

ENERGY TRANSITION OUTLOOK 2017

The global and regional energy
transition to 2050

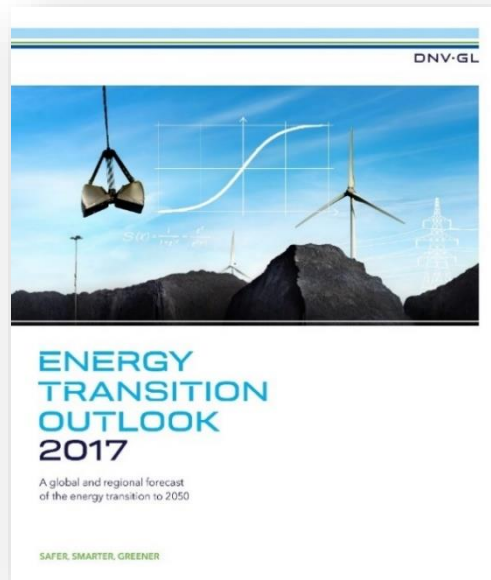
MARITIME FORECAST

Bent Erik Bakken, Group Technology & Research



Introduction

- In September 2017, DNV GL issued the *Energy Transition Outlook* forecasting the world's energy future through 2050
- Shipping is a vital part of the world's transport system, and the energy future holds significant impact for the future of seaborne trade
- We use the independent DNV GL model of the energy future to also give a forecast for maritime trade growth



Well placed to see into the energy future

- DNV GL, 13 000 professionals in 100 countries, 70% of whom are serving the energy industries
- Equal exposure to both the fossil and renewable energy worlds; our aim has been to produce a objective, balanced view of the future
- Daily involvement across entire energy supply chains: complex offshore infrastructure, onshore oil and gas installations, large- and small-scale wind, solar and energy efficiency projects, and electricity transmission and distribution grids
- **Covering globally interconnected demand and supply of energy in ten regions, and the transport of energy, other raw materials, and goods within and between those regions**





ENERGY TRANSITION OUTLOOK 2017

A global and regional forecast
of the energy transition to 2050

SAFER, SMARTER, GREENER

Ports might play new roles in the future energy system



BRINGING NORTH SEA ENERGY ASHORE EFFICIENTLY



ROLE OF PORTS AS ENERGY HUBS

North Sea ports could become important receivers of North Sea energy at the intersection of sea and land, and because ports are already needed for receiving stations, conversion plants, storage and distribution of energy to inland end user, as ports are already equipped with infrastructures, including road, rail, water, pipelines and other facilities. Users in the port, such as chemical industries, refineries and other industrial users already provide warehousing, storage and logistics facilities, whereby we see substantial hydrogen use in the future.

Ports are already becoming receiving points for power and energy. They have long been receiving points for natural gas from offshore fields. Adapting those ports to become receivers of renewable energy is paramount. System ports would need to act as storage facilities for energy, but also as transportation of energy to other storage facilities.

Storage could take various forms from electrochemical storage in large batteries to short term storage to green molecules for longer term storage, including liquid hydrogen (-253 °C). In terms of long term storage ports in North West Europe could be used for storage of hydrogen, as well as for variations over the subsequent winters are colder than average. Against this background, there will be a need for storage plants at the port location.

ABOUT THE WORLD ENERGY COUNCIL

energy stakeholders. We inform energy stakeholders. We inform strategies by hosting high-level Congress and publishing authoritative work through our extensive member network to foster dialogue.

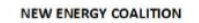
Further details at www.worldenergycouncil.nl and @WECouncil

