebate Program Springfield Utility Board - Super Good Cents Manufactured Homes Rebate Program Tillamook County PUD - Dairy Lighting Retrofit Rebate Program Tillamook County PUD - Residential Energy Efficiency Rebate Program

Source: DSIRE (Database of State Incentives for Renewables and Efficiency), "Oregon Incentives/Policies for Renewables and Efficiency", DSIRE website, *www.dsireusa.org/incentives/index.cfm?State=OR*, accessed 5 May 2012.

Local policy

In Wallowa County investment in RE is aimed at employment creation and is built on community collaboration. For the community, renewable energy is valued as contributing to economic growth. As the common expression goes, "energy has to have a job" for a RE project to be considered. This means that the local focus is on cost-effective actions, and not the capture of subsidies. Wallowa County has more limited renewable energy opportunities than the state as a whole. Its main renewable energy opportunity is forest-based biomass, supplemented by some small-scale hydro and the potential for small-scale wind in some parts of the county. The economic crisis in forestry led the residents of Wallowa County to look for alternative sources of income and employment. Given their geographic isolation and small local economy they needed to act collectively to build multiple co-ordinated initiatives. A series of community planning processes identified "natural resources" as not only an important economic factor but also the "social fabric of the community". Local governments, businesses and residents working together pursued a vision for restoring the economy. They adopted a new definition of sustainability along with a new strategic approach that involved a shift from relying on saw mills and timber harvesting to a more diversified economy based on natural resources and renewable energy (Williams and Williams, 2011). The community vision that emerged called for the generation and maintenance of family-wage jobs and business opportunities from natural resource stewardship. The County Commissioners formed the not-for-profit organisation Wallowa Resources (WR) to identify and promote a new relationship with the land in the county in 1996. It was created to support the transition of the economy and specifically to create and develop local capacity in R&D, introduce new sources of financing, and provide a variety of technical services.

Wallowa Resources both implements its own projects and incubates businesses. Its for-profit subsidiary, Community Solutions, supports business owners to start, improve, and expand ventures and creates employment opportunities. It created another subsidiary, Renewable Energy Solutions, to specialise in renewable energy projects and business solutions for rural residents and communities. Working through both these arms, WR started to invest in small-scale local community renewable energy projects. The total energy economy in the county was around USD 20.5 million, the cost of imported energy to the county. Developing renewable energy projects created opportunities to help local businesses take advantage of the incentives offered by the federal and state government. The county had around 208 000 ha of timber land but timber management practices had led to a build-up of fuels, putting the county at an "extremely" high risk of a catastrophic fire (Williams and Williams, 2011). Biomass projects provided an opportunity for the county to use woody biomass from existing forest management operations to lower municipal operating costs. According to the Government of Oregon's Forest Biomass Working Group, harvesting and using forest biomass in an ecologically and economically sustainable manner can help the state accomplish important goals including moving it towards energy independence, promoting sustainable forest management and environmental protection and providing new economic opportunities. A 2008 feasibility study commissioned by WR indicated that 60 000 tonnes of woody biomass were available in the county for a power production facility along with 4 000 tons of municipal solid waste, and between 20 000 and 50 000 tons of agricultural waste and residue (Renewable Energy Solutions and Wallowa Resources Community Solutions, Inc., 2008).

The local community has engaged in a series of projects, some of which are complex and require expertise to be built up locally:

- **Biomass boiler for the Enterprise School District.** Due to rising fuel oil costs and tighter budgets, the Enterprise School District in Wallowa County needed to increase heating efficiency and reduce costs. For this reason, Wallowa Resources designed the first project in Oregon to convert an existing oil-powered boiler to a biomass facility in 2008. It obtained a USDA grant to fund the pre-feasibility studies, while the Enterprise School District conducted a request for proposals and invited several firms to visit the facility. The school district entered into an Energy Savings Performance Contract (ESPC) to finance the project out of guaranteed energy savings. The cost to convert the school facility to a biomass boiler was USD 1.5 million. An estimated 18 jobs were created by the construction process and the total value added was estimated at USD 0.8 million. The facility's annual operating activities have created an estimated four jobs and the value added is USD 0.2 million.

- **Small-scale solar projects to reduce energy costs in rural communities**. Over the past four years The USDA Energy for America Program has helped businesses and agricultural producers across the state install solar panels. These solar energy producers generate from 8 000 to 113 000 kilowatt hours (kWh) per year. Some of these deployments have a closer link with the local economy or with local infrastructure than others. For instance, Sun Storage Inc. developed a 500kW solar array on private farm land in the city of Joseph in Wallowa County and a system to provide energy to a sewer treatment plant. This demonstration project will provide electricity to approximately 100 homes for a year. Sun Storage and the city of Joseph also installed a 100kW-capacity solar array on top of the city's water treatment plant. This project will reduce the city's power use and costs for treating the water. Both projects were built with the help of The Oregon Solar Incentive Program. The panels were made by SolarWorld in Hillsboro and the inverters were also manufactured in Oregon by Advanced Energy

Industries. This project involved several installers. The impact on the local labour market was mostly temporary and the total value added was USD 1.2 million. The project's annual operating activities has created an estimated four jobs, with a total value added of USD 0.2 million. The city of Joseph expects to save USD 12 000 to 14 000 a year in power costs through solar energy.

