BP Energy Outlook 2035

January 2014

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Outline

Outlook 2035 - the headlines

Risks to the outlook – how we think about them

Building an outlook – on solid data foundations

"Big data" – what does it mean for energy forecasting

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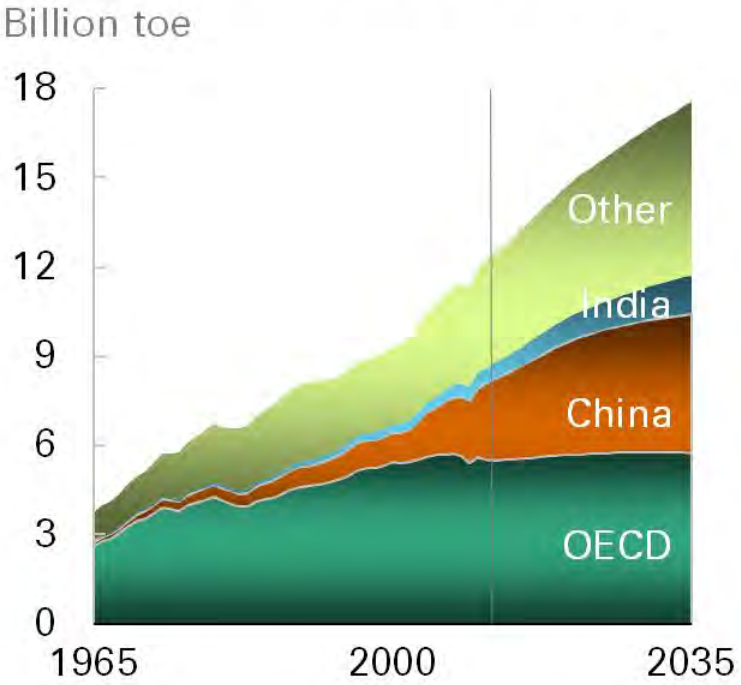
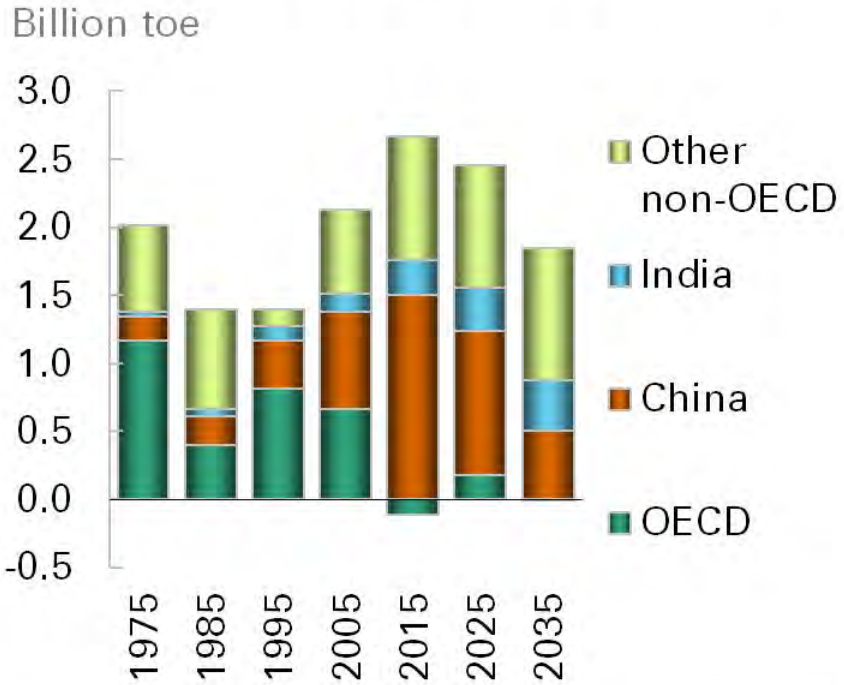
Primary energy consumption growth slows

Consumption by region



Ten year increments by region



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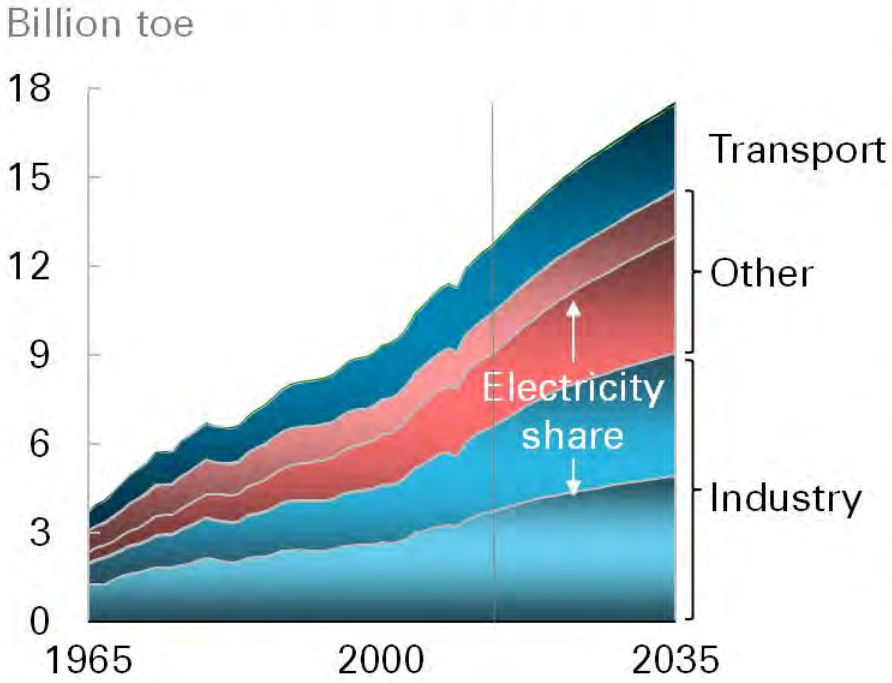
The strong impetus from industrialization starts to fade

