OPPORTUNITIES FOR FOSTERING ECO-INNOVATION IN EASTERN EUROPE, CAUCASUS AND CENTRAL ASIA: MAJOR LESSONS FROM INTERNATIONAL PRACTICE

Background paper

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<tr>
<td>BAs</td>
<td>Business Angels</td>
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<td>BAT</td>
<td>Best Available Techniques</td>
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<td>EAP Task Force</td>
<td>Task Force for the Implementation of the Environmental Action Programme</td>
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<td>EC</td>
<td>European Commission</td>
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<td>EECCA</td>
<td>Eastern Europe, Caucasus and Central Asia</td>
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<td>ETV</td>
<td>Environmental technology verification</td>
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<td>EU</td>
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<td>KTN</td>
<td>Knowledge Transfer Network</td>
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<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<td>NGO</td>
<td>Non-governmental organisation</td>
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<td>NOK</td>
<td>Norwegian Krone</td>
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<td>R&amp;D</td>
<td>Research and development</td>
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<td>SMEs</td>
<td>Small and Medium-sized Enterprises</td>
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<td>UN</td>
<td>United Nations</td>
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<td>UNECE</td>
<td>United Nations Economic Commission for Europe</td>
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<td>UNEP</td>
<td>United Nations Environment Programme</td>
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<td>UNIDO</td>
<td>United Nations Industrial Development Organization</td>
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<td>USD</td>
<td>United States Dollar</td>
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<td>VOCs</td>
<td>Volatile organic compounds</td>
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INTRODUCTION

Background and purpose of the paper

1. The next Annual Meeting of the Task Force for the Implementation of the Environmental Action programme (the EAP Task Force) is scheduled for 24-25 September 2012. One of the meeting’s sessions will aim to discuss the challenges and needs related to innovation and technology cooperation in support to green growth in countries of Eastern Europe, Caucasus and Central Asia (EECCA), based on lessons learned by OECD countries, and experience from the EECCA region and worldwide. More specifically, participants will be invited to: (i) share experience on benefits of, and policies in support to, eco-innovation; (ii) take stock of technology cooperation mechanisms involving OECD and EECCA countries; (iii) agree on priority needs and how the OECD/EAP Task Force could contribute towards promoting eco-innovation in EECCA.

2. The session will be organised in two segments that will address (i) national-level policies, and (ii) international-level cooperation. This background paper was developed in support to discussions during the session by making a synthesis of lessons learned from international experience. Its development is part of the EAP Task Force’s work on policies for greener development in EECCA. The paper is based on a wide range of analytical papers on innovation and eco-innovation, issued in the recent years by the OECD.

Scope and key definitions

3. The document addresses innovation in its broader sense as both the creation and diffusion of technologies, products and processes (see Box 1). The assumption is that innovation will be present, in one form or another, in all sectors, including in resource-based industries such as oil industry, for instance.

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**Box 1. Definition and typology of innovation – the Oslo Manual**

The *Oslo Manual* is the principal international source of guidance on the collection and use of data on innovation activities in industry. Its latest (3rd) edition defines innovation as the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organisation or external relations. This definition captures the following four types of innovation:

- **Product innovation**: the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses;
- **Process innovation**: the implementation of a new or significantly improved production or delivery method;
- **Marketing innovation**: the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing;
- **Organisational innovation**: the implementation of a new organisational method in the firm’s business practices, workplace organisation or external relations.

Innovation activities vary greatly in their nature. Some actors engage in well-defined innovation projects, such as the development and introduction of a new product, whereas many firms primarily make continuous improvements to their products, processes and operations. In all cases novelty must be part of any innovation. Three types of novelty could be distinguished (OECD and Eurostat, 2005), and an innovation can be: (i) new to the firm though it may have already been implemented by other firms; (ii) new to the market, i.e. the firm is the first to introduce the innovation on its market; or (iii) new to the world, i.e. the firm is the first to introduce the innovation for all markets and industries.


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4. While the private sector actors are the main sponsors and beneficiaries of innovation, public policies and sometimes funding are essential to shape the overall framework and incentives for the private sector’s action. Policy interventions are necessary in order to address market failures and other types of barriers that inhibit innovation.

5. An internationally accepted definition of eco-innovation has still to be developed though there is wide consensus that eco-innovation:
   - Is innovation that aims at or results in significant reduction or prevention of environmental impacts, whether such an effect is intended or not;
   - Has a wide span covering products, processes, marketing methods, organisations and institutions, thus being both technological or non-technological in nature;
   - Takes various forms, including: (i) incremental innovation, such as small, progressive product and process adjustments; (ii) adaptive innovation, referring to significant changes in existing products, processes, organizational structures, etc. so that they can be applied to new context and to “substitution”, such as the introduction of goods and services that can fulfil the same functional need and operate as alternatives for other products; and (iii) radical innovation, which refers to the design and introduction of entirely new products, processes, procedures, organisations and institutions.

6. Innovations that qualify as “eco-innovations” very often come from non-environmental areas, e.g. chemical engineering, energy and transport, etc. As a result, delineating the boundaries of eco-innovation is quite challenging. In the same vein, enabling eco-innovations becomes a task that encompasses many policy areas and whose results are very difficult to measure.

7. Because of this inherently complex nature of eco-innovation, carrying it out exclusively at a firm level may not always be feasible. More fundamentally, private sector’s eco-innovation activities are often inhibited because of absent or inadequate pricing of environmental (public and common) goods and services. The market’s failure to capture environmentally-related costs and benefits results in very low and often uncertain returns from investments into eco-innovation projects, thus contributing to comparatively higher costs of eco-innovation and limited private sector involvement. Hence, the public authorities play a particularly prominent role, at all levels of governance, in order to create demand for, and enable, eco-innovation.

8. The current understanding of eco-innovation, particularly in the EECCA context, is mostly linked to the invention of new, advanced technological developments, which sometimes detracts the policymakers’ attention from the technology diffusion element of eco-innovation and leads to misallocation of resources to areas where impacts on environmental performance, economic competitiveness, but also poverty reduction are insignificant.

**Role of eco-innovation in the green transformation of economies**

9. The fact that innovation is a key tool for breaking societies’ dependence on obsolete institutions and technologies makes it crucial for the transition towards green growth. More specifically, innovative products, processes, infrastructures and management approaches are needed to further decouple growth from natural capital depletion and pollution generation, and to create new markets and jobs.
10. Most OECD governments are already regarding eco-innovation as a way to meet sustainable development targets while keeping industry and the economy competitive. For instance, in the European Union (EU), eco-innovation is considered to support the wider objectives of increasing resource efficiency, competitiveness and fostering economic growth overall. Green technologies are also considered to have promise for improving environmental conditions without impeding economic growth in the United States. In Japan, the government’s Industrial Science Technology Policy Committee sees eco-innovation as a new field of techno-social innovations. In Korea, eco-innovation is at the heart of the national Green Growth Strategy.

11. An OECD Innovation Strategy was adopted in 2010. Among others, the Strategy report highlights experience and good practices from countries around the world and points to a number of issues that deserve consideration by OECD governments, such as the need to: empower people to innovate by providing high-quality and relevant education, as well as enabling the development of wide-ranging skills that complement formal education; support small and medium-sized enterprises, which translate knowledge and ideas into jobs and wealth, frequently revealing unexploited opportunities; enact policies in support to innovative entrepreneurial efforts; finance fundamental research and development; and enable more actors to engage in knowledge sharing. Eco-innovation needs have been reflected in the OECD Innovation Strategy, and then further enhanced in the OECD’s Green Growth Strategy (2011).

12. On the ground, eco-innovation has already resulted in new business models, for example by establishing eco-industrial parks that harness economic and environmental synergies between traditionally unrelated industrial producers. One of the earliest and best-known eco-industrial parks is located in Kalundborg, Denmark. This park gradually evolved into a production system that revitalises disposed products into new resources for production (Box 2). This industrial symbiosis has led to significant economic savings and has reduced environmental impacts. It illustrates well the non-technological aspect of eco-innovation.

