The Global Energy Transition: Exploring the Uncertainty

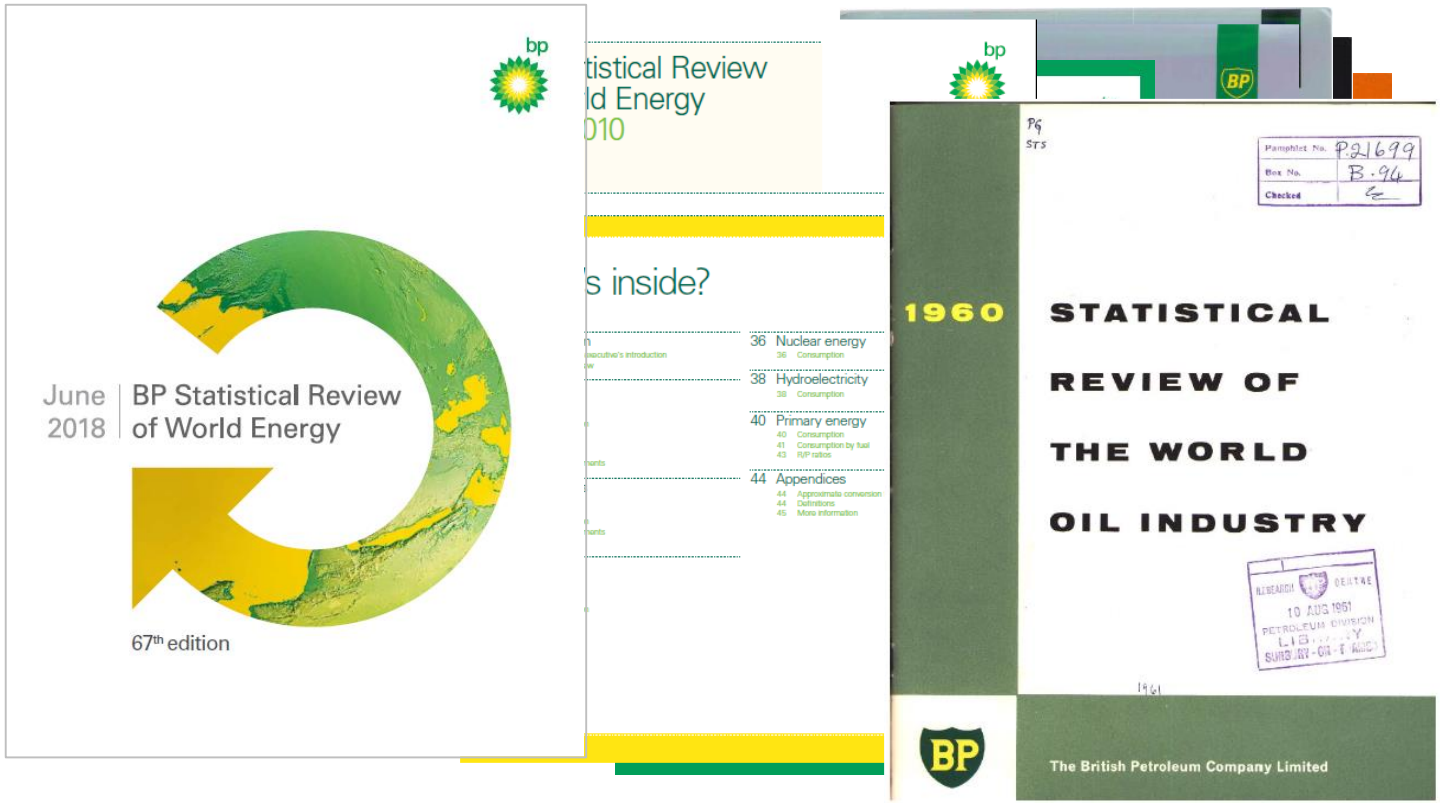
International Symposium, University of Tokyo, December 2018

Paul Appleby– BP Group Strategic Planning

How to handle the energy transition?

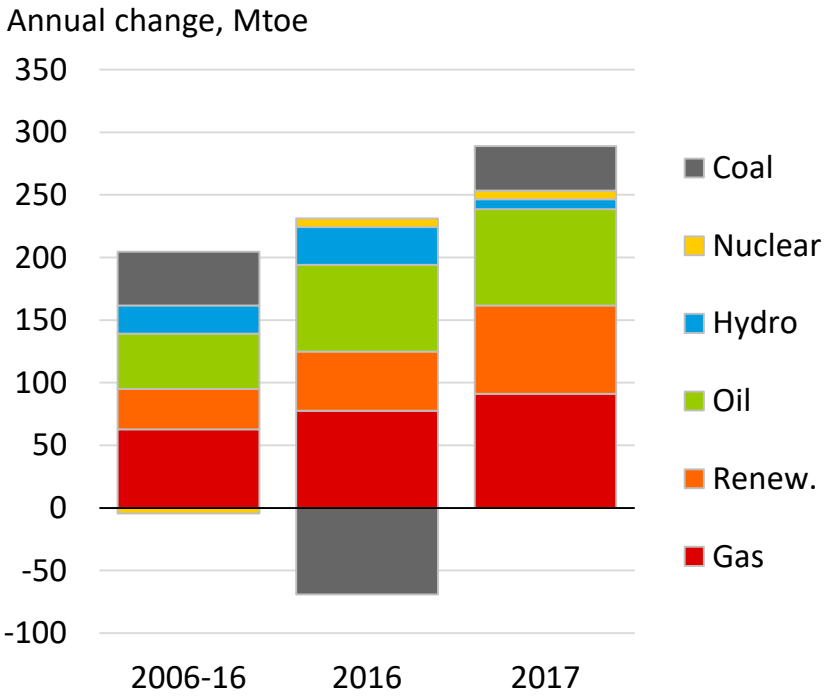
- Track the transition
- Explore the uncertainty – scenarios
- Get on board: “Advancing the energy transition”
- Get into action – do, learn, do

Tracking the transition



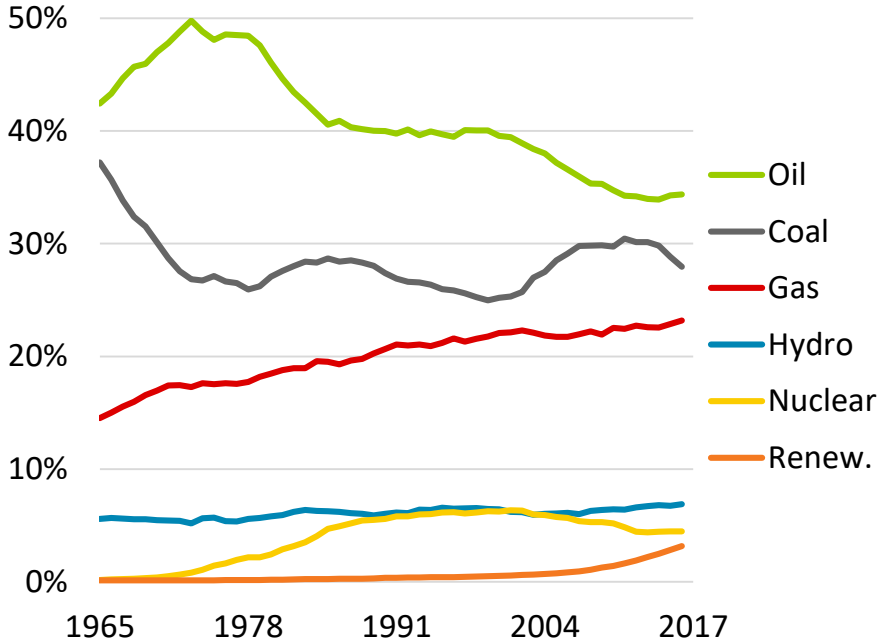
Primary energy fuel mix

Consumption growth by fuel



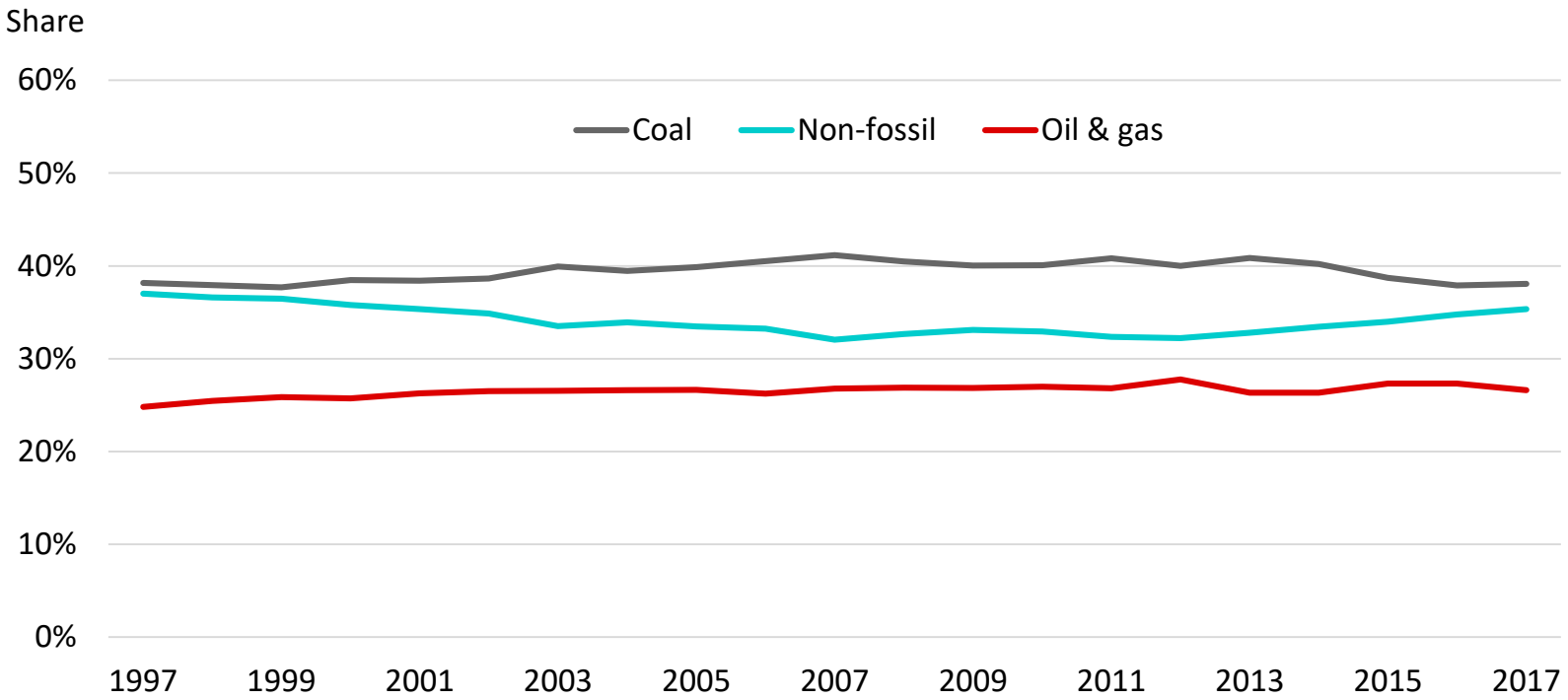
Note: Oil includes biofuels

Shares of primary energy consumption



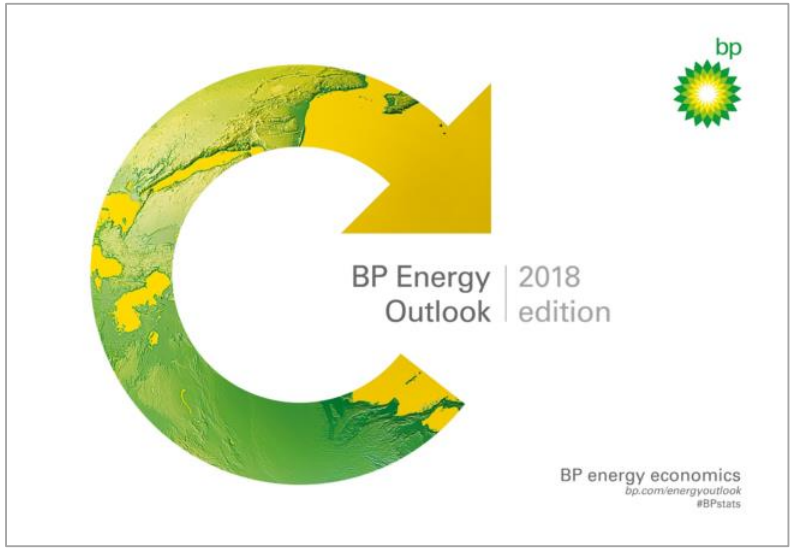
BP Statistical Review of World Energy

Fuel shares in power generation



BP Statistical Review of World Energy

Exploring the uncertainty

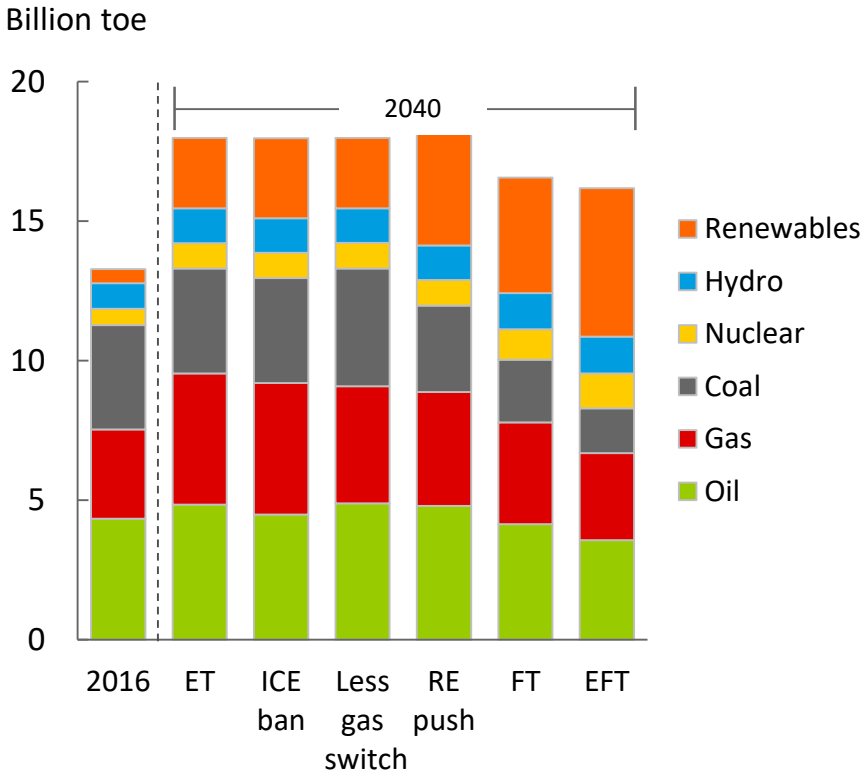


"Scenarios are not about predicting the future, rather they are about perceiving futures in the present. …The end result is not an accurate picture of tomorrow, but better decisions about the future."

