Green Growth Indicators 2017

OECD

BETTER POLICIES FOR BETTER LIVES

"Green growth is about fostering growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies.

Governments that pursue policies designed to promote green growth need to catalyse investment and innovation that underpin growth and give rise to new economic opportunities.

They also need indicators that can help raise awareness, measure progress and identify opportunities and risks."

Rintaro Tamaki, OECD Deputy Secretary-General

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http://oe.cd/ggi

Overview

Our ability to sustain economic and social progress in the long run will depend on our capacity to reduce dependence on natural capital as a source of growth, abate pollution, enhance the quality of physical and human capital and reinforce our institutions.

Delivering the quality of growth to which citizens aspire requires concerted action across countries and within ministries invested in green growth – finance, economy, industry, trade and agriculture, among others.

This report provides information on the results achieved by OECD and G20 countries since 1990. The indicators help answer four questions that are at the heart of green growth:

- **Are we becoming more efficient in using natural resources and environmental services?** PAGE 6
- **How does greening the economy generate opportunities for growth and development?** PAGE 10
- **Is the natural asset base of our economies maintained?** PAGE 12
- **Does greening growth generate benefits for people?** PAGE 14

Green Growth Indicators 2017 updates and extends the green growth indicators presented in the 2014 and 2011 editions.

It charts the progress that OECD countries and G20 economies have made since 1990. The 2017 edition places greater emphasis on productivity gains and on the role of policy action, with enriched analysis on environmentally related taxes and subsidies, technology and innovation, and international financial flows.

The report was prepared by the OECD Environment Directorate, in co-operation with the Statistics Directorate and the Economics Department, with expert advice from other OECD directorates, as well as ministries and statistical offices in member and partner countries.

These *Highlights* present key messages and selected indicators from the report. The full report and complete datasets are available in open access on the OECD website: http://oe.cd/ggi

Progress towards green growth

Several countries are at the forefront of the transition towards green growth, but no country leads in all areas. In fact, countries often advance in one dimension of green growth while remaining stagnant on other fronts. Too often, progress has been insufficient to protect the natural asset base.

There are signs of greening growth in OECD countries. Most countries use the available natural resources and environmental services more productively. They have reduced air pollution and some of the associated risks for the population. Many countries have stabilised extraction of renewable natural resources (wood, fish, freshwater), and are advancing towards more sustainable management practices.

Luxembourg, Iceland, Denmark, Norway and the Netherlands consistently rank high across most of the selected green growth dimensions. Among the non-OECD economies studied, Colombia and Costa Rica lead the way.

Countries such as Denmark, Estonia, the United Kingdom, Italy and the Slovak Republic achieved the greatest overall improvements towards green growth compared to 2000 (Figure 1). The top performers vary substantially according to each of the indicators. This diversity underlines the need to assess progress towards green growth across a set of multiple indicators, and to place the ranking in a broader growth context, such as GDP per capita and income inequality.

How to read this graph

For each indicator, performance of an individual country is assessed relative to the best outcome (leader) among all 46 countries studied. Improvements shown here are determined by comparing outcomes in 2015 to 2000 (as a change in the "distance to the leader"). Countries started at different levels in 2000. The base year chosen for monitoring progress also plays a role.

The best improvement (relative to the leader) is located on the outer frontier of each axis, the worst improvement is located in the origin. The green line indicates no change; values below that level indicate deterioration.

Data and sources: http://doi.org/b8rw

Environmentally adjusted multifactor productivity

Low land consumption

Low air pollution exposure

Environmentally related innovation

Environmentally related taxation

GDP per capita

Low income inequality

CO_2 productivity (production-based)

CO_2 productivity (demand-based)

Material productivity

Figure 1. **Highest overall improvements towards green growth, 2000-2015**

1 Productivity
Are we becoming more efficient in using natural resources and environmental services?

The environmental productivity of OECD countries in terms of carbon, energy and materials has improved, with wide variation across countries and sectors.

Multifactor productivity

Rising productivity is a key source of economic growth and better living standards. In some cases, economic growth can be over-estimated if it relies on depletion of natural capital or on heavily polluting technology.

Multifactor productivity accounts for the role of multiple inputs (labour, produced capital, natural capital) and outputs (GDP and pollution). Some OECD countries generated growth almost exclusively through productivity gains. BRIICS economies have drawn to a much greater extent on increased use of labour, produced capital and natural capital to generate additional growth.

Natural capital can contribute significantly to output growth. About 23% of output growth in the Russian Federation since 1994 has been due to extraction of subsoil assets. This raises concerns over dependence on natural resource extraction and the need to identify new sources of growth in the long run.

Pollution abatement can also affect growth performance. Some countries have achieved economic growth at the expense of environmental quality. Particularly, this is the case of India, Saudi Arabia and China, and some OECD countries such as Turkey, Korea and Mexico.

How to read this graph

On the first graph, pollution-adjusted GDP growth is shown as bars. It is broken down into four components: labour, produced capital, natural capital, and the share of growth that is not explained by these factors: environmentally adjusted multifactor productivity (EAMFP).

EAMFP complements the traditional measure of multifactor productivity, widely used by economic and finance policy makers. It fosters greater consideration of environmental concerns in economic policy decisions.

