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Cities and Green Growth: The Case of the Chicago Tri-State Metropolitan Area

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CITIES AND GREEN GROWTH: THE CASE OF THE CHICAGO TRI-STATE METROPOLITAN AREA

This working paper assesses opportunities and policies for green growth in the Chicago Tri-State Metropolitan Area. It first examines the Chicago metro-region's economic and environmental performance and potential constraints to regional growth, and identifies emerging regional specialisations in green products and services. This is followed by a review of sector-specific policies that can contribute to green jobs, green firms and urban attractiveness, with particular attention to energy-efficient buildings, the wind energy industry, public transportation, and the water and waste sectors. Finally, the working paper considers the role of workforce, innovation and governance policies, focusing on skill shortages and skill mismatches in the regional labour market, ways to make the most of the region's innovation assets, and opportunities for regional institutional co-ordination.

JEL Classification:

O18 - Urban, Rural, Regional, and Transportation Analysis; Housing; Infrastructure
O44 - Environment and Growth
Q01 - Sustainable Development
Q55 - Technological Innovation
Q58 – Environment, Government Policy
R11 - Regional Economic Activity: Growth, Development, Environmental Issues, and Changes
R58 - Regional Development Planning and Policy

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Cities, green growth, urban sustainability, green cities, urban development, sustainable development, climate change, green technologies, green economy, energy efficiency, attractiveness, metro-region, Chicago, Illinois, Indiana, Wisconsin, Milwaukee, regional clusters, innovation, transport, renewable energy, multi-level governance.

FOREWORD

Green growth has been a strategic topic of the OECD's work since 2009, when OECD member countries mandated the organisation to develop a *Green Growth Strategy*. Green growth has entered a number of areas of work in the OECD, including the Directorate for Public Governance and Territorial Development. The Directorate's mission is to help governments at all levels design and implement strategic, evidence-based and innovative policies to strengthen public governance, respond effectively to diverse and disruptive economic, social and environmental challenges, and deliver on government's commitments to citizens.

This working paper is one of four metropolitan-level case studies undertaken by the OECD Green Cities Programme, which was initiated by the 2010 OECD Roundtable of Mayors and Ministers in Paris. The aim of the programme is to increase understanding of the concept of green growth in cities, to enhance the potential of urban policies to contribute to urban and national green growth, and to inform national, sub-national and municipal governments as they seek to address economic and environmental challenges by pursuing green growth.

This working paper contributes to the synthesis report of the OECD Green Cities Programme, *Green Growth in Cities*, and is relevant to the *OECD Green Growth Papers* series.

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This case study was produced as part of the *OECD Territorial Review of the Chicago Tri-State Metro-Region* by the OECD Directorate of Public Governance and Territorial Development (GOV), with the support and co-operation of the United States Department of Commerce's Economic Development Administration (EDA), and the Chicagoland Chamber of Commerce and its Foundation. The case study was drafted by Alexis Robert, Professor Stephen Hammer (Massachusetts Institute of Technology), David Gierten and Marissa Plouin, under the supervision of Javier Sánchez-Reaza (Head of the Urban Development Unit) and Lamia Kamal-Chaoui (Advisor to the Secretary-General). It draws on contributions to the *OECD Territorial Review of the Chicago Tri-State Metro-Region* by Javier Sanchez-Reaza and Jose-Luis Alvarez-Galvan (Economic Analysis), Karen Maguire and Giulia Ajmone Marsan (Innovation) Olaf Merk (Transportation and Logistics), Emily Farchy (Workforce Development) and Adam Ostry (Governance). It has benefited from the insight and written contributions of international experts: Professor Kenneth Button, George Mason University (USA) (Transportation and Logistics), Professor Paula Worthington, University of Chicago (USA (Governance), (Green Growth), Dr. Randall Eberts and Mr. George Erickcek, W. E. Upjohn Institute for Employment Research (USA) (Workforce Development) and Mr. Ola Göranssen, Deputy Director, Climate Division, Ministry of the Environment, Sweden. Valuable comments were provided by William Thompson (OECD), Stephen Friedman (Urban Land Institute), Phil O'Connor, Sophie Cohen and Bob Weissbourd (RW Ventures), Ed Sitar (ComEd) and several representatives of the Chicago Metropolitan Agency for Planning (CMAP), Metropolis Strategies and the Southeastern Wisconsin Regional Planning Commission (SEWRPC). Jeanette Duboys and Istar Vignal provided editing support. Erin Byrne and Gemma Sheen prepared the working paper for publication.

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EXECUTIVE SUMMARY

The Chicago Tri-State metro-region faces the challenge of boosting economic growth while also responding to urgent environmental priorities. Higher energy consumption, rising greenhouse gas emissions, road congestion and deteriorating water quality are the negative externalities that have come with urban growth. The City of Chicago has declared its ambition to become the most environmentally friendly city in the US, and has grown into a model for green buildings and infrastructure. The Chicago Tri-State metro-region is home to important and growing green clusters, particularly in the professional energy services. In the Chicago-area 21-county region, the Milwaukee metro-region boasts the most important water technology cluster in the US, and is attracting international attention for it. These activities point to strong potential in the Chicago Tri-State metro-region for "growing green", but they are still in the early stages. The right mix of financing mechanisms and pricing signals remains elusive and poses a challenge to efforts to stimulate economic growth while reducing environmental impact. A co-ordinated, regional approach is needed to measure progress and identify financing mechanisms necessary to the success of green activities, particularly related to energy-efficiency services, clean technologies and public transportation.

This case study assesses the policies intended to reduce environmental pressures and analyse their potential impact on growth. Green growth aims to steer economic growth in a different direction, addressing externalities and other factors poorly served by current measures of economic activity. It also recognizes that environmental policies that do not support economic growth and wealth creation are not sustainable in the long term. For the purposes of this case study, we define green growth in cities as:

> *Fostering economic growth and development through urban activities that reduce negative environmental externalities, the impact on natural resources and the pressure on ecosystem services* (OECD, 2013).

To assess the potential benefits of pursuing green growth in cities, we focus on the impact of policies to reduce environmental pressures and externalities on:

1. **Urban attractiveness,** defined here as the conditions that will attract firms and high-skilled workers to a metropolitan region.

2. **Job creation,** which includes job opportunities at low, medium and high skill levels. We do not attempt to calculate net job growth, but rather look at which activities might foster job creation in a particular green growth sector.

3. **Increasing the supply and demand of regionally produced greens goods and services,** which we define as those that reduce negative environmental externalities, the impact on natural resources and the pressure on ecosystem services.

Section 1 of the report examines the socio-economic and environmental trends in the Chicago Tri-State metro-region. While the metro-region is one of the richest, most populated metro-regions in the world, ranking third in the US and eighth among 90 OECD metro-regions in terms of GDP per capita, growth has slowed since 2000, in terms of both GDP growth and per capita GDP growth. Although the

metro-region benefits from an extensive public transit system, including the second-longest commuter rail system in the US, public transit investment has not kept up with sprawling suburbanisation patterns, requiring most residents to commute by car. This contributes to the metro-region's greenhouse gas emissions, which are exacerbated by high demand for energy to heat and cool buildings. This section concludes with an assessment of the strategies and green sectors that hold the most promise for creating jobs and contributing to a regional specialisation in specific clusters of green activities. The Chicago Tri-State metro-region is among the top five metro-regions in the US for specialisations in professional energy services, and the metro-region also exhibits specialisations in Air and Water Purification Technologies, Lighting, and Green Architecture and Construction Services. In the Chicago-area 21-county region, the Milwaukee metro-region has the strongest specialisation in the US in water efficient technologies. The growth of the green sector in the Chicago Tri-State metro-region has brought with it a significant number of green-sector jobs; the sector has grown by 20% since 2003. The metro-region could build on these strengths to improve economic and environmental outcomes in the long run.

Section 2 analyses green growth opportunities in five sectors (buildings, energy, transport, water and wastewater, and solid waste), and makes concrete policy recommendations for boosting green jobs, green firms and urban attractiveness. Energy efficiency retrofitting and green building design could be considered top priorities for job growth and distinguishing the metro-region's green architectural expertise, but financing mechanisms for lowering the barriers to energy efficiency investments would need to be improved. Wind energy holds the promise of developing a sector that is beginning to call the Chicago Tri-State metro-region home, but needs clearer pricing signals and technical assistance to become more price-competitive. The public transit system helps the Chicago Tri-State metro-region rank high on attractiveness indexes, but underfunding for maintenance and expansion risks squandering this asset, losing with it the opportunity to fight congestion and greenhouse gas emissions, and provide jobs. Congestion charges and on roadways and value-capture taxes should be considered as part of a comprehensive financing package. Water and waste service delivery is costly and does not sufficiently take into account environmental impacts, which calls for a restructuring of rates to incentivise conservation and recycling.

Section 3 presents implications and opportunities for workforce, innovation and governance policies. Skill shortages are evident across the regional economy, and particularly in the green sector. The public and private sectors will need to co-ordinate efforts to address the skill mismatch problem at all skill levels. In terms of innovation, policymakers could more purposefully foster the growth of key green clusters, in tandem with the metro-region's wealth of research institutions. A stronger venture capital base is needed to keep young talent from moving to the coasts and to attract and retain start-ups in the region. Finally, with one of the highest numbers of local governments among OECD metro-regions, Chicago could improve governance by fostering greater co-operation among the metro-region's existing institutions. Additional mechanisms for co-ordination at the regional, state and national level could also be considered to improve the metro-region's green growth outcomes. Information-sharing and common energy-efficiency programmes across the metro-region (and thus across state lines) would help provide a more stable business environment for the metro-region's green clusters. US federal policy also has an important role to play in fostering green growth in the Chicago Tri-State metro-region, by supporting green R&D, removing legislative obstacles, and providing clear signals on carbon pricing.

1. SOCIOECONOMIC AND ENVIRONMENTAL TRENDS

Key findings on socioeconomic and environmental trends

- While the metro-region is one of the richest, most populated metro-regions in the world, ranking third in the US and eighth among 90 OECD metro-regions in terms of GDP per capita, growth has slowed in recent years. Chicago's position may be slipping relative to other large US metro-regions.
- The metro-region is responsible for high GHG emissions that result in part from resource inefficient buildings, an underfunded and underperforming public transport network, and sprawling land use patterns.
- Water and waste management are also of concern: water scarcity is an increasingly pressing issue in the metro-region, while solid waste generation levels are double the national average.
- A green economy has emerged in the Tri-State metro-region, with specialisations in several green sectors: professional energy services, air and water purification technologies, lighting, and green architecture and construction services.
- Green jobs are growing in metro-region, with building-related activities boasting the largest share of jobs after transport. Green job growth over the next 5-10 years is expected to be highest in the building and transportation sectors.

The Chicago Tri-State metro-region faces the challenge of sustaining economic growth while also responding to urgent environmental priorities. Higher energy consumption, rising greenhouse gas emissions, road congestion and deteriorating water quality are the negative externalities that have come with urban growth. Many metropolitan regions across the OECD have turned their attention to the concept of green growth as a means of increasing economic competitiveness through addressing environmental challenges (Box 1.1).

Box 1.1. What do we mean by urban green growth?

Green growth aims to steer economic growth in a different direction, addressing externalities and other factors poorly served by current measures of economic activity. It also recognises that environmental policies that do not support economic growth and wealth creation are not sustainable in the long term. The OECD Green Growth Strategy (2011) defines the concept as follows: "Green growth means fostering economic growth and development while ensuring that natural assets continue to provide the resources and ecosystem services on which our well-being relies. To do this it must catalyse investment, competition and innovation which will underpin sustained growth and give rise to new economic opportunities."

The scope of this definition can be extended in three ways when applied to urban areas, by accounting for:

1. **A need for new sources of urban growth:** given the negative externalities generated by urban agglomeration and cities' urgent need to reduce their energy consumption and greenhouse gas emissions, urban areas have the opportunity to conduct environmental policies that can foster these new sources of economic growth.
2. **Policy complementarities present at the local level:** there are more opportunities on the local level to enact environmental and economic policies that are complementary, as activities related to environmental protection and economic development are more integrated at the local level than at the national level. Green growth policies benefit from these policy complementarities and can thus be more effective when applied at a local scale.
3. **The importance of social equity to urban development:** the implementation of green growth at the local level addresses social issues in a more direct way than at the national level. There are clear instances where green growth initiatives can provide social co-benefits and others where the transition might generate concerns for social equity.

Taking these into account, we urban define green growth in this report as: *fostering economic growth and development through urban activities that reduce negative environmental externalities, the impact on natural resources and the pressure on ecosystem services* (OECD, 2013).

Source: OECD (2011), *Towards Green Growth*, OECD, Paris; Hammer, S., et al. (2011), "Cities and Green Growth: A Conceptual Framework", *OECD Regional Development Working Papers*, No. 2011/08, OECD Publishing, doi: *10.1787/5kg0tflmzx34-en* and OECD (2013), *Green Growth in Cities*, OECD Green Growth Studies, OECD Publishing, doi: *10.1787/9789264195325-en.*

This case study assesses the policies intended to reduce environmental pressures and analyse their potential impact on growth in the Chicago Tri-State metro-region. The case study refers principally to three units of analysis when speaking about Chicago (Table 1.1):

- The ***Chicago Tri-State metro-region*** will be the primary unit of analysis (9.5 million inhabitants in 2010). It corresponds to the Chicago-Joliet-Naperville, IL-IN-WI 14 Counties Metropolitan Statistical Area (MSA) as defined by the U. S. Office of Management and Budget, and is also often referred to as Chicagoland.[1] This area is a good proxy to the OECD's definition of metro-regions, which makes it possible to compare the Chicago ***Tri-State*** metro-region with the other 89 metropolitan regions with 1.5 million or more inhabitants in the *OECD Metropolitan Database*.[2] This definition includes the municipalities that currently have a high degree of functional integration with the City of Chicago as measured by commuting flows. It comprises nine counties in Illinois (Cook, DeKalb, DuPage, Grundy, Kane, Kendall, Lake, McHenry and Will), four in Indiana (Jasper, Lake, Newton, Porter) and one in Wisconsin (Kenosha).

- To analyse trends particular to Chicago proper, including socio-economic data, and concentration of certain income groups, the Review will refer to data from the ***City of Chicago***, that is, the municipality (2.7 million inhabitants in 2010). The city of Chicago is located almost exclusively within Cook County, which is the second most populated county in the US, but portions extend into DuPage County in the vicinity of O'Hare Airport.

- To discuss larger questions of inter-regional coordination, the ***21-county Chicago Region*** *w*ill be utilised (11.5 million inhabitants). This region is also referred to as the Gary-Chicago-Milwaukee (GCM) corridor. It is increasingly regarded by civic, business and political leaders as comprising a common economic area. The 21-county Chicago Region encompasses the Chicago Tri-State metro-region along with the Milwaukee-Racine-West Allis, Wisconsin MSA[3] and two smaller MSAs on the edge of the Chicago metro-region: Kankakee – Bradley in Illinois and Michigan City-La Porte in Indiana (Figure 1.1).[4]

These three units will in some cases be complemented by two other units, where data limitations make this necessary:

---

1. The US Office of Management and Budget defines MSAs as "[a] Core Based Statistical Area associated with at least one urbanized area that has a population of at least 50 000. The Metropolitan Statistical Area comprises the central county or counties containing the core, plus adjacent outlying counties having a high degree of social and economic integration with the central county or counties as measured through commuting" (Office of Management and Budget, 2010).

2. The OECD methodology defining functional metropolitan regions considers population size, population density and commuting flows as an indicator of whether an urban area represents a contained labour market. The OECD has developed a methodology to gather and analyse metropolitan data based on three criteria. The first is urban density: the population should exceed a critical value set at 150 people per square kilometre. Second, the region should represent a contained labour market, with a net commuting rate not exceeding 10% of the resident population. Third, the population of the central city must be at least 1 million and that of the whole metropolitan area at least 1.5 million people (OECD, 2006).

3. This includes Milwaukee, Ozaukee, Racine, Washington, and Waukesha counties in southeastern Wisconsin.

4. Currently, Kankakee – Bradley, IL and Michigan City-La Porte, IN are part of the Chicago-Naperville-Michigan City, IL-IN-WI Combined Statistical Area (CSA) though Milwaukee is not a part.

- ***The CMAP region*** is the unit of analysis for the Chicago Metropolitan Agency for Planning (CMAP) *Go To 2040 Comprehensive Regional Plan*, published in 2010. The CMAP plan, which is the federally recognized Metropolitan Planning Organization (MPO) for the Illinois portion of the Chicago Tri-State metro-region, area covers the seven counties closest to the City of Chicago, and represents 89% of the metro-region's population.[5] This unit will be used primarily to discuss transportation and environmental data. The MPO corresponding to the Indiana portion of the Chicago Tri-State metro-region is the *Northwestern Indiana Regional Planning Commission* (NIRPC), and the MPO corresponding to the Wisconsin portion of the Chicago Tri-State metro-region is the *Southeastern Wisconsin Regional Planning Commission* (SEWRPC).

- ***TL2 Regions*** (Territorial Level 2) is an OECD unit that refers to the first level of sub-national units, which in the US corresponds to states. These units will be used especially when discussing innovation data to provide comparisons with other TL2 OECD Regions.[6] In this case, we will refer essentially to Illinois which corresponds to 91% of the metro-region's population.

Table 1.1. Levels of analysis in the Chicago region

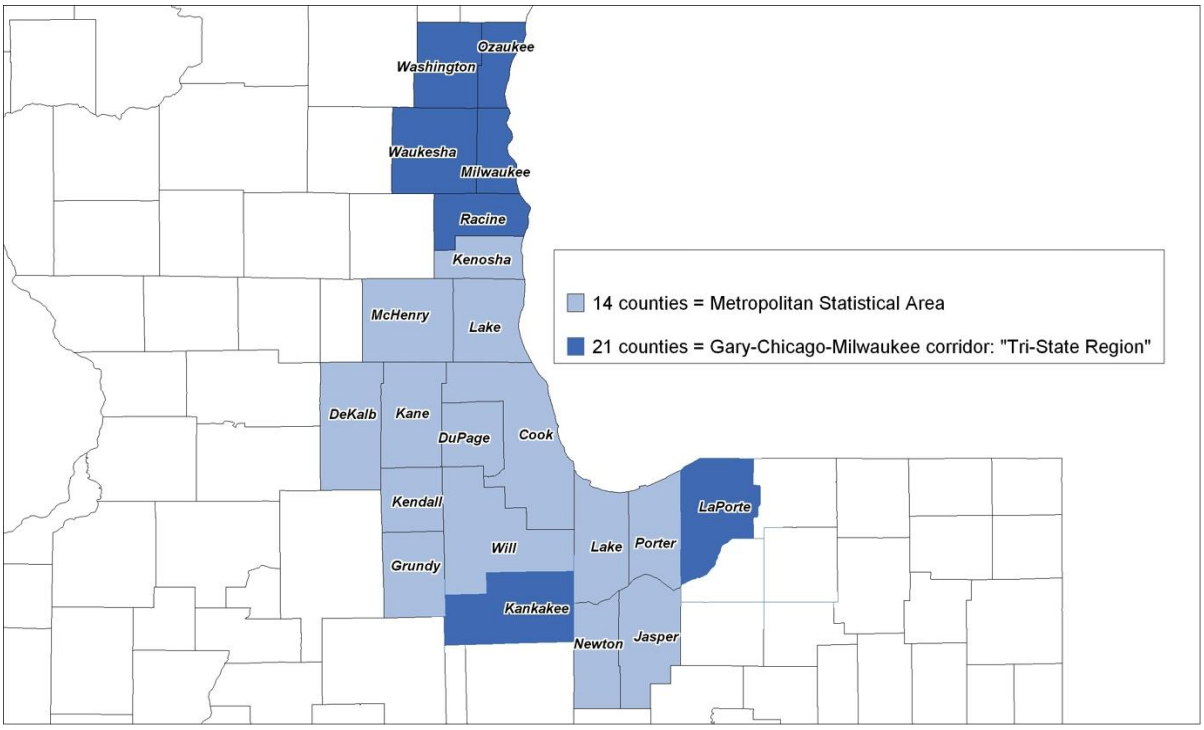
		States represented	Surface (km²)	Population (2010)	Employment (2010)	Labour Force (2010)	GDP (Current USD, millions)	Population Density (population/ km²)
Chicago Tri-State metro-region		Illinois, Indiana, Wisconsin	20 353	9 461 105	4 374 102	4 870 138	532 331	465
Including	City of Chicago (municipality)	Illinois	606	2 695 598	--	--	--	4 447
	CMAP	Illinois	--	8 431 386	--	--	--	1 773
Chicago-area 21 county region		Illinois, Indiana, Wisconsin	28 268	11 437 337	5 282 014	5 870 780	623 620	405
UNITED STATES		--	9 826 675	308 745 538	153 186 000	13 323 000	14 861 000	31

Source:
1. Surface data comes from the background report of March 9, 2011.
2. Population data comes from the 2010 US Census Data Redistricting Summary File, except for US population, which comes from *http://2010.census.gov/2010census/data.*
3. Chicago population data is from *http://2010.census.gov/news/releases/operations/cb11-cn31.html.*
4. Employment and Labour Force data come from Bureau of Labor Statistics (revised as of July 2011).
5. GDP data come from US Bureau of Labor Statistics (revised as of September 2011).
6. US data except for population comes from background report of March 9, 2011. US Population comes from *http://quickfacts.census.gov/qfd/states/00000.html.*

5. The counties in the CMAP study area are: Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will.

6. Regions in OECD Member Countries have been classified according to two territorial levels (TL), to facilitate international comparability. The higher level (Territorial level 2) consists of macro-regions, while the lower level (Territorial level 3) is composed of micro-regions in the 30 OECD member countries. These levels are officially established, relatively stable and are used in most countries as a framework for implementing regional policies. TL2 regions in the US and Canada correspond to the States/Province, whilst in France and Italy to the Regions and in Japan and Korea to the prefectures (see *www.oecd.org/dataoecd/19/29/43428422.pdf*). The OECD Regional Database provides a unique set of comparable statistics and indicators on about 2000 regions in 30 countries. It currently encompasses yearly time-series for around 40 indicators of demography, economic accounts, labour market, social and innovation themes in the OECD member countries and other economies.

Figure 1.1. Map of the Chicago Tri-State metro-region



Source: OECD elaboration with data from *Census 2000 County and County Equivalent Areas Cartographic Boundary Files*, US Census Bureau.

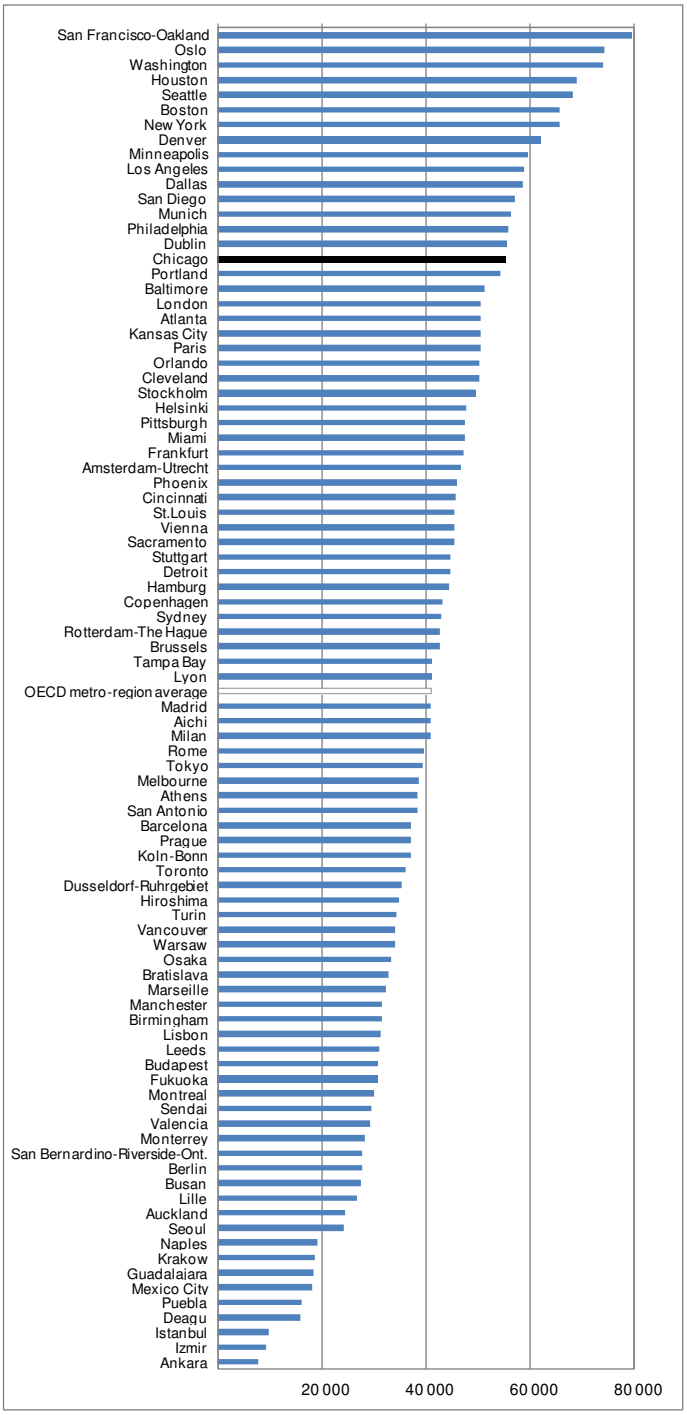
A global leader showing signs of sluggishness

A wealthy global metro-region with key assets

The Chicago Tri-State metro-region stands among the largest, richest and most productive metro-regions in the world, though not among the richest in the US. With 9.5 million inhabitants, the region is the tenth largest metropolitan area among the 90 OECD metro-regions, and the third largest urban agglomeration in the US (behind New York and Los Angeles). Although its ranking in terms of GDP per capita among OECD metro-regions is not as high as it is in terms of GDP (16th among the 90 metro-regions vs. 8th), Chicago still counts among the big players in the OECD urban world. With GDP per capita over USD 55 000 in 2008, Chicago ranked higher than traditionally rich European metro-regions such as London, Stockholm, Helsinki, Amsterdam-Utrecht, Paris and Milan (Figure 1.2). Among US metro-regions, Chicago's GDP per capita is similar to that of San Diego and Philadelphia, but below that of a number of US metro-regions such as New York, Los Angeles, San Francisco-Oakland, Boston or Houston. In the same vein, the Chicago Tri-State metro-region ranks 13th out of 90 OECD metro-regions for its level of labour productivity (expressed as GDP per worker), above all non-US OECD metro-regions except Oslo, but below many US metro-regions including Philadelphia, Denver and Dallas (Figure 1.3).