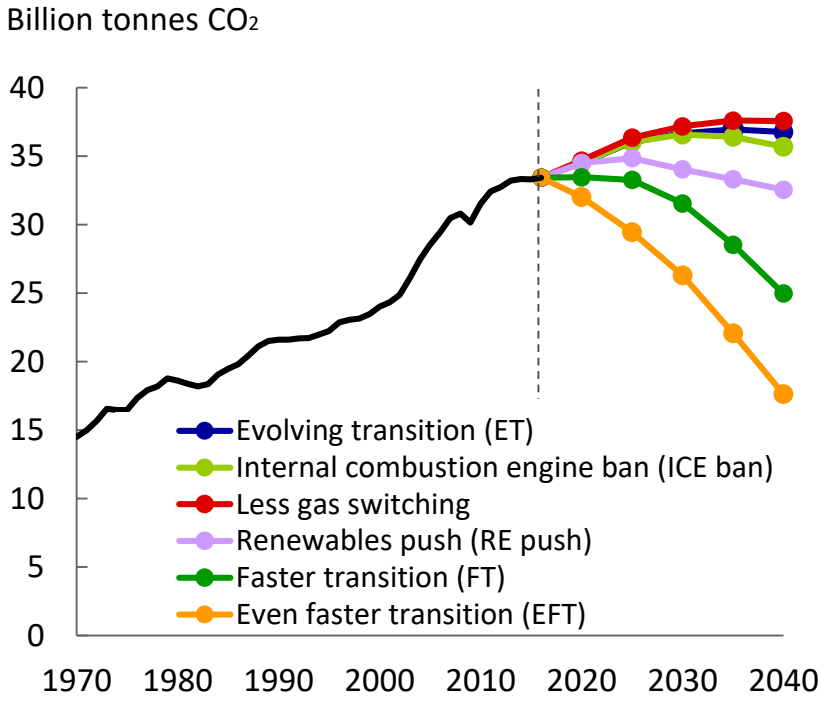
Peter Schwartz, 'The Art of the Long View'

Alternative scenarios

Primary energy consumption by fuel



Carbon emissions



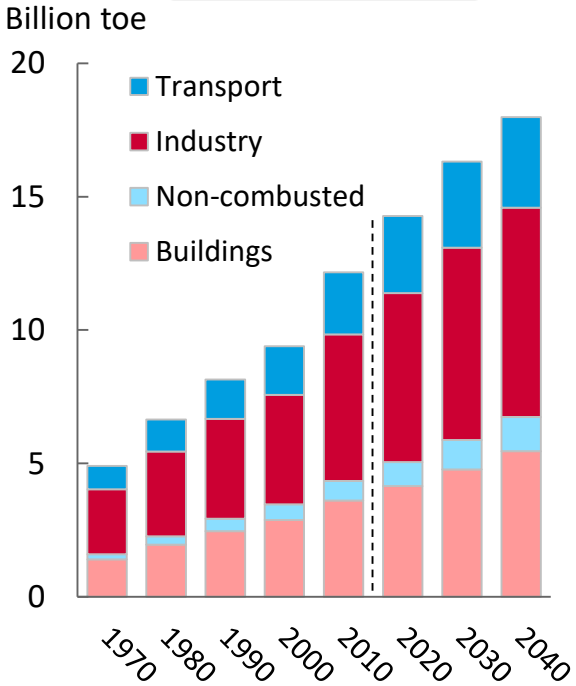
Three windows on the energy transition

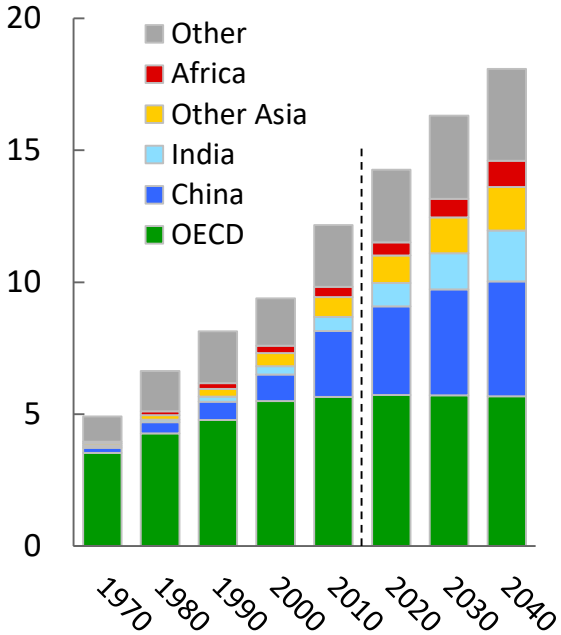
Primary energy demand

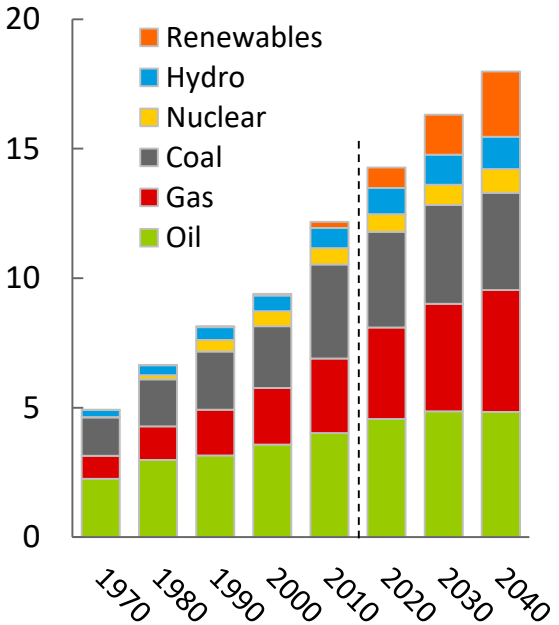
End-use sector

Region

Fuel

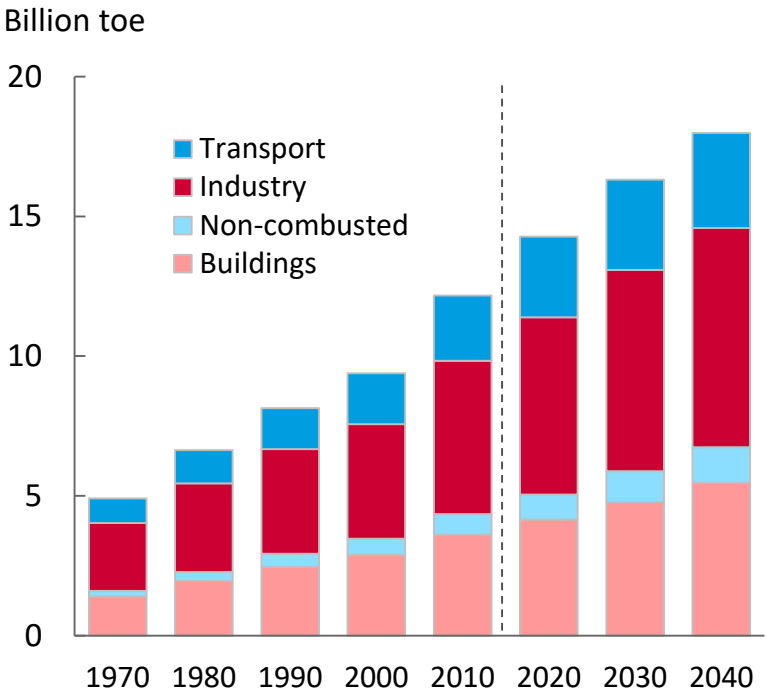




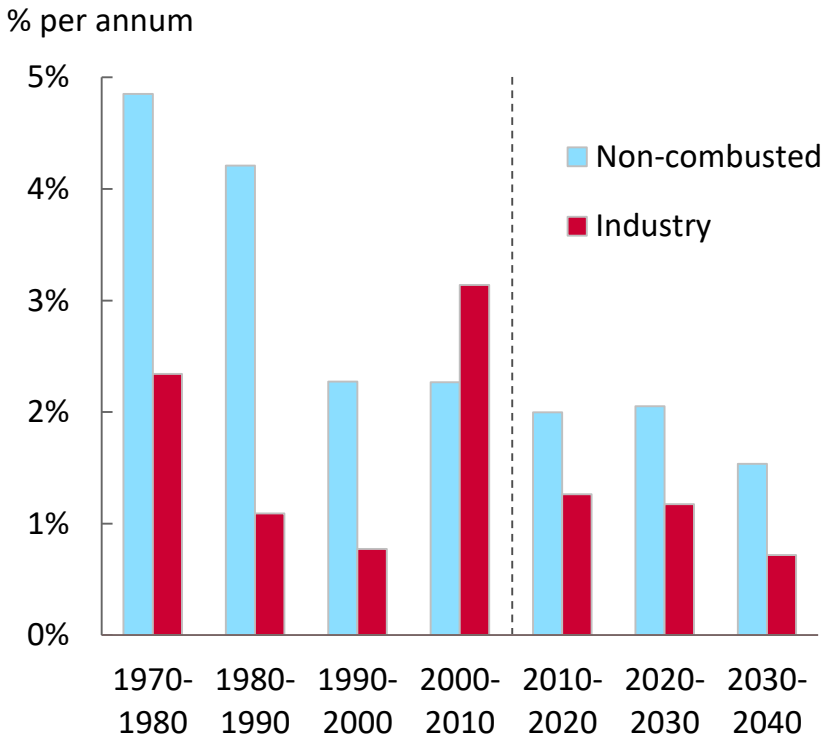


Energy demand by sector

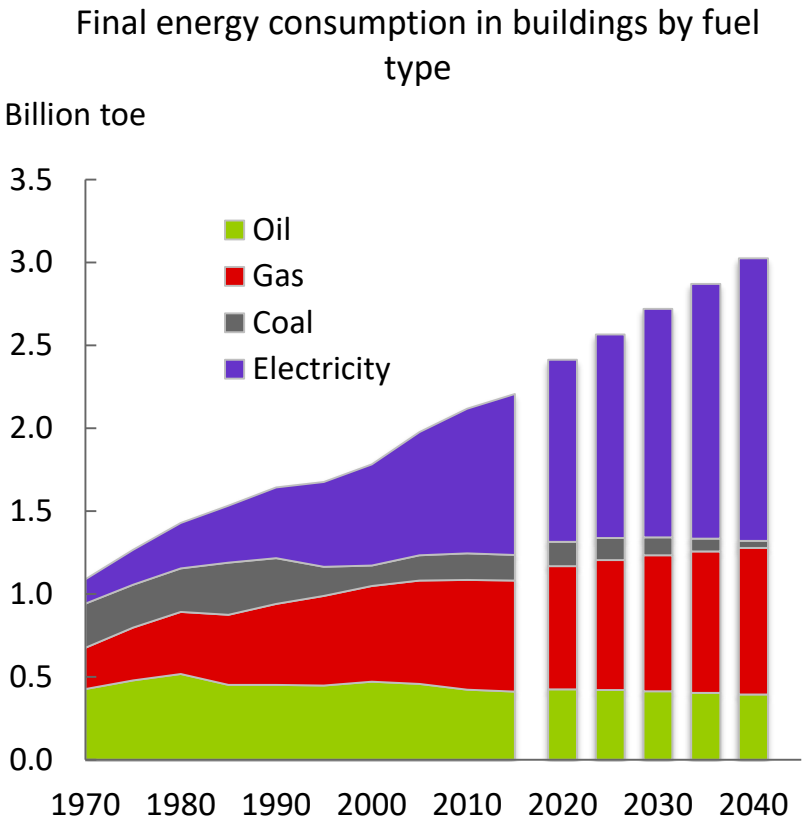
Primary energy consumption
by end use sector



Final energy consumption growth:
non-combusted versus industry

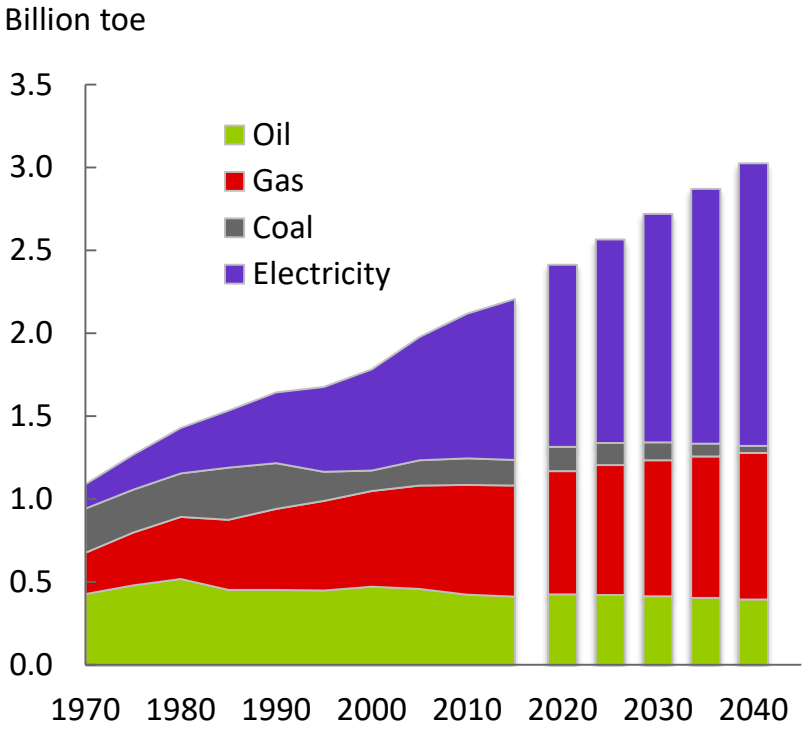


Energy demand in buildings

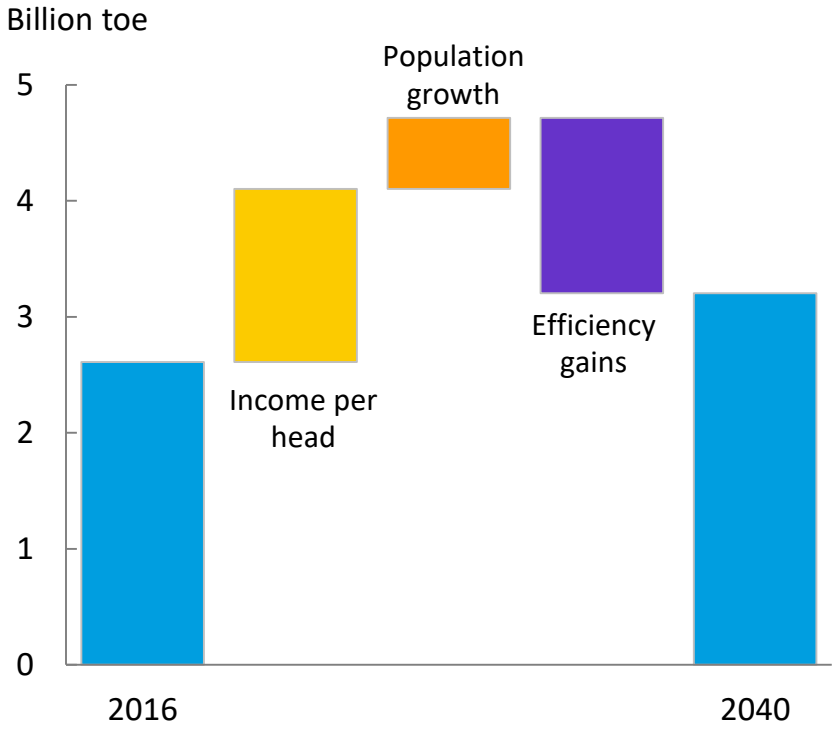


Energy demand in buildings and transport sector

Final energy consumption in buildings by fuel type



Contributions to transport energy consumption growth



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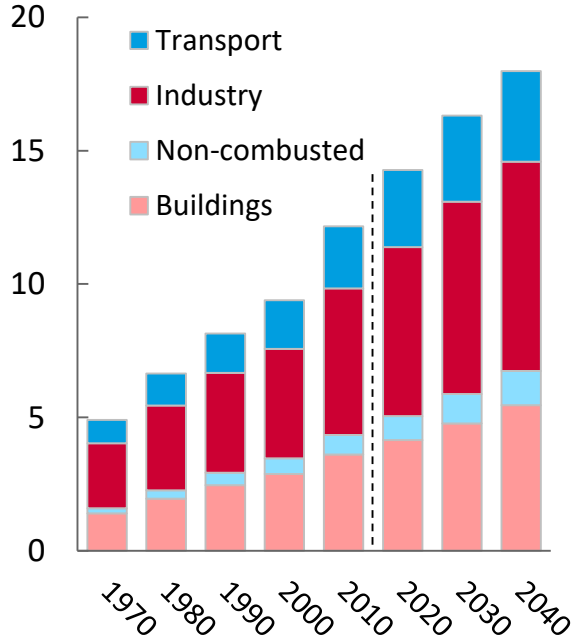
End-use sector

