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Sustainability

"Ability to Sustain"

"Capacity to endure"

"Maintenance of well-being"

"Decent quality of life and equity"

"Sustainable consumption of resources"

"Responsible environmental management"

Enabling earth to continue to support (human) life

Source: Wikimedia commons, wikipedia article 'Sustainability' and various public reports

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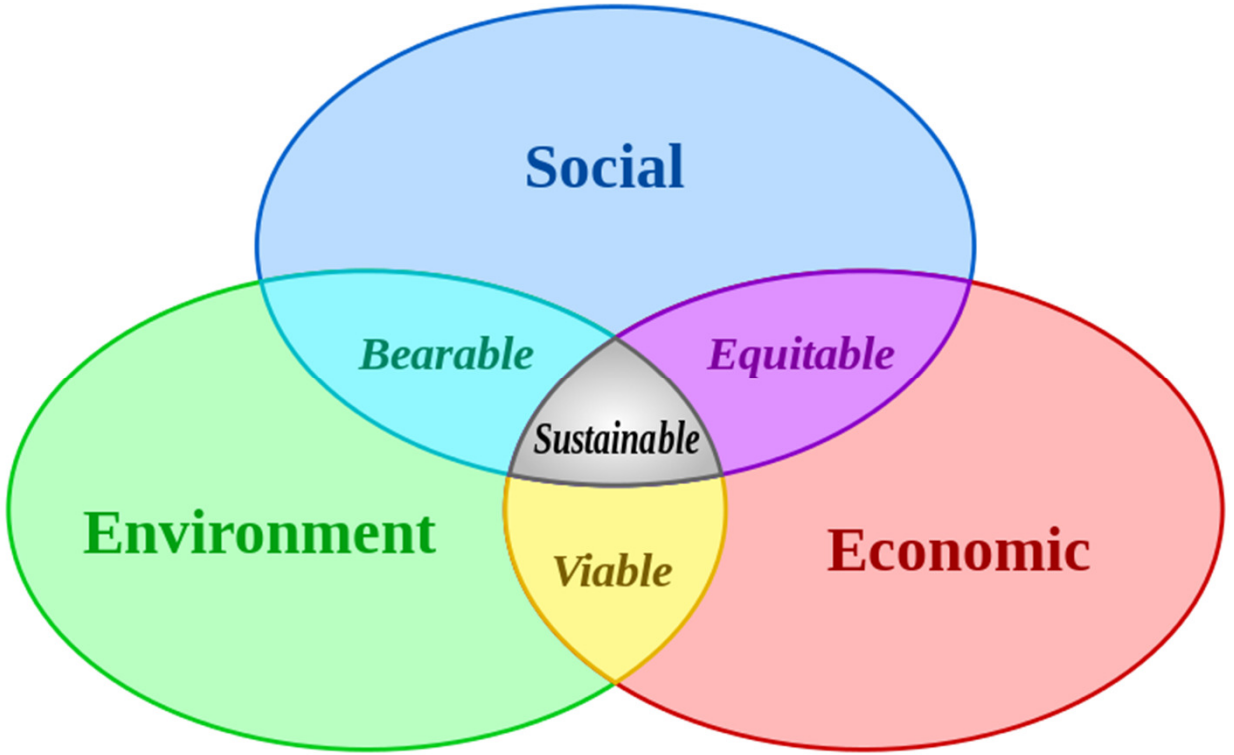
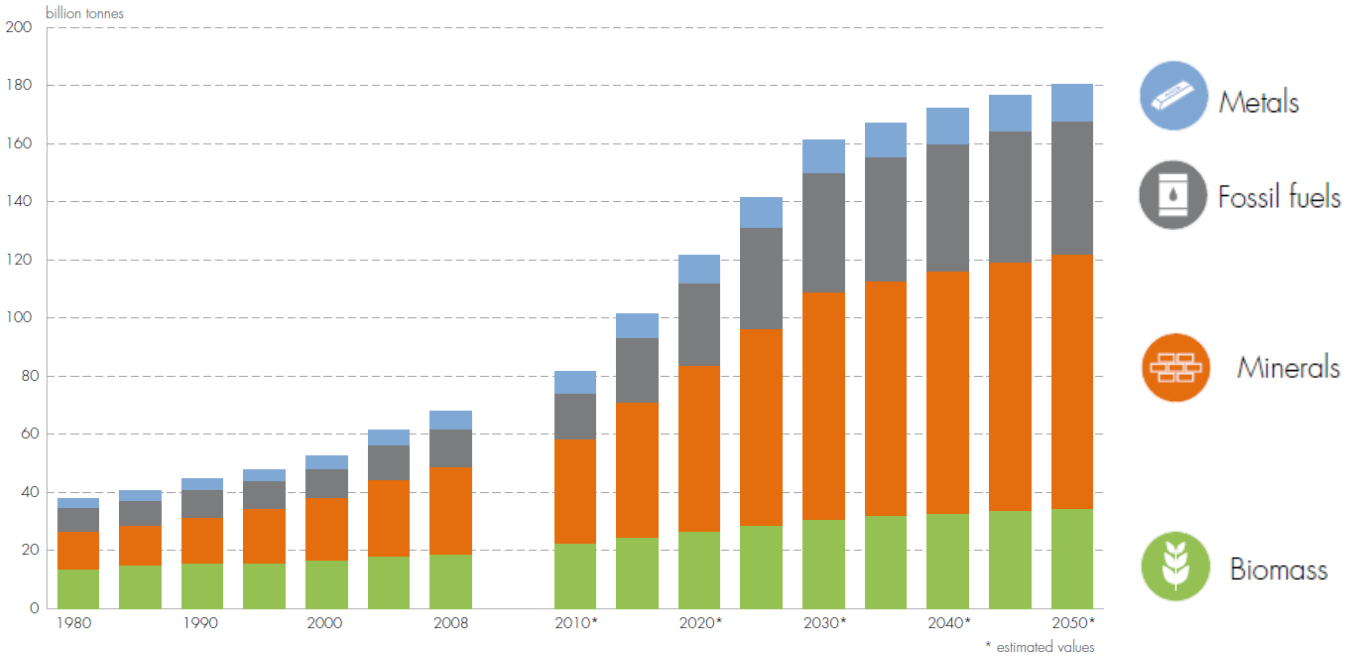
Sustainable development

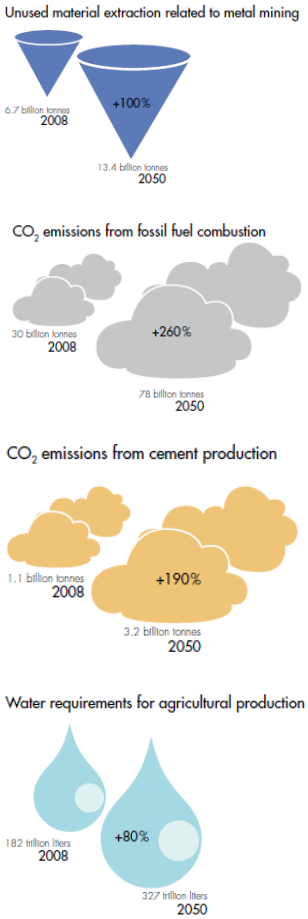


At the confluence of the '3 pillars' of sustainability

Source: Wikimedia commons

Material consumption





Is *'business as usual'* really an option for the future?

Source: Green economies around the world? (SERI, 2012)

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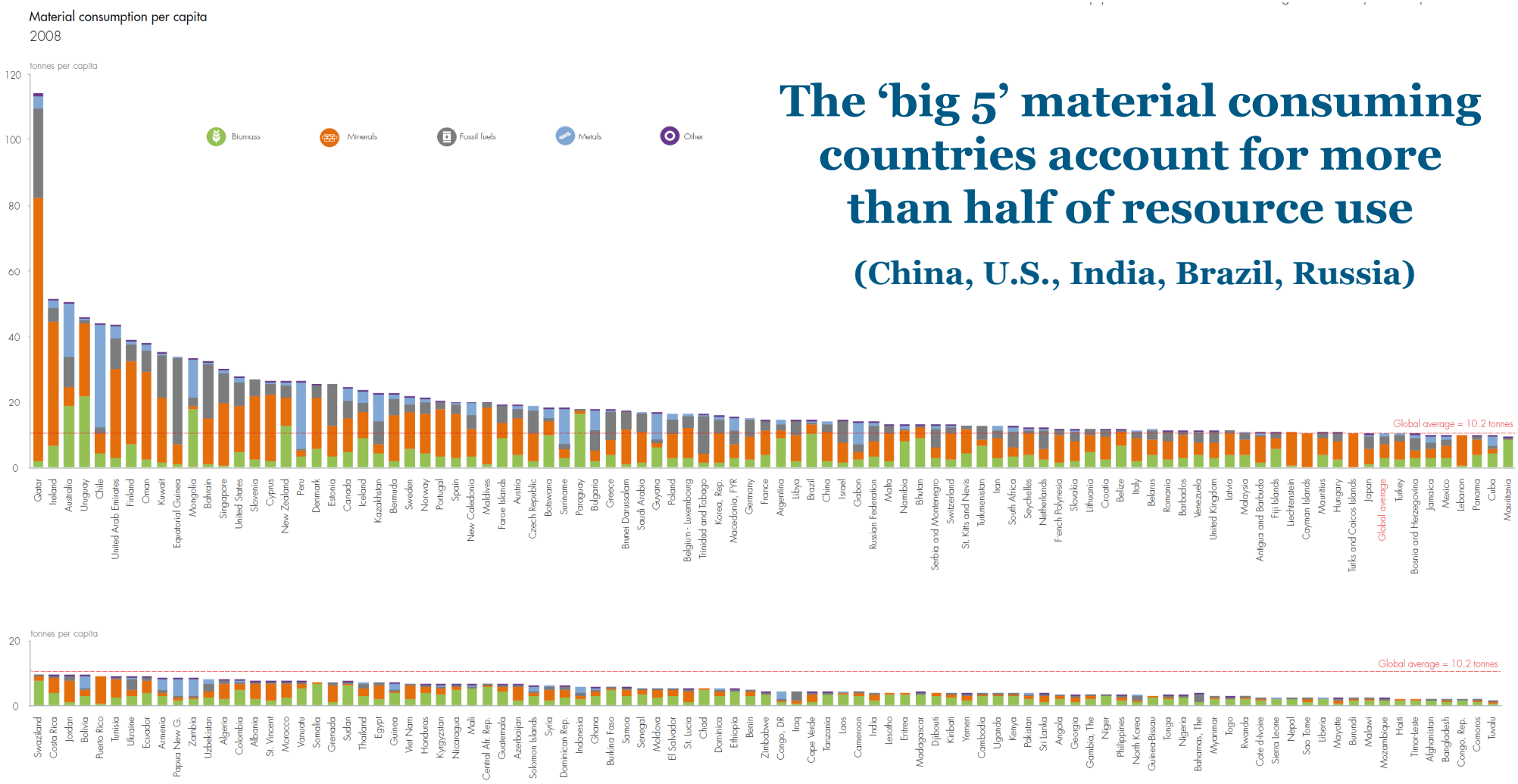
Material consumption around the world



The ‘big 5’ material consuming countries account for more than half of resource use

(China, U.S., India, Brazil, Russia)

Source: Green economies around the world? (SERI, 2012)

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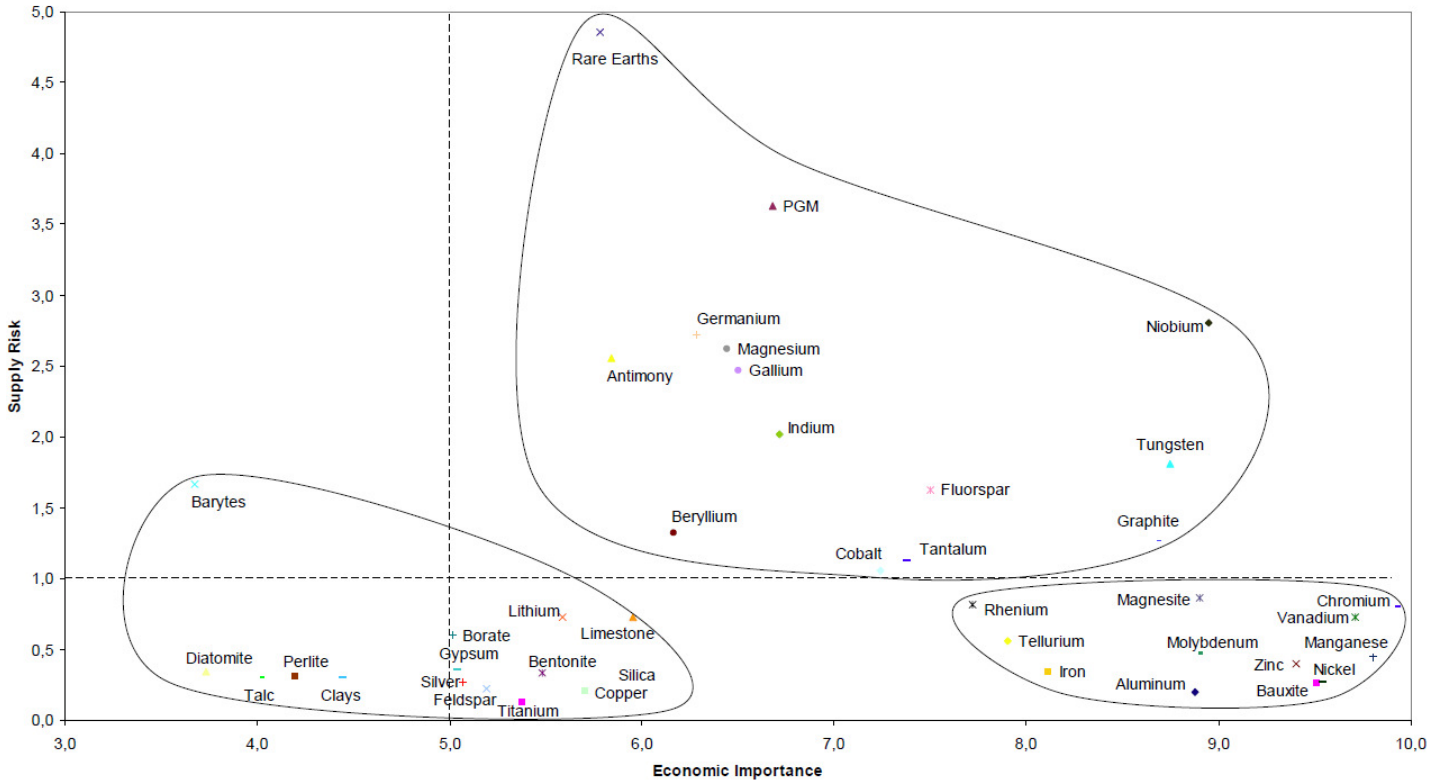
Material scarcity