- **Micro-hydroelectric power.** Due to the state's abundant water and suitable topology, Oregon is a good place for small-scale hydroelectricity generation. These small installations have a capacity of some 100 kWs and sell energy into the grid, benefitting from a feed-in tariff. Small-scale hydroelectricity can have a significant impact on local economies. The Oregon Energy Trust has been working with water stakeholders connected to the networks of Portland General Electric and Pacific Power to help micro-hydro power development. Though the energy trust can help qualifying projects with initial costs, the number of projects that get off the ground is small in part because of high permit fees. However, the consulting firm Renewable Energy Solutions reports that it studied 19 conduits in Wallowa County which could produce 1 MW of energy, worth USD 244 000 annually (Renewable Energy Solutions and Wallowa Resources Community Solutions, Inc., 2008). The total construction impacts for the deployment of micro-hydro plants are estimated to be USD 33 844. An estimated 0.4 jobs would be created in total, and the estimated value added would be USD 17 263. In general the total economic impact of the annual operating activities of such installations on the state in general are estimated to be USD 38 300. The estimated total number of jobs is 0.1 and the total value added USD 7 437.

Assessment of policy impacts on rural development

Stimulating local economies

Oregon's aggressive approach to RE has had limited impact in Wallowa County. It appears as if much of the national and state support for RE is geared to promoting projects that are too large for the county. Nevertheless the local population has embraced RE and while its initiatives are all micro-scale, they reduce costs for existing enterprises and may allow some expansion of employment.

Small-scale distributed renewable energy projects have made a noticeable impact on the total energy supply in Wallowa County. By the end of 2011, more than 10 140 MWh of renewable electricity will be generated in Wallowa County, enough to power 27% of the county's households, or about 840 homes (Renewable Energy Solutions, 2009). The combined value of renewable heat and electricity generated in Wallowa County is about USD 5.1 million annually (nearly 2% of the county's gross domestic product). Approximately, 65% of these energy dollars, USD 3.4 million, remain in Wallowa County through local ownership or investment. The USDA has made a number of small but strategic investments in biomass production, solar energy, and small-scale hydropower in Wallowa County. Working through the Rural Energy for America Program (REAP), Rural Business Enterprise Grant, and Advanced Biofuel Producer Payment Program, the USDA has helped to stimulate access to public and private investments for RE deployment.

The gradual phasing out of public incentives will allow the selection of local initiatives that can connect to the local productive framework and generate value for the hosting community. REAP has invested mostly in distributed generation projects that produce renewable energy for use on site. For example, SPS Auto of Oregon received the

state's first micro hydro REAP grant. This USD 19 695 grant, combined with tax breaks and other incentives, funded a USD 75 000 10.5 kW turbine in an irrigation ditch. It produces approximately 75 000 kWh of power annually. The Oregon Department of Energy awarded USD 483 208 in American Recovery and Reinvestment Act funds to six energy projects in Wallowa County. The funds were part of the State Energy Program and Energy Efficiency and Conservation Block Grant for energy efficiency and renewable energy projects. One grant of USD 275 000 was used to help fund a USD 1.4 million small-scale combined heat and power facility at the Wallowa County Integrated Biomass Energy Centre.

As in other case studies, the overall impact of RE deployment on the state's economy is difficult to measure. Estimates for the number of jobs in wind and sun energy range from 600 to almost 3 000 (taking into account manufacturing and related activities).[7] While it is difficult to verify such numbers, it is certainly possible to confirm that new sources of investment have prompted local communities to organise a development strategy based on local assets. RE deployment is also a means to support the competitiveness of sectors that had been wiped out by international competition, such as forestry, or certain activities within manufacturing.

Main challenges

Grants and subsidies have triggered new economic activities in rural communities in Oregon and helped rural dwellers to explore new investment opportunities. The next challenge is to find a mechanism that can select those community-based initiatives that are sustainable in the long term, without public support, and find ways to transfer these initiatives to other communities. In other words, new institutions, whether government, NGO or networks, are needed that can make the link between RE and rural economies and replicate these experiences in communities struggling to find new investment opportunities.

Rural communities can rarely engage in large-scale projects; their opportunities mostly lie in small-scale initiatives. In Wallowa County there are RE opportunities in wood-based biomass, small hydro and wind. These installations, however, can only produce energy for local demand, as their export potential is weak due to long distance to markets and weak grid connections. They therefore need to be linked to (struggling) rural sectors, in the way the declining forestry sector in Wallowa County has benefitted from RE policy.

Notes

1. Metropolitan counties are defined as counties with an urbanised area of 50 000 or more where there is a "high degree of integration" with the urbanised core. All other counties are classified as non metropolitan (Crandall and Weber, 2005)
2. The tracts consist of 1 500 to 8 000 people with similar socio-economic characteristics. In this system, rural areas are those census tracts that do not have significant commuting ties to areas with 50 000 or more people.
3. The implementation of "ecosystem management" in the 1990s as the dominant paradigm guiding public land management in the United States, as well as new Endangered Species Act (ESA) listings, caused dramatic declines in the revenues and economic benefits derived from public land.
4. "Leading" industries surpassed the industry-wide average annual employment growth both in the long term (2001-2009 = 0.78%) as well as in the short term (2008-2009 = -2.42%).
5. The Columbia River marks most of Oregon's border with the state of Washington, and the Snake River forms a large part of Oregon's border with the state of Idaho.
6. The Business Energy Tax Credit (BETC) programme allowed business or property owners to receive tax credits to trade if they install renewable energy projects or make energy efficiency improvements.
7. Based on its installed renewable energy capacity and its diversified renewable energy portfolio, Oregon has a leading position in different renewable energy sectors. Business Facilities' (2011) State Rankings Report named Oregon as the US renewable energy leader. The 2011 Brookings Study recognised that the state is expanding its renewable energy reach. The study suggested that the impact on the economy included 300 solar and 317 wind jobs but there is some evidence that these numbers under-represent the true impact of Oregon's renewable energy sector on the economy. According to Brookings, the clean tech segments of the green economy in Oregon – especially renewable wind and solar energy sectors - have grown so rapidly that the typical data sources used to tabulate the employment figures proved ineffective.