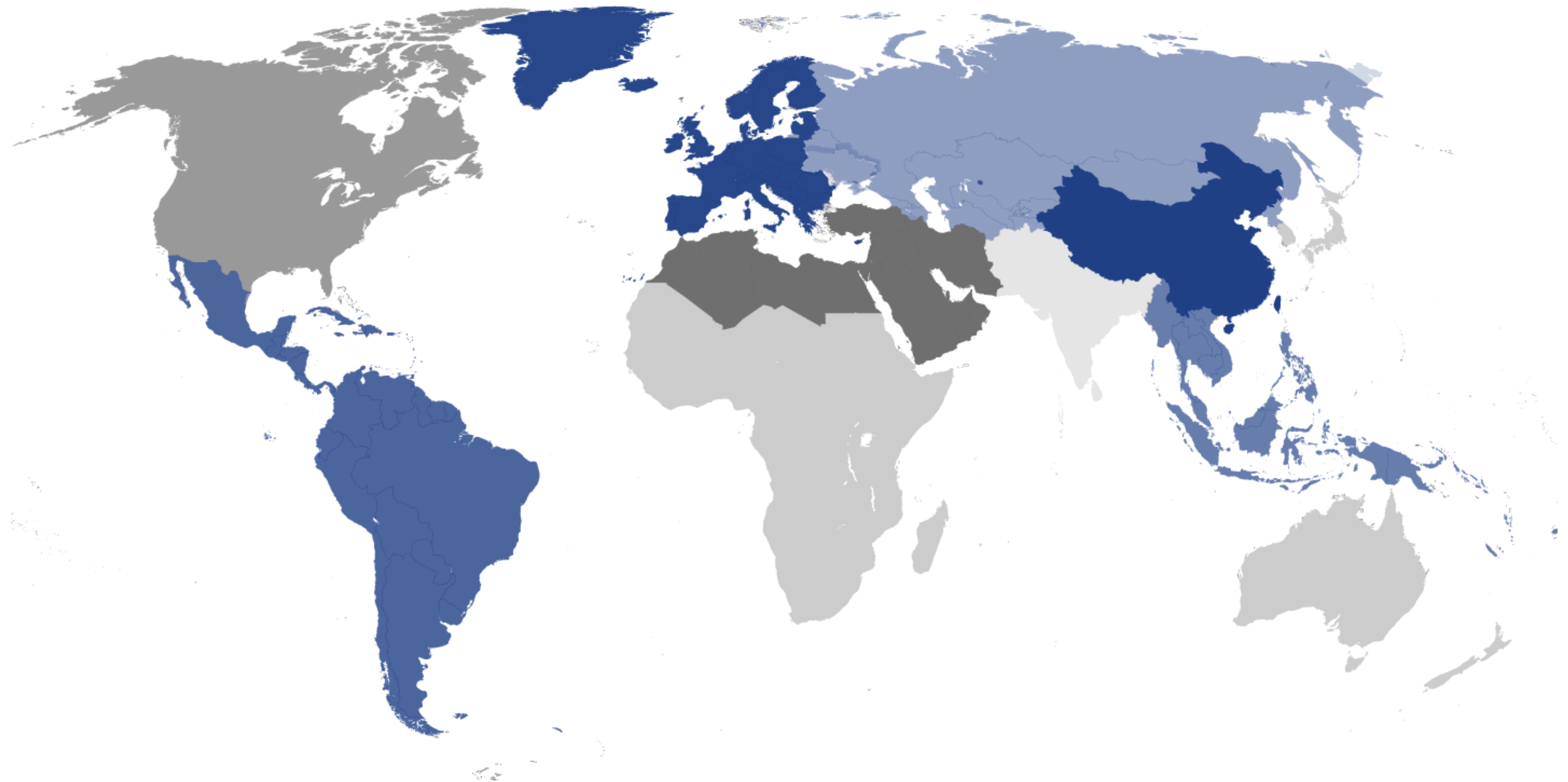
World Energy Perspective

World Energy Council Netherlands
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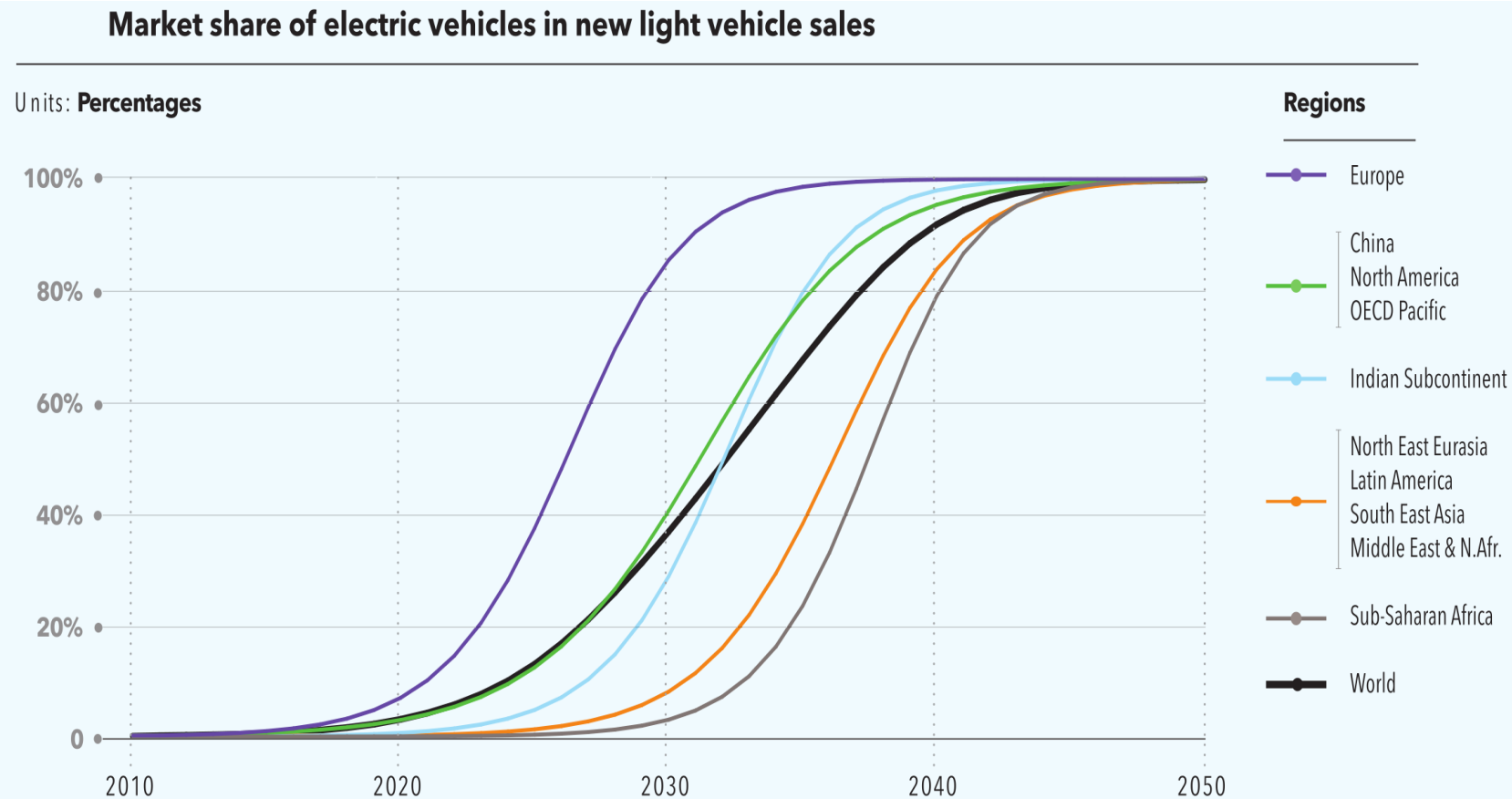