The 14 raw materials in the top-right cluster are already critical

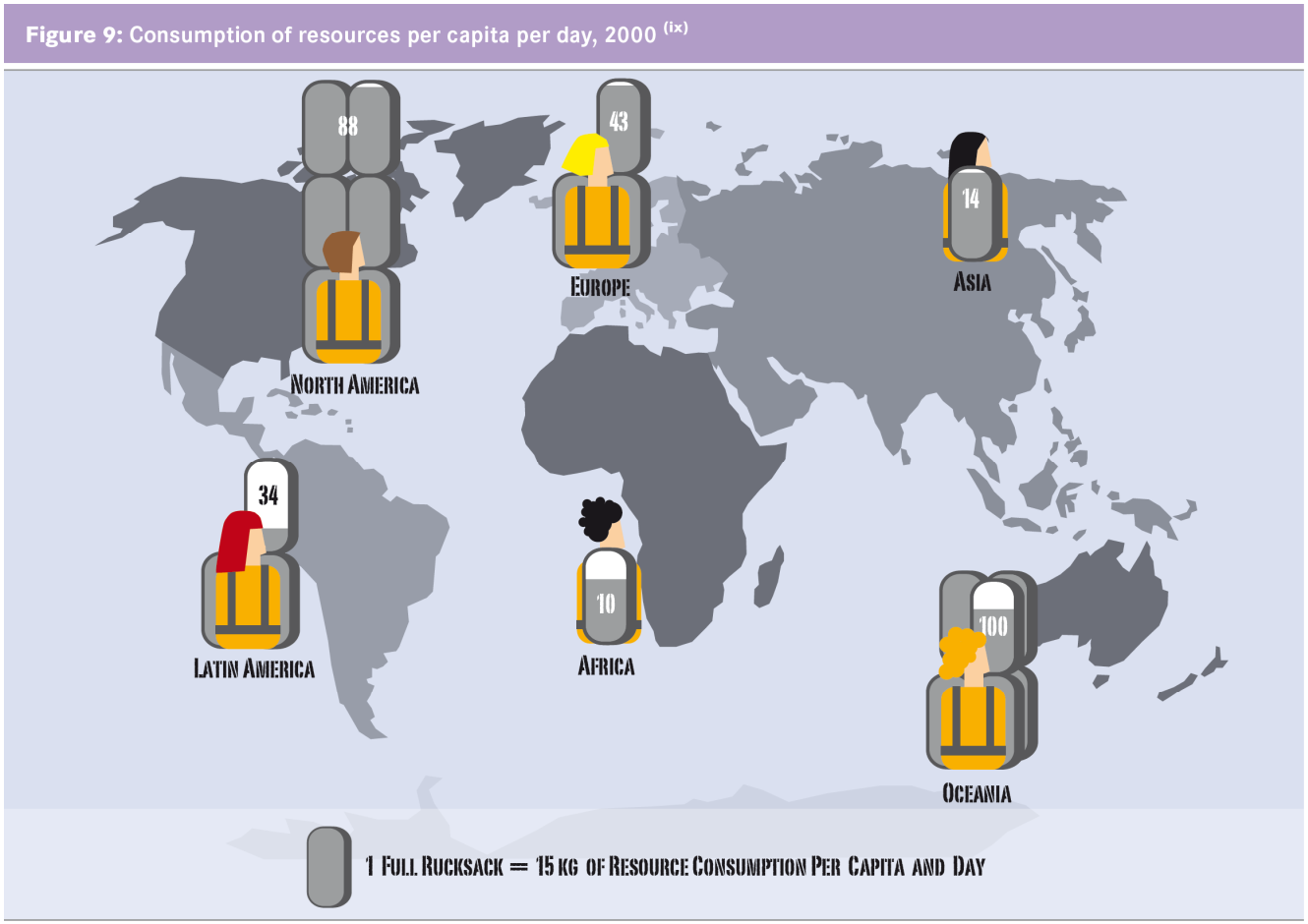
Source: Critical raw materials for the EU (EC, 2010)

Consumption compunction

Animal protein is far more $CO_2(e)$ intensive than plant protein

Source: http://www.behance.net/dothegreenthing

Consumption around the world



'Ecological ruck sack': all the resources used to make a product

Source: Overconsumption? Our use of the world's natural resources (SERI, FOE, 2009)

Global action required!

UK accounts for only 1.5% of global emissions – a global deal is needed

US 2010 emissions 6% below 2005 level, may meet Copenhagen commitment of 17% in 2020

EU is pushing a package of measures for emissions reductions

UN process towards a global deal

China has committed to 45% reduction by 2020

Other countries have passed climate change legislation e.g. Mexico, South Korea

Source: Reducing the UK's carbon emissions and managing competitiveness risks (Committee on Climate Change, 2013)

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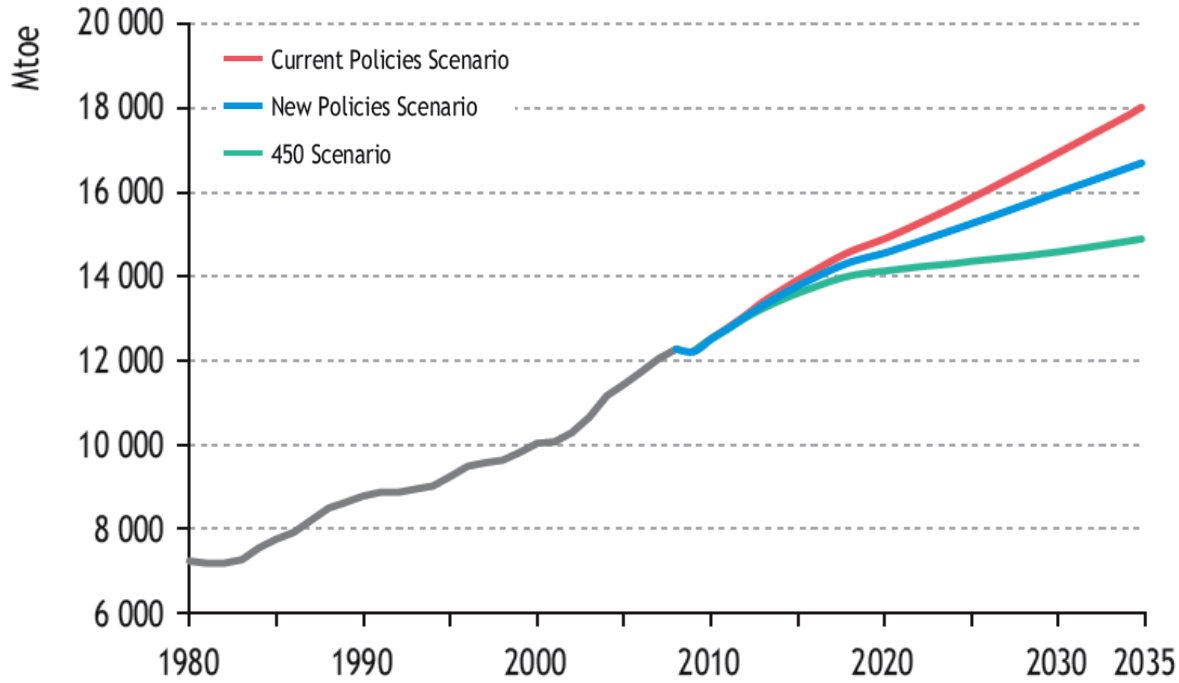
Global energy demand

Figure 2.1 ● World primary energy demand by scenario



New Policies Scenario includes (relatively cautious) estimates of impacts of policy commitments/pledges

450 Scenario is the energy pathway required to limit global temperature increase to 2° C (450ppm)

Demand projected to grow by 40% between 2009-2035

Source: World Energy Outlook 2010 and 2011 (IEA, 2010 and 2011)

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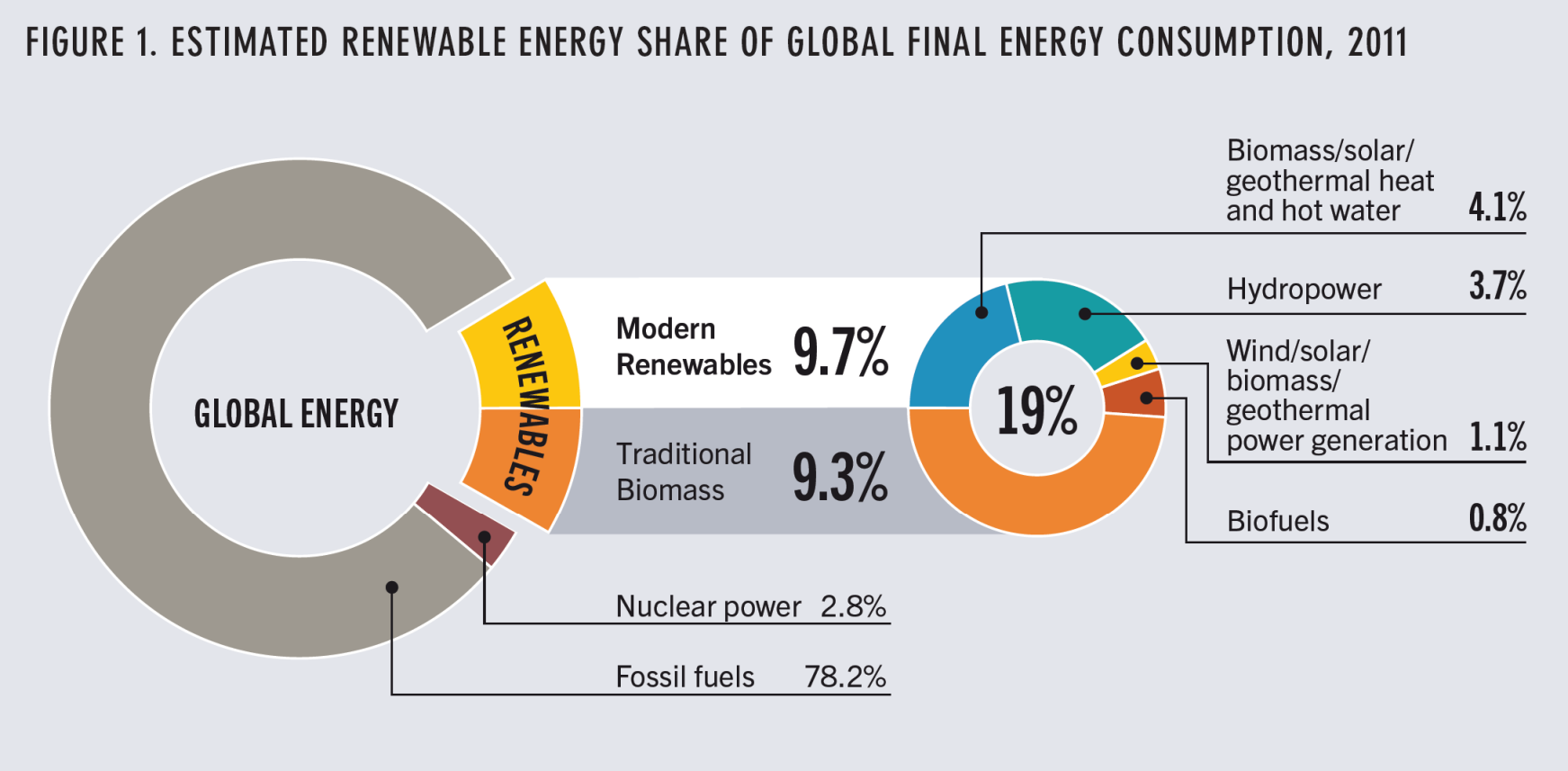
Renewable energy



Renewables' share up from 16.7% to 19% in one year

Source: Renewables 2013: Global Status Report (REN, 2013)

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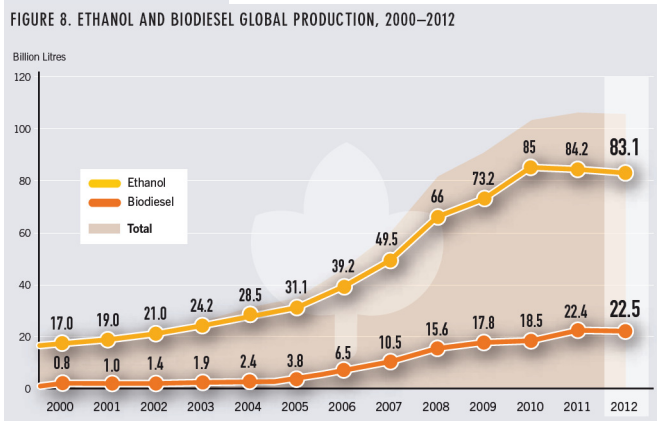
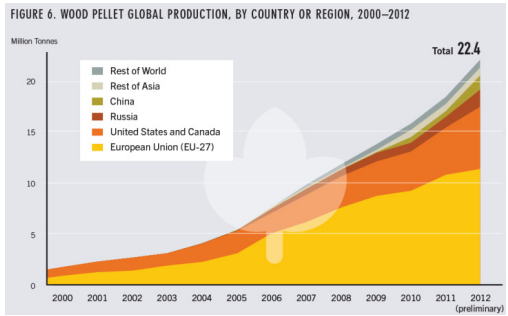
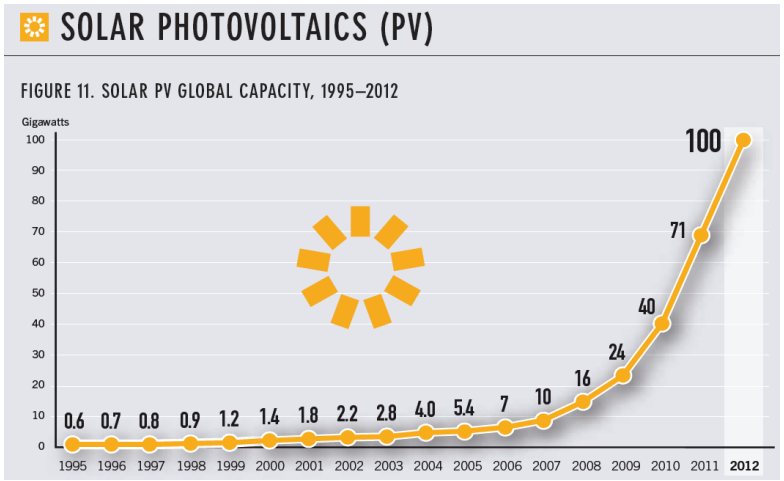
Renewables gaining ground