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Chapter 20

Tennessee, United States

Rural development and renewable energy (RE) in Tennessee: Summary and conclusions

Main findings. *i*) Although RE deployment is generally capital intensive, it might create some valuable employment opportunities in rural communities along the supply chain. *ii*) RE deployment could conflict with policies that try to hold down energy prices to attract manufacturing activities. *iii*) Research facilities in RE could be better connected to the productive framework of their home region to build on existing strengths and maintain competitive advantage.

Renewable energy in Tennessee: A summary. Despite a higher than average population density, Tennessee is a predominantly rural state, which has historically specialised in the production of energy. The federally-administered Tennessee Valley Authority (TVA) has played a pivotal role in developing an exceptional energy infrastructure in Tennessee and keeping energy costs low. This has helped manufacturing and other energy-intensive industries by providing them with cheap electricity. In fact, Tennessee displays an above average specialisation in primary and manufacturing activities than the United States as a whole, where employment in these sectors has been declining. However, such industrial specialisation is one reason why Tennessee has experienced slightly above-average unemployment rates in recent years.

Tennessee's rivers have helped make it one of the top hydroelectric power producers east of the Rocky Mountains, with many hydroelectric power plants located along the Cumberland and Tennessee River systems. It is also a major nuclear power producer, ranked eighth in the nation for total nuclear energy generation in 2007. Both hydroelectric and nuclear power are low-cost energy sources with low carbon emissions. The state's energy framework, however, continues to be dominated by coal. Mirroring the current national push toward sustainable energy, Tennessee aims to create policies to connect manufacturing and agriculture to RE, particularly solar energy and cellulosic ethanol.

How is RE contributing to rural development? The overall employment effects of these renewable energy policies are limited due to the capital intensity of the energy sector and its small share of the overall economy. Thus, even high growth rates imply limited overall employment growth in the state. Nevertheless, even small employment growth can have a large impact on low-density rural areas if the jobs in question are sustainable. In the short term construction jobs can provide considerable employment, but often not for local residents. In the longer term, operating and maintenance jobs are limited. Employment from growing switchgrass or other biofuel crops may be limited or even displace other, more valuable activities. The most sustainable jobs are where the RE project is closely linked to existing activity, such as crop production or metal fabrication, allowing the expansion of existing firms. In Tennessee the best opportunity for expanding employment from RE may come from better connecting Tennessee's firms (including small and medium-sized enterprises) to world-class research facilities. This offers the best chance for driving down the cost of RE, which is essential if it is to be a driver of economic development.

Future challenges. In general, rather than relying on public subsidies and focusing on job creation in the RE sector, which may prove ephemeral, RE deployment in Tennessee should be better linked to local industries and contribute to keep the energy cost low. Tennessee already has cheap electricity thanks to the TVA, with a considerable share coming from nuclear and hydroelectric power. This means it is already emitting less carbon than surrounding states. This cheap energy has been a driving force in economic development. Yet the state has adopted a renewables strategy based on two high-cost sources; photovoltaic (PV) and cellulosic ethanol. In both cases, there is little to suggest that rapid adoption results in large rural development benefits, because the technology is rapidly improving and readily transferable. Like other early adopters, the state runs the risk of driving up energy costs and being stuck with obsolete technology. To maximise the potential economic benefits of renewable energy, Tennessee will need to focus on issues other than job creation and ensure that the RE industry has some comparative advantage building on Tennessee's strengths.

The context

Tennessee's socio-economic profile and performance

Tennessee is a predominantly rural region despite having a higher population density than the national average (Table 20.1). Despite its cities, such as Memphis, Nashville (its capital), Knoxville, and Chattanooga, Tennessee is still significantly more rural than the US average, with 26.6% of its population residing in rural areas compared to only 16.5% of the US as a whole. Under the OECD classification (OECD, 2006), it is a predominantly rural region. The eastern portion of Tennessee is mountainous with an average elevation of over 1 524m and rugged terrain. Knoxville and Chattanooga lie within a valley called the Great Valley (within the Tennessee Valley). The central and western portion of the state is considerably less rugged, with significant plains and the Mississippi River Valley on the western border.

Table 20.1. **Tennessee: Demographic data**

	Tennessee	United States
Population	6 296 254	307 006 550
Population share	2.05%	
Population density	58 in/km^2	33 in/km^2
Percent rural	26.6%	16.5%
Elderly dependency rate	0.20	0.19

Source: OECD Regional Database, http://dotstat/wbos/.

Tennessee's economy has tended to follow national trends, but the recent recession hit Tennessee a bit harder. During 2008/09, US employment declined by approximately 3%, whereas employment in Tennessee fell by about 4%. Tennessee's unemployment rates have also tended to follow national trends. In 2009, it was 10.5%, compared to a national average of 9.3% (Table 20.2); by the end of 2011, however, it had fallen to just about the national average. Tennessee also fares worse than the US both in terms of income and employment. It has one of the lowest median incomes in the country. This may be due in part to the relatively poor educational attainments, with a higher proportion of its labour force with only primary attainments (19%) in contrast to national values (14.9%) and a lower proportion of tertiary attainments (20% as opposed to 24.3% nationally). Consequently, innovation in Tennessee, as measured by patents per million inhabitants, is just over half the national average (Table 20.2). Against this state-wide figure, however, must be set the presence of nationally-important centres of knowledge creation, particularly at Oak Ridge, which is home to the largest US Department of Energy research complex. Public expenditure on research and development (R&D) is therefore higher in Tennessee than nationally (0.48% as opposed to 0.41%) and private-sector involvement is lower (0.67% against 1.47% nationally). Tennessee can make up some ground attracting employers with relatively low costs of doing business (which includes low energy costs, rental rates, and taxes) and also low costs of living (housing, food, and energy costs). Thus, Tennessee ranks about 20th in the nation for states that are good for business (Forbes, 2011; CNBC, 2011).