Billion toe



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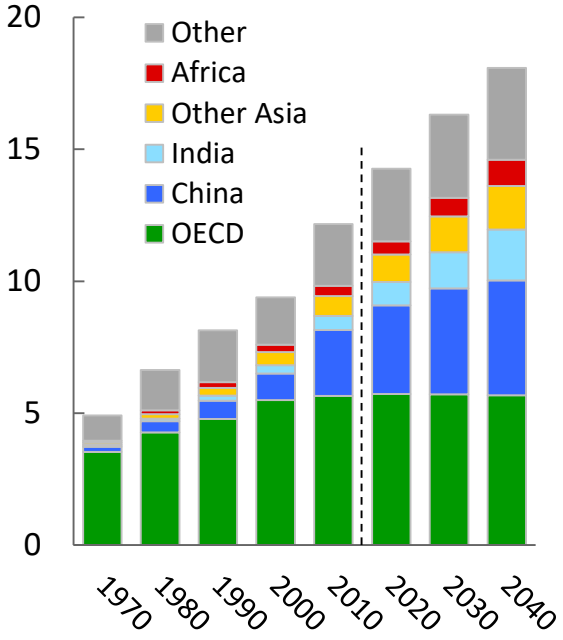
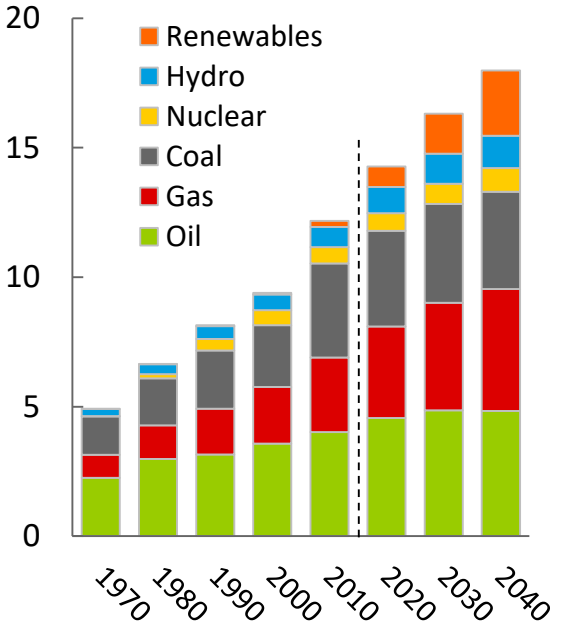
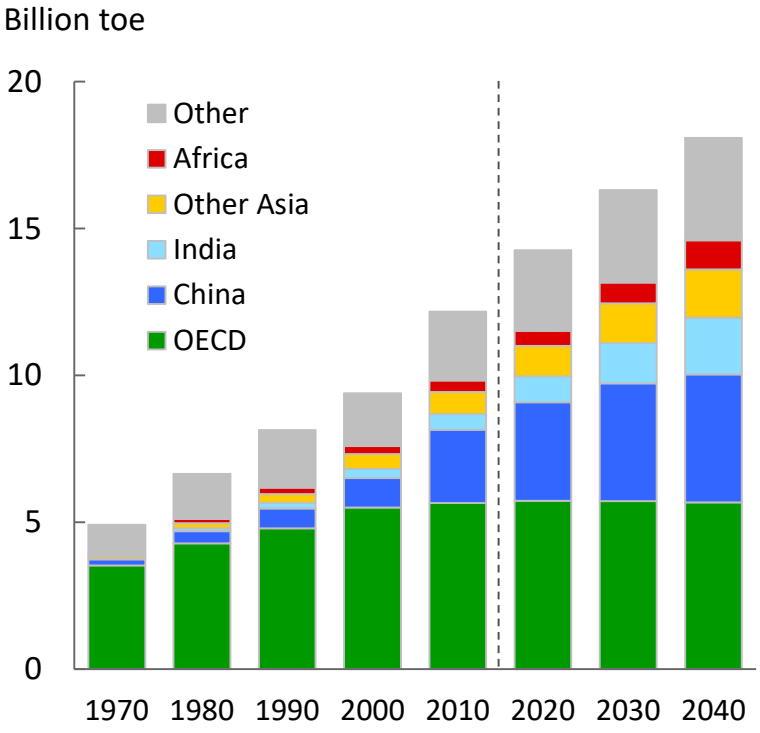


Fuel

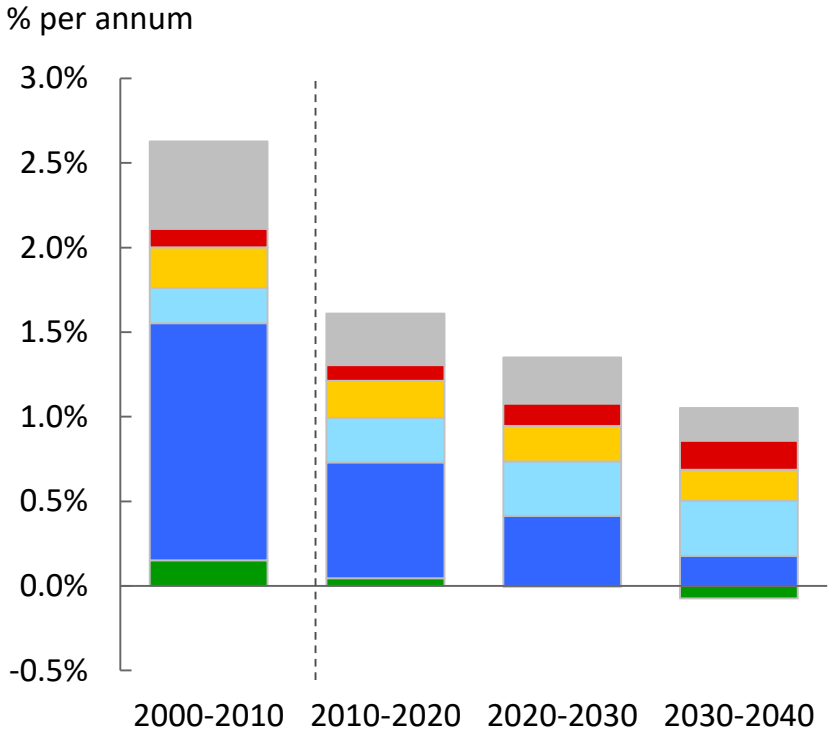


Regional energy demand

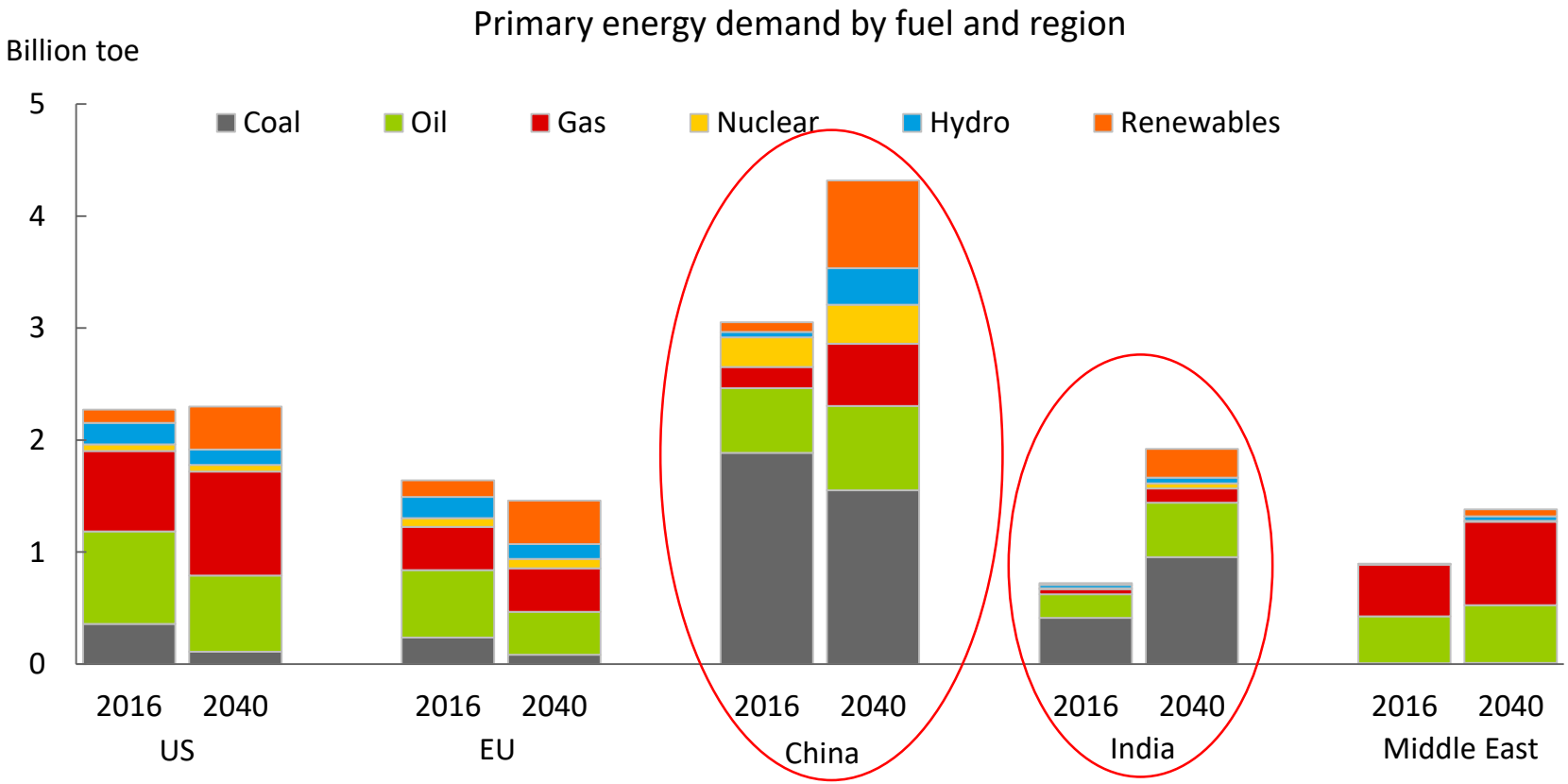
Primary energy consumption by region



Primary energy growth and regional contributions



Energy mix by region



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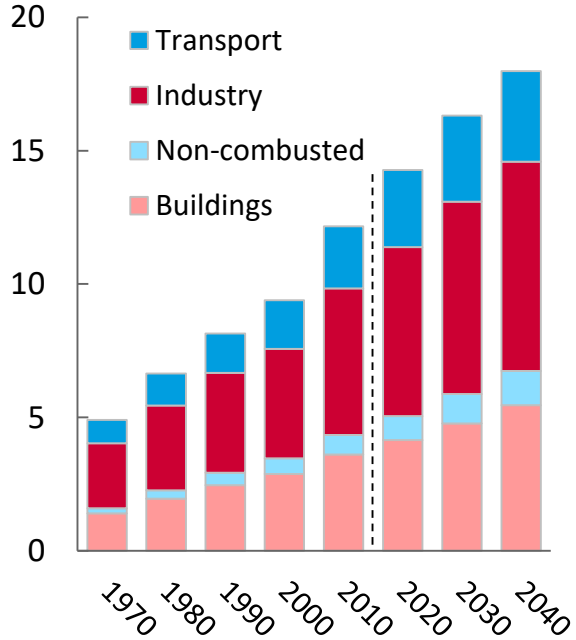

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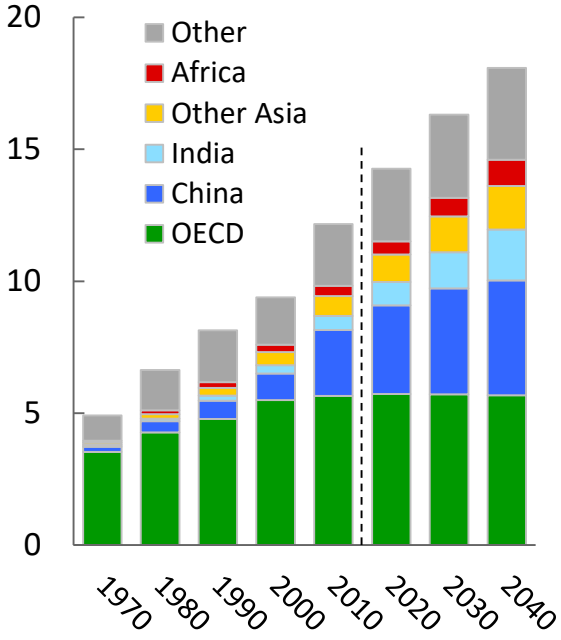
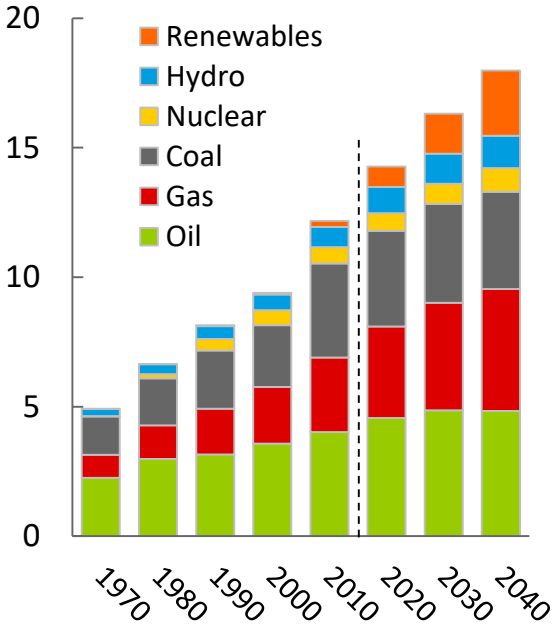
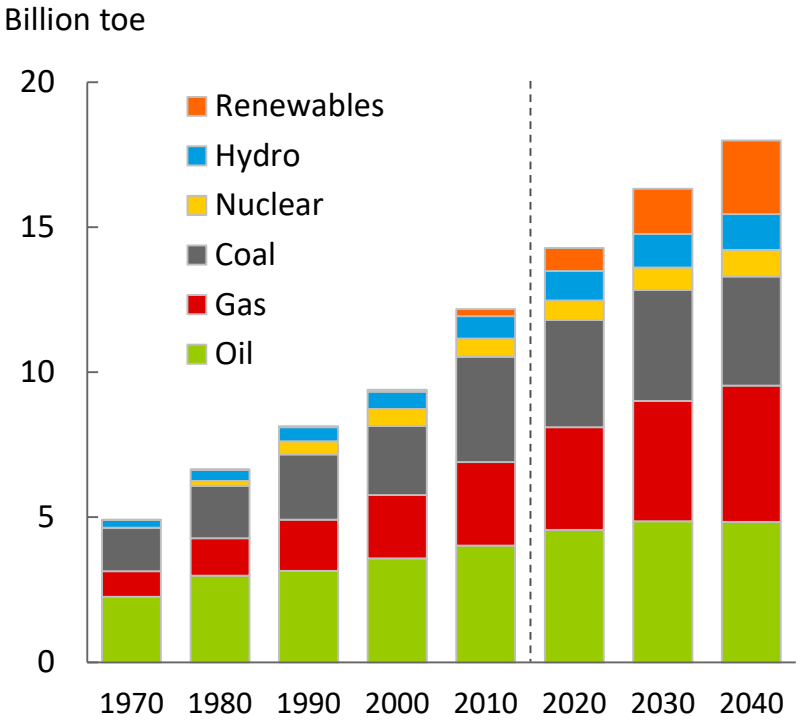