Consumption by sector



Ten year increments by sector

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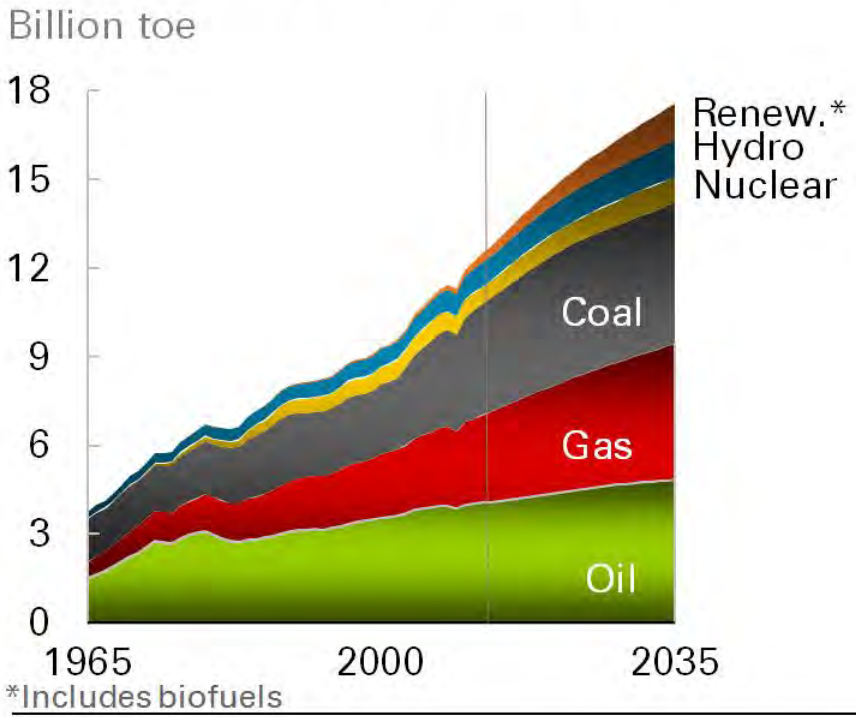
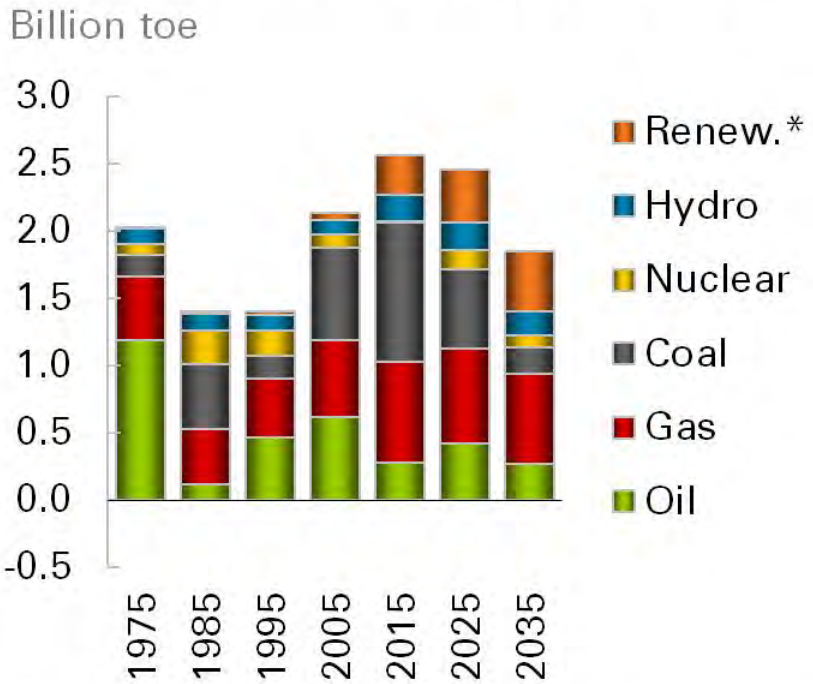
The slowdown in China and industry is reflected in coal

Consumption by fuel



*Includes biofuels

Ten year increments by fuel



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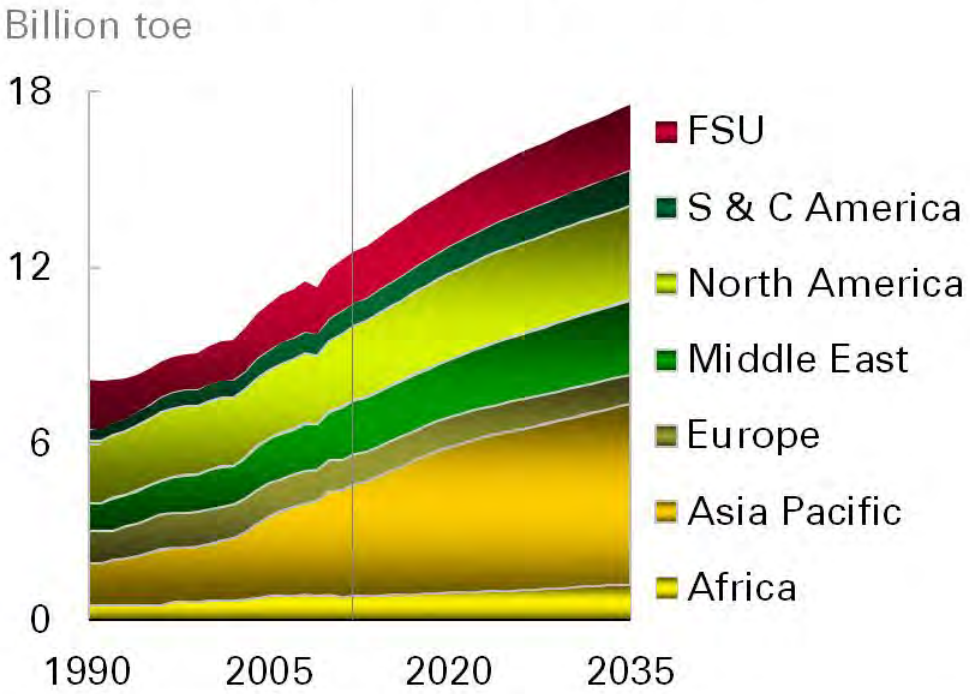
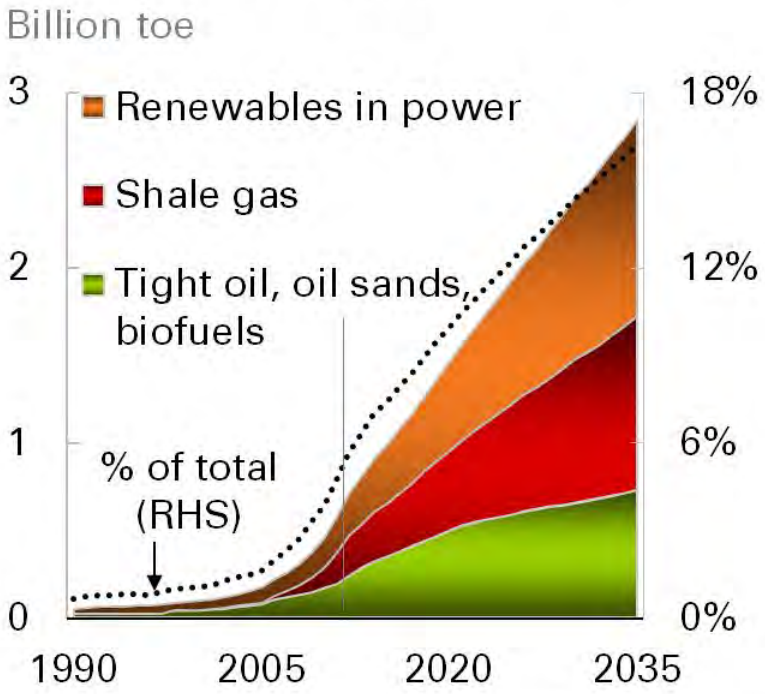
New sources help to supply sufficient energy