Table 20.2. **Tennessee: Main economic indicators**

	Tennessee	United States
GDP *per capita* (2008) – current USD PPP	40 568	46 540
GDP (2008) – millions current USD PPP	252 157	14 165 565
GDP per worker	88 597	97 700
Employment	2 846 105	144 989 525
Unemployment rate (2009)	10.5%	9.3%
Employment rate (2009)	71.1%	74.9%
Youth unemployment	15.0%	12.9%
Infrastructure (motorway density)	0.35	0.2
Tertiary education attainment (2006)	19.9	38.1
Patents per million inhabitants (2006)	98.8	175.2
Green patent applications (2006)	16.0	1 091.6

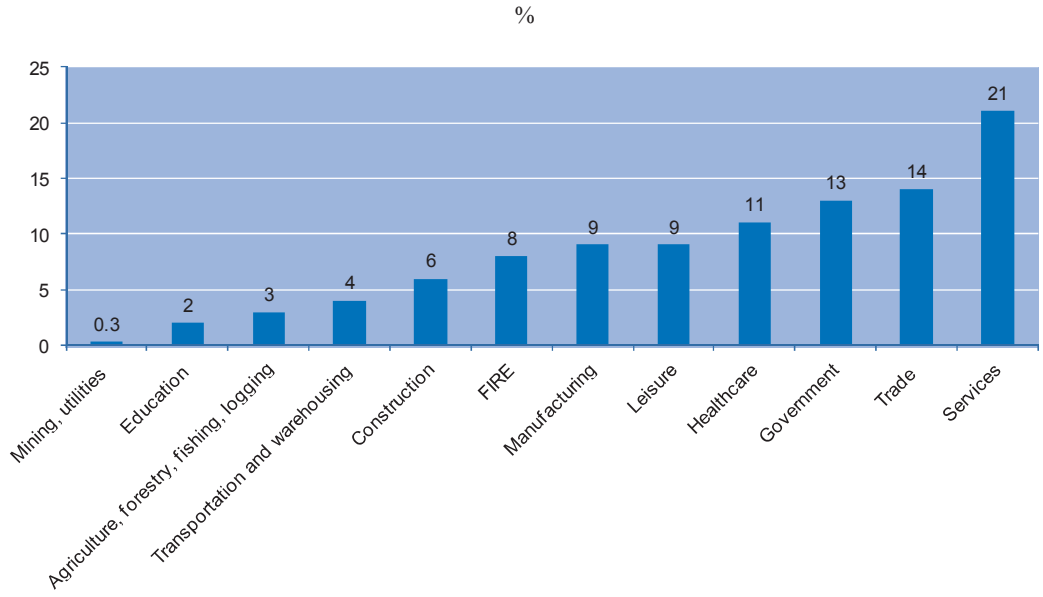
Source: OECD Regional Database, http://dotstat/wbos/.

Tennessee's industry mix focuses slightly more on agriculture and manufacturing than the US. Both sectors have experienced downward trends in employment nationwide. This also helps explain why Tennessee tends to follow the US economically and suffered only slightly more in the recent recession. Just under half of Tennessee's land area is covered by farmland. Beef, poultry, and soybeans are the state's primary agricultural and farming products. However, farming accounts for only 3% of employment and its employment share has been steadily declining. Though manufacturing has been struggling in Tennessee, as in the rest of the US, Eastman Chemical in Kingsport is still by far the largest employer, with approximately 10 000 employees. Tennessee's manufacturing industry is fairly diverse: from Eastman Chemical producing chemical, fibres, and plastics, to Nissan manufacturing vehicles and Maytag manufacturing appliances. Tennessee is shifting towards services: education, healthcare and "FIRE" (finance, insurance, and real estate) have been the fastest growing sectors in Tennessee over the last 10 years. Leisure, which includes tourism, is an important and growing industry for the state, with its musical heritage, the Great Smokey Mountains, its rivers and lakes, and other attractions. Tennessee's central location also makes it well-suited for transport and warehousing. Thus, Tennessee is home to companies like Covenant Transportation Group, one of the state's largest employers, and the FedEx Corporate headquarters located in Memphis. Its location and resources have also led Tennessee to develop electrical energy as an export sector (Figure 20.1).

Tennessee's energy resources

Tennessee's energy mix is dominated by fossil fuels, followed by nuclear and hydropower (Figure 20.2). Approximately 60% of its electricity generation is from coal, compared to about 50% for the US as a whole, and around 30% is from nuclear power (DOE). The federally-administered Tennessee Valley Authority (TVA) owns more than 90% of the state's electricity generation capacity, and much of Tennessee's energy generation reflects historical policies rather than its own natural resources (US EIA, 2012). For instance, although Tennessee has a small amount of coal, most of its coal power plants receive the majority of their coal from out of state. Similarly, Tennessee has one oil refinery located in Memphis that receives crude oil from out of state. Tennessee has some natural gas resources, including shale gas, though with low gas prices the industry has focused on areas with more potential, such as Pennsylvania. Tennessee is also a major nuclear power producer, with two nuclear power plants, the Sequoyah and

Figure 20.1. **Tennessee's industry mix, 2010**



Source: US Bureau of Economic Analysis.

