How's life?
Measuring well-being

Chapter 10

Environmental quality

People's lives are strongly affected by the healthiness of their physical environment. The impact of pollutants, hazardous substances and noise on people's health is sizeable. Environmental quality also matters intrinsically, as most people value the beauty and healthiness of the place where they live, and care about the degradation of the planet and the depletion of its natural resources. Preserving environmental and natural resources is also one of the most important challenges for ensuring the sustainability of well-being over time. This chapter shows that in OECD countries the concentrations of particulate matters in the air have dropped in the last twenty years, although in many countries they remain above target levels. People in other major economies, in addition to being exposed to high pollutant concentrations, often lack access to basic environmental services such as safe drinking water and sanitation. For the world as a whole, around one-fourth of the total burden of disease, or 13 million premature deaths, could be prevented every year through environmental improvements. Environmental policies have a critical role to play in dealing with global health priorities and in improving people's lives.

Why does environmental quality matter for well-being?

Environmental quality is a key dimension of people's well-being, as quality of life is strongly affected by a healthy physical environment (Khan, 2002; Holman and Coan, 2008). The impact of environmental pollutants, hazardous substances and noise on people's health is sizeable: environmental factors play a role in more than 80% of the major diseases, and worldwide around one-fourth of diseases and overall deaths are due to poor environmental conditions (Prüss-Üstün and Corvalán, 2006). Environmental factors of a more extreme nature, such as natural disasters (earthquakes, cyclones, floods, drought, volcanic eruptions and epidemic outbreaks) may also cause deaths, injury and disease in significant proportions.[1] In the long term, drastic changes in the environment may also impair human health through climate change, transformations in the carbon and water cycles and biodiversity loss.

Besides affecting people's health, the environment also matters intrinsically as many people attach importance to the beauty and the healthiness of the place where they live, and because they care about the degradation of the planet and the depletion of natural resources (Balestra and Dottori, 2011). People also directly benefit from environmental assets and services, such as water, sanitation services, clear air, lands, forests, and access to green spaces, as they allow them to satisfy basic needs and to enjoy free time and the company of others.

Preserving environmental and natural resources is also one of the most important challenges for ensuring the sustainability of well-being over time. However, measuring environmental sustainability is difficult; first, because the size of the impacts of current environmental trends on future well-being is uncertain; second, because there are few comparable indicators that meet agreed standards. For these reasons, this chapter mainly looks at the importance of the environment for people's current well-being. Selected measures of environmental sustainability based on some of the OECD Green Growth Indicators (OECD, 2011b) are presented in Annex 10.A.

Measuring environmental quality

The concept of "environmental quality" is a broad one, and an ideal set of indicators would inform on a number of environmental media (soil, water, air), on people's access to environmental services and amenities, as well as on the impact of environmental hazards on human health. Unfortunately, available data are scattered and not comparable across countries. For these reasons, the objective indicators presented in this chapter are limited to only a subset of the relevant conditions.

Objective indicators, such as the concentrations and emissions of various pollutants, are combined here with indicators based on people's subjective perceptions of the quality of the environment where they live. These subjective indicators are useful as they: *i)* summarise in one indicator a multidimensional phenomenon; *ii)* offer information about the environmental hazards that individuals may experience due to their own specific circumstances (*e.g.* people suffering from asthma will report, ceteris paribus, lower satisfaction with air quality, a type of information that is not provided by objective indicators); and *iii)* may capture the intrinsic value that people give to the environment (*e.g.* people attaching greater importance to nature are more likely to report lower satisfaction with the quality of the environment, due to their higher standards). As in the case of other subjective data, indicators of satisfaction with environmental quality may suffer from cultural biases and other limits that may affect cross-country comparisons.

Selected indicators

Air quality (EN I)

Air quality is measured through population-weighted average annual concentrations of fine particles in the air (measured in micro grams per cubic meter). The data refer to residential areas of cities larger than 100 000 inhabitants. Particulate matters (PM) consist of small liquid and solid particles floating in the air, and include sulphate, nitrate, elemental carbon, organic carbon matter, sodium and ammonium ions in varying concentrations. Of greatest concern to public health are the particles small enough to be inhaled into the deepest parts of the lung: these particles are less than 10 microns in diameter (PM_{10}). Looking at concentrations rather than at emissions allows assessing the effective impacts of air pollution on people's health (Box 10.1).

Ideally, several measures of air quality should be grouped together in a composite air quality index. However, constructing a composite indicator is difficult, as it involves contentious challenges in terms of gathering and weighting data (given that pollutants mixed together can have additive, synergistic, or antagonistic effects on human health). PM pollution is regularly monitored in most OECD countries and has been consistently associated with serious effects on human health.[2] This indicator is based on good-quality time-series data that allow comparisons across countries and over time. Improvements in pollution monitoring and statistical techniques during the last decades have enhanced the ability to measure air pollution and provided a broad picture of how pollution affects urban spaces and the people within them. However, these data are limited in several respects. First, they relate to annual levels, and they may obscure important variations at smaller time scales (*e.g.* hours or months). Second, air pollution data assume that everyone living in an urban area is equally exposed; in practice, personal exposure varies substantially, depending on where people live and work, their occupations, lifestyles and behaviours.

Box 10.1. **Impact of air pollution on health**

The particulate matter levels that are most relevant to human health are commonly less than 10 micrometers across and are known as PM_{10} (particle ten micrometers = 10µm). The fraction of the PM_{10} which are thought to be the most poisonous are less than 2.5 micrometers across and are called $PM_{2.5}$. Epidemiological studies conducted over the past twenty years have reported significant associations between short-term and long-term exposure to increased ambient PM concentrations and increased morbidity (*e.g.* cardiovascular and respiratory diseases) and (premature) mortality. PM_{10} are readily inhalable and because of their small size are not filtered and reach the upper part of the airways and lungs. Those smaller than 2.5 µm penetrate deep into the bottom of the lung, where they can move to the blood stream, thus allowing many chemicals harmful to human health to reach many internal organs and causing a wide range of illness and mortality including cancer, brain damage and damage to the fetus.

Although it is commonly assumed that there is no threshold below which health effects of PM are unlikely to occur, the recent update of the WHO Air Quality Guidelines for PM proposed that guidelines should be set to minimise the risk of adverse effects of both short- and long-term exposure to PM. These values are set at 20 µg/m3 as an annual mean and 50 µg/m3 as a daily mean for PM_{10}, with corresponding values of 10 µg/m3 and 25 µg/m3 for

> $PM_{2.5}$. The WHO also suggests using as indicators of health risks the mass concentrations of PM_{10} and $PM_{2.5}$. The health outcomes of air pollution depend upon the sensitivity and the exposure of the susceptible population to a specific pollutant. Pollutant exposure levels may be difficult to estimate because of individual time-activity patterns. As a result, health impacts are generally based on the population-weighted average ambient concentration of the pollutants measured at fixed monitoring sites located in different parts of cities.

Environmental burden of disease (en 1)

The environmental burden of disease (EBD) quantifies the disease burden that could be avoided by modifying the environment as a whole. Health effects relate to pollution of air, water and soil, radiations, noise, occupational risks, land use patterns, agricultural methods and irrigation schemes, as well as man-made changes to the climate and ecosystems (Prüss-Üstün and Corvalán, 2006). Measures of the environmental burden of disease at the country level are made by the World Health Organisation (WHO) according to an exposure approach, and supported by a comprehensive analysis of the evidence for the given health risks. Exposure-response relationships for a given risk factor are obtained from epidemiological studies, and the derived attributable fractions are then applied to disease burden, expressed in terms of either premature deaths or DALYs (Disability-Adjusted Life Years), a measure that combines information on deaths and disabilities.[3]

Conceptually, the overall EBD estimate has some limitations. First, people are exposed to a complex mix of environmental factors, yet EBD estimates often treat each environmental hazard individually, thus simplifying the underlying causal processes. Second, EBD does not account for benefits other than health gain, while environmental modifications may deliver other types of social benefits. Third, the population-based approach allows estimating total national impacts, but does not allow identifying impacts on specific population groups, *e.g.* people who are highly exposed or especially vulnerable due to worse health conditions. For these reasons, EBD is presented here as a secondary indicator. This indicator covers all OECD and emerging countries, although time trends at the national level are hard to establish since data are not collected regularly.

Satisfaction with the quality of local environment (en 2)

In addition to the objective measures presented above, subjective data on environmental quality also provide critical information on environmental conditions. The indicator considered here is informative about people's subjective appreciation of the environment where they live. The indicator is based on the following two questions: "In the city or area where you live, are you satisfied or dissatisfied with the quality of air?"; and "In the city or area where you live, are you satisfied or dissatisfied with the quality of water?" Answers are grouped into two categories (yes/no). Data are based on the World Gallup Poll, with all OECD and emerging countries covered in the Poll.[4]

Since the samples are small and the dataset suffers from other methodological limitations, the evidence from this indicator has to be taken with caution. In addition, self-reported satisfaction with the quality of the local environment may reflect cultural biases or other individual influences. For these reasons, this indicator is shown here as a secondary indicator.

Access to green spaces (en 3)

This indicator refers to the share of people who have "very many reasons" or "many reasons" to complain about the lack of access to recreational or green zones, as measured on a four-item scale. Access to green spaces is essential for quality of life, as an unspoiled environment is a source of satisfaction (World Bank, 1992), improves mental well-being (Pretty *et al.*, 2005, Brown and Grant, 2007), allows people to recover from the stress of everyday life (Mace *et al.*, 1999) and to perform physical activity. Cross-sectional studies find that levels of physical activity are higher and obesity is lower in areas with higher levels of greenery (Ellaway *et al.*, 2005). Natural resources also play an important role in building social ties and reducing physical violence. Several studies show that green spaces in urban areas encourage social interaction, alleviate crime and aggression and generate a sense of place (Ward Thompson, 2002; Armstrong, 2000; Milligan *et al.*, 2004).

This indicator is based on data from the European Quality of Life Survey, a non-official household survey limited to European countries. This survey is based on small samples and is conducted with low frequency. This implies that small differences between countries may not be statistically significant. Given these shortcomings, the indicator is presented here as a secondary indicator.

A summary of the quality of the indicators used in this chapter is provided in Table 10.1.

Table 10.1. **The quality of environmental indicators**

	Target concept	INDICATORS							
		Relevance to measure and monitor well-being				Statistical quality			
		Face validity	Unambiguous interpretation (good/bad)	Policy amenable outcomes	Can be disaggregated	Well-established instrument collected	Comparable definition	Country coverage	Recurrent data collection
Environmental quality									
EN I Air quality	Quality of environment	~	√	√	x	√	√	√	~
en 1 Environmental burden of disease	Impact of environmental hazards on human health	√	√	√	x	√	√	√	~
en 2 Satisfaction with local environment	Subjective perceptions of environment	√	~	~	√	x	√	√	√
en 3 Access to green spaces		√	√	√	√	x	√	~	~

Note: The symbol √ shows that the indicator selected largely meets the criterion shown in the table; the symbol ~ that the indicator meets the criterion to a large extent; the symbol X that the indicator does not meet the criterion or it meets it only to a limited extent.