The second graph shows EAMFP (the green part of the first graph) as a share of GDP growth (the whole bar on the first graph). On average, it amounts to 60% of GDP growth in OECD countries, and 20% in BRIICS countries. The top ten countries are highlighted.

EAMFP is a work in progress. The coverage of environmental services remains partial, currently limited to air emissions and subsoil assets. Pending better data availability, future work will expand the range of environmental services included.

More information: http://oe.cd/eamfp

Data and sources: http://doi.org/b8rx

Figure 2. **Productivity gains have played a key role in sustaining economic growth**

Sources of growth

Role of productivity gains

Country	Role of productivity gains
China	26%
India	38%
Chile	31%
Israel	35%
Latvia	41%
Lithuania	63%
Indonesia	47%
Ireland	66%
Estonia	70%
Korea	65%
Slovak Republic	54%
Costa Rica	36%
Argentina	41%
Luxembourg	37%
Poland	69%
Saudi Arabia	53%
Colombia	42%
Czech Republic	52%
Australia	57%
Turkey	14%
Russia	74%
Brazil	48%
Iceland	93%
Norway	57%
Slovenia	74%
United States	67%
New Zealand	39%
South Africa	46%
United Kingdom	75%
Netherlands	57%
Canada	57%
Sweden	61%
Hungary	68%
Austria	68%
Mexico	46%
Germany	84%
Belgium	61%
Finland	85%
Spain	51%
France	74%
Switzerland	52%
Denmark	67%
Portugal	54%
Japan	84%
Greece	30%
Italy	67%

Legend:
- Labour
- Produced capital
- Natural capital
- Environmentally adjusted multifactor productivity

Pollution-adjusted GDP growth, % points
0 1 2 3 4 5 6 7 8 9

Environmentally adjusted multifactor productivity as % of pollution-adjusted GDP growth

Long-term averages (circa 1991-2013)

Material consumption remains high, often driven by construction. To generate **USD 1 000 of GDP** in 2015, OECD countries, on average, consume **416 kg of non-energy materials and 111 kg of energy products** (in oil equivalent, down from 143 kg in 2000).

Carbon productivity: Despite a slowdown in OECD countries, global CO_2 emissions continued to grow, up 58% from 1990. Some countries managed to reduce the absolute level of emissions. However, most countries only reduced CO_2 emissions growth relative to GDP growth.

Figure 3. **Carbon productivity improved in most countries,** but a more nuanced picture emerges when emissions are considered from the perspective of final demand.

	Production-based (GDP for each kg of CO_2 emitted on the national territory)		Demand-based (GDP for each kg of CO_2 emitted anywhere to satisfy domestic final demand)
	2011	2014	2011
Switzerland	$10.5	$11.4	$4.3
Sweden	$9.5	$11.1	$5.2
Colombia	$8.0	$8.2	$6.0
Brazil	$7.5	$6.4	$6.2
OECD	$3.6	$3.9	$3.2
United States	$2.9	$3.1	$2.6
Korea	$2.7	$3.0	$3.0
Australia	$2.5	$2.8	$2.2
China	$1.6	$1.9	$1.9
South Africa	$1.6	$1.5	$2.0

How to read this graph

Production-based productivity accounts for CO_2 emissions generated on the national territory, without taking trade flows into account.

However, we all consume products that have been, at least partially, manufactured and shipped from other countries. Trade patterns change, and polluting industries are shifted to lower-cost locations, often with more lax environmental standards. This is why another indicator is useful: demand-based CO_2 productivity shows the economic value generated per unit of CO_2 emitted to satisfy domestic final demand, irrespective of where production occurred.

Total emissions generated to satisfy domestic final **demand** in OECD countries have increased faster than emissions from domestic **production**. As a result, most OECD countries are "net importers" of CO_2 emissions.

Data and sources: http://doi.org/b8rz and http://doi.org/4f5

2 | Policies
How does greening growth generate economic opportunities?

Taxes and subsidies send important market signals that can influence the behaviour of producers and consumers. Shifting taxes away from labour and capital and towards environmental bads and phasing out harmful subsidies play a key role in a transition to a greener economy.

Fossil fuel support amounts to more than USD 60 billion per year in OECD countries.