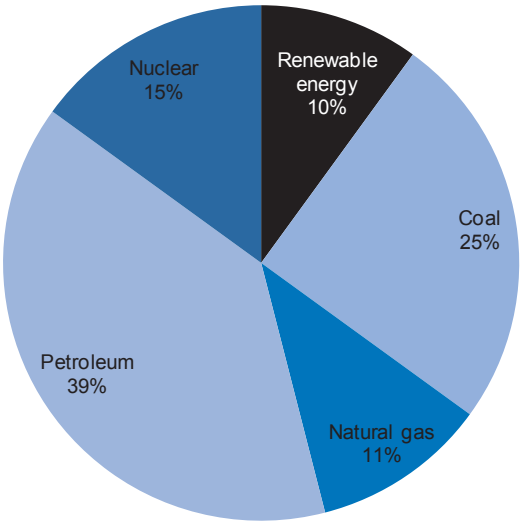
Watts Bar (the last nuclear power plant to come online in the US – in 1996). Babcock and Wilcox, a nuclear power generation company, is one of the largest employers in Tennessee. The state ranked eighth in the country in terms of total nuclear energy generation in 2007.

Tennessee arguably has more natural potential in energy production from its own renewable resources. Tennessee's rivers have helped make it one of the top hydroelectric power producers east of the Rocky Mountains. This potential spurred the deployment of 29 hydroelectric power plants, which are located along the Cumberland and Tennessee River systems. Hydroelectric power alone provided 12.7 million megawatt-hours (MWh) of electricity in 2011; approximately 4.3% of the entire US production (US Department of Energy EERE, 2012a), Tennessee's significant agricultural sector suggests it has biomass resources that could be used for energy development and it has started to use these biomass resources in its two operating ethanol plants. Tennessee is second only to Texas in the US south in terms of ethanol production (US EIA, 2012). The state has limited wind potential: maximum wind speed (measured at a height of 80 metres) is around 7 metres per second (m/s) and the average is around 5 m/s (US Department of Energy, undated). This limited potential is mirrored by the small installed capacity of 29 MW. Tennessee has the solar potential to produce between 4 and 5 kW/m^2/day (flat plate tilted south at latitude) (NREL, 2012).[1] This compares with a potential of 7 to 8 kW/m^2/day in places like New Mexico and Arizona.

Tennessee is among the top 20 states in terms of energy consumption per head, partially due to its large industrial sector (US EIA, 2012). Its low energy costs are good for firms and residents, but provide less incentive to pursue more costly renewable energy strategies. Although renewable energy generation is typically land intensive, it also requires easy access to energy consumers. This represents an opportunity for Tennessee

given the presence of important medium-sized cities, nearby manufacturing and an established energy grid, which is another legacy of its specialisation in energy production.

Figure 20.2. **Tennessee's primary energy consumption by fuel type, 2009**



Source: US EIA State Energy Data, *www.eia.gov/state/state-energy-profiles-print.cfm?sid=TN.*

Renewable energy policy in Tennessee: Objectives, opportunities and challenges

The policy drivers: Why is Tennessee implementing a renewable energy policy?

Tennessee is deploying renewable energy to create development opportunities in a promising industry, to align itself with federal policies to reduce carbon dioxide (CO_2) emissions and to increase energy autonomy. In 1933, a congressional charter created the Tennessee Valley Authority (TVA), using electricity as an instrument of economic development to help deal with the particularly devastating impact of the Great Depression on the Tennessee Valley. Through the TVA, the federal government has considerable influence over the energy outlook in Tennessee. Electrical energy is now one of Tennessee's main outputs. As federal programmes began supporting an emerging renewable energy industry and many other states began passing renewable energy portfolio standards, Tennessee began to see a need to produce electrical energy from renewable resources in addition to fossil fuels. This would help maintain and grow its energy industry while promoting economic development throughout the state.

The policy framework for renewable energy in Tennessee's rural areas

RE deployment in rural Tennessee depends on a complex set of policies cutting across state and national governments**.** At the national level, renewable energy is

supported mainly through financial incentives such as tax incentives, subsidies, and loans. These financial incentives are used to encourage both the R&D of renewable energy programmes, including wind and solar farms and biofuel plants. Incentivising the production of energy from renewable sources is one method of reducing carbon emissions. The federal government also promotes the reduction of carbon emissions through energy efficiency programmes: the reduction of total energy consumption by incentivising the construction of new buildings with energy efficiency in mind, and the retrofitting of older buildings to make them more energy efficient. As well as its influence through the TVA, the federal government also has world-class research facilities, such as the Oak Ridge National Laboratory near Knoxville. Thus, Tennessee's renewable energy policies are closely aligned with that of the federal government. Tennessee has no renewable energy portfolio standard (see the Oregon case study) and relies largely on financial incentives such as subsidies to encourage investment in renewables.

National policy

The US strategy supporting RE deployment has evolved over time, gradually encompassing energy security and economic development objectives. The Energy Policy Acts of 1992 and 2005, the Energy Independence and Security Act of 2007, the Emergency Economic Stabilization Act of 2008, and the American Recovery and Reinvestment Act of 2009 (ARRA) legislated financial assistance for renewable energy. The severity of the recent recession, coupled with growing concerns over climate change, created an opportunity for unprecedented national support and funding for renewable energy and energy conservation. The ARRA alone included more than USD 70 billion in investments and tax credits for alternative energy-related programmes. These investments are expected to move the US renewable energy market forward, enhancing its global competitiveness, while creating jobs and promoting energy security.