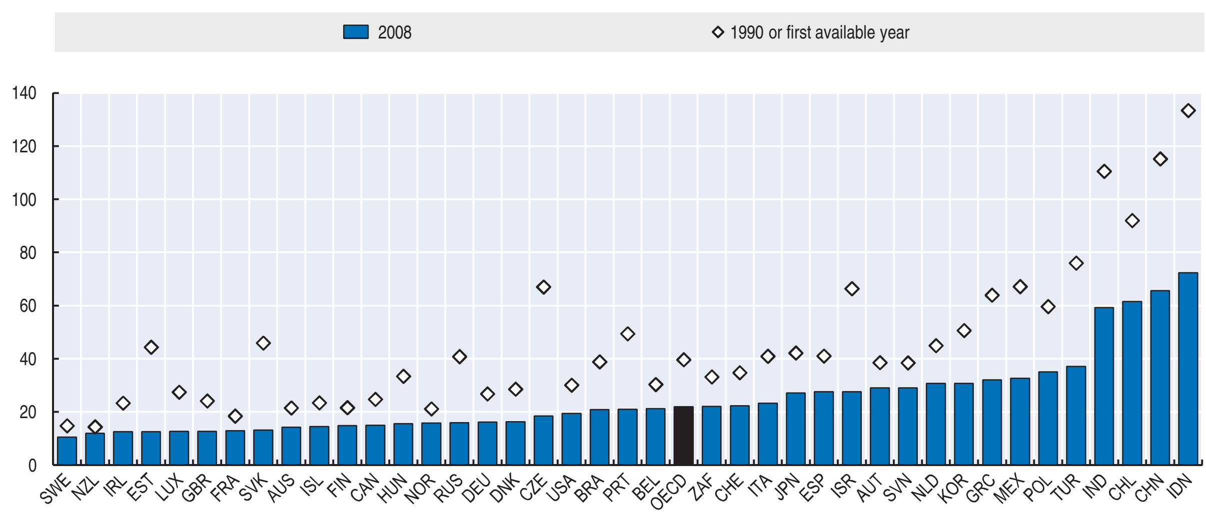
Average patterns

Air pollution remains above dangerous levels

In 2008, PM_{10} concentrations in many OECD countries were above the mean annual WHO target level of 20 µg/m3 (Figure 10.1). Within the OECD region, the highest concentration levels were found in Chile, Turkey and Poland. Over time, PM concentrations have dropped steadily – due to improvements in technology and structural shifts in economies, especially in Eastern Europe (*i.e.* the Czech Republic, Estonia, the Slovak Republic), though not as much as other pollutants. While this trend is visible in all regions, air pollution still shows high concentrations in urban areas in parts of Africa and Asia (Figure 10.2). All emerging countries except Brazil and South Africa have concentration levels well above the OECD average. Since air pollution by particulate matter is linked to a range of anthropogenic activities such as industrial production and traffic (Box 10.2), the recent economic and financial crisis might have contributed to a further decline (Arruti *et al.*, 2011). However, the OECD projects a further increase of PM concentrations by 2030 in the most polluted regions of the world, where 50-90% of the urban population will be exposed to concentrations above 70 µg/m3 (OECD, 2008)

Figure 10.1 **Air concentrations of particulate matter**

PM_{10} concentrations, micrograms per cubic meter



Note: Data are urban-population weighted PM10 levels in residential areas of cities with more than 100 000 residents. The first available year is 1994 for Slovenia.
Source: World Bank; OECD (2008), *OECD Environmental Outlook to 2030*, Paris.

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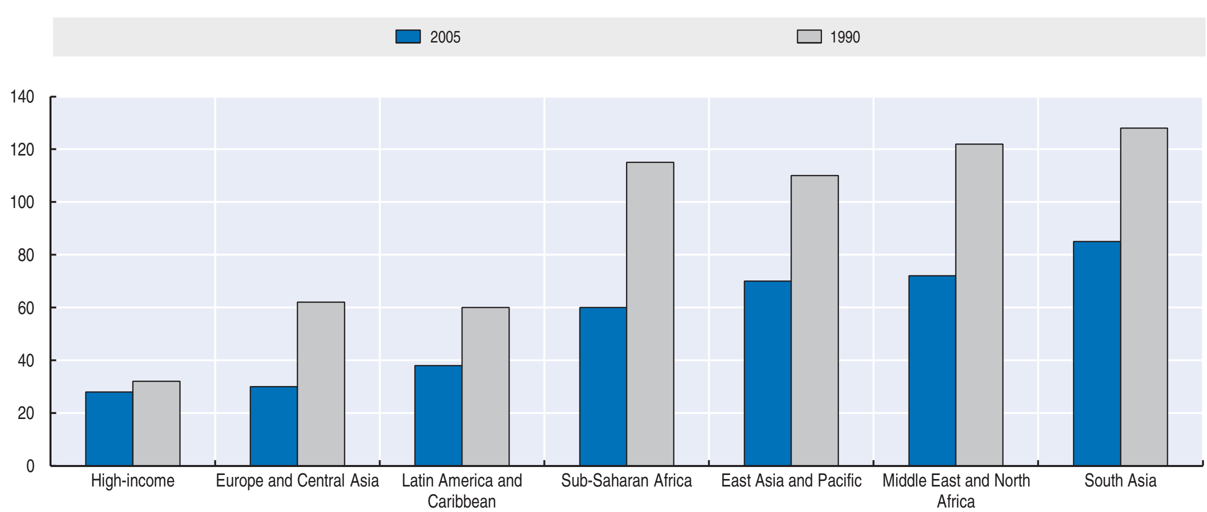
Figure 10.2. **Air concentrations of particulate matter by region**

PM_{10} concentrations, micrograms per cubic meter



Source: World Bank (2009), Atlas of Global Development: Second Edition, Glasgow.

StatLink http://dx.doi.org/10.1787/888932493252

Box 10.2. **Drivers of air pollution**

In 2008, for the first time in history, more than half of the world's population lived in towns and cities. By 2030 this number will swell to almost 5 billion (UNFPA, 2008). Rapid urbanisation presents challenges that may threaten the environment and quality of life. One of the main problems facing burgeoning towns is outdoor air pollution from a range of anthropogenic sources:

- **Road transport.** In many countries, air pollution from motor vehicles has replaced coal smoke as the major cause for concern; the continuing growth in the use of motor vehicle means that efforts to reduce emissions from individual vehicles are in danger of being overtaken by increases in the volume of traffic. In many developing countries the use of old vehicles, which do not meet modern pollution control requirements, makes efforts to control pollution from this source increasingly difficult.
- **Power generation**. Generating power produces more pollution (in particular, sulphur dioxide and nitrogen oxides) than any other single industry. Better dispersion of pollutants emitted by tall chimneys brings better dilution in the air and lowers local concentrations of pollutants. This, however, leads to pollution being dispersed more widely and to transboundary air pollution. Stricter operating practices and the use of modern abatement techniques have resulted in a sizeable reduction in the amount of pollutants emitted from power stations. High concentrations still occur in many developing countries, particularly from older power stations and from the use of high sulphur lignite or coal.
- **Waste disposal**. Landfill and incineration are the most common methods of waste disposal. If not properly managed, landfill sites can cause a number of problems, such as the production of methane gas, dangerous levels of carbon dioxide, and trace concentrations of a range of organic gases and vapors. Poorly managed incineration can result in the production of poisonous chemicals such as hydrochloric acid, dioxins, furans and heavy metals. Hydrochloric acid produced by the burning of plastics contributes locally to acid rain. The burning at low temperature of organic matter and plastics can also lead to emissions of dioxins.

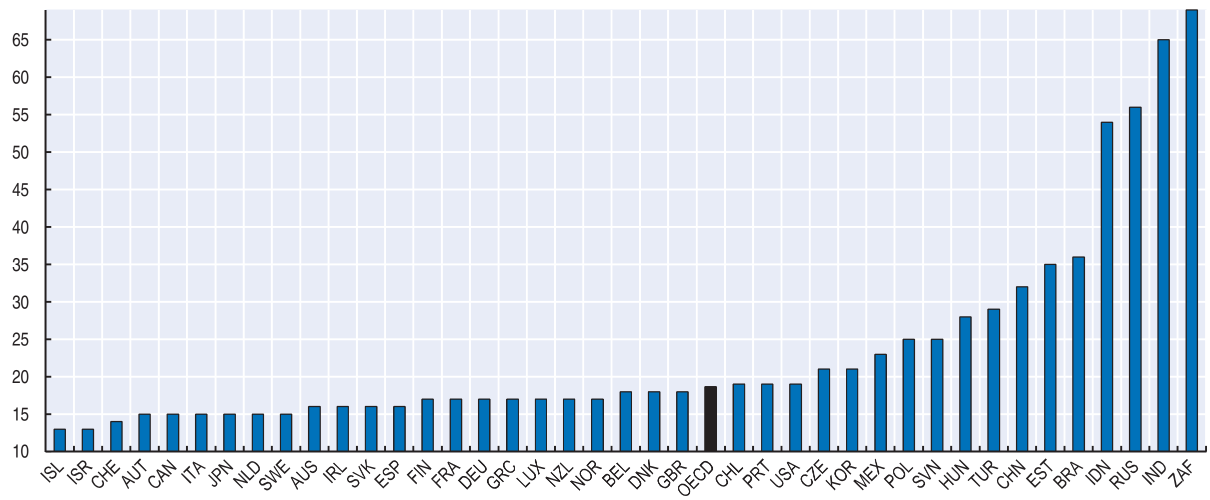
Source: Adapted from EEA, 2010; 2011 and EEA website

The environmental burden of disease is substantial in emerging countries

According to the WHO, 24% of the total burden of disease at the world level, or 13 million premature deaths, could be prevented through environmental improvements (Prüss-Üstün and Corvalán, 2006). While the EBD ranges between 13% and 20% in many OECD countries (Figure 10.3), it reaches higher levels in Eastern Europe, Korea and Turkey, where up to one-third of the disease burden could be prevented through better environmental conditions. Emerging economies suffer the most from poor environmental factors, losing up to 6 times more healthy years of life per person per year than high-income countries (Box 10.3).

Figure 10.3. **Environmental Burden of Disease**

DALYs per 1000 people, 2006



Source: WHO (2004), Water, Sanitation and Hygiene Links to Health: Facts and Figures updated March 2004, Geneva.