BIOENERGY

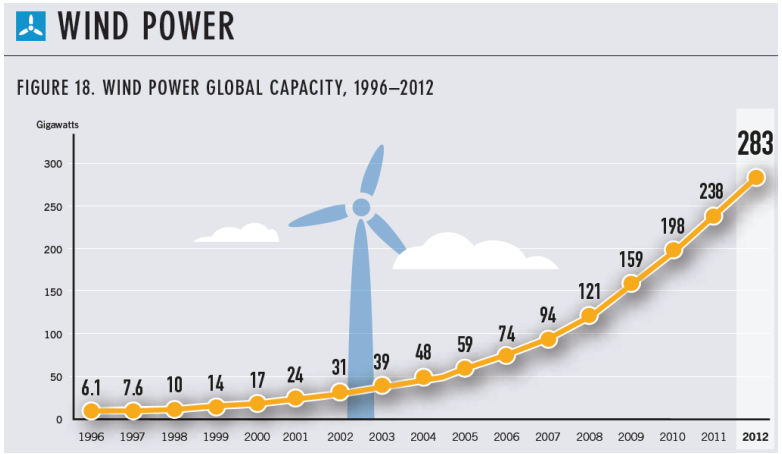


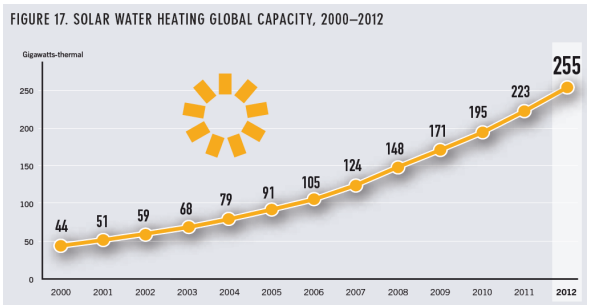


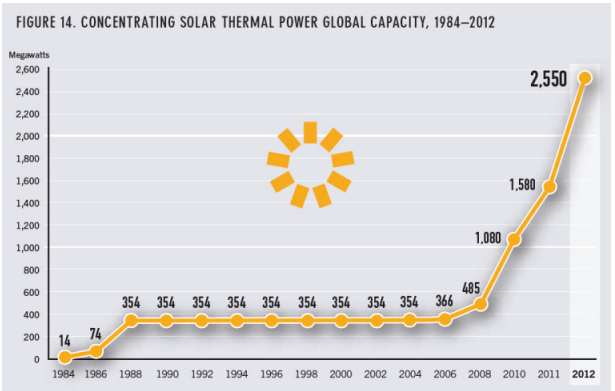
SOLAR PHOTOVOLTAICS (PV)



WIND POWER







70% of EU electric capacity additions 2011-2012 from renewables

Source: Renewables 2013: Global Status Report (REN, 2013)

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Fossil fuels remain primary fuel

Figure 2.4 ● World primary energy demand by fuel in the New Policies Scenario

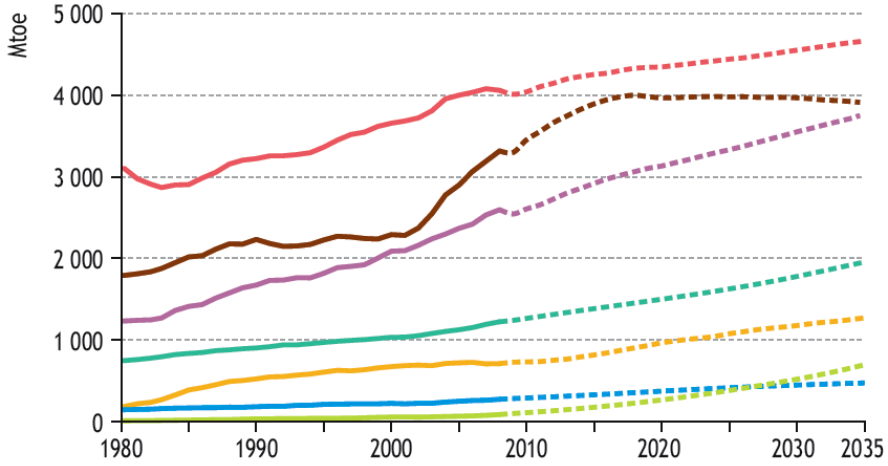
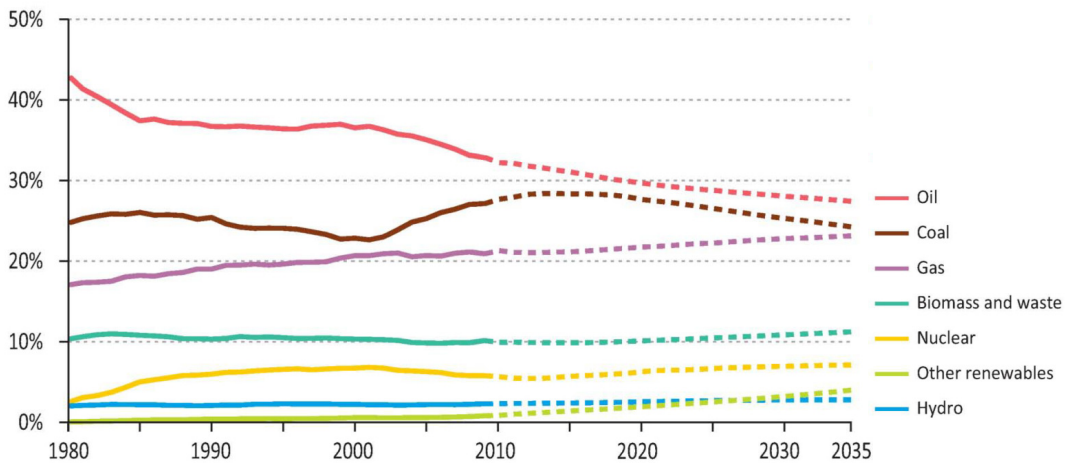


Figure 2.7: Shares of energy sources in world primary energy demand in the New Policies Scenario



New Policies Scenario includes (relatively cautious) estimates of impacts of policy commitments/pledges

Fossil fuels projected to still account for 75% of energy in 2035

Source: World Energy Outlook 2010 and 2011 (IEA, 2010 and 2011)

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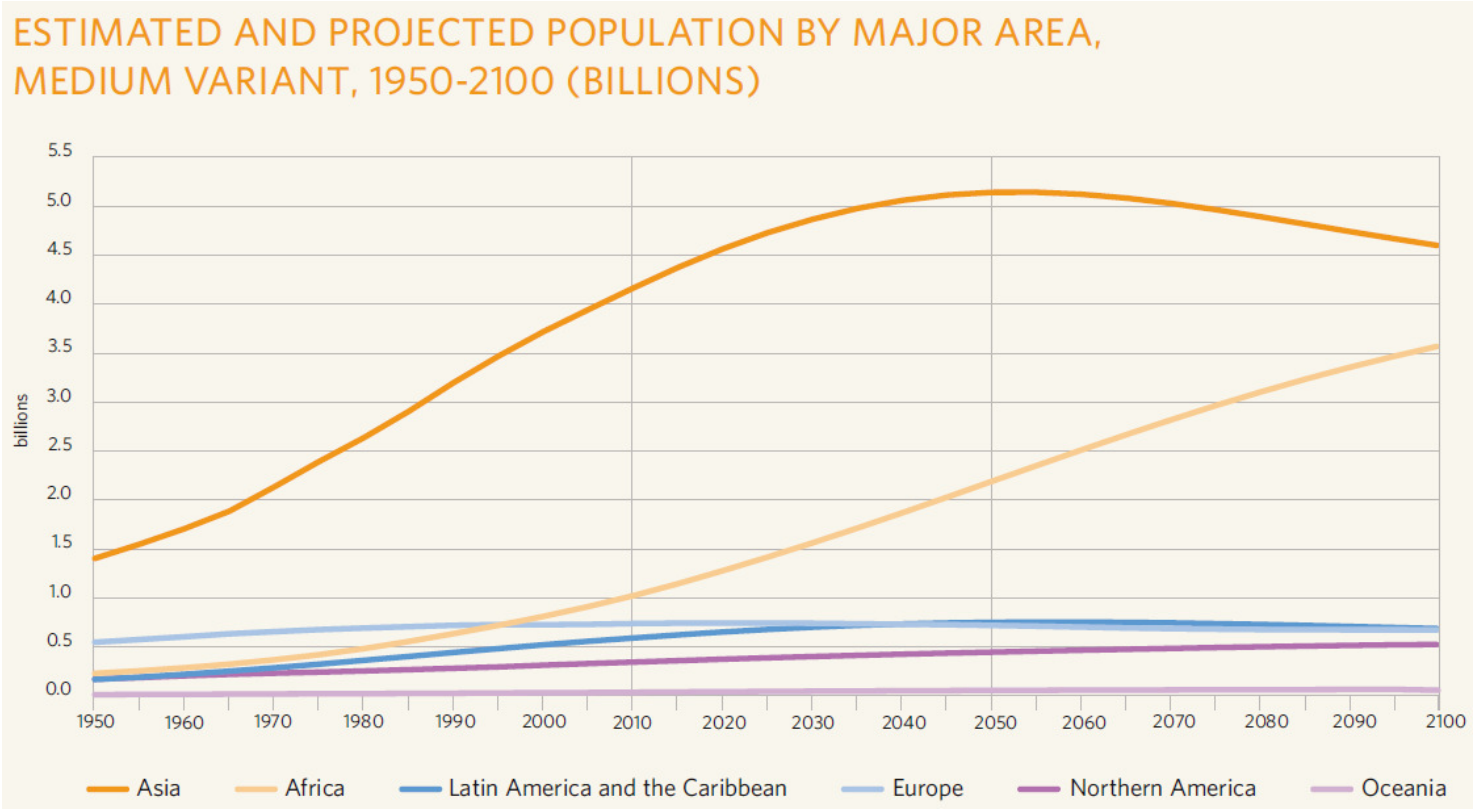
Population change



Source: Population Division of the United Nations Department of Economic and Social Affairs.

Asia's population will level off, Africa maintains rapid growth

Source: State of world population 2011 (UNFPA, 2011)

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What is in the Human Development Index?

HDI and components, by region and HDI group, 2012

Region and HDI group	HDI	Life expectancy at birth (years)	Mean years of schooling (years)	Expected years of schooling (years)	Gross national income per capita (2005 PPP $)
Region					
Arab States	0.652	71.0	6.0	10.6	8,317
East Asia and the Pacific	0.683	72.7	7.2	11.8	6,874
Europe and Central Asia	0.771	71.5	10.4	13.7	12,243
Latin America and the Caribbean	0.741	74.7	7.8	13.7	10,300
South Asia	0.558	66.2	4.7	10.2	3,343
Sub-Saharan Africa	0.475	54.9	4.7	9.3	2,010
HDI group					
Very high human development	0.905	80.1	11.5	16.3	33,391
High human development	0.758	73.4	8.8	13.9	11,501
Medium human development	0.640	69.9	6.3	11.4	5,428
Low human development	0.466	59.1	4.2	8.5	1,633
World	0.694	70.1	7.5	11.6	10,184

Note: Data are weighted by population and calculated based on HDI values for 187 countries. PPP is purchasing power parity.

Composite measure of income, education and life expectancy

Source: Human Development Report 2013 (UNDP, 2013)

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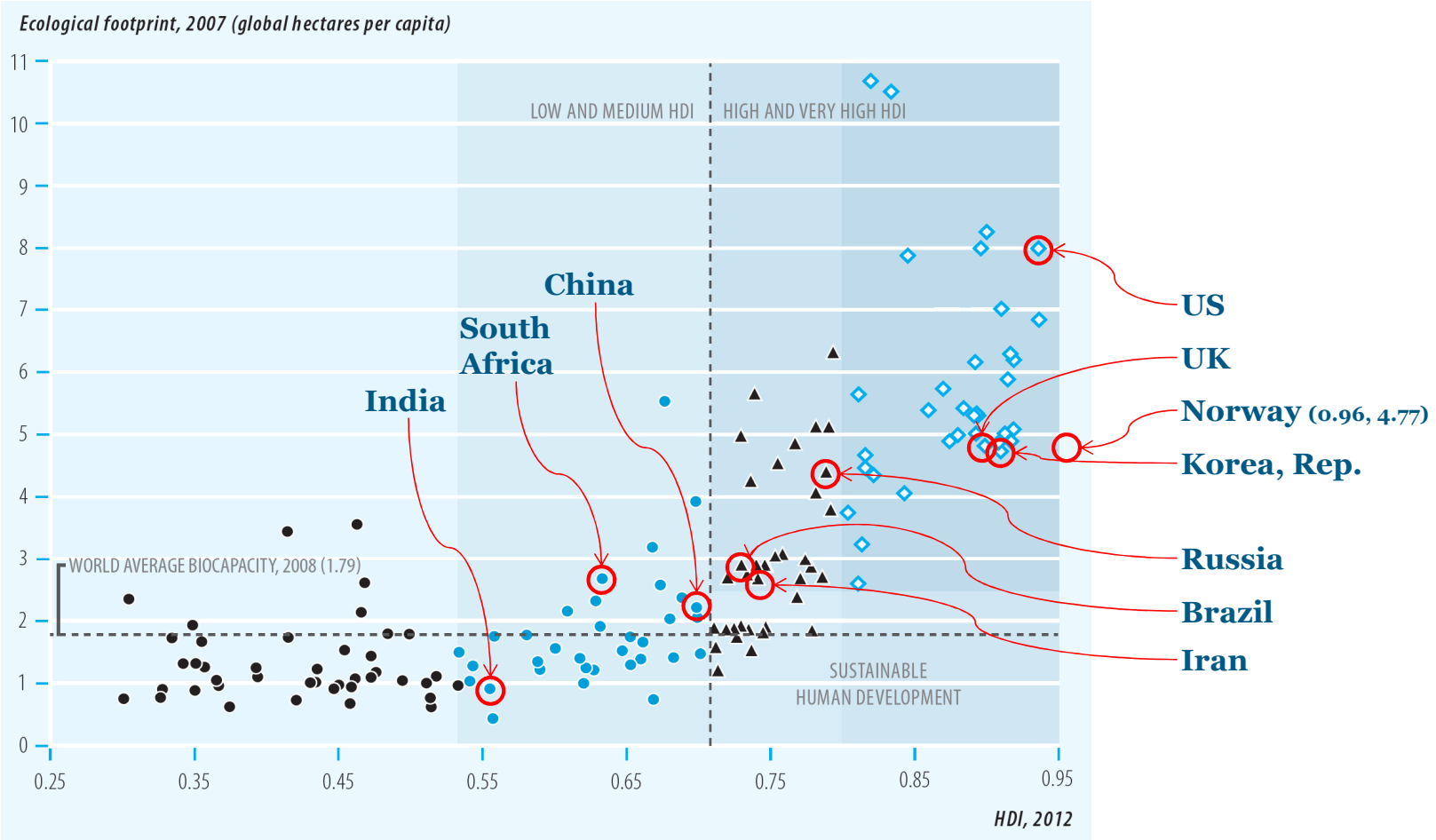
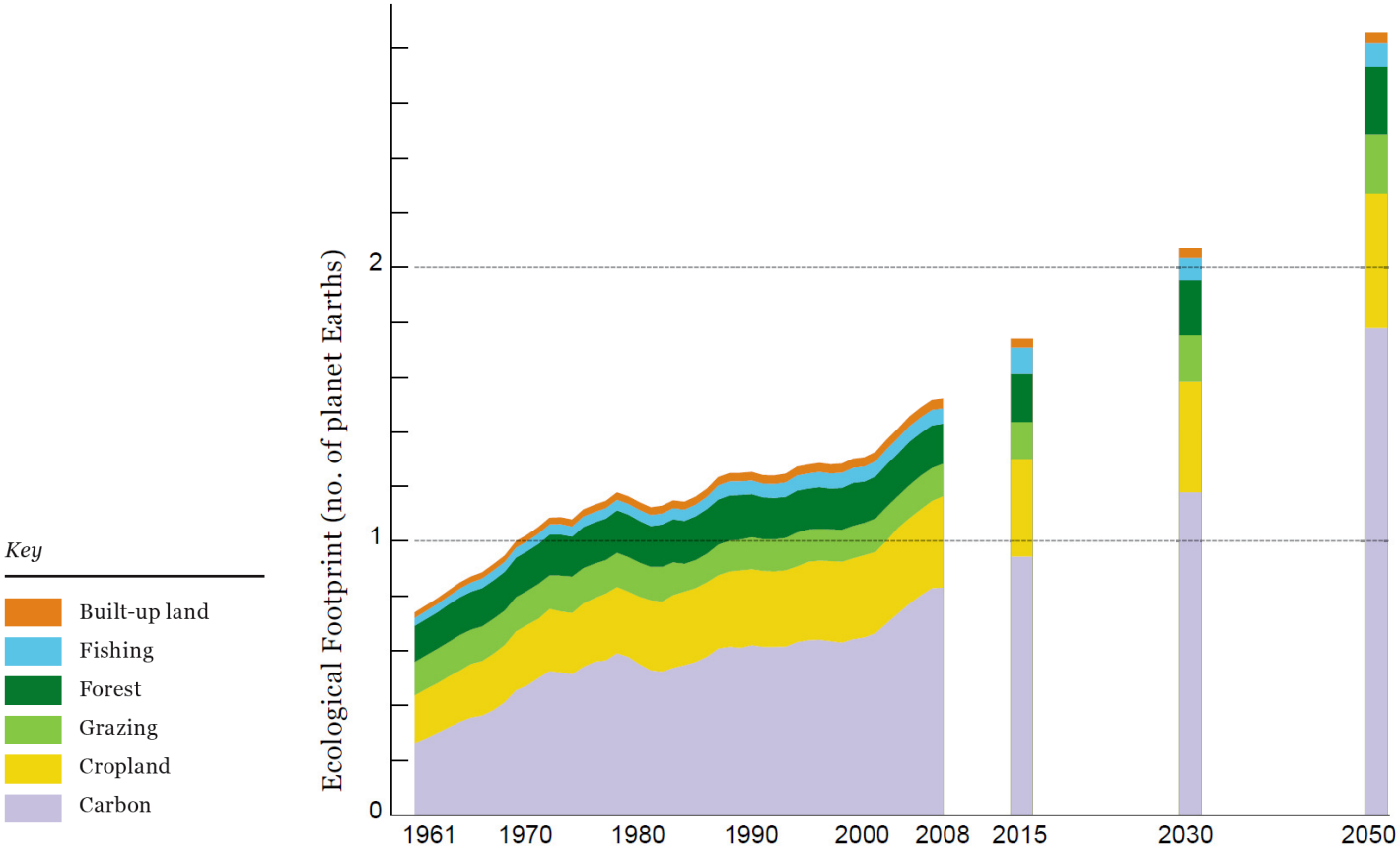
Human Development & Ecological Footprint



