

ENERGY USE IN CITIES

H I G H L I G H T S

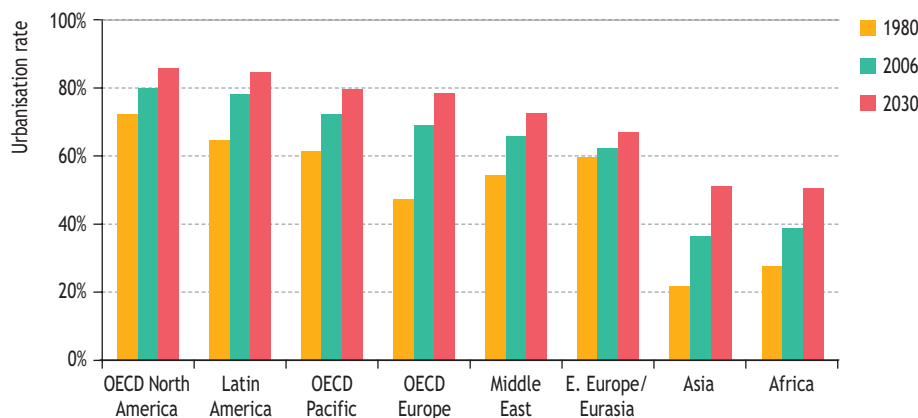
- Cities are a dynamic and vital part of global culture and are the main engines of social, economic and technological development. According to UN projections, by 2030, cities will house 60% of the world's population – equivalent to the total global population in 1986. The geographic distribution of urban population is set to change: while global urbanisation in the first half of the 20th century was dominated by European cities, the majority of urban residents today live in Asia, despite the relatively low proportion there of city residents.
- The scale and pattern of city energy use has significant implications both for energy security and global greenhouse-gas emissions. Alert to the climate-change challenge, some city authorities are actively involved in reducing energy use and CO₂ emissions.
- About two-thirds of the world's energy – an estimated 7 900 Mtoe in 2006 – is consumed in cities, even though only around half of the world's population lives in urban areas. City residents consume more coal, gas and electricity than the global average, but less oil.
- Increases in urbanisation through to 2030 are projected to drive up city energy use to almost 12 400 Mtoe in the Reference Scenario. By 2030, cities are responsible for 73% of the world's energy use. Some 81% of the projected increase in energy use in cities between 2006 and 2030 comes from non-OECD countries.
- Energy use per capita of city residents is slightly lower than the national average in the United States, the European Union and Australasia (Australia and New Zealand). By contrast, city residents in China use almost twice as much energy per capita as the national average, due to higher average incomes and better access to modern energy services.
- The gap between rural and city energy use per capita is assumed to narrow over the projection period in China, but increasing urbanisation pushes up substantially the share of China's energy used in cities.
- By 2030, 87% of US energy will be consumed in cities, up from 80% in 2006. In the European Union that figure will rise from 69% to 75% over the *Outlook* period. Australasian cities' share of energy consumption will rise from 78% to 80% by 2030 and Chinese cities account for 83% of Chinese energy consumption in 2030, up from 80% today.

Why focus on cities?

This chapter analyses the size and pattern of energy consumption in the world's cities and towns today and projected developments through to 2030.¹ Cities (including towns) currently use over two-thirds of the world's energy and account for more than 70% of global CO₂ emissions.² Driven by growing urbanisation, city energy use is set to increase significantly through to 2030: in the Reference Scenario, energy use in cities rises to 73% of the global total and CO₂ emissions to 76%. Given the scale of city energy use and CO₂ emissions, if cities and their authorities were to take action to mitigate climate change, this growth could be curtailed.

Cities are a dynamic and vital part of global culture and are the main engines of social, economic and technological development. From the small cities in the Pacific to the large mega-cities of Asia or North America, cities are home to an ever-increasing number of people. But to provide their populations with the myriad of services demanded, cities need large amounts of energy. Today, much of that energy is fossil-fuel based. As the urban population, economic activity and wealth increase, urban energy use is set to grow. In 2008, half of the world's population live in cities. According to UN projections, by 2030, cities will house 60% of the world's population – equivalent to the total global population in 1986. At the same time, the geographic distribution of urban population is set to change: while global urbanisation in the first half of the 20th century was dominated by European cities, the majority of urban residents today live in Asia, despite the relatively low proportion there of city residents (Figure 8.1). Some of the fastest-growing cities are in Africa.

Figure 8.1 • Regional trends in urbanisation



Sources: UNPD, 2007a and 2007b.

1. Throughout this chapter, "cities" refers to all urban areas, including towns. The terms "cities" and "urban" are used interchangeably. Box 8.1 describes the ways energy data and projections of energy use in cities were prepared.