Fuel

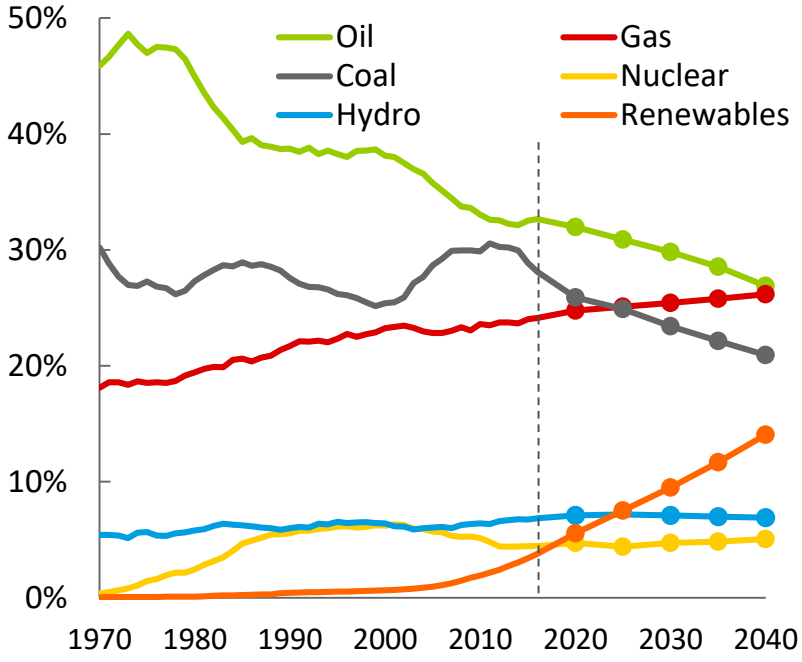


Global energy by fuel

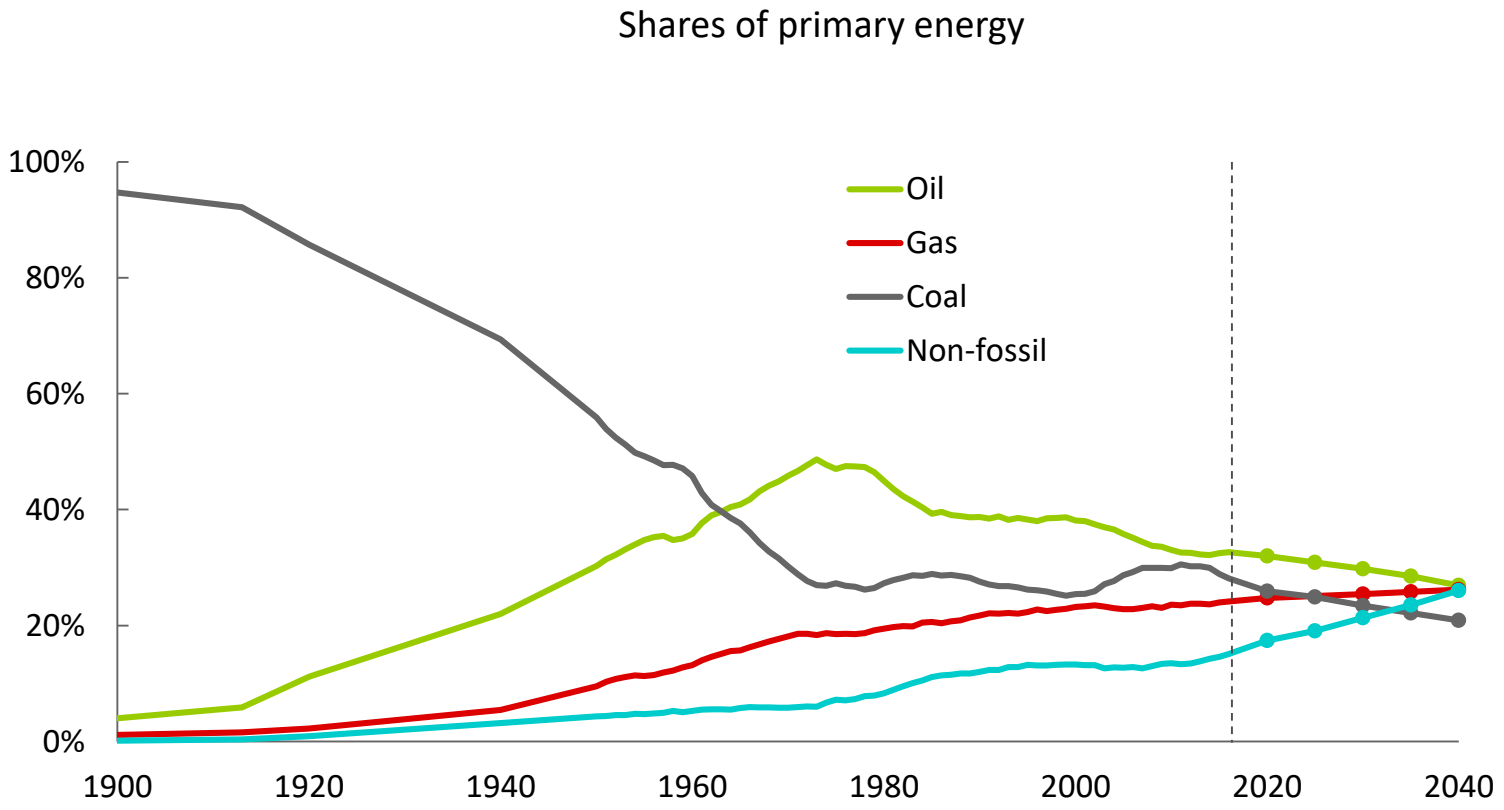
Primary energy consumption by fuel



Shares of primary energy



Diversified fuel mix



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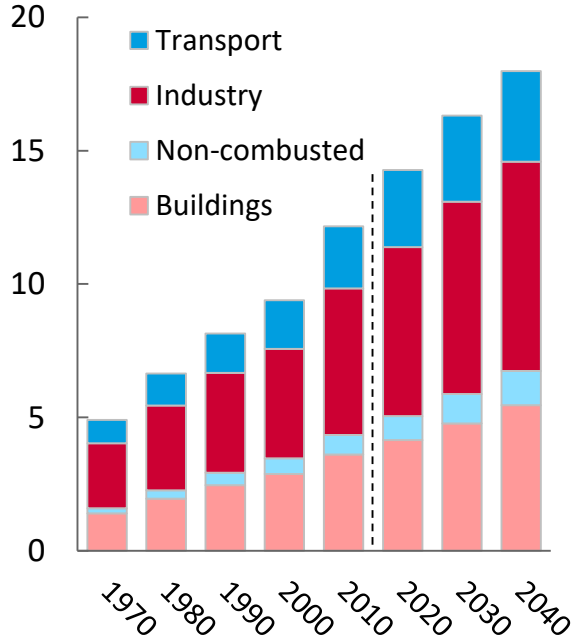
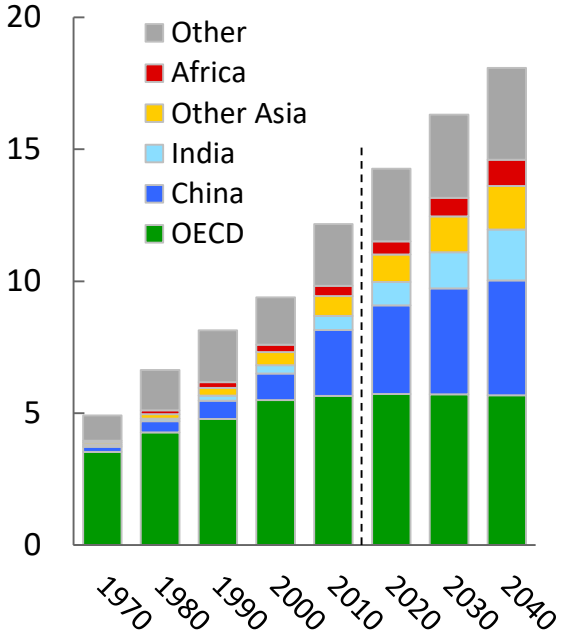


Region



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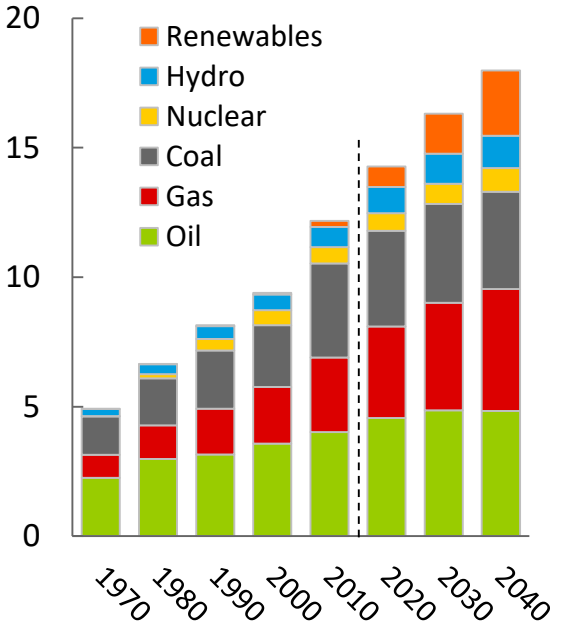

Five key questions

- **Is the transition to a lower carbon energy system happening fast enough?**
- **What have we learnt about electric cars and the mobility revolution?**
- **When is global oil demand likely to stop growing?**
- **Just how fast will renewable energy grow?**
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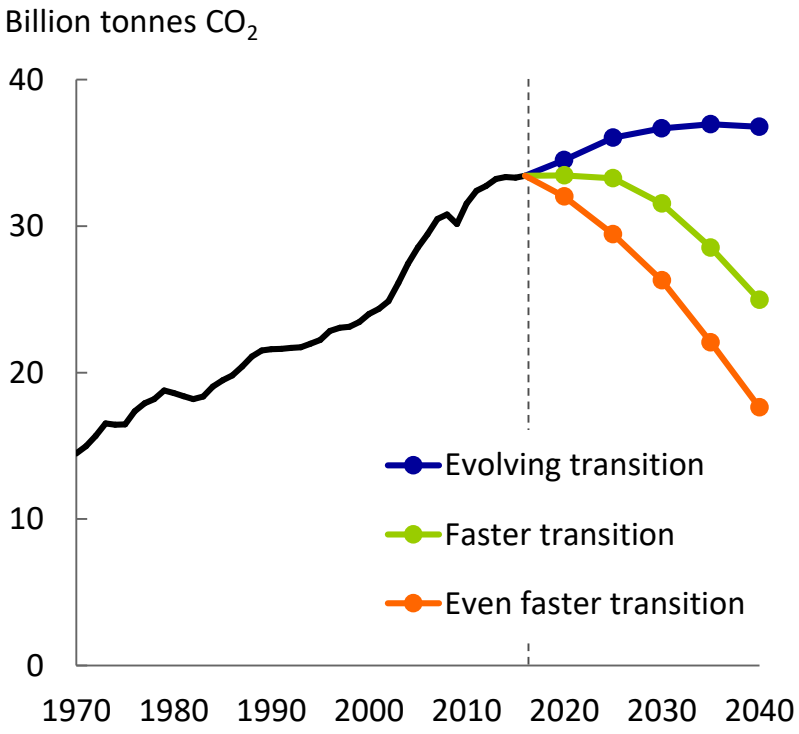
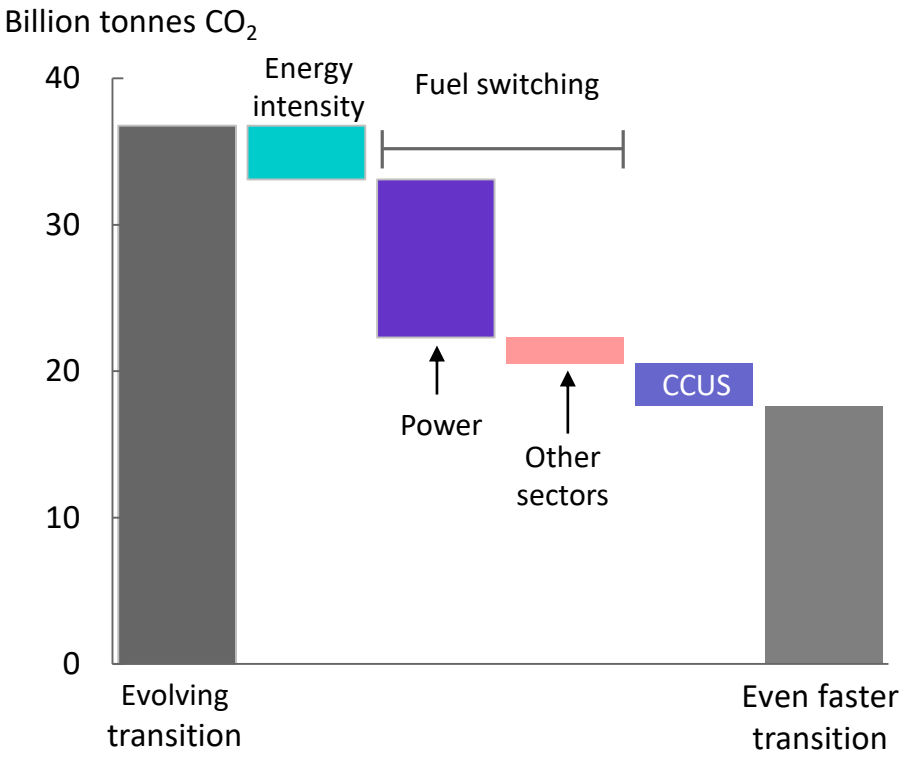
Carbon emissions continue to rise in the ET scenario