Figure 1.2. GDP per capita in OECD metro-regions, 2008

Purchasing power parity (PPP) in USD

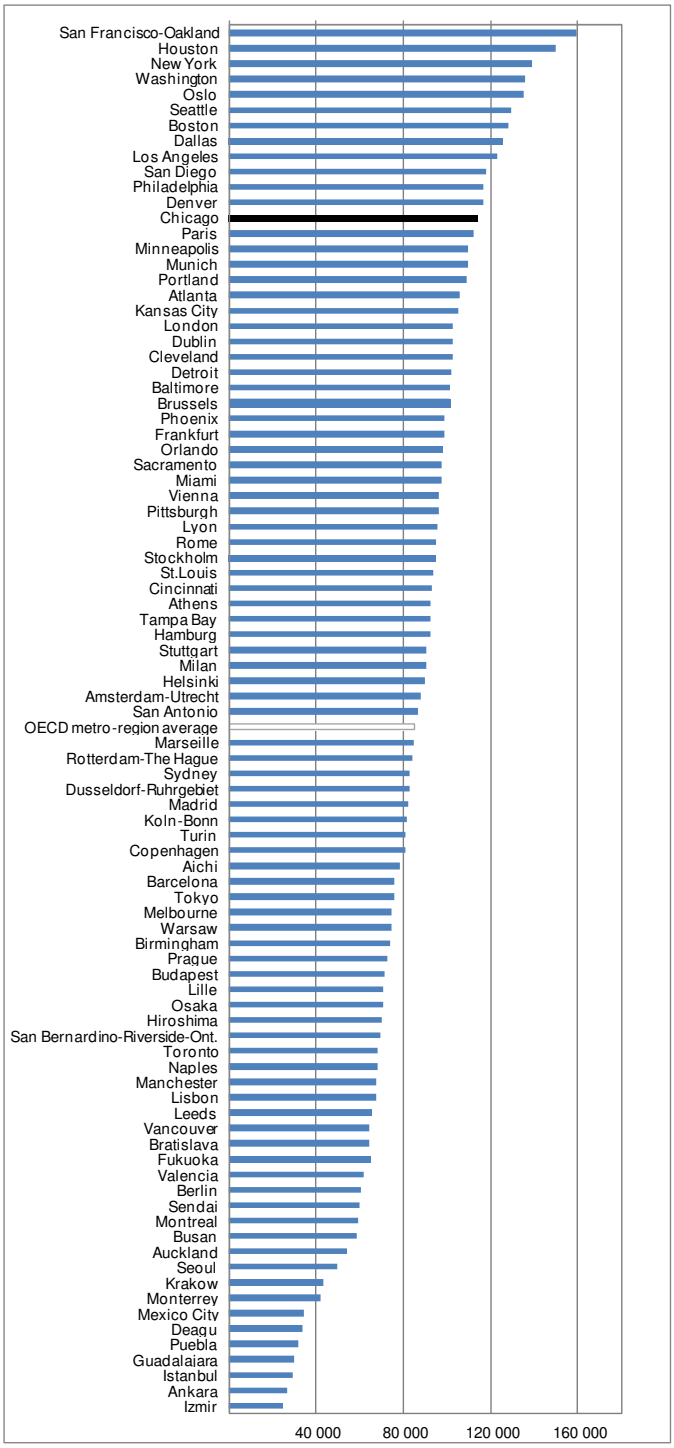


Note: Data for Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, and United Kingdom refer to 2007; data for New Zealand refer to 2003; data for Turkey refer to 2001. Chicago here refers to the Tri-State Chicago metro-region which corresponds to the Metropolitan Statistical Area (MSA).

Source: *OECD Metropolitan Regions Database*.

Figure 1.3. Labour productivity (GDP per worker) in OECD metro-regions, 2008

Purchasing power parity (PPP) in USD



Note: Data for Austria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Japan, Korea, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, and United Kingdom refer to 2007; data for Belgium and Ireland refer to 2006; data for New Zealand refer to 2003; data for Mexico and Turkey refer to 2000; data for Switzerland were not available. Chicago here refers to the Tri-State Chicago metro-region which corresponds to the Metropolitan Statistical Area (MSA).

Source: *OECD Metropolitan Regions Database*.

A diversified and globally oriented industrial mix

The metro-region's industry mix reflects not just its past as a leading manufacturing centre or its convenient geographic location as a logistics hub, but also its attractiveness for knowledge-intensive activities. Chicago's transformation into a knowledge-based economy is a common process among large metro-regions in the US. Such a process features a decline of most manufacturing and a surge in financial, professional and educational services. However, while the Chicago Tri-State metro-region is competing to consolidate its knowledge-based economy, traditional activities such as manufacturing and transportation are still strong in the economy. Although the share of manufacturing in the region's total employment has been declining since the late 1960s, the region still has a larger share than the nation's and therefore is still specialised as an industrial centre in the US.

The Chicago Tri-State metro-region has become one of the most influential financial and business centres in the world, yet faces intense competition from other large and prosperous metro-regions. Its outstanding position as a global leader in financial and business services has attracted the headquarters and facilities of a substantial number of large international firms, making the metro-region a leading employer in financial and business-related activities in the US. Chicago is the global centre for derivatives, hosting the largest derivatives exchanges, and home to 57 headquarters in the Fortune 500, including Boeing, McDonald's, Motorola Solutions, Discover Financial Services, Abbott and United Airlines. Professional and Business Services and Financial Activities combined represented 26.2% of total employment in the region in 2010 (Table 1.2). Boston is the only large US metro-region ahead of Chicago in all three sectors that feature knowledge-intensive services: financial, professional and educational.

Chicago is also well known as the freight crossroad of the nation. Approximately 50% of US rail freight passes through the metro-region's yards. The metro-region is the largest intermodal container handler in the Western Hemisphere and the fifth biggest in the world. It handles more containers than Los Angeles and Long Beach combined, and three times as much as New York and New Jersey. Not surprisingly, trade, transportation and utilities activities are the largest single employer sector in the Chicago Tri-State metro-region, accounting for 23.1% of total employment in 2010 (Table 1.2). This sector includes air and ground passenger transportation as well as goods' transportation services for which the Chicago Tri-State metro-region's employment level and share of the US total have been growing over the past ten years. The transportation and logistics sectors are in a strong position to continue to contribute to future regional growth.

Table 1.2. Employment shares and growth in the Chicago Tri-State metro-region by industry, 2001-2010

Industry	Employment share 2010 (%)	Annual average growth 2001-2010 (%)
Trade, Transportation, and Utilities	23.1	-1.1
Professional and Business Services	18.3	-0.4
Education and Health Services	17.6	2.4
Manufacturing	11.4	-4.2
Leisure and Hospitality	11.1	1.0
Financial Activities	7.9	-1.4
Other Services	6.4	-1.8
Construction	4.0	-4.2
Natural Resources and Mining	0.2	-2.8
Unclassified	0.1	-0.2

Note: Dey et al. (2006) estimate the effects of the use of employment services by manufacturers on measured employment and labour productivity in manufacturing between 1989 and 2004. They show that a growing share of manufacturing work in the United States is being performed by employment agencies. Therefore, if Chicago Tri-State metro-region manufacturing employers demonstrate the same behaviour as manufacturers generally, the employment shares for manufacturing may be understated in terms of the workers actually performing manufacturing work.

Source: Author's calculations based on data from U.S. Bureau of Labor Statistics, *Quarterly Census of Employment and Wages*, *http://data.bls.gov/location_quotient/ControllerServlet*, accessed 5 September 2011.

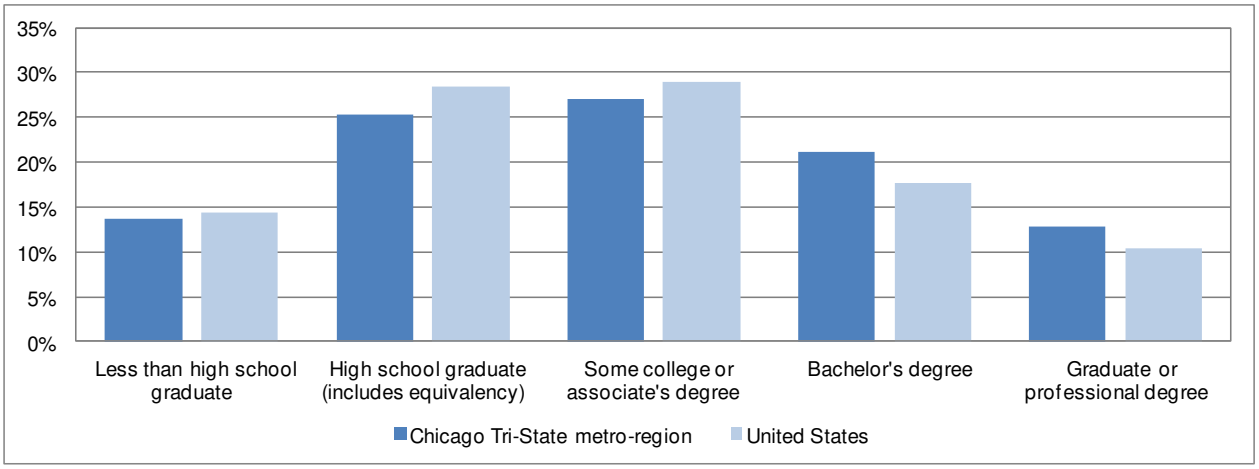
Even though Chicago's manufacturing employment has been declining at a faster rate than the US overall, the metro-region remains strongly specialised in this sector and, in line with the national trend, is moving towards high value-added manufacturing. Besides Los Angeles, the Chicago Tri-State metro-region is the only other large US metro-region to keep a larger specialisation in manufacturing than the national average. As a result, manufacturing remains a significant employer in the region, 11.4% of total employment in 2010 (Table 1.2). The resilience of manufacturing activities in Chicago's metro-region (something comparable only to what is observed in Los Angeles) reflects both the importance of high value-added manufacturing in the region, including chemicals, paper, foodstuff, and petroleum-based products, and also the historical relevance of Chicago's manufacturing for the rest of the nation.

A skilled labour force and quality higher education institutions

The Chicago Tri-State metro-region displays key strengths in its workforce and training capacity. With nearly 5 million workers, the region boasts the third largest labour market in the US and draws workers from beyond the metropolitan area's outlying counties. Over 21 000 workers living in the Milwaukee metropolitan region (part of the 21-county Tri-State region) commute to work in metropolitan Chicago, around 17% of these workers travel into the City of Chicago. An equal number commute from the Indianapolis metro-region (which lies beyond the 21-county region) into the Chicago metro-region. The region offers a large, diversified pool of highly qualified workers, with a diverse and rich set of skills and attributes. The Tri-State metro-region benefits from over 200 post-secondary education and training institutions, both publicly and privately funded, that enrol over 660 000 students each year and graduate 140 000 annually. The Chicago Tri-State metro-region's workforce is, on average, well trained (Figure 4). Educational attainment is above the national average; indeed, of the 20 most populous metro-regions in the United States, the Tri-State region ranks fourth in educational attainment ,with only Boston (37%), New York (30%) and Atlanta (31%) boasting higher percentages (US Census Bureau, 2009a). Thirty-two% of the region's workers hold a BA degree or higher, and just over one-quarter have some college (20%) or an associate degree (7%).

Figure 1.4. Educational attainment in the Chicago Tri-State metro-region

Estimated percentages for 2005-2009



Source: US Census Bureau (2010).

High-calibre educational institutions in the Chicago region are another key asset and have played a central role in attracting world-leading firms and high-value added activities into the region. Two private, not-for-profit institutions, Northwestern University and the University of Chicago, are recognised as leading research universities in the world. A world ranking places the University of Chicago 9th and Northwestern University

29th.[7] The University of Chicago and Northwestern University are ranked number two and eleven in the world in economics and business, and Northwestern is ranked twelfth in engineering, both disciplines that are important for a region's economic growth. Complementing these two universities are scores of public and private not-for-profit and for-profit colleges and universities in the 21-county region, some of which are more specialised and offer a variety of programmes and experiences to meet student needs and preferences.

An attractive business environment and quality of life

The Chicago Tri-State metro-region is attractive to domestic and international firms. The City of Chicago is regularly placed in the top five or top ten of global city rankings, primarily due to its well developed infrastructure, excellent research facilities, strong human capital and high network connectivity. The Financial Times' Foreign Direct Investment ranked the City of Chicago second among the "American Cities of the Future" in 2011-12, behind New York, based on criteria that assess the attractiveness to business investment (fDi, 2011). Chicago was chosen for its economic potential, business development and investment promotion and infrastructure. The growing presence of headquarters of multinational firms such as Boeing and Mittal attests to these strengths in the metro-region. A recent study from PricewaterhouseCoopers (2011) on "Cities of Opportunity", which assesses 26 world cities on 10 indicators of economic energy and intellectual vitality, ranks the City of Chicago in the top five for technological readiness, cost, transportation infrastructure, and health, safety and security.[8] Similarly, the Global Cities Index prepared by A.T. Kearney, Foreign Policy, and the Chicago Council on Global Affairs ranked the City of Chicago 6th of 65 cities in 2010, up slightly from the city's 8th place ranking (out of 60 cities) in 2008.

A large volume of innovative activity

The Chicago Tri-State metro-region ranks high among OECD metro-regions on many technology-based innovation indicators. In terms of patents, the Chicago Tri-State metro-region's number of patent applications is higher than the OECD metro-region average. In 2009, the Chicago Tri-State metro-region ranked 12th out of 86 OECD metropolitan regions in terms of the number of Patent Co-operation Treaty (PCT) patents, just behind San Diego, San Francisco, New York, Boston, Los Angeles, and Houston in the US (Figure 1.5).[9] The Chicago Tri-State metro-region ranks particularly high for PCT patents in nanotech, green technologies, ICT and biotech (Table 1.3). Among OECD TL2 regions, the state of Illinois is also among the top 20 in terms of patenting volume overall, with particular strengths in the biotech and information and communications technology (ICT) sectors.[10] In terms of the volume of R&D investment by all sectors, Illinois ranked 13 of 258 OECD TL2

7. Academic Ranking of World Universities is compiled and published by the Center for World-Class Universities and the Institute of Higher Education of Shanghai Jiao Tong University, China. The ranking uses six objective indicators to rank world universities, including the number of alumni and staff winning Nobel Prizes and Fields Medals, number of highly cited researchers selected by Thomson Scientific, number of articles published in journals of Nature and Science, number of articles indexed in Science Citation Index - Expanded and Social Sciences Citation Index, and per capita performance with respect to the size of an institution.

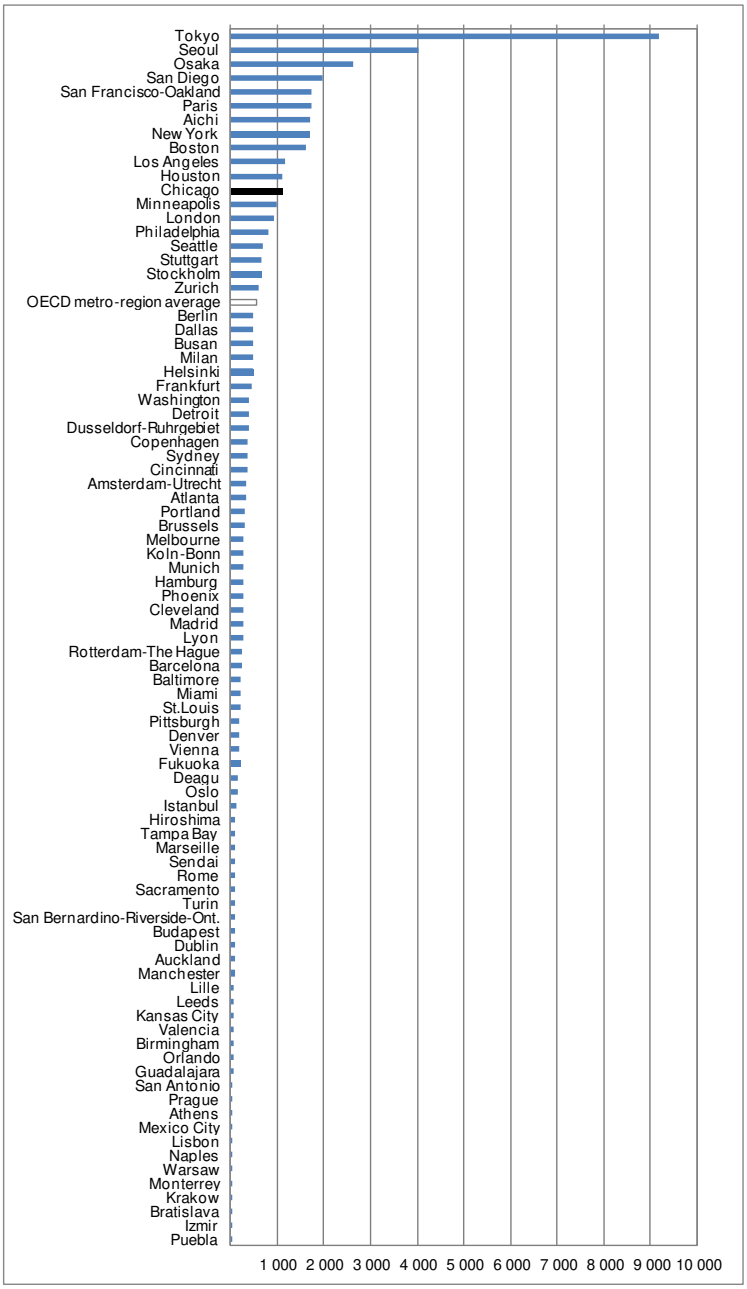
8 . These rankings were based on i) the region's public transit coverage and miles of transit track; ii) the ease of doing business, including the fluidity of the labour market, low cost of business occupancy, low cost of living, and high purchasing power; and iii) the great number of hospitals the city offers; and iv) low crime rates (PricewaterhouseCoopers, 2011)

9. The *Patent Cooperation Treaty* is an international patent law treaty that provides a unified procedure for filing patent applications. OECD regional level data on patents is derived from applications to the European Patent Office based on the Patent Co-operation Treaty applications that are recognized worldwide by countries party to the treaty.

10. Many common innovation indicators are only available at the TL2 (corresponding to the state level in the US), rather than the metropolitan region level. In this case, we use Illinois is used as a proxy for the Chicago Tri-State metro-region. With respect to patents, for which data is available at the Chicago MSA level, its share of the Illinois total has averaged 87% over the last couple of decades.

regions. For the number of high and medium-high-technology jobs, the state ranks 14 out of 268 TL2, and even stronger with respect to knowledge-intensive services, at 7 out of 272 TL2.[11]

Figure 1.5. PCT patent applications in OECD metropolitan regions, 2009



Note: PCT refers to *Patent Cooperation Treaty,* an international patent law treaty that provides a unified procedure for filing patent applications. Chicago here refers to the Tri-State Chicago metro-region which corresponds to the Metropolitan Statistical Area (MSA).

Source: *OECD Metropolitan Regions Database.*

11. The number of regions compared varies because not all regions provided data.

Table 1.3. Chicago Tri-State Metro-region's patent intensity rankings

Patent applications (fractional count, by inventor and priority year)	**Per capita**		**Per unit of GDP (measured in million of USD PPP)**	
	Among 90 OECD metropolitan regions	*Among 29 US metropolitan regions*	*Among 90 OECD metropolitan regions*	*Among 29 US metropolitan regions*
Green technologies	32	11	43	11
ICT	9	8	16	7
Nanotechnologies	47	11	30	11
Biotechnologies	78	17	34	18
Total PCT patent applications	23	11	27	12

Note: All the Canadian metro-regions (Montreal, Toronto and Vancouver) were excluded as there was no information available for these regions in the database.

Source: *OECD Metropolitan Regions Database*.

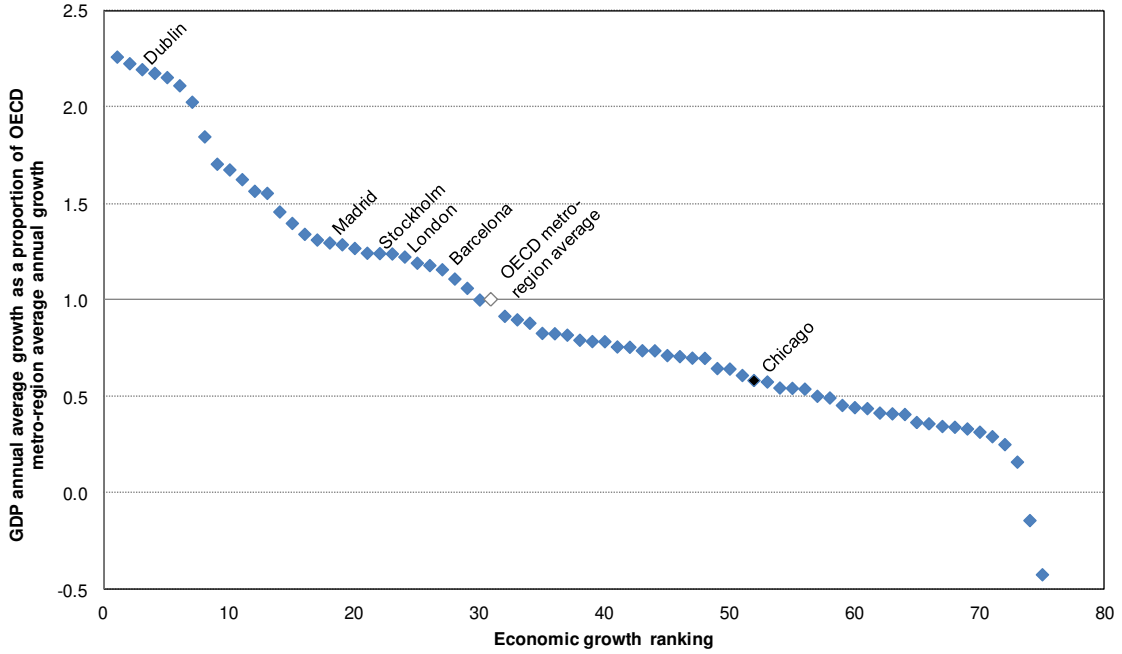
Constraints to regional growth

Lagging growth rates

While the Chicago Tri-State metro-region has one of the highest levels of output and GDP per capita among OECD metro-regions, its economic growth has lagged in recent years. From 2001-2007, before the onset of the global crisis, Chicago's average real GDP growth (1.6%) was lower than the OECD average for metro-regions (2.6%). Major European metro-regions such as London, Madrid, Dublin, Barcelona and Stockholm all recorded faster growth during this period (Figure 1.6). During the years before the crisis, Chicago's growth rate also lagged behind that of the US economy as a whole, which grew at an average rate of 2.4% over the period (Figure 1.7). Los Angeles and New York, by contrast, grew at almost the same average rate as the national economy. Even though growth in the Chicago Tri-State metro-region picked up just before the crisis, exceeding the average for all US metro regions in 2006-07, the subsequent shock of the crisis hit Chicago very hard indeed.

Figure 1.6. Economic growth in OECD metro-regions, 2001-2007

OECD metro-region average annual GDP growth of 2.6% = 1.0

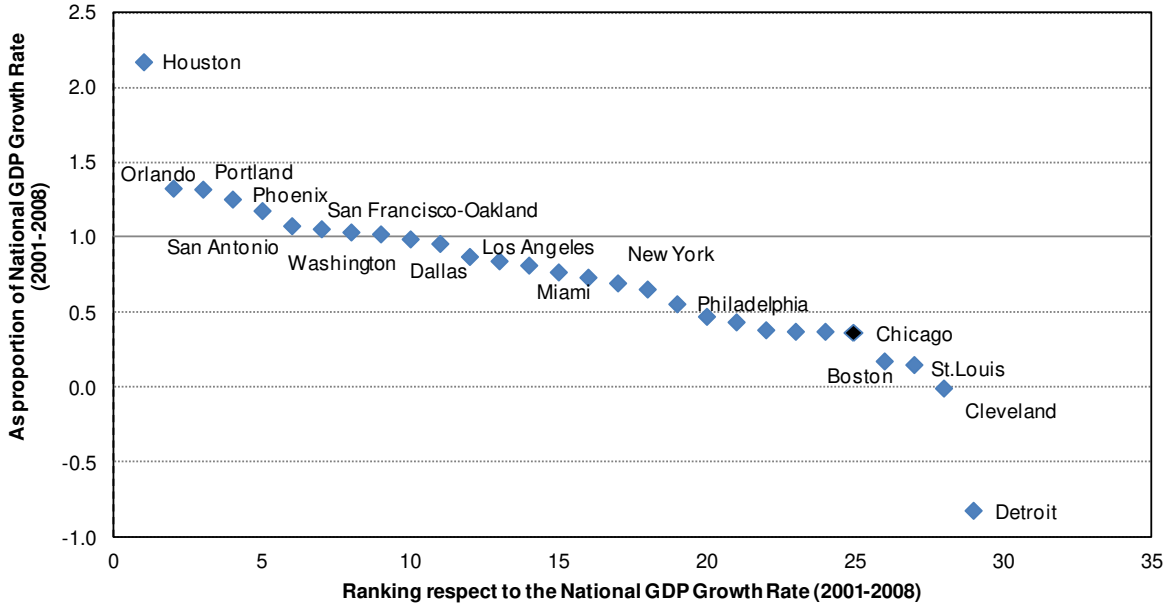


Note: Chicago refers to the Chicago Tri-State metro-region which corresponds to the Metropolitan Statistical Area (MSA).

Source: *OECD Metropolitan Regions Database*.

Figure 1.7. US OECD metro-regions annual real GDP growth rates, 2001-2008

United States average annual GDP growth of 2.4% = 1.0

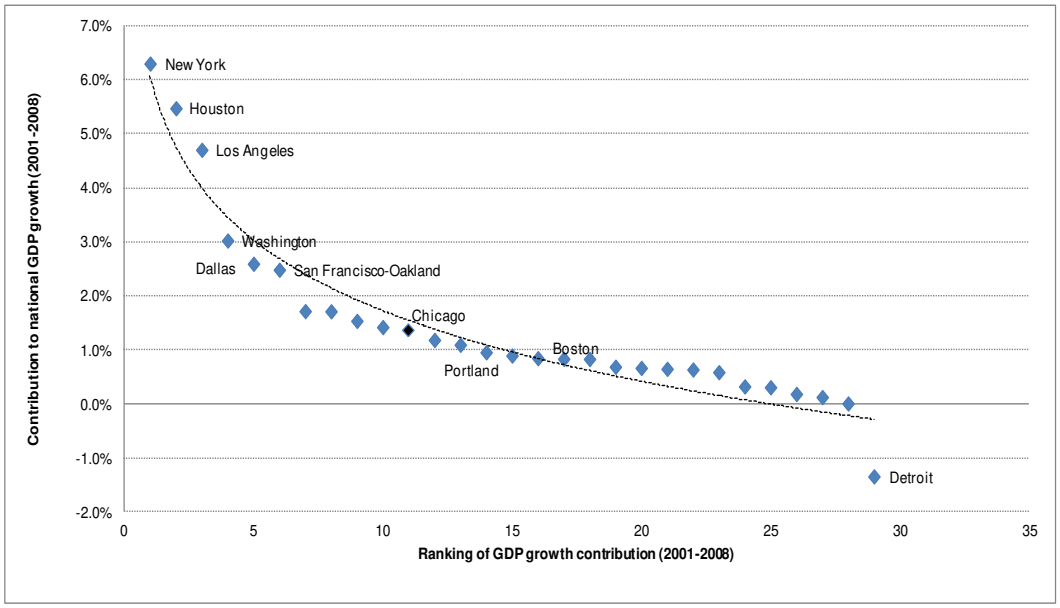


Note: Chicago refers to the Tri-State Chicago metro-region which corresponds to the Metropolitan Statistical Area (MSA).