The 'goal' for sustainability: 'one planet' footprint, high development

Sources: Human Development Report 2013 (UNDP, 2013); Global Footprint Network 2011, in Living Planet Report 2012 (WWF, 2012)

Ecological footprint



"Business as usual" scenario – 2.9 planet Earths required

Overshoot: our ecological footprint exceeds biocapacity by 50%

Source: Living Planet Report 2012 (WWF, 2012)

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What is an ecological footprint?

Carbon
Represents the amount of forest land that could sequester CO_2 emissions from the burning of fossil fuels, excluding the fraction absorbed by the oceans which leads to acidification.

Cropland
Represents the amount of cropland used to grow crops for food and fibre for human consumption as well as for animal feed, oil crops and rubber.

Grazing Land
Represents the amount of grazing land used to raise livestock for meat, dairy, hide and wool products.

Forest
Represents the amount of forest required to supply timber products, pulp and fuel wood.

Built-up Land
Represents the amount of land covered by human infrastructure, including transportation, housing, industrial structures and reservoirs for hydropower.

Fishing Grounds
Calculated from the estimated primary production required to support the fish and seafood caught, based on catch data for marine and freshwater species.

What is ecological overshoot?

This means humanity is using ecological services faster than Earth can replenish them.

A measure of human demand on the Earth's ecosystems

Source: Living Planet Report 2012 summary booklet (WWF, 2012)

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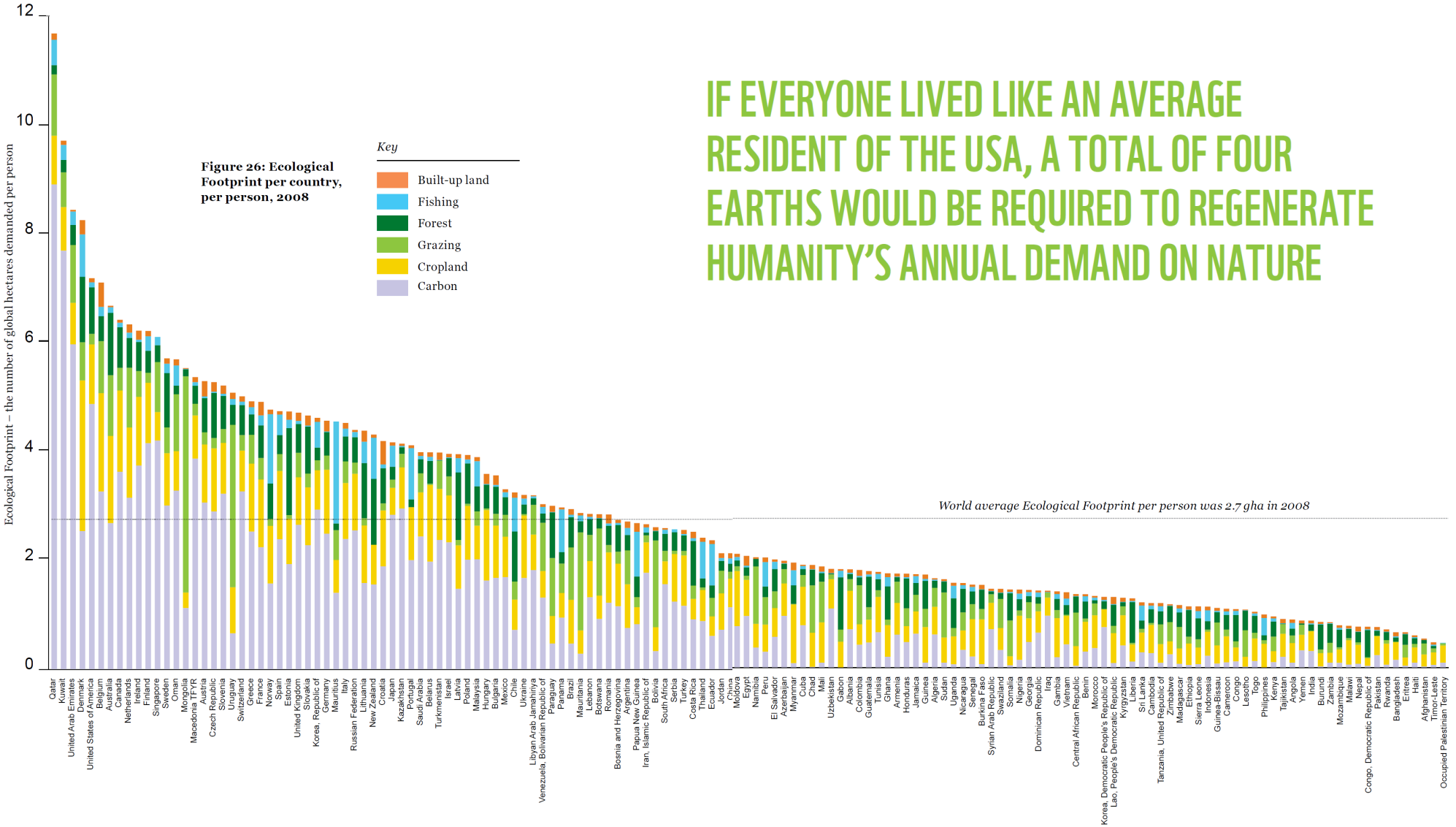
Ecological footprints vary significantly



Source: Global Footprint Network, 2011, *In* Living Planet Report 2012 (WWF, 2012)

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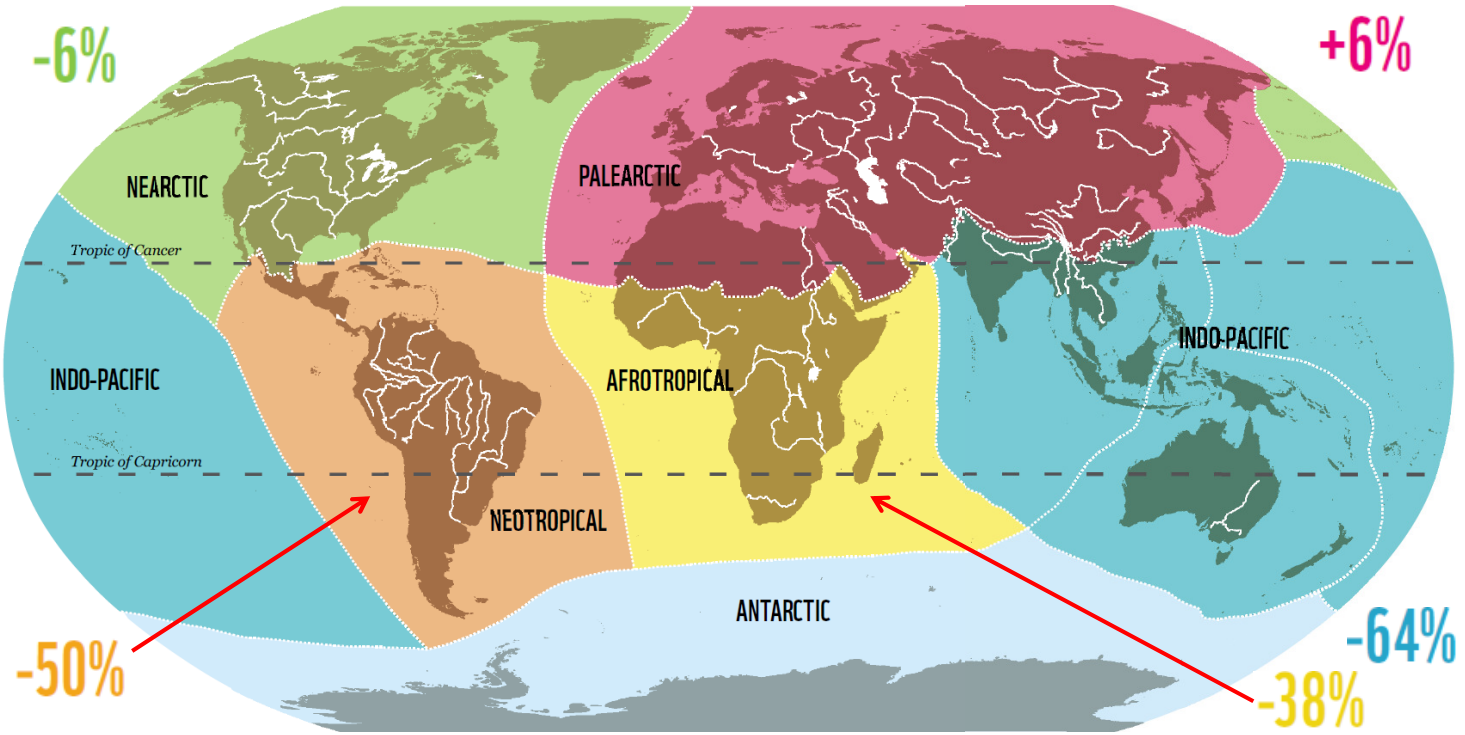
Biodiversity: Living Planet Index



Overall decline 28% 1970-2008

Abundance of biodiversity is an indicator of ecological condition

Source: Living Planet Report 2012 (WWF, 2012)

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European species under threat

Freshwater molluscs
59% threatened*

Freshwater fishes
40% threatened*

Amphibians
23% threatened

Terrestrial molluscs
22% threatened*

Reptiles
20% threatened*

Mammals
17% threatened*

Dragonflies
16% threatened*

Crop Wild Relatives
16% threatened*

Butterflies
9% threatened

Loss/degradation of habitat is causing Europe's species to disappear

Source: European species under threat: overview of European Red List results (EC/IUCN, 2011)

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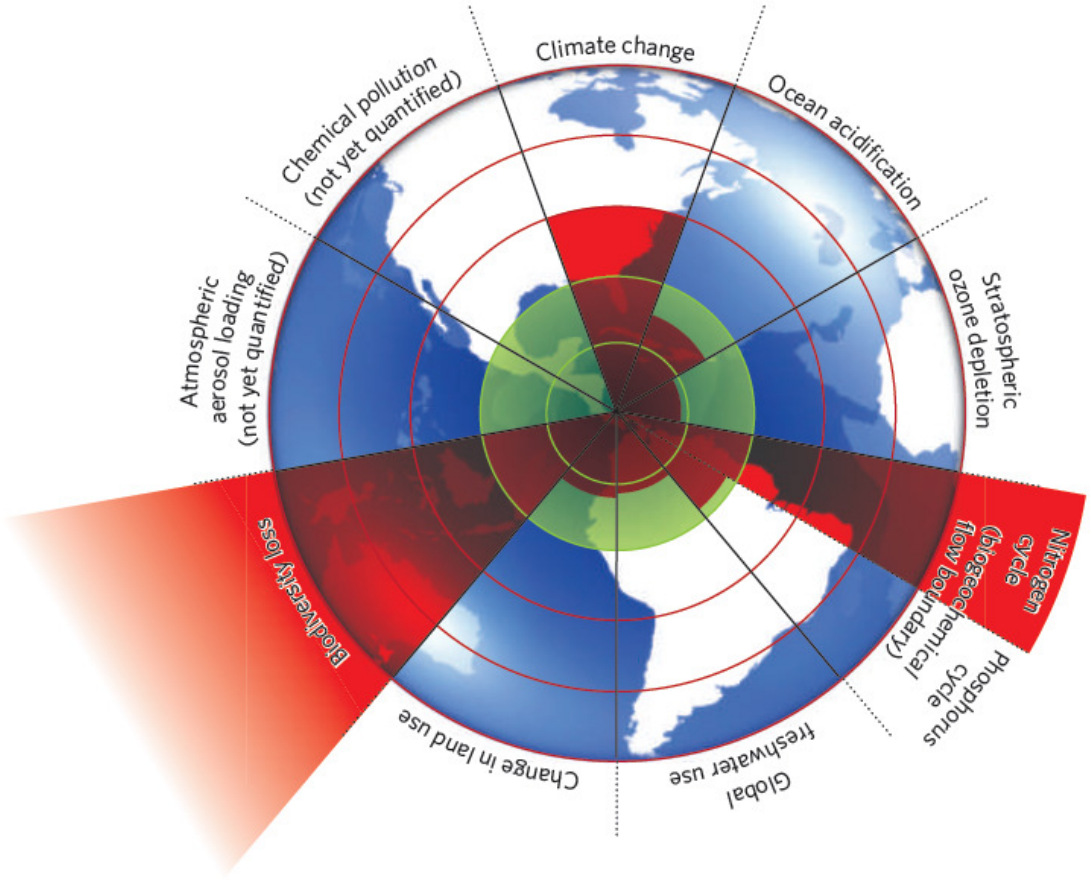
Planetary boundaries