Many of these renewable energy programmes would not be competitive without these subsidies, raising concerns about the sustainability of these initiatives. In response, the US Department of Energy created the SunShot programme, with the goal of making unsubsidised solar energy competitive on the electricity market by reducing costs by 75% by 2020. Similarly, the 2012 federal budget proposes a 70% increase in the allocation of funds for renewable energy R&D, with USD 457 million for solar energy and USD 341 million for biofuels. Investment in innovations aimed at making renewables competitive will, it is hoped, make the industry and the jobs that go with it sustainable in the long run. Because investments in biofuels also largely support rural communities, those subsidies also aim at promoting rural development. Biofuel subsidies have the potential to increase farm income and to promote rural development. The US Department of Agriculture's (USDA) Rural Energy for America Program (REAP, formerly the Renewable Energy Grant and Loan Program) provides funds to farmers and small businesses to purchase renewable energy systems or make current systems more efficient. Table 20.3 summarises the renewable energy incentives put in place at the federal level.

Table 20.3. **Tennessee's federal renewable energy incentives**

Financial incentives	
Corporate deduction	Energy-Efficient Commercial Buildings Tax Deduction
Corporate depreciation	Modified Accelerated Cost-Recovery System (MACRC) + Bonus Depreciation (2008-2012)
Corporate exemption	Residential Energy Conservation Subsidy Exclusion (Corporate)
Corporate tax credit	Business Energy Investment Tax Credit (ITC) Energy-Efficient New Homes Tax Credit for Home Builders Renewable Electricity Production Tax Credit (PTC)
Federal grant programme	Tribal Energy Programme Grant US Department of Treasury – Renewable Energy Grants USDA – High Energy Cost Grant Programme USDA – Rural Energy for America Programme (REAP) Grants
Federal loan programme	Clean Renewable Energy Bonds (CREBs) Energy-Efficient Mortgages Qualified Energy Conservation Bonds (QECBs) US Department of Energy – Loan Guarantee Programme USDA – Rural Energy for America Programme (REAP) Loan Guarantees
Industry recruitment/support	Energy-Efficient Appliance Manufacturing Tax Credit
Personal exemption	Residential Energy Conservation Subsidy Exclusion (Personal)
Personal tax credit	Residential Energy Efficiency Tax Credit Residential Renewable Energy Tax Credit
Rules, regulations and policies	
Appliance/equipment efficiency standards	Federal Appliance Standards
Energy standards for public buildings	Energy Goals and Standards for Federal Government
Green power purchasing	U.S. Federal Government - Green Power Purchasing Goal
Interconnection	Interconnection Standards for Small Generators

Source: DSIRE (Database of State Incentives for Renewables and Efficiency), "Federal Incentives/Policies for Renewables & Efficiency", DSIRE website, *www.dsireusa.org/incentives/index.cfm?State=US&ee=1&re=1.*

State and local policy

Tennessee's state and local programmes supporting RE development have taken their lead from federal programmes with the main goal of enhancing economic development. The main focus has been on biomass and solar. Federal funding has spurred a number of renewable energy initiatives in Tennessee. For example, the state used USD 62 million from ARRA to fund the State Energy Program (SEP). SEP funds have been used for the Volunteer State Initiative, with the goals of promoting solar energy and economic development and focusing on two main projects: the Tennessee Solar Institute (at the University of Tennessee and the Oak Ridge National Laboratory) and the West Tennessee Solar Farm (WTSF). The Tennessee Solar Institute will focus on improving the efficiency and affordability of solar products. Its funding includes USD 23.5 million related to the Solar Opportunity Fund, USD 7.25 million in solar innovation grants, and USD 4.8 million in solar installation grants. These and other initiatives have taken the lead from the federally-run TVA, which owns and operates numerous solar farms throughout the area. TVA also purchases solar power from Tennessee's 1 MW capacity solar plant in Jackson which uses solar arrays built in Memphis. TVA's Green Power Switch programme allows residential and commercial customers to buy blocks of this renewable energy. In 2009, the Tennessee Clean Energy Future Act was adopted, providing additional financial incentives for new solar energy and electric vehicle initiatives and grants of up to USD 100 000 for cities or counties promoting energy efficiency efforts. The act takes advantage of the Nissan Leaf electric cars that will be manufactured in Tennessee and further encourages the renewable energy supply chain.

Tennessee has a green energy tax credit of up to USD 1.5 million per company available to all industries that invest more than USD 250 million within the renewable energy supply chain in the state. The Department of Revenue, Department of Economic and Community Development, as well as the Department of Environment and Conservation, are authorised to certify whether "green energy supply chain manufacturers" are eligible for this tax credit. Tennessee has also invested USD 70 million in the University of Tennessee Biofuel Initiative (NRDC, 2012), encouraging farmers to provide Switchgrass or corn stover (Box 20.1) to Genera DDCE, a cellulosic ethanol biorefinery plant in Vonroe with a capacity of 250 000 gallons (947 500 litres) per year (see Box 20.1). Table 20.4 shows the various renewable energy incentives put in place by Tennessee.

Table 20.4. **Tennessee's renewable energy incentives**

Financial incentives	
Industry recruitment/support	Green Energy Tax Credit Sales and Use Tax Credit for Emerging Clean Energy Industry
Performance-based incentive	TVA - Generation Partners Program TVA - Mid-Sized Renewable Standard Offer Program
Property tax incentive	Wind Energy Systems Exemption
Sales tax incentive	Sales Tax Credit for Clean Energy Technology
State grant programme	Energy Efficient Schools Initiative – Grants
State loan programme	Commercial Energy Efficiency Loan Program Energy Efficient Schools Initiative – Loans
State rebate programme	Tennessee - Residential Energy Efficient Appliance Rebates
Utility loan programme	Bristol Tennessee Electric Service - Energy Savings Loan Program Gibson Electric Membership Corporation - Residential Energy Efficient Water Heater Loan Program TVA Partner Utilities - energy right Heat Pump Program
Utility rebate programme	Cookeville Electric Department - Residential Energy Efficiency Rebate Program Cumberland EMC - Energy Efficient New Homes Program Electric Power Board of Chattanooga - Energy Efficient New Homes Program for Builders & Developers Gibson Electric Membership Corporation - Energy Efficiency Rebates Memphis Light, Gas and Water (Electric) - Commercial Efficiency Advice and Incentives Program Middle Tennessee EMC - Residential Energy Efficiency Rebate Program Murfreesboro Electric Department - Energy Efficiency Rebate Program Southwest Tennessee EMC - Residential Energy Efficiency Rebate Program TVA - Energy Right Solutions for Business TVA Partner Utilities - energy right New Homes Program TVA Partner Utilities - energy right Water Heater Program TVA Partner Utilities - In-Home Energy Evaluation Program Upper Cumberland EMC - Energy Efficiency Rebate Programs Winchester Utilities - Residential Energy Efficiency Rebate Program
Rules, regulations and policies	
Building energy code	Memphis - Energy Efficiency of Rental Properties Tennessee State Energy Code for Buildings
Energy standards for public buildings	Energy Star Procurement Requirement for Agencies
Solar/wind access policy	Solar Easements