2. See Chapter 16 for detailed CO₂ emission projections for cities.

Box 8.1 • Methodological issues and city energy data

There is no international consensus on the definition of a city. For reasons of data availability, in this *Outlook* “city” refers to all urban areas, from “mega-cities” to smaller-scale urban settlements. City energy data are difficult to find, often incomplete and rarely in a format that allows comparisons between cities or with national data. Once data are acquired, analysis requires consideration of city boundary issues – what energy was consumed within the city, how to deal with energy supplied from outside the city (for example, power generation) and transit energy consumption (for example, vehicles passing through a city). Many cities are collecting their own data on energy consumption, but there is a lack of standard reporting methods. Various local government associations, for example the International Council for Local Environmental Initiatives (ICLEI), are attempting to establish more uniform data-collection methods.

The global estimates of city energy use and CO₂ emissions presented in this *Outlook* have been calculated on the basis of the detailed energy-consumption projections for the 21 *WEO* regions in the IEA’s World Energy Model. City energy use was calculated using detailed analysis from four regions selected on the basis of the importance of these regions and the availability of city energy data: the United States, the European Union (split into two), Australia and New Zealand combined, and China. These regions account for over half of the world’s current energy consumption. For each of these four regions a detailed analysis of 2006 data produced, for each fuel and by end-use sector, a per-capita ratio of city energy use to national energy use. These ratios were used to derive total final consumption in these four regions. The share of electricity consumed in cities was used to apportion national power generation, regardless of whether the electricity was generated in the city or not. This result was then used to calculate the primary energy used in power generation associated with the electricity consumed in cities.³ Each of the four modelling region’s ratios were calculated using methods appropriate to the data available.⁴

In addition to these four detailed regional analyses, selected major cities in other regions for which detailed data were available, such as Tokyo, Moscow and Delhi, were used to further refine the ratios. We applied the most appropriate per-capita ratios, and the UN urbanisation projections, to the energy projections of the 21 *WEO* regions to calculate energy demand in cities at the global level through to 2030. For OECD regions, the differential between rural and urban per-capita energy consumption is assumed to remain constant over the *Outlook* period. For non-OECD regions, we assume that the differential converges over the *Outlook* period towards the urban/rural differential in OECD regions. Energy-related CO₂ emissions were calculated using national carbon factors by sector and fuel (see Chapter 16 for detailed CO₂ emissions projections).

3. Based on the assumption that the city power-generation mix and conversion efficiencies are the same as those at the regional level.

4. A detailed definition of regions and a description of the methodology for modelling city energy use are available at www.worldenergyoutlook.org.

The scale and pattern of city energy use has significant implications both for energy security and global greenhouse-gas emissions. Alert to the climate-change challenge, some city authorities are actively involved in reducing energy use and CO₂ emissions. For example, London has an aggressive climate-change policy involving a range of activities, such as working in partnership with private sector companies to design, finance, build, own and operate decentralised, low-energy and zero-carbon projects.

The analysis of global city energy use presented here is, to our knowledge, the most in-depth ever attempted. In view of data deficiencies and methodological challenges, however, the results should be treated as no more than indicative.

Current and projected energy use in cities

Our detailed analysis of current city energy use focuses particularly on four regions: the United States, the European Union, Australasia (defined here as Australia and New Zealand), and China. In the first three, city energy use per capita is roughly the same as the national average (Table 8.1). Cities in the European Union tend to use less energy per capita than US and Australasian cities, because of higher population densities, more extensive urban public transport systems, and more district heating. By contrast, cities in China are significantly more energy intensive per capita than the national average as a result of higher incomes and better availability of energy services compared with rural areas. The recent increase in Chinese national per-capita energy consumption – 8.5% per year between 2000 and 2006 – has been driven partly by urbanisation. During that period the urban population in China grew by 3.2% per year, adding a further 91 million inhabitants to Chinese cities.

Table 8.1 • Overview of city energy use and urbanisation rate in regions and countries analysed in depth, 2006

Region	Share of city primary energy demand in regional total	Ratio of city per-capita primary energy demand to regional average	Urbanisation rate
United States	80%	0.99	81%
European Union	69%	0.94	73%
Australasia	78%	0.88	88%
China	75%	1.82	41%

Note: Fuel breakdowns for each region are in the regional section.