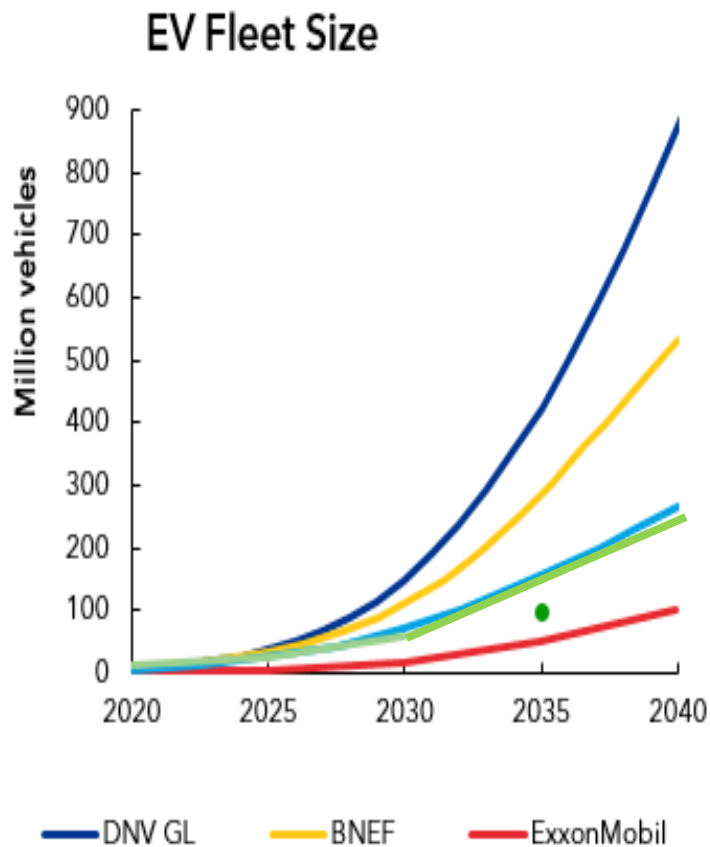
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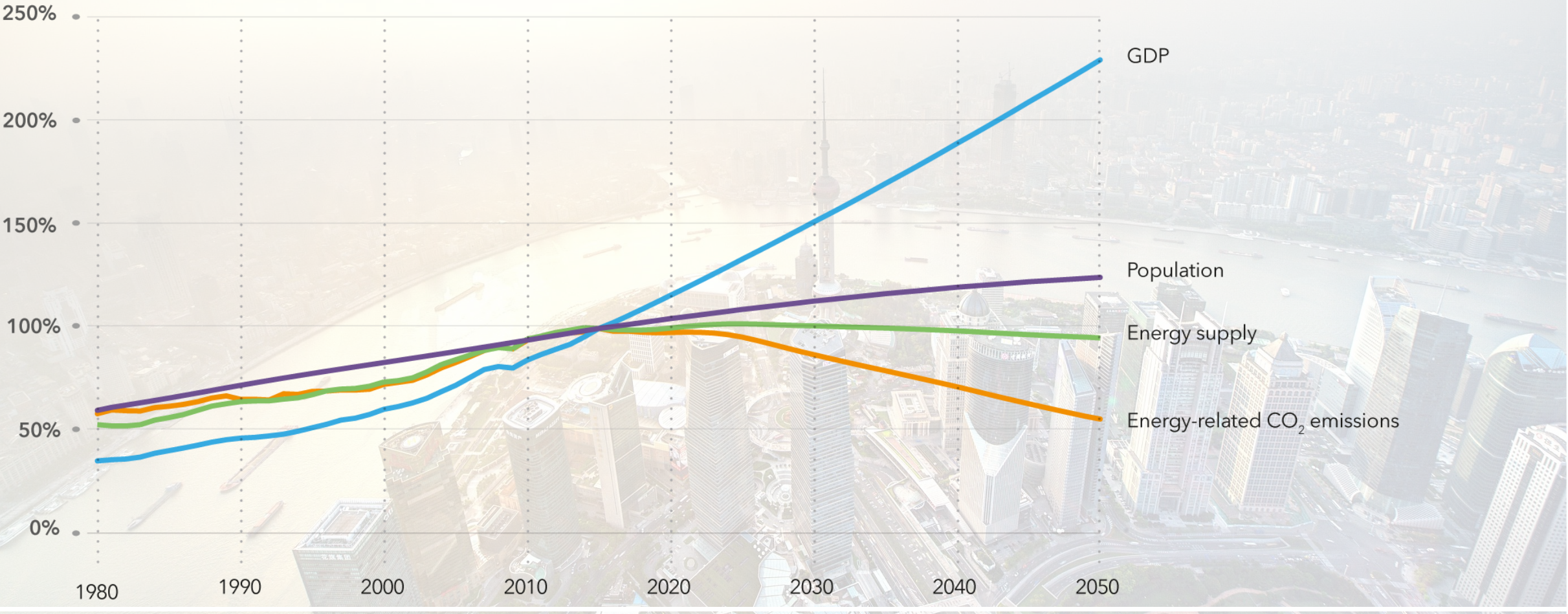
Electric Vehicles (EVs) and the S-Curve