Figure 4. **Environmental taxes remain limited, particularly when compared to labour taxes**
Environmentally-related tax revenue in 1995, in 2014 (top 7 countries selected here), and labour tax revenue, as % of GDP
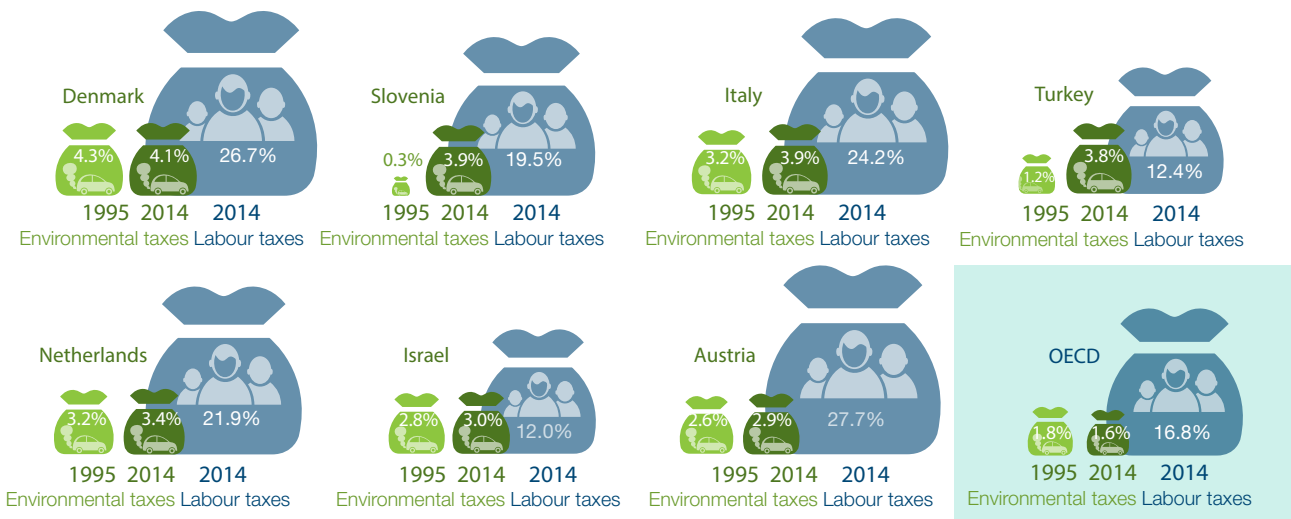

Denmark — 4.3% (1995) 4.1% (2014) 26.7% (2014)
Environmental taxes Labour taxes

Slovenia — 0.3% (1995) 3.9% (2014) 19.5% (2014)
Environmental taxes Labour taxes

Italy — 3.2% (1995) 3.9% (2014) 24.2% (2014)
Environmental taxes Labour taxes

Turkey — 1.2% (1995) 3.8% (2014) 12.4% (2014)
Environmental taxes Labour taxes

Netherlands — 3.2% (1995) 3.4% (2014) 21.9% (2014)
Environmental taxes Labour taxes

Israel — 2.8% (1995) 3.0% (2014) 12.0% (2014)
Environmental taxes Labour taxes

Austria — 2.6% (1995) 2.9% (2014) 27.7% (2014)
Environmental taxes Labour taxes

OECD — 1.8% (1995) 1.6% (2014) 16.8% (2014)
Environmental taxes Labour taxes

Figure 5. **OECD countries continue to support potentially environmentally harmful activities**
OECD total, index 2000=100.

Fossil fuel support
GDP

Potentially environmentally harmful agricultural subsidies
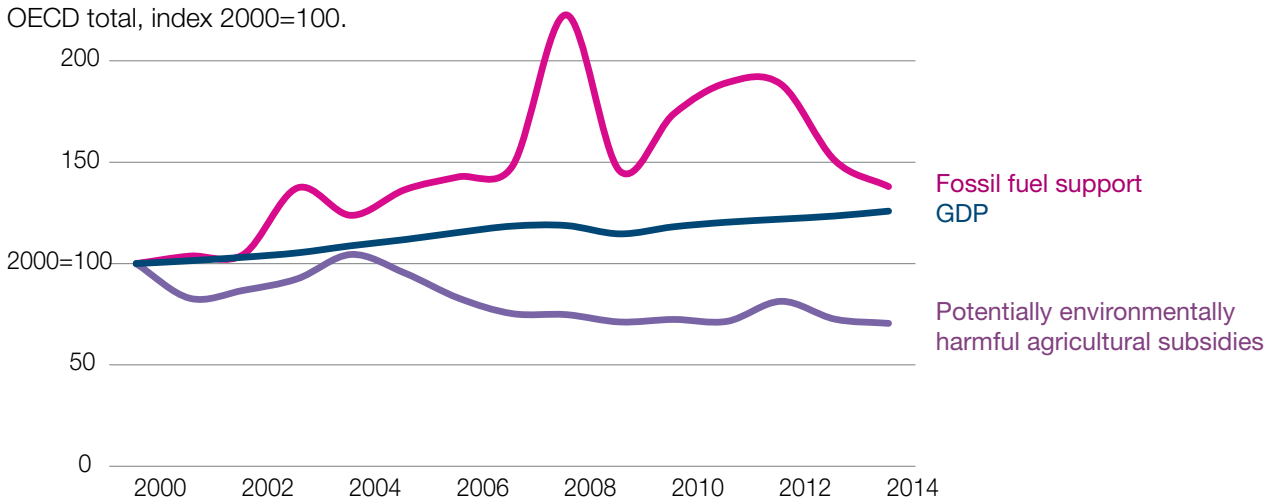
On the innovation front, progress has been mixed: governments spend more on research and development, but the share dedicated to environment and energy objectives has remained stagnant. Long-term incentives are needed to direct innovation towards environmental objectives more effectively.