StatLink http://dx.doi.org/10.1787/888932493271

Box 10.3. **Drivers of the environmental burden of disease**

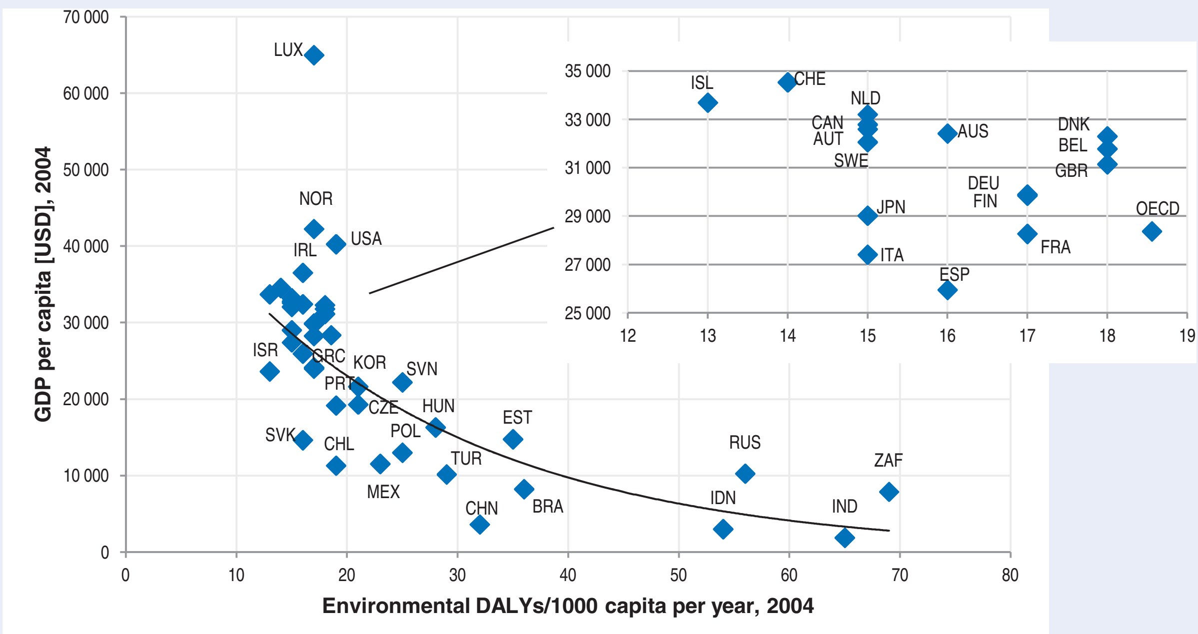
Results of international studies on the environmental burden of disease (EBD) differ significantly across countries: estimates of the total disease burden caused by environmental exposure range from about 2 to 20%. These differences may in part reflect differences in methodologies, in data quality (information on environment and health is often scattered across many institutions and gathered in a non-standardised format), and in the range of risk factors considered by different studies. However, most of the variation in estimates is likely to reflect actual differences in environmental conditions.

WHO recent profiles of EBD for 192 countries refer to a selected set of the known environmental risk factors for which quantification of health impacts is possible. In particular, the core set of environmental risks considered by the WHO includes: *i)* water, sanitation and hygiene; *ii)* indoor air; and *iii)* outdoor air. These environmental factors display a clear socio-economic pattern: while in developed countries the environmental component of the disease burden operates mainly through non-communicable diseases (*e.g.* lung cancer and cardiovascular diseases) related to outdoor air pollution, developing countries suffer most from indoor air pollution from solid fuel use and communicable diseases due to unsafe water, scarce hygiene and sanitation (*e.g.* diarrhea and malaria).

Although richer countries are not immune to environmental risks, the environmental burden of disease per capita falls as per capita GDP increases (Figure 10.4). People in poorer countries typically live in less healthy areas and are more vulnerable to the effects of environmental hazards due to their lower health status and poorer access to basic services. In richer countries (where the greatest environmental burden relates to outdoor air pollution) deaths caused by environmental hazards generally occur later in life, leading to high premature death rates but low DALY rates.

Countries with similar GDP per capita may also perform differently in terms of environmental health impacts. For countries with GDP per capita below 10 000 USD, the environmental burden can vary by a factor of two (*e.g.* China and Brazil perform considerably better than India, Indonesia and South Africa). These differences are explained mainly by differences in terms of unsafe water, poor hygiene and sanitation; in India, Indonesia and South Africa a sizeable share of EBD is caused by these environmental hazards, while in China and Brazil this share is much lower. Differences in DALY rates are magnified by the fact that most of the mortality from malnutrition, diarrhoea and other communicable diseases concern children under the age of five.Box 10.3.

Figure 10.4. **The relationship between the environmental burden of diseases and GDP per capita**



Note: Data on GDP per capita are expressed in US dollars, current prices and PPPs.
Source: OECD National Accounts Database; World Health Organization.

Source: Prüss-Üstün and Corvalán (2006)

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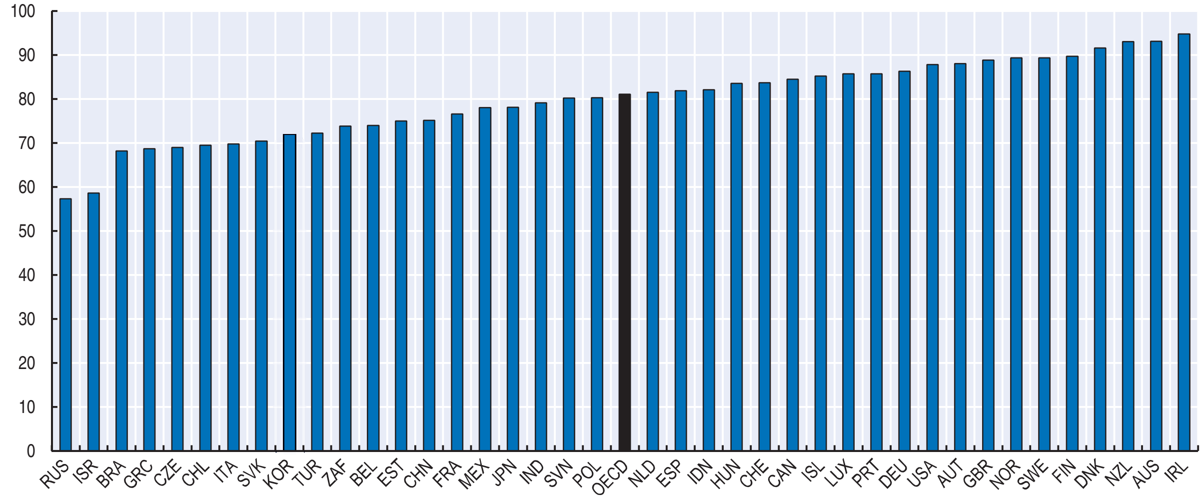
Satisfaction with the quality of the local environment varies considerably across OECD countries

The majority of respondents in OECD countries report being satisfied with the air quality of the surrounding area. In Denmark, New Zealand, Australia and Ireland, more than 90% of the population expresses contentment over the quality of local air. However in Brazil, Greece and the Czech Republic, one individual in three declare being dissatisfied with air quality. In the Russian Federation and Israel, the share of dissatisfied people is close to 50% (Figure 10.5).

A larger share of the population declares being satisfied with the quality of the water. However, in some countries such as Turkey, Israel, Greece, Estonia and Mexico, the proportion of those not satisfied with water quality is high. In India only 60% of the population is satisfied with the quality of the local water, while in the Russian Federation this percentage falls to 40% (Figure 10.6).

Figure 10.5. **Satisfaction with air quality**

Percentage of satisfied people, 2010 or latest available year



Note: Data refer to 2008 for Iceland and Norway; and to 2009 for Estonia, Israel, Switzerland, the Russian Federation and South Africa.
Source: Gallup World Poll.

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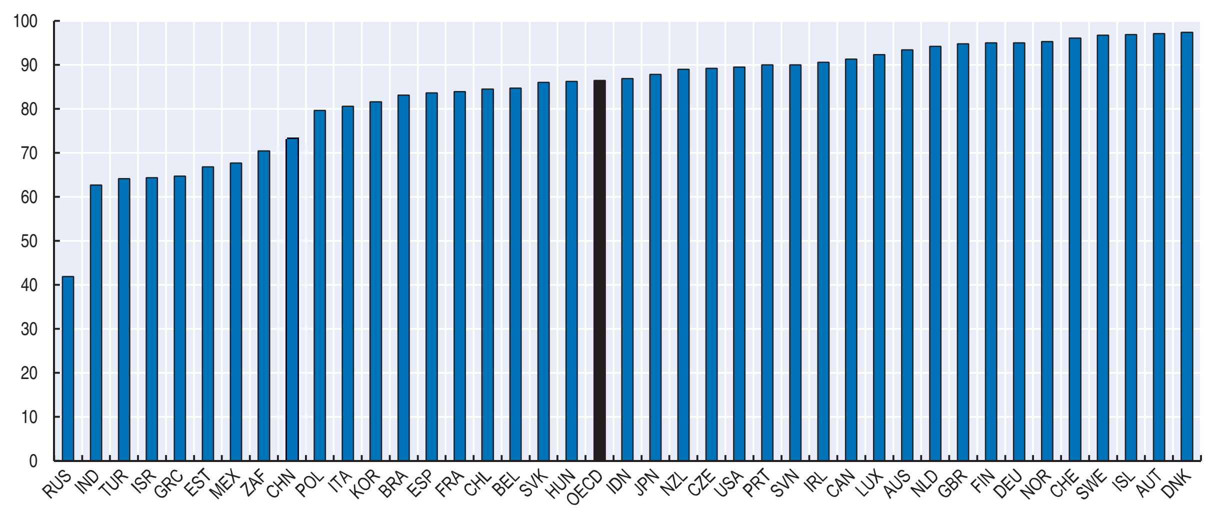
Figure 10.6. **Satisfaction with water quality**

Percentage of satisfied people, 2010 or latest available year



Note: Data refer to 2008 for Iceland and Norway; and to 2009 for Estonia, Israel, Switzerland, the Russian Federation and South Africa.
Source: Gallup World Poll.

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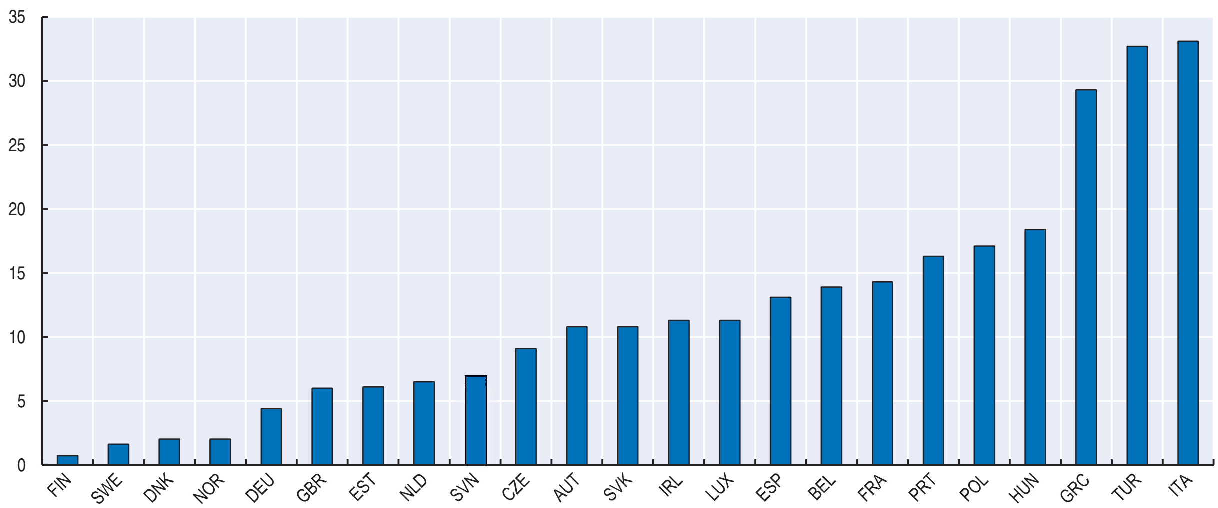
A large share of the European population report having very limited access to green spaces

The available data on the access to green spaces show that there are large differences across European countries in terms of the share of population who declare that they have access to green space. In Italy and Turkey, almost one person in three declares having very many or many reasons to complain about the lack of green space. In the Nordic countries, less than 5% of the population is dissatisfied with their access to green spaces (Figure 10.7).