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**Box 2. The Kalundborg eco-industrial park in Denmark**

Rather than being the result of a carefully planned process, the Kalundborg eco-industrial park developed gradually through co-operation by a number of neighbouring industrial companies. The main participating companies are a coal-fired power plant (Asnaesværket), a refinery (Statoil), a pharmaceutical and industrial enzyme plant (Novo Nordisk and Novozymes), a plasterboard factory (Gyproc), a soil remediation company (AS Bioteknisk Jordrens), and the municipality of Kalundborg through the town’s heating facility. The eco-park was initiated when Gyproc located its facility in Kalundborg in 1970 to take advantage of the butane gas available from the Statoil refinery. This also enabled Statoil to stop flaring this gas. Since then, the network has grown, and the participating companies are now highly integrated. For instance, surplus heat from the power plant is used to heat about 4 500 private homes and water for fish farming, and fly ash is supplied for cement production. Process sludge from fish farming is supplied to nearby farms as fertiliser. Novo Nordisk also supplies farms with surplus yeast from insulin production for pig food. The Statoil refinery supplies pure liquid sulphur from its de-sulphurisation operations to a sulphuric acid producer (Kemira). These exchanges are only part of the material flow of the Kalundborg eco-park, which has been estimated at a total of around 2.9 million tonnes a year including fuel gases, sludge, fly ash, steam, water, sulphur and gypsum.

Source: Kalundborg Centre for Industrial Symbiosis, www.symbiosis.dk.
13. Over the last years, eco-innovation has accelerated in several sectors\textsuperscript{1}. Thus, between 1999 and 2008, internationally patented inventions increased annually by 24% for renewable energy, 20% for electric and hybrid vehicles, and 11% for energy efficiency in building and lighting (OECD, 2011\textsuperscript{o}). These and several other areas (e.g. urban water leakage, industrial energy and resource efficiency, biomass and alternative energy use, etc.) may well present a shared interest for the EECCA countries.

14. Lately, political interest and will to promote innovation have been increasing across the EECCA region. Many countries, for example, Azerbaijan, Belarus, Kazakhstan, the Kyrgyz Republic, the Russian Federation and Ukraine have developed relevant legislation and strategies, and established specialised agencies or earmarked funding mechanisms. Action on cross-cutting aspects of innovation is sometimes echoed in the efforts, as well as organisational structures of environmental ministries, e.g. in Azerbaijan and Kazakhstan where dedicated units to facilitate eco-innovations were recently established. At the same time, the experience of practical policy-making and implementation in support to eco-innovation is still limited in EECCA and would benefit from international-level knowledge sharing and national policy dialogue.

\textsuperscript{1} It remains difficult to gauge and project how rapidly green innovation is progressing. While some data are available on green technologies and products, much less information is available on the role of non-technological innovation, such as changes in work patterns, city planning, transportation, etc.
National Action in Support to Eco-Innovation

General Considerations

15. As already mentioned, facilitating eco-innovation requires governments to adjust many of their policies, including innovation, environmental, and sector policies. In reality, innovation policies have long remained too broad to address eco-innovation needs properly. Environmental policies, in turn, have traditionally focused on resolving such problems in a rather compartmentalised way, which often resulted in a continued use of “end-of-pipe” technological solutions. Therefore eco-innovation goals have long been absent from the radar screen of policy-makers in both policy areas. Sectoral policies showed similar patterns, largely due to the poor understanding of links between the natural and productive capital. The issue is how to re-design all these policies with often competing interests and how to achieve closer horizontal integration and coherence across various areas.

16. In order to come up with effective policies in support to eco-innovation, governments need to be aware of market failures and other types of barriers to this activity. A good understanding of such barriers is necessary from the local, national, and international perspectives. Some of the market failures (such as lacking or limited pricing of environmental externalities and ecosystem services, high costs of innovation, particularly in relation to infrastructure, or poor capacity to differentiate an innovative product on the market) may be unique to, or more prevalent in, the market for green innovation. Other barriers to innovation may be linked to systemic failures such as enabling framework failures and specifics (e.g. deficiencies in regulatory frameworks, specifics of consumer demand, cultural and social values); failures in governance structures and organisational capacity; knowledge diffusion failures; and capability failures (e.g. managerial deficits, lack of technological understanding, or limited absorptive capacity to make use of externally generated technology). Many of them may well be common for various countries though differences stemming from contextual specifics will exist.

17. Policies that make use of both supply and demand side instruments can help overcome such barriers. Several types of such instruments are outlined in the current section. Designing these instruments in a way that they effectively influence innovation, directly or indirectly, and blending them with cross-cutting measures (such as, for instance, support for networks or long-term modelling and prognosis) will be a matter of careful analysis of what is feasible in each country’s context.

18. In EECCA, the context for eco-innovation is far from being uniform making the typology of countries quite diverse from an eco-innovation perspective. Understanding the presence of, and limitations imposed by, determinant factors of country’s eco-innovation profile (such as (i) the size of its market for environmental goods and services, (ii) the knowledge base as concerns eco-innovation, and (iii) the maturity of venture capital regulation) will be therefore important for EECCA governments (OECD, 2011a). This will help them to define feasible policy objectives with regard to domestic eco-innovation and

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2 There is no strict grouping of such measures; the one used in this paper is inspired by the EU eco-innovation roadmaps.

3 Venture capital is “formal” or “professional” equity, in the form of a fund run by general partners, to invest in early to expansion stages of high-growth firms. Venture capital is an important source of funding for young, technology-based firms.
positioning themselves in relation to international markets. Adjusting existing technologies and speeding up technology diffusion, i.e. acting primarily as “technology takers”, may be the strategy that would bring the highest results in EECCA, at least in a short-term perspective.

**Getting environmental policies right – key assessment criteria**

19. In order to make sure that they influence eco-innovation, environmental policies should be assessed against a number of criteria, the following ones being most relevant (OECD, 2011m):

- **Stringency** – *How ambitious is the environmental policy objective relative to business as usual?* A more “stringent” policy will provide greater incentives for polluters to search for ways to avoid the costs imposed by the policy.

- **Predictability** – *What effect does the policy measure have on investor uncertainty; is the signal consistent, foreseeable, and credible?* Signals that are difficult to predict over time make investors to postpone investments. For example, price signals that are difficult to predict (such as unclear environmental tax rates) encourage investors to postpone investments, including the risky investments which lead to innovation. By adding to the risk which investors face in the market, an “unpredictable” policy regime can stifle innovation both in terms of technology invention and adoption. Similarly, frequently changing policy conditions come at a cost because of unexpected (and often high) expenditures imposed by retrofitting. Unlike market uncertainty (such as commodity prices), policy uncertainty is more difficult to address.

- **Flexibility** – *Does the policy instrument allow the innovators themselves identify the best ways to meet the policy objective (whatever that objective may be)?* The more “flexible” – or technology-neutral – a policy regime, the more innovation takes place. This implies that rather than prescribing certain abatement methods through technology-based standards, governments should, wherever possible, give firms stronger incentives to seek out the best means to meet a given environmental objective.

20. The issue is to integrate such criteria in decision-making. Both the OECD and EECCA countries have in place mechanisms, e.g. Regulatory Impact Assessment, that make it mandatory for governments to take evidence-based decisions. These mechanisms will need to be applied in a way that takes full account of eco-innovation goals.