Source: OECD own calculations based on *OECD Metropolitan Regions Database* and *OECD Regional Database*.

Further, although the Tri-State metro-region remains a major contributor to US GDP, its contribution to US aggregate growth has lagged behind that of other US metro-regions. The Chicago Tri-State metro-region's GDP represented 3.4% of the US economy in 2008 – just above its share of the national population (3.1%) – reflecting the fact that productivity and GDP per capita tend, all other things being equal, to be higher in urban areas than elsewhere.[12] Over 2001-2008, however, Chicago's contribution to aggregate US GDP *growth* amounted to less than 1.5% (Figure 1.8). For the same period, the Tri-State metro-region ranked 11th among the 29 US metro regions in terms of its contribution to aggregate US growth, although it ranks third in terms of both population and size of the economy. Indeed, the Tri-State metro-region's contribution to aggregate growth over the period was far smaller than the contribution of metro-regions like Houston and Dallas, which are a fraction of its size. This is a loss not only for the Chicago Tri-State metro-region but, given the region's size, for the US economy as a whole, since it means that this large, developed region could be making a more significant contribution to national growth.

Figure 1.8. US OECD metro-regions' contribution to national GDP growth, 2001-2008



Source: OECD own calculations based on *OECD Metropolitan Regions Database* and *OECD Regional Database.*

Unimpressive labour-market performance

Chicago's labour market has traditionally been characterised by high employment and relatively low unemployment rates, but the economic crisis that began in late 2007 disrupted this trend. The rise in unemployment recorded in the metro-region in 2009-10 was substantially larger than the average for OECD metro-regions. Yet the crisis is far from the whole story. The Chicago faces a number of longer-term structural challenges with respect to the labour market. During 2000-07, employment growth in the region amounted to just 0.4% per annum, less than half the average of all US metro-regions – which was itself below the national average (1.1%). In recent years, moreover, Chicago's labour force has actually been shrinking in absolute terms. For instance, from May 2010 to May 2011, the civilian labour force decreased from 4.87 million to 4.82 million workers, a reduction of 0.8% (Bureau of Labor Statistics, 2011).

12. The total contribution of the 29 largest US metro-regions to the US GDP was 53.4% in 2008, as compared with their combined population share of just under 45%.

Over the past decade, most major sectors of the Chicago Tri-State metro-region's economy under-performed the nation in terms of employment creation (Table 1.4). This performance contrasts sharply with the 1990s, when employment growth in the Chicago Tri-State metro-region was stronger and closer to the average growth rate of metro-regions. Between 2002 and 2007, the goods-producing sector was shedding jobs even during the years of growth that preceded the crisis, and the services sector, which is usually more resilient to both cyclical and structural changes, also under-performed the nation and even lost jobs in some key sub-sectors.

Table 1.4. Percent employment change in the Chicago Tri-State metro-region and the US, 2002-2007

Sector	Chicago (%)	National (%)
Goods-producing	-8.62	-1.44
Of which		
Manufacturing	-11.87	-9.04
Service-providing	4.59	7.03
Of which		
Private service-providing	5.49	7.97
Of which:		
Trade, Transportation and Utilities	1.02	4.44
Wholesale Trade	-0.20	6.42
Retail Trade	1.32	3.29
Information	-16.07	-10.69
Financial Activities	1.86	5.79
Professional and Business Services	9.68	12.31
Education and Health Services	11.89	13.11
Leisure and Hospitality	9.97	12.02
Other Services	4.08	2.27
Construction	-0.37	13.61
Government	-0.30	3.28

Source: U.S. Bureau of Labor Statistics, Quarterly Census of Occupations and Wages, 2010.

Evidence of a skill mismatch problem

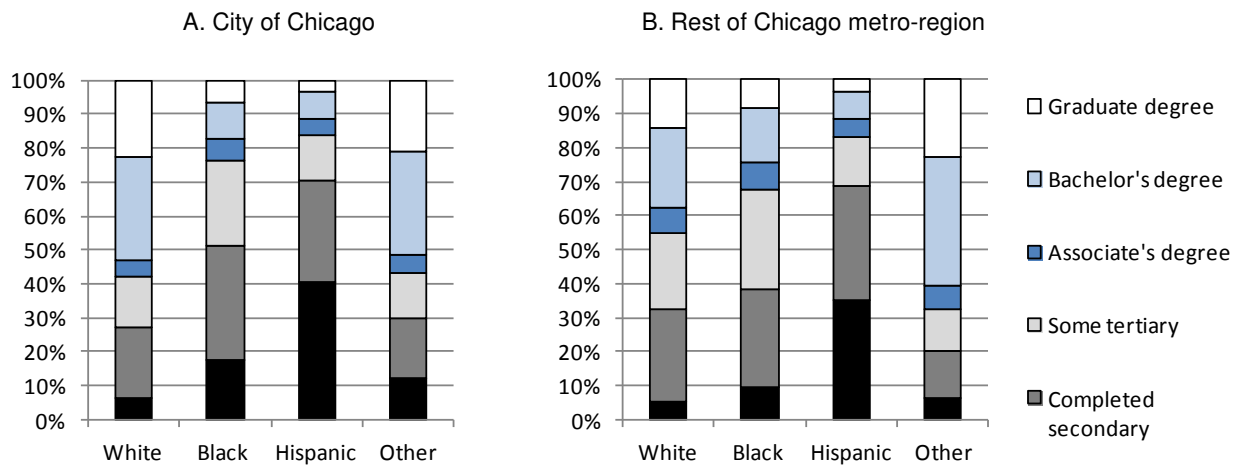
Sluggish productivity and job creation might be explained in part by a skill mismatch problem. Significant restructuring of the region's economy over the past twenty years has transformed the demand for skills, making it more difficult for low-skilled workers to find employment in more knowledge-based, innovation-driven, growing sectors. Despite the higher-than-average levels of educational attainment in the region, chronic low graduation rates from the region's public post-secondary educational institutions, particularly community colleges, slows the upgrading of the region's workforce. Further, the increase in specialisation towards higher value-added activities in the Chicago Tri-State metro-region has not gone hand in hand with an increase of the share of the labour force with high qualifications. Skills shortages have been reported in several advanced economic sectors. In manufacturing, many firms are reporting problematic skills shortages in basic math skills as the sector has grown more sophisticated.[13] Findings from Şahin *et al*. (2011) suggest, on the one hand, a possible imbalance between formal educational qualifications and desired workforce skills, and, on the other hand, a potentially significant deficit in medium-skill segments of the labour market (those requiring workers to have completed secondary and/or some higher education). In short, it appears that the region is home to large pools of under-skilled and high-skilled workers, with gaps in between. Since workers in this intermediate category are often needed to

13. Per interviews with firms, workforce development professionals and other agencies during OECD mission 21-25 March 2011.

support the work of the high-skilled, this may represent a constraint employment growth at the top of the skill distribution as well. If, as is expected, growth in high-skilled occupations significantly outpaces growth in low-skilled occupations, this mismatch of skill supply and demand is likely to worsen.

Further, the skills divide is linked to a racial – and spatial – divide. The racial/ethnic composition of the workforce varies by industry and by area within the metro-region. In the City of Chicago, whites make up the largest share of employees in management and the professions; blacks predominate in transportation and warehousing, as well as healthcare and social assistance; Hispanics predominate in manufacturing. In the rest of the metro-region, the relative concentrations of the racial/ethnic groups within different industries are about the same, but the actual concentrations are lower, reflecting the overall smaller percentage of minorities outside the city. The concentration of racial/ethnic groups within certain industries is linked to differences in educational attainment by race (Figure 1.9), and is highly spatially segregated. Whites in the City of Chicago are far more likely to have a bachelor's degree or higher than whites residing outside the city, blacks living in the suburbs register a higher level of educational attainment than those living in the city. For Hispanics, the differences between the city and the surrounding region are not as great.

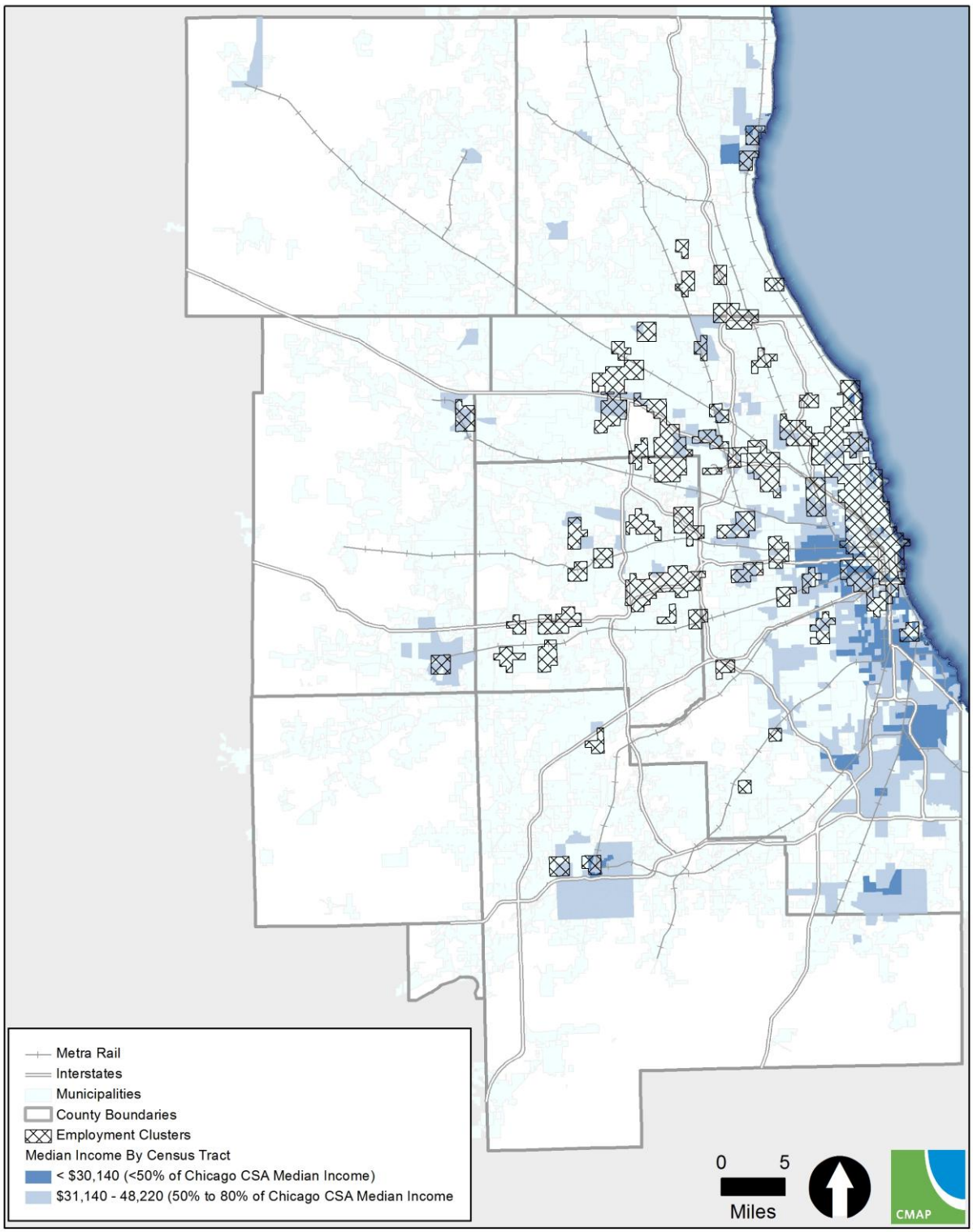
Figure 1.9. Average educational attainment by race (2007-2008)



Source: Ruggles, Steven et al. (2011), Integrated Public Use Microdata Series: Version 5.0, University of Minnesota, Minneapolis, MN, US, *http://usa.ipums.org/usa/cite.shtml.*

Social exclusion both reflects and reinforces labour-market problems. The metro-region's labour market is characterised by a high degree of geographic segmentation that reduces low-income residents' access to employment, since they are likely to find it hardest to bear the cost of commuting. Eight% of the residents in Cook County and 5% of residents in the metro-region live in high poverty neighbourhoods (in which 35% or more of residents live in poverty). Residents in high-poverty areas typically have access to fewer jobs, in part because businesses tend not to locate in them (Figure 10). Low-wage residents are less likely to have access to a car, and commuter train lines and bus routes do not serve the south side of the Tri-State metro-region as well as they serve other parts of the region. Commuting times are even longer for those who commute across the region instead of following the hub and spoke system. Investment in public transport infrastructure does not sufficiently respond to demand for access to jobs, especially in lower-income neighbourhoods.

Figure 1.10. Disadvantaged communities and major employment centres



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: CMAP (2011), Analysis of American Community Survey data, 2006-2010, and Illinois Department of Employment Security data, 2010.

Unrealised innovation potential

Innovation, which along with human capital formation is a key driver of sustained regional growth, has also been sluggish in Chicago relative to other major US metro-regions. While the Tri-State metro-region ranks high among OECD regions on many technology-based innovation indicators in terms of volume, its position has slipped and it is not among top regions when controlling for the size of its population and economy. For instance, in terms of patents per capita, the Tri-State metro-region ranked 23rd among OECD metro-regions and 11th among US metro-regions in 2007, the last year for which data are available; it ranked 27th and 12th, respectively, when adjusting for GDP (Table 1.5). These are hardly poor scores, but neither do they suggest that the Tri-State metro-region is fulfilling its innovation potential, particularly given that it ranks below so many other US metro-regions, including San Diego, San Francisco, New York, Boston, Los Angeles and Houston. The same pattern can be identified at the level of particular types of technologies: for example, the Tri-State metro-region was the 6th largest in terms of nanotech publications over 1990-2006 (Shapira & Youtie, 2008), but the patent data suggest that its performance when controlling for population and economic size has been unspectacular.

Table 1.5. Chicago Tri-State metro-region's patent intensity rankings

Patent applications (fractional count, by inventor and priority year)	Ranking per capita		Ranking per unit of GDP (measured in millions of USD PPP)	
	Among 90 OECD metropolitan regions	*Among 29 US metropolitan regions*	*Among 90 OECD metropolitan regions*	*Among 29 US metropolitan regions*
Green technologies	32	11	43	11
ICT	9	8	16	7
Nano technologies	47	11	30	11
Bio technologies	78	17	34	18
Total PCT patent applications	23	11	27	12

Note: All the Canadian metro-regions (Montreal, Toronto and Vancouver) were excluded as there was no information available for these regions in the database.

Source: *OECD Metropolitan Regions Database.*

Energy consumption, sprawling development and public transport top environmental concerns

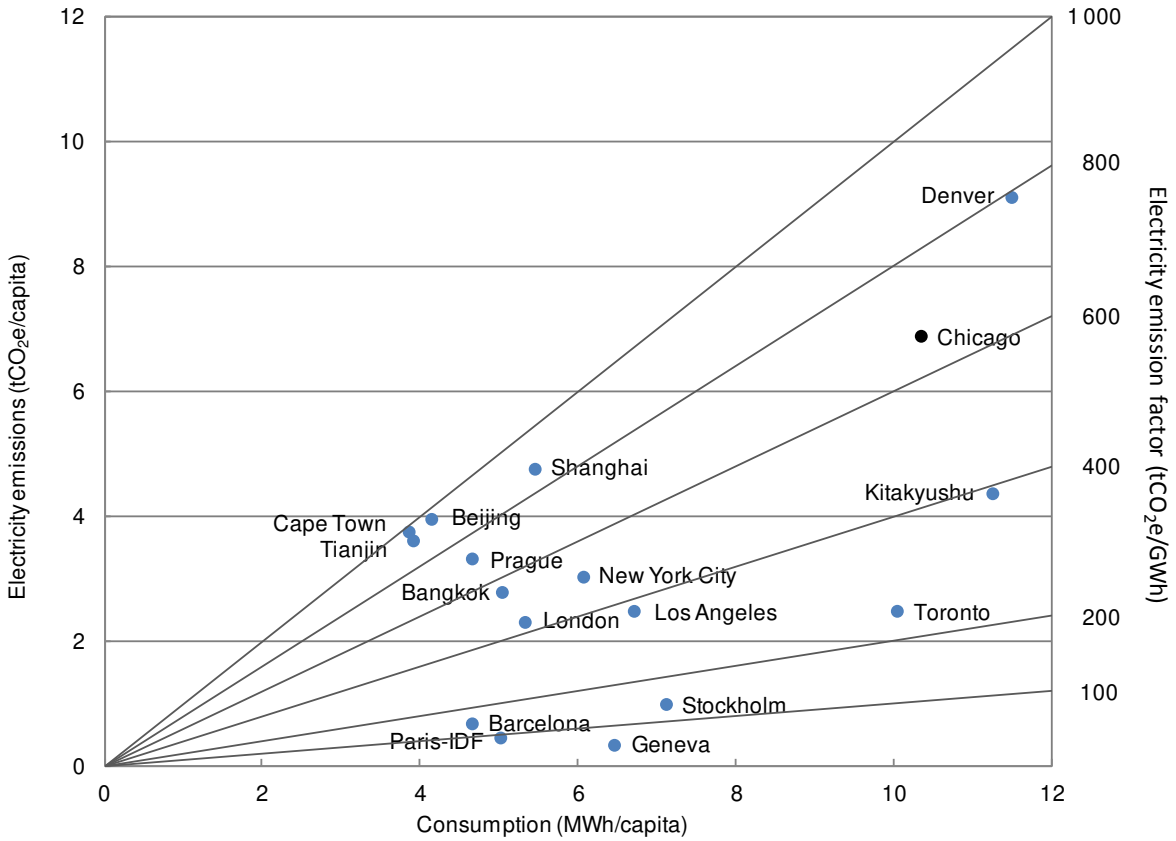
The Chicago Tri-State metro-region faces a number of environmental and spatial challenges, which present opportunities for green technologies and services that may be developed in response to these challenges. Greenhouse gas emissions are a primary concern for the metro-region, and result both from high demand for heating and cooling buildings, as well as from personal vehicle travel. Emissions from transportation have been exacerbated by a sprawling pattern of development and insufficient investment in public transport, which together have made it necessary for most residents in the metro-region to travel to work by car. While water and air quality have improved, they remain substandard in important aspects. Finally, high rates of waste generation point to opportunities for increased recycling.

High energy consumption drives elevated GHG emissions and poor air quality

Elevated greenhouse gas (GHG) emissions are among the metro-region's most prominent environmental challenges, particularly emissions related to electricity consumption. GHG emissions from electricity consumption in Chicago-CMAP are high compared to peer city-regions (Figure 1.11), due to elevated electricity consumption and the relatively high carbon intensity of the regional electricity grid (664 tons CO_2 equivalent/Gigawatt-hour (t CO_2 e/gWh)), which relies heavily on fossil fuels (CNT,

2009a).[14] In addition, the metro-region is also home to several coal-fired power plants (i.e. Crawford and Fisk) that are among the oldest operating in the US and thus exempt from federal regulations requiring the use of the best available pollution control technology (ELPC, 2010). Electricity consumption levels in Chicago-CMAP (10.35 MWh/capita) are similar to those of other interior North American city-regions, falling between Toronto (10.04 MWh/capita) and Denver (11.49 MWh/capita). When combined with the carbon intensity of the grid, the resulting GHG emissions rate of 6.9 t CO_2 e/capita is higher than that of all comparative city-regions except Denver, which also relies heavily on fossil fuels for electricity production (Figure 1.12). On a per capita level, the second most important emission source after electricity is transportation (5.1 t CO_2 e/capita, including aviation), followed by natural gas (3-5 t CO_2 e/capita) (CNT, 2009c). Energy consumption is determined in part by climate, as well as by economic structure; an economy based on manufacturing will tend to be more energy-intensive than one based on services.

Figure 1.11. GHG emissions from electricity use in selected cities

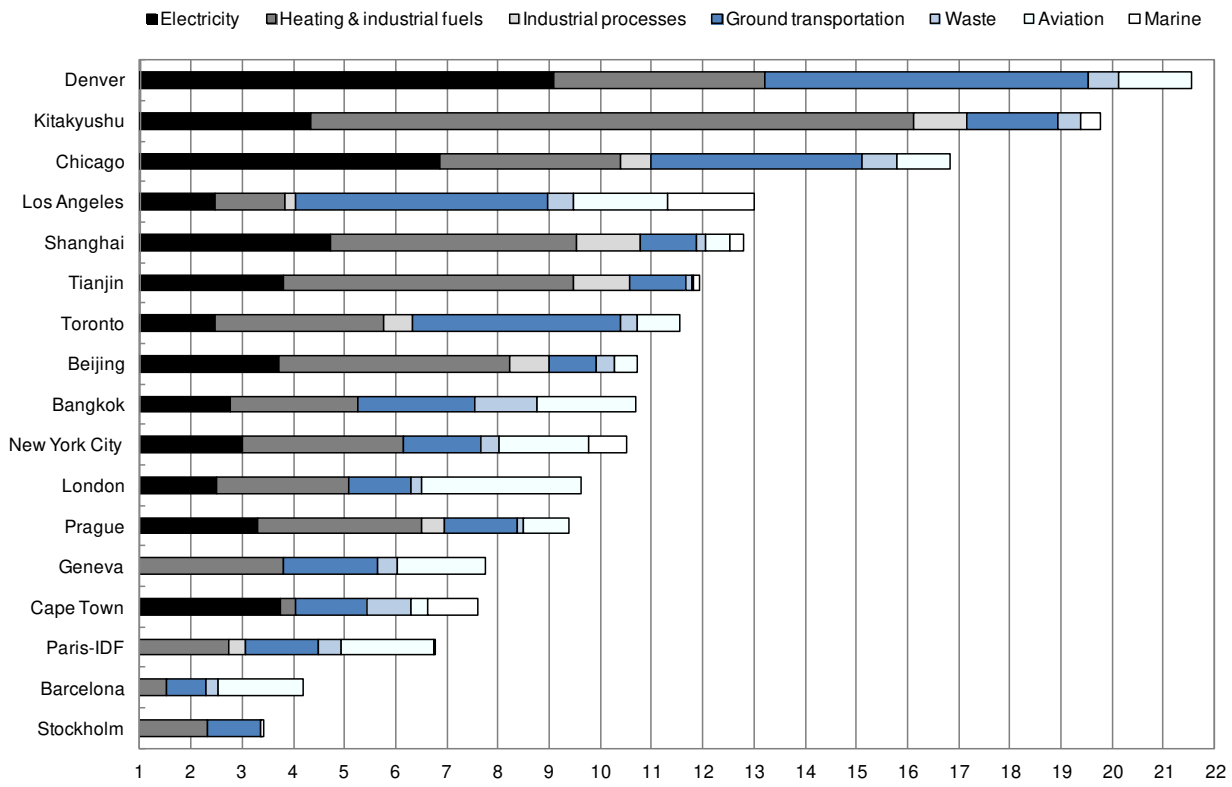


Note: the Chicago region corresponds to the CMAP region (7 counties)

Source: Kennedy, C. (2012), calculations (personal communication) adapted by Christopher Kennedy, March 2012, using methodology from Kennedy C., et al. (2009), "Greenhouse Gas Emissions from Global Cities", *Environmental Science and Technology*, Vol. 43, No. 19, American Chemical Society, Washington, DC; City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan; City of Stockholm (2012), "OECD Green Cities Stockholm Background Report", internal document, City of Stockholm, Sweden.

14 . This analysis includes all GHG emissions from electricity consumed, regardless of whether these emissions occur inside or outside of the region.

Figure 1.12. CO_2 emissions per capita in selected cities



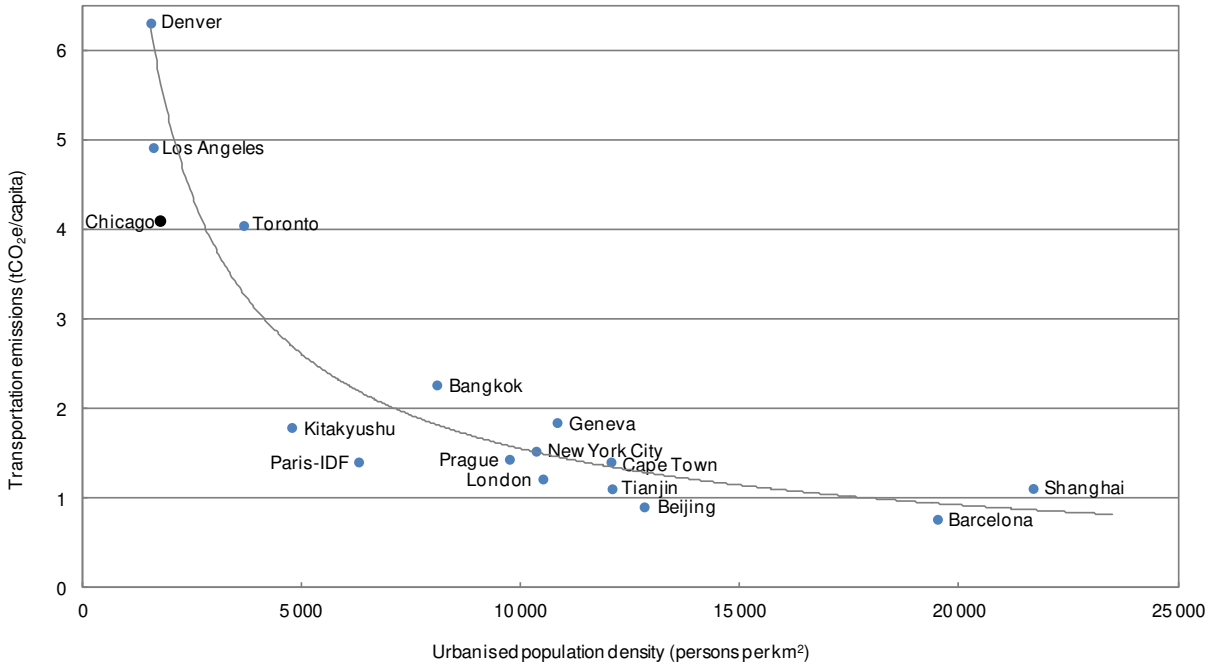
Note: Kitakyushu figures do not contain aviation emissions.