Based on the results of our analysis of primary energy use in cities in these four regions, we estimate that around 7 900 Mtoe was consumed globally in cities in 2006 (Table 8.2). This equates to 67% of the world's primary energy demand in 2006, or more than four times that of China – the world's second-largest energy consumer. The proportion of global energy consumed in cities is greater than the proportion of the world's population living in cities. This is because city energy use is related to economic

activity, as well as city population. A large proportion of industrial and commercial activity, which consume a large proportion of total energy, is located in cities. For example, the majority of commercial buildings are located in cities. Urban energy use is also higher than rural energy use because, in the developing world (with urbanisation rates of 30% to 50%) residential per-capita energy use tends to be significantly higher in cities than in rural areas. This is because energy use is related to income and, as noted above in relation to China, city dwellers in the developing world tend to have higher incomes and better access to energy services. The income effect usually outweighs efficiency gains due to higher density settlement in cities. By contrast, city and rural residents in developed countries tend to enjoy similar levels of energy service access. Because of the rapid growth of cities in the developing world, their pattern of energy use will increasingly shape global energy use, though the rural/urban differential is expected to diminish somewhat.

Table 8.2 • World energy demand in cities by fuel in the Reference Scenario

	2006		2015		2030		2006-2030*
	Mtoe	Cities as a % of world	Mtoe	Cities as a % of world	Mtoe	Cities as a % of world	
Coal	2 330	76%	3 145	78%	3 964	81%	2.2%
Oil	2 519	63%	2 873	63%	3 394	66%	1.2%
Gas	1 984	82%	2 418	83%	3 176	87%	2.0%
Nuclear	551	76%	630	77%	726	81%	1.2%
Hydro	195	75%	245	76%	330	79%	2.2%
Biomass and waste	280	24%	358	26%	520	31%	2.6%
Other renewables	48	72%	115	73%	264	75%	7.4%
Total	7 908	67%	9 785	69%	12 374	73%	1.9%
<i>Electricity</i>	<i>1 019</i>	<i>76%</i>	<i>1 367</i>	<i>77%</i>	<i>1 912</i>	<i>79%</i>	<i>2.7%</i>

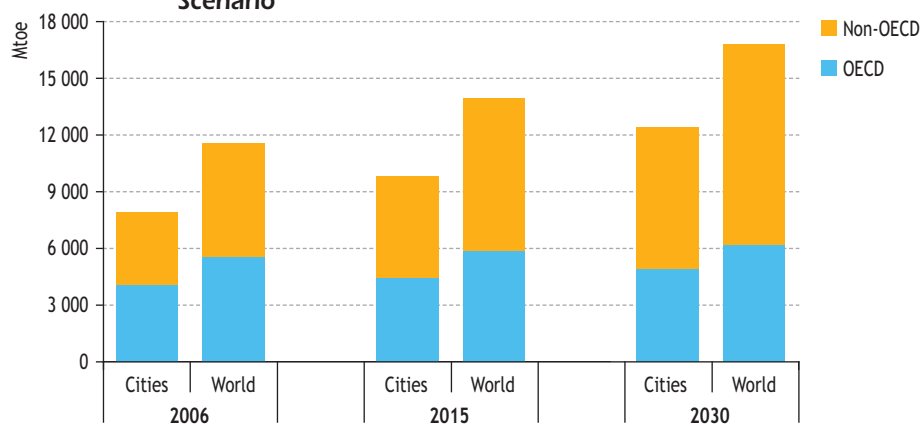
* Average annual growth rate.

Globally, the share of natural gas (82%) and electricity (76%) consumed in cities is higher than the average of all fuels, and much higher than the share of the world's population living in cities. This is due to the more extensive infrastructure in cities for energy distribution and higher appliance-ownership rates in developing cities relative to rural areas. Coal consumption in cities accounts for 76% of the global total, mainly from coal-fired power generation and coal use in urban-based industry in developing countries, such as China. The share of oil consumed in cities (63%) is smaller than the average of all fuels, due to higher penetration of electricity for heating and cooking, and wider use of urban public transport networks. The share of biomass and waste consumption, at 24% globally, is much lower in cities than in rural areas, consisting in OECD cities largely of biofuel consumption and biomass in industry and power generation. In developing countries, traditional biomass and waste is still used for

domestic cooking and heating in cities, but consumption is much less per capita than in rural areas. Some 72% of other renewables are consumed in cities, mainly for power generation in OECD countries.

In the Reference Scenario, global city energy use is projected to grow by 1.9% per year (compared to an overall global growth rate of 1.6% per year), to 12 374 Mtoe in 2030. Its share of global energy use rises from 67% to 73% (Figure 8.2). Non-OECD countries account for 81% of the growth in energy use in cities over the *Outlook* period.

Figure 8.2 • World and city primary energy consumption in the Reference Scenario



United States

Background

Over the past century, the United States has evolved from a largely industrial economy, dominated by the large cities of the Northeast and Midwest, towards a more dispersed, services-oriented economy. This shift has been characterised by growth in suburban areas and smaller cities, along with the expansion of urban areas in the Southwest which are dependent on cars and air conditioning. The proportion of the US population living in urban areas has increased from 40% in 1900 to over 80% today, with most population growth over the 20th century occurring in urban areas (USGCRP, 2001). Over the next 20 years, urban population in the United States is expected to grow by approximately 1% per year, reaching 87% of the total population by 2030.