Besides green space, access to other types of environmental services is also critical for people's well-being, especially for the population of emerging countries who may lack access to important basic amenities (Box 10.4).

Figure 10.7. **Access to green spaces in European countries**

Percentage of population having reasons to complain about the lack of access to recreational and green spaces, 2000



Source: European Quality of Life Survey.

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Box 10.4. **Access to basic environmental services**

While in industrialised countries, most people have access to basic environmental services such as fresh water, basic sanitation facilities and wastewater treatment, in developing countries a large share of the population remains without these basic services. A poor water supply and poor hygiene practices cause 1.8 million deaths every year from diarrheal diseases, 90% of whom are children under the age of 5 (WH0, 2004). Access to these basic environmental services is also essential to ensure human dignity, reduce poverty and social exclusion and promote economic development (OECD, 2011a)

The data presented here refer to the share of the population who have access to: *i)* safe drinking water sources; *ii)* improved sanitation facilities; and *iii)* wastewater treatment. Safe drinking water sources include several types of water supply for drinking: *i)* piped water into the dwelling, plot or yard; *ii)* public tap/standpipe; *iii)* borehole/tube well; *iv)* protected dug well; *v)* protected spring; *vi)* rainwater collection; and *vii)* bottled water (if a secondary available source is also available). Improved sanitation facilities refer to: *i)* flush/pour flush toilets or latrines connected to a sewer; *ii)* ventilated improved pit latrines; and *iii)* pit latrines with a slab or platform of any material that covers the pit entirely. As for access to wastewater treatment, the indicator takes into account several systems, ranging from the most basic (primary system) to the most sophisticated, effective and safest (tertiary system).

With respect to water sources and sanitation, most people in OECD countries have access to these services, although there are some disparities across urban and rural areas. However, in India, Indonesia and China a relatively large share of the population does not have adequate access to safe water and sanitation facilities. Over time, access to improved water and sanitation has increased in all the countries considered, particularly in those countries where the access to these amenities was particularly low (*e.g.* Turkey, India, China). In Estonia, Poland and Russia, however, access to sanitation has not improved much (Figure 10.8).

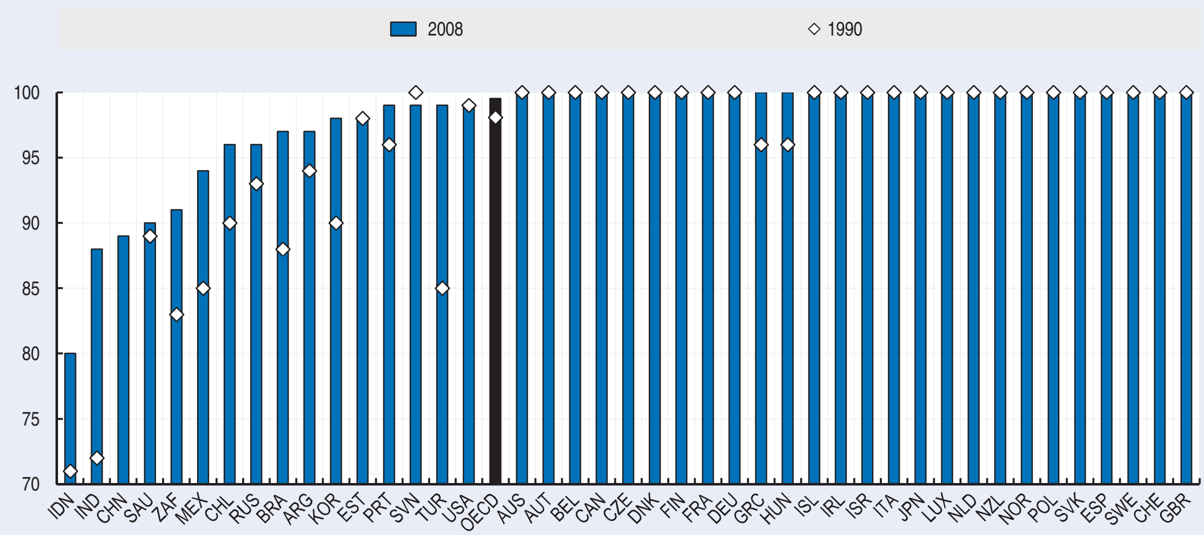
Connection to wastewater treatment has increased substantially in Turkey, Greece, Iceland, Korea and Spain in the last 30 years (Figure 10.9, Panel a). A large majority of OECD countries have either secondary or tertiary waste water treatment. Exceptions are Iceland, where more than the half of the population is connected to primary wastewater treatment, and Turkey, Greece and Hungary where the access to tertiary treatment is limited (Figure 10.9, Panel b).

Box 10.4. **Access to basic environmental services** *(cont.)*

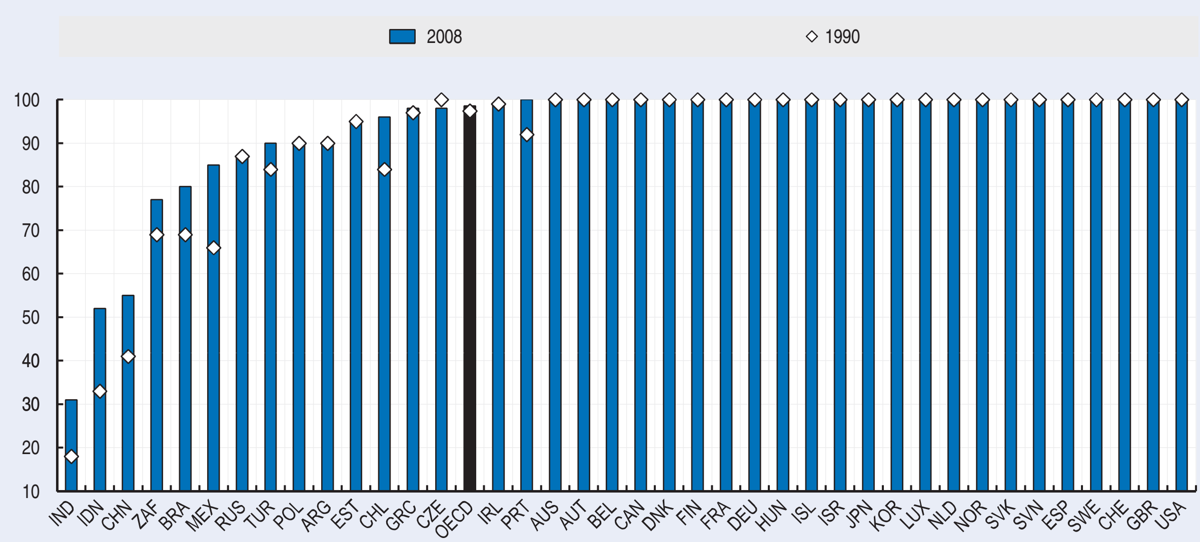
Figure 10.8. **Access to water and sanitation**

Percentage of population

Panel a: Access to improved water source



Panel b: Access to improved sanitation facilities



Notes: Panel a: Data refer to 1995 and 2008 for Korea; and to 2000 and 2008 for the Slovak Republic. Panel b: Data refer to 2000 and 2008 for Poland; and to 1995 and 2008 for Estonia. Data are not available for Italy and New Zealand.
Source: WHO/UNICEF Joint Monitoring Programme.

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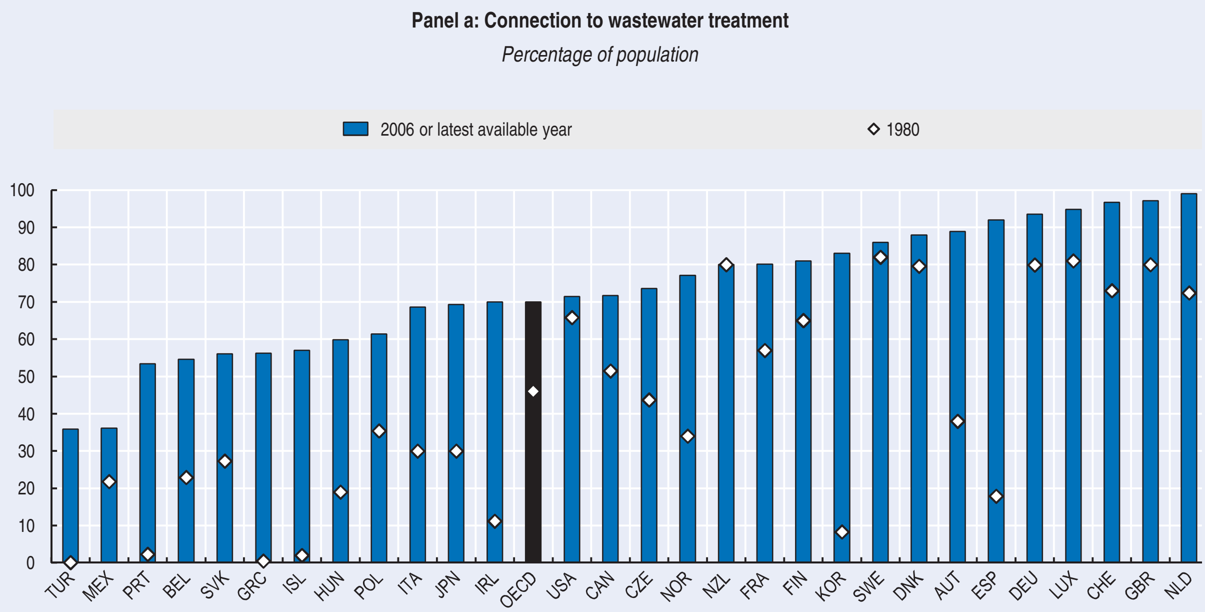
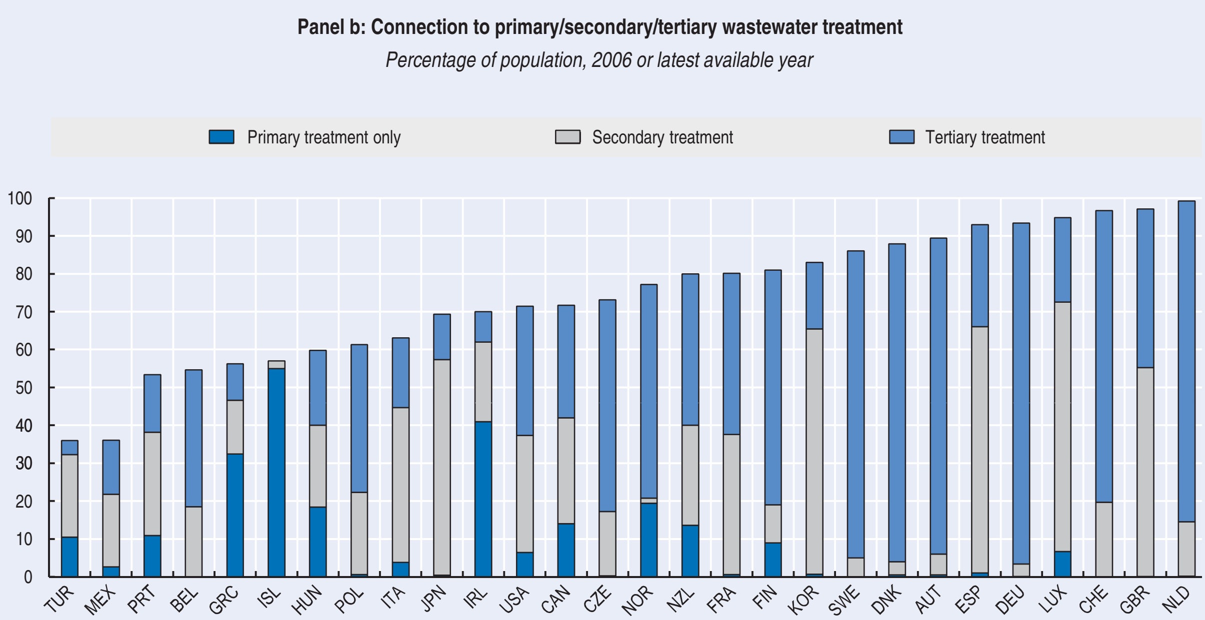
Box 10.4. **Access to basic environmental services** *(cont.)*