Figure 6. **In most countries, environmental technologies progressed faster than other technologies**
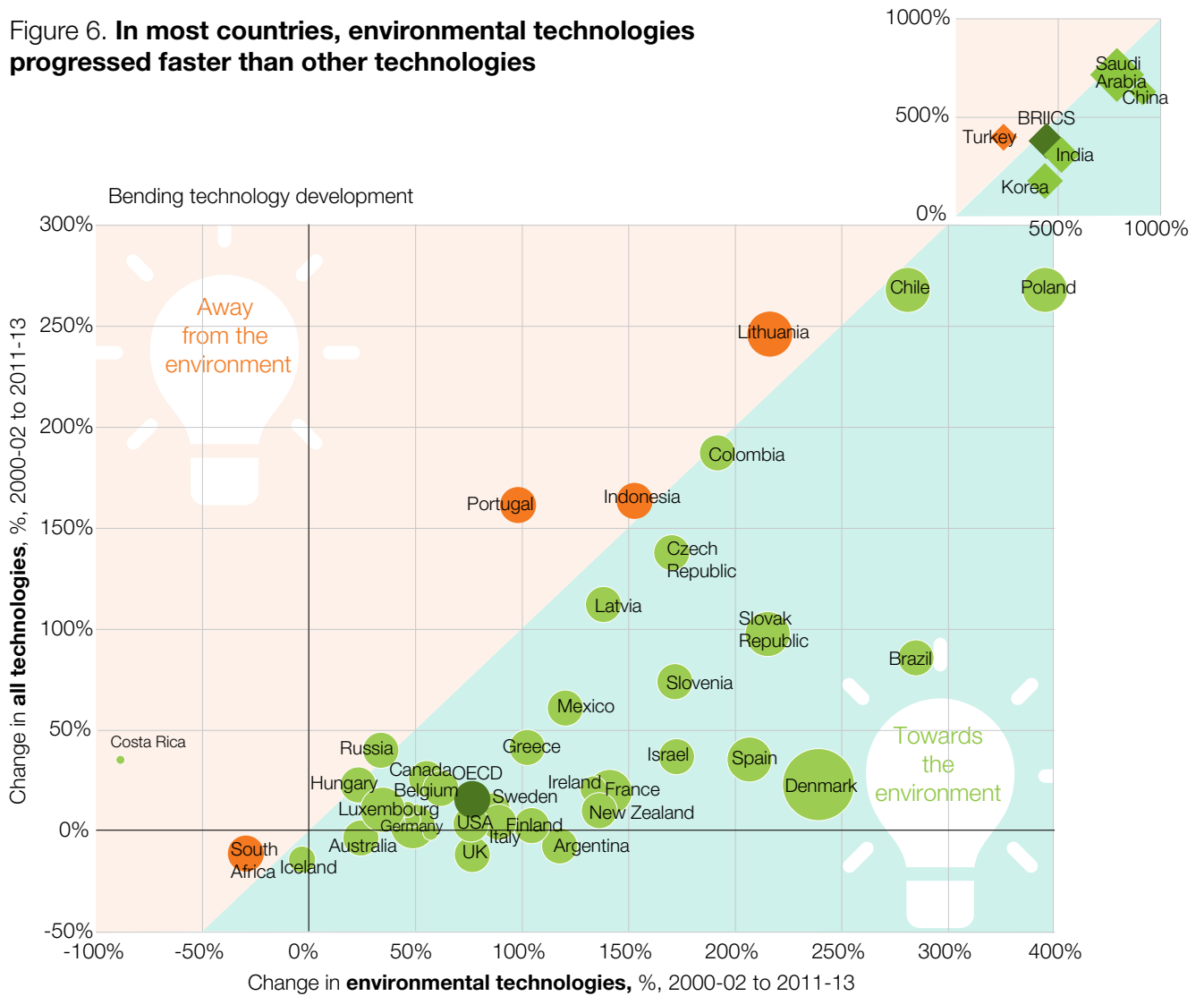

How to read these graphs

Figure 6 shows the change in patent applications, for all technologies on the vertical axis, for environmental technologies on the horizontal axis. In countries in the green area, environmental technologies progressed faster than all technologies; in the orange area, they progressed less. The size of the bubble represents the share of environmental technologies among all innovations, in 2011-2013: for example, Denmark, a leading innovator, contributes twice as much to the world stock of environmental technologies than to technologies in general.

Figure 7 shows the amount of priority patent applications worldwide for high-value inventions (two patents or more). It shows that patent applications to climate change mitigation grew remarkably from 2000 to 2010, before slowing down. For example, by 2013, global patent applications for climate change mitigation in buildings had increased by 289%.