The United States contributes just 5% of global population and 8% of urban population, but it is responsible for over 25% of global GDP,⁵ nearly 87% of which is generated in metropolitan areas.⁶ US energy policy is mainly controlled by the federal government,

5. At market exchange rates.

though state-level authorities are increasingly influential. For example, although the United States has not ratified the Kyoto Protocol, several states have voluntarily set their own targets which meet or exceed Kyoto targets. California aims to reduce its emissions to 80% below 1990 levels by 2050. The Regional Greenhouse Gas Initiative in the eastern part of the United States and the Western Governors' Initiative are multi-state climate change and greenhouse-gas emissions assessment and reduction initiatives.

Three frequent drivers of local policy in the United States are the security of the local energy supply, the affordability of energy services, and the long-term economic prospects of the city. New York City's 2004 Energy Policy Task Force report and 2007 Citywide Sustainability Plan were explicit in warning that the city would soon be unable to meet peak demand for power and in identifying what steps must be taken to remedy the problem. In other cases, such as in San Francisco, local environmental concerns have been pre-eminent, expressed particularly in efforts to force local utilities to reduce power-plant emissions levels. Several large cities, including Los Angeles, Austin and Seattle, actually own and operate the utility providing local gas and electric services, giving them significant influence over the types of fuels used to generate power.

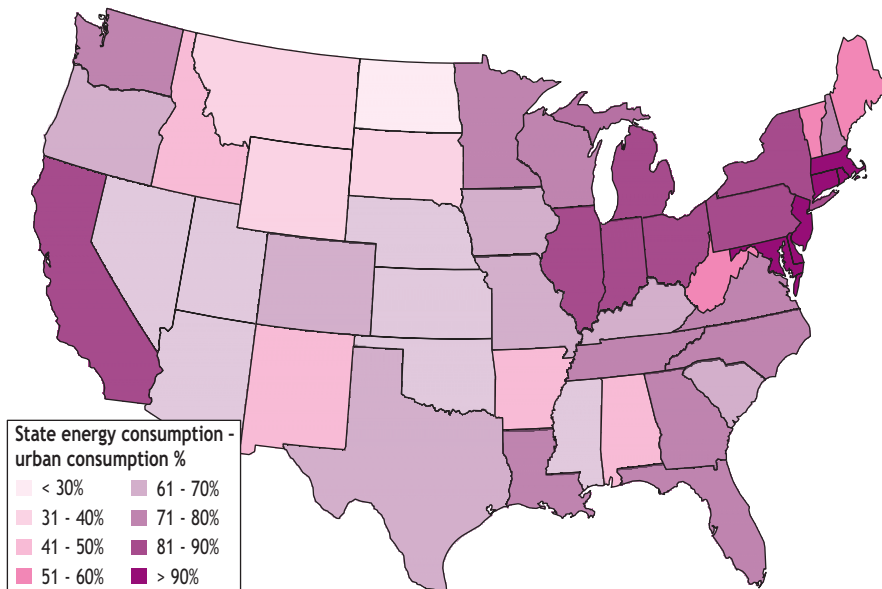
Several mayors, including those of Seattle, New York, Salt Lake City, Chicago and San Francisco, have made climate and energy planning a central tenet of their administrations. They have also been vocal in rallying other cities to join in these efforts. In 2005, the mayor of Seattle spearheaded the formation of the US Conference of Mayors Climate Protection Agreement, an initiative whereby cities pledge to reduce local greenhouse-gas emissions to 7% below 1990 levels by 2012. As of July 2008, 850 mayors across the United States – representing 80 million people – have signed this pledge. In 2007, the mayor of New York hosted the second C40 Large Cities for Climate Protection conference, an international initiative involving 40 of the largest cities around the world. Later that year, the mayor of New York spoke at the Bali Climate Change Conference on behalf of mayors around the world, calling on international climate negotiators to reflect on the role cities can have in global climate-change mitigation efforts.