Source: Kennedy, C. (2012), calculations (personal communication) adapted by Christopher Kennedy, March 2012, using methodology from Kennedy C., et al. (2009), "Greenhouse Gas Emissions from Global Cities", *Environmental Science and Technology*, Vol. 43, No. 19, American Chemical Society, Washington, DC; City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan; City of Stockholm (2012), "OECD Green Cities Stockholm Background Report", internal document, City of Stockholm, Sweden.

Most of the Chicago-CMAP region's CO_2 emissions result from electricity and natural gas consumptions in buildings: 70% of emissions in Chicago and 61% in the metropolitan area (City of Chicago, 2010). Commercial and industrial structures account for most building electricity consumption (69%) and households for the biggest share of natural gas consumption (57%). Electricity consumption increased 25.3% between 2000 and 2005, contrary to natural gas consumption, which decreased by 6.2% from 2000-2005. This is partly due to a 53% rise of the number of hot days per year on which air conditioning is used, and a 3% decrease of heating days over the same time period (CNT, 2009b). Buildings in the region consume significantly more energy on average than in the larger Midwest, which may be linked in part to the fact that over 70% of the regional housing stock dates from before the introduction of energy codes (CMAP, 2010a).

Emissions from transportation account for the second largest share of CO_2 emissions in the Chicago-CMAP region and have been on the rise over the last decade (CNT, 2009c). Transportation emissions for the Chicago-CMAP region are over 4 t CO2 e/capita, as is typical for North American metro-regions (Figure 1.13). The Chicago-CMAP region actually compares favourably to cities with similar densities, such as Los Angeles and Denver, as it has lower per capita CO2 emissions from transport (Kennedy, 2011). Nevertheless, the region has relatively high CO2 emissions per capita from transport when compared with fourteen other world cities.

Figure 1.13. GHG emissions from ground transportation



Note: Density of urbanised area is calculated excluding green space. The Chicago region corresponds to the CMAP region (7 counties).

Source: Kennedy, C. (2012), calculations (personal communication) adapted by Christopher Kennedy, March 2012, using methodology from Kennedy C., et al. (2009), "Greenhouse Gas Emissions from Global Cities", *Environmental Science and Technology*, Vol. 43, No. 19, American Chemical Society, Washington, DC; City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan; City of Stockholm (2012), "OECD Green Cities Stockholm Background Report", internal document, City of Stockholm, Sweden.

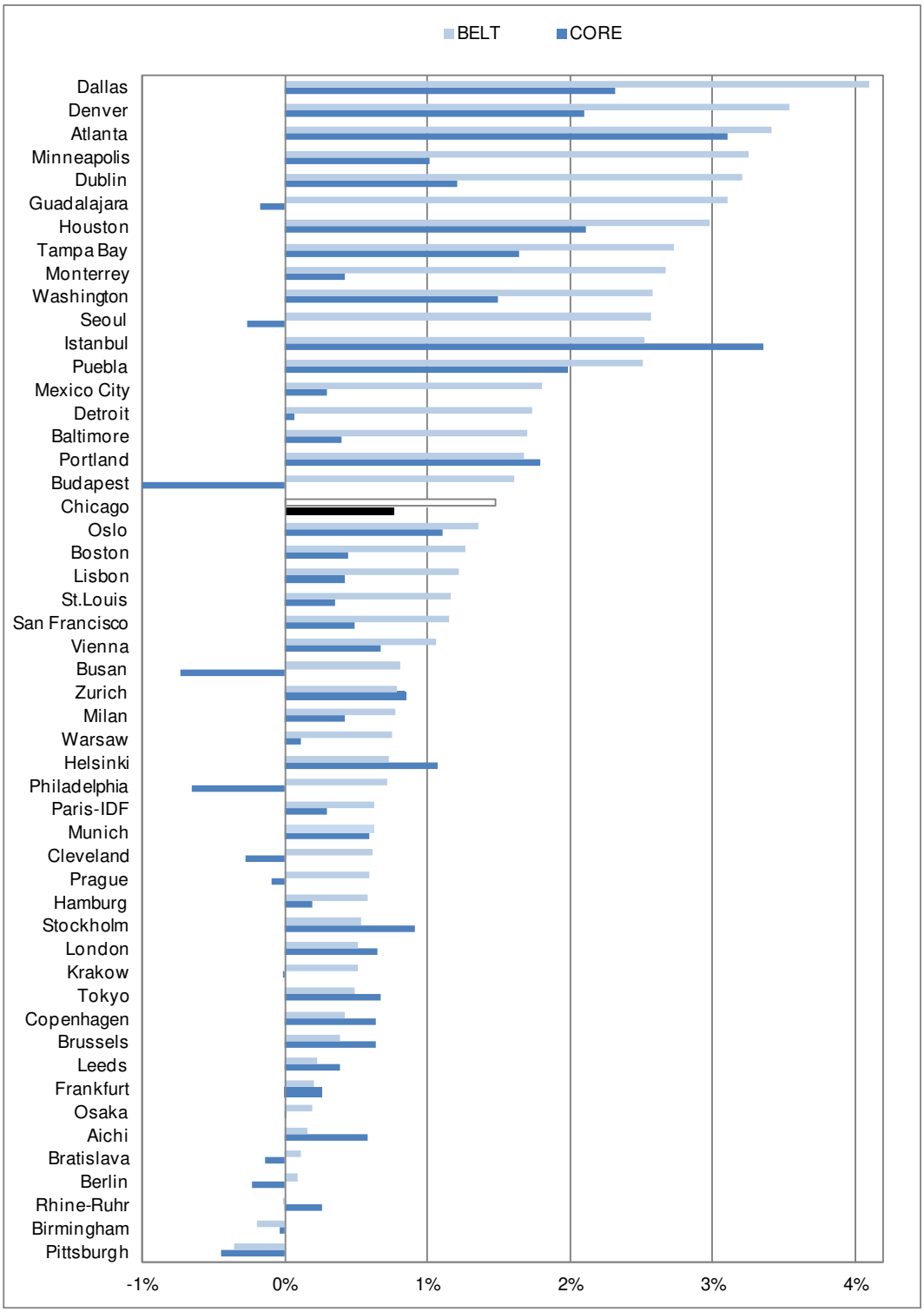
Elevated levels of some air pollutants continue to affect regional air quality, although the situation is improving. Compared to other US cities, Chicago ranks about average on the national Air Quality Index (AIQ). In the years 2005-2010, the AIQ registered 42 days per year (on average) on which Chicago exceeded the threshold value 100 on the AIQ (EPA, 2012). Northeastern Illinois does not meet the national Clean Air Act standards for two pollutants – ground level ozone (smog), and fine particulate matter ($PM_{2.5}$). The situation is improving however, as average pollutant levels have decreased fairly steadily over the past decade (CMAP, 2010a).

Transportation infrastructure not keeping up with sprawling land-use patterns

Sprawling growth patterns have resulted in a disconnect between the location of public transport, housing and employment. Suburbanisation continues to occur in the region: the Chicago Tri-State metro-region is among the top 20 OECD regions in terms of growth of the suburban belt relative to the urban core (Figure 1.14).[15] The suburbanisation of housing has been met by the suburbanisation of employment: between 1960 and 1990, over 96% of new jobs in the region were created outside downtown (Chicago Council on Global Affairs, 2007; CMAP, 2010a). Low levels of housing and employment densities in the suburbs have resulted in an auto-dependent built environment in which the provision of transit services is inefficient and cost-prohibitive.

15. Comparison based on 51 OECD metro-regions.

Figure 1.14. Annual average population growth OECD metro-regions' core and belt (1995-2007)

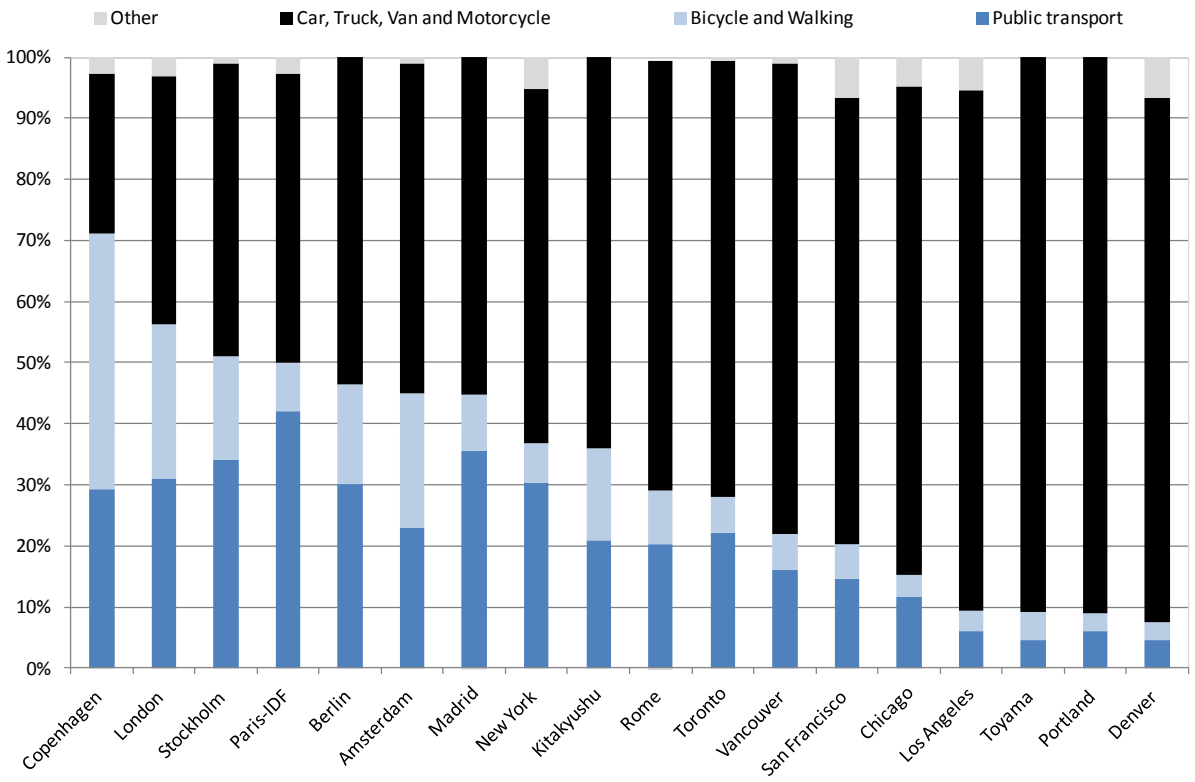


Note: Data for Belgium, Denmark, Germany, Mexico, Sweden, and United States refer to 1995-2005; data for Poland refer to 2000-2007. Chicago here refers to the Tri-State Chicago metro-region which corresponds to the Metropolitan Statistical Area (MSA).

Source: *OECD Metropolitan Regions Database* and *OECD Regional Database.*

Public transport infrastructure has been unable to keep up with these suburbanisation patterns, leading to very high congestion levels. Public transportation accounts for just 2.5% of daily commuting in the Chicago Tri-State metro-region (9% in the seven counties of the CMAP area) (CMAP, 2010a). While the modal share of cars, trucks and vans in the Chicago Tri-State metro-region is lower than that of US cities such as Portland (Oregon), Denver and Los Angeles, it is higher than shares in San Francisco and New York, as well as in Canadian cities such as Vancouver and Toronto (Figure 1.15). Even though nearly 70% of people in the seven-county CMAP region live within one quarter of a mile (400 m) of a fixed-route public transport station and 76% of jobs are located within this range, the system is far from efficient: just under a quarter of the working population living within three-quarters of a mile (1.2 km) of public transport can get to work within 90 minutes using public transport (CMAP, 2010a, 294; Brookings Institution, 2011a, 35-44). In suburban areas this figure drops to 14%. One problem is the inability of the transport network to adjust to the increase in inter-suburban commuting and "reverse commute" trips from the urban core to the suburban belt (Chicago Council on Global Affairs, 2007, 25; CMAP, 2010a, 292). Inter-suburban trips are difficult to accommodate within the existing transport system, which is still organised around a hub-and-spoke pattern.

Figure 1.15. Modal share for commuting in selected OECD Cities



Note: For London, the category "Other" comprises Motorcycle and Bicycle.

Source: Units of analysis, sources and years : Paris-IDF (Paris-IDF region, Insee, Enquête Nationale Transport, 2008) ; Melbourne (Melbourne Statistical Division, Victoria State Government, 2007) ; Vancouver (Census Metropolitan Area, Census Statistics Canada, 2006) ; Toyama (Toyama-Takaoka Wider Urban Zone, 3rd Person Trip Survey, 2001) ; Portland (Metropolitan Statistical Area, American Community Survey, 2009) ; Chicago (Chicago Tri-state metro-region (MSA), American Community Survey, 2005-2009) ; New York, Los Angeles, San Francisco (OCDE metropolitan regions definition, American Community Survey, 2005-2009) ; London (London Boroughs, Department for Transport, 2008-2009) ; Berlin, Copenhagen, Stockholm (Eurostat metropolitan regions definition (larger urban zone), Eurostat, 2003-2006) ; Toronto (Census Metropolitan Area, Statistics Canada, 2006) ; Denver (OECD metropolitan regions definition, American Community Survey, 2005-2009); Madrid, Rome, Amsterdam (Eurostat metropolitan regions definition (larger urban zone), Eurostat, 2003-2006).

In addition to its labour market implications for low-income populations, the growing inadequacy of Chicago's public transportation system is a threat to the metro-region's competitiveness. Despite benefiting from past investments that have given it the second-longest commuter rail system in the US, investment has not kept up with the region's needs. OECD analysis has shown that regions with the highest concentration of economic activity tend to have greater endowments of infrastructure and physical capital, thus a higher stock of infrastructure per capita that can positively impact productivity (OECD, 2009a). The Chicago Tri-State metro-region's competitiveness is being undermined in part by the growing inadequacy of its transportation infrastructure, which is typified by high rates of road congestion. Road congestion imposes costs and effectively fragments the labour market in the metro-region, preventing the metro-region for benefitting fully from the potential productivity gains associated with agglomeration economies.[16] According to one recent estimate, road congestion in the Chicago Tri-State metro-region implies a cost of USD 1 568 per commuter per year in terms of value of travel time delay and excess fuel consumption – the highest figure in the United States (Texas Transportation Institute, 2011).[17]

Moderate water quality and increasing water scarcity

The metro-region's water quality is relatively poor and represents an immediate concern. Over 80% of the 4 009 stream miles assessed in Illinois are considered sufficiently polluted to prohibit primary human contact (*e.g.* swimming) (IEPA, 2010). Ageing waste-water infrastructure in the Chicago Tri-State metro-region has resulted in treatment facilities ill-equipped to meet need. Many wastewater systems in the metro-region combine storm drains and sewer systems, putting local waterways at risk for combined sewer overflow (CSO) events, in which high levels of storm runoff flood the wastewater system and release raw sewage into the waterways. CSO events occurred once every 7.4 days in 2007 in the Metropolitan Water Reclamation District of Greater Chicago (approximately the City of Chicago and the remainder of Cook County) (CMAP, 2008a). To address this problem, the Metropolitan Water Reclamation District of Greater Chicago has invested in infrastructure improvements, developing a tunnel and reservoir plan (TARP) which capture and store sewer overflow until it can be pumped into existing treatment facilities prior to release into local waterways (Landis, 2008 in CMAP, 2008a).

Water supply to the region has not yet been a critical issue, but growing demand combined with dwindling groundwater availability and increasing restrictions on surface water use will make water management increasingly critical for the region. The water supply from Lake Michigan, which provides the vast-majority of the metro-region's supply, is expected to suffice only until 2030. Areas that rely on groundwater and inland surface water sources may face shortages even earlier (CMAP, 2010b). Water users in Chicago and its surrounding suburbs have successfully reduced water consumption by 18% since 1990, despite a 24% increase in population (CMAP, 2010b). Nevertheless, water demand is expected to increase by at least 36% by 2050.

Solid waste generation levels are double the national average

The metro-region's high per capita solid waste generation levels (10.2 lbs/day (4.6 kg/day) in 2009) – double the national average of 4.3 lbs/day (2.0 kg/day) – further contribute to Chicago's elevated GHG emissions (IEPA, 2011; EPA, 2010). Even though per capita waste generation declined from 12.9 lbs/day in 2006, so has the share of recycled waste, from 41% in 2006 to 36% in 2009 (CMAP, 2008b; IEPA, 2011). Moreover, waste collection costs remain much higher than average. In the City of Chicago,

16. Agglomeration economies occur when firms enjoy increasing returns to scale (IRS) in a particular place. The presence of IRS also induces other firms to locate there, as people come in search of higher wages, job opportunities and cultural values. This self-reinforcing process contributes to, *inter alia*, the formation of deeper, more efficient factor markets and more active generation and dissemination of knowledge. The result is that urban agglomerations to tend to generate higher levels of productivity and output. For an over view of the many mechanisms involved, see Duranton and Puga (2004).

17. The Chicago IL-IN region here corresponds to the US census definition of "urbanized area", which is smaller than the Chicago metro-region: *www.fhwa.dot.gov/planning/census_issues/metropolitan_planning/faqa2cdt.cfm#q24*.

waste collection is twice as costly as in Los Angeles and roughly three times as much as in Dallas, Phoenix, Miami, San Diego and Houston, in large part due to inefficiently structured waste collection routes (Belkin, 2011a). The City of Chicago has approximately 31 recycling and reclamation facilities for various C&D materials and another 40 are located within Cook County. Currently, only one waste-to-energy facility operates in the Chicago Tri-State metro-region: a 45.5 MW_p tire-derived fuel plant located twenty-five miles south of the City of Chicago. While 18 landfill gas-fired power plants are also in operation around the region operating at closed-landfills, they are small (average output is 6.4 MW_p). Finally, a concentration of "hot spots" for building material reuse in the north-western suburbs of Chicago reflect a significant potential demand for material reuse, which is still underdeveloped (Weber *et al*, 2009).

An emerging green economy

In response to the region's pressing environmental and economic challenges, the Chicago Tri-State metro-region has been successful in developing regional specialisation in green sectors and fostering job growth in these sectors. The City of Chicago has declared its ambition to become the most environmentally friendly city in the US, and has grown into a model for green buildings and infrastructure. The metro-region is home to important and growing green clusters, particularly in the professional energy services. In the Chicago-area 21-county region, the Milwaukee metro-region boasts the most important water technology cluster in the US, and is attracting international attention for it. These activities point to strong potential in the Chicago Tri-State metro-region for "growing green", but they are still in the early stages.

Regional specialisation in green sectors

The Chicago Tri-State metro-region stands out for the number of green sectors that are specialised in the region, particularly those related to buildings and, in the Chicago-area 21-county region, water technologies. Brookings Institution (2011b) has ranked the Chicago Tri-State metro-region among the top five metro-regions in the US for specialisations in professional energy services, and the metro-region also exhibits specialisations in Air and Water Purification Technologies, Lighting, and Green Architecture and Construction Services (Table 1.6). Strong opportunities for future growth identified by RW Ventures include green buildings, wind energy, smart grid, vehicle electrification, and water purification and treatment. All were seen as areas where there was solid intellectual capital development occurring around the region at local research institutions (including Argonne National Laboratory); good niche market opportunities that leverage areas where Chicago has sizable market activity (e.g. the possible electrification of freight drayage vehicles at the region's massive rail yards); and areas where there is already evidence of regional clustering (e.g. proximity to the Milwaukee Water Cluster) (RW Ventures / INC, 2012).

Green sectors related to buildings and energy efficiency particularly stand out as specialties in the Chicago Tri-State metro-region. Sectors related to building represent three of the top four specialisations in the metro-region: Professional Energy Services, Lighting, and Green Architecture and Construction Services (Table 1.6). A fourth related sector, HVAC and Building Control Systems, is not far behind. The metro-region's large architectural and engineering community contributes to the strength of this specialization. The City of Chicago's distinction as being home to the highest number of LEED-certified square-footage also contributes to local demand for green energy, architecture and construction services, and energy-efficiency technologies including lighting (USGBC, 2011). In addition, the Chicago Climate Exchange (CCX), though no longer operating, created a pool of environmental professionals skilled in carbon auditing in the Chicago Tri-State metro-region (Merrion, 2010), adding to the range of professional energy services.

In the Chicago-area 21-county region, the Milwaukee metro-region has the strongest specialisation in the US in water efficient technologies (Brookings Institution, 2011b) (Table 1.6). This is complemented by specialisation in air and water purification technologies. Both activities reflect the strength Milwaukee Water Council, which advances the interests of more than 150 companies and research institutions located in the greater Milwaukee region, that produce water-related goods, services, or research. The Milwaukee metro-region also hosts significant specialisations in Battery Technologies, Appliances and Lighting,

which present opportunities for strengthening supply chains with firms engaged in related activities in the Chicago Tri-State metro-region.

Table 1.6. Green sector specialisations and jobs in the Chicago Tri-State metro-region

Segment[1]	Special -isation	Ranking[2]	Jobs in Segment 2010	Change in jobs 2003-2010	Share of all Green Jobs[3]	Sub-category
Professional Energy Services	3.4	4	5353	4%	12%	buildings
Air and Water Purification Technologies	2.6	10	2031	97%	4%	water/air
Lighting	2.3	12	1063	5%	2%	buildings
Green Architecture and Construction Services	1.9	15	3332	3%	7%	buildings
Public Mass Transit	*1.9*	*8*	*20664*	*58%*	-	
Green Chemical Products	1.4	16	983	33%	2%	
Biofuels/Biomass	1.3	11	856	21%	2%	energy
HVAC and Building Control Systems	1.3	20	2936	4%	7%	buildings
Green Consumer Products	1.3	14	3213	-5%	7%	
Recycling and Reuse	1.2	25	5123	89%	11%	
Pollution Reduction	1.1	28	337	66%	1%	
Nuclear Energy	1.1	20	2622	9%	6%	energy
Waste Management and Treatment	*1.1*	*39*	*13567*	*24%*	-	
Renewable Energy Services	1	13	64	12%	0%	energy
Battery Technologies	1	27	531	7%	1%	energy
Wind	0.7	28	540	919%	1%	energy
Remediation	0.7	59	1267	37%	3%	
Organic Food and Farming	0.7	44	2809	37%	6%	
Professional Environmental Services	0.7	64	3007	30%	7%	
Water Efficient Products	0.6	19	261	-67%	1%	water/air
Recycled-Content Products	0.6	32	1152	7%	3%	
Green Building Materials	0.6	30	1556	29%	3%	buildings
Training	0.5	54	4	-	0%	
Sustainable Forestry Products	0.5	31	942	-26%	2%	
Energy-saving Building Materials	0.4	84	2189	40%	5%	buildings
Geothermal	0.3	25	30	43%	0%	energy
Solar Thermal	0.2	41	32	1500%	0%	energy
Smart Grid	0.2	34	119	0%	0%	energy
Energy-saving Consumer Products	0.2	27	142	-19%	0%	
Appliances	0.2	34	233	203%	1%	
Conservation	0.2	81	1714	28%	4%	
Fuel Cells	0.1	33	16	-	0%	energy
Solar Photovoltaic	0.1	58	101	742%	0%	energy
Regulation and Compliance	0.1	74	587	-14%	1%	
Waste-to-Energy	0	30	5	-	0%	energy
Hydropower	0	58	7	-22%	0%	energy
Total (excluding waste and transit)			45157	20%		
Building activities combined			*16429*	*10%*	*36%*	
Energy activities combined			*4923*	*26%*	*11%*	
Water/air activities combined			*2292*	*25%*	*5%*	

1. These segments do not include suppliers to green companies, thus potentially understating the size of green clusters in the metro-region.
2. Specialisation ranking among US metro-regions: the numerator is the ratio of jobs in the segment and metro-region in 2010 to total metro-region employment in 2010. The denominator is the ratio of total US jobs in the segment in 2010 to total US employment in 2010.
3. Total does not include public transit or waste management.

Source: OECD adaptation of Brookings Institution (2011) "Sizing the Clean Economy, a National and Regional Green Jobs Assessment", Brookings Institution Metropolitan Policy Program, Washington, DC, US, available at: *www.brookings.edu/~/media/Files/Programs/Metro/clean_economy/0713_clean_economy.pdf*.

Table 1.7. Green sector specialisations and jobs in the Milwaukee metro-region

Segment[1]	Special-isation	Ranking[2]	Jobs in Segment 2010	Change in jobs 2003-2010	Share of all Green Jobs[3]	Sub-category
Water Efficient Products	14.8	1	1167	9%	13%	water/air
Battery Technologies	6.2	8	603	1%	7%	energy
Lighting	3.4	9	290	0%	3%	buildings
Appliances	2.4	11	540	-58%	6%	
Air and Water Purification	1.8	16	266	16%	3%	water/air
Pollution Reduction	1.7	15	104	3%	1%	
Green Chemical Products	1.5	14	206	-3%	2%	
Green Architecture and Construction	1.3	32	435	14%	5%	buildings
Recycling and Reuse	1.2	26	968	26%	11%	
HVAC and Building Control Systems	1.2	22	520	-64%	6%	buildings
Sustainable Forestry Products	1.2	13	435	6%	5%	
Training	1.2	22	2	-	0%	
Renewable Energy Services	1.1	12	13	-	0%	energy
Public Mass Transit	*1*	*36*	*2107*	*1%*	-	
Organic Food and Farming	1	30	781	46%	9%	
Recycled-Content Products	1	23	349	1%	4%	
Waste Management and Treatment	*0.8*	*78*	*1792*	*50%*	-	
Green Consumer Products	0.8	26	370	60%	4%	
Remediation	0.8	54	270	9%	3%	
Energy-saving Building Materials	0.5	76	491	19%	5%	buildings
Conservation	0.4	49	821	14%	9%	
Regulation and Compliance	0.4	53	310	3%	3%	
Wind	0.4	36	62	-59%	1%	energy
Professional Energy Services	0.2	72	48	92%	1%	buildings
Professional Environmental Services	0.2	72	48	-90%	1%	
Solar Photovoltaic	0.1	63	12	71%	0%	energy
Energy-saving Consumer Products	0.1	41	10	-	0%	
Biofuels/Biomass	0.1	58	8	-	0%	energy
Nuclear Energy	0	40	0	-	0%	energy
Green Building Materials	0	82	0	-	0%	buildings
Geothermal	0	30	0	-	0%	energy
Solar Thermal	0	46	0	-	0%	energy
Smart Grid	0	44	0	-	0%	energy
Fuel Cells	0	34	0	-	0%	energy
Waste-to-Energy	0	31	0	-	0%	energy
Hydropower	0	64	0	-	0%	energy
Total (excluding waste and transit)			9129	-11%		
Building activities combined			*1784*	*-30%*	*20%*	
Energy activities combined			*698*	*-8%*	*8%*	
Water/air activities combined			*1433*	*10%*	*16%*	

1. These segments do not include suppliers to green companies, thus potentially understating the size of green clusters in the metro-region.
2. Specialisation ranking among US metro-regions: the numerator is the ratio of jobs in the segment and metro-region in 2010 to total metro-region employment in 2010. The denominator is the ratio of total US jobs in the segment in 2010 to total US employment in 2010.
3. Total does not include public transit or waste management.