Source: DSIRE (Database of State Incentives for Renewables and Efficiency), "Tennessee Incentives/Policies for Renewables and Efficiency", DSIRE website, *www.dsireusa.org/incentives/index.cfm?getRE=1?re=undefined&ee=1&spv=0&st=0&srp=1&state=TN*, accessed 12 April 2012.

State funding from the Solar Opportunity Fund has been essential for the establishment of the West Tennessee Solar Farm (WTSF), which will be one of the

largest solar farms in the southeast. It is part of a larger initiative to establish the state as a centre for the solar industry, encouraging the development of an entire solar supply chain. An investment of approximately USD 31 million was used to create the 200 acre farm in Haywood County, with photovoltaic installations covering just 20 acres. The TVA has agreed to purchase the 5 MW generated by the facility, once fully operational, at approximately USD 0.22 per kWh (compared to the USD 0.10 per kWh TVA customers are currently paying for electricity). Haywood County is a mainly agricultural and rural area of Tennessee in the western part of the state, with a population of less than 19 000. Here solar resources are slightly better, though not ideal. However, energy generation is just one goal of this project. The site also provides an opportunity for solar experimentation and innovation. It will be used for educational purposes and as a tourist attraction, with the construction of a visitors' centre for travellers on the I-40 interstate. The project is located adjacent to a future industrial site aimed at attracting other solar firms or encouraging industrial consumers to locate there. Once operational, the farm will employ five people in maintenance and operations. A study by Pollin, Heintz and Garret-Peltier (2009) suggests that total operating industry output for the state, including direct, indirect, and induced output, is likely to be approximately USD 2.6 million and will create 9 jobs (using a multiplier of 1.14 and an employment multiplier of 1.6). The total construction output for the state, including direct, indirect, and induced output, is likely to be approximately USD 58 million and 393 jobs (using a multiplier of 1.28 and an employment multiplier of 2.28).

Assessment of policy impacts on rural development

Stimulating local economies

Although Tennessee's renewable energy policies seem to offer environmental benefits, they have so far delivered little employment and may even have a negative impact if they fail to build upon Tennessee's strengths. The employment effects of renewable energy policies are limited, particularly in rural areas. The energy sector in general is capital intensive, and this holds true for solar, wind, and hydroelectric energy production. It is somewhat less true of biofuels, since these are the only renewable source that does not rely on a free energy source provided by nature. The largest share of long-term jobs is not in energy generation, but along the RE supply chain, which includes operation and maintenance but also manufacturing, farming, and specialised services. Despite an impressive growth rate of 18.2%, the "clean jobs" sector of the economy accounted for only 0.49% of Tennessee's employment in 2007, with 1 090 businesses and 15 507 jobs (Pew Charitable Trusts, 2009). Even if the renewable energy sector is able to replace the non-renewable sector, it will still be a small percentage of overall employment.[2] There may be additional farm employment from the production of switchgrass, but cellulosic ethanol facilities from corn stover may only add additional hours onto a farmer's workload and not necessarily generate additional employment (Box 20.1).[3] The income effect for local farmers is also important to local economic development. Many of the net effects of the construction and operation of these facilities may be overstated by input-output analysis, especially assessing the impact on the local area. For example, in the construction phase, work crews living elsewhere may be hired to build the facility, with the consequence that they will spend their earnings in their home regions. Other leakages may occur with the increased income coming into the area.

Small rural communities can benefit from even a small number of additional jobs but they will only have a lasting real impact if they are sustainable. In order for renewable energy jobs to be sustainable, the industry needs to become competitive without

government subsidies. Tennessee's cheap energy has been a driving force for the state's economic development but it has adopted a renewables strategy based on two high-cost sources; photovoltaic and cellulosic ethanol. In both cases, there is little to suggest that rapid adoption will result in a large benefit, because the technology is still rapidly improving and readily transferable. By being an early adopter, the state runs the risk of driving up energy costs and locking in obsolete technology. The West Tennessee Solar Farm (WTSF) was built a considerable distance from the nearest substation, raising the cost of the additional infrastructure needed to plug it into the grid, and an expensive interstate interchange will be required for public access to the visitor's centre. Moreover, since solar photovoltaic (PV) is now an established and rapidly growing sector, the case for such expenditure on the grounds that a demonstration farm was needed looks rather weak.