Reference Scenario projections

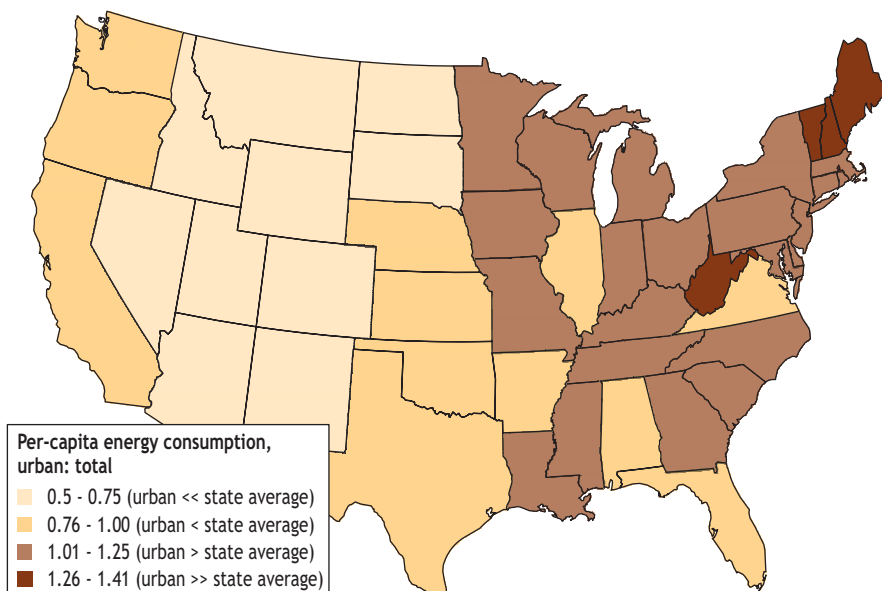
City and urban areas account for 80% of total US primary energy demand (Table 8.6) driven by the high rate of urbanisation. This is significantly higher than the global average of around 67%. US cities tend to have slightly lower per-capita energy consumption than the national average. Most urban efficiency gains are attributable to the transportation sector, where each urban resident consumes 11% less transport energy than the average US resident.

6. Defined as core urban centres and adjacent surrounding counties (US Census Bureau, 2000; BEA, 2007).

Figure 8.3 • US energy consumption in cities by state, 2006



The boundaries and names shown and the designations used on maps included in this publication do not imply official endorsement or acceptance by the IEA.



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Source: IEA analysis.

Table 8.3 • US energy demand in cities by fuel in the Reference Scenario

	2006		2015		2030		2006-2030*
	Mtoe	Cities as a % of national	Mtoe	Cities as a % of national	Mtoe	Cities as a % of national	
Coal	470	85%	512	88%	577	91%	0.9%
Oil	679	72%	668	75%	683	77%	0.0%
Gas	432	86%	454	89%	478	92%	0.4%
Nuclear	184	86%	199	89%	232	93%	1.0%
Hydro	22	86%	23	89%	24	93%	0.4%
Biomass and waste	68	85%	111	88%	170	92%	3.9%
Other renewables	11	85%	29	88%	65	91%	7.9%
Total	1 865	80%	1 996	83%	2 229	87%	0.7%
<i>Electricity</i>	<i>277</i>	<i>86%</i>	<i>310</i>	<i>89%</i>	<i>376</i>	<i>93%</i>	<i>1.3%</i>

* Average annual growth rate.

Total urban energy consumption in US cities is set to increase from 1 865 Mtoe in 2006 to 2 229 Mtoe by 2030, growing at 0.7% per annum, almost double the 0.4% per annum growth at the US national level. This growth is driven by projected growth of the urban population in the United States, from 81% today to 87% by 2030. However, improvements in energy intensity at the national level result in a drop in per-capita energy consumption of urban residents from 7.6 Mtoe today to 7.0 Mtoe by 2030.

Findings for the United States as a whole mask strong regional variations in urban consumption, driven by large differences in individual city size, levels of urbanisation, climate, density, housing stock and per-capita income (Figure 8.3). In most coastal states, urban energy consumption is over 70% of the total; in many of the densely populated and highly urbanised states of the Northeast, urban energy consumption accounts for over 90% of state consumption. Per-capita consumption tends to be higher in urban areas east of the Mississippi and lower in urban areas west of the Mississippi.

European Union

Background

As one of the early centres of industrial transformation, the area that makes up the European Union is characterised by high levels of population density, urbanisation and energy use. With a current population of almost 500 million, accounting for 8% of the global population, the European Union generates 31% of global GDP.⁷ Population projections are flat throughout the *Outlook* period, while urbanisation is projected to continue growing from 73% today to 80% by 2030.

Over the past decade, the European Union has been one of the driving forces behind international policy agreements for binding climate-protection targets. The European Union has set up an internal market for emission trading, which was operational before the Kyoto Protocol came in to force in February 2005.

7. At market exchange rates.

Compared with other world regions, the European Union has a distinctive form of multi-level governance uniting 27 member states. It does not have a truly common and comprehensive energy policy, though a growing body of EU legislation does affect the energy sector in member countries. European Union directives cover a range of issues, including co-generation using renewable energy (combined heat and power), internal markets in electricity and gas, and energy efficiency. Additionally, industrial point-source greenhouse-gas emissions are traded in the world's largest multi-national and multi-sector market for emission trading, the European Union Emissions Trading Scheme (see Chapter 17), covering more than 10 000 installations of the energy and industrial sectors. Urban and regional climate-protection strategies operate in parallel with the efforts at the national and supra-national scale.