Figure 10.9. **Access to different types of wastewater treatment**





Note: The latest available year is 2000 for Canada, Greece, Italy and the New Zealand; and 1995 for the United States. Panel a: The first available year is 1985 for Turkey and the United Kingdom; 1990 for Iceland, New Zealand and Poland; and 1995 for Mexico.
Source: OECD Environmental Data.

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The various indicators capture different dimensions of environmental quality

The set of indicators presented in this chapter summarises information about major dimensions of environmental quality and how environmental hazards impact on human health. It is important to assess whether and how these indicators are interlinked (Table 10.2). In general:

- At a given point in time, the relation between the objective indicator of air quality (*i.e.* PM_{10} concentrations) and people's subjective judgement on air quality in the surroundings is quite weak. In countries with high PM_{10} concentrations (*e.g.* Poland and Turkey), people do not seem much more dissatisfied with air quality than people in countries where PM_{10} concentrations are significantly lower. This might reflect several factors.
- First, the objective measure of air quality used here takes into account PM_{10} concentrations only, while tropospheric air pollution – as perceived by individuals – may refer to a complex mixture of single pollutants. Second, people's perception of the local environment is also shaped by additional factors, such as cultural values, media exposure and local economic development. Third, people's environmental satisfaction may be influenced by relative changes in air quality rather than absolute values. People living in clean areas become accustomed to a high environmental quality, but are not content with this and request an even higher quality. By contrast, when the quality of local natural resources is poor, even small improvements make people contented, as they feel that the environment has become better (Zheng, 2010).
- In terms of subjective appreciations of environmental quality in general, measured as perceived air and water quality and lack of access to green spaces, the correlation is pretty strong, suggesting that these indicators are consistent with the level of subjective satisfaction with the local environment.
- Measures of the environmental burden of disease display a significant correlation with PM_{10} concentrations.

Table 10.2. **Correlation between different indicators of environmental quality**

		EN I Air quality	en 1 Environmental burden of disease		en 2 Satisfaction with local environment				en 3 Lack of access to green spaces	
					air		water			
EN I	Air quality	1	0.42***	(41)	-0.27	(41)	-0.31	(41)	0.57**	(23)
en 1	Environmental burden of disease		1	(41)	-0.33**	(41)	-0.60***	(41)	0	(23)
en 2	Satisfaction with local environment									
	Satisfaction with local air				1	(41)	0.75***	(41)	-0.63***	(23)
	Satisfaction with local water						1	(41)	-0.73***	(23)
en 3	Lack of access to green spaces								1	(23)

Note: Values in parenthesis refer to the number of observations. ** Indicates that correlations are significant at the 5% level; *** indicates that they are significant at the 1% level.

Source: OECD's calculations.

StatLink http://dx.doi.org/10.1787/888932494335

Inequalities

Youth, elderly and people from poor socio-economic backgrounds are the most vulnerable to pollution

The association between fine-particle pollution and heart and respiratory diseases is mediated by many factors, including occupational exposure, age, gender, underlying disease, smoking, health habits, body mass, education and income (Hill, 2004). Studies have shown that some groups of the population are especially vulnerable to air pollution and other environmental hazards. The very young (Box 10.5) and the very old are more at risk than the remainder of the population (Pope and Dockery, 1992; Schwarz, 1994). People with pre-existing cardiovascular and respiratory disease are also more susceptible to ambient PM (Goldberg et al., 2001; Dockery et al. 2001). Short-term effects of PM appear to be restricted largely to people with low socio-economic status (Gwynn and Thurston, 2001). Moreover, attributes of poor education (*e.g.* nutritional status, increased exposure, lack of access to good-quality medical care) may modify people's susceptibility to fine-particle pollution (Dockery et al., 2001). Most of these studies of air-pollution-related adverse health effects are based on national or local samples.

Box 10.5. **The effects of air pollution on children's health**

According to the WHO Task Force on the Protection of Children's Environmental Health, respiratory infections account for 20% of mortality in children under the age of five. Many OECD countries also report asthma epidemics that have been shown to be aggravated by air pollution: for example, in the United States approximately 4.8 million school-age children have asthma. It has been estimated that 43% of the global environmental burden of disease falls on children under five, and that 80% of the burden of disease for infants and young children has an environmental origin.

Much of the existing literature on the impact of the environment on human health has focused on adults. Even though the current knowledge of children's vulnerability is not sufficient, epidemiological evidence suggests that there are differences between children and adults with respect to air pollution and environmental toxicity. In many cases, children do not have the capacity to metabolise and detoxify toxic compounds. Moreover, their developing organisms require a higher rate of energy consumption and thus of food, air and water intake (*e.g.* when children are exercising during sport events, they may take in 20 to 50% more air – and thus air pollution – than adults in comparable activities). Different behavioural patterns may also play a role in the special vulnerability of children to environmental degradation: children spend more time outside than adults, and are often outdoors during times when air pollution is at its highest. Children also have more time to develop diseases that take a long time to develop, such as cancer, cardiovascular and neurodegenerative disease. Moreover, they may be exposed to a specific agent throughout their life, as compared to shorter periods of exposure by adults to chemicals that have only recently appeared on the market. Despite a large number of actions undertaken in OECD countries to protect children's health from environmental degradation, most existing legislation does not take into account children's special vulnerability to environmental risks.

Source: OECD (2006a); OECD (2008).

Satisfaction with the local environment varies according to social and geographical conditions

From an analytic and policy perspective, it is important to know how social and geographical influences may affect perceptions of how pollution is experienced (King and Stedman, 2000; Day, 2007). Early works explored some possibilities, with mixed results; some authors suggested that habituation could occur following higher or longer exposure, though others did not. Some studies reported that environmental concerns were higher among people with a higher socio-economic status, while others found mixed results. For example, Bickerstaff and Walker (2001) reported an inverse relationship between socio-economic status and concern for air quality, suggesting that this reflect differences in environmental quality and a reluctance to recognise negative conditions in localities where satisfaction is high. Elliot *et al.* (1999) found that the presence of other social problems in the neighbourhood could lead to a lower relative importance being ascribed to air pollution.

Table 10.3 below reports the results of a multivariate analysis based on a selection of socio-economic variables available in the Gallup World Poll (see Balestra and Sultan, 2012 for more details). The results are shown separately for both OECD and other major countries. Some of the main patterns are:

- The area where people live is the strongest predictor of perceptions of local environmental quality. In OECD countries, populations living in large cities or in their suburbs are significantly less satisfied with the quality of local air than people living in rural areas or small towns. The effect of the living area on the satisfaction with the quality of local water is however milder
- More educated people are less satisfied with the quality of the local environment, a pattern that holds in both OECD and emerging countries. This result is in line with the existing research, which suggests that more educated people appreciate more the consequences of certain human effects on the environment, and that they can make a stronger connection between social welfare and the environment (Van Liere and Dunlap, 1980; Thalmann, 2004; Kahn and Matsusaka, 1997).
- Access to the Internet (a proxy for media exposure) has an ambiguous effect on satisfaction with the local environmental quality. In emerging countries, people who potentially have access to a larger set of scientific information on environmental hazards and their harmful effects on human health, are less satisfied with the quality of local air and water. By contrast, in OECD countries the access to the Internet has a positive and significant effect on people's perception of the quality of local water.[5]
- Age also affects perceived environmental quality, although its effect is not strong. In OECD countries, older people are less satisfied with air and water quality, possibly because they are likely to suffer from pre-existing respiratory or cardiovascular diseases and spend more time outdoors.
- Similarly, gender seems to play a role in satisfaction with the local environment, with women significantly more dissatisfied than men, but only in OECD countries.
- Unemployed people living in emerging countries are on average less satisfied with the environment than their employed counterparts.

Table 10.3. **The determinants of satisfaction with environmental quality**

Marginal effects of explanatory variables on satisfaction with air and water quality

	Satisfaction with air quality		Satisfaction with water quality	
Explanatory variables	OECD countries only	Other major economies only	OECD countries only	Other major economies only
Female	-0.03***	0.01	-0.02**	0.01
Age	-0.01*	0.01	-0.01***	-0.01
Age squared	0.01**	-0.01	0.01***	0.01
Household income	0.01	0.01	0.01*	0.02***
Unemployed	0.01	-0.11***	-0.03	-0.09***
Secondary education	-0.03*	-0.05**	-0.03***	-0.04***
Tertiary education	-0.03*	-0.05***	-0.02*	-0.05**
Small town	-0.06***	-0.05***	-0.02	-0.03**
Big city	-0.20***	-0.14***	-0.06***	0.01
Suburb of a big city	-0.14***	-0.11***	-0.01	0.01
Children	-0.01*	-0.01	-0.01	-0.02*
Access to the Internet	0.01	-0.06***	0.03***	-0.05**

Note: Probit analysis includes all OECD countries, Brazil, China, India, Indonesia, the Russian Federation and South Africa. * indicates that values are significant at 10% confidence level; ** indicates that they are significant at 5% confidence level; and *** indicates that they are significant at 1% confidence level. The variable "household income" refers to the base-2 logarithm of the household disposable income. The variable "children" refers to having at least one child under 15 years old living at home. The number of observations is 28 432 for OECD countries and 11 830 for other major economies.
Source: OECD's calculations based on Gallup World Poll., 2009 and 2010.