Carbon emissions

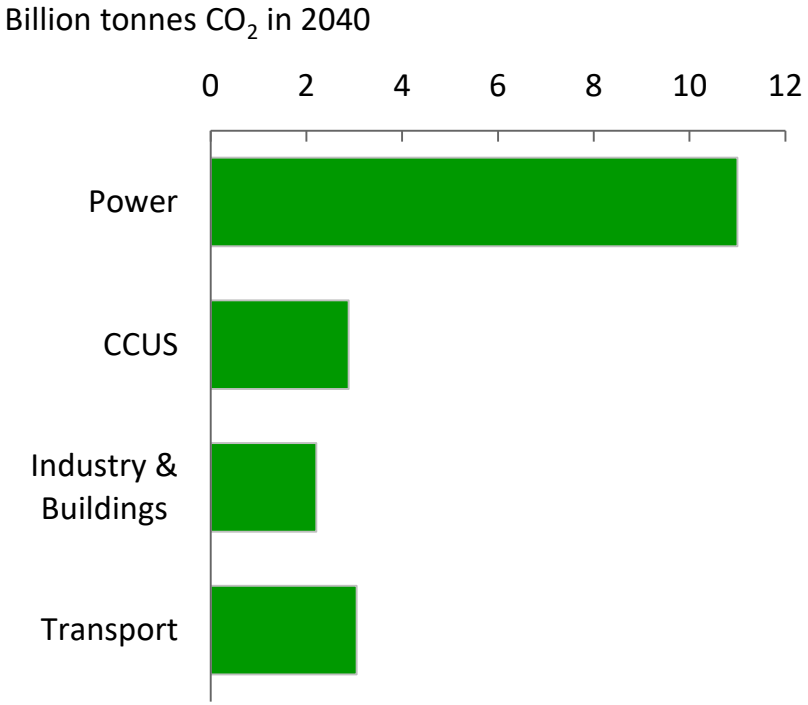


Carbon emissions in 2040:
EFT versus ET scenario

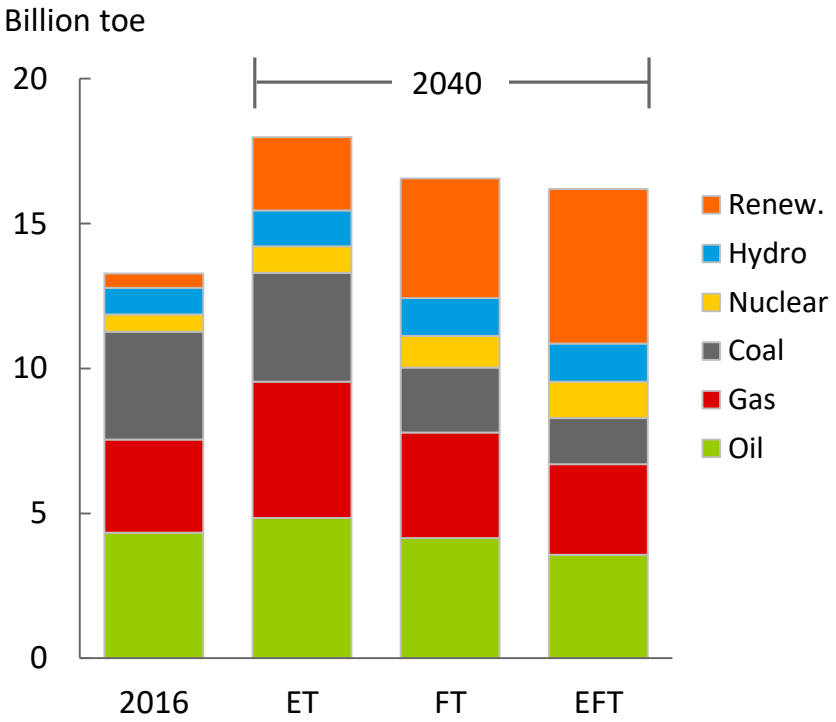


Impact of faster transition on global energy system

Reductions in carbon emissions:
EFT versus ET scenario



Primary energy consumption under different scenarios



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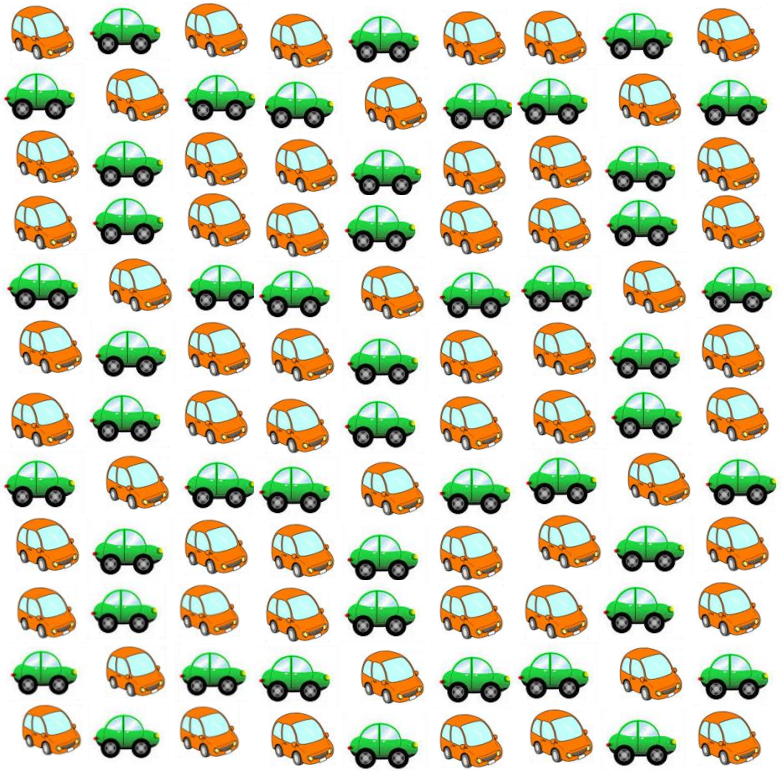
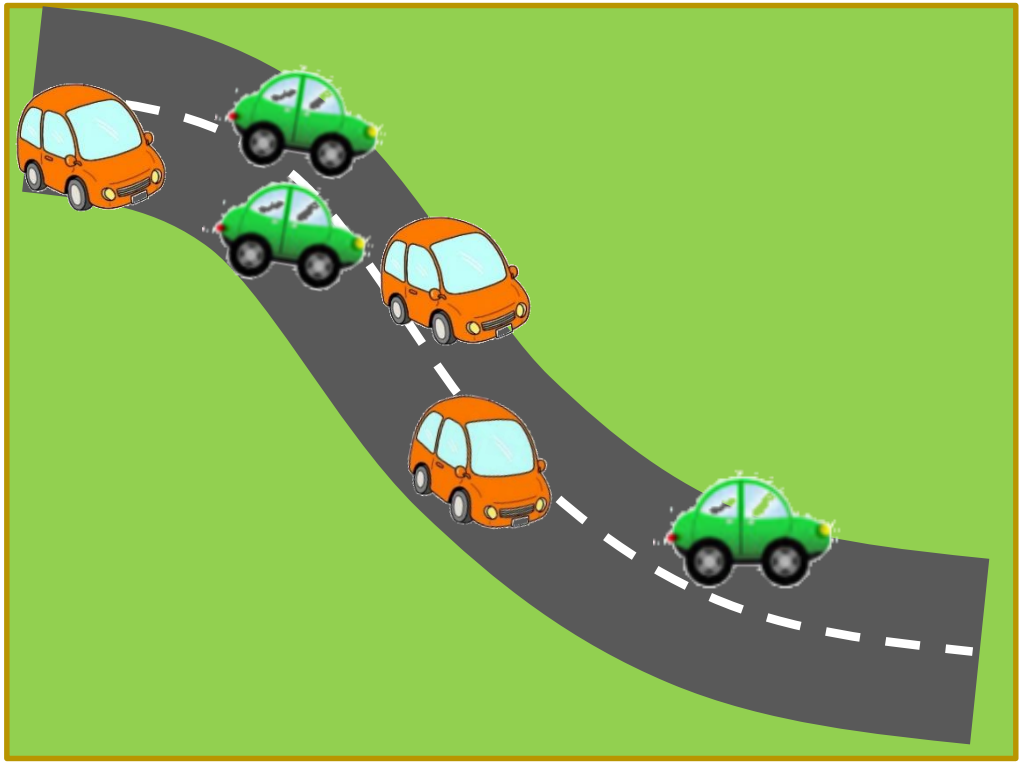
Penetration of electric cars in 2040





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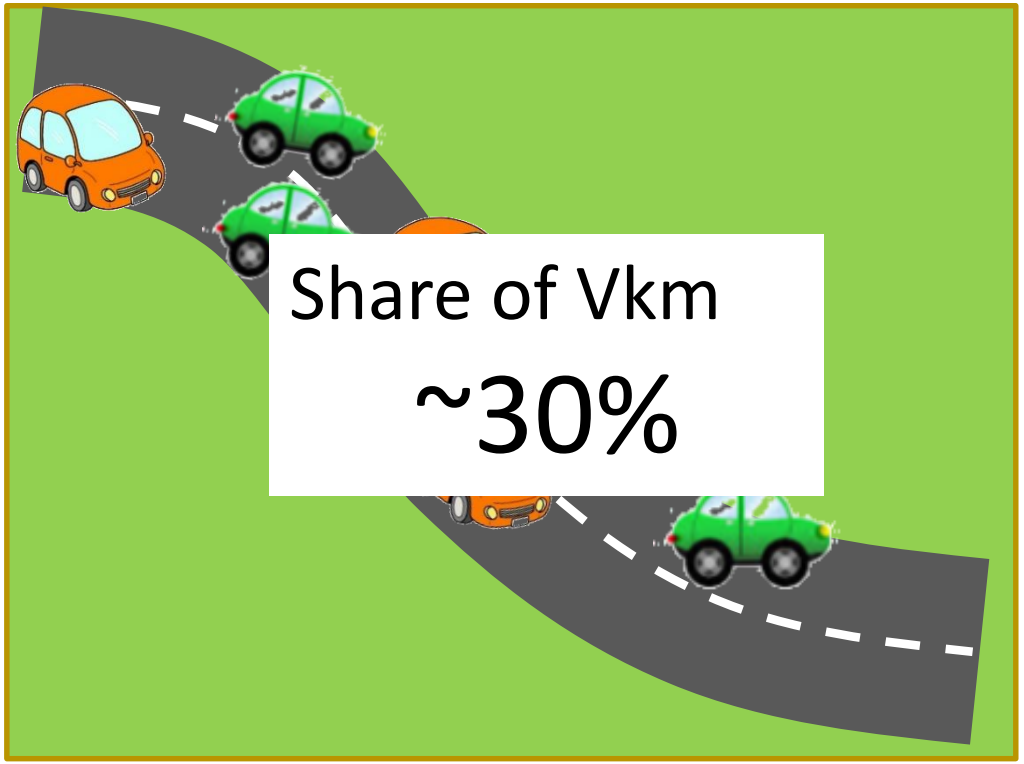
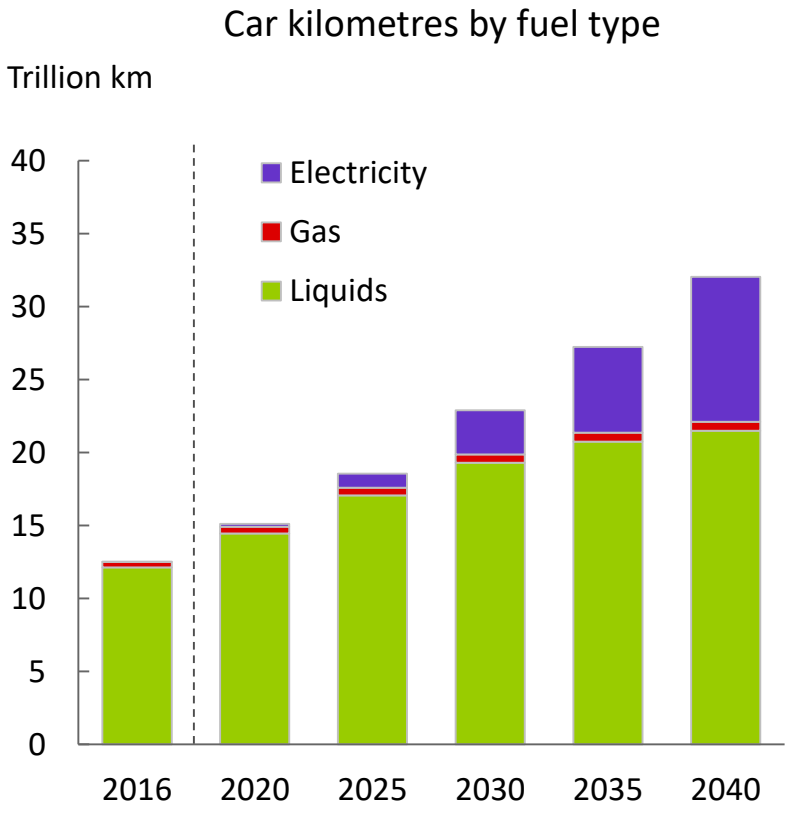
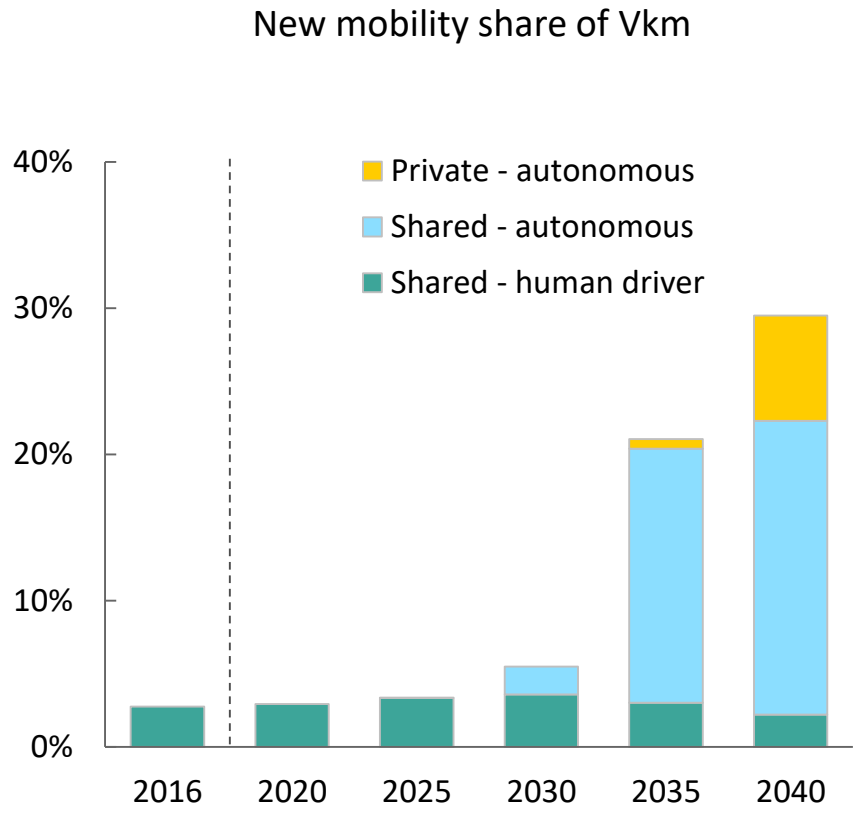
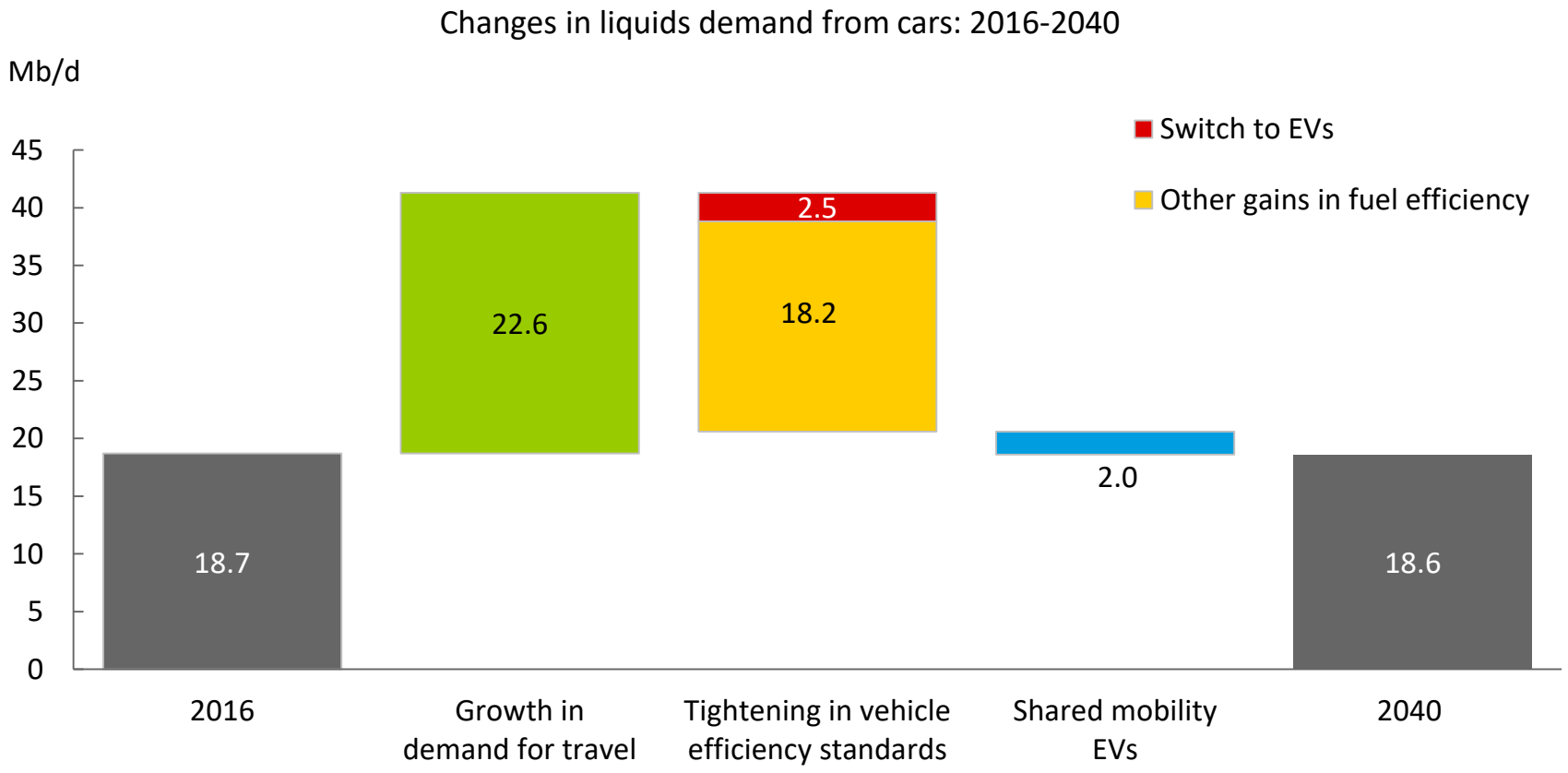