Arrangements for, and the extent of, energy planning and policy at the urban and regional level vary considerably among member states, reflecting the heterogeneity of the structure of government and the levels of local participation in member states. Some members of the European Union have a federal organisation, with extensive powers exercised at the urban and regional level. Cities like Berlin, Bremen or Hamburg, for example, are federal states (Länder) in their own right, able to decide their individual energy programmes. Communes in the Nordic countries have considerable control over how to spend their tax income; and in the UK many planning decisions are devolved to the local authority or metropolitan level.

European cities have given a lead, internationally, to efforts to mitigate climate change. Almost all EU capitals and large cities have adopted, or are currently discussing, local climate-change action plans and greenhouse-gas emissions reduction targets that are, at times, more ambitious than those at the European and national levels. A specific characteristic of the European institutional framework for energy and climate policy is the importance of city networks, many of them partly financed by the European Union, as a way of sharing ideas and best practice.

Reference Scenario projections

In 2006, urban areas accounted for 1 259 Mtoe, about 69%, of the total primary energy demand of the European Union. Final energy demand on a per-capita basis was about 3.5 Mtoe in urban areas, slightly lower than the EU average of 3.7 Mtoe per capita. Average per-capita consumption in rural areas was even higher, at around 4.9 Mtoe.

Total urban primary energy consumption in the European Union is projected to increase by 168 Mtoe over the projection period, reaching 1 427 Mtoe by 2030 – an average rate of growth of 0.5% per year. This is more than twice the rate of the European Union as a whole, which averages 0.2% per year and is accounted for by the growth in the urban share of the EU population to 80% by 2030 (Table 8.4). Urban energy consumption increases in absolute terms as the urban population rises, because improvements in energy intensity can not keep pace with the rise in population. Per-capita energy consumption increases from 3.5 Mtoe in 2006 to 3.6 Mtoe by 2030 (Figure 8.4).

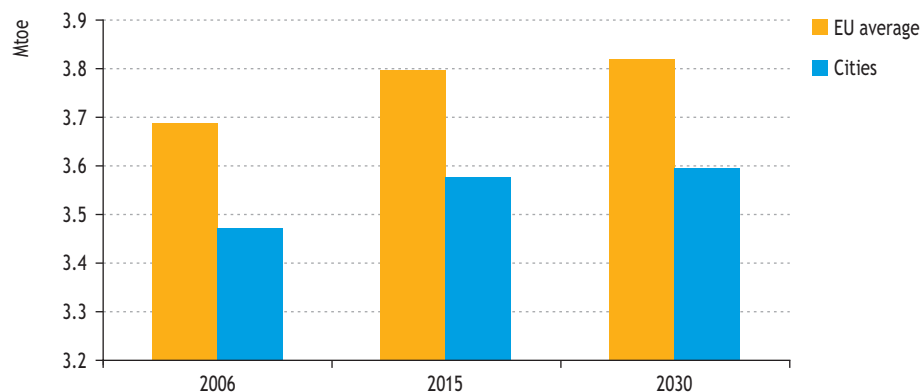
The fuel mix in cities differs considerably from the EU average. A higher share of grid-based fuels, such as gas, heat and electricity, is consumed in cities, compared with the EU average for all fuels, whereas a lower proportion of coal, biomass and oil is used.

Table 8.4 • European Union energy demand in cities by fuel in the Reference Scenario

	2006		2015		2030		2006-2030*
	Mtoe	Cities as a % of regional	Mtoe	Cities as a % of regional	Mtoe	Cities as a % of regional	
Coal	207	64%	214	66%	183	70%	-0.5%
Oil	397	59%	388	60%	384	64%	-0.1%
Gas	397	91%	456	92%	536	96%	1.3%
Nuclear	187	73%	171	74%	138	80%	-1.3%
Hydro	19	74%	25	76%	31	82%	1.9%
Biomass and waste	41	45%	61	46%	93	49%	3.4%
Other renewables	10	70%	29	72%	62	76%	8.1%
Total	1 259	69%	1 344	71%	1 427	75%	0.5%
<i>Electricity</i>	<i>176</i>	<i>73%</i>	<i>204</i>	<i>75%</i>	<i>245</i>	<i>79%</i>	<i>1.4%</i>

* Average annual growth rate.