‘Safe operating space’ already exceeded in 3 areas

Source: A safe operating space for humanity (Rockstrom et al., 2009. In Nature, Vol. 461)

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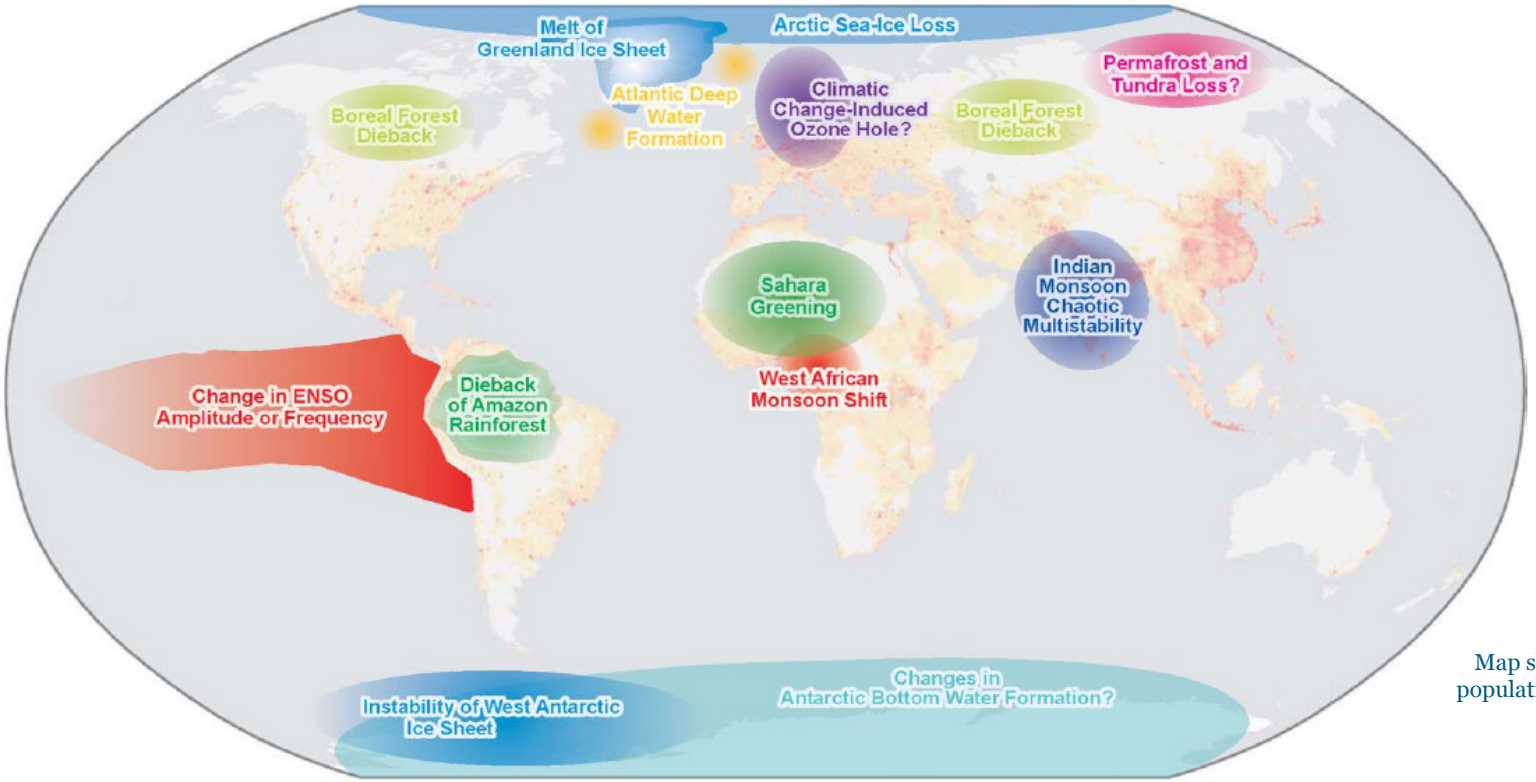
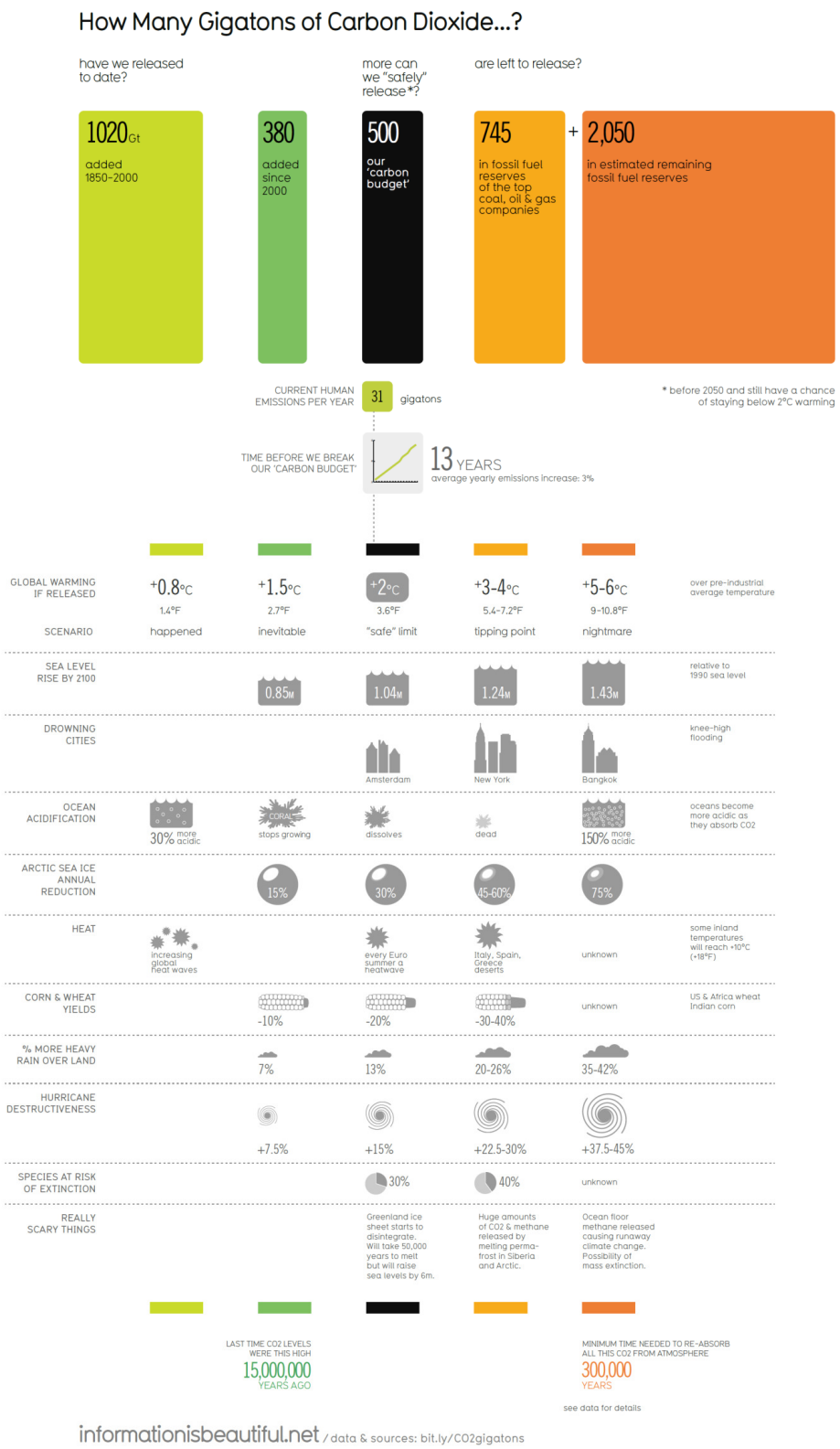
Tipping elements



Map shading is population density

Human activities may push the Earth system past critical states

Source: Tipping elements in the Earth's climate system (Lenton et al., 2008. In PNAS, Vol. 105, No. 6)



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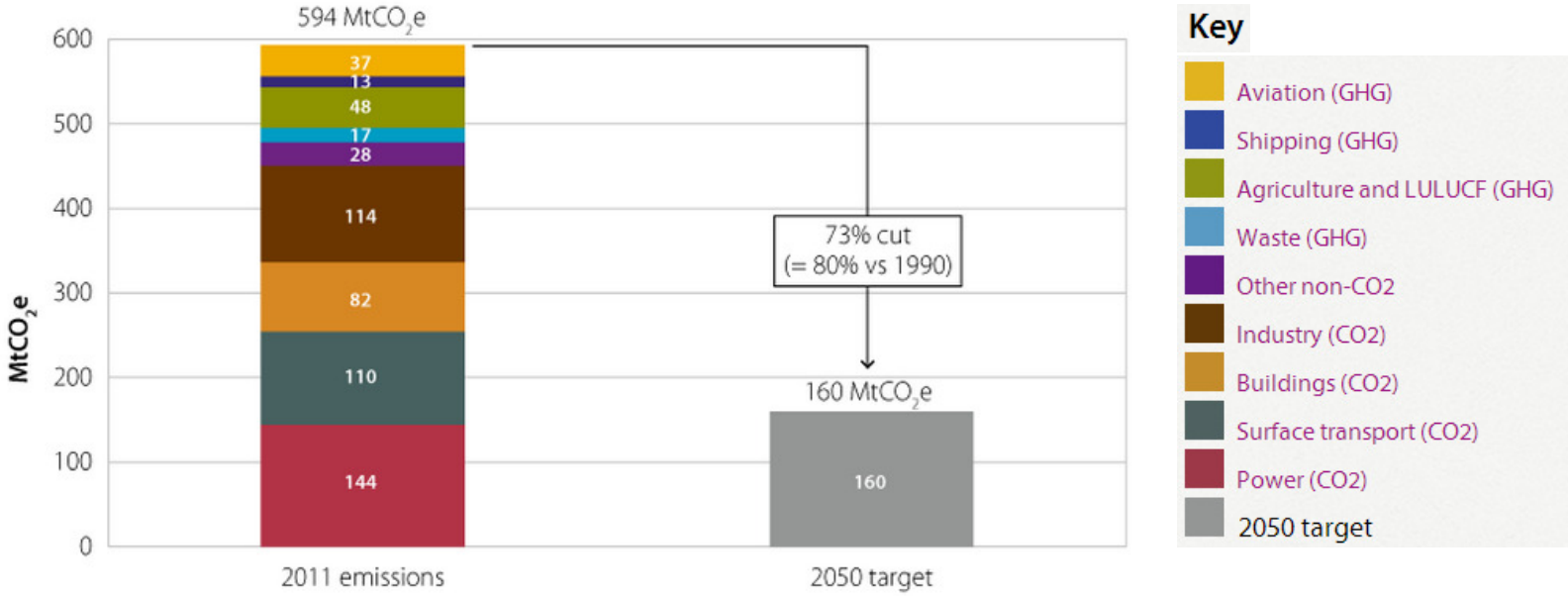
(printed A4)

Also printed A4, the 8 x CCC sectoral factsheets, most double sided

UK emissions

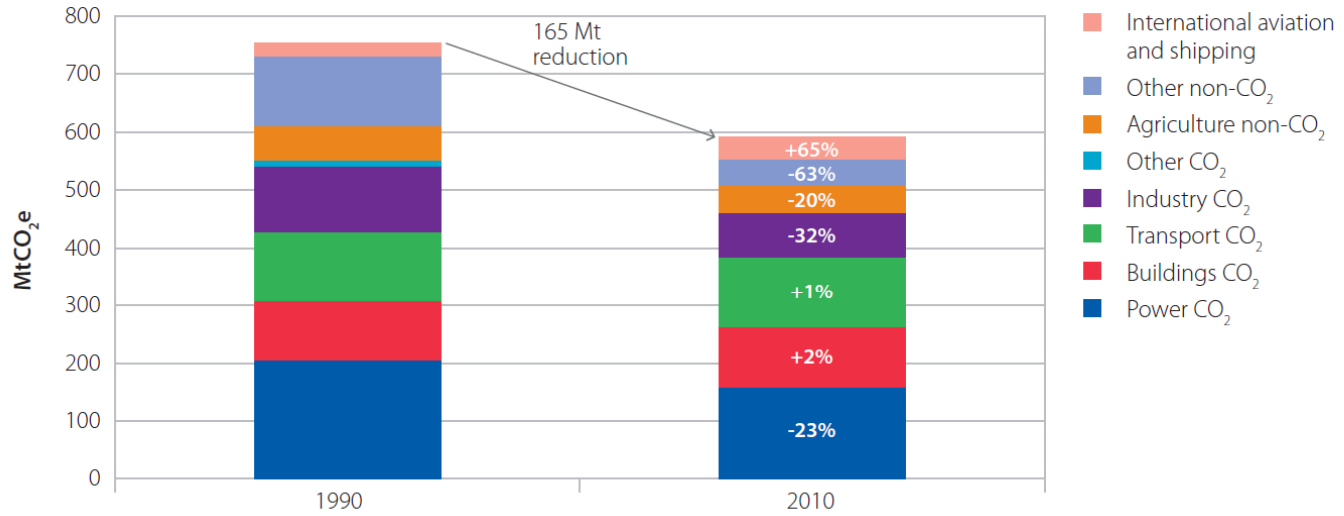


Production emissions by sector

Source: Committee on Climate Change (http://www.theccc.org.uk/charts-data/ukemissions-by-sector/, accessed Aug 2013)

UK production emissions falling

Figure 1.3: UK greenhouse gas production emissions by sector (1990 and 2010)



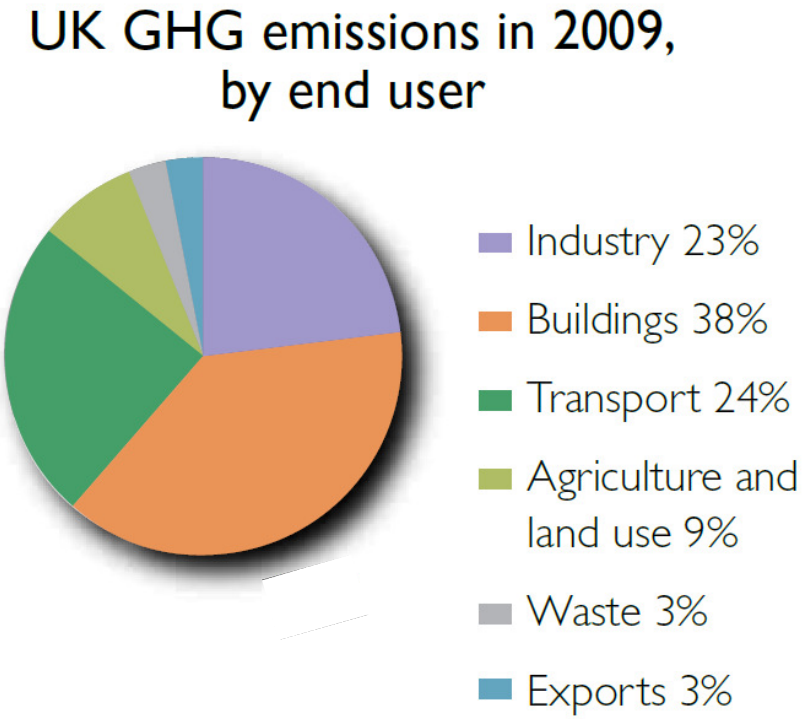
Source: NAEI (2012).
Notes: Other CO_2 include CO_2 emissions from domestic and military aviation, agricultural energy use and LULUCF. Due to negative LULUCF emissions, other CO_2 emissions were close to zero in 2010 on a net basis. Other non-CO_2 includes non-CO_2 emissions from waste, buildings, industry, energy supply and transport.