Source: OECD adaptation of Brookings Institution (2011), "Sizing the Clean Economy, a National and Regional Green Jobs Assessment", Brookings Institution Metropolitan Policy Program, Washington, DC, US, available at: *www.brookings.edu/~/media/Files/Programs/Metro/clean_economy/0713_clean_economy.pdf*.

Job growth across a range of green sectors

The growth of the green sector in the Chicago Tri-State metro-region has brought with it a significant number of green-sector jobs.[18] The Chicago Tri-State metro-region is among the top five metro-regions in the US for a range of green sectors jobs, demonstrating the diversity of the metro-region's green economy. There were roughly 45 000 clean economy jobs in the Chicago Tri-State metro-region in 2010 (excluding public transit and waste management jobs, which would add roughly 34 000 jobs) (Table 1.6). While it is important to recognise that Chicago's green sector represents only a small share (1%) of the 4.4 million jobs in the total regional economy in 2009 (OECD, 2009b), the green sector has grown by 20% over 2003-2010, from nearly 38 000 jobs in 2003.[19] The metro-region is home to more jobs in air and water purification technologies than any other metro area in the US, and is the second-largest employer in the fields of green chemical products, green architecture and construction, and public mass transit. The Chicago metro-region is also home to a comparatively large number of jobs in the sectors of lighting, professional energy services, green consumer products, recycling and waste management (Brookings Institution, 2011c) (Table 1.8).

Building-related activities account for 36% of all green jobs in the Chicago Tri-State metro-region (excluding public transit and waste management jobs) and comprise the largest share (Table 1.8). It is notable that employment in the most-specialised building-related activities (Professional Energy Services, Lighting, Green Architecture and Construction Services, and HVAC and Building Control Systems) grew more slowly over the past seven years than in other building-related activities that are less specialised, such as Energy-saving Building Materials (35%) and Green Building Materials (30%). Both of those subsectors may have seen their market expand with the increasing number of buildings in the region pursuing LEED certification. The metro-region's large architectural and engineering community overall accounted for more than 39 000 jobs in 2009, including more than 4 000 LEED-certified experts in the City of Chicago alone. There are currently 1 600 members of the Chicago chapter of the US Green Building Council (USGBC, 2009). Energy-related activities account for the second-largest share of the green sector (11%), and include nuclear energy, biofuels/biomass, wind, battery technologies, smart grid, solar photovoltaic, renewable energy services, solar thermal, geothermal and fuel cells. If public transportation were included in this count, at nearly 20 700 jobs in 2010, it would represent the largest share of green jobs in the metro-region (Brookings Institution, 2011c).

Although growth in building-related sectors has been slower than in those related to energy and water/air, according to recent studies conducted in the Chicago-area labour market, building related-sectors, and energy retrofitting in particular, are projected to add the highest number of green jobs over 2009-20, followed by the energy sector (Table 1.8).

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18. For the discussion of green firms and green jobs, we have used the definition in Brookings (2011a) Methodology: "The clean economy is economic activity—measured in terms of establishments and the jobs associated with them—that produces goods and services with an environmental benefit or adds value to such products using skills or technologies that are uniquely applied to those products."

19. To allow for comparison with future government studies, Brookings (2011a) relied on a job-category system recently devised by the US Bureau of Labor Statistics. Because other local green economy studies in the Chicago Tri-State metro-region employ broader definitions of energy and waste-related jobs, this report presents an alternative categorisation method. Under this more expansive category definition of energy jobs, for example, job growth occurred more slowly in building-related activities than in activities related to energy or water and air.

Table 1.8. Green job forecasts

Sector	Estimated new jobs	Specific activity	Area covered	Time Period	Source
Buildings	3 770	Retrofitting	City of Chicago	2009-2020	Schrock (2009)
Buildings	400	Green roofs	City of Chicago	2009-2020	Schrock and Sundquist (2009)
Energy distribution and supply	2 000	Smart grid	City of Chicago	2011-2020	Val Jensen, Com Ed, July 2011
Energy distribution and supply	Hundreds	CCAP renewable energy goals	City of Chicago	2009-2020	Schrock and Sundquist (2009)
Transport	Thousands	Construction jobs for new train line expansion	RTA service area	2009-2020	Schrock and Sundquist (2009)
Water / wastewater	2 000	Water/wastewater system upgrades	City of Chicago	2009-2020	Schrock and Sundquist (2009)
Solid waste, reuse and recycling	920	Per each 10% increase in recycling	City of Chicago	Unknown timeframe	Schrock and Sundquist (2009) citing Chicago Department of the Environment
Open space (green infrastructure)	2 800	Green infrastructure	Cook County	2004-14	Schrock and Sundquist (2009) citing Illinois Department of Employment Security

Source: Schrock, G. (2009), "Career Ladders and Training Gaps in CCAP Workforce Impact Areas: Energy Efficiency, Landscape/Horticulture, and Recycling/Reuse", *Report to the Chicago Climate Action Plan Workforce Advisory Committee*, University of Illinois-Chicago, Center for Urban Economic Development, *www.chicagoclimateaction.org/filebin/pdf/CUED_WorkforceAnalysis_Final.pdf*; Schrock, G. and E. Sundquist (2009), *Potential Workforce Impacts of the Chicago Climate Action Plan: Quantitative and Qualitative Assessments*, Report to the Chicago Climate Action Plan Workforce Advisory Committee, revised and expanded from original draft (September 2008), University of Illinois at Chicago Center for Urban Economic Development, Chicago; Val Jensen, Com Ed, July 2011; Chicago Department of the Environment, Zero Waste Strategy Report, Section 8 "Business Opportunities and Job Creation; Illinois Department of Employment Security, Occupational Employment Projections.

An opportunity to increase international exports and regional attractiveness

The green sector also provides the Chicago Tri-State metro-region with an opportunity to increase its international exports, as it has become the largest green economy exporter in the US. Exports of clean technologies, goods and services are estimated at USB 2 billion annually, ahead of the Los Angeles, New York, Albany and San Francisco metro-regions, which each export over USD 1 billion annually. Seven sectors each export over an estimated USD 100 million annually, led by professional energy services. Most of the exports from this sector come from a single diversified company whose activities include energy efficient engineering related research related to petro-chemicals. The other large exporters are HVAC and building control systems, followed by bio-fuels, green consumer products, air and water purification technologies, green chemicals and organic food (Brookings Institution, 2011b).

Growth in the green sector is also an important factor in the Chicago Tri-State metro-region's attractiveness, particularly for sectors related to buildings and transportation. Prominent city indexes increasingly include sustainability as a factor of attractiveness or specifically rank cities by their "green-ness", including the Siemens Green City Index, Forbes World's Smartest Cities. The Chicago Tri-State metro-region has the potential to build on its reputation as a leader in innovative architecture and green building design. To sustain this reputation, there is a need to increase the scale of efforts like the City of Chicago's green roofs and alleyway re-paving initiatives. Moreover, improvements to the public transportation system will be necessary to secure the region's long-term attractiveness. Despite the City of Chicago's ranking among the top five of 26 world cities for transportation infrastructure (PricewaterhouseCoopers, 2011), the metro-region is at risk of squandering this competitive advantage without sufficient investment for system expansion and upgrades.

2. SECTORAL POLICIES TO PROMOTE GREEN GROWTH

Key findings on policies to promote green growth

- Activities to reduce the environmental impact of the built environment should be a priority, given their potential for creating jobs, strengthening sectors in which the Tri-State metro-region is strong, and increasing the region's attractiveness.
- Sustainable financing mechanisms are needed for energy-efficiency retrofits and energy audits to fulfil the sector's potential to significantly reduce energy consumption, create jobs, and build a regional specialty in green architecture and construction.
- The emerging wind energy sector, which may still need public intervention to remain competitively priced for the consumer, could benefit from technical assistance to strengthen the regional wind energy supply chain
- The public transit system is facing a severe funding shortage; congestion charges on roadways and value-capture taxes should be considered as part of a comprehensive financing package.
- Changing water and waste fees across the metro-region to better reflect consumption and cost of service delivery would encourage water conservation and recycling, and could provide an additional source of revenue.

The Chicago Tri-State metro-region is home to a growing set of green tech clusters and to policies intended to both reduce the metro-region's environmental impact and contribute to economic growth. Progress has been made on energy-efficiency retrofits, green building design, and the metro-region's ability to attract wind energy headquarter functions. A number of opportunities remain however to further stimulate growth through activities that reduce environmental impact, particularly related to transportation, waste and water. This section first describes the green growth lens through which the Chicago Tri-State metro-region's policies will be evaluated and discusses local vision and strategy documents that provide the framework for green growth in the metro-region. It then considers opportunities for further stimulating green growth in the sectors of buildings, energy, transportation, water and waste. A recurring finding is that the right mix of financing mechanisms and pricing signals remains elusive, and poses a challenge to efforts to stimulate economic growth while reducing environmental impact.

Assessing green growth

The concept of green growth has given rise to much debate. Green growth aims to steer economic growth in a different direction, addressing externalities and other factors poorly served by current measures of economic activity. It also recognizes that environmental policies that do not support economic growth and wealth creation are not sustainable in the long term. For the purposes of this case study, we define green growth in cities as:

Fostering economic growth and development through urban activities that reduce negative environmental externalities, the impact on natural resources and the pressure on ecosystem services (OECD, 2013).

It is valuable to examine opportunities for green growth in cities because it is at the urban level that complementarities between environmental and economic policies can be greatest. The existence of a policy complementarity signals a benefit in the form of the return generated when one policy is enacted along with another (De Macedo & Oliveira Martins, 2006). Cities' activities to deliver the public services and conditions that will foster growth can enhance, and be enhanced by, cities' activities to improve environmental quality and reduce pressures on the environment. In this way, cities may more effectively deliver on national-level environmental and economic targets – whether or not they are called "green growth" targets – than national-level policies.

To assess the potential benefits of pursuing green growth in cities, we focus on the impact of policies to reduce environmental pressures and externalities on:

1. **Urban attractiveness,** defined here as the conditions that will attract firms and high-skilled workers to a metropolitan region.

2. **Job creation,** which includes job opportunities at low, medium and high skill levels. We do not attempt to calculate net job growth, but rather look at which activities might foster job creation in a particular green growth sector..

3. **Increasing the supply and demand of regionally produced greens goods and services,** which we define as those that reduce negative environmental externalities, the impact on natural resources and the pressure on ecosystem services.

Identifying opportunities for green growth

Absent an explicit regional green growth strategy, two key planning documents serve as the starting point for identifying green growth opportunities and targets in the metro-region. The first is the Chicago Metropolitan Planning Agency's *Go To 2040 Comprehensive Regional Plan*, which covers the seven Illinois counties surrounding the City of Chicago (CMAP, 2010a). The plan provides indicators, recommendations, implementation actions and financing strategies for four core themes: i) liveable communities; human capital; efficient governance; and regional mobility. More limited in scope, but no less important, is the City of Chicago's Climate Action Plan (CCAP) (City of Chicago, 2008). With a time horizon of 2020, the CCAP seeks to reduce energy usage around the city, promote the use of clean and renewable energy sources, improve the public transit system and change transport patterns around the city, reduce local waste and pollution levels, and make the city more climate change resilient. The City of Chicago mayor's transition plan committed to refocus CCAP around jobs goals (Chicago 2011, 2011). Similarly, regional plans by the Southeastern Wisconsin Regional Planning Commission (SEWRPC) and Northwestern Indiana Regional Planning Commission (NIRPC) regional plans serve as starting points for identifying green growth opportunities and targets for their respective regions. Southeastern Wisconsin regional plans for the year 2035 address land use, transportation, water supply and quality, flooding mitigation, open space, and natural resource preservation. The NIPRC Comprehensive Regional Plan 2040 addresses growth patterns, transportation and environmental and green infrastructure. Green growth efforts in the Chicago Tri-State metro-region are also being driven by several other analyses prepared by different consulting firms or non-governmental organisations analysing the state of the green job marketplace, and analysing opportunities and impediments to expansion.

Assessing sector-specific policies to boost green jobs, green firms and urban attractiveness

Boosting jobs and a regional specialisation through energy-efficiency building retrofits and design

The built environment in the Chicago Tri-State metro-region presents both an important environmental challenge and green growth opportunity and should be a top priority for a green growth strategy. In terms of the challenge, building energy consumption accounts for well over half (63%) of the metro region's greenhouse gas emissions and imposes comparatively high costs on energy consumers (CNT, 2009b). Buildings in the Chicago Tri-State metro-region tend to use far more energy than even comparable buildings in the Midwest, in part due to their age and lack of insulation. While energy efficiency is unlikely to contribute much to emissions reduction if it is not accompanied by a high carbon price, it is still a necessary element of any policy to address climate change (OECD, 2013).[20] In terms of the opportunity, retrofitting of existing buildings to increase their energy-efficiency involves a relatively high demand for low and semi-skilled labour and strengthens the local cluster in professional energy services. Design and construction of new green buildings calls for medium-to-high skilled labour and can enhance the metro-region's green architecture and construction services sector. Green roofs and permeable services can expand landscaping and road working job opportunities and increase the city's attractiveness in part by reducing vulnerabilities to potential climate change impacts. These activities would go far in reinforcing the Chicago Tri-State metro-region's reputation as a global leader in green buildings.

Close the funding gap for energy efficiency retrofitting

Energy efficiency retrofits are needed to reduce existing buildings' energy consumption, but they face financing and information obstacles. Energy efficiency technologies need to be retrofitted on to existing buildings in order to reduce their energy consumption. Retrofits require up-front investments, which can be recovered over time through energy savings. However, many building owners do not have access to financing for the required investment or lack the information necessary about potential energy cost savings to justify such an investment. To address these obstacles, the Center for Neighborhood Technology in the City of Chicago established the Energy Savers program, which leverages government funds, utility grants, and charitable foundation support to conduct energy efficiency audits, provide technical assistance, and offer low interest energy retrofit project financing to the owners of multi-family dwellings serving low income populations. In 2010, CMAP and the cities of Chicago and Rockford sought to increase retrofits

20. While energy efficiency measures in buildings can significantly lower energy consumption and thus public and private expenditure on energy, the environmental benefits of energy efficiency are less clear. If heat and electricity is provided by emission intensive energy production, cutting energy demand does not only reduce spending on energy, but – in the first instance – also emissions. However, the financial resources freed through energy efficiency measures might be spent on products and embedded emissions that exceed the amount of emission saved through energy efficiency. This substitution effect might lead to even higher emissions per unit of consumption than it was the case before the energy efficiency measures. In order to avoid such unintended consequences and to increase the potential of energy efficiency for reducing pressure on the environment, large scale energy efficiency measures should be implemented together with other policies that can more generally internalise environmental externalities of economic activities, such as removing or reducing fossil fuel subsidies, introducing an effective price on carbon, carbon trading scheme, and the like. On their own, then, energy efficiency measures must therefore be seen as – at best – a very imperfect substitute for demand reduction. Nevertheless, they are an indispensable element of any serious green growth strategy, since they can play a critical role in softening the impact of higher fuel prices (resulting from a carbon tax or some other price-based mechanism) on production and consumption. Moreover, programmes to help low-income households improve energy efficiency can also help mitigate the distributional consequences of many demand-reduction policies, as these can sometimes hit the poorest hardest.

region-wide by establishing Energy Impact Illinois, which seeks to increase the pace of retrofitting across all property sectors by increasing access to financing and information (Box 2.1).

Box 2.1. Energy Impact Illinois

CMAP, the City of Chicago and the City of Rockford established Energy Impact Illinois in May of 2010, out of recognition that the current energy efficiency market in the region is fragmented and still in the beginning stages of growth, facing impediments like multiple and incomplete information sources, inadequate financing products that do not meet market needs, and a lack of trained workers being connected with appropriate jobs. The program was started with USD 25 million in funds from the US DOE's Better Buildings Neighborhood Program, which is authorized through the American Recovery and Reinvestment Act (ARRA) of 2009.

Rather than directly fund retrofit projects, Energy Impact Illinois seeks to remove the key institutional barriers preventing more widespread investment in retrofits. Most of the program funds (USD 15.75 million) are for improving access to finance across the multifamily, single-family residential and commercial building sectors. This activity is accomplished mostly through creation of Revolving Loan Funds and/or credit enhancements like Loan Loss Reserves that have allowed the program to secure commitment of USD 128.5 million in private investment leverage from multiple financial institutions nationwide. An additional USD 6.5 million is dedicated to increasing public access to information, through a broad-based marketing campaign, a web-based information system and on-line building energy tools to help consumers understand their home or building's greatest energy savings potential. Finally, USD 200 000 of grant funds is committed to development of a workforce intermediary, which looks to align the workforce with the jobs created through EI2 and other energy efficiency programs in the region.

It is expected that over the three-year life of the ARRA funds (2010-13), approximately 6 000 residential units and 10 million square feet of commercial space will be retrofitted, resulting in the creation of an estimated 2 000 jobs.

Source: CMAP (2009), Energy Impact Illinois – Program Summary, CMAP, Chicago.

Long-term funding sources for energy-efficiency retrofit programme are still needed. This is especially true since the ARRA funds for Energy Impact Illinois will end in 2013, leaving the programme without a reliable source of funding. Energy service companies (ESCOs) are a private-sector solution to the problem of funding up-front retrofit costs. ESCOs guarantee minimum energy savings and frequently structure the deals in ways to eliminate any out-of-pocket costs by the building owner, instead recovering their costs through the owners' energy savings. In July 2011, the City of Chicago announced a new initiative whereby the City will partner with one or more ESCOs to complete energy retrofits on up to 100 public buildings around the city. Under the terms of the agreement, ESCOs selected by the city will perform audits of targeted buildings, secure private financing for all appropriate upgrades, and then carry out the retrofit. Savings would be guaranteed to the City, and are expected to amount to USD 4-5.7 million annually. This work is projected to generate 375 new jobs (of unknown duration) and USD 40 million in construction work (Public Building Commission of Chicago, 2011). While ESCOs have been filling the need for commercial and institutional energy retrofits, they have been involved in comparatively few residential retrofitting projects. The City of Berlin overcame this problem by partnering with investment banks to provide loans for retrofits by residential property owners and tenants (Box 2.2).

Box 2.2. The City of Berlin energy efficiency retrofit programme

The City of Berlin has worked with the German public investment bank Kreditanstalt für Wiederaufbau (KfW), the principal financial institution in Germany that finances retrofits, and Investionsbank Berlin to provide private buildings owners, tenants and housing corporations with access to loans. Since 1991 over EUR 4 billion has been invested in retrofits that save roughly 631 000 tons of CO_2 every year (City of Berlin, 2011). The refinancing of those loans is in principle done via rent increases up to 11%, a model that applies particularly well in a city like Berlin where a large part of the housing stock consists of rented flats, much as in other German cities. The higher rent in renovated buildings is balanced through the savings that tenants have on their heating and electricity bills. As a result of various KfW program since the early 1990s, around one third of the residential buildings in Berlin have been retrofitted, including 273 000 prefabricated apartments, for which energy consumption was reduced by 50% (City of Berlin, 2011).

Source: City of Berlin (2011), *Climate Protection in Berlin*, Senatsverwaltung für Gesundheit, Umwelt und Verbraucherschutz, Berlin.

Widespread use of energy audits could support the efforts of Energy Impact Illinois and ESCOs. The European Union's Energy Performance of Buildings Directive and new requirements imposed by New York City's "Greener, Great Buildings Plan" both seek to use information about a building's energy performance to incentivise its owner to improve the building's efficiency. The incentive arises from the belief that the attractiveness of a building will be influenced by its energy use relative to other buildings. Renters and buyers will take this information into account when comparing new homes, buildings or offices, recognising that even though less efficient buildings may have cheaper rents or sales prices, higher monthly energy bills could offset any savings. Research in both the US and Europe has demonstrated the link between certification of lower energy consumption and higher real estate values (Popescu *et al.*, 2011). Policy makers in the Chicago Tri-State metro-region could take this one step further by requiring a full assessment of the viability of clean and renewable energy retrofits any time a commercial or industrial building is sold. The new owner would not be obliged to pursue any specific installation, but ready access to this information could incite owners to voluntarily take action shortly thereafter.

Municipalities in the Chicago Tri-State metro-region could also lower the cost of building owners' investments in energy-efficiency distributed renewable energy technologies through low-cost loans, but this would require a change in federal legislation. The Property-Assessed Clean Energy (PACE) program allows property owners to borrow funds from their municipality to pay for efficiency improvements. The cost of the loan is added to the property tax bill, meaning repayment occurs on a quarterly basis as part of the regular tax payment. This strategy eliminates the problem that property owners who intend to sell their property have little incentive to invest in efficiency upgrades, because PACE passes the repayment obligation on to the new property owner. Under PACE, municipalities establish a funding pool to pay for the upfront installation costs, and the pool is repaid over time, allowing funds to be reused to support additional loans. PACE attracted considerable attention nationally when it was first employed in California, and in 2009, the Illinois Legislature passed a law allowing municipalities to set up these programs. Interest stalled in 2010, however, after the Federal Housing Finance Administration, Federal National Mortgage Association (Fannie Mae), and Federal Home Loan Mortgage Corporation's (Freddie Mac) declared they would not buy mortgages from homes with PACE assessments, citing concerns about the potential risk of default on mortgages involved in PACE program (Speer, 2010). Currently, no municipalities in Illinois have established PACE programs, and this will likely remain true until this issue is resolved at the national level (DSIRE, 2011). Legislation to address this problem was introduced in Congress in 2011, but no action has occurred to date. At the federal level, support for legislation to remove the impediments to PACE project financing could have very beneficial consequences for retrofit activity around the Chicago Tri-State metro-region.

Stimulate new green building design

Green building codes and incentives provide an opportunity to strengthen the activities of the metro-region's architectural and professional energy services firms, helping to secure Chicago's reputation as an international centre for green building design. More stringent building design standards for new construction at the state and local level could help to ensure the long-term resource efficiency of the region's built environment. Currently, the Illinois Energy Conservation Code incorporates the 2009 International Energy Conservation Code, which is considered the current global building code standard. Local governments around the state may adopt more-stringent energy codes for commercial buildings, but not residential buildings. The City of Chicago was granted an exception, thus the City of Chicago Energy Conservation Code of 2008 requires residential buildings applying for construction permits to exceed the standards called for by the Illinois Building Energy Code. If other municipalities in the Chicago Tri-State metro-region were also allowed to require buildings to exceed state standards, this could give rise to policy innovations and reduce the potential for intra-regional competition caused by differing building standards.

As a complement to more resource-efficient building standards, local governments can also offer incentives to property developers who adopt cost-effective green building designs via expedited permitting processes or fee waivers. These policies can also help to address possible added costs in more price sensitive-sectors, such as affordable housing. The City of Chicago provides incentives for green building design through the Chicago Green Permit and Green Homes Program, which expedites the permitting process of applicants that meet a minimum score on the City of Chicago's Green Homes green building rating system. As of May 2010, there were 250 homes enrolled in the Green Homes program. Regionally, the Metropolitan Mayor's Caucus, which involves mayors from 273 communities within the Chicago Tri-State metro-region, prepared best practice guidance for member communities on municipal energy code compliance and enforcement.

Build on green infrastructure expertise

The City of Chicago has gone beyond building energy efficiency measures to become a leader in implementing green roofs and green infrastructure strategies that adapt to potential climate change impacts. The City supported the deployment of 72 green roofs over 2005-2007, and now requires large new developments to capture the first half-inch of rainfall on site (City of Chicago, 2011a; City of Chicago 2008), lessening runoff levels. If these measures would be adopted at a larger scale throughout the metro-region, they could have significant impact on wastewater treatment demand levels and ease CSO problems. A unique feature of the City of Chicago Energy Conservation Code is its requirement that buildings seek to minimise solar energy absorbed by building green roofs, which is intended to decrease the energy used for cooling the building and encourage the use of green roofs. To reduce the risk of flooding and wastewater releases during storm events, the City of Chicago "greened" more than 100 alleys around the city between 2006-10, replacing pavement with more permeable surfaces and plantings (City of Chicago, 2011b). Additional measures to consider as a means of reducing the amount of impervious surfaces include limiting the amount of impermeable surfaces allowed on a lot; levying stormwater or utility management fees that vary based on the level of impervious surface on a site; and awarding floor-to-area-ratio (FAR) bonuses to developers who protect natural landscapes and drainage systems on a lot.

Green infrastructure strategies create job opportunities related to construction, landscaping and horticultural services and nurseries, among others. It is estimated that there are over 10 000 jobs in Landscaping and Grounds maintenance jobs in the City of Chicago and 21 000 in Cook County, though it can be debated whether all of these should be considered green jobs (Schrock, 2009). Overall, "moderate job growth" in the landscaping and horticulture field is projected for the region in the coming decade (Schrock, 2009). Schrock and Sundquist (2009) suggest that green infrastructure investments could build on recent increases in the number of landscaping and groundskeeping jobs in the region. One study for the

City of Washington, DC, estimates that the construction of one million square feet (92 900m^2) per year of green roofs would support 400 jobs, 60% of which would be roofing and landscaping jobs, while the balance would require professional design skills (Schrock and Sundquist, 2009 citing Casey Trees Endowment Fund and Limno-Tech Inc.) Assuming the impact is similar in the City of Chicago, achieving the Chicago Climate Action Plan's goal of 10 million square feet (929 000 m^2) of new green roofs by 2020 would result in approximately 400 new jobs. However, CWIC-CJC (2010) is less optimistic about the level of new job creation that will occur, particularly in the landscaping and horticulture maintenance space, given the large number of trained but currently unemployed workers around the region.

Enhancing the potential of wind and other renewable energies

Renewable energy and smart-grid technologies are still in their infancy, but hold promise for contributing to growth in the Chicago Tri-State metro-region. Renewable energy sources represent a very small share of the metro region's energy supply. In March 2010, 46% of the power supply sold within the ComEd service area was derived from nuclear power plants, 40% from coal-fired power plants, 10% from natural gas, and only small amounts of wind power (1%), biomass (1%), hydropower (1%), and assorted other sources (1%) (ComEd, 2010). However, wind power is a growing industry that is attracting headquarter functions to the Chicago Tri-State metro-region.

Exploit potential for wind energy industry

The Chicago Tri-State metro-region shapes up as an important centre for the wind energy industry due to its strategic position for the growing market in the Midwest "wind belt". Together with other Great Lakes states such as Michigan and Ohio, the Chicago-area 21-county region has one of the highest concentrations of wind energy component suppliers in the US. Thirteen wind industry corporations have set up their headquarters in the Chicago Tri-State metro-region, including some of the major international firms involved in turbine manufacturing and renewable project developers, such as Goldwind, Acciona, Suzlon, Nordex or E.On. The Chicago-area 21-county region counts over 60 wind companies, which cover a large part of the supply chain, including turbine and tower makers, manufacturers of gears, couplings, bearings and fasteners, as well legal, financial and engineering consulting and diagnostic software designers (ELPC, 2011). In Wisconsin, the Wisconsin Wind Works, a consortium of suppliers and vendors to wind energy counts 300 companies, with 40 companies joining in 2010 alone, and a high concentration of firms around Milwaukee (Wisconsin Wind Works, 2011).