**Regulations and standards**

21. Traditionally, instruments of direct regulation, such as emission or technology standards, have tended to be viewed negatively as adding costs and creating an adverse effect on competitiveness. Nevertheless, the new generation of flexible, performance-oriented standards can in fact provide positive signals and accelerate the development, introduction and diffusion of eco-innovative solutions. In the OECD countries, such standards are pursued in particular in the field of energy and resource efficiency, but are also used to address industrial pollution (for instance, in the European Union this role is played by BAT – Best Available Techniques). Performance standards can only have a lasting positive effect on innovation if they are continuously revised and used in a policy mix. Schemes such as, for instance, the Top Runner Programme in Japan aim to address this challenge (Box 3). Furthermore, while setting standards it is important to adopt a life-cycle perspective, e.g. by extending the useful life of a product or by promoting good’s recycling.
Box 3. Performance targets: Japan’s Top Runner Programme for energy efficiency

The Top Runner Programme, introduced in 1998 by the Japan’s Ministry of Economy, Trade and Industry, is a system of “dynamic” energy efficiency targets for a variety of products, ranging from vehicles to household electric appliances. Targets are set at the level of the best performing model on the market. Manufacturers are directly involved in target setting. The programme focuses on realistic levels of energy efficiency, thereby encouraging incremental improvements rather than breakthrough innovations. It is complemented by information disclosure (the names of under-performing companies are communicated to the public), as well as an e-Mark voluntary labelling scheme to help consumer choices at the point of sale. The latter mechanism puts the brand image of companies at risk, representing an incentive for eco-innovation that is probably more effective than the stringency of performance targets as such.

Source: OECD Environmental Performance Reviews: Japan 2010.

22. Technology standards may be useful as a complementary tool (OECD, 2011f). For example, technology standards ensure interoperability between different technologies, products or systems, thus reducing uncertainty and enhancing economies of scale. They are important for developing infrastructure that is required for some of the new products, such as, for instance, standards for a common charging system for electric vehicles or standards to achieve interoperability of smart grid devices and systems.

23. Several EECCA countries have legally adopted (e.g. Belarus and Kazakhstan) or are moving towards (e.g. Armenia, Russia and Ukraine) BAT-based regulation of large industry. There is interest to improve building standards. In Russia, the development of mandatory standards in this area is preceded by a voluntary certification scheme of real estate, which was developed in 2009-2010 by the Ministry of Natural Resources. It is not clear whether the Ministry has any intention to go beyond a voluntary application of these standards though. More generally, the impact of regulatory instruments on innovation in the region needs further analysis and improvement. Several aspects would require to be addressed, including the extremely low pace of regulatory reforms, the tendency to interpret and misuse BAT as technology-based regulation, and the Small and Medium-sized Enterprises (SMEs) regulation as compared to large industrial companies.

Market based instruments

24. In addition to encouraging the adoption of known pollution abatement measures, which is their core function, environmentally related taxes can provide incentives for innovation, as firms and consumers seek new, cleaner solutions in response to the price put on pollution. Such incentives should also make it commercially attractive to invest in research and development activities, either by the polluter or by a third-party innovator. The level of the tax and the predictability in tax rates are critical ingredients.

25. Establishing a direct link between taxation and eco-innovation is however difficult. Case studies, developed by OECD (OECD, 2012k) do not provide unambiguous evidence that environmentally related taxation will always lead to innovation and the adoption of new technologies and processes (see Box 4). Locating and assessing potential innovations that arise from the incentives created by taxation is difficult because of poorly adapted measurement frameworks, the novelty of the instrument, design flaws in the instrument itself, and difficulties to disentangle the isolated effect of taxation within a policy package.
Box 4. Switzerland’s tax on volatile organic compounds and innovation

Starting in 2000, the Swiss federal government instituted a product tax on volatile organic compounds (VOCs) in order to reduce VOC-triggered human health effects and the formation of ground-level ozone. Exports of VOCs or exports of goods containing them were exempted from the tax. There were significant variations in the reactions of firms to the new charge. Larger firms generally innovated and adopted new technologies rather quickly, while smaller firms, due to financial or informational constraints, were less likely to act. The role of officials in the cantons also varied, with some viewing their role as facilitative and administrative (and who helped with information and technology diffusion), compared to others who only viewed their role as tax administrator. In the paint making sector, product innovation occurred through the introduction of low-VOC (high solid) paints to the market. For the most part, the identified innovations occurred through the process of trial and error, such as looking to use less VOCs while maintaining the quality of printing jobs. The tax also spurred the creation of an industry-wide initiative by paint makers to offer recycling options for customers, an indication of organisational innovation. With the tax regime, emissions of VOCs have decreased significantly. In the 1998-2001 period, emissions on taxed products declined 12%; in the 2001-04 period, when the tax was fully implemented, emissions dropped a further 25%. This decline is significant, but reductions in VOCs from non-taxed sources declined by 28% over the same period, largely due to reductions from automobile use.

Source: Based on OECD (2012), Taxation, Innovation and the Environment.

26. After a decade of use, the design of market-based instruments in EECCA is still flawed (see details in ENV/EPOC/EAP(2012)3), and they do little to encourage eco-innovation. As part of their reform, an important issue for EECCA governments would be to take into consideration these instruments’ potential function to promote eco-innovation, and re-design them accordingly.

Support for research and development

27. Research and development (R&D) activities, focused on the development of environmental technologies, are one of the key elements of innovation activity. In OECD countries, most R&D programmes are sector- or technology-specific, and few countries seem to focus on shifting R&D investments towards the environment or eco-innovation (OECD, 2009a, d). It is currently not clear what proportion of total R&D expenditures is directed towards eco-innovation. Furthermore, R&D in general-purpose technologies, such as information technology, biotechnology and nanotechnology may be very relevant to eco-innovation but may not be identified as such.

28. Public research has been the source of significant scientific and technological breakthroughs that have become major innovations, e.g. the Internet. The private sector draws on the results of public research directly, by using publications and patents, as often seen in the pharmaceuticals sector, or indirectly (OECD, 2010c). The indirect links can occur through joint research projects, training, consultancy and contract work, attendance at conferences, staff mobility between workplaces and informal co-operation between researchers. Public infrastructure and other shared resources are also avenues for interaction. In addition to public research, governments provide funding for the private sector R&D (Box 5) or use tax incentives. Some countries have programmes supporting R&D in SMEs, e.g. the Netherlands and the US have programmes called “Small Business Innovation Research” (OECD, 2012c).

Box 5. Technology incubators in Israel

Technological Incubators provide a framework and support for nascent companies to develop their innovative technological ideas. Each Incubator provides suitable facilities for R&D activity & administrative and logistic support to projects for a maximum period of 2 years (3 years for biotech). Financing provided is up to USD 500 thousand. Incubators get 85% investment from the Government and should invest additional 15% from private sources. A number of incubators in Israel have clean tech projects in their portfolios.

29. In order to expand their countries’ science and innovation capabilities, several OECD governments have lately increased funding for public-sector research. In the OECD area between 2000 and 2006, government R&D budgets grew on average by 3.8% a year in real terms (OECD, 2010).

30. In many EECCA countries, substantial scientific and technological capabilities were in place during the Soviet period, although they were exclusively concentrated in the public sector and mostly geared to military innovation rather than innovation to support well-being. During the transition period, much of the human capital and funds were siphoned out of public R&D, although the basic institutional framework and a certain level of activities were preserved within the public sector in some EECCA countries. Overall, there is limited understanding of current capabilities in the field of R&D in EECCA.

31. The transition involved the diversification of the original institutional landscape, which now includes private firms in addition to traditional state-run research institutes and universities. However, actors supporting R&D are still insufficiently coordinated and often lack a critical mass of resources. Publicly owned branch research institutes and design bureaus are still the central players in the current innovation system. Although the number of personnel employed fell sharply in this sector during the 1990s, many institutes managed to survive, often at a level of basic subsistence, due to public funding, donor grants and, occasionally, contracts with the private sector. The inadequacy of the predominant role of the public sector in innovation was already well documented in the late Soviet period: weak knowledge flows and lack of interaction between technology developers and technology producers/users are a major problem. Re-focusing the current system on production-oriented firms as the central players will involve more than simply re-organising the former branch institutes. Crucially, innovation performance in EECCA will depend on firms developing the interests and capabilities to carry out R&D and the size of eco-innovation markets.