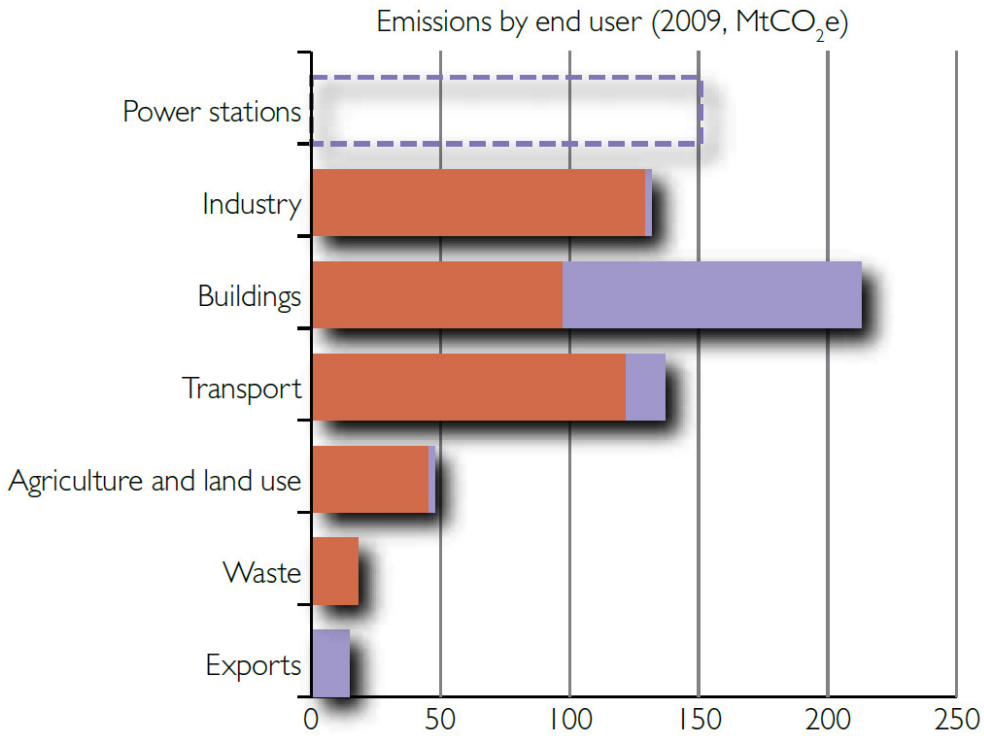
Fell 25% since 1990

Cleaner gas replaced coal use, some manufacturing moved abroad

Sources: Reducing the UK's carbon emissions and managing competitiveness risks (Committee on Climate Change, 2013); http://www.theguardian.com/environment/2013/mar/28/uk-co2-emissions-up-2012; The Carbon Plan (HMG, 2011, Executive Summary, page 1)

UK emissions



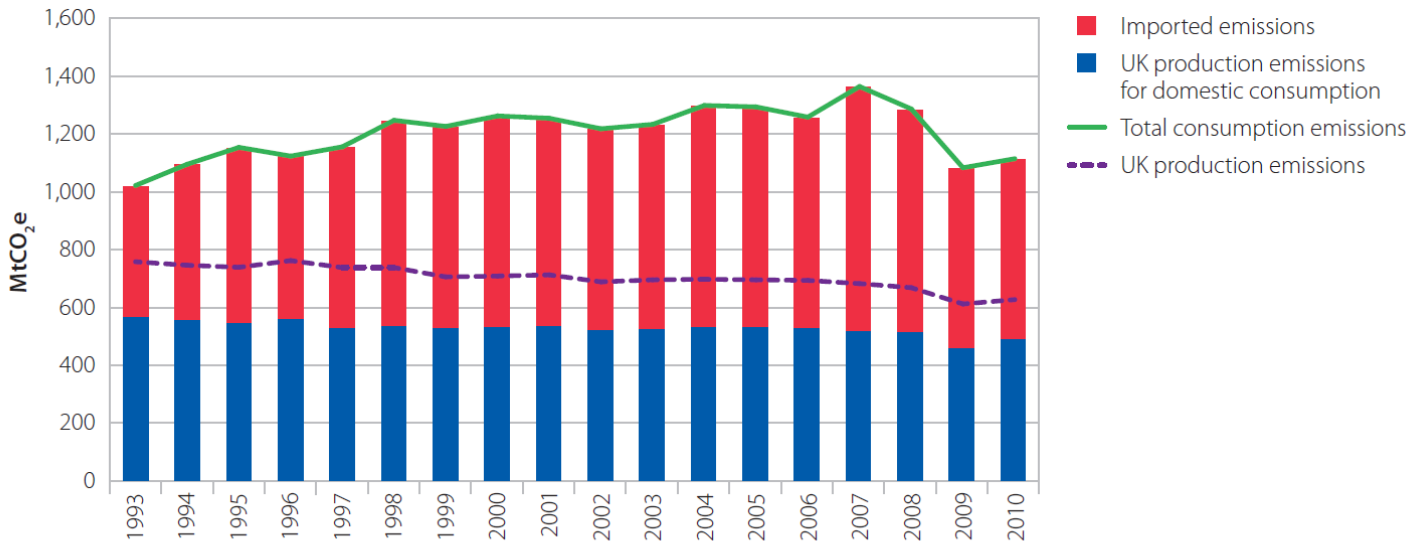


Production emissions re-attributed to end use

Sources: UK Carbon Plan (2011)

UK emissions

Figure 1.4: Greenhouse gas emissions associated with UK consumption – imported and domestic emissions (1993-2010)



Source: CCC estimates developed by the University of Leeds (2013); NAEI (2012).
Notes: The green line shows estimates of total UK consumption emissions and the red and blue bars break down consumption emissions by goods and services produced and consumed within the UK versus imported goods and services. Domestic consumption emissions are estimated to have decreased over time while imported emissions are increasing. The dotted purple line shows trends in UK production emissions (including international aviation & shipping emissions), which have decreased over time. The gap between the dotted purple line and blue bar represents UK production emissions in goods and services for export.

Consumption emissions – national 'carbon' footprint

Source: Reducing the UK's carbon emissions and managing competitiveness risks (Committee on Climate Change, 2013)

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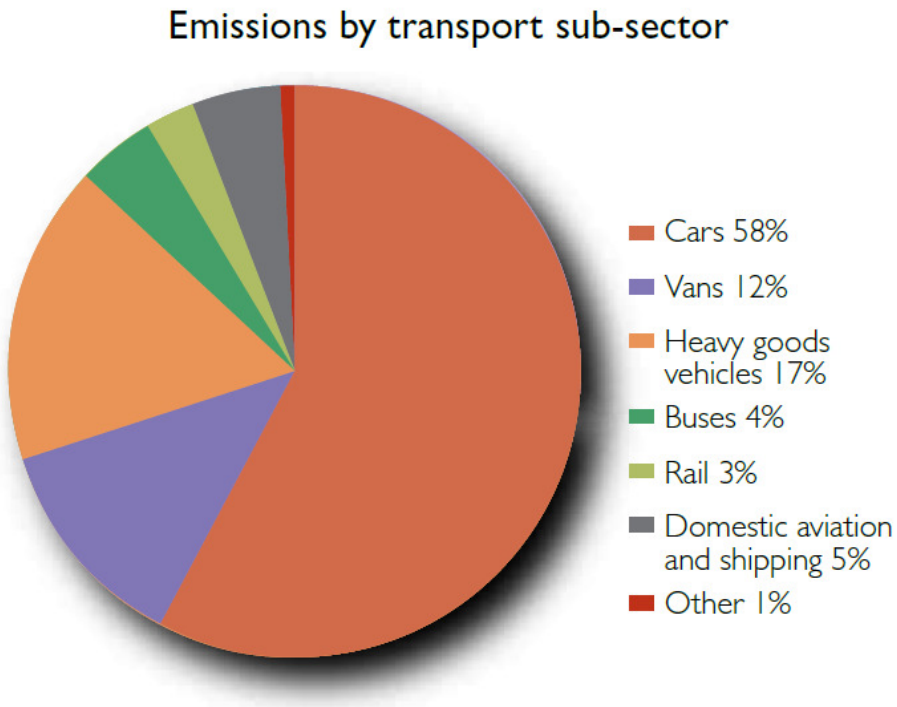
UK emissions – transport

(by end-use)

Present emissions

(24%, 137 $MtCO_2e$)



In 2050

(20-40 $MtCO_2e$?)

Ultra-low emission vehicles
- **electric**
- **hydrogen**
- **biofuels**

Efficient, electrified rail

Modal shift
- **public transport**
- **more cycling, walking**
- **freight by rail and water**

Less travel? (e.g. work from home)

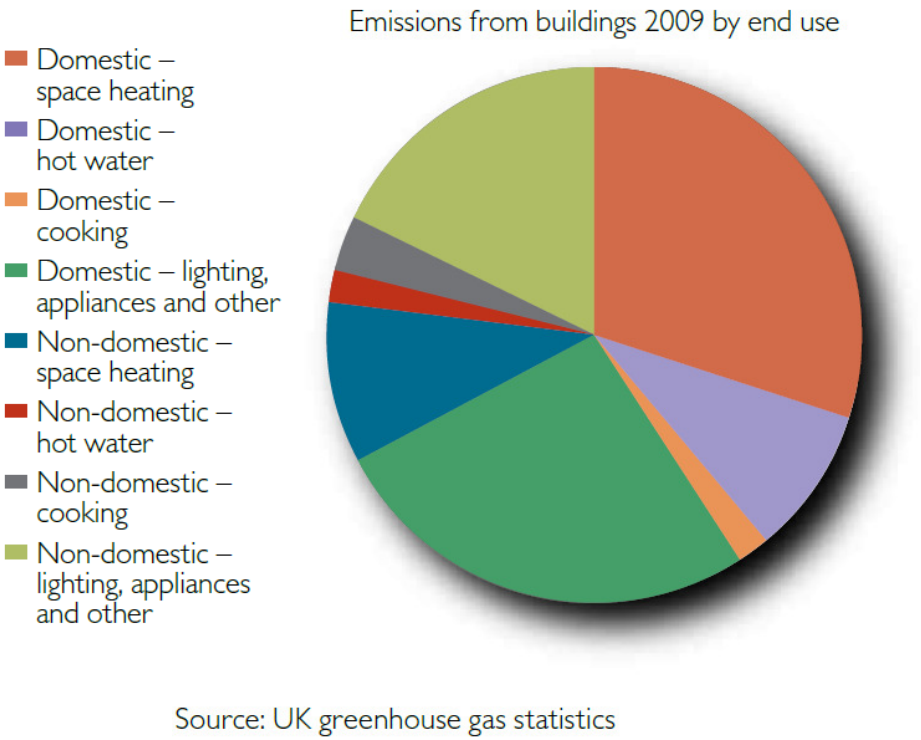
Sources: UK Carbon Plan (2011), Committee on Climate Change Factsheet (2013)

UK emissions – buildings

(by end-use)

1990-2012

(38%, 217 $MtCO_2e$)



Source: UK greenhouse gas statistics

In 2050

(near zero?)

Reduced energy demand
- **increased thermal efficiency**
- **smart controls and smart meters**
- **efficient lighting/appliances**
- **efficient use of hot water**

Decarbonised energy supply
- **low carbon energy sources**
- **heat pumps, condensing boilers**
- **CHP and heating networks**

Sources: UK Carbon Plan (2011), Committee on Climate Change Factsheet (2013)

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UK emissions – industry

(by end-use)

Present emissions

(23%, 132 $MtCO_2e$)

>80% from generating heat for industrial processes such as manufacturing steel and ceramics

Remainder from chemical reactions

UK industry emissions already fallen by 46% since 1990

In 2050

(25-70 $MtCO_2e$?)

Reduced energy demand
- **reduced energy intensity**
- **efficient equipment & processes**
- **efficient use of hot water**

Decarbonised energy supply
- **low carbon electricity supply**
- **bioenergy**

Carbon Capture and Storage

Improved competitiveness

Sources: UK Carbon Plan (2011), Committee on Climate Change Factsheet (2013)

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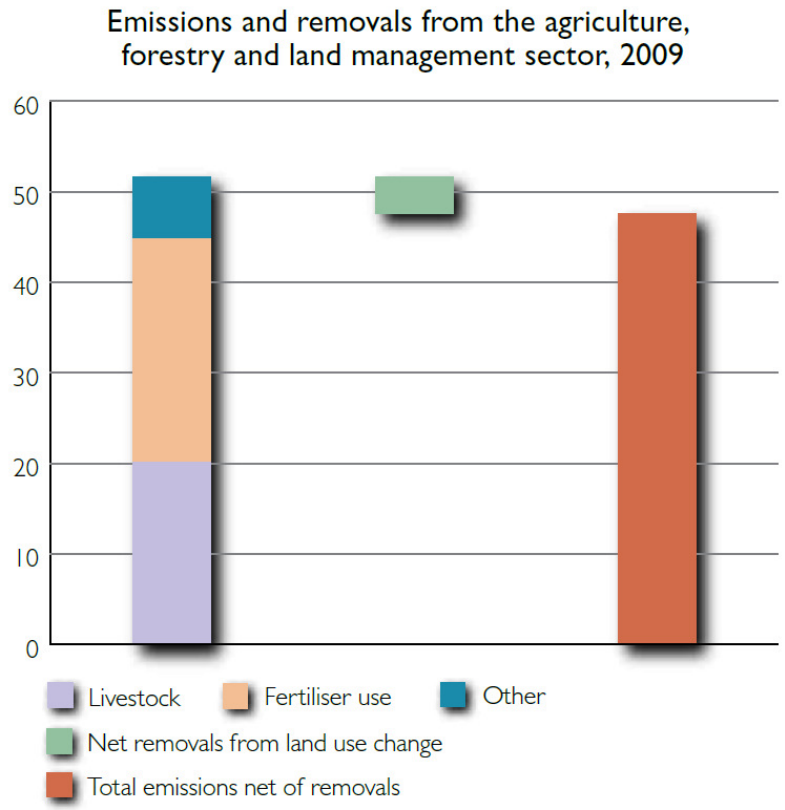
UK emissions – agriculture, forestry and land management