Primary energy production



New energy forms



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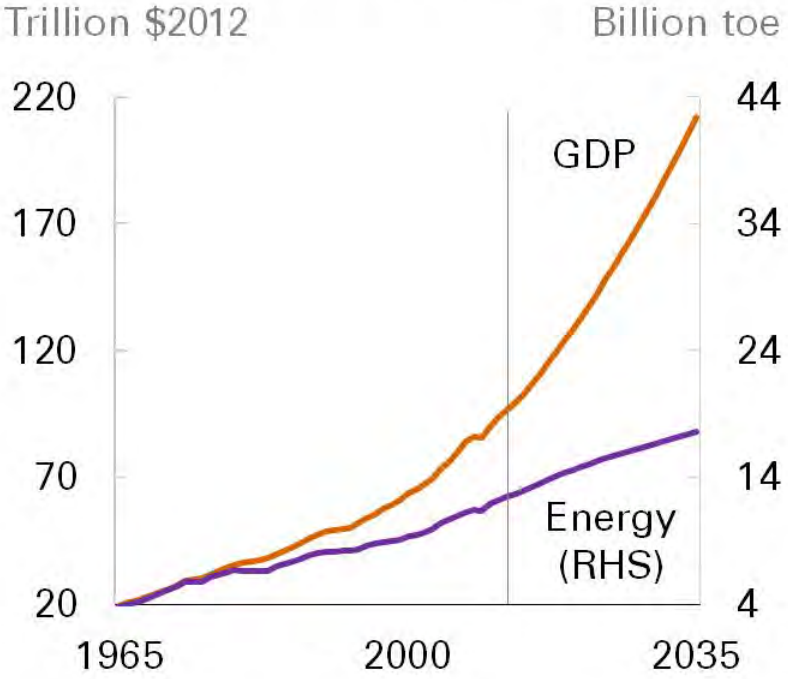
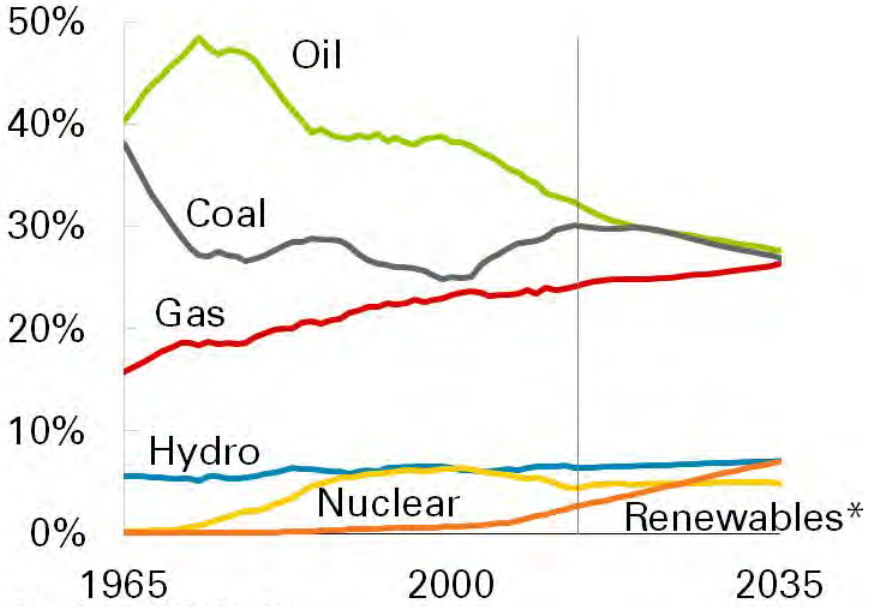
Energy decouples from GDP and fuel mix evolves

GDP and energy



Shares of primary energy



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Risks to the Outlook

"**Forks in the road**" – key decision points where the system can choose alternative paths

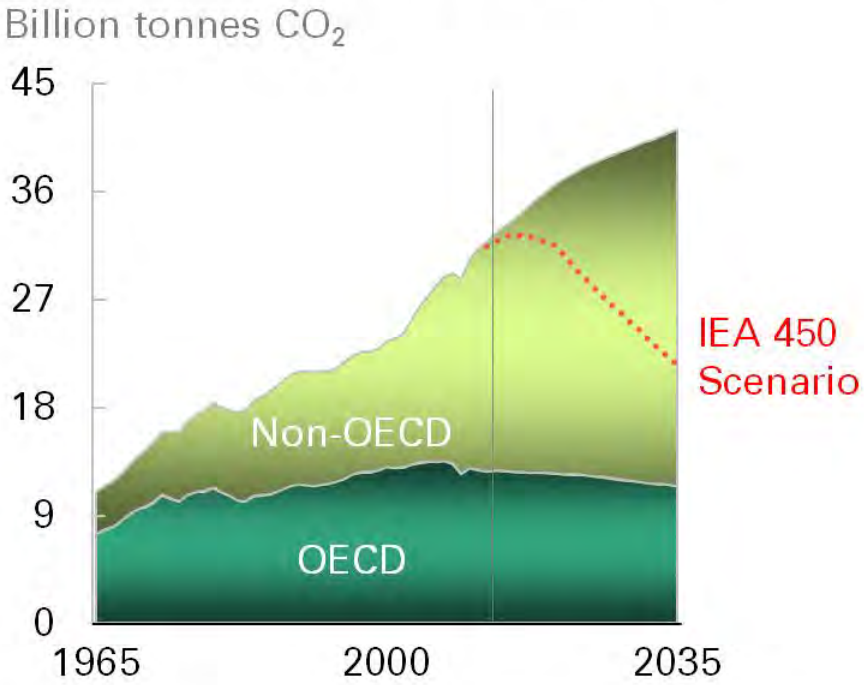
"**Fault lines**" – pressure building for change, but not clear when it will break or which way

Make assumptions for the "base case", but always keep in mind the implications of alternative choices.