Figure 8.4 • Per-capita energy demand in the European Union and EU cities in the Reference Scenario



Australasia

Background

Both Australia and New Zealand have developed largely through agriculture and natural resource production, and are now characterised by a few cities that are large relative to the national population. Urbanisation rates have been traditionally high

and continue to grow. In 2006, Australia had a population of 20.6 million people, with 13.1 million (63.5% of the total population) living in eight regional capital cities. In 2006, New Zealand's population was 3.9 million people, with 1.9 million (48.5%) living in the three major urban areas. As most of the development of cities in Australia and New Zealand has taken place since the advent of the motor vehicle, the density of the residential urban population, approximately 1 500 people per square kilometre, is low. Cities tend to conform to a spread-out suburban model, with a denser inner ring (around a core that has become denser in the last decade) and gradual reduction of population density as the city expands.

Most major Australian cities are governed by multiple local governments, each of which is responsible for a portion of the urban area. Local governments have the power to enact laws and implement policies relating to planning, transport, building, waste and other local issues relating to energy management and climate change. In general, local governments in Australia can implement policy that affects energy demand, both stationary and mobile, but not energy supply. Their role as the planning authority, with responsibility for approving residential and commercial developments, is their main source of influence in relation to energy consumption and CO₂ emissions.

New Zealand cities are governed by local governments, comprising of 12 regional councils, 74 territorial local authorities and four unitary authorities in total. Each local authority has some degree of control over energy-using activities. Typically, local governments (such as Christchurch and Auckland) have intervened on air quality issues and seek to take climate-change issues into consideration in developing other policies for which they are responsible. This has been particularly important in the development of the Long-Term Council Community Plans. Additionally, as the planning authority for wind farms and hydro developments, local governments have been at the forefront of the development of alternative energy systems. Local governments are not prevented from developing power generation facilities or operating an electricity-supply business but, to date, the focus of policy has been on managing demand through policy implementation or ambitious targets such as the zero net-emissions target of Wellington.

The commercial and services sector together now dominate the Australian economy, accounting for 60% of GDP in 2006. This proportion of the economy has been increasing for a number of years (ABS, 2007). Most commercial activity is office-based and has relatively low energy intensity. Residential energy consumption, on the other hand, has been increasing steadily for many years, driven by increasing appliance-ownership rates. Moving people and goods around sparsely populated countries such as Australia and New Zealand requires a large amount of energy.

Reference Scenario projections

In 2006, the cities in Australia and New Zealand consumed 78% of total energy demand, totalling 109 Mtoe (Table 8.8). Cities consumed 80% of total electricity and almost all natural gas in the end-use sectors, as there is little local distribution of natural gas in rural areas. Energy use per capita in cities is lower than the national average, at 5.0 Mtoe in 2006, compared to 5.6 Mtoe for Australia and New Zealand as a whole.

Table 8.5 • Australasian energy demand in cities by fuel in the Reference Scenario

	2006		2015		2030		2006-2030*
	Mtoe	Cities as a % of regional	Mtoe	Cities as a % of regional	Mtoe	Cities as a % of regional	
Coal	45	80%	49	82%	47	83%	0.2%
Oil	30	66%	34	67%	35	69%	0.7%
Gas	25	93%	28	95%	34	97%	1.3%
Nuclear	0	n.a.	0	n.a.	0	n.a.	n.a
Hydro	3	80%	3	82%	3	84%	0.8%
Biomass and waste	5	75%	7	77%	10	79%	3.5%
Other renewables	2	70%	3	67%	7	64%	5.9%
Total	109	78%	124	79%	136	80%	0.9%
<i>Electricity</i>	17	80%	20	82%	24	84%	1.4%

* Average annual growth rate.

The commercial sector is less energy intensive per capita than the residential sector, and industry and transport are the most energy-intensive sectors. Total urban energy demand in Australasia is projected to increase from 109 Mtoe today to 136 Mtoe by 2030, growing at 0.9% per year. This is slightly quicker than the 0.8% per year consumption growth for the region as a whole. In addition to an increased use of oil in the rural residential sector, there is an increase in the use of biomass, due to the proximity of fuelwood sources and lower population density reducing air pollution concerns.

China

Background

China contributes 20% of the global population and 17% of the global urban population. In 2006, China's urban population was 545 million, more than the entire population of the European Union. The UN projections see the current rate of urbanisation in China – around 40% – reaching 60% by 2030. Given that Chinese cities are more energy intensive per capita than rural areas, this will have significant implications for the national energy system and global energy markets.