(by end-use)

Present emissions

(9%, 48 $MtCO_2e$)



Sources: UK Carbon Plan (2011), Committee on Climate Change Factsheet (2013)

In 2050

(Lower? High uncertainty)

Agriculture: improved:
- crop nutrient management
- breeding and feeding practices
- 'sustainable intensification'

Forestry
- carbon sequestration
- more sustainable wood products

Soils (large carbon store)
- responsibly managed

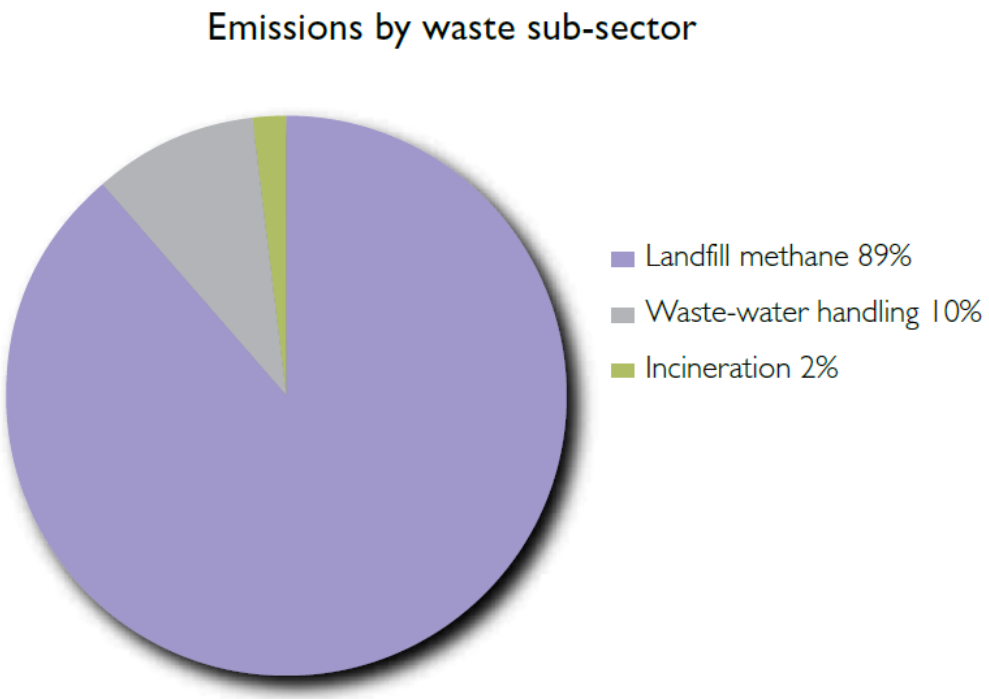
Sustainable bioenergy feedstock

UK emissions – waste

(by end-use)

Present emissions

(3%, 17 $MtCO_2e$)



In 2050

(~7 $MtCO_2e$?)

Landfill methane
- **waste prevention**
- **less waste to landfill**
- **higher methane capture**

Efficient waste-water handling

Incineration - further innovation

Pursuit of 'zero waste'

Resource efficiency

Sources: UK Carbon Plan (2011), Committee on Climate Change Factsheet (2013)

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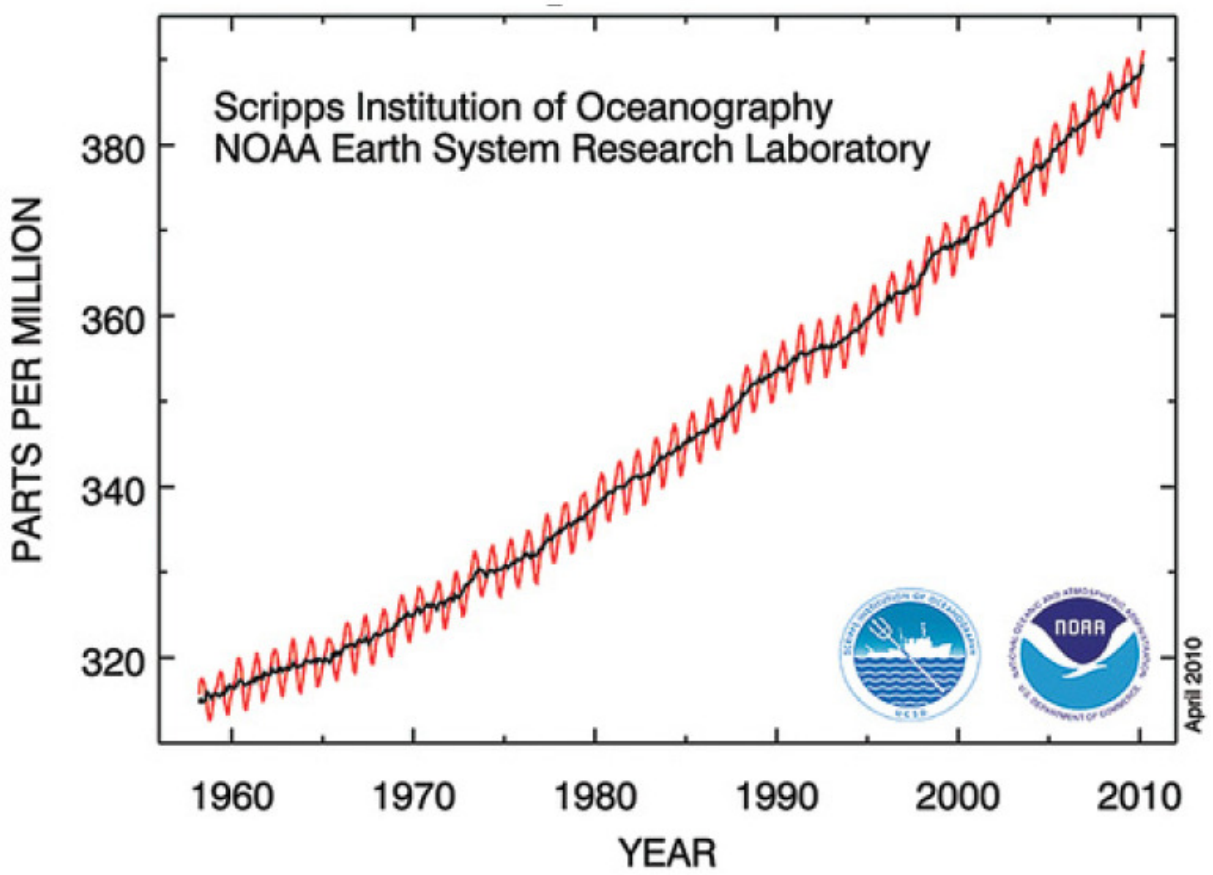
The rise of CO_2 concentrations



Atmospheric CO_2 concentrations, Mauna Loa Observatory

Source: Turn down the heat: why a 4ºC warmer world must be avoided (World Bank, 2012)

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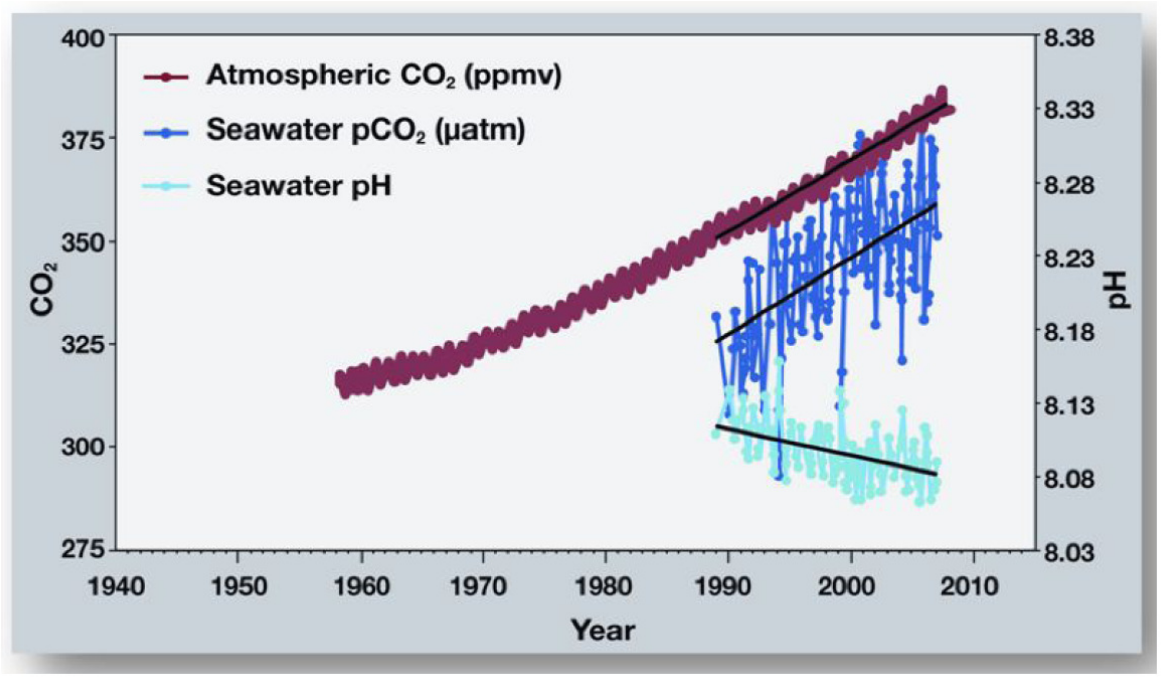
Ocean acidification



Source: NOAA 2012, PMEL Carbon Program.

The oceans absorbed 25% of anthropogenic CO_2 emissions 2000-2006.

Ocean acidity has risen by 30% in recent times.

Impact on marine wildlife and ecosystems?

The oceans play a major role in climate regulation

Source: Turn down the heat: why a 4ºC warmer world must be avoided (World Bank, 2012)

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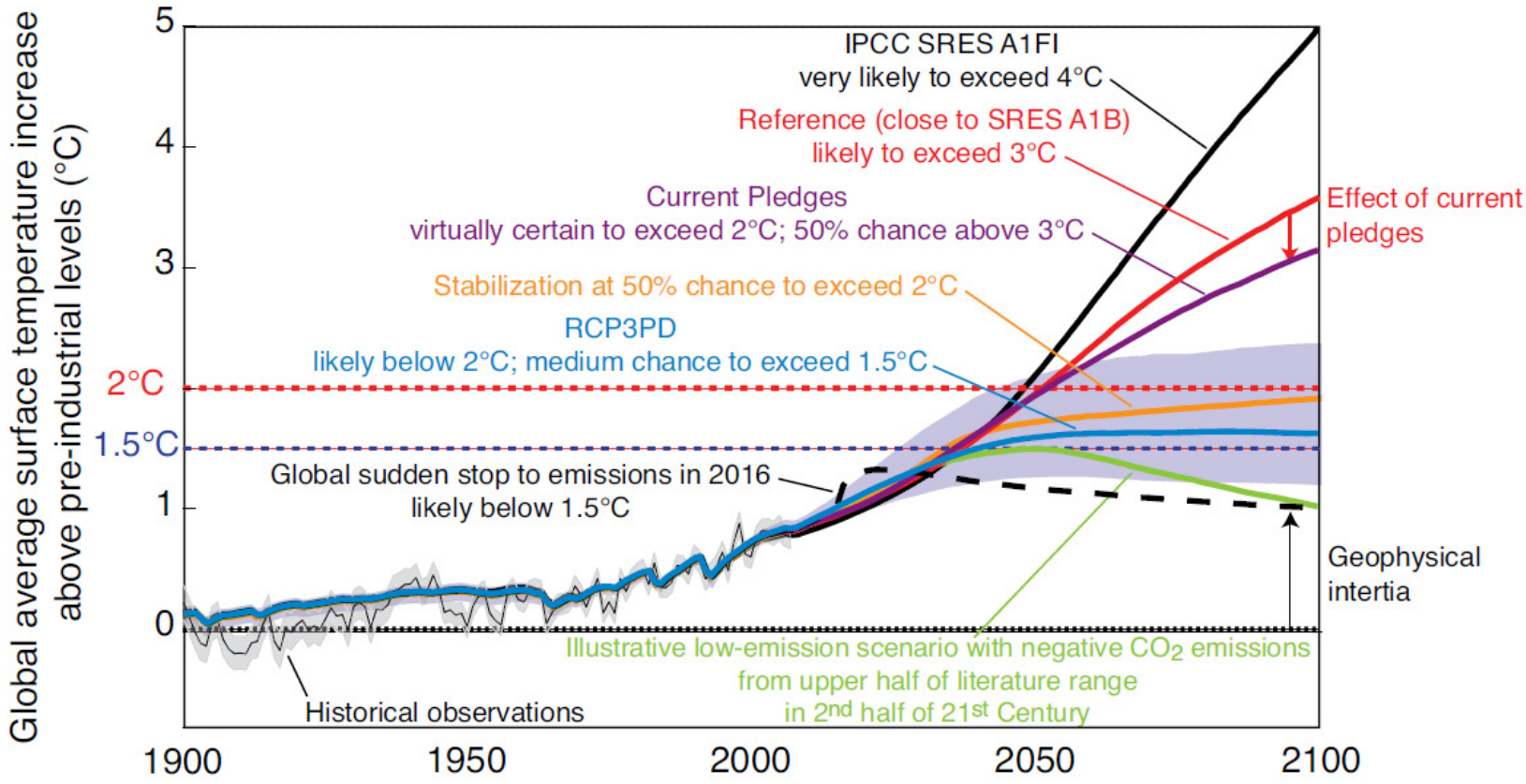
Temperature rise projections



Estimates for two non-mitigation scenarios (already at +0.8°C)

Source: Turn down the heat: why a 4°C warmer world must be avoided (World Bank, 2012)

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Signs of climate change?

Region (Year)	Meteorological Record-breaking Event	Confidence in attribution to climate change	Impact, costs
Europe (2003)	hottest summer in at least 500 years[6]	High based on[7,8]	Death toll exceeding 70,000[9]
England and Wales (2007)	May to July wettest since records began in 1766[10]	Medium based on[3,4]	Major flooding causing ~£3 billion damage
Victoria (Aus) (2009)	Heat wave, many station temperature records (32–154 years of data)[17]	Medium based on[8,14]	Worst bushfires on record, 173 deaths, 3,500 houses destroyed[17]
Western Russia (2010)	Hottest summer since 1500[18]	Medium based on[8,13,14,19]	500 wildfires around Moscow, crop failure of ~25%, death toll ~55,000, ~US$15B economic losses[18]
Pakistan (2010)	Rainfall records[20]	Low to Medium based on[21,22]	Worst flooding in its history, nearly 3000 deaths, affected 20M people[23].
Continental U.S. (2012)	July warmest month on record since 1895[34] and severe drought conditions	Medium based on[13,14,32]	Abrupt global food price increase due to crop losses[35]

Recent record-breaking extreme events

Source: Turn down the heat: why a 4ºC warmer world must be avoided (World Bank, 2012)

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"The 4°C scenarios are devastating:

inundation of coastal cities

increasing risks for food production potentially leading to higher malnutrition rates

many dry regions becoming dryer, wet regions wetter

unprecedented heat waves in many regions

substantially exacerbated water scarcity

increased frequency of high-intensity tropical cyclones

irreversible loss of biodiversity."