Data and sources: http://doi.org/b8r2 and http://doi.org/b8r3

Figure 7. **Following a rapid increase, development of green technologies is slowing down**
World total, index 2000=100. CCM= Climate change mitigation
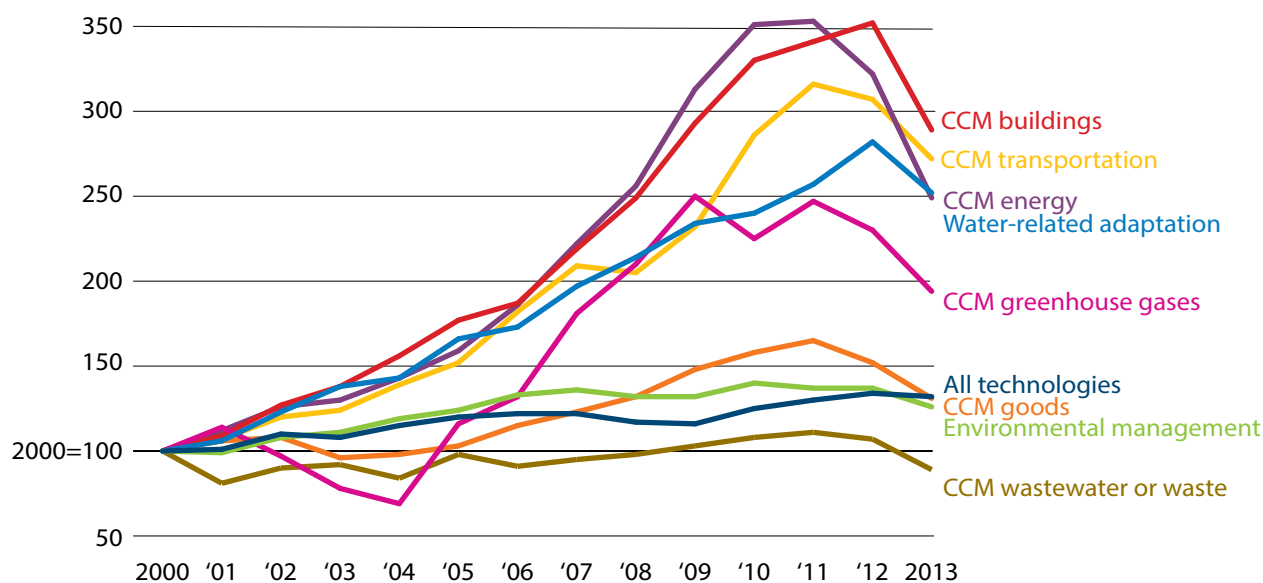
Countries are accelerating their efforts to encourage innovation and changes in consumer behaviour. Worldwide, the number of inventions in climate change mitigation technologies (especially for buildings, transport and energy generation) have tripled since 2000, while inventive activity in general (all technologies) has risen only by about 30%. However, inventive activity has generally been slowing down across all major environment-related technological domains since 2011.

About 90% of green technologies still originate in the OECD, especially in the United States, Japan Germany, Korea and France. The contributions of China and India are rising fast.

Policy instruments that encourage innovation include better protection of intellectual property, support to basic research and development, innovation clusters or investment in workforce skills. These instruments must be complemented with measures that help direct innovation towards more environmentally effective and cost-efficient solutions, by tracing a predictable path for pricing emissions or tightening emission limits.

Public budgets for energy-related research, development and demonstration are shifting towards renewables. Yet, in a handful of countries, support for fossil fuel energy technology keeps rising. In many countries, policies that spur innovation are not aligned with environmental and resource efficiency policies.

Industry: In the European Union, the ten most carbon-intensive industries account for **83% of all CO_2 emissions**, but only **28% of employment** and **21% of value added:** electricity and gas, rubber and plastic products, land transport, metals, chemicals, coke and refined petroleum, air transport, water transport, agriculture, wholesale and retail trade. **In the absence of carbon pricing across the economy, mitigation efforts could be tailored to these industries.**

3 Natural asset base
Is the natural asset base of our economies being maintained?

The overall pressure on natural resources remains high. In more than one-third of OECD countries, freshwater resources are under moderate to medium-high stress. Many forests are threatened by degradation, fragmentation and conversion to other types; and many ecosystems have been degraded.

Urban growth and infrastructure development pose serious threats to biodiversity. Intense urban growth occurs even in some already highly urbanised countries and across the OECD, built-up areas grow faster than populations. This is due to an increase in single-person households, lifestyle changes (suburban housing), the construction of commercial and industrial buildings, and changes in urban form towards low-density developments.

Land development and the resulting changes in land cover lead to a loss of natural resources and agricultural land, soil sealing and negative effects on the water cycle. Protected areas and sustainable resource management can help. Yet, these policies need to be complemented with more general measures, so that biodiversity protection is mainstreamed into investment and taxation decisions, for example.

Globally, an area the size of the United Kingdom has been converted to buildings since 1990.

How to read these graphs

In Figure 8, each square shows the built-up areas in OECD and BRIICS countries, in thousand km^2. The smaller square inside represents the area newly built since 1990.

"Built-up" refers only to buildings, excluding all other types of urban land such as paved surfaces (roads, parking lots), commercial and industrial sites (ports, landfills) and urban green spaces (parks, gardens).

Figure 9 plots change in built-up areas against change in population. The size of the bubble refers to built-up area as a percentage of land area: the bigger the bubble, the more urbanised the country.