Electric cars, shared mobility and autonomy

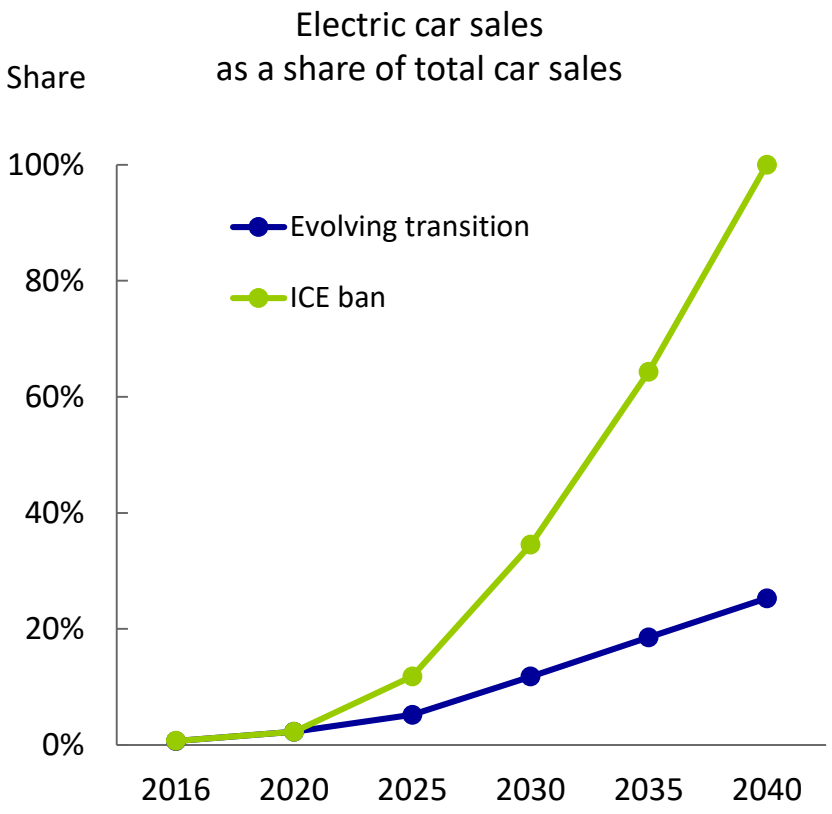


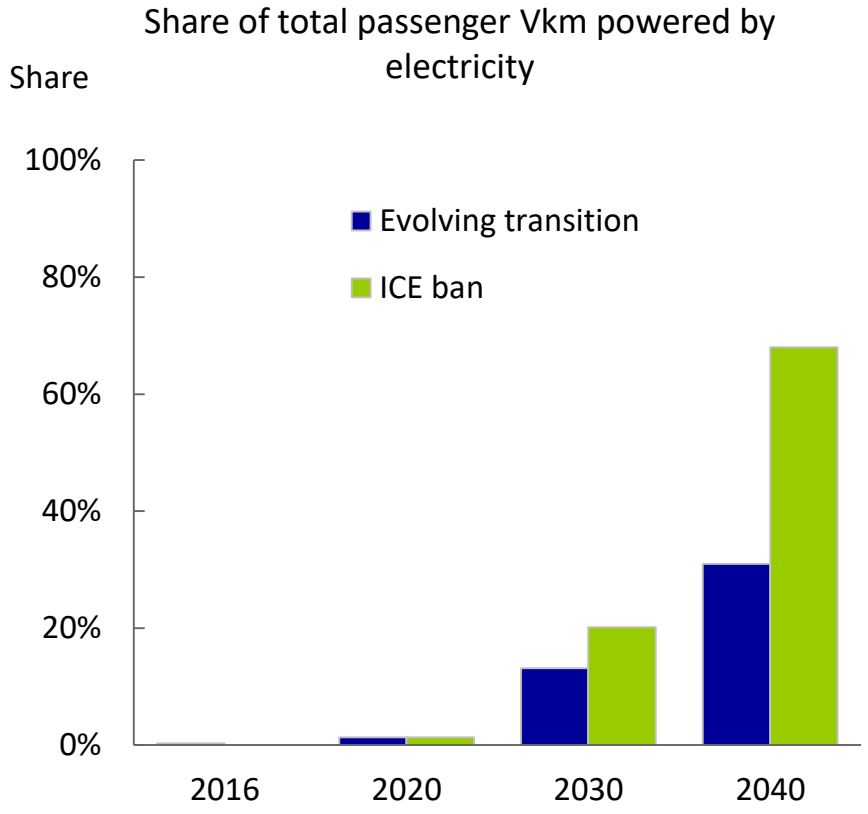


Liquid fuel demand from passenger cars



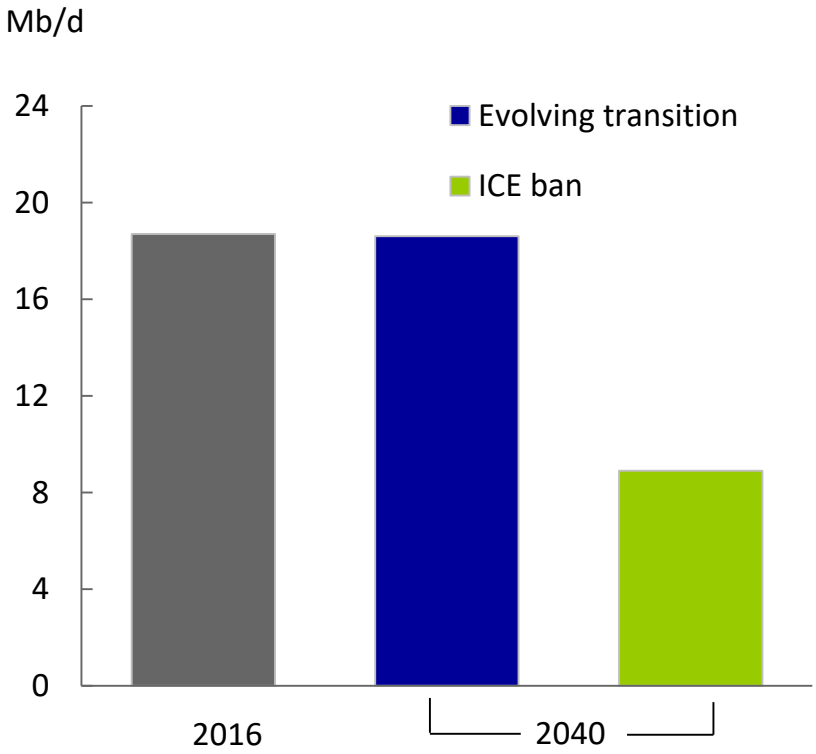
Global ban on internal-combustion engine (ICE) cars



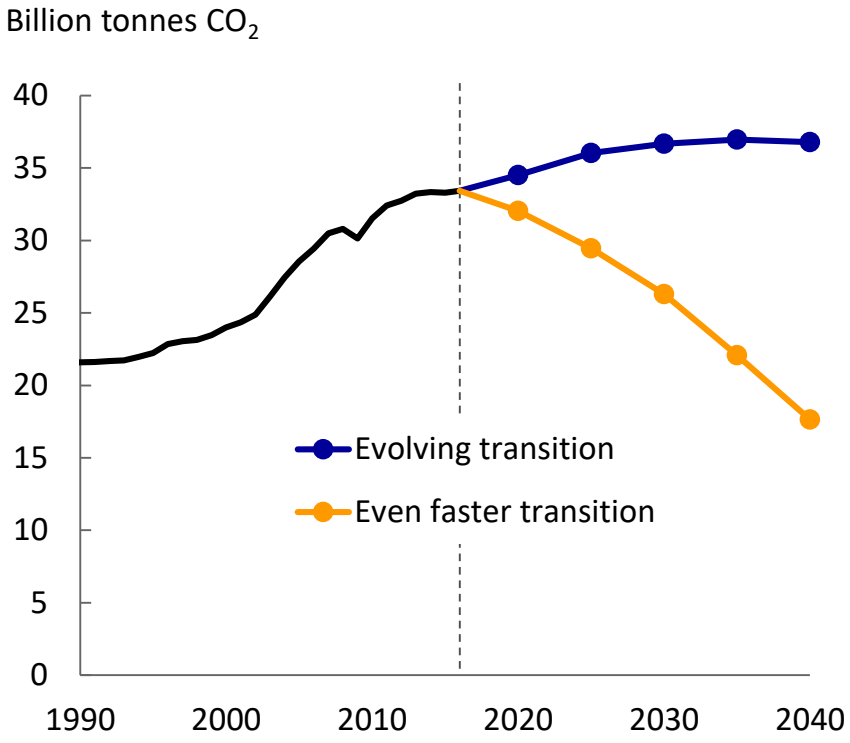


Impact of ICE ban

Passenger cars liquids demand



Carbon emissions from energy



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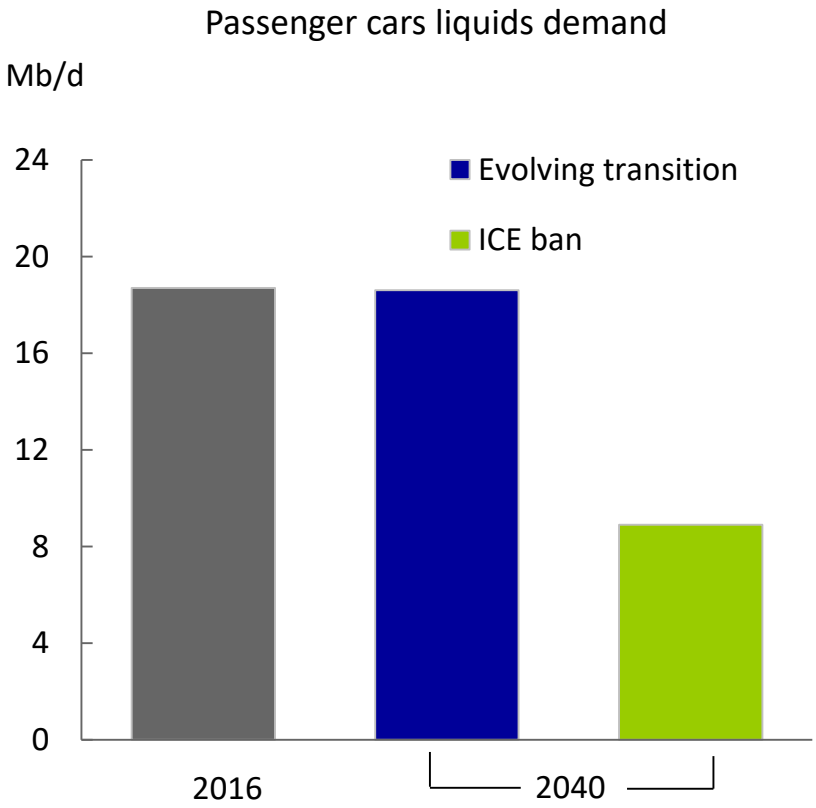