Jim Yong Kim, President, World Bank (2012)

A sustainable food future?

Agriculture

1. Economic and Social factors

- 60% more food will be required in 2050
- 28% of global population involved in agriculture industry – inclusive economic and social development required

2. Environmental impacts

- 24% of global GHG emissions
- Dominant driver of deforestation
- 70% of freshwater use

"Growth in the agricultural sector can reduce poverty more effectively than growth arising from other economic sectors."

World Bank

'The great balancing act': sustainable food provision for 9 billion?

Source: http://www.worldresourcesreport.org/

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Future of: cars

UK target: transport emissions 15-30% of present level

Electric?

Nissan Leaf (2013)
Range up to 124 miles
Time to charge: 0.5/4/10 hrs
Zero CO_2 from exhaust

Hybrid?

Toyota Yaris (2013)
81 mpg (65 realistic?)
CO_2 emissions 79 g/km

Hydrogen?

Hyundai ix35 Fuel Cell (2015?)
Range up to 369 miles
Time to fuel: 3 minutes
Emissions: water vapour

Other options?

- **Public transport (electrified)**
- **Run on biofuels**
- **Share/rent models**

Sources: www.nissan.co.uk, www.toyota.co.uk, www.hyundai.co.uk; models shown are illustrative only and not to be taken as recommended. Other models are available.

Personal actions to reduce $CO_2(e)$

a world you like
with a climate you like

Source: http://world-you-like.europa.eu/en/

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In the home

CO_2(e) savings for personal actions (per year)

194 kg
Thermostat down 1°

292 kg
Shorten showers
(5 minutes not 10)

520 kg
Get a 'green roof'

800 kg
Condensing boiler
(if current one >10yrs old)

2540 kg
Fully insulate

Source: http://ew.eea.europa.eu/BendTheTrend/pledges/eea-background-information-on-individual-pledges-to-reduce-greenhouse-gas

Appliances & 'stuff'

CO_2(e) savings for personal actions (per year)

444 kg
Power off not standby

164 kg
Air not tumble dry

223 kg
Laptop not desktop

135 kg
B to A++ fridge

252 kg
Recycle
(paper 98, glass 78, cans 76)

200 kg
Low energy bulbs

Source: http://ew.eea.europa.eu/BendTheTrend/pledges/eea-background-information-on-individual-pledges-to-reduce-greenhouse-gas

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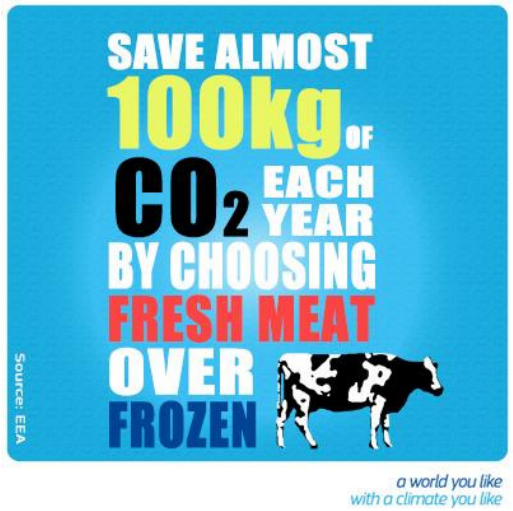
Food and drink

CO_2(e) savings for personal actions (per year)

420 kg

Going meat-free
(60 kg per weekday)



292 kg

Replace beef with pork or chicken

146 kg

Drink tap not bottled water

97 kg

Fresh meat not frozen

31 kg

Go organic
(wheat/pasta only)

Sources: http://ew.eea.europa.eu/BendTheTrend/pledges/eea-background-information-on-individual-pledges-to-reduce-greenhouse-gas; EEA 'EU Climate Action' campaign 2013

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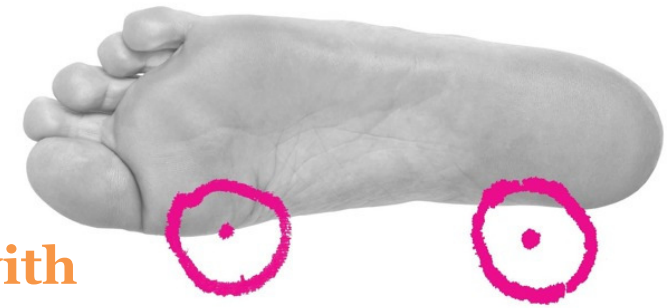
Car travel

CO_2(e) savings for personal actions (per year)

3750 kg
Public transport instead of car



392 kg
Car share (instead of owning)

1872 kg
Replace car with walking/cycling

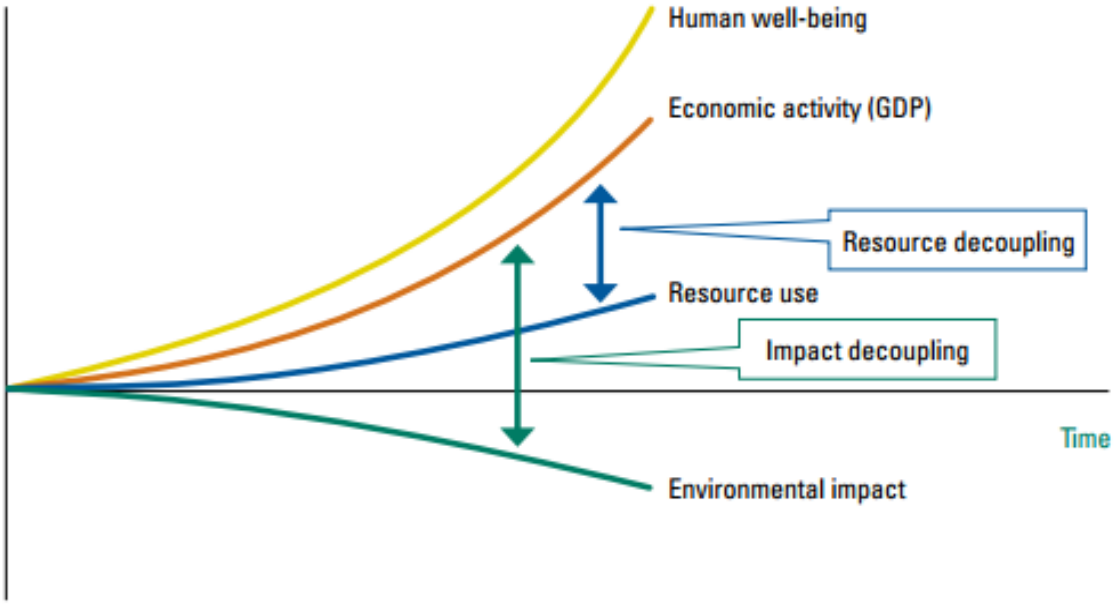
2400 kg
Car pool

1200 kg
Drive slower on motorway

200 kg
Drive efficiently (http://www.ecodrive.org/)

Sources: http://ew.eea.europa.eu/BendTheTrend/pledges/eea-background-information-on-individual-pledges-to-reduce-greenhouse-gas; http://www.behance.net/dothegreenthing

Decoupling



How to decouple?

Transition to a Green Economy that enhances human welfare while sustaining environmental resources – become resource efficient and eliminate waste

Resource use and impact must be decoupled from economic growth

Source: Decoupling natural resource use and environmental impacts from economic growth (UNEP, 2011)

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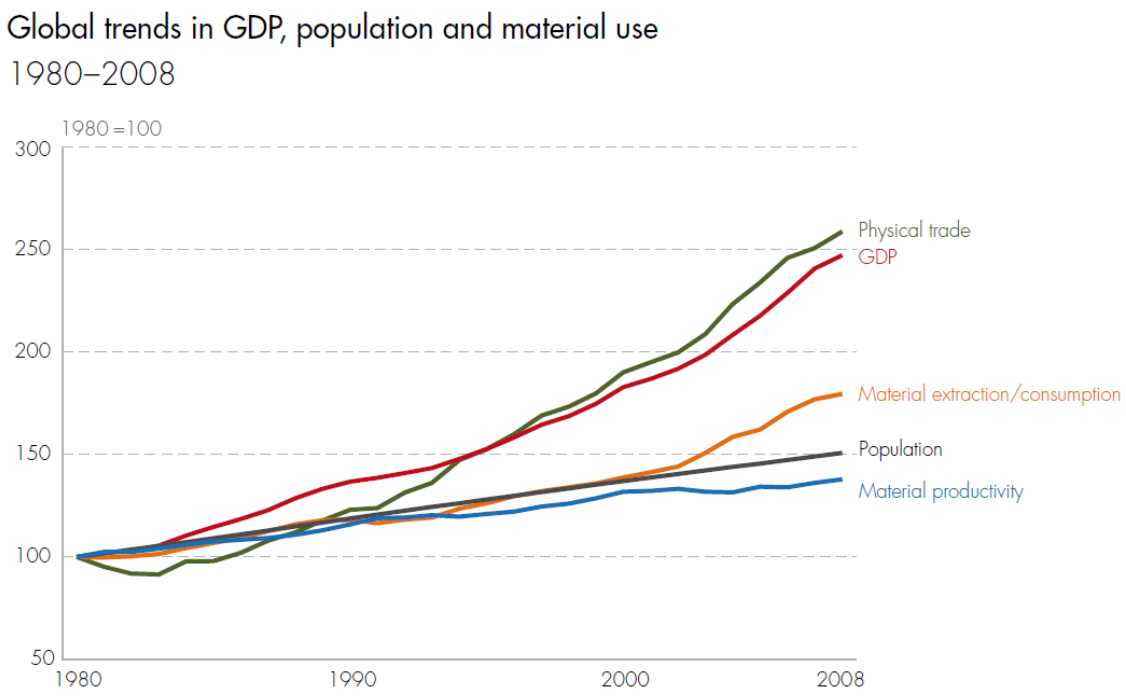
Resource efficiency



Resource consumption still growing, but efficiency increased 40%

Source: Green economies around the world? (SERI, 2012)

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Sustainable Consumption and Production

Growing recognition of issues and calls for action, but deaf ears?

Source: ABC of SCP - Clarifying Concepts on SCP (UNEP, 2010)

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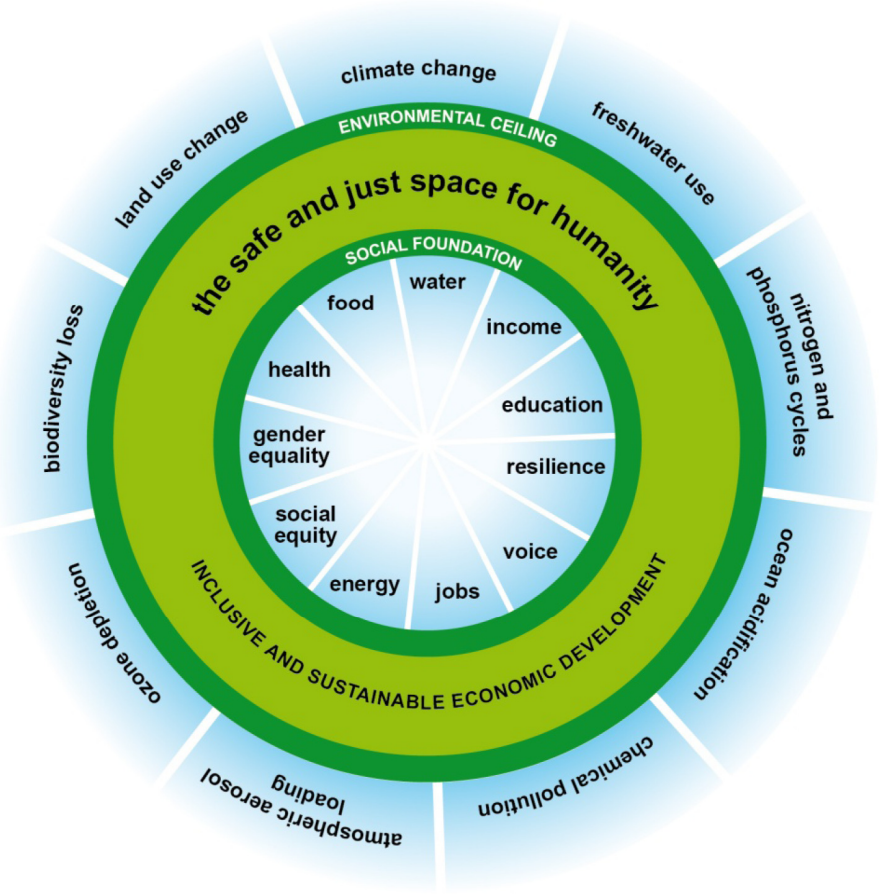
Sustainable development?



Can we live in the 'safe and just space'? (*Within the 'doughnut'*)

Source: A safe and just space for humanity (Oxfam, 2012)

Sources

Most if not all of the sources used are available online (search by title)

Source: The Carbon Plan (HMG, 2011, Executive Summary, page 1)

Source: http://www.theguardian.com/environment/2013/mar/28/uk-co2-emissions-up-2012

Source: Overconsumption? Our use of the world's natural resources (SERI, FOE, 2009)

Source: State of world population 2011 (UNFPA, 2011)

Source: Human Development Report 2013 (UNDP, 2013)

Source: http://www.worldresourcesreport.org/

Source: http://world-you-like.europa.eu/en/

Source: World Energy Outlook 2010 and 2011 (IEA, 2010 and 2011)

Source: Renewables 2013: Global Status Report (REN, 2013)

Source: Global Footprint Network, 2011, *In* Living Planet Report 2012 (WWF, 2012)

Sources: www.nissan.co.uk, www.toyota.co.uk, www.hyundai.co.uk

Source: A safe and just space for humanity (Oxfam, 2012)

Source: Decoupling natural resource use and environmental impacts from economic growth (UNEP, 2011)

Source: EEA 'EU Climate Action' campaign 2013

Source: http://www.behance.net/dothegreenthing

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Source: ABC of SCP - Clarifying Concepts on SCP (UNEP, 2010)

Source: Living Planet Report 2012 (WWF, 2012)

Source: Living Planet Report 2012 summary booklet (WWF, 2012)

Source: European species under threat: overview of European Red List results (EC/IUCN, 2011)

Source: A safe operating space for humanity (Rockstrom et al., 2009. In Nature, Vol. 461)

Source: Tipping elements in the Earth's climate system (Lenton et al., 2008. In PNAS, Vol. 105, No. 6)

Source: Committee on Climate Change (http://www.theccc.org.uk/charts-data/ukemissions-by-sector/, accessed Aug 2013)

Source: Reducing the UK's carbon emissions and managing competitiveness risks (Committee on Climate Change, 2013)

Source: Committee on Climate Change Factsheets (2013)

Source: UK Carbon Plan (2011)

Source: Green economies around the world? (SERI, 2012)

Source: Critical raw materials for the EU (EC, 2010)

Source: Turn down the heat: why a 4ºC warmer world must be avoided (World Bank, 2012)