Support at the pre-commercialization stages

32. Many available environmental technologies have not been successfully introduced in the market, either because the market for them is not well developed or because existing infrastructure and production and consumption systems may be an obstacle to commercialisation. Consideration of the post-R&D stages of innovation, prior to commercialisation as marketable products and services, is thus particularly important for eco-innovation. Sometimes, governments help firms bring new environmental technologies to the market. For example, in the United States the Department of Energy’s Technology Commercialization Fund makes funds available to private-sector actors willing to deploy technologies that face “commercialization valley of death”. There are many other examples of such programmes.

33. Environmental technology verification (ETV) schemes have also been introduced in some OECD countries as a support measure at the pre-commercialization stage (see Box 6). The ETV has attracted considerable international interest. A nationally recognized ETV programme exists in Canada. The European Union (EU), Japan, Korea, the Nordic countries and the Philippines have now developed similar pilot or fully operating programmes, and Bangladesh, India and Singapore have expressed interest in following suit (OECD, 2009a). The EU is also currently sponsoring the AdvanceETV initiative, which attempts to involve technology vendors in a scheme where technologies receive joint verification under all three of the US, Canadian, and European verification programmes, thus increasing the international standardisation of the verification process and the potential access to international markets for technology vendors.
Box 6. Environmental technology verification in the United States

The US Environmental Protection Agency is currently coordinating the Environmental Technology Verification (ETV) Programme which “… develops test protocols and verifies the performance of innovative technologies that have the potential to improve protection of human health and the environment”. This can play an important role in reducing the risk to investors in eco-innovations, including firms in developing countries. The fact that the ETV is not a private company (it operates on the basis of a not-for-profit public/private partnership) gives a certain level of independence from the commercial interests of technology owning firms.


Public procurement and demand support

34. As attention to demand-side policies increases, some governments have started to highlight procurement as a way to spur innovation. As the public sector is a large consumer, green public procurement (GPP) can be a strong driver for greening enterprises and is increasingly used in OECD countries, e.g. in Nordic countries (Box 7). At the same time, there is a need for more evidence on the success of green procurement initiatives in creating markets, especially in the EECCA countries.

Box 7. Green public procurement in Norway

The Norwegian Public Procurement Act (2001) aims to minimise the life-cycle environmental impact of procurement while taking procurement costs into account. In 2005 the Ministry of Environment established a three-year advisory panel on developing green public procurement policy. In June 2007, the Action Plan for Environmental and Social Responsibility in Public Procurement was adopted. The Agency for Public Management and e-Government (DIFI), established under the Ministry of Government Administration and Reform in 2008, is responsible for following up the action plan. Under the Action Plan, requirements for 15 priority product groups were introduced in 2008. Guidelines and standard procurement criteria have been developed and capacity-building assistance has been provided to assist procurement officers at the central level. Collaborative initiatives were also launched to encourage sustainable procurement at the municipal level. Total public procurement amounts to some NOK 270 billion annually, or more than 10% of GDP. Various environmental criteria are applied for some 70% of procurement operations.


35. As a general rule, tenders for goods to be procured can include environmental specifications among other technical characteristics — such as quality, safety, dimensions, packaging and labelling. The main product categories to which GPP is now applied are paper products (recycled, chlorine-free), heating appliances, information technology equipment, cleaning products, packaging, furniture, motor vehicles, and energy and waste services. As revealed through OECD work on GPP (Box 8), the main barriers to implementing green procurement are a lack of training for public procurement officers, intergovernmental coordination, and information on financial benefits as well as initial higher costs. Procurement decisions which take life-cycle costs into account are still rare, partly due to methodological difficulties. To overcome the lack of green products and services on the market, partnerships with suppliers, training programmes and competitions could be used. Use of GPP can be optimised through credible and factual information, so that the criteria for making GPP decisions result in improved resource allocation rather than in the establishment of hidden trade barriers.
Box 8. The OECD work on green public procurement

At OECD, work on green public procurement (GPP) started in 1996. The first stage work resulted in the OECD Council Recommendation on the Environmental Performance of Public Procurement (2002). Later on, green public procurement principle found its reflection in the Recommendation of the Council on Principles for Integrity in Public Procurement (2008). Several reviews of GPP use in OECD countries have been developed. Recent OECD analysis (OECD, 2011) shows that there is strong progress since 2007 where “know how” was identified as most common barrier to GPP in OECD countries.

Source: OECD Secretariat.

36. Governments may also directly support business and individual consumers with subsidies, tax incentives or other benefits for purchasing particular eco-products and services in order to stimulate demand. There are a few good examples of the proactive use of demand support measures for shifting the course of technology and product developments, such as, for instance, the France’s Bonus-Malus (reward-penalty) scheme for personal automobiles to support consumer purchase of greener cars. Eco-labelling is another example. Commonly, eco-labelling requires significant human and financial resources from the government and companies that would like to label their products. Establishing national eco-label schemes in small countries often does not pay off because of a limited market and relatively high cost for companies. In some cases, it could be economically and practically feasible to establish a simplified national product certification scheme for particular products widely produced in the country.

37. To be effective, product certification systems should be backed by an intensive marketing campaign and other promotional activities to get appropriate attention from both enterprises and consumers. In order to avoid these schemes becoming disguised market barriers, they need to be non-discriminatory, transparent, involve widespread consultation on eco-label criteria and, above all, be non-protectionist in intent. This is especially important when criteria related to the production phase are included. They may then also serve as a means to enhance the competitiveness of developing-country products.

38. In EECCA, green procurement criteria are at the very beginning of application through initiatives that often have a symbolic nature, such as the procurement of electric cars by the Georgian Government. A new risky practice is the exemption of green investment projects in Ukraine from the general procurement rules. To this end, an amendment to the Law on Public Procurement was passed in June 2012, with a declared objective to use at full income from carbon emissions trading. Effective eco-labeling measures to promote eco-innovation in the EECCA countries are not known to the author of this paper.

Mobilization of financing

39. Many governments have taken measures to ease access to finance through venture capital for firms developing innovative technologies or setting up new businesses. The focus is often on SMEs and entrepreneurs (EC, 2011). Both OECD and some of the EECCA countries (Box 9) have adopted mechanisms to stimulate innovation through earmarked financing.

Box 9. The Russian Federation’s Skolkovo Foundation

The Russian Government has mandated the Skolkovo Foundation to help accelerate the transformation of Russia from a resource-intensive to an innovation-based economy through strategic partnerships with leading scientists and corporations. To achieve this objective it is overseeing the creation of the Skolkovo Innovation Centre composed of five R&D clusters, a Technopark, the Skolkovo Institute of Technology (a new graduate research university established in collaboration with the Massachusetts Institute of Technology) and Skolkovo City, located near Moscow. The Foundation is a non-for-profit organisation founded in May 2010 by the Russian Government with a grant of USD 5 billion.

Source: http://www.sk.ru/en/
40. The so called “angel investment” is becoming a powerful source of financing for young innovative firms (OECD, 2011t). Unlike venture capitalists, angel investors invest their own money and tend to be more committed to the long-term success of the businesses which they support. Government policies to boost angel investment can make a difference though tax incentives (such as in the UK and France), co-investment funds (such as in the Netherlands and New Zealand) or by supporting national angel associations, groups and networks (as in Germany). Business Angels (BAs) are an important financing source for SMEs, and seed and start-up companies in particular (EIF, 2011). According to the European Investment Fund, BAs are even more important in countries and regions lacking an institutionalised venture capital infrastructure, often being the only major source of equity finance for young innovative SMEs.

41. However, apart from a few examples, some of which are reflected in Box 10, there is a lack of specific mechanisms for firms developing environmental technologies or eco-friendly products and services, as the majority of measures target general business start-up and development. More support is provided for speeding up the diffusion of green technologies. The effectiveness of existing mechanisms still needs to be assessed.