Despite the potential for growth, the wind energy sector still relies on state and federal programmes to be competitive. A main driver for the growing wind industry in the United States is a favourable investment environment, supported by tax credits, feed-in tariffs or grants, which attracts and spurs private investment. The Illinois Renewable Energy Portfolio Standard promotes wind energy by requiring that 25% of the state's electricity be provided by renewable sources by 2025, and that 75% of that amount come from wind power. Wisconsin is on track to reach its RPS target of 10% renewable electricity by 2015 and has enough potential, thanks in part to its capacity for wind generation, to reach the 25% aimed for by 2025. While Indiana does not have binding renewable energy targets, the state did enact a voluntary Clean Energy Portfolio Standard, which has the goal of reaching a 10% share of electricity from renewable sources by 2025 (UCS, 2010; FERC, 2011). Growth in renewable energy generation is driven by the federal Renewable Electricity Production Tax Credit, which provides a credit of USD 0.022/kWH for wind, geothermal and closed-loop biomass energy production for the first 10 years of operation (DSIRE, 2011). However, this tax credit is due to expire in 2012.

Growth in the wind energy sector could be accelerated through public sector purchasing of renewable energy, such as the city of Calgary has done with the "Calgary Ride the Wind" initiative, which provides 100% of the city's light rail electricity consumption through wind power (Box 2.3). Other opportunities for

wind could increase with the adoption of the more stringent power plant emission regulations currently being promulgated by the US Environmental Protection Agency, which would force coal power plants to invest in new pollution control equipment. Wernau (2011a) estimates that up to one-fifth of the state's power generation capacity could decide to exit the market rather than invest in the necessary upgrades, potentially driving up the price of coal by 65% and offering opportunities for renewable energy sources.

Box 2.3. Calgary Ride the Wind

Since 2011, the City of Calgary's light rail "C-train" has operated entirely on wind-generated electricity. It saves approximately 47 000 tons of CO_2 per year and replaces annually over eight million private vehicle trips in the city of Calgary. Through a wind power purchasing agreement with their local energy distributor (ENMAX), the amount of electricity needed to transport 90 000 million people each year with the C-train is provided to the grid by a wind-farm located in Southern Alberta. Calgary *Ride the Wind* is the only public rail system entirely powered by wind-generated electricity in North America (Calgary Transit, 2011). System expansions are planned, which will lead to further CO_2 savings. Calgary Ride the Wind is a key element of the city's overall energy strategy, which aims to purchase 100% of the city's electricity from renewable sources by 2012, and to reduce CO_2 emissions by 80% below 2005 levels by 2050 (City of Calgary, 2010).

Source: Calgary Transit (2011), "Environment", website of Calgary Transit, *www.calgarytransit.com/environment/environment.html*, accessed 1 December 2011; City of Calgary (2010), *Corporate Environment, Health and Safety*, Annual Report 2010, City of Calgary, Calgary.

Technical assistance is another important way to promote the wind industry, as other Great Lakes states have demonstrated. For manufacturing companies to understand the market opportunities and the needs of the wind industry, the states of Michigan or Ohio provide technical assistance to companies to retool their operations to become wind energy suppliers. For example, The Ohio Energy Office is financing a collaborative project, led by the Great Lakes Wind Network (GLWN) and Ohio's Edison Technology Center, to identify suitable companies for retrofitting of their facilities to produce wind energy components (AWEA, 2010). Strengthening the regional wind energy supply chain in the Chicago Tri-State metro-region may require both informing firms about this new business opportunity and connecting these firms with those managing the supply chain. One study has identified particularly strong opportunities for local gear and drive train manufacturers to penetrate the wind turbine component parts market (CMC/JARC, 2009). The Midwest Governors Association also provides a platform for attracting investment to renewable energy producers and their supply chain, across the states of Illinois, Indiana, Wisconsin, Iowa, Kansas, Ohio, Michigan, Minnesota, Missouri and South Dakota. Given the need to manufacture wind turbines relatively close to where they will be installed, working with other states in the "wind belt" can benefit wind-related suppliers and manufacturers in the Chicago-area 21-county region.

Fostering the growth of other renewable forms of energy

Distributed renewable energy, produced on-site in small installations, is being encouraged in the region but still represents a fraction of the region's energy use. The Illinois net-metering law encourages deploying small scale (≤40 kW) solar, hydropower, wind, and anaerobic digestion systems, also known as distributed renewable energy generation, by providing a financial credit for any power that they generate.[21]

21 . The credit applies against the host site's grid based power purchase, and is intended as an offset rather than an inducement of merchant power sales. All investor-owned utilities in Illinois must provide net metering; municipally-owned utilities and electric power cooperatives are not required to offer this benefit. Net metering credits are equivalent in value to the retail price of electricity charged for grid-based power.

If this cap would be lifted to 2MW for commercial installations, as it is the case in 16 other US states, larger installations would also become profitable (ELPC, 2011). Other incentives for distributed energy generation are available, including federal tax credits, state subsidies and rebates, and – depending on the size of the system – the potential to earn renewable energy credits (Delta Redevelopment Institute, 2009). Small-scale solar systems (e.g. rooftop systems) have faced difficulty finding market acceptance in the metropolitan Chicago region because of the high price of solar power compared to grid-based power. As of March 2011, other than a 10 MW solar PV site that their parent company Exelon constructed on an old brownfield site in Chicago's West Pullman neighbourhood (Exelon City Solar, 2010), ComEd reports 257 customers with solar PV systems participating in their net-metering programme across their entire service territory. Collectively these customers generate slightly more than 1 megawatt of power,[22] which is a tiny fraction of the peak demand of 23 753 megawatts that ComEd served in July 2011 (ComEd, 2011). Waste-to-energy has been recognised by the state of Wisconsin and Indiana as a renewable energy, which allows municipalities with waste-to-energy plants to sell credits in renewable energy markets to make plants profitable. In each of the two states currently on plant is operating. Illinois does not recognise waste-to-energy as renewable however, discouraging investment in waste-to-energy plants (ERC, 2010).

The feasibility of the distribution of energy from renewable sources depends on the ability of the electricity grid to accommodate inputs from smaller energy generators and to manage peak demand. The Building Owners and Managers Association (BOMA) of Chicago, a leading real estate group, aims to create a "virtual generator" composed of up to 14 commercial and residential buildings in the downtown area. Using smart grid technology, the participating buildings will monitor usage and PJM Interconnection wholesale prices, automatically scheduling and implementing curtailment strategies based on this information. The ultimate goal of the programme is to expand to over 200 BOMA member-owned buildings in downtown City of Chicago, as they collectively represent 1 000 MW of peak load, and could potentially reduce peak demand by 200 MW under this system (BOMA, 2010). This smart grid pilot is being carried out in collaboration with the Korean Smart Grid Association, indicating the presence of a market that smart-grid firms in the Chicago Tri-State metro-region could potentially meet. Other smart grid initiatives are being launched by ComEd along the "Smart Grid Innovation Corridor", ten communities where 130 000 smart metres have already been installed. With funding support from the US Department of Energy, ComEd will test out a variety of system upgrades, including the deployment of an "intelligent" substation, electric vehicle charging infrastructure, self-correcting power lines, and equipment to more accurately gauge the locational impacts of solar photovoltaic system integration on the grid (GreenBiz, 2010). Smart grid legislation adopted in the State of Illinois in October 2011 now sets the stage for large-scale investments to update the electricity grid in that state, but it has been criticised for reducing oversight of electricity rates and its potential to raise rates (Wernau, 2011b).

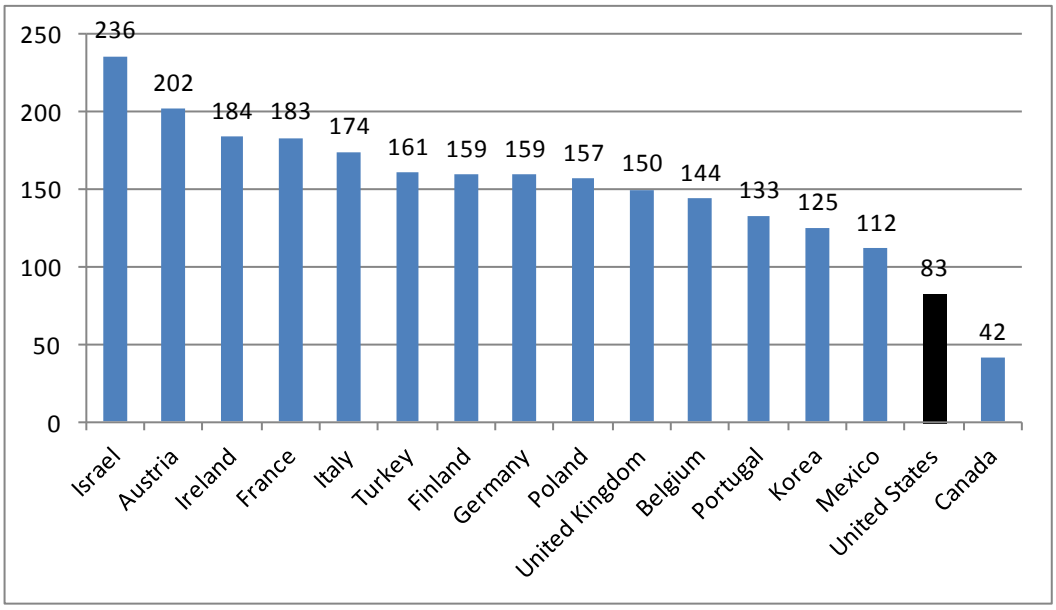
Wind energy cannot currently compete with the low cost of coal and other fossil-fuel sources, but it is becoming increasingly cost competitive. Furthermore, the size of wind energy turbines requires them to be produced closer to installation sites, which provides opportunities for manufacturers in regions near wind-energy installations, such as the Chicago-area 21-county region. However, the low price of coal-generated electricity in the US (Figure 2.1) will likely continue to exert pressure on wind technologies to become more cost-effective. A national price signal that internalises the environmental externalities associated with fossil fuels, such as a cap-and-trade programme or a carbon tax, could make renewable energy sources significantly more cost-competitive with fossil fuel sources, depending on the baseline price. A pricing signal that reflects the negative externalities associated with greenhouse gas emissions would be in line with consumption-based pricing structures for water and waste water services that are intended to better represent the sustainable cost of distributing a scarce resource. The Chicago Climate Exchange (CCX) voluntary carbon market demonstrated the potential of a cap-and-trade programme. At its peak, allowances for a ton of carbon were valued at USD 7.40, a price expected to double if the US had enacted a

22. Personal communication with Val Jensen, Vice President, Marketing and Environmental Programs, ComEd, 30 June 2011.

comprehensive carbon trading scheme. Trading through CCX stopped after it became clear that the US would not enact a carbon-trading scheme, however, demonstrating the importance of national pricing signals (Merrion, 2010).

Figure 2.1. Comparative prices of electricity from coal, 2009

Total end-use price: USD/toe (tonne of oil equivalent), NCV (net calorific value)



Note: OECD countries for which data is unavailable are not displayed. Price is shown in USD/MWh. The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Source: IEA (2011), "End-use prices: Energy prices in US dollars", *IEA Energy Prices and Taxes Statistics* (database), doi: *10.1787/data-00442-en*.

Expanding public transportation and reducing congestion to increase employment and competitiveness

Public transportation is an important factor in the Chicago Tri-State metro-region's attractiveness and a key green employer, but investment in the system not kept up with the region's needs. While there is little doubt that improvements to the region's public transport system could generate significant economic and environmental gains, the current system barely has enough funding to operate, let alone upgrade or expand. This poses a problem for the metro-region's future attractiveness, as public transit access and ease of mobility have been cited as key factors in the region's high rankings among world cities. The Regional Transport Authority (RTA), which serves six counties and 88% of the population in the metro-region, has applied most of its funding on operations (over USD 2 billion annually) rather than maintenance or capital investment.[23] This is due in part to operating costs that have outpaced inflation, rising 4.5% annually (CMAP, 2010a). Approximately half of RTA's operating costs are financed by fares and other system-related revenues (e.g. advertising and concession), with the remainder supplied by an RTA sales tax applied, a real estate transfer tax in the City of Chicago, and state matching funds and contributions. Capital funds come primarily from federal and state sources; while federal sources of capital funding are relatively consistent from year to year, annual state funding can vary significantly. In 2007, the RTA lacked USD 226 million to keep all services running, which prompted an increase in the RTA sales tax and real estate transfer tax (CMAP, 2010a). The RTA (2007) estimates that investments of USD 7.3 billion

23. RTA serves Cook, DuPage, Kane, Lake, McHenry and Will counties.

would be necessary over a five year period to maintain the transport system, an additional USD 1.1 billion would be needed to enhance it, and USD 2 billion more would be needed to expand it over that time period. The cost of maintaining, enhancing and expanding the system over 2007-2037 is estimated at USD 57 billion (RTA, 2007; CMAP, 2010a). It is estimated that investments to maintain and enhance the transport system would result in annual benefits of USD 2 billion (Chicago Metropolis 2020, 2007). Furthermore, public opinion is overwhelmingly in favour of investments to improve the public transportation system (95% of those surveyed), representing a larger share than those in favour of investing in new roads (75%) (CMAP, 2010a).

To reverse the decline of the Chicago Tri-State metro-region's public transportation system, a long-term, region-wide transportation plan and funding strategy is needed. CMAP (2010a) provides a comprehensive inventory of transit projects that are possible under both fiscally constrained and unconstrained scenarios. The fiscally constrained scenarios prioritise bringing the existing system to a state of good repair. New projects are limited to extension of the CTA Red Line and creation of the West Loop Transit Center to improve system-wide transit connections. The Plan also recommends that expressway extensions and/or lane additions should be planned to integrate additional transit facilities where appropriate (CMAP, 2010a). The unconstrained scenario delivers a wealth of transit projects currently under study, but none of these will be possible without greater funding and hard decisions by the cities and counties of the metro-region on funding priorities. The SEWRPC regional transportation system plan for southeastern Wisconsin to 2035 recommends significant improvement and expansion of public transit in the region, centred around Milwaukee. This would include nearly doubling public transit service by 2035, the development a rapid and express transit systems, and improvement of existing local bus transit systems. The NIRPC plan places a priority on transit-oriented development around existing commuter rail stations along the south shore of Lake Michigan, and at regional bus and multi-modal hubs (NIPRC, 2011). While these plans represent an important starting point, there is a need for all 21-counties in the Chicago-area 21-county region to contribute actively to regional transportation planning and funding. One potential model is the New York-New Jersey Port Authority, the first cross-state agency in the US, which plans and manages air, train and water transportation in the New York metro-region. A common platform for transportation planning and funding could enable key stakeholders from across the Chicago-area 21-county region to make the case that in so far as state and federal funding currently supports road infrastructure, it might make more sense from a long-term regional economic development viewpoint to place a higher priority on investing in public transit.

New sources of funding are needed for the upgrading and expansion of the public transit system in the Chicago Tri-State metro-region, given its important role in attracting businesses to the metro-region and providing jobs, and the potential to better connect residents to jobs. While policy makers may be reluctant to raise taxes, it would be worth considering expanding the value capture tax. The base for a value capture tax is an increase in property values arising from public infrastructure development. This increased value results from the increased desirability of the location, better access, and the potential for higher rents, increased resale value and higher-density development. Value capture taxes have been used to finance transport infrastructure in cities as different as Hong Kong, Miami, Milan and Bogotá. Manhattan is also considering a similar tax, on new construction, only to fund the Subway line 7 extension. A value capture tax can only be applied when the property value increase can be unambiguously attributed to infrastructure investment. Value capture taxes are less useful when property taxes are assessed on a yearly or regular basis, since the annual assessment captures any increases in the property value that might result from public infrastructure investment; this does however not take place in most OECD countries (Hammer, S., et al., 2011). In addition, some metropolitan transit authorities in OECD countries dispose of tax income. In France, the *versement transport* is used to finance metropolitan public transport. This tax is collected from companies employing nine or more people, as a surcharge on salaries at a rate that varies between 1% and 2.2%, and is earmarked for public transport at the discretion of the metropolitan transit authority. These revenue sources, although not uncontroversial, complement other public transportation

fees and provide a substantial part of revenues for metropolitan public transport (around 70% of the income for the metropolitan transport authority of the Paris/Île-de-France region).

Congestion charges should be considered as an integral part of a transport funding package. The congestion charge has in some OECD metropolitan areas contributed to the reduction of GHG-emissions. This instrument is similar to toll roads in that it charges for road use, but differs in that it charges exclusively or more intensely during peak traffic periods. Some congestion charges have to be paid when entering a certain delineated area within the city (cordon-based charges), while others charge according to kilometres travelled within an area (OECD, 2010) (Box 2.4). London, where public transportation subsidies are much lower and the proportion of commuters using bus and rapid transit is much higher, has addressed the problem of public transit funding in part through a combination of direct charging for taking an automobile into the city, and competitive contracting out of private bus services. This has enhanced the quality of service offered and significantly reduced cost inefficiencies, leaving more resources for rail systems, some of which are themselves provided under concession, by the private sector. Congestion charges on vehicle use have been considered in the Chicago Tri-State metro-region, but not yet actively pursued. In 2007, the US Department of Transportation allocated funds to the Chicago Tollway and the Metropolitan Planning Council to investigate the viability of congestion pricing schemes around the region. Their report focused heavily on the tolling highway lanes rather than a scheme focused on limiting travel into the central business district in Chicago. The study found support for this concept among a range of stakeholder groups, although there are concerns about equity issues (MPC/Wilbur Smith Associates, 2010).

Box 2.4. The impacts of congestion charges

Congestion charging systems vary considerably based in part on when they were initiated and the technology available at the time, the geography of the city involved and the nature of its transportation system, and the political environment under which the scheme operates. In some cases, such as the schemes introduced in Norwegian cities, the primary objective was to raise revenues for infrastructure expansion rather than to control traffic congestion levels. The initial scheme in Singapore simply forced automobile users to show a daily license to enter congested parts of the city, the London scheme involves electronic pre payment to enter the main urban area, where as the more recent schemes in Singapore and Stockholm, and the freeway embrace variable charges by time of day with the congestion price being collected. There are also freeways with variable charging in California and Indiana, and specific facilities with congestion charges; e.g. on the Oakland-San Francisco Bay Bridge.

One of the main concerns of policy makers is that congestion charges will be unpopular. Congestion charges tend to poll more favourably after their introduction than before, however. For example, in Stockholm, residents elected to maintain the congestion charge after a nine-month trial period. Measures can be taken to address concerns before establishing a congestion charging system. In London, for example, concerns about “political” use of congestion charge revenues was largely removed by national legislation that made it obligatory to use such revenues for regional transportation improvement over the decade of the scheme (Leape, 2009).

The costs of operating the different types of scheme have fallen as technology has improved. For example, while the relatively crude original London scheme cost roughly USD 4.10 per vehicle in operational costs, the electronic Singapore system costs USD 0.12 per vehicle.

The success of congestion charges depends in part on their joint implementation with other policies, such as policies to improve alternatives to car use. For example, congestion fees worked well in London in part because they were combined with improvements in management of the road network and substantial enhancements in bus service. Congestion charges can also be subject to the risk of “rebound effects” (with more people willing to take the car if congestion charges manage to actually de-congest traffic) if not accompanied by other policies, such as parking fees

Congestion charges have been associated with environmental benefits. For example, it has been estimated that the Stockholm scheme reduced CO_2 emissions by 10%-14% in the inner city area and by 2%-3% in the surrounding area, although there was little impact on noise levels, while the London charging scheme produced an annual USD 6 million benefit in terms of reduced CO_2 emissions, and USD 30 million in lower accident costs.

Box 2.4. The impacts of congestion charges (*cont.*)

The effects of major urban road pricing schemes

City	Traffic effects	Congestion effects	Public transport effects
Singapore, 1975-1998	-44%; -31% by 1988	Average speed increased from 12 to 23 mph	Modal Shift, from 33% to 46% trips to work by city bus, 69% in 1983
Trondheim, 1991	-10%	n.a.	+7% city bus patronage
Singapore, 1998	-10 to -15%	Average speed increased 12.5 to 19 mph roads, 28 to 41 mph expressways	Slight shift to city bus
Rome, 2001	-20%	n.a.	+6%
London, 2003	-18% 2003 vs 2002, 0% 2004	-30%. 2.6. min/m typical delay 2003, versus 4.2 min/m in 2002	+18% during peak hours bus patronage 2003, +12% in 2004
London, 2005	Small net reductions	-22%. 2.9 min/m typical delay	Bus patronage steady
Stockholm, 2006	+30% 2006 versus 2004	-30% to -50% journey time	+6%

Source: Button, K. and H. Vega (2007), "The Costs of Setting up and Operating Electronic Road Pricing in Cities", *Traffic Engineering and Control*, Vol. 48, No. 6, pp. 284-285; OECD (2010), *Cities and Climate Change*, OECD Publishing, doi: *10.1787/9789264091375-en.*

While public transit investment should be driven by customers' needs, it is important to note that public transportation is also a very large employer, and employment is growing despite funding constraints. The Brookings Institution (2011c) identified roughly 24 000 public transport jobs in the Greater Chicago metropolitan region, an increase of 50% from 2003, although the cause of this increase is unclear. Implementation of the strategies called for by CMAP (2010a) and the Chicago Climate Action Plan (2008a) would likely result in additional employment opportunities, although the size of this impact will hinge on the level and nature of the transit system expansion. Schrock and Sundquist (2009) suggest that if major capital investments in new rail lines were to occur, the construction jobs created could be significant in number. Absent such expansion, however, job impacts in this sector will likely be modest, concentrated in repair and maintenance jobs, with lesser demand for additional train operators, conductors, and yard workers. Chicago Metropolis 2020 (2007) calculates that simply maintaining current spending on public transportation will result in the retention of 11 395 jobs in Chicago, compared to a scenario where transit investments are allowed to decline. Higher levels of transit investment are associated with actual job growth, as reduced traffic levels are presumed to enhance the city's attractiveness as a place to do business.

Fostering the potential of the water and waste sectors

In the water and solid waste sectors, restructuring fees to encourage conservation could reduce the costs of service delivery and could increase demand for water-conservation technologies and recycling services, encouraging growth in those activities. In the Chicago Tri-State metro-region, and in particular the City of Chicago, the prices many consumers pay for water and waste services are disconnected from the cost of delivery and impact on the environment. The wastewater system faces problems related to ageing infrastructure, including combined sewer overflow events in older systems where storm runoff combines with the sewer system. Solid waste service delivery does not yet encourage recycling, and fees for most customers are low and do not fully reflect the costs of collecting solid waste.

Water and wastewater services

Despite growing concerns over the metro-region's future water supply, water rates for most metro-region residents are not currently structured to promote conservation. Although all customers in the metro-region pay higher bills as their water usage increases, fewer than one in seven are subject to rates specifically structured to discourage high rates of water usage. Seventy-nine% of customers in the region are charged according to a uniform rate structure, meaning each additional increment of water consumed is charged at the same rate as the previous increment. Only 9% of customers incur increasing block rates (meaning the price paid for each block of water increases as their total usage increases) while 14% actually receive price discounts as their water usage increases. In the City of Chicago, 321 000 customers lacked water metres as of 2007, meaning the City charged them a flat rate for water service regardless of the amount of water consumption. The City of Chicago hopes to have all customers metered by 2023, and estimates that this could result in water savings of 30 million gallons per day (CMAP, 2010b).

There is a need to restructure water fees to send a more accurate price signal, with the goal of increasing efficiency and revenues. By better matching the block rate structure to current (or desired) usage levels, water utilities may be able to cut demand across the system. Full-cost pricing schemes, which separate water charges into fixed charges and commodity charges (which reflect actual water usage and the cost of providing it) send a pro-conservation message to water consumers. Most water systems in northeastern Illinois do separate the charges, but in some areas minimum charges are set at levels higher than actual average usage, thus disincentivising conservation (CMAP, 2010b). In addition, several hundred thousand customers lack water meters, which compounds the problem. The current 2023 timeline to install these meters would target just under 25 000 customers per year. Local officials should considering develop a strategy across the metro-region to transform the rate structure to one with increasing block rates, complementing rate structure changes with an expanded customer education programme or other efforts designed to reduce water usage. The City of Chicago's 2011 budget proposal goes in this direction, as it aims to double water fees, which are currently among the lowest of any major US city (Belkin, 2011b).

Grey-water systems would reduce pressure on ageing wastewater treatment and combined sewer systems, but require legislative changes. Grey-water from laundry machines, bathtubs, showers, and bath sinks can be reused in homes for toilet flushing, displacing roughly 30% of the clean water used daily in homes (CMAP, 2010b). Grey-water can also potentially be used for landscaping irrigation purposes. The City of Chicago and other cities around the region might also benefit from a policy similar to that of the City of Melbourne, Australia, which requires the use of "Class A" recycled water for toilet flushing, car washing, and landscaping irrigation purposes in certain buildings (OECD, 2010) (Box 2.5). CMAP (2010b) has also suggested the establishment of tax credits for homeowners installing these systems. Grey-water use requirements would be easiest in areas closest to water treatment facilities, as the cost of distribution of treated water from these facilities to the ultimate point of use would be reduced. In Wisconsin, the Uniform Plumbing Code allows the installation of grey-water and stormwater systems, and the Department of Safety and Professional offers advice and regular installations education on Private Onsite Wastewater Treatment Systems (POWTS) (WIDC, 2011a, 2011b). Wisconsin has over 65 approved stormwater use and wastewater reuse plumbing systems (WIDNR, 2011). For grey-water systems to work in Illinois and Indiana, those states would need to establish rules permitting the installation of grey-water reuse systems.

Box 2.5. Water recycling in Melbourne

In response to repeated severe droughts, the City of Melbourne developed water infrastructure that allows for the distribution of Class A recycled water. Class A water has close to drinking water quality and can be used for various water intense applications and activities such as watering vegetable or other gardens, irrigating open spaces, toilet flushing, car washing, construction or fire fighting. It is delivered by a purple pipe system that runs alongside existing water pipes and brings recycled water to homes, businesses or public facilities. The city of Melbourne has already achieved its first target to recycle 20% of its wastewater, and is upgrading its Eastern Treatment Plant (which treats about 40% of Melbourne's wastewater) over 2012 to allow it to produce 100 billion litres of Class A recycled water per year (DSE, 2011a). The state of Victoria's *Our Water Our Future* action plan includes recycled water in its Sustainable Water Strategy for the region around Melbourne (DSE, 2011b). Current development projects in Victoria that build infrastructure for recycled water are under way for the Werribee Plains, the Cascades on Clyde, Eynesbury, The Hunt Club, Mariott Water and Aurora (DSE, 2011c, Purplepipe, 2011). In the Werribee Plains 8.5 billion litres of Class A recycled water per year will be used, and almost 60% of water used by Eynesbury households is Class A water delivered via purple pipes. Together the current projects will provide over 40 000 people with Class A water (DSE, 2011b; Savewater, 2009). Five additional purple pipes projects are envisioned in the state of Victoria, as well as several more in three other Australian states, New South Wales, South Australia and Queensland.