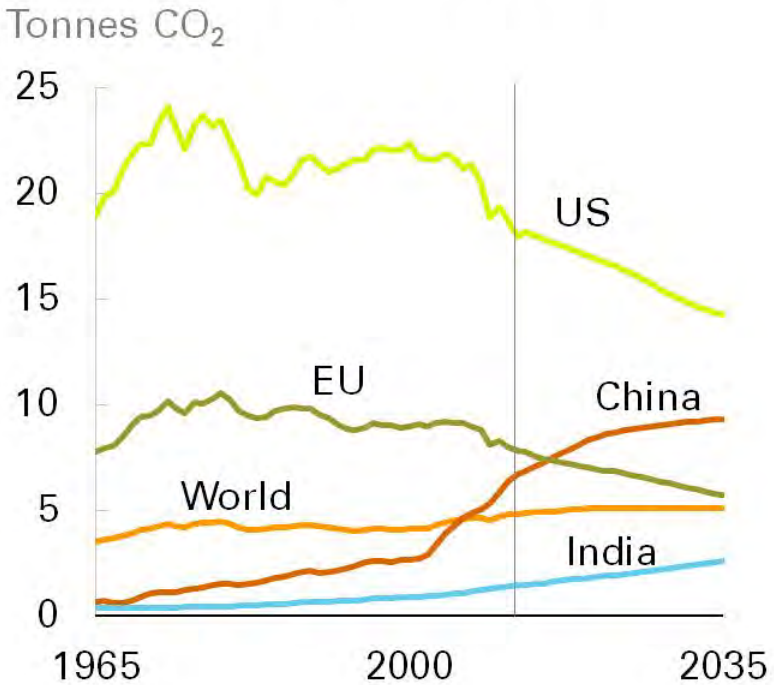
Example – carbon emissions

CO_2 emissions from energy use continue to rise

Emissions by region



Emissions per capita



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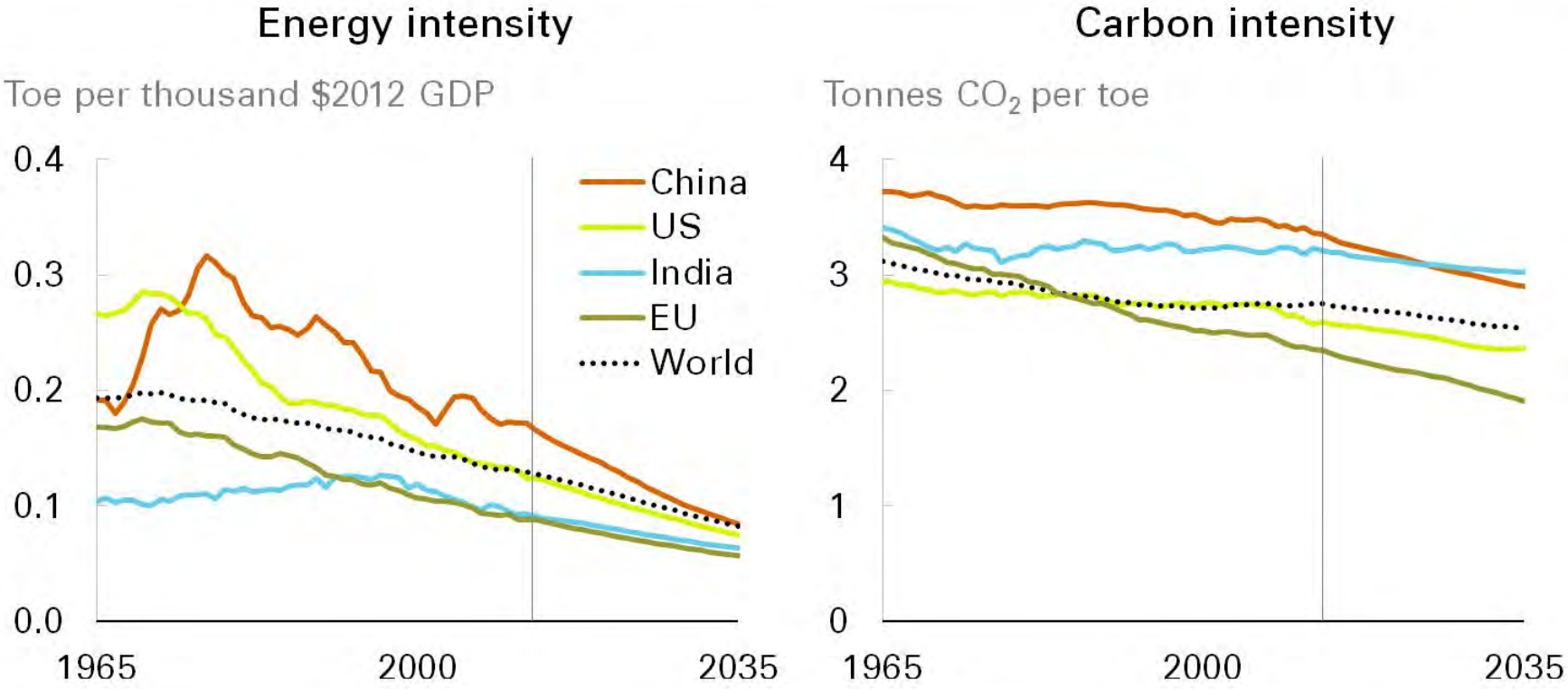
Energy intensity and carbon intensity follow different patterns



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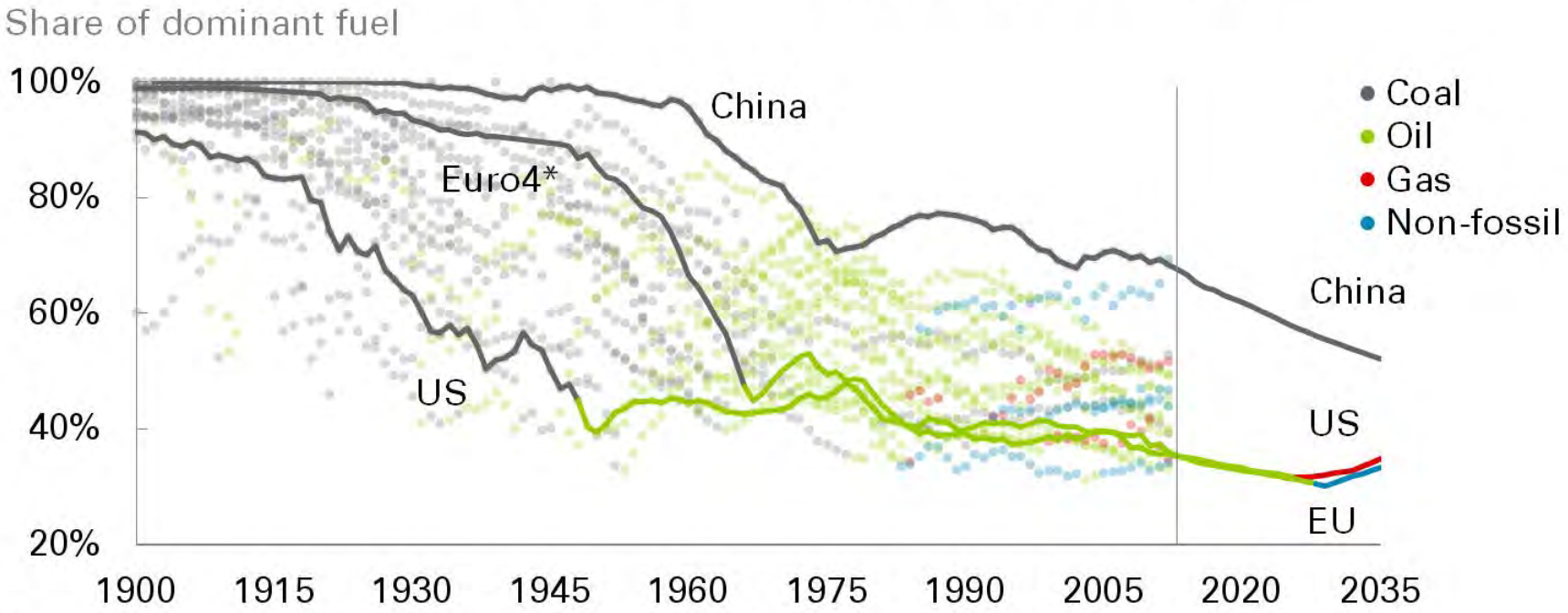
The fuel mix diversifies over time