<table>
<thead>
<tr>
<th>Box 10. Examples of low-interest loans in support to green technology diffusion</th>
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<tr>
<td><strong>Finland</strong>: The state’s special financing company Finnvera gives reduced interest loans for environmental investments by SMEs, but the loans are conditional on the planned measures going beyond regulatory requirements and the use of best available techniques, and applications need to be certified by the competent environmental authority.</td>
</tr>
<tr>
<td><strong>France</strong>: OSEO public investment bank offers loans at favourable rates and without collateral from EUR 50,000 to EUR 3 million for up to seven years for SMEs who adopt environmentally friendly technologies (with the share of capital costs exceeding 60%) or develop new ones.</td>
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Provision of infrastructure

42. Some types of infrastructure are essential for innovation activities. In particular, transport and communication infrastructures are increasingly considered a critical factor for economic success and raising productivity. Innovation related to alternative fuel vehicles, user-friendly public transport or renewable energy relies on infrastructure for new fuelling systems, sophisticated traffic control, diffused energy distribution systems, etc. This area requires further attention in both OECD and EECCA countries given that current innovation policies are short of actions addressing infrastructure provision among eco-innovation measures.

Knowledge diffusion for eco-innovation and education and training

43. Many OECD countries have sought to influence the structure of innovation by requiring cooperation in research projects and by supporting network development. To improve the overall sustainability performance of products and services, eco-innovation activities need to address the entire value chain. Government can play a role as facilitator of networks of innovation actors, notably by establishing public-private partnerships and networking platforms/”techno parks” for eco-innovation. To date, a few networks in OECD countries specifically target the development of new environmental technologies and solutions (Box 11). In EECCA, such networks have not yet emerged, though there is networking on innovation.
Box 11. Knowledge networks for eco-innovation in the United Kingdom

The UK Technology Strategy Board, in charge of promoting technology-driven innovation, relies heavily on networking to drive innovation within UK businesses. The UK innovation platforms pull together policy, business, government procurement, research perspectives and resources, including two innovation platforms in the environment-related areas of low-impact buildings and low-carbon vehicles. Also Knowledge Transfer Networks (KTNs) have been set up to increase the depth and breadth of transfers of technology to UK-based businesses. Networks in the fields of technology and business applications include some environmental fields such as resource efficiency. KTNs bring together people from business, universities, research, finance and technology organisations. The most highly rated functions of the KTNs are monitoring and reporting on technologies, applications and markets, high-quality network opportunities, and identifying and prioritizing key innovation-related issues and challenges.

Source: OECD (2009), Sustainable Manufacturing and Eco-innovation.

44. Education and training programmes are essential for developing the human capital needed to deliver eco-innovative solutions and create a potential labour force for “green jobs”. A number of countries have taken measures to mainstream environmental education in the school curricula or vocational training. A few countries have also started to focus on creating specific skills and a knowledgeable workforce for emerging environmental industries. The UNECE-led activities on education for sustainable development in EECCA can play an important role in this regard though countries still have to implement many of the measures defined nationally in this area. An important objective will be the development of training programmes related to “green jobs”. The lack of relevant knowledge and skills is likely to be a key impediment to moving faster on innovation and green growth, since it will be difficult to address in a short- to medium-term perspective, particularly in those EECCA countries that were most affected by the brain-drain over the last two decades.

Technology roadmaps

45. Technology roadmapping is a structured (sometimes graphical) support tool to decision-making on technology strategy and transition, and “technology management” more generally. This tool can be used within a company, a particular group of stakeholders or an entire sector. By exploring the linkages between technologies, products, and market demands, technology roadmapping provides the basis for decisions on technology gaps and directions and ways to leverage R&D investments. Roadmapping is systematically used mostly by large companies though there are pertinent examples of roadmapping at the sectoral level, as shown in Box 12 below. The latter approach can be useful to inform decisions in sectoral ministries.

4 According to a definition proposed by the European Institute of Technology and Innovation Management, “technology management” addresses the effective identification, selection, acquisition, development, exploitation and protection of technologies (product, process and infrastructural) needed to achieve, maintain [and grow] a market position and business performance in accordance with the companies’ objectives.
Box 12. Energy Technology Roadmaps by the International Energy Agency (IEA)

There is a pressing need to accelerate the development of low-carbon energy technologies in order to address the global challenges of energy security, climate change and economic growth. This challenge was acknowledged by the Ministers from G8 countries at their meeting in June 2008 in Aomori, Japan where they declared the wish to have IEA prepare roadmaps to advance innovative energy technology. It has been reconfirmed by IEA member countries. To achieve this ambitious goal, the IEA is developing a series of global low-carbon energy technology roadmaps covering the most important technologies. The IEA is leading the process, under international guidance and in close consultation with government and industry. The overall aim is to advance global development and uptake of key technologies to reach a 50% reduction in energy-related CO2 emissions by 2050. The roadmaps will identify priority actions for governments, industry, financial partners and civil society that will advance technology development and uptake to achieve international climate change goals. Each roadmap represents international consensus on milestones for technology development, legal/regulatory needs, investment requirements, public engagement/outreach and international collaboration. As of July 2012, twelve roadmaps have been developed, including for solar, wind, and geothermal energy production, as well as smart grids. Some of these are available in Russian translation.


National strategies and roadmaps

46. Most OECD countries have developed national strategies to support eco-innovation. In the European Union, the Environmental Technology Action Plan (ETAP) has invited EU members to develop eco-innovation roadmaps and to report initiatives taken at national and/or local level to support eco-innovation. An Eco-innovation Action Plan (EcoAP) was launched by the European Commission in December 2011 and is the ETAP’s logical successor. A High Level Working Group – composed of representatives from EU Member States and European Commission services – helps facilitate EcoAP implementation. Outside Europe, a number of OECD countries have similar initiatives. In particular, Korea and the United States have designed explicit strategies to stimulate eco-innovation. Many EECCA countries, for example, Azerbaijan, Belarus, Kazakhstan, the Kyrgyz Republic, the Russian Federation and Ukraine have developed relevant legislation and strategies.

Box 13. ETAP national roadmaps

The European Commission has invited EU member states to formalise their national transposition of strategies and action plans towards environmental technologies. These transpositions took the form of national roadmaps (action plans). The main objective of this exercise was to promote experience sharing on eco-innovations and best practices. The aim of the ETAP roadmaps is to help focus on relevant plans, actions, and achievements (relevant to environmental technologies and eco innovations).

For the purpose of ETAP reporting, countries were asked to group the priorities along the following lines: (i) Research & Development; (ii) Mobilisation of Financing; (iii) Market-based Instruments; (iv) Procurement; and (v) Acting Globally. For each line, it was suggested that Member States provide the relevant information on: the state of the art or state of play; existing strategies and action plans; milestones and measures; and major achievements and best practice.

The analysis of the balance of instruments indicates that the roadmaps of the majority of countries show a strong bias towards supply side instruments (Kletzan-Slamanig D. et al., 2009). Prevalence is given to R&D support, the support of networks and partnerships, demonstration and commercialisation as well as information service.

Source: http://ec.europa.eu/environment/ecoap
Commonly, national strategies address a variety of objectives (bridging the gap from the demonstration phase to commercialisation, improving consumer awareness, defining technical standards, etc.) thus covering a wide range of policy areas (from environment to science and technology, industry, transport, competition, and energy) and instruments. They involve initiatives by public authorities at both national and local levels and delineate the split of responsibilities between these levels. Roadmap development provides a framework to balance different objectives and instruments, assess the coherence of these policies and enable stakeholder cooperation and progress monitoring. The policy coordination element of such kind of horizontal initiatives is well illustrated by the German experience (Box 14).