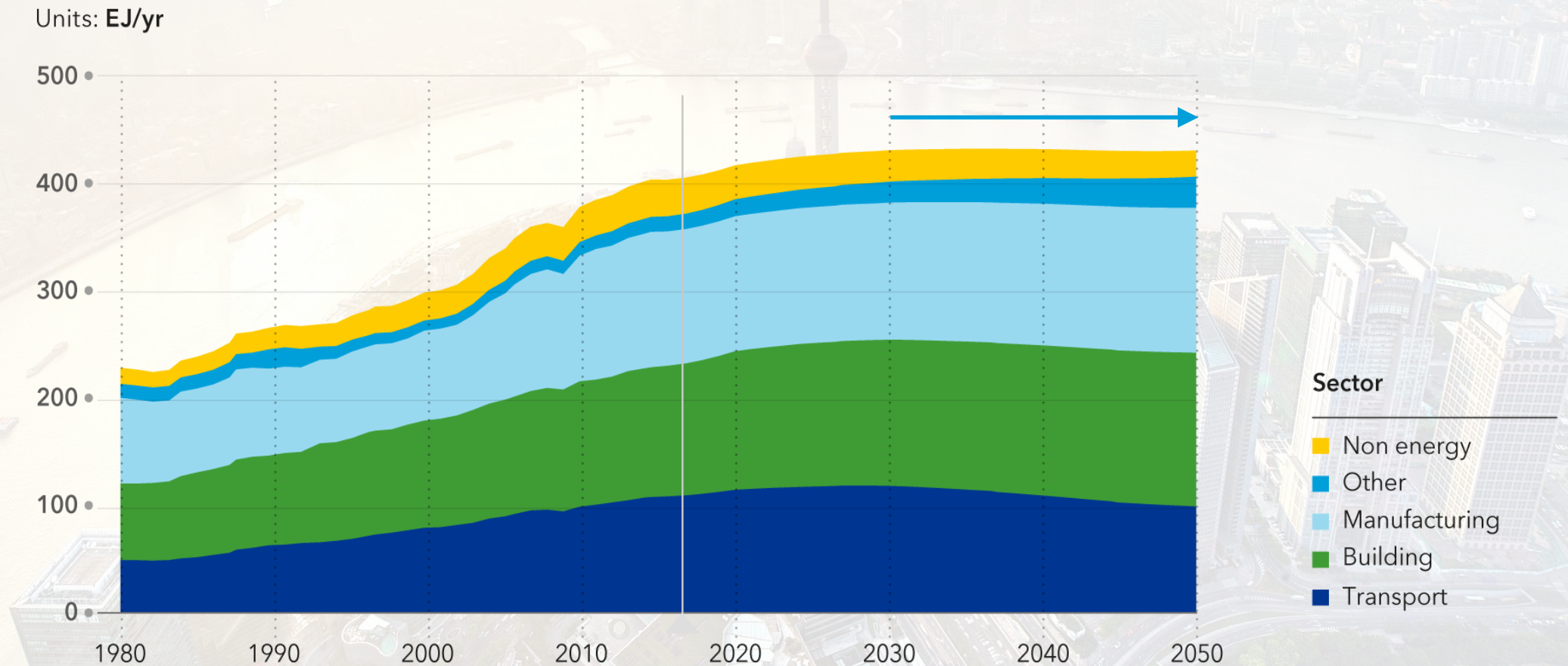
Source: Bloomberg New Energy Finance, DNV GL Energy Transition Outlook