Evolution of the fuel mix in 20 major countries



*France, Germany, Italy and United Kingdom pre-1965

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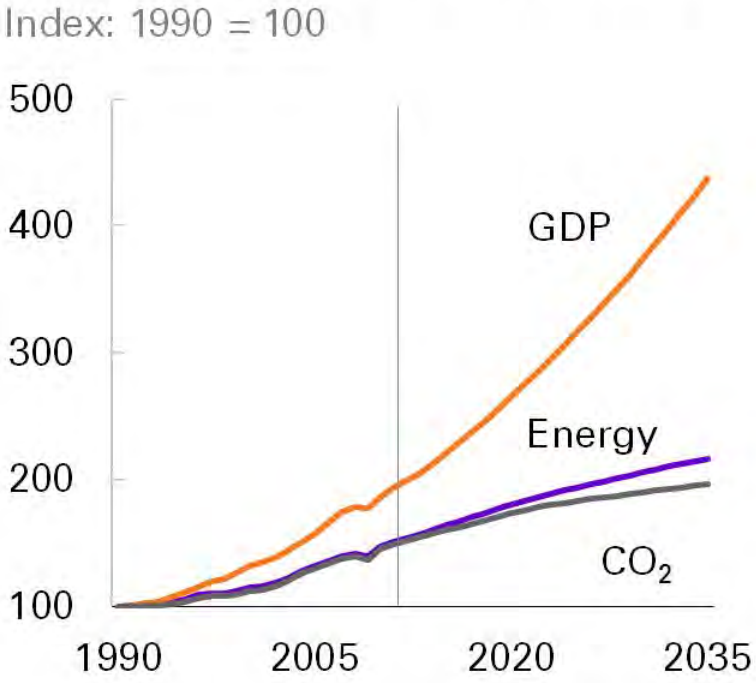
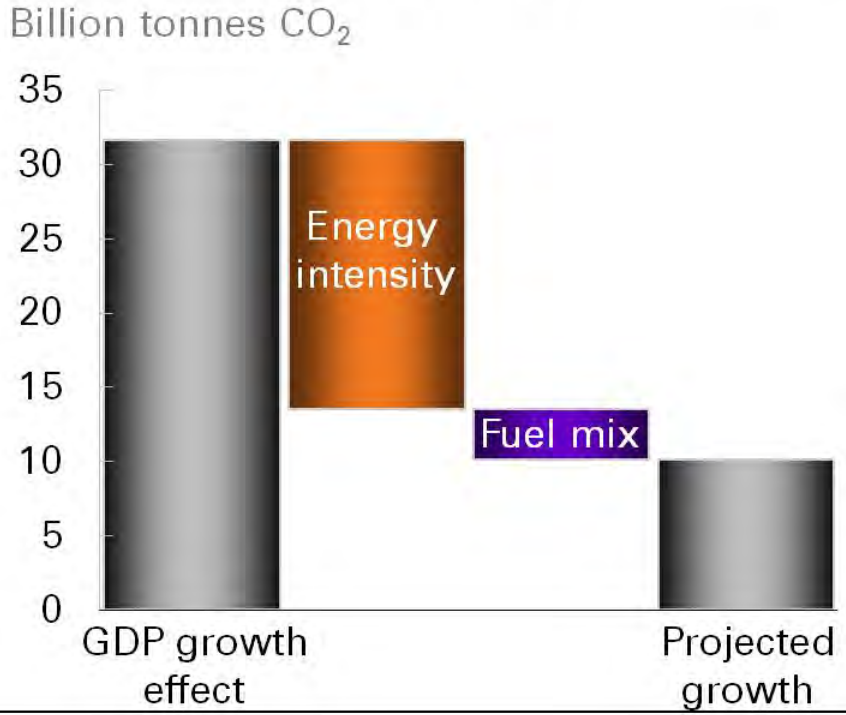
Energy efficiency and fuel mix restrain emissions growth

GDP, energy and emissions



Emissions growth 2012 to 2035



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BP Statistical Review of World Energy June 2014

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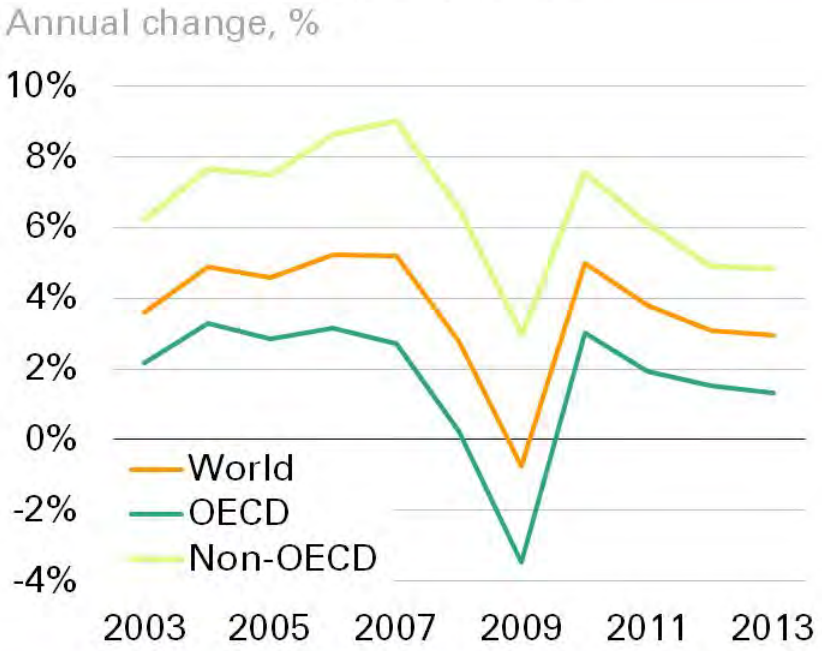
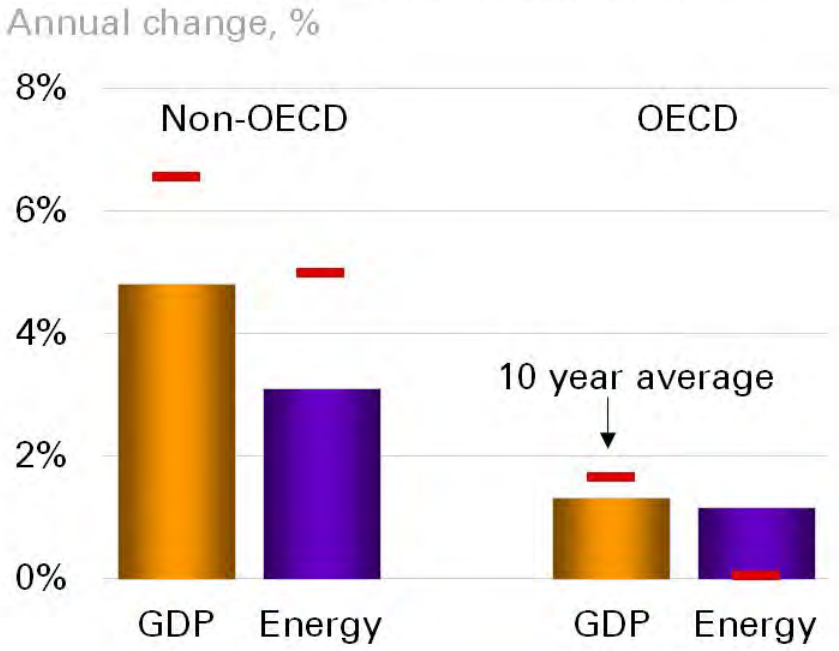
Energy in 2013: Taking stock