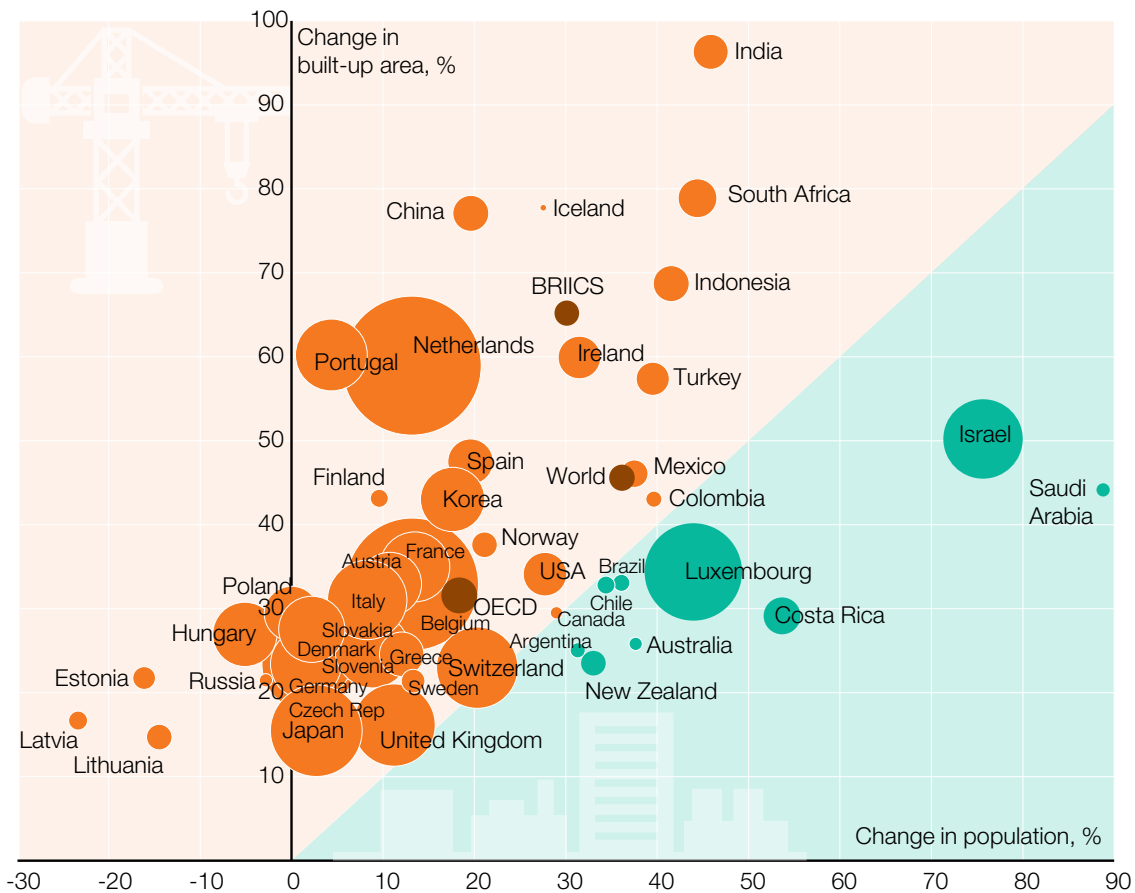*Data and sources:* http://doi.org/b8r4 and http://doi.org/b8r5

Figure 8. **Buildings cover 30% more land than in 1990**
Built-up area in thousand km^2 in a selection of countries, in 2014 and new
constructions since 1990.

OECD

USA
150
38 since 1990

France
23
6 since 1990

Italy
16
4 since 1990

Germany
27
5 since 1990

Japan
27
4 since 1990

Rest of OECD
123
31 since 1990

BRIICS

South Africa
16
7 since 1990

Brazil
21
5 since 1990

India
32
16 since 1990

Indonesia
21
9 since 1990

Russia
24
4 since 1990

China
105
46 since 1990

Rest of the world
193
69 since 1990

Figure 9. **Built-up area per capita is increasing, including countries that are already very urbanised,** 1990-2014

Change in built-up area, %

India, China, Iceland, South Africa, Indonesia, BRIICS, Netherlands, Ireland, Turkey, Portugal, Israel, Saudi Arabia, Spain, Finland, World, Mexico, Korea, Colombia, Norway, Austria, France, USA, Brazil, Luxembourg, Poland, Italy, Chile, Costa Rica, Belgium, OECD, Canada, Hungary, Slovakia, Argentina, Australia, Denmark, Greece, Estonia, Russia, Slovenia, Switzerland, Germany, Sweden, New Zealand, Latvia, Czech Rep, Japan, United Kingdom, Lithuania

Change in population, %

4 Quality of life

Does greening growth generate benefits for people?

Air pollution is the single greatest environmental health risk worldwide. Human exposure to air pollution by fine particulates (PM$_{2.5}$) remains dangerously high in most OECD countries, despite improvements since 1990.

Less than one in three OECD countries meet the WHO Air Quality Guideline. Exposure to PM$_{2.5}$ continues to rise in China and India and now attains extreme levels. There has been little improvement in population exposure to air pollution by ground-level ozone. Exposure to these two air pollutants has serious consequences for human health. In OECD countries, exposure to outdoor PM$_{2.5}$ and ozone is estimated to cause around 0.5 million premature deaths each year. This has an annual welfare cost equivalent to 3.8% of GDP.