Economic growth vs. energy efficiency growth

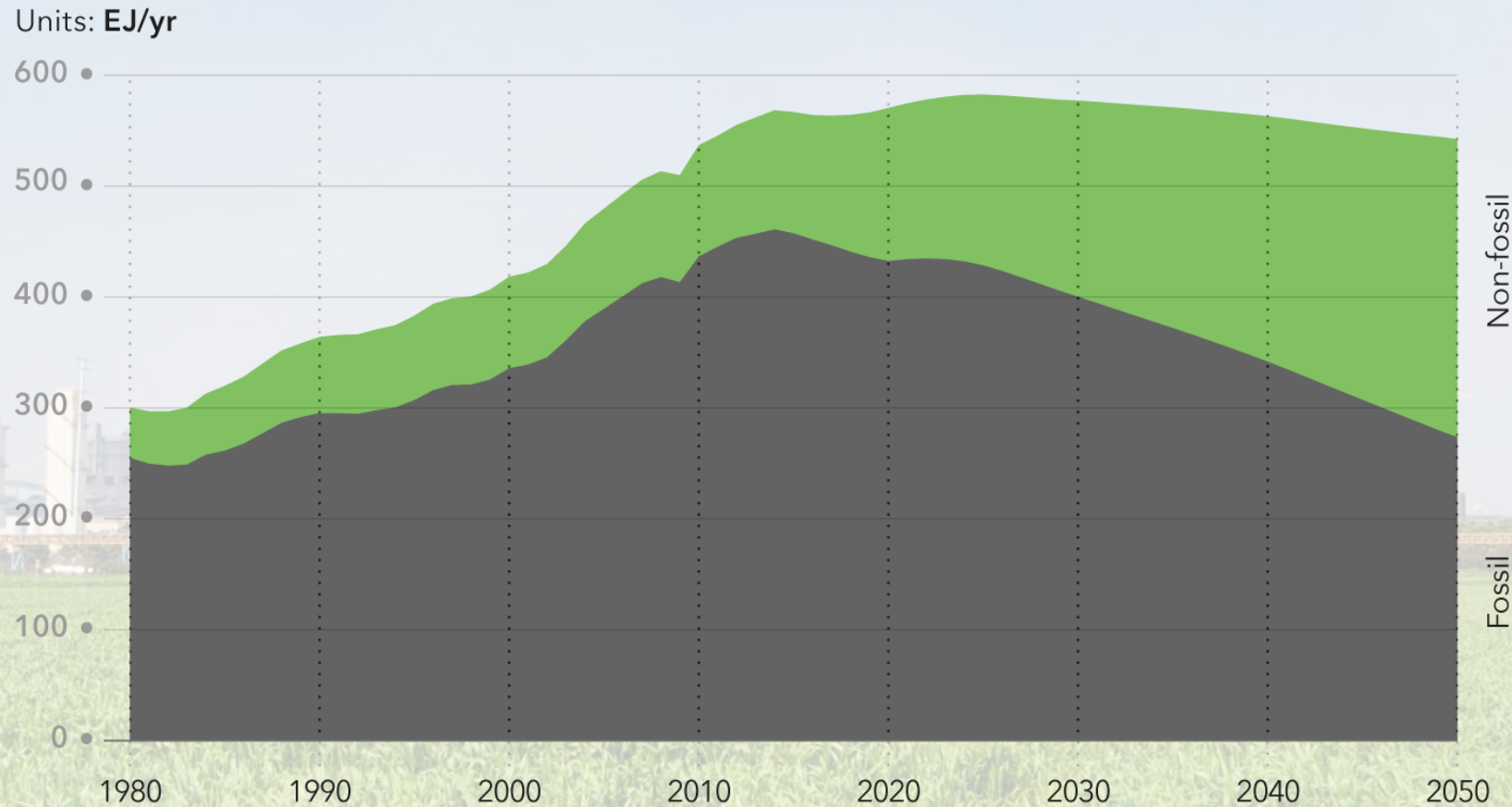
Units: Percentage of 2015 level



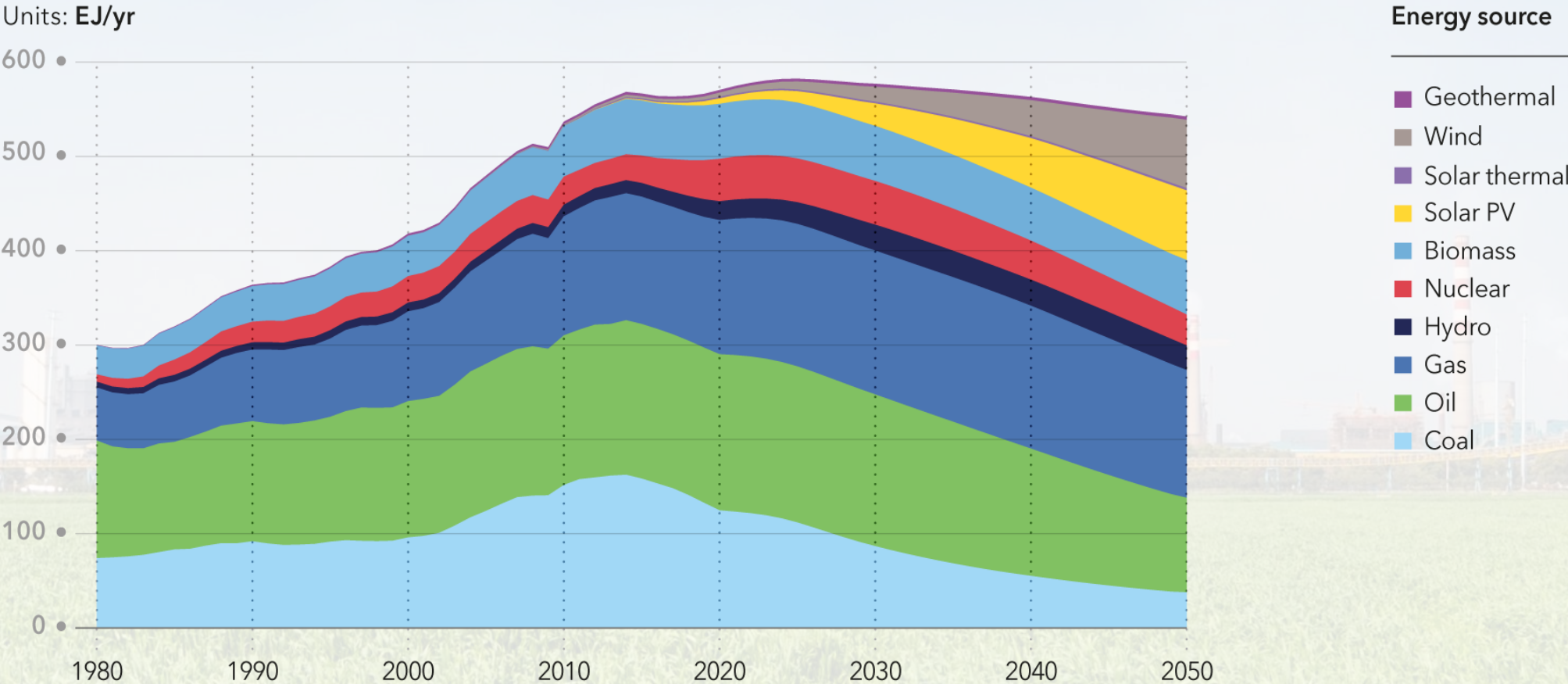
World final energy demand by sector