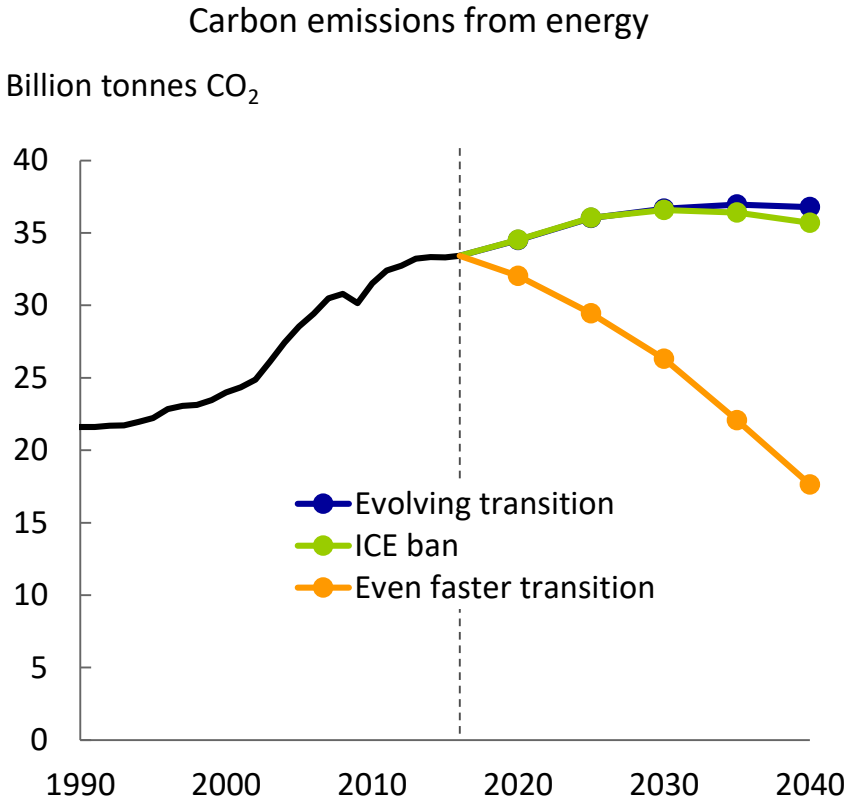

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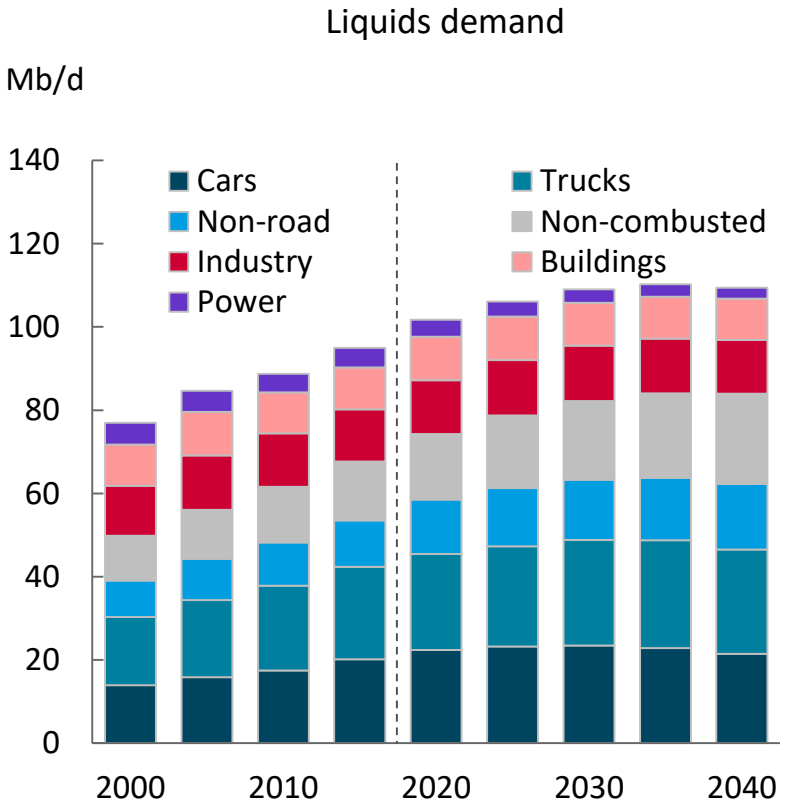
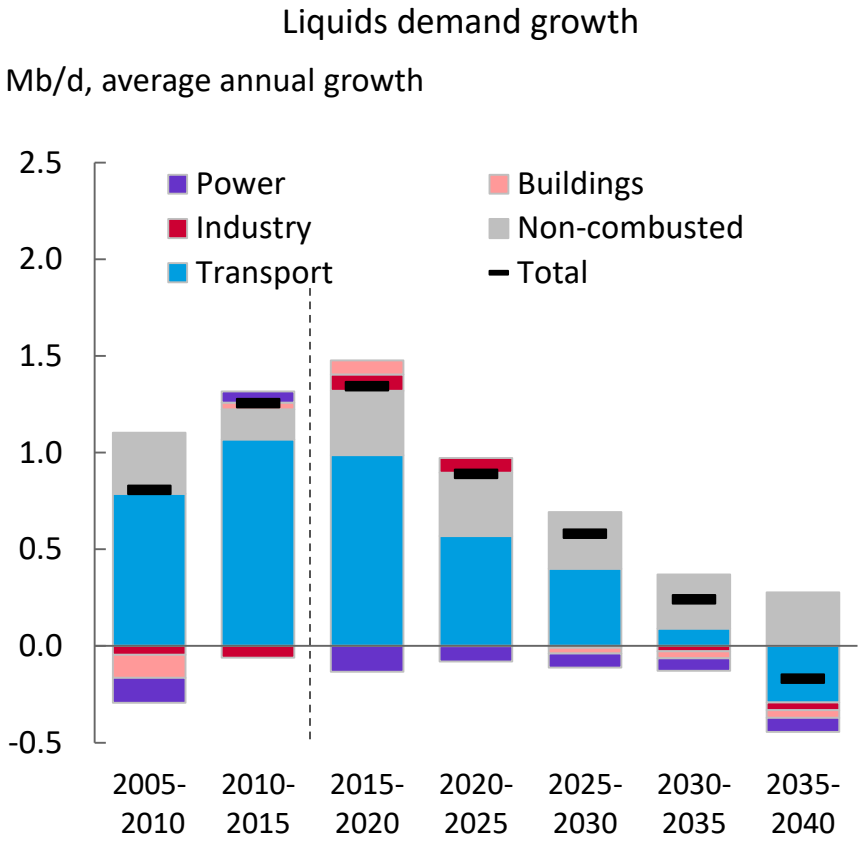
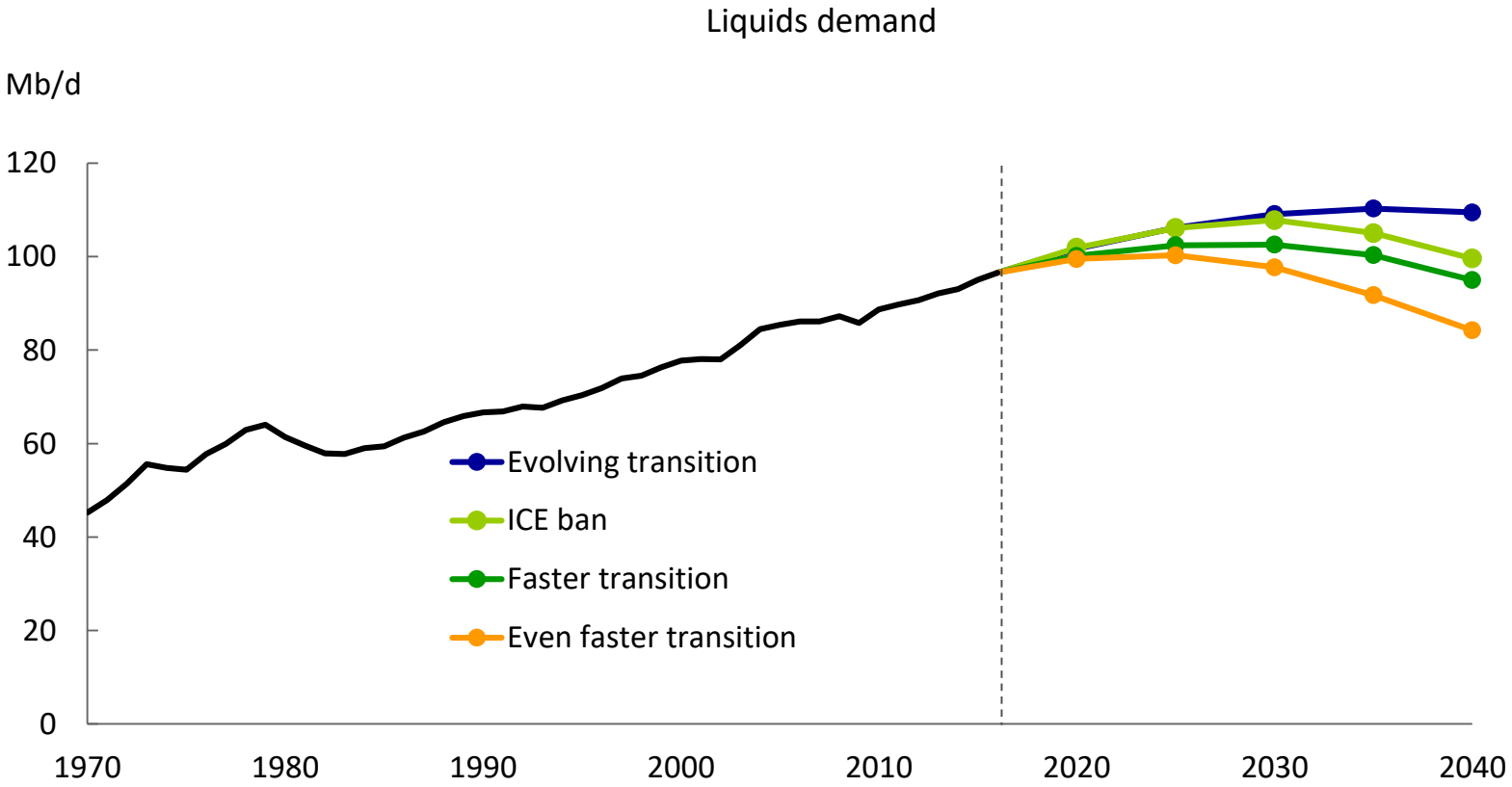
Demand for oil and other liquid fuels

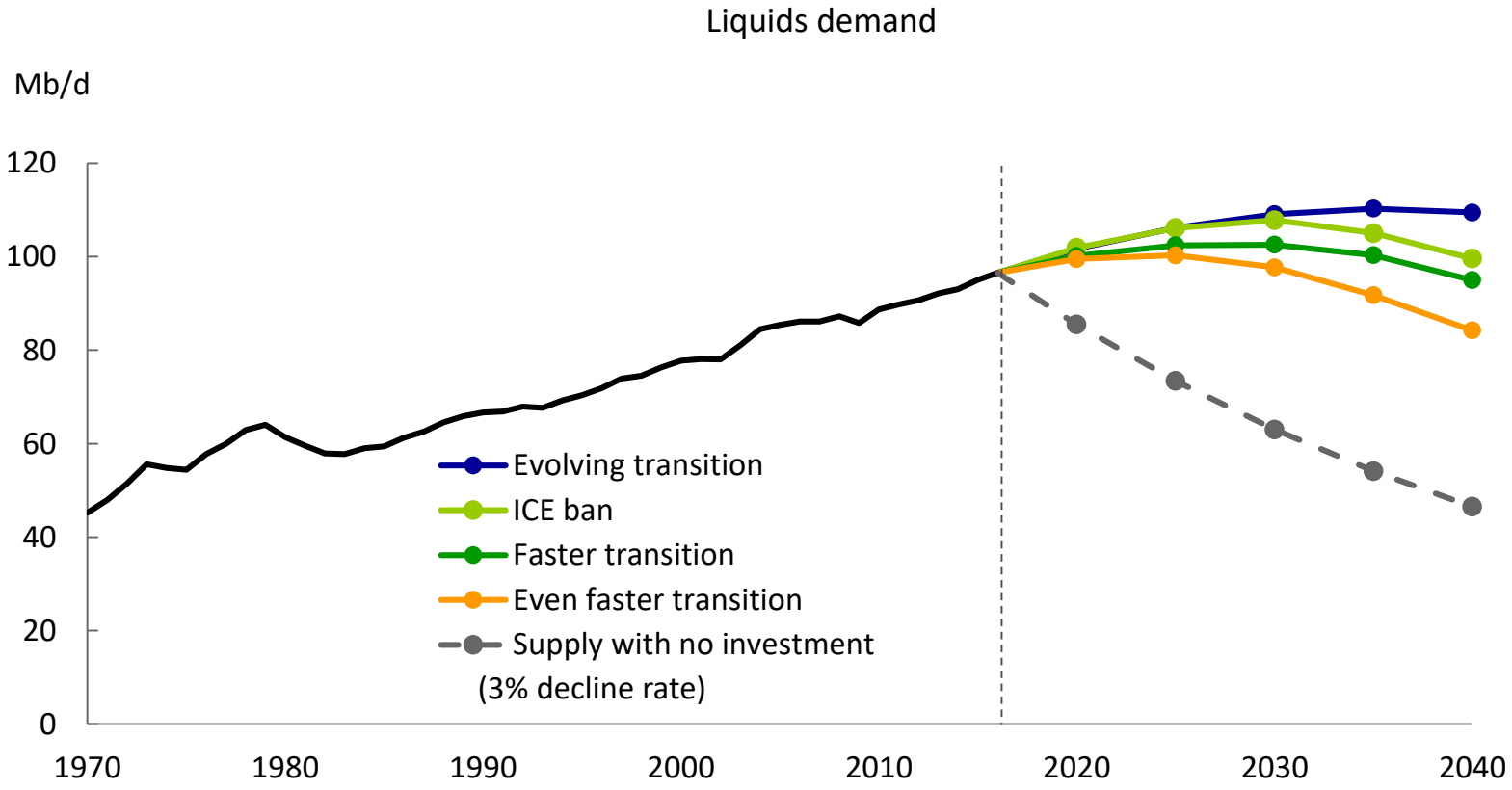




Demand for liquid fuels by scenario



Demand for liquid fuels by scenario



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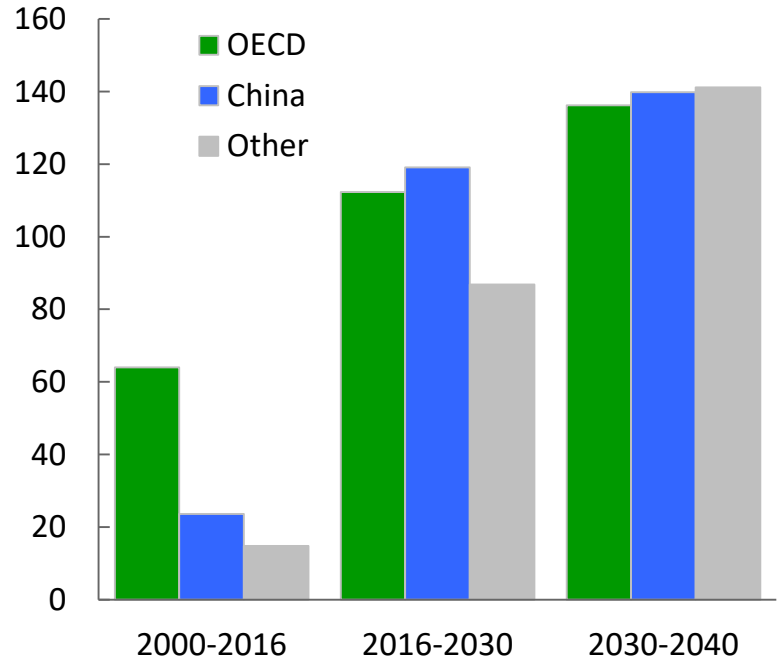
Rapid growth in renewable energy