Box 14. Policy co-ordination to promote eco-innovation in Germany

The 2008 Master Plan on Environmental Technologies, a step towards implementing the High-Tech Strategy for Germany (EUR 2.5 billion of federal funding), was initiated jointly by the Federal Ministry of Environment (BMU) and the Federal Ministry of Economy (BMBF). It was designed as a cross-sectoral environmental and innovation policy measure. Its aim is to speed up the innovation process from the research stage to the development of national and international markets in environmental technologies. It comprises a range of measures aimed at improving the framework conditions for innovation (promoting basic research and its conversion into applications, assisting market introduction, providing targeted support for SMEs and assisting diffusion of these technologies in national and international markets). The German Water Partnership is a component of the Master Plan on Environmental Technologies. Another component of the Master Plan is the Electric Mobility Development Plan, a recent step in efforts to encourage development of alternative-fuel vehicle technologies in Germany.

Source: OECD (2012), OECD Environmental Performance Reviews: Germany 2012.

In the EECCA context, the issue of roadmap development needs to be addressed in conjunction with existing planning processes. Roadmaps need to be viewed as planning tools and outcomes of policy dialogues involving various stakeholders rather than self-standing (and often shelf-standing) papers written by technical personnel in a lead government agency or by external consultants. At the same time, they need to be as much as technically sound and politically accepted hence the need for the technical experts’ participation, including with a solid knowledge of good international practices. Roadmap development may be either a way to initiate a policy dialogue on eco-innovation, spurring new policies, or just a vehicle to gather and share information and to reorganise pre-existent policy measures, as it has been often the case with ETAP roadmaps.

Multi-level approach to support eco-innovation

There is ample room for local initiatives in support to green innovation. OECD experience confirms that local authorities can take initiatives to support the development and/or diffusion of green innovations. They do this either to address a particular environmental concern, or as a driver for growth (OECD, 2012a). Local authorities have various opportunities to establish and pursue their own eco-innovation objectives while carrying out their functions, particularly as (co-)regulators, facilitators or executive agents in the environmental or other policy sectors, as well as purchasers or contractors. Many local authorities decide to develop a “green” profile for the region or community in order to make it more attractive (OECD, 2011q). In such cases the main function of eco-innovation initiatives is to add to that profile. The European Covenant of Mayors, which now has many adherents in EECCA, is a good example of sub-national authorities positioning themselves as drivers of green growth (OECD, 2012 c).

In their desire to stimulate eco-innovation, local authorities can be constrained by the limits in their legal mandate, including the possibility to use a specific policy instrument, as well as limits in available resources following specifics of fiscal and budget management arrangement in the country. Furthermore, there might be diverging policy priorities between central and local authorities, including in terms of ambition, e.g. less interest to act on climate change, and more on local pollution. Sometimes, eco-innovation support can lead to distortions in the level playing field for businesses. It may happen that local
and central authorities decide to support competing technologies, thus hampering synergies and economies of scale in the public sector. Finally, an insufficient exchange of information can result in “re-inventing the wheel”. Thus a degree of alignment between national and sub-national objectives and policies is needed.

51. In order to address possible problems, and, more generally, increase the alignment of national and sub-national eco-innovation initiatives, several measures can be used. Central governments can create frameworks which will encourage local initiatives. Constitutional and legal arrangements should leave as much room as possible for the local authorities to pursue their own eco-innovation policies. Central authorities can apply financial incentives to make it attractive for local authorities to launch and host eco-innovation projects. While preserving a level playing field and national policy coherence, they should avoid unnecessary restrictions on the local authorities’ autonomy to design their own taxes, charges, and budget management policies in an “eco-innovation friendly” way. In some cases, eco-innovative clusters could be established with help from central authorities, in which the role of the innovating industry is prominent, as it is the case in Korea (Box 15).

52. Finally, information exchange, consultation and knowledge sharing will be crucial. By sharing examples of successes and failures the parties involved may obtain insights and discover patterns that can be helpful to find a ‘tailor-made’ solution that suits their particular situation. This process may also shed more light on the question to what extent conflicts and coordination problems are actually significantly reducing the cost-effectiveness of eco-innovation policies.

53. In EECCA, the “green growth” activism of local authorities seems to be quite high. Over 40 cities from Armenia, Belarus, Georgia, Kyrgyzstan, Moldova, and Ukraine are involved in the European Covenant of Mayors. Since the turn of the century, the EECCA Regional Environmental Centres have supported improvements in local capacity for environmental action planning in several EECCA countries. More recently, in the Russian Federation, the Moscow City has launched reflection on its green growth strategy. Such initiatives need further support and visibility.

Box 15. Regional industrial promotion programmes and innovation in Korea

The Korean industrial policy model has been characterised by the development of industrial complexes, including at the regional level, as in the case of the photonics industry in the Gwangju area. The so-called “techno parks” played a pivotal role in supporting the implementation of Regional Strategic Industries Programmes. They allowed business creation and development, establishment of public-private partnerships in regions and networking with local universities and research centres. Techno parks in Korea tend to be specialised in different industries, some are green-field developments, and others build up on installed industrial capacities. Some support business creation, others favour technological upgrading of existing firms and others perform both functions. Techno parks have simultaneously been acting as an operating agency transferring resources to SMEs in the region. In a context of weak regional institutional capacities, techno parks started to perform functions similar to those of a regional development agency.

In 1997 the Korean Government invested KRW 25 billion for five years in the creation of each of the six pilot techno parks. Following the success of this experience, the government supported the creation of additional eight parks. Today in Korea there are 18 operating parks, among which four are financed by private investments. Over the years, the central government has carried out several impact evaluation studies which conclude that there are performance gaps between the 18 techno parks; on average techno parks contributed to technology transfer, venture business and rising sales and employment in the hosting region. After a first phase of the implementation of regional industrial promotion programmes in Korea, the country’s government carried out an assessment which revealed that the lack of a regionally based institution jeopardised the positive impact of these programmes. In the second phase, on the basis of this assessment, Regional Innovation Agencies were introduced to fill the institutional gap at the regional level. Increasing the space for bottom-up initiatives also required investing in capacity building at the local level. The country has supported improvements in the quality of public administration at the local level by promoting secondment practices from central to local governments and vice versa and by increasing the standards and variety of public administration training programmes.

The role of national framework conditions and impact of the economic crisis on innovation

54. Framework conditions should be supportive to innovation and create a sound business environment. This includes well-functioning product, labour and financial markets and openness to domestic and international competition. Specific policy areas for particular attention are the public and private financing of innovative efforts and the fostering of the start-up and growth of new firms.

55. Further efforts are needed in EECCA to establish the enabling conditions for green innovation. This includes such measures as strengthening the rule of law and the domestic venture capital industry, and protection of intellectual property rights. Maintaining a sound macroeconomic climate, including the sustainability of public finances, is also an important condition for boosting private and public investment in innovation. Prospects for innovation, which are uncertain, will greatly depend on broader economic restructuring. It has to be noted that currently innovation is not placed at the top of the immediate policy agenda.

Box 16. Mechanisms to stimulate venture capital for green technologies in Korea

Venture capital (VC) is a key resource for developing green technologies. For example, Korea has taken specific action to stimulate VC for green technologies. This is the role of the Environmental Venture Fund. Unfortunately, the Fund’s performance was plagued by a number of factors, including uncertainty about the profit rate of environmental industry, and the lack of management capacity in the field. Other eco-innovation support funds included Eco-Technopia 21 and the Environmental Technology Business Incubator. The Korea Environmental Industry and Technology Institute (KEITI) was established in 2009, to co-ordinate a comprehensive support system for environmental ventures. KEITI activities cover development of environmental technology, certification of environmental technologies and products, support to the promotion of Korea's environmental industry, including in foreign markets, and framework conditions (promoting green firms and green procurement).