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The statistical agenda ahead

Comparing environmental quality across countries is difficult because of several reasons:

- First, objective data on local environmental conditions are typically collected by different public agencies in the context of programmes to monitor public health and environmental conditions. The quality of such measures depends on the number of monitoring stations, their distribution on the territory, and the type of pollutants that they monitor. While monitoring systems are generally well developed for air quality, this is less the case for many other environmental media. Further, most of these statistics are developed outside the framework of official statistics and with little concerns for international comparability. The statistical community agrees that it is timely to further develop environmental-economic accounting and related statistics within the national statistical system, in order to respond to increasing policy demands. To this end, the United Nations Statistical Commission issued the Handbook of National Accounting: Integrated Environmental and Economic Accounting (SEEA) (United Nations et al., 2003), which enables environmental statistics to be compared to economic statistics and shows different patterns of sustainability for production and consumption.
- Second, a variety of pollutants will affect the quality of a given environmental media, and each of them may be monitored in different ways.[6] Even with respect to air, while the monitoring of concentrations of particulate matter below 10 microns in diameter is relatively well established, this is not the case for the particles that are the most harmful to human health, *i.e.* those below 2.5 microns. [7]

- Third, it is difficult to move from data on the concentration of various pollutants to information on the number of people exposed to them. Traditionally, data on air pollution are assigned to populations in an area of interest by assuming that everyone in the population is equally exposed. However, personal exposure may vary substantially, depending on several factors (*e.g.,* daily movements, work activities, lifestyle or behaviours). Further, environmental media tend to be affected by site-specific factors: environmental quality is a local public good, rather than a national one. Better-quality data on personal exposure are needed, and the Geographical Information System (GIS) could provide a better insight into topical environmental pressures and generate new environmental indicators at the local level.
- The need to better relate data on exposure to people's susceptibility to its consequences is particularly important for measuring health effects better. More research is needed to disentangle the impact of different air pollutants on the health of children as well as the pollutants' interactions with other environmental hazards and with genetic factors affecting susceptibility. Existing measures of the environmental burden of disease may underestimate the magnitude of these effects, as research suggests that official health statistics (deaths, illnesses, hospitalisations, etc.) represent only a portion of the environmental impact on human health. Many health effects (*e.g.*, sub-clinical toxicity, neuropsychiatric disorders, fertility impairment, intellectual impairment, etc.) often escape detection, are not reported, or are attributed to non-environmental factors. Further research on the environmental burden of disease should extend the range of health effects attributed to environmental conditions and focus more on vulnerable populations (*e.g.*, children, women, low-income populations).
- Finally, objective data on environmental quality need to be combined with data on people's subjective perceptions of local environmental quality, so as to provide a more detailed picture of both the determinants of satisfaction with the quality of natural assets and the socio-economic distribution of environmental impacts. While specific surveys on these issues are undertaken in some countries as part of their official statistical systems (*e.g.* Canada, the United Kingdom, Switzerland), and some comparative information is available from a few non-official surveys (*e.g.* the Gallup World Poll and, at the European level, the European Quality of Life Survey), more could be achieved by developing and coordinating activities in this field.

Conclusion

This chapter has provided a general picture of the impacts of environmental quality on public health and well-being. The concept of environmental quality is a broad one, encompassing a number of environmental media (*e.g.* soil, water, air). However, due to the lack of relevant data for some of these media and the evidence of sizeable effects of air pollutants on human health, this chapter paid great attention to air pollution. The chapter has used measures covering: *i)* people's exposure to air pollutants and the associated health effects; *ii)* people's exposure to environmental risks; and *iii)* subjective perceptions of the quality of the environment where people live.

In OECD countries the concentrations of PM_{10} have dropped in the last twenty years, although in many OECD countries they remain well above the WHO annual target. In major non-OECD countries, in addition to being exposed to high pollutant concentrations, a large share of the population remains without basic services, such as access to safe drinking water and sanitation. For the world as a whole, 24% of the total burden of disease, or 13 million premature deaths, could be prevented through environmental improvements. Environmental policies could be of great importance in dealing with existing global health priorities.

Notes

1. Natural disasters may also cause malnutrition and associated disorders through the failure of crops; diarrhoeal diseases via contaminated water; and food poisoning. These side effects are more likely to affect people in developing countries due to their lower capacity to cope with natural disasters.

2. Time-series studies have established that the effects of PM on health were not attenuated after other gaseous pollutants were considered (Samet *et al.* 2000; Katsouyanni, 2001), thus suggesting that PM may be serving as a general proxy for the overall air pollution mixture.

3. The DALY is a health gap measure, which extends the concept of potential years of life lost due to premature death to include equivalent years of healthy life lost by virtue of individuals being in states of poor health or disability. One DALY can be thought of as one lost year of healthy life and the burden of disease as the measure of the gap between current health status and an ideal situation where everyone lives into old age free from disease and disability (World Bank, 2006).

4. Surveys on public attitudes and behaviours towards the environment have been carried out in many countries (*e.g.* the United Kingdom, Canada, Australia and Switzerland) in the past few years. However, data from national surveys are difficult to compare, as they rely on different methodologies and questionnaires. Comparative results on households attitudes and environmental behaviours, limited to 10 OECD countries, are presented in OECD (2011d).

5. The variable "access to the Internet" is based on the following question: "Does your home have access to the Internet?"

6. There is a wealth of air quality indices and even countries that share the same legislation or cities within the same country may have different indicators. This hampers the comparison of air quality at the international level. The CITEAIR project started in March 2004, proposes a single common index (CAQI) aimed at comparing the air quality of European cities, http://www.airqualitynow.eu. At the moment, about 60 European cities and regions are taking part in the project.

7. In the quest for concise information, a large set of indicators that refer to each individual pollutant can prove too cumbersome and not suitable for cross- and within-country comparisons. One way to deal with this information overload is to develop aggregate indices that summarise the information from many environmental pollutants affecting the same environmental media. However, summarising different data into a single value is difficul, and the scientific community is still divided between different types of approaches, such as providing either aggregate indicators or indicator "profiles" (matrices). Both approaches have positive and negative aspects, and there is no perfect solution. While the scientific debate centres on the amount of information lost in the simplification made possible by the aggregate index, and on the potential misinterpretation of the data to which the aggregation can lead, it is critical for better reporting and comparability to respond to this demand for concise measures.

References

Ahmad, N and N. Yamano (2011), "Carbon Dioxide Emissions Embodied in Goods and Services: Domestic Consumption versus Production", OECD Statistics Directorate Working Papers, forthcoming, OECD, Paris

Armstrong, D. (2000), "A survey of community gardens in upstate New York: Implications for health promotion and community development", *Health & Place*, Vol. 6, No. 4, pp. 319-327.

Arruti, A., I. Fernández-Olmo and A. Irabien (2010), "Impact of the global economic crisis on metal levels in particulate matter (PM) at an urban area in the Cantabria Region (Northern Spain)", *Journal of Environmental Monitoring*, Vol. 7, No. 12, pp. 1451-1458.

Balestra, C. and D. Dottori (2011), “Ageing Society, Health and the Environment”, *Journal of Population Economics,* http://dx.doi.org/10.1007/s00148-011-0380-x.

Balestra, C. and J. Sultan (2012), “Home sweet home: The determinants of residential satisfaction and its relation with well-being”, OECD Statistics Directorate Working Papers (forthcoming), OECD, Paris.

Bickerstaff, K. and G. Walker (2001), “Public understandings of air pollution: The ‘localisation’ of environmental risk”, *Global Environmental Change*, 11, pp. 133-145.

Brown, C. and M. Grant (2007), “Natural medicine for planners”, *Town and Country Planning*, Vol. 76, No. 2, pp. 67-68.

Day, R. (2007), “Place and the experience of air quality”, *Health & Place*, vol 13, pp. 249-260.

Dockery, D.W. (2001), “Epidemiologic evidence of cardiovascular effects of particulate air pollution”, *Environmental health perspectives*, Vol. 109, pp. 483–486.

EEA (2010), *The European Environment. State and Outlook 2010: Air Pollution*, European Environmental Agency, Copenhagen.

Ellaway, A., S. Macintyre and X. Bonnefoy (2005), “Graffiti, greenery, and obesity in adults: Secondary analysis of European cross-sectional survey”, *British Medical Journal*, Vol. 331, 17 September, pp. 611-613.

Elliot, S., D. Cole, P. Krueger, N. Voorberg and S. Wakefield (1999), “The power of perception: Health risk attributed to air pollution in an urban industrial neighbourhood”, *Risk analysis*, Vol. 19, pp. 621-634.

European Commission (2010), *Green Paper on Forest Protection and Information in the EU: Preparing forests for climate change*, http://ec.europa.eu/environment/forests/pdf/green_paper.pdf.

Goldberg, M.S., R.T. Burnett, J.C. Bailar, R. Tamblyn, P. Ernst, K. Flegel, J. Brook, Y. Bonvalot, R. Singh, M.F. Valois and R. Vincent (2001), “Identification of persons with cardio-respiratory conditions who are at risk of dying from the acute effects of ambient air particles”, *American Journal of Epidemiology,* Vol. 109, pp. 487–494.

Gwynn, R.C. and G.D. Thurston (2001), “The burden of air pollution: Impacts among racial minorities”, *Environmental Health Perspectives*, Vol. 109, pp. 501–506.

Hill, M.K. (2004), *Understanding Environmental Pollution*, Cambridge University Press, New York.

Holman, M.R. and T. G. Coan (2008), “Voting Green”, *Social Science Quarterly*, Vol. 89, pp. 1121–1135.

Kahn, M.E. and J.G. Matsusaka (1997), “Demand for Environmental Goods: Evidence from Voting Patterns on California Initiatives” *Journal of Law & Economics*, Vol. 40, No. 1, pp. 137–173.

Kahn, M.E. (2002), “Demographic change and the demand for environmental regulation”, *Journal of Policy Analysis and Management*, Vol. 21, No. 1, pp. 45–62.

Katsouyanni, K., G. Touloumi, E. Samoli, A. Gryparis, A. Le Tertre, Y. Monopolis, G. Rossi, D. Zmirou, F. Ballester, A. Boumghar, H.R. Anderson, B. Wojtyniak, A. Paldy, R. Braunstein, J. Pekkanen, C. Schindler and J. Schwartz (2001), “Confounding and effect modification in the short-term effects of ambient particles on total mortality: Results from 29 European cities within the APHEA2 project”, *Epidemiology*, Vol. 12, pp. 521-531.

King, K. and J. Stedman (2000), *Analysis of air pollution and social deprivation*, AEA Technology Environment report AEAT/R/ENV/0241.