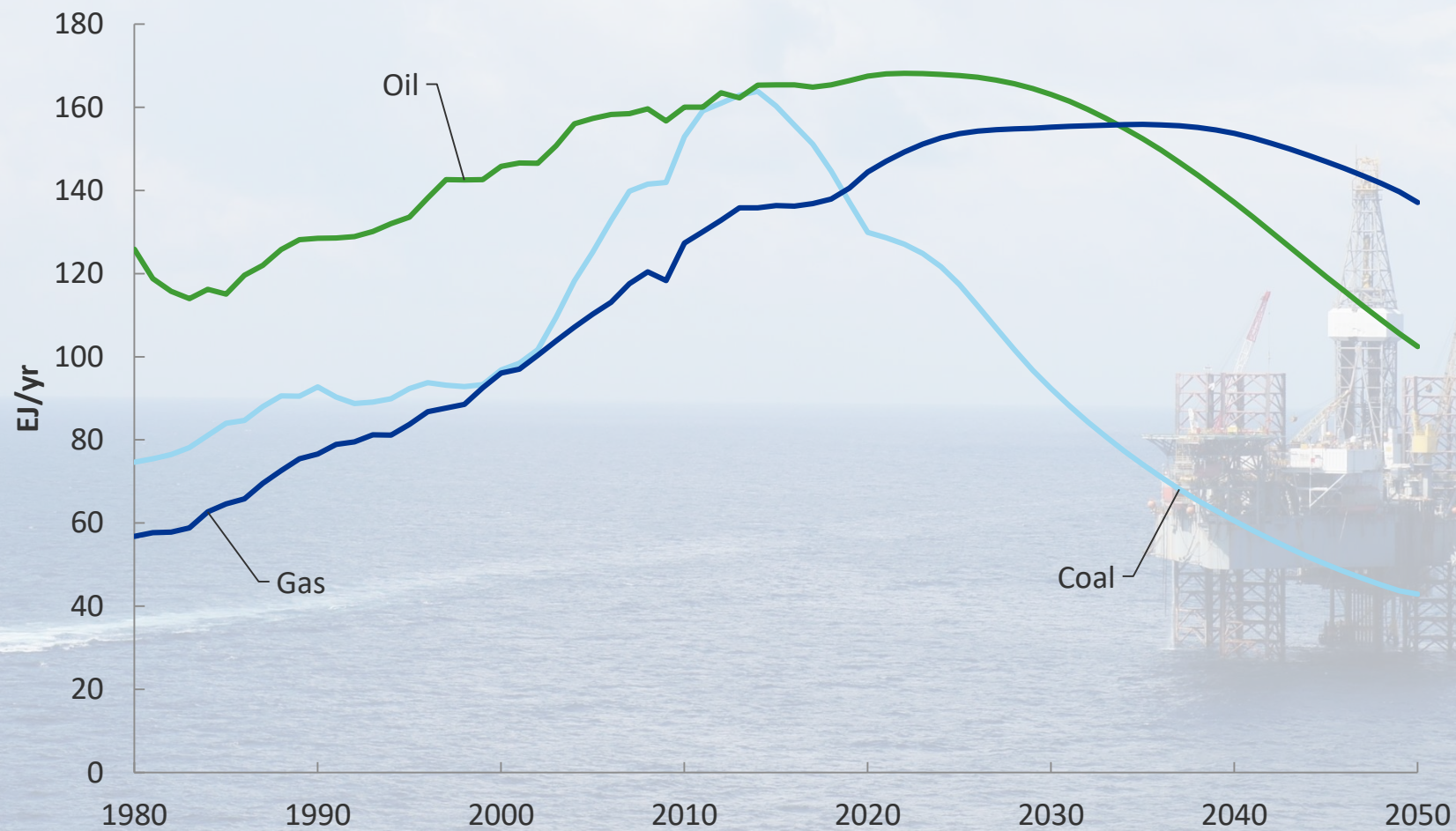
Forecast world primary energy supply



Forecast world primary energy supply by source



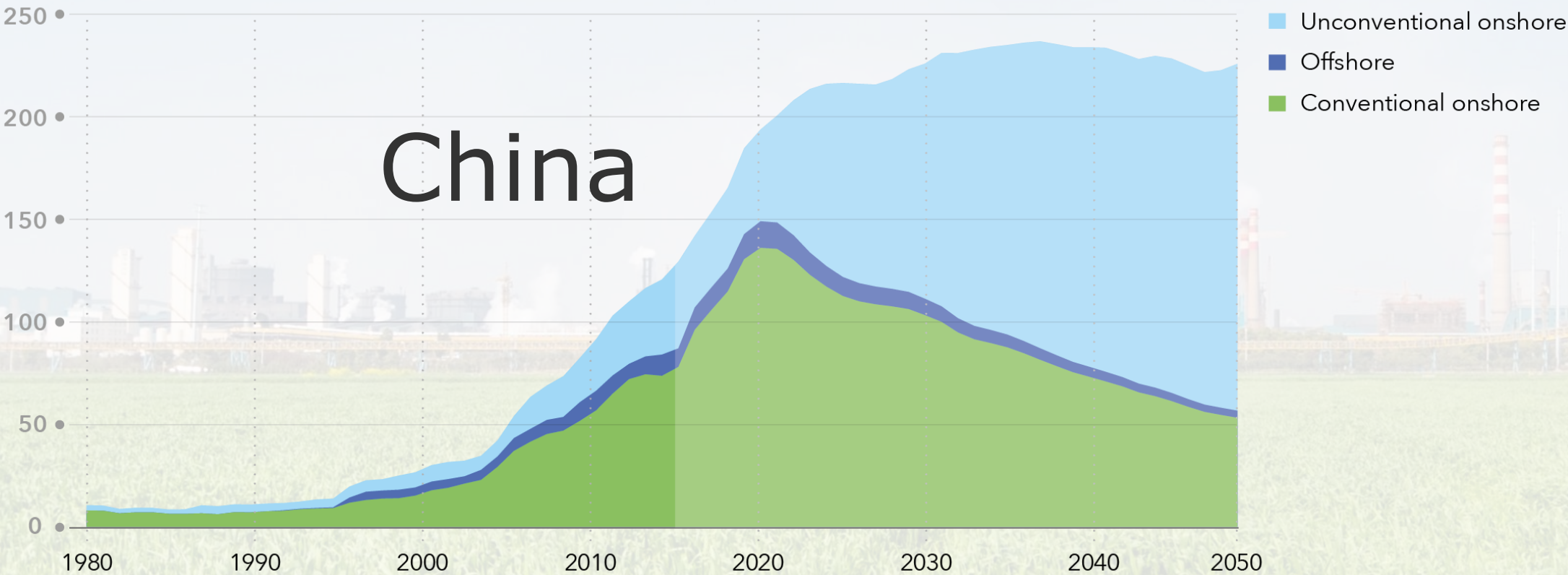
Forecast fossil energy use