Source: DSE (Department of Sustainability and Environment of the state of Victoria) (2011), "Recycling", DSE website, *www.water.vic.gov.au/programs/recycling*, accessed 1 December 2011; DSE (2011), "Sustainable Water Strategies", DSE website, *www.water.vic.gov.au/programs/sws*, accessed 1 December 2011 ; DSE (2011), "Werribee Irrigation District Recycled Water Scheme", DSE website, *www.water.vic.gov.au/programs/recycling/werribee*, accessed 1 December 2011; Purplepipe (2011), "Australian Recycled Water Communities", Purplepipe website, *www.purplepipe.org.au/_/Communities.html*, accessed 1 December 2011; Savewater (2009), "Western Water wins national 2009 savewater! Award", Savewater website, *www.savewater.com.au/news-media/?newsid=345*, accessed 1 December 2011.

A wide range of potential funding sources can support local water planning efforts and system upgrades (CMAP, 2010b). Municipalities can tap into federal Clean Water Act funding, which is funnelled through the Illinois EPA in the form of revolving loan funds. CMAP (2010b) also highlights financing strategies used in other states, such as water infrastructure bond funds that can be used to implement water supply and metering projects, or one-time user fees that charge property owners/developers for the contribution their property makes to storm runoff problems. Such user fees both provide new funding sources and incentivise developers to allow for on-site water containment or the downsizing of impermeable surfaces.

Opportunities for job growth exist in a range of occupations, but depend on whether policies emphasise infrastructure investment or demand-side management. Water system upgrades can result in opportunities for job creation in the construction trades, metre installation, the manufacture and sale of water efficient devices and appliances, and the development and installation of advanced water treatment technologies. Previous estimates by the Chicago Department of Water Management suggest that the installation of new metres and replacement of aging water mains and pumping stations could result in up to 2 000 construction jobs (Schrock and Sundquist, 2009). To support this work, there would be demand for civil engineers, although whether this would result in sectoral growth or simply represent new project opportunities for existing firms is unclear.

Solid waste reduction, recycling, reuse, and waste-to-energy

Solid waste generation rates are higher in the Chicago than in other US areas, contributing to greenhouse gas emission and high waste collection costs. Reducing the share of solid waste that goes to landfill by increasing the recycling of municipal waste, construction and demolition (C&D) materials and composting could help reduce GHG emissions generated by waste. Energy production from waste is far from reaching its potential in the Chicago Tri-State metro-region. While there is one waste-to-energy

facility and 18 gas-fired power plants operating at closed landfills, these do very little to exploit the metro-region's potential for energy production from waste.

While experiences with waste-to-energy in the Chicago Tri-State metro-region, and in other US metro-regions more generally, have been negative in recent decades, other OECD countries have been successfully deploying waste-to-energy. The early generation of waste-to-energy incinerators that were built in the Chicago Tri-State metro-region during a period of limited landfill capacity in the early 1970s have proven to be environmentally and financially unsustainable. Tighter federal environmental regulation led to their closing or to costly retrofitting (Sendzik *et al,* 1996). In contrast, waste-to-energy in Denmark, the Netherlands and Germany has evolved under tight European environmental regulation as a clean and cost-effective alternative to landfill. The Afval Energie Bedrijf plant in Amsterdam uses state-of-the-art technology to transform non-recyclable waste, biomass and sewage sludge into electricity, heat, metals and building materials, and thus processes almost 25% of the Netherlands' annual combustible waste (4 400 tons of waste daily), provides 285 000 households with electricity, 20 000 with district heating and hot water, and generates profits for the municipality that owns the plant (City of Amsterdam, 2011). Horsholm in Denmark recycles 61% of its waste, incinerates 34%, sends 4% to landfill and can handle the remaining 1% of hazardous waste safely instead of spreading it in landfills (Rosenthal, 2010). The social acceptance of waste-to-energy has been a key to the successful deployment of waste-to-energy plants, which is in turn closely related to the plants' environmental performance, which today results in no more than 10-20% of the maximum EU standards for air and water discharges.

The City of Chicago and other municipalities throughout the metro-region have implemented recycling programmes with varying degrees of success. The diversion requirements and collection strategy for recyclable materials are determined by local government, often in response to local market conditions. Recycling rates in the Chicago metro-region currently range from 11% to 52%, averaging 41% overall (CMAP, 2008b). To reduce the costs of the municipal recycling programme, the City of Chicago announced in July 2011 a "managed competition" plan that will split collection responsibilities between the private sector and the Department of Streets and Sanitation crews. After six months the programme will be reviewed to assess which method is most cost-effective.

"Pay-as-you-throw" (PAYT) or variable-rate pricing schemes could raise revenue from waste fees, increase recycling and reduce waste going to landfill. However, variable rate pricing schemes have not been widely applied in the metro-region. In 2009, the City of Chicago began working with the private sector to offer financial rewards to households based on the amount that they recycle, but this partnership has reportedly been abandoned and will not be expanded citywide (City of Chicago, 2011c). Variable-rate pricing programmes successfully operate in hundreds of cities throughout the US, in Zurich, and in many municipalities across Germany, among others (Reichenbach, 2008). Variable-rate pricing schemes have proven successful in promoting both recycling and waste prevention efforts (Skumatz, 2008). In most programmes, households are not charged for recycling services, while waste collection service is charged based on the level of waste generated.[24] Households thus have an incentive to maximise the amount of recyclable material. This model can lead to an increase in the incidence of illegal dumping, as some households might seek to avoid the cost of waste disposal, so additional enforcement may be necessary.

To promote business development in the waste management sector that capitalises on locally available materials, the metro-region would benefit from an up-to-date, comprehensive inventory of the types and volumes of recyclable materials currently diverted from the local waste stream. Waste composition inventories have been conducted in some cities, including the City of Chicago in 2010, on a piecemeal

24 . There is a cost for the recycling program, of course, but the cost may be offset by the sale of commodities captured by the recycling program. Costs may also be covered as part of the fee for waste collection services.

basis. Currently, smaller municipalities may target different types of recyclable materials than larger communities, as the volume of material captured will influence the relative value of this material to commodity markets and the cost effectiveness of its collection. The state-wide *Eco-Point database* has been helpful in directing waste generators to outlets for specific commodities, but the service does not help programme operators or entrepreneurs fully understand the composition or quantity of materials available locally. Such an inventory could also serve as a starting point for common recycling standards across municipalities, which would help expand the volume of recoverable materials available locally that could serve as feedstock for reuse programmes or reprocessing ventures.

While performance in recycling in the metro-region may be lacklustre, the City of Chicago stands out for its recycling of construction and demolition (C&D) waste. A 2005 ordinance requires general contractors to recycle at least 50% of the construction and demolition debris generated at larger construction or demolition projects, which are defined as new residential buildings of four units or more, or new non-residential buildings of more than 4 000 square feet. Compliance is monitored through voluntary reporting. The City of Chicago also provides expedited permitting through its Green Permit program for projects meeting certain green building requirements, including the on-site recycling of construction and demolition waste, although this step is not enough alone to earn an expedited permit. The reuse of building materials can also earn a mixed-income housing development project points towards eligibility for the Illinois Low-Income Housing Tax Credit Qualified Allocation Plan (Weber *et al.,* 2009). The Delta Institute has also been involved in the development of a building material reuse centre designed to support do-it-yourself building construction, renovation, and restoration projects. Several other non-profit and for-profit organizations also target building materials salvaged from old homes and businesses around the city.

Because construction and demolition debris constitutes such a sizable portion of the local waste stream, the metro-region could also benefit from uniform C&D recycling and deconstruction policies. C&D debris remains the largest component of the local waste stream, and local policy makers could consider imposing more aggressive C&D deconstruction or recycling requirements on building retrofits. The metro-region's deconstruction sector has yet to prove itself capable of handling a dramatic increase in business, either on the supply side, or in terms of finding economic markets for the materials removed from buildings. Nonetheless, these businesses can divert significant amounts of material, and there may be value in growing this sector regionally because of the employment pathway it creates for low-skilled workers. Business development efforts to support new reuse or recycling businesses will generally follow traditional patterns, as there do not appear to be any special state or local funds dedicated to waste sector business start-ups. Non-profit organisations have been active in starting or promoting building materials exchanges and the Waste-to-Profit network, and these organisations typically benefit from state or local government grant support. It may be possible to expand the amount of grant funding available for such purposes through an increase in demolition permit fees, with additional funds devoted to supporting deconstruction programs or buildings materials exchanges. State and federal support for these programmes could take the form of tax credits for those donating the building materials, thus giving them a financial incentive to maximise the amount of materials recovered through deconstruction efforts (Weber *et al*., 2009).

While the recycling and reuse sector has experienced a large increase in jobs over 2003-2010, new job growth potential in this field is considered limited. According to Brookings (2011), there are approximately 6 200 recycling and reuse sector jobs in the region as of 2010, a 73% jump from 2003. Another 1 500 workers are involved in the manufacture of recycled content products, and some 16 000 jobs exist in the waste management and treatment sector, although the latter figure may be misleading as it also includes jobs related to wastewater treatment. Net job growth is limited, however, because most jobs are likely filled by currently unemployed workers or training programme graduates (CWIC-CJC, 2010). However, an analysis prepared for the Chicago Department of the Environment estimated that a 5% improvement in the local recycling rate would yield direct employment gains of 230 jobs and a comparable amount of indirect job gains (Schrock and Sundquist, 2009).

3. LEVERAGING WORKFORCE, INNOVATION AND GOVERNANCE POLICIES FOR GREEN GROWTH

Key findings on workforce, innovation and governance policies

- Skill shortages are evident across the economy, and particularly in the green sector. The public and private sectors will need to co-ordinate efforts to address the skill mismatch problem at all skill levels.
- Green-related R&D activities in the Chicago Tri-State metro-region should be more closely linked to green firms in the region, which could benefit from technology transfers.
- Information-sharing and uniform energy-efficiency programmes across the metro-region (and thus across state lines) would help provide a more stable business environment for the metro-region's green clusters.
- US federal policy has an important role to play in fostering green growth in the Chicago Tri-State metro-region, by supporting green R&D, removing legislative obstacles, and providing clear signals on carbon pricing.

This section presents implications and opportunities for workforce, innovation and governance policies. First, addressing skill shortages in the green sector requires an understanding of the larger, systemic challenges to workforce development in the metro-region, where evidence of a significant skill mismatch stymies regional economic growth. Over the long term, the metro-region will need to build a labour force that is more adaptable to the changing needs of the market. Skill shortages are also present within a number of green sectors (particularly the building, energy and recycling sectors) and across the skill spectrum (from low-skilled to high-skilled workers). Second, to leverage the region's innovation assets, policymakers could more purposefully foster the growth of key green clusters, in tandem with the metro-region's wealth of research institutions and community colleges. A stronger venture capital base is needed to keep young talent from moving to the coasts and to attract and retain start-ups in the region. Third, with one of the highest numbers of local governments among OECD metro-regions, Chicago could improve governance by fostering greater co-operation among the metro-region's existing institutions, improving performance measurement tools, and promoting and attracting green firms. Finally, US federal policy has an important role to play in fostering green growth within the metro-region by supporting green R&D, removing legislative obstacles, and providing clear signals on carbon pricing.

Making workforce development work for green growth

Address systemic challenges to workforce development

Evidence of a skill mismatch throughout the metro-region, which extends well beyond the green sector, poses a pressing challenge in terms of human capital. The local workforce does not currently correspond to the skill demand of local industries, due to i) the region's weakness to attract high-skilled labour, ii) insufficient alignment of training services with business needs, and iii) a fragmented workforce development infrastructure. While the higher education infrastructure in the Chicago Tri-State metro-region is of high calibre, many of the young, well-educated workers leave the metro-region upon

graduation. This is partly due to weak regional job creation, but it is also connected to a lack of information from the private sector to orient young professionals toward existing needs and opportunities in the region. Public authorities could strengthen existing institutional mechanisms to intensify a more comprehensive region-wide dialogue between training service providers and the private sector. The resulting information-sharing could allow a more efficient allocation of scarce resources to the large number of training services and providers within the currently highly fragmented workforce development infrastructure.

In the long run, in order to ensure the match of local skill supply with local skill demand – and hence secure the region's resilience to external trends and shocks – the Tri-State metro-region will need to train a labour force that is adaptable to the changing needs of the market, and build skill-supply systems that are responsive to the changing needs of business. Engendering this adaptability will require a dual approach:

- First, by ensuring that basic educational establishments are of sufficient quality to guarantee that the labour force – both skilled and unskilled – can leave school with a high level of basic skills, both cognitive (literacy and numeracy) and non-cognitive (the ability to analyse, problem-solve, communicate).

- Second, workforce adaptability will require an ongoing dialogue with the private sector. Both priorities will require supply co-ordination: vertically – in order to ensure that individuals are not left behind, falling through the cracks between educational progression and job market entry, and horizontally – to ensure that the private sector is able to interact with the disparate training and education service providers – both public and private – to ensure that their skills needs are being met on an ongoing basis.

Tackle skill shortages in the green sector

While present across the economy, skill shortages are particularly acute in several green sectors, notably in the building, energy and recycling sectors. Even the green jobs at the lower end of the skills spectrum will require specific training, calling for an engagement by both the public and private sectors. It is important that workforce incentives be built into new environmental policies and green industries are taken into account in workforce development services. Necessary resources are available for example through the 21st Century Workforce Development Fund, which prioritises green industry workforce development, and the Illinois Green Energy Network (CGCI, 2009) (Box 3.1). Job growth is seen as being largest in the sectors of buildings and transport. A comprehensive and standardised workforce development strategy is needed to develop and co-ordinate related training programmes. Such a strategy should offer training for multiple entry points into the sector, and pay particular attention to the potential of local hiring, "first source" agreements with publically funded development organisations, and the actual need of contractors. The transportation sector may not require a new approach to workforce development, as much of the skills associated with upgrading or expanding the public transportation network do not represent a change from past skill sets.

Box 3.1. Illinois Green Energy Network (IGEN)

The Illinois Green Energy Network was launched in 2008 as a consortium of all 48 Illinois community colleges dedicated to the training and education of a green workforce and deployment of energy conservation and green technology. With financial support from the Illinois Governor's Office and Illinois DCEO, IGEN works continuously to leverage the strengths and contributions of individual colleges to benefit all colleges and their communities. IGEN combines community colleges education and training capabilities with research and technical expertise from universities and green businesses. IGEN partnerships focus on the critical problems associated with the green economy that can be solved together, but not alone. The mission of IGEN is to establish best practices in greening communities and campuses, promote energy efficiency, and drive growth of the green economy. It's strategic goals include:

- Green Campus – Enabling colleges to serve as sustainability demonstration sites by making sustainability a guiding principle for all institutional practices, promoting initiatives that reduce energy use and the environmental impact.
- Green Curriculum – Providing assistance and training to college faculty and staff to integrate sustainability and green economy content into most disciplines and in general education programs.
- Green Careers – Identifying, developing and expanding quality green job/career training for students and workers, effectively informed by community and employer partnerships (balancing demand/supply).
- Green Communities – Serving as regional and sector partners for mobilising community and employer engagement, fostering community education, and supporting action for environmental sustainability.

The 18 community colleges of IGEN in the Chicago region are partnering to bring training in energy efficiency, building codes, energy auditing, and green construction. In October 2011, IGEN received a USD 19.3 million grant from the Department of Labor to develop 33 stackable curricula in green career fields such as architecture, local agriculture, bioenergy, renewable energy, and advanced green manufacturing. The materials developed through this grant will use the Department of Energy open source platform for national training for energy.

Source: Illinois Green Economy Network, *www.igencc.org/about-us.*

There is currently a shortage of qualified labour to meet green sector demand for energy-efficiency retrofits. Job growth from energy efficiency retrofits ranges from low- to high-skilled jobs, some of which will require training. In the case of residential retrofit projects, for instance, most tasks will involve the installation of insulation and window replacement, both of which tend to be more labour-intensive than the heating/ventilation/air conditioning (HVAC) or electrical work likely to occur on retrofit projects in large commercial buildings (Schrock, 2009; Schrock and Sundquist, 2009). Insulation jobs are relatively low-skilled, while window replacement jobs involve semi-skilled carpentry experience. Regardless, on-the-job training may suffice, as formal credentials in carpentry are usually not required. By contrast, electrical and HVAC workers will likely need to attend accredited training programmes at community colleges or through their local trade union. For example, to support the transition to green jobs, in 2008 the Mechanical Contractors Association of Chicago established a green construction institute, to providing training to local building contractors, apprentices and journeyman of United Association of Pipe Fitters Local 597 (MCA Chicago, 2011). According to one analysis, 2 200 jobs will be created by full implementation of the retrofit programme called for by the Chicago Climate Action Plan (Schrock, 2009), but given that this is a small fraction of total construction employment in the region, and because there is currently a large volume of skilled trades people currently unemployed (CWIC-CJC, 2010), it is likely that current training programme will suffice.

The renewable energy workforce ranges from high to low-skilled jobs, but the need in the Chicago Tri-State metro-region is stronger for the higher skilled segment. Renewable energy development creates jobs primarily in sales, finance, operations and engineering, the latter being also critical for design and implementation. Medium and lower skilled workers are needed for the installation and maintenance of renewable energy technologies. The training of engineers is most effective if administered in connection with actors operating in the renewable energy sector, such as at the Energy Resources Center at the University of Illinois at Chicago (Schrock, 2009). In regards to wind turbine manufacturing, the existing efforts to inform and retool local manufacturers should also include skill upgrades of the manufacturing workforce as necessary for working for original equipment manufacturers of wind turbines. To this effect, the work done by the Chicago Manufacturing Center, Jane Addams Resource Corporation and the Chicago Manufacturing Renaissance Council is leading the way, but could improve if complemented with a stronger workforce training component (Schrock, 2009).

Smart grid projects will tend to require a highly skilled workforce, both in their design and installation. At the development level, projects can involve those trained in electrical and mechanical engineering and computer science. Firms designing component parts for the smart grid – be it switches, battery storage devices, or building energy control systems, will similarly tend to require advanced knowledge obtained at the university or post-graduate level. Chicago is well positioned in this regard, with respected programs at the University of Chicago, Northwestern, the University of Illinois-Chicago, IIT, and other top colleges in the area. Argonne National lab and IIT are engaged in leading edge research on battery storage devices and microgrid development, and to the extent these efforts can serve as the hub of greater business development in the region, these universities may find it helpful to expand their offerings, including in the area of executive education programs. On the implementation side, ComEd's unionised workforce of trained linesmen and other private electricians would be responsible for installing new technology on the grid itself or in homes and businesses, which may require some modest skill upgrades.

As the skills in the recycling sector vary greatly, it poses challenges for workforce training. Schrock (2009) notes that there is no typical recycling job, as jobs range from collecting, sorting and remanufacturing activities. Some jobs involve construction and deconstruction skills, while others involve more traditional retail sales functions. Depending on the commodity being targeted, semi-specialised skills may be required, such as those involved in the removal of ozone-depleting refrigerants from old appliances. Other jobs may involve safety hazards, such as the sorting of glass jars and bottles passing by on a picking line, or the removal of valuable building materials from homes and businesses with asbestos or lead paint. There are a few training programmes in the region that touch on recycling/reuse issues, and organisations that provide on-the-job training through their building material reuse stores (Schrock, 2009).

Leveraging innovation assets

The Chicago Tri-State metro-region and the Chicago-area 21-county region both have strong green research and development (R&D) assets that contribute to green innovation. Existing research laboratories in the metro-region are already contributing to green firms' R&D. For example, the 1 200 researchers at Argonne National Laboratory, a US Department of Energy-funded research laboratory operated by an academic consortium, undertakes a range of research useful to green firms, including research related to climate science, pollution remediation, impacts of energy production, vehicle efficiency and batteries, environmental technology, alternative fuels and carbon sequestration. There is a long history of research at Argonne being commercialised by industries around the region or as new ventures. NextGen is one of the most recent technology spinoffs emanating from the lab's energy division, focused on the use of conductive liquid nanoparticles as the substrate for a new type of thin-film solar technology (Clean Energy Trust, 2011a). Argonne has also recently licensed technology to a local smart grid software firm and battery technology to General Motors for use in its new Chevy Volt electric vehicle (Clean Energy Trust, 2011b). Other licensing or collaborative research opportunities exist in several key green growth areas, including grid security and infrastructure and recycling (Argonne, 2011). In the Chicago-area 21-county

region, the Milwaukee metro-region is home to the largest water-technologies cluster in the US. This is thanks in no small part to the Milwaukee Water Council, which convenes firms and relevant research institutions, including the University of Wisconsin at Milwaukee's Great Lakes Water Institute and the School of Fresh Water Sciences (Box 3.2).

Box 3.2. Milwaukee Water Council

The Milwaukee Water Council advances the interests of more than 150 companies and research institutions located in the greater Milwaukee region, all of whom produce goods, services, or research that relates to water in some way. Formally established in 2009, the Council grew out of an analysis launched by officials from the Milwaukee 7, a non-profit economic development organisation focused on the seven-county region around Milwaukee, Wisconsin.

The Milwaukee 7 identified a wide range of firms in the area that had at the core of their business an interest in water quality, water supply and distribution, water recreation, or water engineering. Some of these firms have been in the area for hundreds of years, but until the Council was created, few know that these firms were located nearby or recognised that they shared a common interest. The region also had a huge asset in its midst in the form of the Great Lakes Water Institute at the University of Wisconsin at Milwaukee, which uses land secured by the Council to test and showcase cutting edge water treatment technologies.

Milwaukee 7 water companies

Category	Within 7 Counties	Outside 7 Counties
Water/Wastewater Treatment Systems	15	5
Industrial Water Process Systems	6	11
Water System Products: Non-mechanical	7	4
Water System Products: Mechanical	31	2
Water System Components	36	17
Chemical/Biological Treatment Producer	7	6
Engineering/Planning/Software Services	19	13
Maintenance Equipment and Services	4	2
Distributor	9	3
Well Equipment and Services	5	0
General Consumer Products	10	2
Miscellaneous Product Manufacturers	3	2
Total	152	67

Source: White, S. (2011) Data provided in personal communication on 25 July 2011 by Professor Sammis B. White, University of Wisconsin Milwaukee, School of Architecture and Urban Planning, Milwaukee, WI, US.

An early census of the water-related firms in the area found their core business operations are quite diverse, with half of the firms involved in the manufacture or distribution of various water components (metres, pumps, valves, filters, monitors, heaters) used by government, businesses, or homeowners. Twelve% of firms are solution providers working all over the world to satisfy water supply or treatment needs of cities and regions (White and Lenz, 2009). The economic activity driven by these firms is sizable, as collectively they employ roughly 20 000 people in the immediate area. Five of the eleven largest water firms in the world have operations in the Milwaukee region, with their local operations doing USD 10.5 billion in business annually, the equivalent of 4% of the total global water market.

The Water Council has launched a venture fund to provide capital to water start-ups and begun work on business incubator. The Council worked with University of Wisconsin at Milwaukee and the City of Milwaukee to procure land adjacent to the School of Fresh Water Sciences for testing and showcasing cutting-edge water treatment technologies.

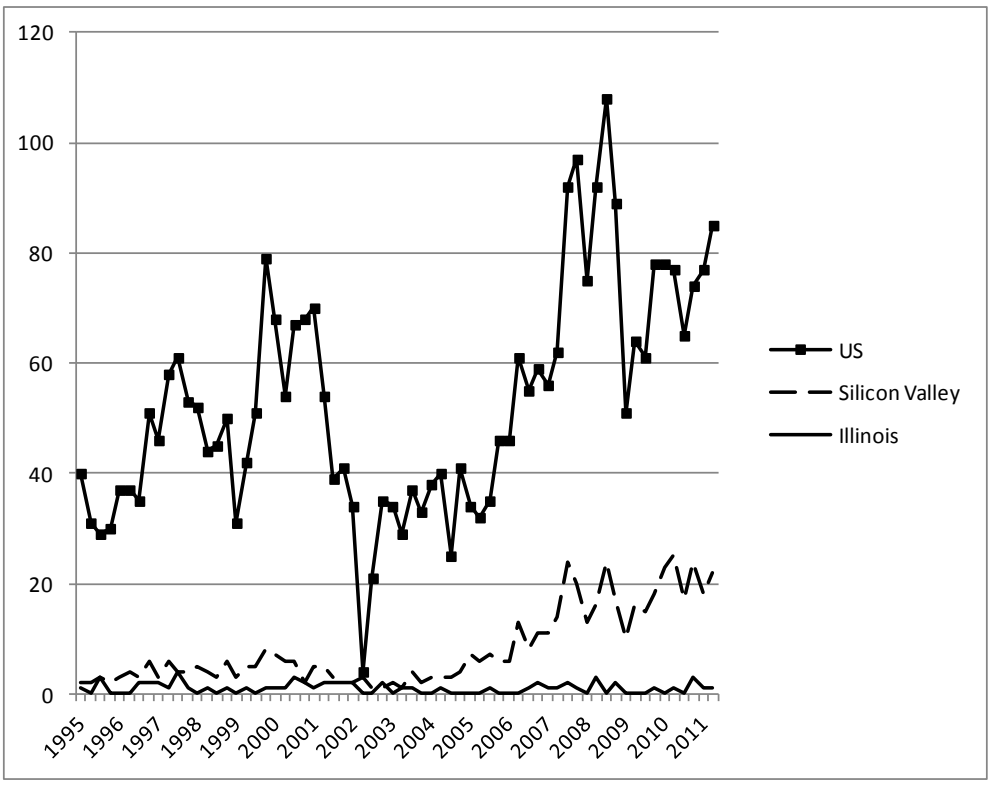
The world has also taken note. Milwaukee was selected as one of 14 Global Compact Cities, deliberately chosen for the region's focus on water quality issues. Universities around the world are now in conversation with University of Wisconsin at Milwaukee about research partnerships, while the National Science Foundation has awarded UW-M and Marquette USD 675 000 for research on seven different projects over the next five years. The Council helped arrange another USD 1.5 million in private sector donations to supplement that amount.