Mace, B., P. Bell and R. Loomis (1999), “Aesthetic, affective, and cognitive effects of noise on natural landscape assessment”, *Social and Natural Resources*, Vol. 12, No. 3, pp. 225-242.

Milligan, C., A. Gatrell and A. Bingley (2004), “Cultivating health. Therapeutic landscapes and older people in Northern England”, *Social Science and Medicine*, Vol. 58, No. 9, pp. 1781-1793.

OECD (2006a), *Economic Valuation on Environmental Health Risks to Children*, OECD Publishing, Paris.

OECD (2006b). *OECD Environmental Data. Compendium 2006-2008*, OECD Publishing, Paris.

OECD (2008), *OECD Environmental Outlook to 2030*, OECD Publishing, Paris.

OECD (2010), *OECD Factbook 2010*, OECD Publishing, Paris.

OECD (2011a), *Benefits of Investing in Water and Sanitation: An OECD Perspective*, OECD Publishing, Paris.

OECD (2011b), *Towards green growth: Monitoring Progress – OECD Indicators*, OECD Publishing, Paris.

OECD (2011c), *Towards Green Growth*, OECD Publishing, Paris.

OECD (2011d), *Greening Household Behaviour - The Role of Public Policy,* OECD Publishing, Paris.

Pope, C.A. and D.W. Dockery (1992), "Acute effects of PM10 pollution on symptomatic and asymptomatic children", *American Review of Respirratory Disease*, Vol. 145, pp. 1123-8.

Pretty, J., J. Peacock, M. Sellens and M. Griffin (2005), "The mental and physical health outcomes of green exercise", *International Journal of Environmental Health Research*, Vol. 15, No. 5, pp. 319-337.

Prüss-Üstün, A. and C. Corvalán (2006), *Preventing disease through healthy environments: Towards an estimate of the environmental burden of disease.* World Health Organization, Geneva.

Samet, J.M., F. Dominici, F.C. Curriero, I. Coursac and S.L. Zeger (2000), "Fine Particulate Air Pollution and Mortality in 20 U.S. Cities, 1987-1994", *The New England Journal of Medicine*, Vol. 343, No. 24, pp. 1742-1749.

Schwartz, J. (1994), "What are people dying of on high air pollution days?", *Environmental research*, Vol. 64, pp. 26–35.

Stiglitz, J.E., A. Sen and J.-P. Fitoussi (2009), Report by the Commission on the Measurement of Economic Performance and Social Progress, http://www.stiglitz-sen-fitoussi.fr/documents/rapport_anglais.pdf

Thalmann, P. (2004), "The Public Acceptance of Green Taxes: 2 Million Voters Express Their Opinion", *Public Choice*, Vol. 119, No. 4, pp. 179–217.

UNECE (2009), *Measuring sustainable development*, United Nation Economic Commission for Europe, United Nations Publication, New York and Geneva.

UNFPA (2008), *State of the World Population 2008. Reaching Common Ground: Culture, Gender and Human Rights*, United Nations Population Fund, New York.

United Nations (2008), *Measuring Sustainable Development. Report of the Joint UNECE/OECD/Eurostat Working Group on Statistics for Sustainable Development*, New York and Geneva, http://www.oecd.org/dataoecd/30/20/41414440.pdf

United Nations, European Commission, IMF (International Monetary Fund), OECD and World Bank (2003), *Handbook of National Accounting – Integrated Environmental and Economic Accounting*, ST/ESA/STAT/SER.F/Rev.1 (final draft).

Van Liere, K.D. and R.E. Dunlap (1980), "The social bases of environmental concern: A review of hypotheses, explanations, and empirical evidence", *Public Opinion Quarterly,* Vol. 44, No. 2, pp. 181–197.

Ward Thompson, C. (2002), "Urban open space in the 21st century", *Landscape & Urban Planning,* Vol. 60, pp. 59-72.

WHO (2004), Water, *Sanitation and Hygiene Links to Health: Facts and Figures updated March 2004*, WHO Library Cataloguing-in-Publication Data, Geneva.

World Bank (1992), *World Bank Report: Development and the Environment*, Oxford University Press, New York.

World Bank (2006), *Global burden of disease and risk factors,* World Bank, Washington D.C.

World Bank (2009), *Atlas of Global Development: Second Edition*, World Bank, Washington D.C.

Zheng, Y. (2010), "Association Analysis on Pro-environmental Behaviors and Environmental Consciousness in Main Cities of East Asia", *Behaviormetrika*, Vol. 37, No. 1, pp. 55-69.

ANNEX 10.A

Measuring environmental sustainability

This chapter has focused on the effects of environmental quality for the well-being of the present generation. However, measuring sustainability is also critical. The well-being of a generation is determined by the stock of resources that is inherited from previous generations and by the choices that each generation makes. Hence, many policy decisions taken today – by influencing the stock of tangible or intangible resources that will be available in the future – impact on future well-being. In some cases, actions taken today, such as investing in clean technologies, will increase the stock of resources available tomorrow; in other cases, policy decisions that increase current well-being will use up some of that stock.

The Commission on the Measurement of Economic Performance and Social Progress (Stiglitz *et al.*, 2009) recommends measuring environmental sustainability through indicators that inform about changes in the quantities of some key stocks and that forewarn about the proximity to dangerous levels of environmental risk. In practice, few such benchmarks exist or are easily applicable in an international context. This often reflects the fact that critical levels of environmental assets may vary locally, making national averages not very meaningful, and that there is often scientific uncertainty about where critical limits lie.

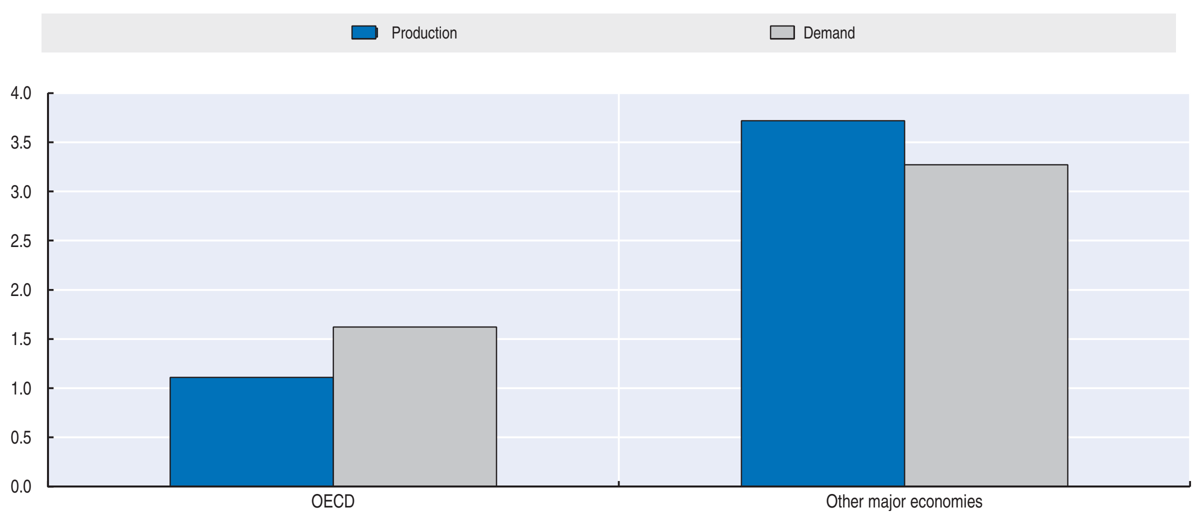
Several international initiatives to build sustainable development dashboards are being pursued. In 2008, the Joint UNECE/Eurostat/OECD Working Group on Measuring Sustainable Development produced a report that advocated a stock-based approach to address the inter-temporal dimension of sustainability as the best way of structuring a set of sustainability indicators that combines both stock and flow variables (United Nations, 2008). This report also suggested a distinction between capital measures of "economic" well-being (amenable to monetary evaluation) and measures of "foundational" well-being (requiring physical measures for various stocks and flows of environmental capital).

In 2009, following a mandate from Ministers, the OECD started to develop a Green Growth Strategy, with the intent of "fostering economic growth and development while ensuring that the quality and quantity of natural assets can continue to provide the environmental services on which our well-being relies" (OECD, 2011c). The set of indicators incorporated in the OECD Green Growth Strategy released in May 2011 mainly focuses on the concept of decoupling environmental pressures from economic growth (*i.e.* indicators on environmental intensities), although some of these indicators refer to the total pressures on the natural asset base (as affected by both environmental intensities and by the scale of economic activities). In a perspective of assessing environmental sustainability, this annex considers some of the Green Growth Strategy indicators as well as additional indicators whose development is still in progress:

- **Change in production- and demand-based CO_2 emissions.** CO_2 emissions have detrimental impacts not only on global temperatures and on the Earth's climate, but also for ecosystems, human settlements and socio-economic activities. It is now generally accepted that policies are needed to stabilise concentrations of CO_2 in the atmosphere at levels that would prevent dangerous anthropogenic interference with the climate system. Many of these policies target those activities that directly result in the use of fossil fuels, either through pricing mechanisms that increase the cost of these activities, or through the adoption of cleaner technologies that result in lower CO_2 emissions. The mechanisms therefore typically focus on reducing emissions on the production side of the economy. However such policies might encourage companies to offshore carbon intensive activities or push up the costs of goods such that the same goods are imported from countries subject to lower environmental costs. As a result, focusing purely on production-based figures may not tell the whole story. Therefore, there is a need for complementary consumption- or demand-based figures that reflect the impact of an economy's demand on global emissions, both to put production figures in an explanatory light and, potentially, to develop demand-based policy measures. Figure 10.A.1 shows the annual rate of change in production- and demand-based CO_2 emissions for OECD and other emerging countries at the aggregate level. Production-based estimates include emissions from domestic economic activities due to the use of oil, natural gas and coal, as well as emissions from natural gas flaring, but exclude emissions from land use and deforestation. Demand-based figures allocate the CO_2 emitted in producing a product to the final purchaser of that product, irrespective of how many intermediate processes and countries the product passes through before arriving to its final purchaser. The comparison of production and demand-based estimates shows that the contribution of OECD countries to overall global emissions has a strong demand component, that, in recent years, has been growing at a faster pace than production based emissions, as OECD economies increasingly source products from emerging economies (see Ahmad and Yamano, 2011 for more details).