Lack of incentives to reduce subsides can also harm Tennessee's competitive energy industry. By committing itself to purchasing energy from the West Tennessee Solar Farm, the TVA provides no incentives for the renewable industry to become more efficient and in fact will likely put upward pressure on Tennessee's relatively low energy prices. This will in turn have a negative effect on the general economic climate and on employment. Solar costs will have to be substantially reduced in order to avoid these outcomes. Tennessee hopes to reduce costs through efficiency gains and improving linkages between its world class research facilities and local firms. Investing in research is clearly more labour-intensive than the operations and maintenance of these facilities, but the employment effects will largely occur in large universities rather than in rural areas. Moreover, by the time solar PV becomes fully cost-competitive, there is the possibility that Tennessee will have invested a significant amount in early, less efficient technologies. This is one problem with the first- or even second-mover strategy. Tennessee is also trying to avoid the need for the renewable energy industry to be competitive by investing in other industries such as tourism, and those industries in the renewable energy supply chain such as solar manufacturing. Although Tennessee has experience in manufacturing, it may have a difficult time competing with China in solar manufacturing.

Box 20.1. **The economics of cellulosic ethanol production**

The cost of producing cellulosic ethanol compared to corn-based ethanol and to oil prices represents important challenges. Not only is the market for cellulosic ethanol limited because of its price, the market for ethanol in general is limited. At 13.23 billion gallons, the existing corn-based ethanol production capacity already provides nearly all of the ethanol it is possible to add to gasoline, because of the 10% cap for most makes of car. A national limit on grain-based ethanol, in order to limit the effects on the food industry, will help to widen the market for cellulosic ethanol, as can flex-fuel cars and an expanded export market for ethanol. Even so, Genera and other cellulosic ethanol plants still have significant hurdles to overcome in terms of acquiring enough switchgrass or corn stover to supply the plant. Switchgrass is a low-value commodity and has opportunity costs: the land, labour and capital involved in growing it might be better used for something else. There are also significant transportation costs. For corn stover, there is also a debate within the farming community as to whether it should be collected at all, as it is currently used to maintain the soil. Tennessee has put funds toward cellulosic ethanol research in the hope of finding innovations that can provide more efficiency. Tennessee has also supported efforts to introduce sweet sorghum as a new source of ethanol, which seems to have potential. Since sorghum produces sugars directly, it is easier to produce than ethanol and has desirable agronomic characteristics that could allow it to be incorporated into field crop rotations. But even with sorghum, the opportunity cost of land and relatively high transport cost for the biomass can limit the economic viability of the enterprise.

The opportunity costs of subsidies should also be at least briefly considered in an analysis of the economic impacts of renewable energy policies. With an investment of approximately USD 31 million and only five operational employees, the subsidy per permanent employee at the West Tennessee Solar Farm is enormous. Conversely, focusing on industries other than renewable energy may provide better rural area employment. Programmes that increase the energy efficiency of homes and buildings may be more labour intensive, while reducing energy costs for firms and residents.

Main challenges

To help ensure Tennessee's economy is competitive, it is important for the region to pursue sectors in which it has a comparative advantage. Tennessee has a good biomass potential but only limited solar and wind potential. Recent state investments and the emphasis on biofuel and biotech potential take advantage of Tennessee's strengths, and they also allow the state to diversify this industry. Using ethanol as a fuel may only be an entry point into using the product as a general feedstock with many uses. It is entirely possible that, as sugar refining results in an increasing range of competitive products for use in fields like pharmaceuticals, fuel will end up as no more than a residual use for what is left over after refining. This reduces the importance of oil prices for the success of the biomass industry. Tennessee has also tried to become a leader in facilitating the diffusion of electric cars. While this is a very small-scale programme, it does have direct connections to existing strengths in electricity supply and distribution and to the growing electric auto sector, particularly Nissan. Electric cars and plug-in hybrids are likely to be good long-term growth markets in the US. In addition, they are more compatible with cheap electricity prices, which accounts for a large share of the competitive advantage of the state, than the high electricity prices which are needed to drive the use of renewable energy sources.

In general, the different policy instruments supporting RE deployment in Tennessee need to be better co-ordinated to avoid affecting regional competitiveness and potential distortions. So far, Tennessee has been able to attract federal investment in RE deployment and has also put in place some state incentives to make RE a key sector within the state's economy. These efforts go in the right direction and should be improved. For instance, having a better understanding of the economic advantages related to certain RE technologies within the regional economy could guide public policies. Support could be funnelled to RE initiatives that involve a large number of actors in key sectors such as manufacturing or agriculture. Rural policy could provide local communities with specific instrument to influence investment decisions. Special attention should be put to constantly reducing the cost of RE, to maintain the current competitive advantage (cheap electricity) that characterises the state. To achieve these results, Tennessee should also capitalise on the world-class research facilities that are located on its territory and find a way to make them more permeable to the local business community.

Notes

1. For more information, see *http://rredc.nrel.gov/solar/old_data/nsrdb/1961-1990/redbook/atlas/Table.html.*

2. The current effort in Tennessee to produce switchgrass and use it as feedstock to produce ethanol may require further assessment. It is possible, in fact, that farmers are required to produce a low-value output through extra labour (which has a high marginal value). Although switchgrass is an endemic plant that does not need specific care, it does require work from farmers in the first two years of its cycle.

3. The environmental benefits of ethanol also include carbon reduction, though there are additional concerns over the transportation requirements and other aspects in the production process. The environmental benefits can easily be increased by carefully choosing the location of the ethanol plant (i.e. near an elevator for corn stover or corn-based ethanol, or near switchgrass farms). Integrating cellulosic ethanol into existing corn ethanol plants will also allow sharing of storage and handling facilities and provide economies of scope, helping them to become more competitive.

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Contents

Executive summary

Part I. Synthesis and policy implications

Introduction

Chapter 1. Trends in global renewable energy markets and national policies

Chapter 2. Overcoming the barriers to renewable energy deployment

Chapter 3. Renewable energy and rural development: Making the link

Chapter 4. The challenges of linking renewable energy to rural development

Chapter 5. Putting renewable energy to work in rural areas

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