China's natural gas production will grow, mostly unconventional

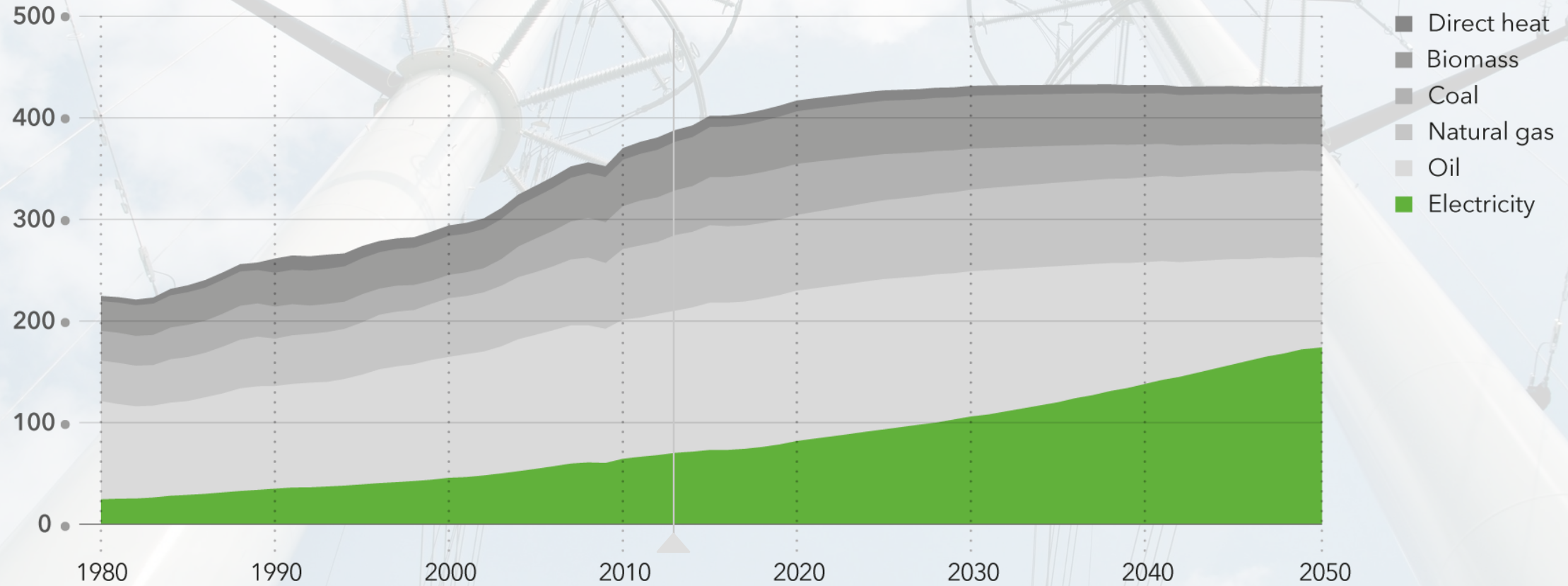
NATURAL GAS PRODUCTION BY FIELD TYPE

Units: Gm³/yr



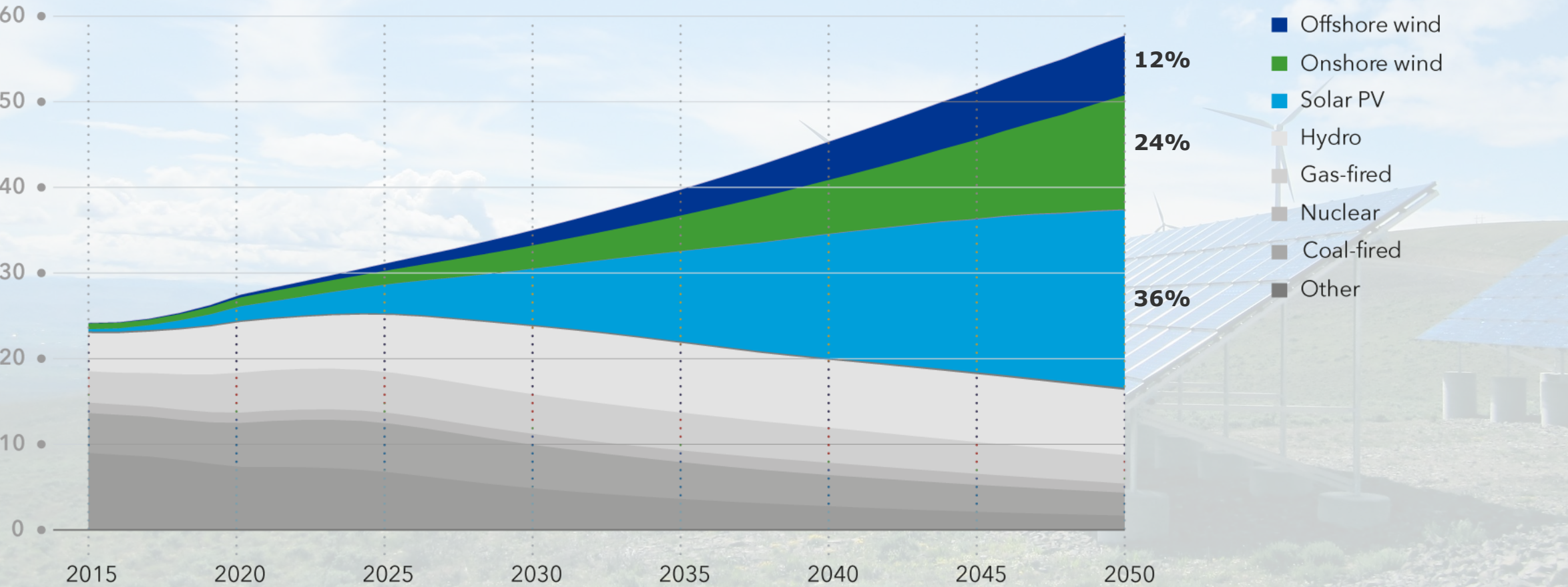
World final energy demand by energy carrier