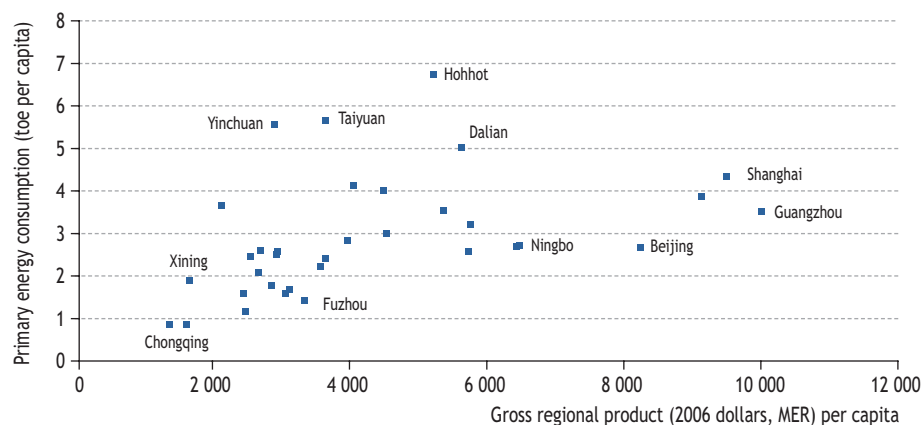
In China, city governments have some influence over local energy supply and demand, one reason being that public utilities and many industries are still owned by city authorities. However, cities are firmly guided by national policies, which they are responsible for implementing. China's 20% energy-intensity reduction target by 2010, in its 11th Five-Year Plan, illustrates the relationship between national and local government. This target was delegated to provincial level in the form of provincial performance targets. Although regional autonomy was strengthened through reforms in the 1990s, energy remains a strategic sector directed by the central government.

There is intense competition between cities in China to attract investment and, as a consequence, cities act to address concerns about energy security and local air pollution. Interventions by city authorities on energy matters tend to concentrate on four major fronts:

- Clean energy, especially by encouraging greater penetration of natural gas and limiting the use of coal in the household and commercial sectors.
- Action in the energy sector to facilitate economic structural change from primary to secondary industries and towards an enlarged tertiary sector.
- Promoting energy efficiency.
- Improving public and mass-transportation systems.

Climate change is becoming an increasingly important policy priority for both the national government and city governments. A number of energy and environmental policies at the city level have an impact on climate issues. Examples include the local air-pollution control policy associated with the 2008 Beijing Olympics, Shanghai's vehicle-supply control policy, and policies to increase investment in renewable energy. Some Chinese cities have also been involved in international efforts to develop low carbon cities, initiated by organisations such as the World Wildlife Fund and others. New cities are putting greater emphasis on energy and climate issues. Dontang Eco-City, which is being built at the mouth of the Yangtze River close to Shanghai, is one example. Differences in the per-capita energy use and CO₂ emissions of Chinese cities reflect a number of local conditions, of which scale and structure of the local economy are key factors (Figure 8.5).

Figure 8.5 • Per-capita energy demand and gross regional product in selected Chinese cities, 2006



Source: Dhakal, 2008

Reference Scenario projections

The share of cities in China's total primary energy demand in 2006 is estimated at 75% or about 1 424 Mtoe (Table 8.6). The per-capita energy use of urban areas in China is about 80% higher than in the country as a whole. On average, each urban citizen in

China consumes 2.6 Mtoe, compared with 1.4 Mtoe nationally, reflecting higher urban incomes. Coal provides about 87% of urban primary energy. Natural gas use in cities in China is increasing rapidly. Beijing leads this trend, and the share of natural gas has dramatically increased since 2000. Further urbanisation and economic development should lead to a convergence of urban and rural energy intensity. Cities will have an increasing role in shaping the energy profile of China, with urban areas providing great opportunities for large-scale policy interventions for managing the overall energy system. By 2030 cities in China are projected to consume 3 220 Mtoe. The proportionate effect on energy consumption of strong urbanisation growth is partially offset by the fact that increasing energy consumption in rural areas is also expected to grow strongly through the *Outlook* period, with the net result that the share of city energy use in China increases to 83% by 2030. Phasing out of coal, and greater use of natural gas and liquefied petroleum gas, in residential and commercial sectors in urban areas is set to increase.

Table 8.6 • Chinese energy demand in cities by fuel in the Reference Scenario

	2006		2015		2030		2006-2030*
	Mtoe	Cities as a % of national	Mtoe	Cities as a % of national	Mtoe	Cities as a % of national	
Coal	1 059	87%	1 665	88%	2 206	90%	3.1%
Oil	271	77%	428	77%	648	80%	3.7%
Gas	40	81%	84	82%	158	84%	5.9%
Nuclear	12	84%	39	84%	67	87%	7.5%
Hydro	31	84%	52	84%	76	87%	3.8%
Biomass and waste	10	4%	12	5%	37	16%	5.6%
Other renewables	2	45%	9	62%	27	67%	12.2%
Total	1 424	75%	2 289	79%	3 220	83%	3.5%
<i>Electricity</i>	161	80%	314	80%	495	83%	4.8%

* Average annual growth rate.