Energy and the economy

GDP growth



Energy and GDP in 2013



Source: includes data from Oxford Economics
Note: GDP growth based on Purchasing Power Parity measure of GDP

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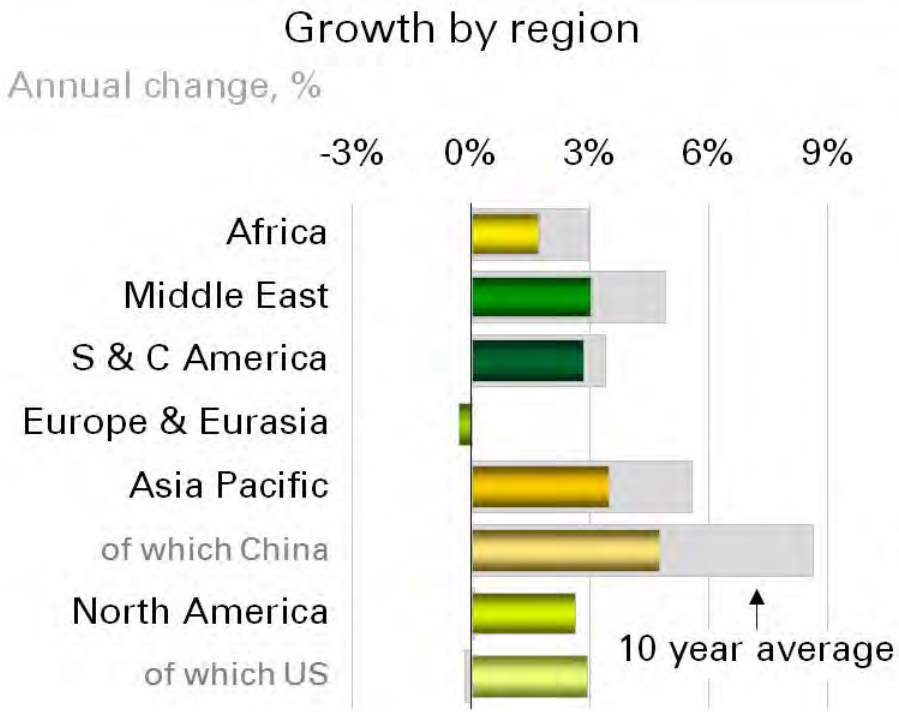
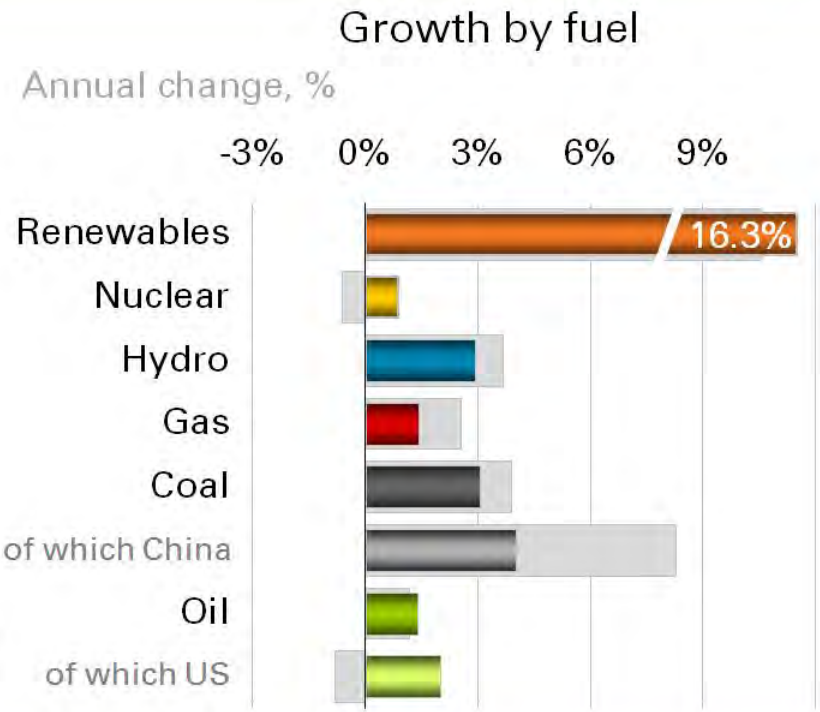
Energy consumption in 2013





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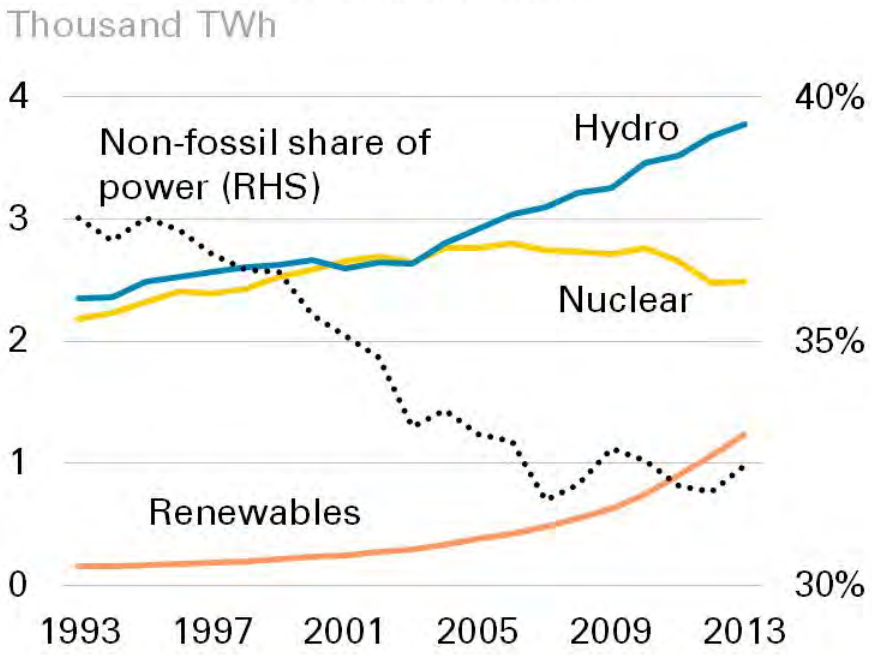
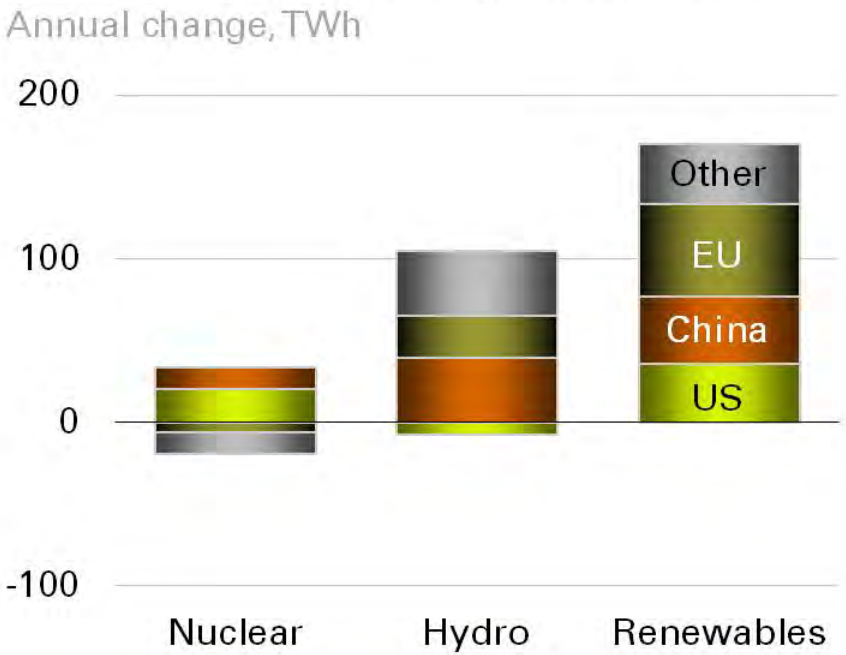
Hydro, renewables and nuclear