56. A recent OECD study (OECD, 2012g) noted that the current economic crisis negatively affected innovation and revealed the pre-crisis weaknesses of some types of innovations (e.g. financial innovations). Many countries have implemented policies to respond to the crisis that include innovation although budgetary constraints have put pressure on governmental support of innovation. Moreover, access from private sources becomes increasingly limited. Financing constraints and, even more, uncertainties over future market developments had a negative effect on firms’ innovation activities. Policies aimed at avoiding employment losses and supporting training are essential to avoid damage to innovation systems.

Measuring eco-innovation

57. To capture diverse areas and characteristics of eco-innovation activities without limiting the scope of understanding, it is important to collect sufficient data that allows identifying the following three aspects: (i) how firms eco-innovate, or the nature of eco-innovation (target, mechanism, etc.); (ii) the drivers and barriers that affect different types of eco-innovations; and (iii) the impacts of different types of eco-innovations (OECD, 2010d). Accordingly, the following four categories of data can be applied for quantitatively measuring and analysing eco-innovation (OECD, 2009d):

- **Input measures**: e.g. R&D expenditures, R&D personnel, other innovation expenditures (such as investment in intangibles including design expenditures and software and marketing costs).
- **Intermediate output measures**: e.g. the number of patents; numbers and types of scientific publications.

- **Direct output measures**: e.g. the number of innovations, descriptions of individual innovations, sales of new products from innovations.

- **Indirect impact measures**: e.g. changes in eco-efficiency and resource productivity.

58. No single existing measurement approach is sufficient to capture the overall trends and characteristics of eco-innovation. Further progress in benchmarking and indicators is needed. This could include the development of an “eco-innovation scoreboard” that combines different statistics or the design of a new dedicated survey. Such efforts could help improve understanding of the nature, drivers/barriers and impacts of eco-innovation as well as raise awareness among policy makers and industry. Measuring the “greenness of national innovation systems” (e.g. environmental standards, environmental education, collaboration, venture capital, subsidy schemes and market-based instruments) could constitute another avenue for benchmarking eco-innovation and could be linked to a scoreboard.

59. More generally, however, eco-innovation measurement is difficult and often misses the necessary data, even in OECD countries. Therefore, attaching high priority to eco-innovation measurement in EECCA may be premature.
INTERNATIONAL DIMENSIONS OF ECO-INNOVATION

Rationale for international cooperation

60. Innovation is increasingly perceived as essential for tackling global challenges. For instance, whatever the origin of greenhouse gases (GHG), their impact concerns all countries and solutions to reduce this impact will benefit them all. The need to invest in innovation to help address global challenges raises corresponding challenges in the policy context. These concern international co-ordination of research needs and priorities; financing levels and provision of other incentive mechanisms or reward systems for innovation; evaluation; mechanisms to ensure technology transfer, equity and sharing of benefits; capacity building to enable countries to absorb innovations and benefits from them; and governance frameworks that establish and legitimate policy actions.

61. Co-operation is necessary because: i) no single country can successfully address the problems alone; ii) individual countries may not be willing to bear the costs of addressing global challenges because they cannot appropriate the benefits; and iii) the uncoordinated efforts of many countries are likely to be more costly and less successful than coordinated, co-operative efforts. Furthermore, acting internationally creates larger markets for innovation. International policy co-ordination, e.g. through adherence to multilateral environmental agreements, and policy dialogue to remove information gaps can induce the development of more adequate national policies and transfer of technologies between countries (OECD, 2011m).

62. Within the OECD’s framework, member countries have repeatedly manifested interest to work on subjects related to eco-innovation. This interest resulted in several work streams, including development of a common definition and vision of eco-innovation, reflection on policies necessary to promote eco-innovation, analysis of relevant multi-level governance arrangements, development of indicators, and so on.

63. Besides the above-mentioned fields that are likely of relevance to all countries, the developing and emerging economies have particular needs as concerns international cooperation for eco-innovation promotion. These needs are often related to the type and extent of donor assistance that they receive.

64. In their turn, the donor community has genuine interest in stimulating the development and deployment of green innovation in partner countries though their support might have been limited in catalysing innovation. The emphasis placed on hardware transfer was often the reason for limited adoption and adaptation on sound technologies by developing countries (OECD, 2009a). At the same time, experience shows that it is often more relevant to strengthen the capacity of developing countries to adapt existing technologies (and to eventually develop the innovations they need) than to simply transfer hardware. An important issue is focusing on those areas of eco-innovation and technology transfer that bring the highest benefits for key development objectives, such as: poverty alleviation, reduction of climate change vulnerability of economies and societies more generally, improvement of competitiveness, human well-being and ecosystem integrity.

65. The need to account for the country’s specific conditions as part of assistance must be both recognised and facilitated. This refers to differences in circumstances and needs between countries (e.g. emerging versus least developed countries) and within countries (e.g. urban versus rural areas).
Individual technologies also may raise context-specific issues. Working in a variety of conditions requires donors to both pay attention to the adjustment of national policies and capacity at the organisational and individual level. Any support must be based on a careful analysis of needs and broad stakeholder consultations.

Central policy goal and areas requiring support

66. In order to facilitate the developing countries access to eco-innovations, action in two area is important (OECD, 2009a):

- **Maximising the impacts on domestic eco-innovation capabilities.** This will encourage the uptake and rapid diffusion of existing eco-innovations, as well as the development of new eco-innovations relevant to specific developing country contexts. It is also necessary in order to facilitate a process of long-term, sustainable economic development in developing countries based on clean technology;

- **Maximising the leverage of private finance.** The vast majority of the new investment required to fund a transition to an economy characterised by widespread adoption of eco-innovations will come from the private sector. It is therefore vital to establish approaches to investing public finances that are likely to have maximum impact in terms of attracting and sustaining private investment in relevant technologies.

67. In conjunction with this, the following actions may require international support:

- Analysis and recommendations to inform national policy and businesses;
- Applied research and development;
- Evaluation of technology performance;
- Strategic and business development advice to start-ups;
- Creation of innovative businesses by bringing together key skills and resources;
- Providing early stage funding (co-investments, loans or risk guarantees to help viable businesses attract private sector funding);
- Accelerated deployment of existing technologies;
- Skills / capacity building.

68. Eco-innovation support can be based on a range of mechanisms, some of which are described below. Focus most often will be put on facilitating incremental and adaptive innovation processes within partner countries rather than radical innovation.

Multilateral Environmental Agreements

69. International obligations can be a driving force behind eco-innovation. To this end, a number of Multilateral Environmental Agreements (MEAs) have included elements which encourage international technology transfer and eco-innovation. For example, the Montreal Protocol on Substances that Deplete the Ozone Layer (1987) is widely regarded as a successful example of an MEA that provided developing countries with access to eco-innovations. Recent quantitative analysis (OECD, 2011m) demonstrates that MEAs do have an impact, at least on technology diffusion: adherence to a series of international protocols under the UNECE’s Convention on Long Range Transboundary Air Pollution (LRTAP) had induced the transfer of technologies between signatory countries. The opposite may well be true: the transfer of technology between signatories could have been a way of encouraging adherence to MEAs.
Box 17. The role of the UNECE’s LRTAP Convention in technology transfer

Acid rain has been a political issue for over three decades and has often resulted in international tensions due to the trans-frontier pattern of its deposition. The downwind countries that imposed the most stringent regulations, and the Nordic countries in particular, suggested a multilateral approach towards solving this problem. This led to the signature of the Convention on Long Range Transboundary Air Pollution (LRTAP) in 1979 within the framework of the United Nations Economic Commission for Europe. Initially there were 32 signatories in 1979 including major emitters of SOX and NOX such as the United States, Germany and the United Kingdom. The Convention has now been signed by 51 countries. The signatories to a series of Protocols arising out of the LRTAP Convention have identified technology transfer as a particular objective. The OECD analysis demonstrated that the Protocols had a positive and statistically highly significant effect on technology transfer: when both source and recipient countries were signatories to these Protocols, the number of transferred inventions increased.