Emissions can be reduced by substituting dirty fuels for cleaner ones, focusing development on cleaner industries, reducing consumption of polluting products and adopting cleaner technologies. Emission or energy taxes tend to be more cost-efficient than policies that target a specific product, fuel or technology (e.g. subsidies for electric cars). Yet, policies should be tailored to local circumstances: more stringent measures are required in densely populated areas or for emission sources located upwind from urban areas.
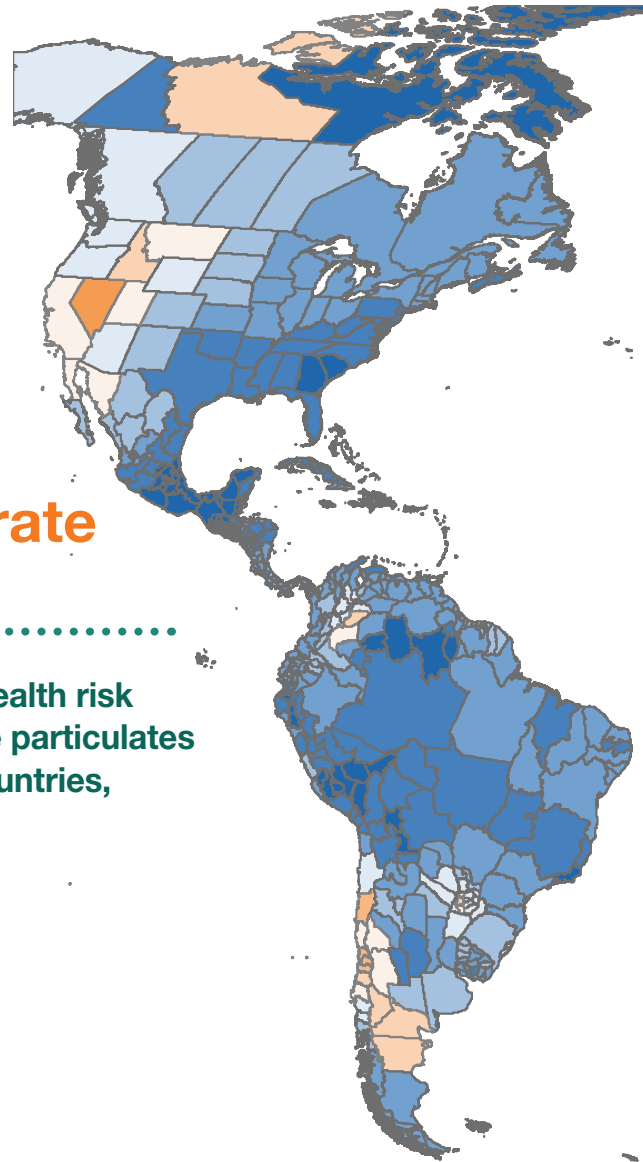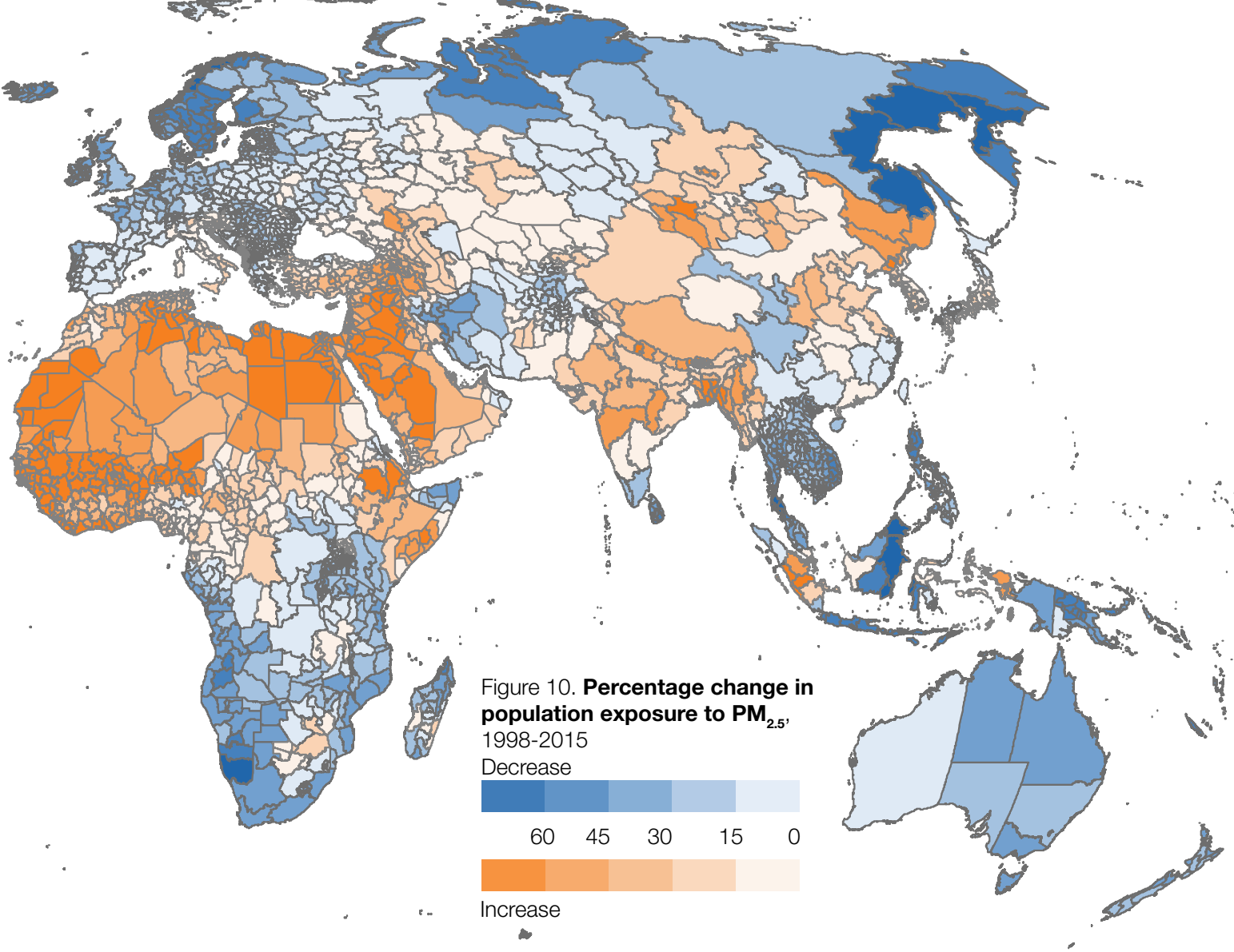
How to read these graphs