Power generation



Output changes in 2013



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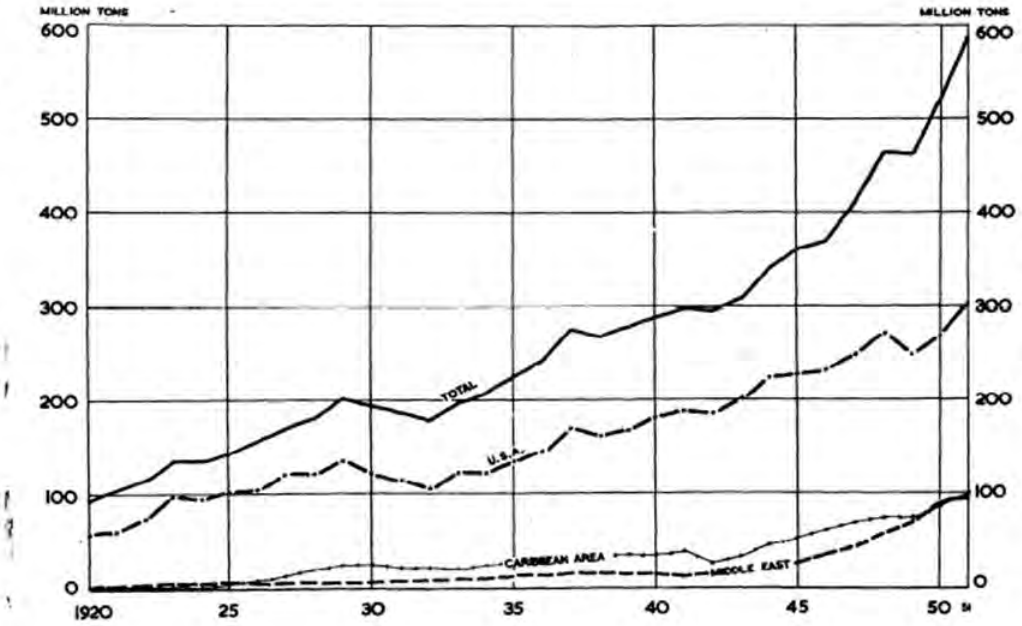
Our own "big data" journey

"The Oil Industry in 1951 Statistical Review"

- internal memo, April 1952
- several type-written pages
- hand drawn charts
- tables with < 100 data points