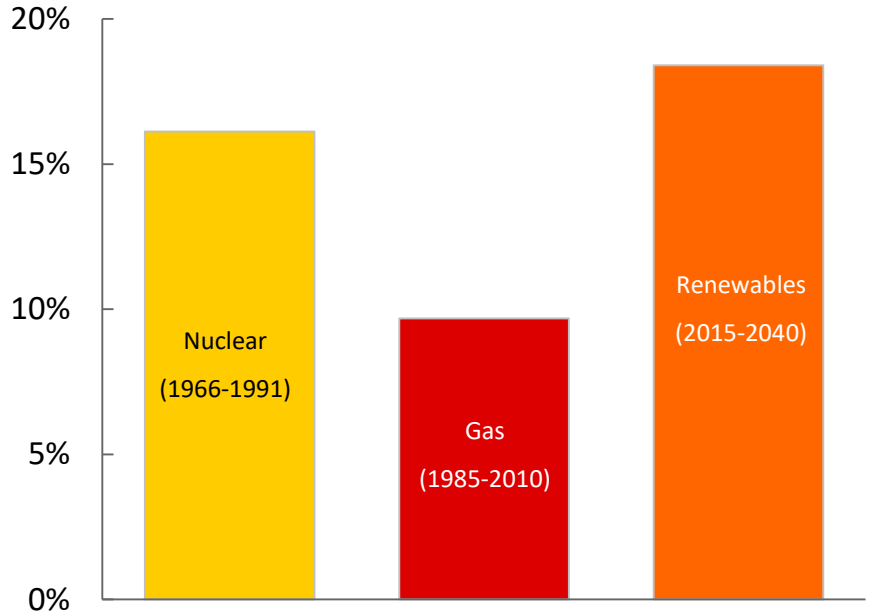
Growth of renewable power

TWh, average annual growth

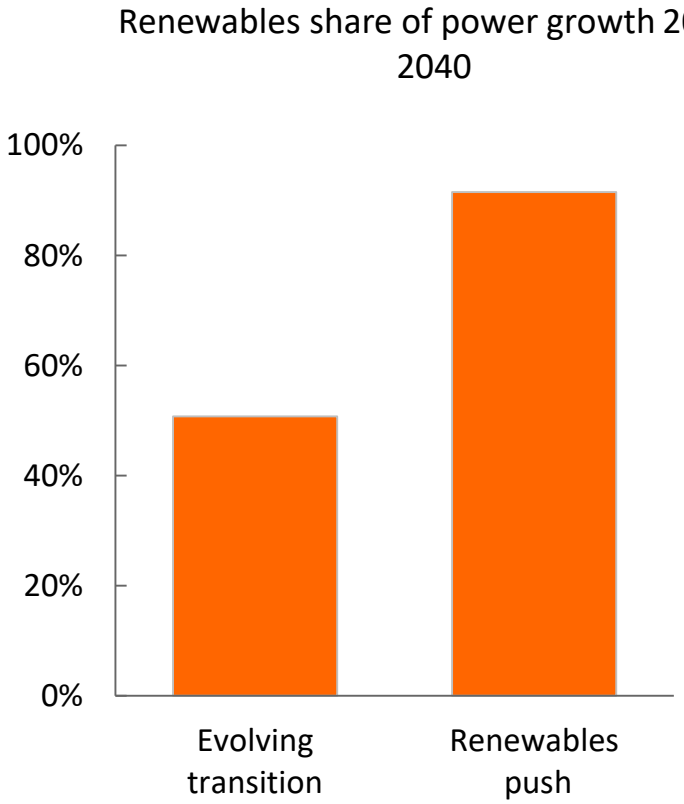


Pace of power market penetration

Largest gains in market share over 25 years, %pts

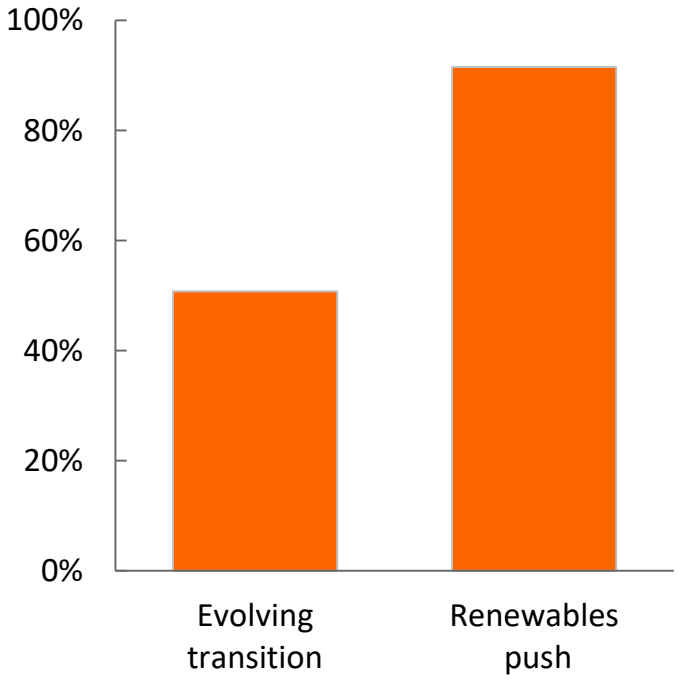


‘Renewables push’ scenario

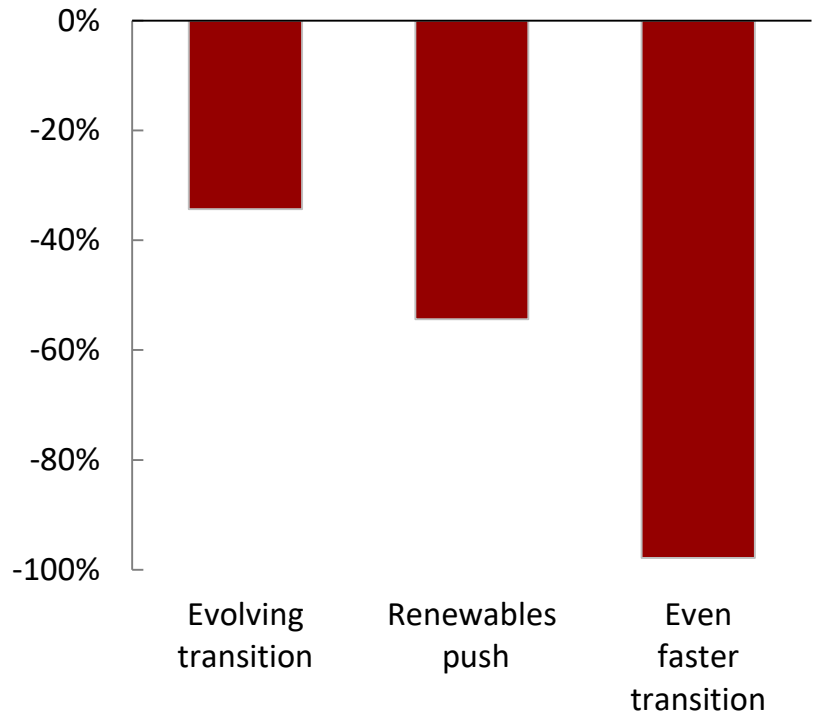


‘Renewables push’ scenario

Renewables share of power growth 2016-2040



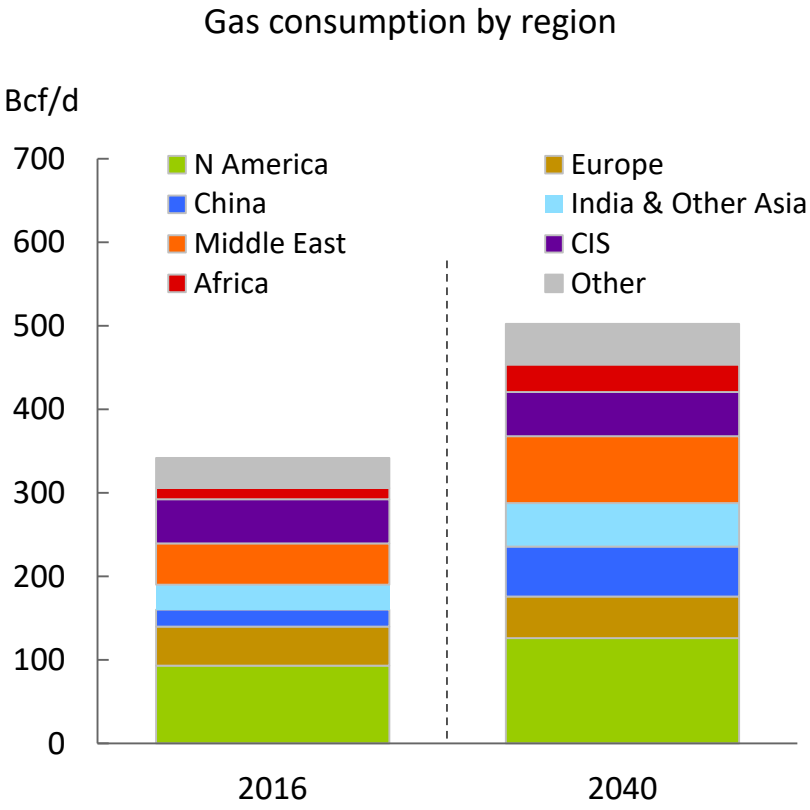
Change in carbon intensity of power 2016-2040

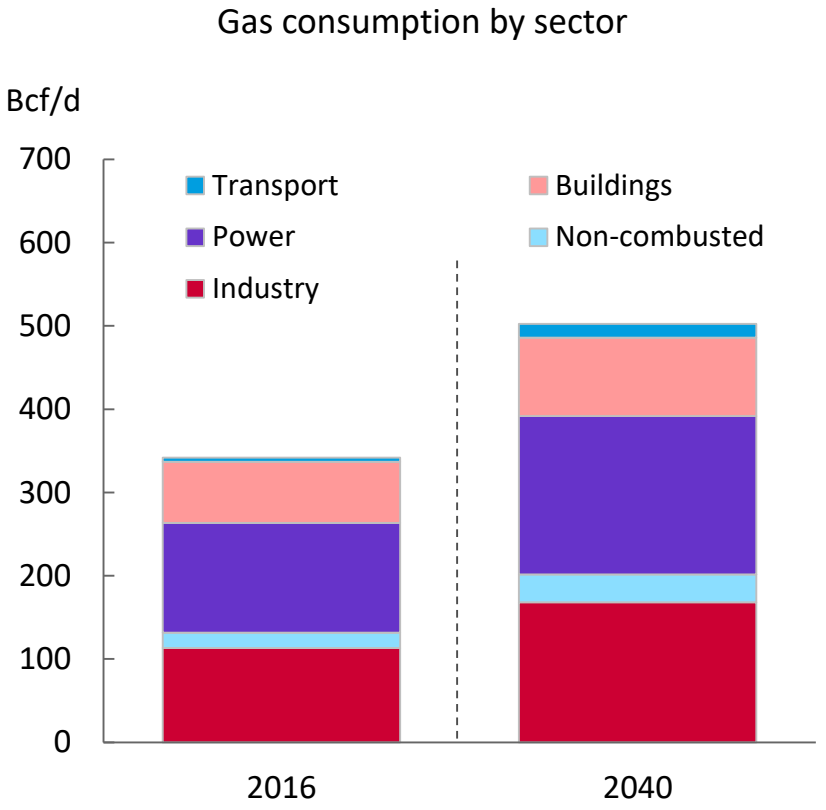


Five key questions

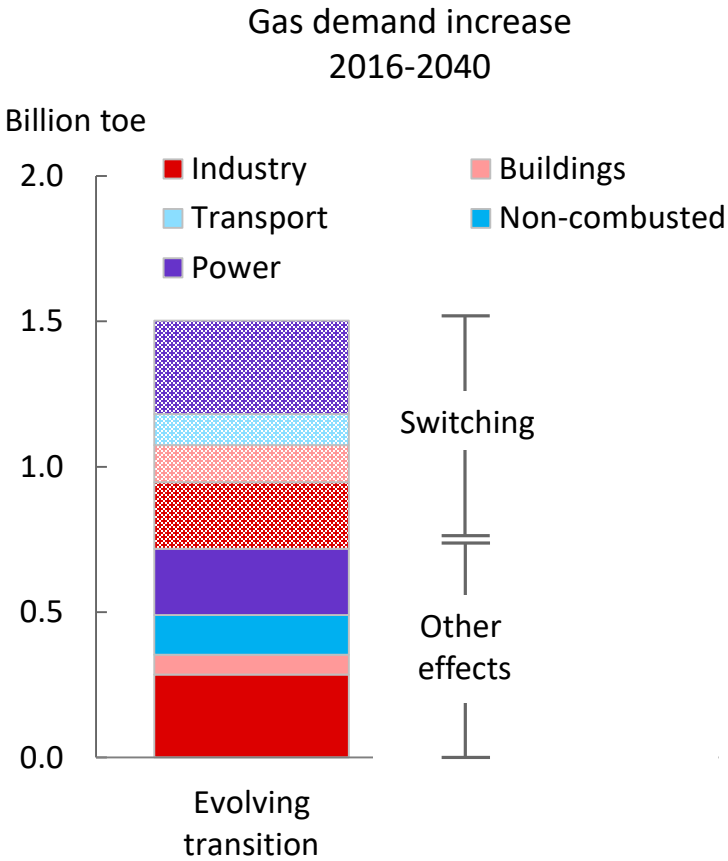
- Is the transition to a lower carbon energy system happening fast enough?
- What have we learnt about electric cars and the mobility revolution?
- When is global oil demand likely to stop growing?
- Just how fast will renewable energy grow?
- **How resilient is the outlook for natural gas?**

Growth in natural gas demand

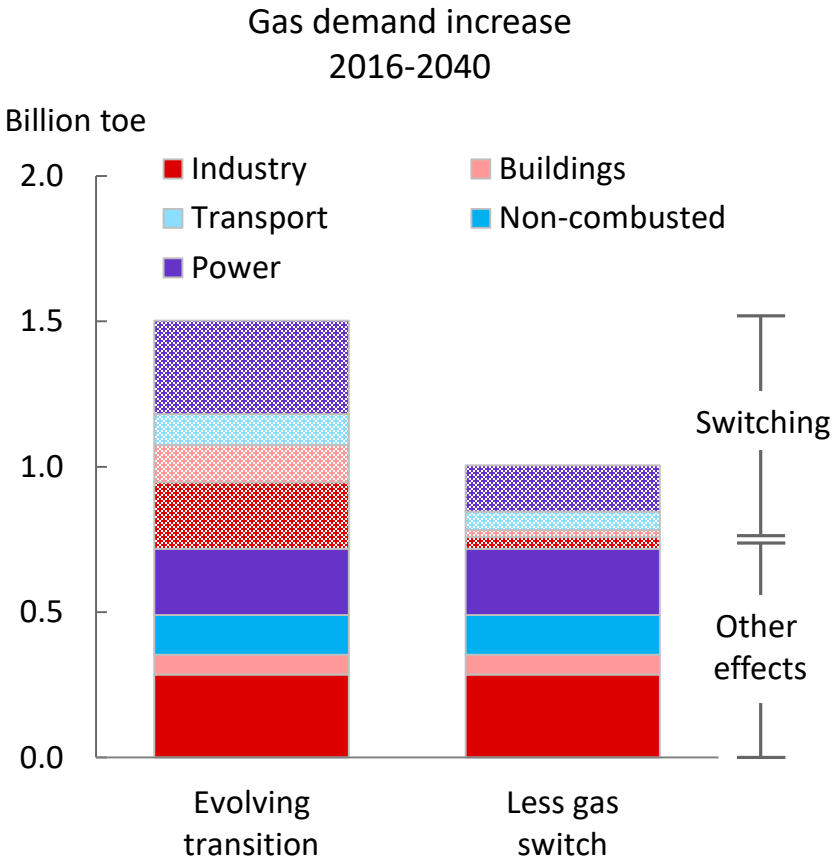


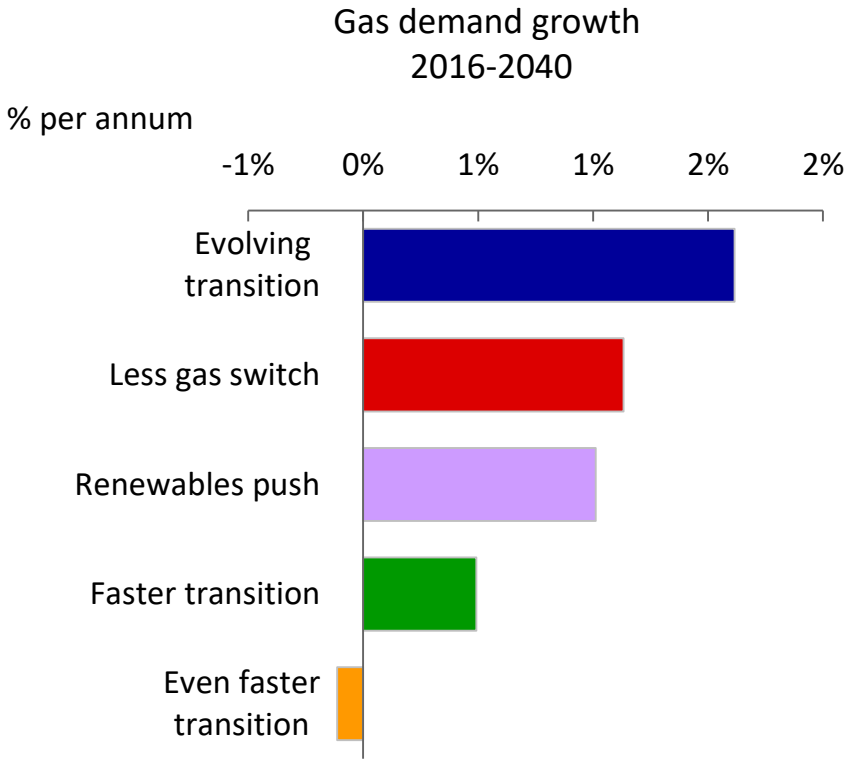


Possible risks to the outlook for natural gas



Possible risks to the outlook for natural gas





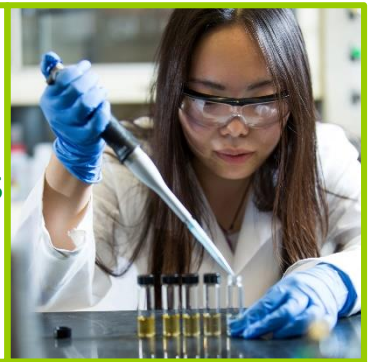
The energy transition: mapping the uncertainty

- Some aspects of energy transition seem relatively likely:
  - global energy demand continues to grow – driven by increasing prosperity
  - slower growth as we learn to do more with less
  - increasing abundance and diversification of energy supplies
  - renewable energy growing in importance
  - oil and gas continue to play a central role in the global energy system

- Other aspects remain far more uncertain:
  - impact of EVs and autonomy in reshaping transport sector
  - role of natural gas and renewables in lower carbon transition
  - how will we achieve a more decisive break from past to achieve sharp fall in carbon emissions?


bp
Advancing the
energy transition
www.bp.com/energytransition

Our strategy for the energy transition

Growing gas and advantaged oil in the Upstream		Venturing and low carbon across multiple fronts	
	Market led growth in the Downstream		Modernising the whole Group

Our commitment to advance a low carbon future

Reducing
emissions in our operations

Zero
net growth in operational emissions out to 2025

3.5 Mte
of sustainable GHG emissions reductions by 2025

Targeting methane intensity of
0.2%
and holding it below 0.3%

Improving
our products

Provide lower emissions gas

Develop more efficient and lower carbon fuels, lubricants and petrochemicals

Grow lower carbon offers for customers

Creating
low carbon businesses

Expand low carbon and renewable businesses

$500 million invested in low carbon activities each year

Collaborate and invest in the Oil and Gas Climate Initiative's **$1 billion** fund for research and technology

Advancing low carbon
Our accreditation programme for low carbon activities

Creating and building low carbon businesses

Advanced mobility

Electric, connected and autonomous vehicles

Bio and low carbon

New fuels, gas, lubricants and plastics

Carbon management

Lowering carbon footprint for customers and BP

Power and storage

Low carbon power, storage and trading

Digital

Transforming productivity and customer experience

Getting into action – Lightsource BP

Joint venture to fund green infrastructure in India

Getting into action – Fulcrum Bioenergy

Biojet set to take off as construction begins on waste-to-fuel plant

Getting into action – Chargemaster

Acquisition of the UK's biggest electric vehicle charging network

The Global Energy Transition: Exploring the Uncertainty

International Symposium, University of Tokyo, December 2018

Paul Appleby– BP Group Strategic Planning