A stronger venture capital base is needed

Despite the Tri-State metro-region's green research assets, R&D in the region has dropped and venture capital for energy-related start-ups remains low. While local research institutions do engage in research that benefits local green firms, venture capital for industrial/energy start-ups is still largely focused on the coasts. Total regional employment in the R&D sector declined by roughly 40% between 2000 and 2009 (CMAP, 2010a). Investments in the industrial/energy sector in Illinois are significantly lower than in the Silicon Valley of California, particularly in the past several years as venture capital levels have rebounded (PWC/NVCA, 2011) (Figure 3.1). Between 1995 and 2011, the industrial/energy sector in Silicon Valley attracted an average of 13 deals/year, compared to 3.6 deals/year in Illinois. The deal value is also widely divergent, with deals over the 1995 2011 time frame totalling USD 7.7 billion for Silicon Valley-based industrial/energy start-ups, as compared to USD 414 million for Illinois-based firms and USD 26.5 billion for the US overall (PWC/NVCA, 2011). Firms in the Tri-State region report that funds for start-ups and major investments are more readily available than for the middle range of VC investments. There is some evidence that start-ups hatched in the Chicago region often end up relocating to either the east or west coast as a precondition to the receipt of venture capital, indicating how important it could be to develop a strong venture capital base that prioritises business investments in the region (CMAP, 2010a).

Figure 3.1. Number of Venture Capital Deals in the Industrial/Energy Sector

(Q1 1995 - Q2 2011)



Source: PWC/NVCA (PricewaterhouseCoopers and National Venture Capital Association) (2011), Money Tree Report (Historical trend data for the Industrial/Energy sectors 1995-2011). Data provided by Thomson Reuters, *www.pwcmoneytree.com/MTPublic/ns/nav.jsp?page=historical*, accessed 28 August 2011.

Foster the growth of key green clusters through an innovation ecosystem

To drive R&D and further exploit the potential of existing assets, stakeholders in the Tri-State region could be more proactive in building and sustaining inter-university strategic alliances. While different forms of *ad hoc* co-operation occur among the region's laboratories and universities, a more deliberate, strategic focus for their joint actions is needed. The University of Chicago and Northwestern University, among the region's most prominent research-intensive universities, are reported to have relatively ad hoc relationships. However, some university officials are beginning to think more strategically about regional strengths. There are multiple examples of more strategic consortiums of universities in OECD regions with the goal of creating greater critical mass to compete for national resources and global recognition. Examples include the Georgia Research Alliance in the US, the N8 Research Partnership in the North of England. In those cases the consortia help co-ordinate research and encourage partnering with industry to maximise the impact of the research base (OECD, 2008). The Illinois Science and Technology Coalition (ISTC) and the Wisconsin Technology Council are well placed to trigger such collaboration and act as "honest brokers" with the different universities across the Tri-State region, given that many local higher education institutions are partners in the coalitions.

Two organisations in the state of Illinois seek to support clean technology business development by focussing on breakthrough technology that can be commercialised. The Illinois Science and Technology Coalition (ISTC), a membership-based organisation established in 2009 and supported by the State of Illinois and 75 other public and private sector partners, currently focuses energy and energy storage as one of four priority areas. In the energy sector, the ISTC has partnered with the State of Illinois, the City of Chicago, several universities, the state's energy regulator, several energy companies, and a leading real estate organisation to examine ways to facilitate smart grid deployment around Illinois. The ISTC played a key role in supporting an Illinois Institute of Technology application for USD 12.9 million in stimulus funds focused on smart grid workforce training. A key goal is to focus on areas where Illinois businesses and universities can both fill a market gap and gain distinction with the marketplace, enhancing the state's overall reputation as the ideal home for science and technology companies. The Illinois Clean Energy Trust, a non-profit clean energy business accelerator, conducts parallel but complementary work by connecting researchers with entrepreneurs and financiers to help commercialise new energy-related business opportunities. The Clean Energy Trust was founded in 2010 by a group of local venture capitalists and market experts interested in expanding the clean tech market in Illinois and the larger Midwest region, with seed funding was provided by the US Department of Energy (Box 3.3). An issue for policymakers is the extent to which these initiatives align with other green growth efforts around the region. For example, several clusters identified thus far by RW Ventures as good candidates for growth overlap with the sectors targeted by the ISTC. Co-ordination between these green growth efforts will improve their outcomes.

Box 3.3. The Illinois Clean Energy Trust

The Clean Energy Trust partners with several local universities and labs, charitable foundations, corporations and venture firms, and trade groups to provide business development support to start-up firms. The most promising ideas may be eligible for grant, loan, and equity finance support

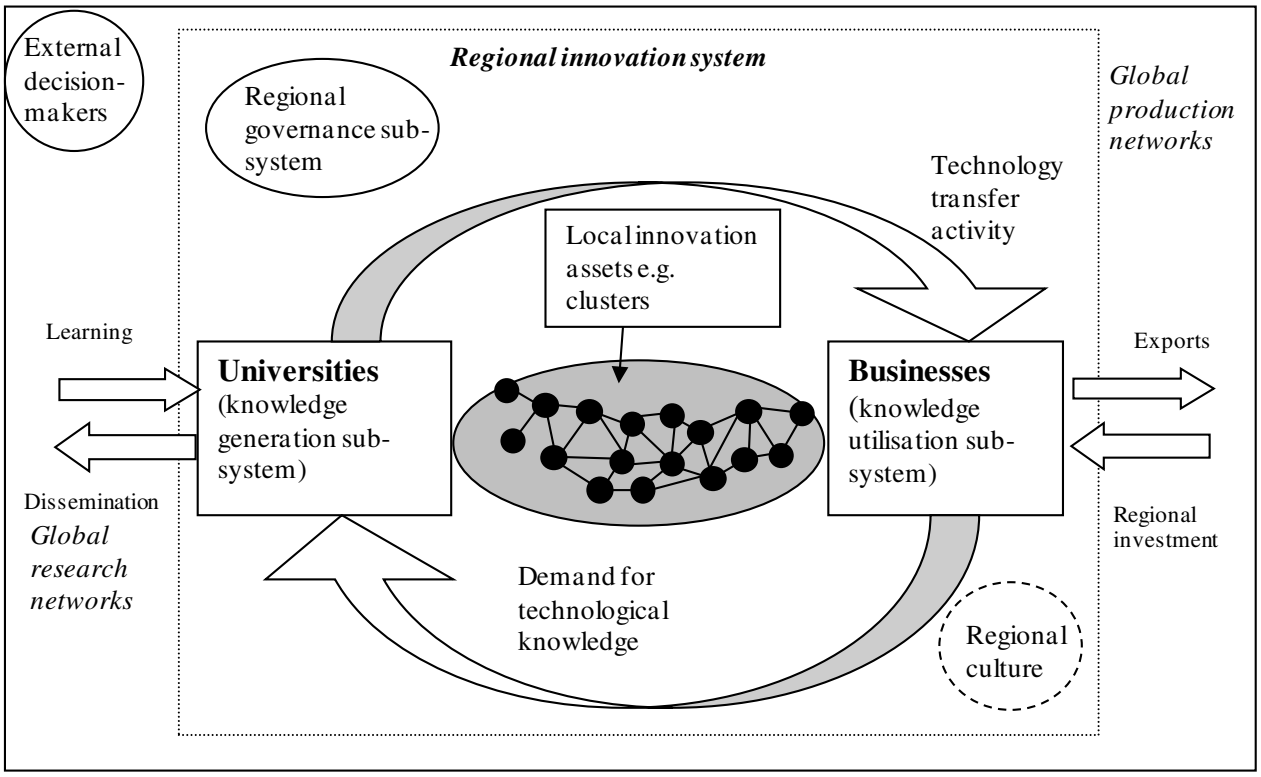
One of the Trust's first major initiatives was a USD 130 000 Clean Energy Challenge, which attracted 70 applicants from across the state who vied for a USD 100 000 early stage business prize or USD 30 000 concept-stage funding prize. Of the fifteen finalists, five firms focused on different types of solar technology, while three firms focused on different energy efficiency technologies. Three firms also specialise in smart grid technology. Finalists received mentoring prior to their pitches to top venture capitalists, corporate investors, and business leaders (Clean Energy Trust, 2011c). The second annual Clean Energy Challenge will give away USD 200 000 in cash prizes in early 2012, with eligibility broadened to include early stage firms located in Illinois, Wisconsin, Michigan, Indiana, and Ohio.

The Trust has also begun focusing on the next generation of entrepreneurs in the region, hosting a week-long Summer Institute on Sustainability and Energy in August 2011. Fifty graduate students and college undergraduates attended lectures, panel discussions, and participated in tours of energy facilities. Students were also divided into teams to tackle projects on water management, building retrofits, smart grid, and electric vehicles. Industry experts met with the teams to provide feedback on their proposed solutions, followed by a networking reception.

Source: Clean Energy Trust (2011), Clean Energy Trust Announces Finalists for the First Clean Energy Challenge, *http://eon.businesswire.com/news/eon/20110125006948/en/Clean-Energy-Trust/entrepreneur-competition/business-competition*; Clean Energy Trust (2011) Clean Energy Trust Co-Produces UIC Summer Institute on Sustainability and Energy, *www.cleanenergytrust.org/press*, accessed 28 August 2011

For green growth clusters, it is important to focus on a range of interconnected sectors rather than restrict efforts to narrowly defined sectors. There is evidence that increasingly innovations are achieved through the convergence of scientific fields and technologies. This convergence requires spaces for interaction and cross-fertilisation of different knowledge domains. The concept of an innovation ecosystem is important: innovation is a product of the interaction between a series of public and private actors, both individual (entrepreneurs) and institutional (universities, research centres, big firms, small start-ups, governments) in a given geographic space; innovation networks usually sustain these linkages and extend them to related actors in other ecosystems beyond the boundary of the given geographic space (Figure 3.2) . The Milwaukee Water Council demonstrates the value of thinking in terms of an innovation ecosystem, as it operates under the premise that gains in one aspect of the water sector (e.g. water distribution and treatment) could have significant knock-on benefits in other related business sectors (e.g. pump and pipe manufacturers) and even areas where there might be a much more tangential relationship (e.g. water-related toys/recreation). Similarly, one could imagine in the buildings sector a situation where the Energy Impact Illinois program is expanded to serve as a convening mechanism bringing together architects, engineers, financial institutions, university researchers, energy technology firms, and installers to systematically examine how retrofit projects could promote made-in-Illinois technology or building materials. All would theoretically benefit from a comprehensive strategy promoting new green building construction or building retrofits, but the level of growth in any individual sector would obviously depend on the particular green building policies that are pursued.

Figure 3.2. Regional Innovation Ecosystems



Source: Benneworth, P. and A. Dassen (2011), "Strengthening Global-Local Connectivity in Regional Innovation Strategies: Implications for Regional Innovation Policy", *OECD Regional Development Working Papers*, 2011/01, OECD Publishing, based on Cooke, P (2005), "Regionally Asymmetric Knowledge Capabilities and Open Innovation: Exploring 'Globalisation 2' – A New Model of Industry Organisation", Research Policy, Vol. 34.

Private-sector intermediary organisations, such as the Milwaukee Water Council and the Illinois Clean Energy Trust, can be considered "brokers," as they help articulate research expertise and business needs that are critical for maximising regional "ecosystem" linkages. The most effective brokers often come from the ranks of business service professionals-individuals who have strong networks and relationships among inventors, transformers, and financiers. Economic development practitioners are less likely to play the broker role because they are expected to provide marketing, recruitment, information collection, technical assistance, or other services. Brokers act as facilitators; they help identify current and potential sources of innovation in a region. They help connect innovators to other key actors in the innovation ecosystem often by facilitating collaboration, thereby contributing to the acceleration and expansion of innovation activity in the region. In the tri-state region, key institutional players, whether in the universities or the private sector, should seek to identify and maximise the role of innovation brokers to enhance innovation capacity in priority business clusters region-wide.

A comprehensive strategy for a regional approach to green growth clusters in the Tri-State metro-region needs further analysis, since the needs of each cluster is different and green growth clusters are only emerging. There are significant variations in the nature of technologies or innovations, product lifecycles, skills gaps and other factors that are cluster specific. Successful examples from other OECD countries, such as the Øresund region (Box 3.4) which builds around a range of innovation platforms, can serve as example. Only through the identification by cluster actors themselves and associated studies can more clear recommendations be addressed by the cluster members themselves or through public policy efforts. The recommendations by both the Chicago Metropolitan Agency for Planning (CMAP, 2010a), in its *GoTo*

2040 report and others such as The Chicago Community Trust to further explore cluster needs are important for taking different components of the innovation system to the next level.

Box 3.4. The Øresund region as an inter-state innovation and economic development strategy

In 1997, the Øresund University Network was created to coordinate cooperation between 12 universities in the two-country Zeeland-Copenhagen-Malmo-Skane region, which today count 165 000 students and 10 000 researchers, with a mandate to facilitate information sharing, research collaboration, network activities and cluster building (Oresund, 2011b). At the same time the Øresund Medicon Valley Academy (MVA) was created to coordinate, network and promote local research and business in the human life sciences in the region in order to improve knowledge exchange and innovation between the private and public sector and to make the region attractive to foreign stakeholders. In recent years the MVA has shifted its focus from academia towards business and today Medicon Valley is recognised as one of the most attractive bioregions in the world.

An important first step for the cross-border region's success was its branding as the Øresund Science Region (ÖSR). Oriented by a 'double triple-helix' model that involved regional authorities, businesses and universities in both countries, the Øresund University Network acts as the umbrella organisation for seven research and innovation platforms that bundled research and innovation cooperation in the sectors of health and pharma (MVA), IT, environment, food, logistics, digital entertainment and nano-technology. The University Network:

- Took over the coordination of 8 higher education institutions in the trans-border region and admits students to any of the Øresund Network institutions enabling them to move and take part in the many educational opportunities offered by the other institutions without physical and administrative hindrances.
- Enabled researchers and teachers to share knowledge, tools and ideas with colleagues in cross-border networks; enabled technical staff and administrators to compare practices on how to address challenges in inter-university collaboration.
- Some of the Network's innovation platforms include the following:
  - *Øresund Environment* provides a regional forum for businesses, universities and local governments for networking and knowledge exchange, and facilitates and promotes new sustainable ideas and projects within energy, building processes, cleantech, eco-mobility, green healthcare, CSR and environmental leadership education.
  - *Øresund Logistics* is a Danish/Swedish non-profit network organisation developing and supporting logistics in the Øresund Region. Øresund Logistics works with the "Double-Triple Helix"-model, working cross borders for the purpose of bringing regional authorities, industries and universities together in an in-depth cooperation. It identifies initiates and coordinates research and development projects in the Öresund Region; facilitates network activities, seminars, workshops and conferences for the interested stakeholders; disseminates knowledge on advanced logistics and supply chain management; acts as a knowledge provider for branding the Øresund Region as a hub for efficient, innovative and environmentally sustainable logistics- and transport processes.
  - The *Øresund Materials Innovation Community (ØMIC)* is a triple helix partnership established to ensure the best possible support for research and innovation in and around the scientific facilities, and to make Northern Europe the central hub for research and innovation in hard, soft and biological materials with a focus on Grand Challenges (from clean tech, green energy and supercomputing to structural biology and pharmaceuticals). It focuses on optimising collaboration and coordinating activities in community development, education, early business planning, knowledge sharing in sciences parks, regional branding, bibliographical investigation, and future planning, grounded in the Øresund region but open to Northern Europe, Europe and the World.
  - *Oresund IT* is a non-profit organisation that provides knowledge and contacts among ICT actors in the Øresund Region. Its goal is to brand the ICT cluster of the region to attract more investments, talent and research, and to deliver a unique value by combining Swedish and Danish best-practices. Partners include 90 ICT companies, education and research institutes, and companies with large IT-departments that benefit from the network, as well as other members providing various services and investments to the industry.
  - *Øresund Entrepreneurship* is a cross-border organisation that promotes entrepreneurship education in higher education and focuses on a thematic approach towards entrepreneurship at universities.

Source: Streijffert, B. (2008), "Øresund Science Region: Cross-border triple helix collaboration", Briefing to the European Commission, Øresund University, Lund; *www.oresund.org; www.mva.org.*

Multi-level governance mechanisms to increase green growth

As with most OECD metropolitan areas, Chicago's institutional framework is characterised by a high level of fragmentation. This fragmentation creates a complex policy environment in which public services can be duplicated and region-wide consensus is difficult to reach on medium- and long-term goals. The Tri-State metro-region alone contains over 1 700 distinct units of government, each with its own set of revenue and service provision responsibilities and authorities; the Chicago-area 21-county region includes over 2 000 local governments; and the state of Illinois has the nation's largest number of local governments, at 6 994 (US Bureau of the Census, 2007 and CMAP, 2010a). By international comparison, the Paris metro-region, which is known to be one of the most fragmented metropolitan areas in the OECD, includes a regional authority in addition to 1 281 cities and over 100 inter-municipal bodies. Local authorities in Greater London, in contrast, are composed of the Greater London Authority, 32 London boroughs, and the City of London. The Greater Toronto Area consists of one large one-tier municipality (the City of Toronto), four regional municipalities, and 23 lower-tier municipalities.

Encourage co-operation among existing regional planning institutions

Improving green growth outcomes in the Chicago Tri-State metro-region calls for a more intentional, co-ordinated effort on the part of municipal and regional institutions. The three Tri-State metropolitan planning organisations (MPOs) could deepen their existing partnership to co-ordinate more deliberately across jurisdictional boundaries. For planning purposes, the functional geography of the Tri-State metro-region is covered by three MPOs which are ideally placed to contribute substantially to the creation of a Tri-State regional vision and agenda: the Chicago Metropolitan Agency for Planning (CMAP); the Southeastern Wisconsin Regional Planning Commission (SEWRPC); and the Northwestern Indiana Regional Planning Commission (NIRPC). These regional planning agencies offer several advantages, as they are equipped with a comprehensive, multi-sector vision of their jurisdiction, including both the challenges faced in a given domain (transportation, housing, land use), as well as the potential complementarities and trade-offs between these issues. They also possess a wealth of regional quantitative data in a variety of areas pertinent to urban and metropolitan development, along with solid experience in engaging citizens to help shape a regional vision. The leaders of these organisations have, by law, limited geographic mandates,[25] but should nonetheless meet and collaborate regularly where possible. A 2002 multi-state accord between NIRPC, SEWRPC, and CMAP, amended in 2008 to include the Southwest Michigan Regional Planning Commission, already exists and has been described as an "historic agreement in which the planning agencies have committed to work together as they consider major environmental and economic issues, enabling planning at the watershed or aquifer scale without the limitation of traditional political boundaries" (NIRPC, 2011). The accord originally led to research and projects related to regional water resource management, for example, the establishment of the Southern Lake Michigan Regional Water Supply Consortium in 2005 (CMAP, 2010b). More recently, the directors of the four constituent regional planning agencies have discussed coordination of projects to develop regional trails, with progress described by CMAP (2010c) in its report on regional greenways and trails in Northeastern Illinois.

Region-wide planning and co-ordination is crucial to improve the performance of the regional transport system, a main component of green growth. To facilitate regional co-ordination on transportation, the Tri-State Region would benefit from a long-term, cross-border regional transportation plan. Local officials understand the need to work with their counterparts in nearby municipalities, counties, and states, to maintain and improve the region's transportation infrastructure and services. These officials would do well to build on successful instances of intergovernmental cooperation and apply lessons learned to more

25 . Each MPO is responsible for engaging in integrated planning in the areas of transportation, housing, land use, open space, and economic development within their state-mandated metropolitan jurisdiction and has recently been engaged in developing metropolitan plans.

difficult conflicts and issues. The expertise of institutions like CMAP, NIRPC, SEWRPC and the other metropolitan planning organisations responsible for regional transportation planning will be essential – all the more so, given these institutions' ability to engage in long-term planning for the range of social, economic and environmental issues that will determine the region's long-term viability and attractiveness.

Transportation investments will require greater vertical co-ordination and reforms at the state and federal level, with priority given to projects with the greatest region-wide return. Regional stakeholders, including elected officials, business leaders, and policy makers, should renew efforts to reform state grant funding allocations to ensure that the Chicago metropolitan area, which is the economic engine, gets a commensurate share of transportation and other infrastructure funding. At the federal level, more efforts could be made to allocate scarce dollars to projects producing the greatest value, with a preference for multi-modal and multi-jurisdictional infrastructure projects (transit systems, bridges, roads, etc.). Similarly, grant programmes could contain financial incentives to local governments to collaborate and co-ordinate funding and programme requests, particularly across state borders. At the state and local level, projects should be prioritised based on expected returns and benefits at the regional level, so that the most effective and value-generating projects are undertaken.

Improve tools to measure performance

A region-wide effort to track progress on green growth goals could help decision makers gauge the effectiveness of different greening or green growth development efforts. This could build off MetroPulse, a regional indicators system designed by CMAP and the Chicago Community Trust to help track the implementation of the *GoTo2040* Comprehensive Regional Plan.[26] The vast majority of the thirty-seven indicators are transport-related, providing insights into the effectiveness of transit-oriented development planning efforts or public transport system operations. Other green growth-related indicators look at air and water quality issues, energy use, green infrastructure development, and waste and pollution issues. However, few MetroPulse indicators track the growth of green firms or clusters, and would thus need to be complemented with additional data. In the case of one of the sectors identified as a specialisation in the Chicago Tri-State metro-region, electric vehicles, tracking the number of electric vehicles registered with the state Department of Motor Vehicles or the number of EV recharging stations deployed around the region – would provide very clear indicators of progress in this sector. For the building energy efficiency sector, it would be valuable to collect data on the number of certified green buildings in the region, or the number of green alleys or green roofs installed around the city. Statistics on tree planting (or tree census data) are another readily definable metric, as is the total number of distributed power systems (*e.g.* solar PV, small wind, CHP) deployed on the local grid. The latter might need to be provided by ComEd, or could be tracked through building permit data.

There is no shortage of individuals or institutions in the Tri-State metro-region engaged in measuring performance in various policy areas, but the capacity to harness this information and to present it in a rational, integrated fashion that coherently "tells the region's story" is lacking. Therefore, MPOs, key private-sector and not-for-profit stakeholders should consider establishing and funding a research centre in the Tri-State metro-region whose mandate would be to network with existing researchers and university responsibility centres to collect relevant academic research, data and indicators with the aim to provide a sound, up-to-date evidence base for the development and implementation of policies designed to address the strategic issues facing the Tri-State metro-region as a whole, and green growth in particular. This research centre could link with the local, county, state and federal authorities responsible for the policies and programmes that affect economic development, workforce development, innovation and green-growth capacity and transportation and logistics in the metro-region. Sharing key data and indicators on an on-going basis with all levels of government decision-making institutions that materially affect policy

26 . *www.metropulsechicago.org*

outcomes and economic performance in the metro-region is of vital importance to ensure that the policies and programming being delivered in the region truly reflect the reality on the ground and can respond effectively to the challenge faced by the region. The research centre could also maintain regular on-going relationships with key public, private and community stakeholders in the region to share information, monitor progress in the development and implementation of key region-wide strategic plans and recommend changes to these plans where changes are warranted.

Focus efforts on attracting and supporting green firms

Beyond data collection on green targets, regional institutions such as CMAP in Northeastern Illinois, SEWRPC and the Milwaukee 7 in Southeastern Wisconsin, and NIRPC in Northwestern Indiana, have an important role to play in regional co-ordination to value and promote the green firms and investments in the Chicago-area 21-county region. In the short-term, this could take the form of a much-needed inventory of green financing resources and a strategy for pursuing funding opportunities on a 21-county region-wide basis. In the longer term, a regional institution may be needed to provide a convening role for key public and private-sector actors to make difficult decisions across state lines on priorities for infrastructure investment. As the labour market extends across the metro-region, regional information collection on green sector training needs would also be an important step to determining the scale of green training needed. The interdependence between economic development and workforce development planning – and region-wide data and performance indicators to measure success in the implementation of this planning, will necessitate on-going, sustained two-way information exchange between key stakeholders implicated in both exercises.

Attracting and supporting green firms is essential to fostering further regional green growth. Current differences in regulation and competition in state taxes on corporate income, personal income, sales, and property, as well as unemployment insurance (payroll) taxes in the three states make it difficult to imagine a region-wide uniform tax policy. But there are examples of initiatives leading towards greater co-ordination among public sector agencies and through public-private partnerships, even if they occur exclusively within state boundaries. In Wisconsin, the City of Milwaukee has recently completed a comprehensive plan to guide policy, land-use and development decisions in the city (Public Policy Forum, 2011), while the private sector has taken the lead in the co-ordination of a multi-county economic development strategy around Milwaukee, through the formation of the Milwaukee 7. Formed in 2005 and composed of private sector representatives from the seven counties of Southeastern Wisconsin, the Milwaukee 7 aims to assist businesses seeking investment opportunities in the region. The Council is designed to offer a "single point of service" for firms who wish to relocate, expand, or otherwise enter the area. Milwaukee 7 has played an active role in educating local economic development officials about the benefits of co-ordinated development plans, thus building awareness among these professionals about the benefits of less parochial pursuits of business activity and investment. Another example is the Milwaukee Water Council (Box 3.2) that convenes academic researchers, the business community, and civic leaders from Wisconsin and Illinois around a common area of interest and expertise to leverage the 21-county region's freshwater assets in view of establishing Milwaukee as the "World Water Hub" for water research, economic development, and education.

Seek policy guidance from the federal government

National government policies can support or undermine urban green growth initiatives. It is important to identify and remove perverse incentives so as to encourage urban policies that are in line with national goals. The need for policy coherence implies a need to understand the distinct contributions to green growth policies that different levels of government can make. The national framework is particularly important for setting the pricing signals to discourage environmental externalities, such as greenhouse gas emissions. Concerns about distributional consequences should be addressed through national regulations,

particularly the tax and benefit system, rather than trying to ensure that each individual policy measure fulfils both environmental and equity objectives. A strong national framework based on a carbon tax or price will broaden the range of environmentally effective options available to cities. If national policy settings are not supportive, some seemingly desirable city-level initiatives may have limited effect or even generate perverse outcomes. With a strong national framework in place, much can often still be done most efficiently at the level of regions or cities. For example, policies to ensure adequate skills in making existing buildings more energy efficient or for encouraging clusters of green industry are probably best designed at city level. Even if there is a national framework in place, there must still be considerable scope for place-specific adaptations, since information about local conditions can be crucial to the effectiveness of such efforts. The same is true of policies dealing with urban form and the built environment: while national standards may be needed, much depends on the nature of the existing buildings in a given place, the materials available and the framework for zoning and land use (OECD, 2013).

US federal policies have a direct impact on many aspects of green growth in the Chicago Tri-State metro-region. The funds for renewable energy companies that were available through the US stimulus bill of 2009 are set to end. Much has been made of the US federal government's loans to renewable energy firms that later went bankrupt, defaulting on the loans. However, the US federal government has an important role in providing the conditions that would support long-term green private sector growth. First, the US government can play a crucial role in funding research and development in the green sector, including in the Argonne National Labs. Second, there are key federal legislative decisions that are needed, particularly to resolve the question about priority of repayment of tax-based loans (also known as senior-lien status), which for now stands in the way of any PACE program to allow building owners to repay loans for energy-efficiency or renewable energy technologies through their property taxes. Finally, the green sector would be significantly more attractive to venture capital and other private-sector investment if a price on carbon were established, either through a cap-and-trade system or a carbon tax.

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