WORLD CRUDE OIL PRODUCTION 1920 — 1951

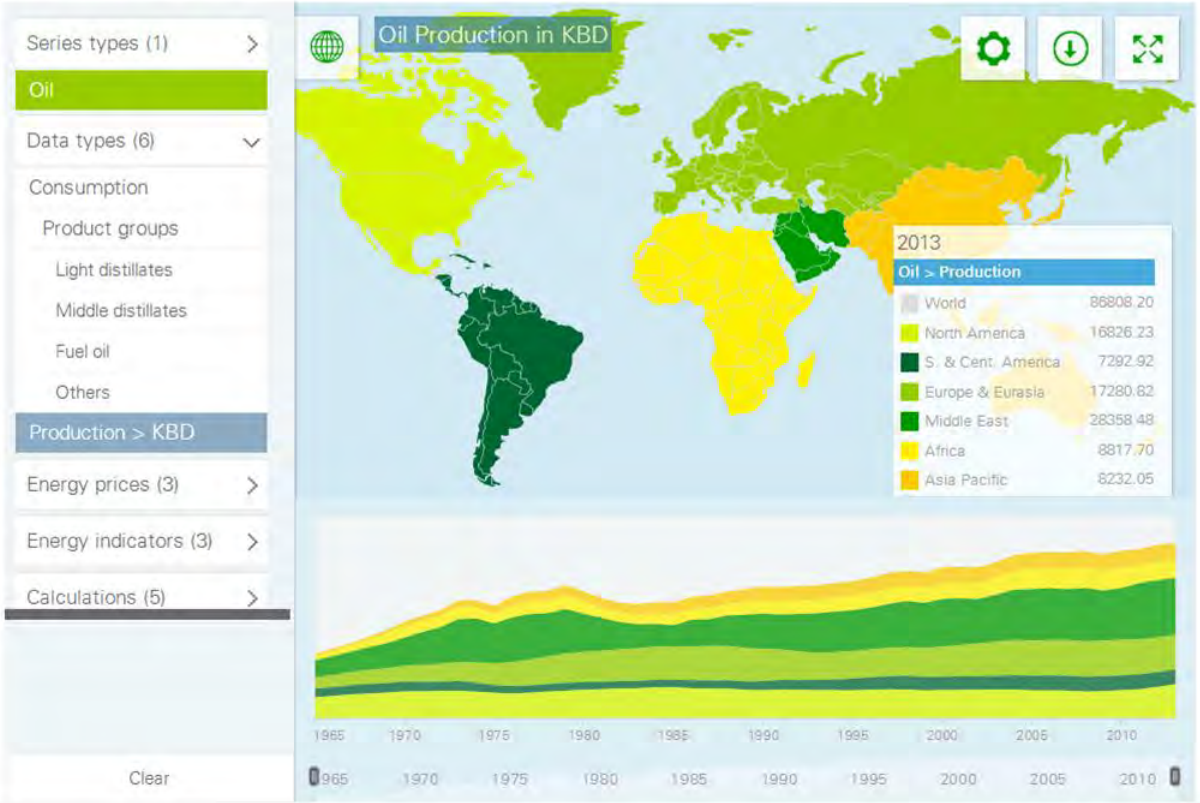
Our own “big data” journey

Access database

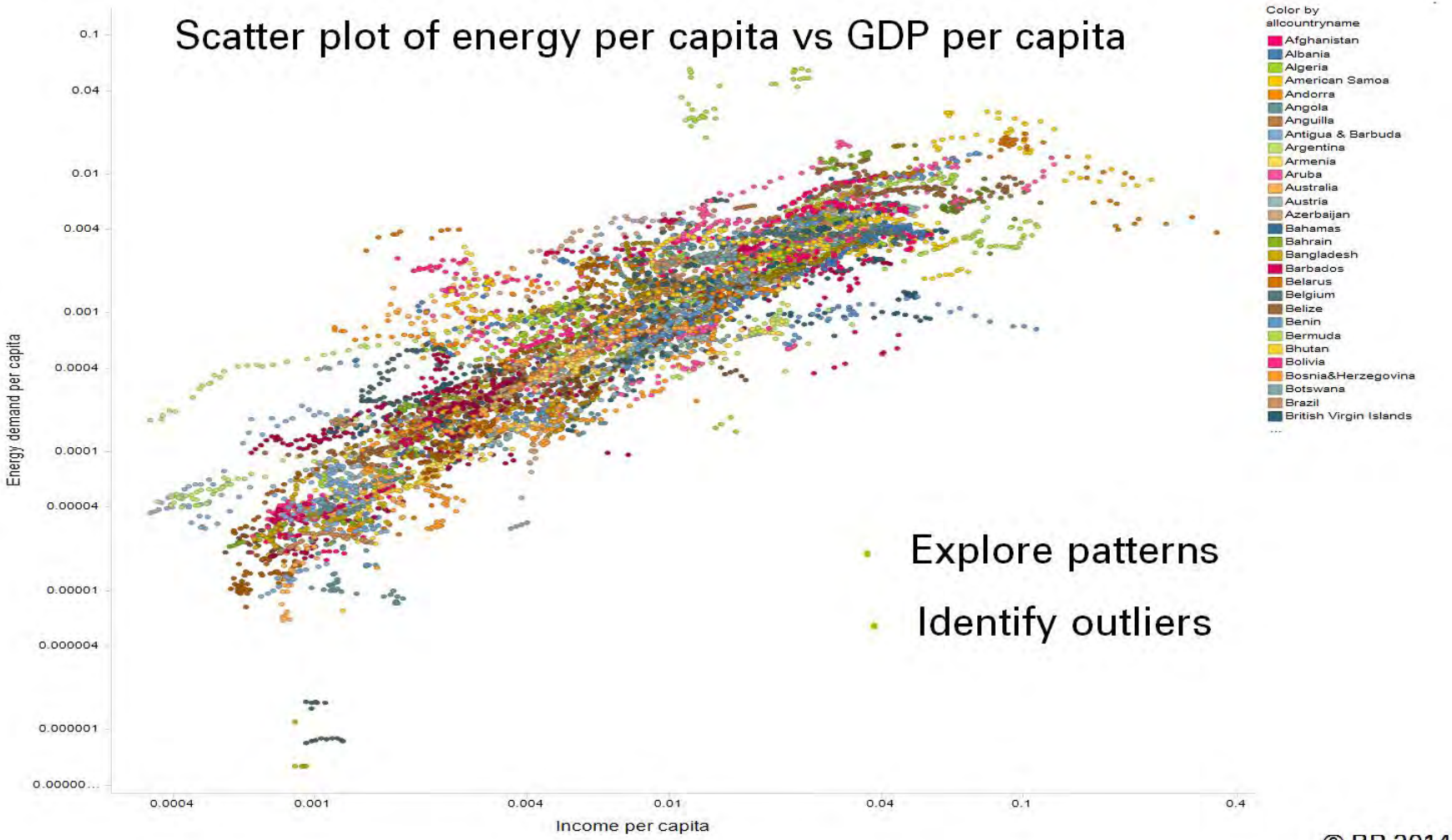
10 million data points

On-line charting tool (and app)

Data collection – some still by hand but increasingly from internet sources



Scatter plot of energy per capita vs GDP per capita



- Explore patterns
- Identify outliers

“Big data” and energy

Oil industry a pioneer in data acquisition and processing

The four V’s – volume, velocity, variety and veracity

Rapid reduction in cost of acquiring and processing data

Many examples of “big data” transforming operations and interactions with customers

- Seismic – vast amounts of data
- Real-time health monitoring of equipment
- Virtual flow metering - predicting rate and phase of well production
- Predicting problems and non productive time in drilling
- Refining operations – process optimization
- Product quality

"Big data" and the energy outlook

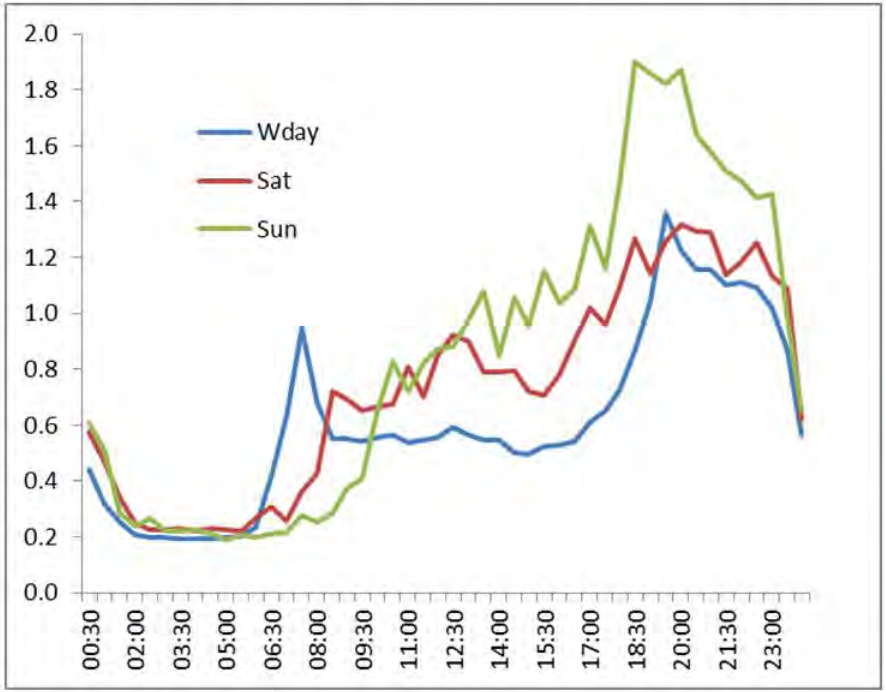
Will "found data" help us spot trends?

Will more information change consumer choices and behaviour?

Example – home energy monitoring

Information as a factor of production – as relative cost falls, does it substitute for energy and/or time?

Home electricity consumption, KWh



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