Chronic exposure to particulate matter contributes to the risk of developing cardiovascular and respiratory diseases. Fine particulates, smaller than 2.5 microns in diameter (PM$_{2.5}$), cause the most severe health effects.

Figure 11 shows population exposure according to World Health Organization (WHO) thresholds. The WHO Air Quality Guideline for annual average PM$_{2.5}$ exposure is 10 micrograms per cubic metre.
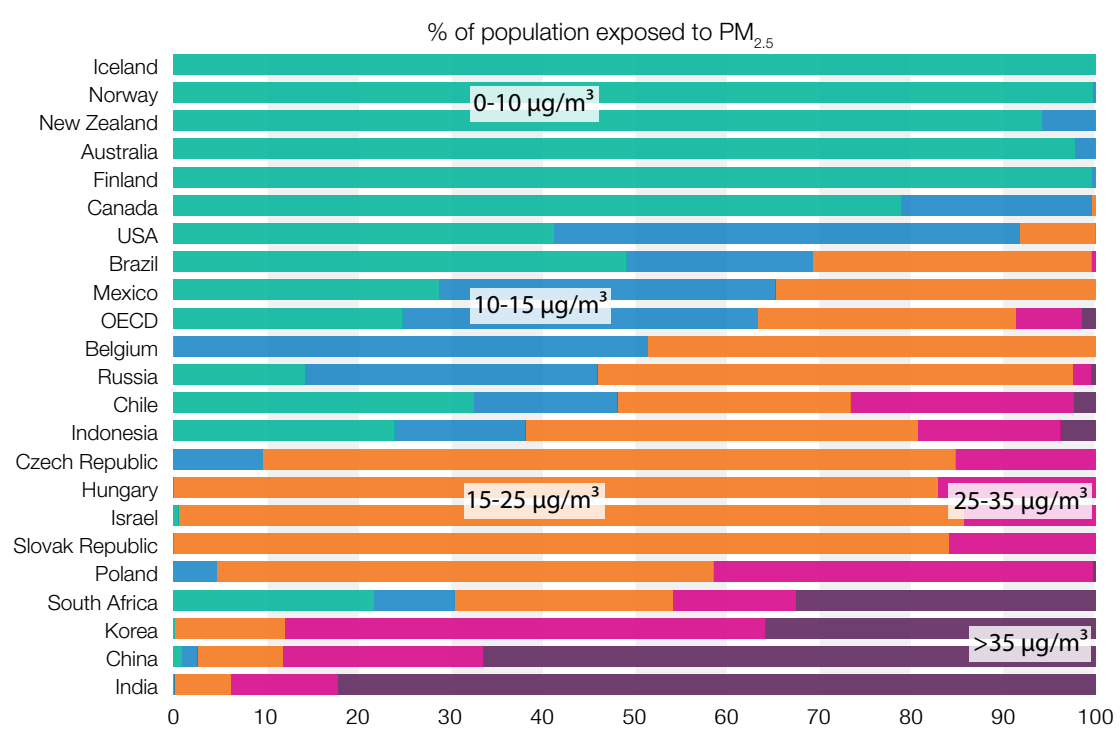
Measures of PM$_{2.5}$ concentrations are derived from satellite observations, chemical transport models and ground monitoring stations. These estimates include pollutants from both anthropogenic and natural sources.

Population exposure to air pollution is calculated by weighting concentrations with populations. Pollution concentrations in densely populated cities will thus carry a bigger weight than in sparsely populated rural areas. This is important to help direct policy action where potential health impacts are highest.

Data and sources: http://doi.org/b8r6 and http://doi.org/b8r7

Figure 10. **Percentage change in population exposure to PM$_{2.5}$,** 1998-2015

Decrease

| 60 | 45 | 30 | 15 | 0 |

Increase

Figure 11. **The population of most OECD countries remain chronically exposed to harmful levels of PM$_{2.5}$**

% of population exposed to PM$_{2.5}$

0-10 µg/m³

10-15 µg/m³

15-25 µg/m³

25-35 µg/m³

>35 µg/m³

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