70. A highly relevant MEA-related example is the Expert Group on Technology Transfer (EGTT) under the UNFCCC, which aims to address some of the key measures supporting eco-innovation, such as technology needs assessments (TNAs), facilitation of access to technology information, creating enabling environments for technology transfer, capacity-building for technology transfer, joint research and development, and identifying relevant financing mechanisms for facilitating technology transfer and development of technology through provision of financial resources. Despite the well conceived nature of the framework under which the EGTT operates, however, technology transfer to developing countries is one of the key areas that the UNFCCC is seen as having failed to deliver on to date (Khor, 2008).

71. The impact of MEAs on national policies is regularly assessed as part of country-level Environmental Performance Reviews (EPRs), conducted by OECD and UNECE. EPRs show that in many instances MEAs are not able to deliver the intended goals because of an acute implementation deficit, particularly in EECCA countries. Disentangling their impact on domestic eco-innovation in EECCA does not seem feasible.

Support to address financing gaps

72. Financing mechanisms need to be used to provide incentives for eco-innovations, including through international risk-sharing. Most often, these mechanisms will not differ from traditional ones (such as the Global Environment Facility, various climate funds or similar) to support environmental improvements and green growth generally. At the same time, more targeted mechanisms are emerging. For example, the German Federal Ministry of the Environment (BMU) provides financial assistance both inside and outside Germany under the “Environmental Innovation Programme” (Box 18). International public-private partnerships are another tool used by governments to address financing gaps in the areas of infrastructure, research or technology development. This may also involve mechanisms to share costs across countries and actors and engage in joint investments, such as the International Energy Agency’s “Energy Technology Agreements”.

Box 18. Germany’s Environment Innovation Programme

The BMU’s Environment Innovation Programme works to promote demonstration projects on a large scale: i.e. exemplary projects that have so far been implemented in the market. They show how new technological methods to protect the environment can be used and combined. The Programme is a loan with interest subsidy for large scale demonstration projects. In 2009 the total volume of the programme was €84 million. The Programme targets non-energy eco-innovation. Financing for major industrial projects that demonstrate for the first time in what ways advanced technological procedures and combinations of procedures can be put to use to reduce pollution. The beneficiaries of the programme are national and international private companies or mainly public sector dominated companies, as well as municipalities, municipality associations and enterprises, etc. The programme has priority in promoting SMEs.

73. The financing architecture in support to eco-innovation, particularly in EECCA, needs further analysis. Tracking development aid that supports eco-innovation is not yet possible because of the way that measurement and reporting frameworks are designed currently.

**Policy support, knowledge sharing and capacity development**

74. Several mechanisms are relevant, including: (i) facilitating the development and dissemination of relevant information sources, such as case studies, good practice guides, success stories and lessons learnt; (ii) assessment of human and institutional capacity needs and implementation of capacity building programmes; (iii) supporting analytical work for evidence-based decision-making; (iv) moderating policy dialogue at the national and international level; (v) establishing partnerships and networks, including technology platforms, business incubators, networks of excellence, etc.; and (vi) promoting public awareness of eco-innovation.

75. National and international technology platforms, bringing together firms and national governments, can help address issues, such as standard-setting and technological deployment, that arise when developing innovative solutions to problems that cross markets and borders. Proven co-operation strategies to improve international science and technology co-operation include mapping of R&D needs; technology transfer initiatives; and scholarships and fellowships for international researchers and students. There is a need to encourage cooperation between developing and emerging economies, and triangular cooperation. The European Technology Platforms (Box 19) and the EU-UNEP Switch Asia Programme are good examples of mechanisms supporting such cooperation. Also UNIDO has an intensive programme on technology cooperation, in industrialised countries (Box 20) and beyond. An important benefit of this approach is the possibility to share knowledge at the nexus of eco-innovation policies and poverty reduction. Support is necessary to increase the involvement of the private sector, civil society, non-governmental organisations, philanthropic organisations and other stakeholders.

**Box 19. European Technology Platforms**

European Technology Platforms (ETPs) are industry-led stakeholder fora charged with defining research priorities in a broad range of technological areas. ETPs provide a framework for stakeholders, led by industry, to define research priorities and action plans on a number of technological areas where achieving EU growth, competitiveness and sustainability requires major research and technological advances in the medium to long term. Some European Technology Platforms are loose networks that come together in annual meetings, but others are establishing legal structures with membership fees. They work on developing and updating agendas of research priorities for their particular sector. These agendas constitute valuable input to define European research funding schemes. Since they are developed through dialogue among industrial and public researchers and national government representatives, they also contribute to create consensus and to improve alignment of investment efforts. Avoiding duplication and making the most of poles of excellence and best practices is one of the great challenges of European research, and ETPs are a very good vehicle to improve synergies. The European Commission does not own or manage European Technology Platforms, which are independent organisations. The European Commission did, however, support their creation and remains engaged with them in structural dialogue on research issues.


**Box 20. UNIDO’s PLATECH**

PLATECH is an online platform dedicated to the support of technology parks development in industrializing countries. It aims at providing global forum services complementary to technology park and technology management on-site technical assistance or to start it through the provision of on-line specialized expertise, methodologies, tools and networking services. PLATECH provides counseling and e-learning tools for the set-up and development of technology parks. It also provides networking services to facilitate specialized exchange of information, news and opportunities for technical and commercial cooperation among technology parks and between their tenants.

76. Cleaner Production Centres, which were established in the late 1990s in many EECCA countries, remain in place but their outreach has not expanded very much and they still rely on external financing. In 2005-2007, the Cleaner Production Centres in Georgia, Moldova, and Kazakhstan received donor support from the EU to carry out facility-specific audits and develop cleaner production manuals in national languages. Currently, UNIDO and UNEP are working jointly to revive such centres in EECCA.

Technology transfer

77. Ensuring a wide diffusion of green technologies will be as important as their invention, in particular in addressing global environmental issues. The speed of deployment of, for example, existing low-carbon technologies will partly determine the global costs of climate-change mitigation and adaptation (OECD, 2009). OECD analysis shows that international transfers of green technology occur primarily between developed countries. Recent data, however, indicate that transfers in green technologies from OECD to non-OECD countries have been increasing over the last years. Numerous tariff and non-tariff barriers to trade in green technologies remain in place, however, which inhibit their free flow (Steenblik and Kim, 2009). In some developing and emerging economies, high import tariffs on energy-consuming goods, like air conditioners and refrigerators, combine with subsidised electricity prices to encourage consumers to favour appliances that are relatively inefficient to operate.

78. Fostering international technology transfer is possible by, for example, removing trade barriers that limit technology transfer across borders, as well as by developing mechanisms that enhance technology transfer (e.g. voluntary patent pools). There is also a need to shift the focus of technology transfer from donor to developing countries from the traditional provision of “hardware” (physical equipment) towards its better combination with the “software” element of technology (knowledge and processes). Multilateral agreements can also be used to encourage technology transfer, allowing for the realisation of public objectives at least cost (e.g. the Clean Development Mechanism). Academic partnerships and cross-border higher education can also facilitate technology transfers between universities, and lead to spillovers in the local innovation system.

The issue of Intellectual Property (IP) Rights

79. Evidence available to date suggests a complex picture in relation to intellectual property (IP) for eco-innovation (OECD, 2009a). Whilst access to IP (patents) might be necessary in some cases, it is unlikely to be sufficient in itself to enable developing country firms to become eco-innovators. Firms also need access to tacit and other related knowledge which are often not patent protected. International technology-leading firms and industrialised countries might have concerns regarding intellectual property protection and their competitive advantage. However, these concerns are likely to be outweighed by the significant economic benefits of accessing new markets via carefully negotiated collaborative initiatives with firms and other institutions within developing countries. More generally, OECD analysis (OECD, 2007) shows that stronger levels of patent protection are positively and significantly associated with the inflows of high-tech products.
REFERENCES


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