Figure 10.A.1. **Production-based and demand-based CO_2 emissions**

Rate of change per year, 1995-2005



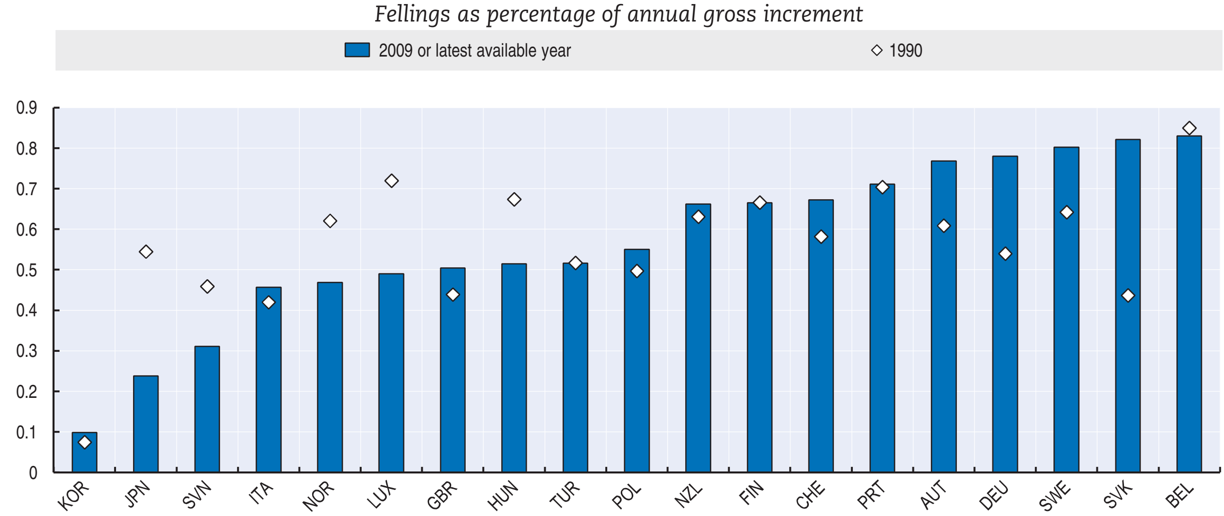
Source: OECD (2011b), *Towards Green Growth: Monitoring Progress – OECD Indicators*, OECD Publishing, Paris.

StatLink http://dx.doi.org/10.1787/888932493423

- **Intensity of forest resource use**. This indicator, which relates fellings to annual gross increment, allows understanding how sustainable is the forest resource management, including for biodiversity (forests hold the vast majority of the world's terrestrial species). Deforestation, along with habitat fragmentation and degradation, is one of the biggest threats for forest biodiversity. Forests also play a key role for the climate, as they act as sinks that remove carbon dioxide from the air and help keep global warming below 2°C (European Commission, 2010). At national levels, most OECD countries make a sustainable use of their forest resources, but with significant variations within countries. From 1990 to 2009 the volume of felled trees as a percentage of annual productive capacity have decreased in Japan, Luxembourg, Hungary, Norway and Slovenia; while it has increased in other countries, notably in the Slovak Republic, Germany, Sweden, Switzerland and Austria (Figure 10.A.2). Over the past 50 years, the area of forests and wooded land has remained broadly stable (or has slightly increased) in most OECD countries, but has been declining at the world level due to the deforestation of tropical forests (OECD, 2008).

Figure 10.A.2. **Intensity of use of forest resources**

Fellings as percentage of annual gross increment



Note: The latest available year is 2007 for Luxembourg; and 2005 for Austria, Belgium, Finland, Japan, Poland and Portugal. The first available year is 1993 for Germany.

Source: OECD Environmental Database.

StatLink http://dx.doi.org/10.1787/888932493442

- **Land used for agriculture**. Land management must ensure a growing supply of food and other resources to human populations, while minimising negative consequences in the form of climate change, biodiversity loss and pollution. Some of these negative consequences reflect the growing intensity of surface nitrogen, which may lead to higher nitrogen levels of drinking water. The total land used for agriculture is projected to increase over the next 20 years in all countries and regions except Japan and Korea. In South Asia, this increase in land used for agriculture could imply further losses of forests and scrublands. In Europe, most of the additional land for agriculture is expected to come from Eastern Europe (Table 10.A.1).

Table 10.A.1 **Changes in land used for agriculture by 2030**

2005=100

North America	Europe	Japan Korea	Australia New Zealand	Brazil	The Russian Federation	South Asia	China	Middle East	South East Asia	Caucasus and Other Central Asia	Other Latin America	Africa	World
104	105	83	104	108	115	124	101	100	127	104	109	118	110

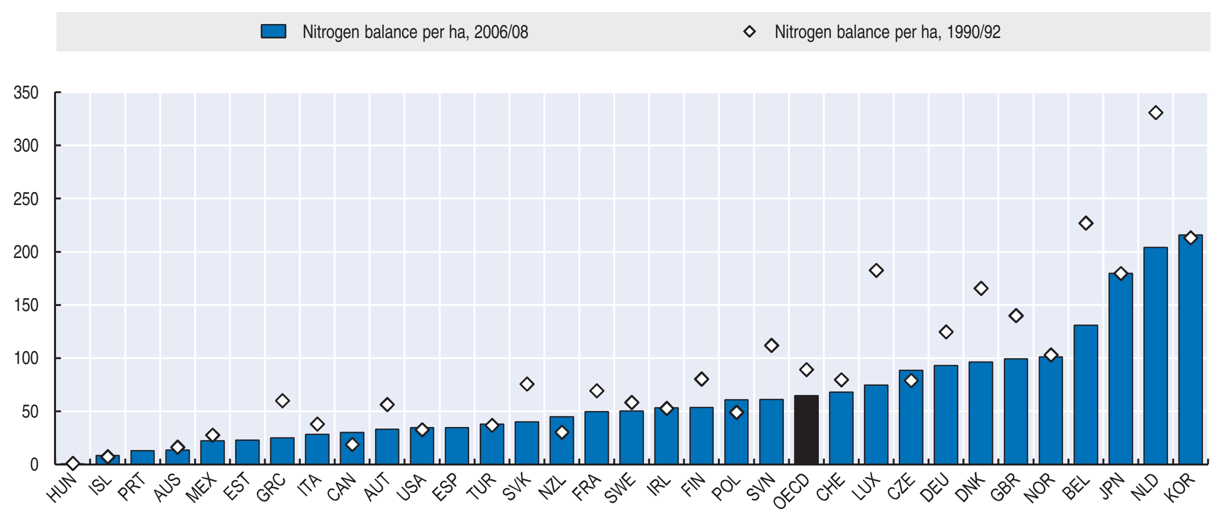
Source: OECD (2008), OECD Environmental Outlook to 2030, OECD Publishing, Paris.

StatLink http://dx.doi.org/10.1787/888932494373

- **Nitrogen surplus**. This indicator is calculated as the difference between the total quantity of nitrogen entering an agricultural system (mainly fertilisers and livestock manure) and the quantity of nutrient leaving the system (mainly uptake of nutrients by crops and grassland). It is a good indication of the level of environmental pressures from nutrients on natural assets, in particular soil and water. Elevated levels of nitrogen contribute to algal blooms in freshwater habitats and coastal areas, thus depriving other species of oxygen and reducing plant diversity. Nitrogen surplus is driven by different factors: agricultural land use, methods of farm management and nitrogen surplus intensities. Nitrogen surplus intensity per unit of agricultural output has decreased between 1900 and 2008, although with large differences between countries (nitrogen surplus intensity has considerably declined in the Netherlands, Belgium, Luxembourg and Denmark but increased in Canada, the Czech Republic, New Zealand and Poland, Figure 10A.3). Due to the combined effect of changes in nitrogen surplus intensities and of land used for agriculture, the total nitrogen surplus from agriculture is projected to increase significantly in India and China, while it may decrease in the United States and Europe. By 2030, most of the projected global increase of 0.8% will be occurring in non-OECD economies (OECD, 2008).

Figure 10.A.3. **Nitrogen surplus intensities**

Kg per hectare of agricultural land, 1990/92 and 2006/08

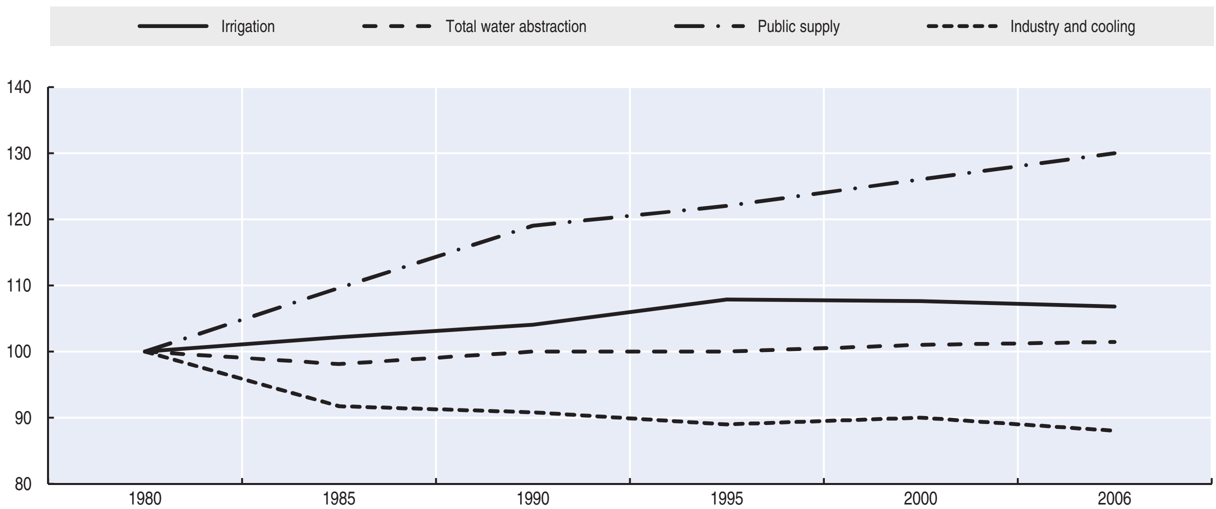


Source: OECD (2011), *Towards Green Growth: Monitoring Progress* – OECD Indicators, OECD Publishing, Paris.

StatLink http://dx.doi.org/10.1787/888932493461

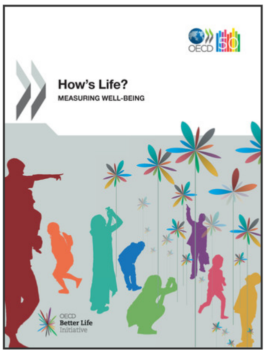
- **Freshwater abstractions.** This indicator refers to freshwater taken from ground or surface water sources, either temporarily or permanently, and conveyed to the place of use. Mine water and drainage are included, while water used for hydroelectricity generation is excluded. In the OECD area, the greatest demands for water come from irrigation (43%), electrical cooling and industry (42%), and public water supplies (15%) (OECD, 2008). Since the 1980s, most OECD countries have stabilised total water abstraction thanks to more efficient irrigation techniques, shrinking water-intensive industries (*e.g.* mining, steel), increased use of cleaner production technologies and reduced losses in pipe networks (Figure 10.A.4). Over the next twenty years, pressures on water use are projected to grow much more in developing countries than in OECD countries, due to population growth and a sharp increase in agricultural production.

Figure 10.A.4. **Freshwater abstraction in OECD countries (1980=100)**



Source: OECD (2010), *OECD Factbook 2010 - Economic, Environmental and Social Statistics*, OECD Publishing, Paris.

StatLink http://dx.doi.org/10.1787/888932493404



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