Units: EJ/yr



Growth of Solar PV and wind by 2050

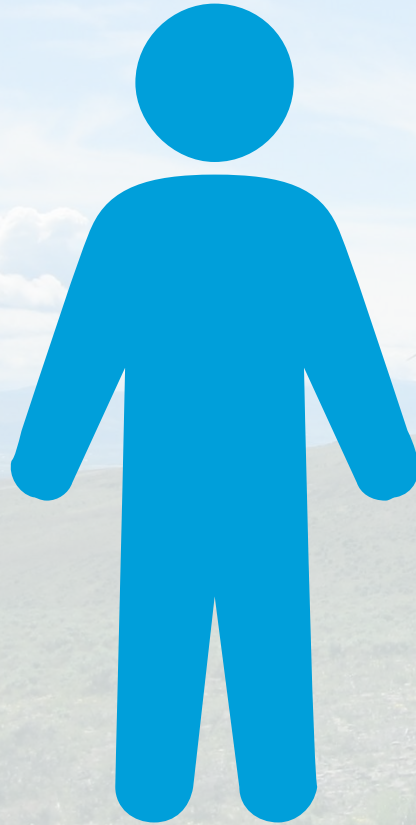
Units: PWh/yr



The average European...

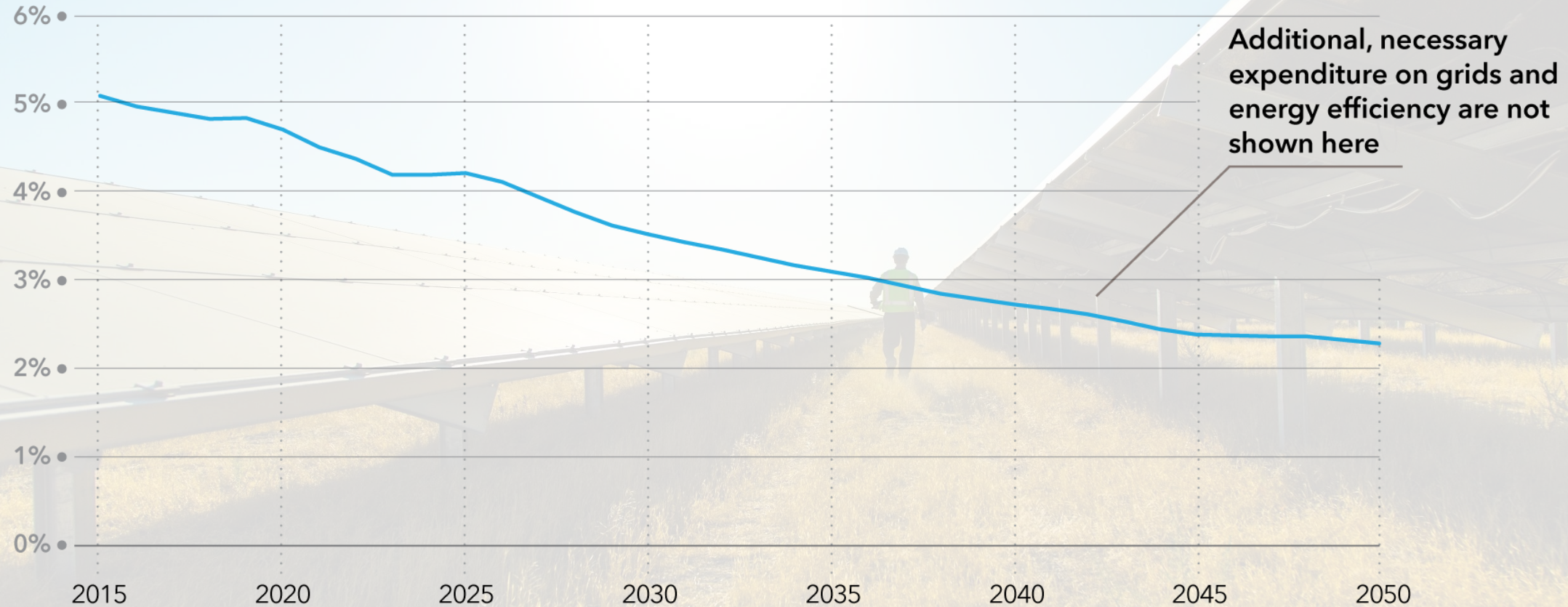
2015
135 GJ/year

2050
76 GJ/year

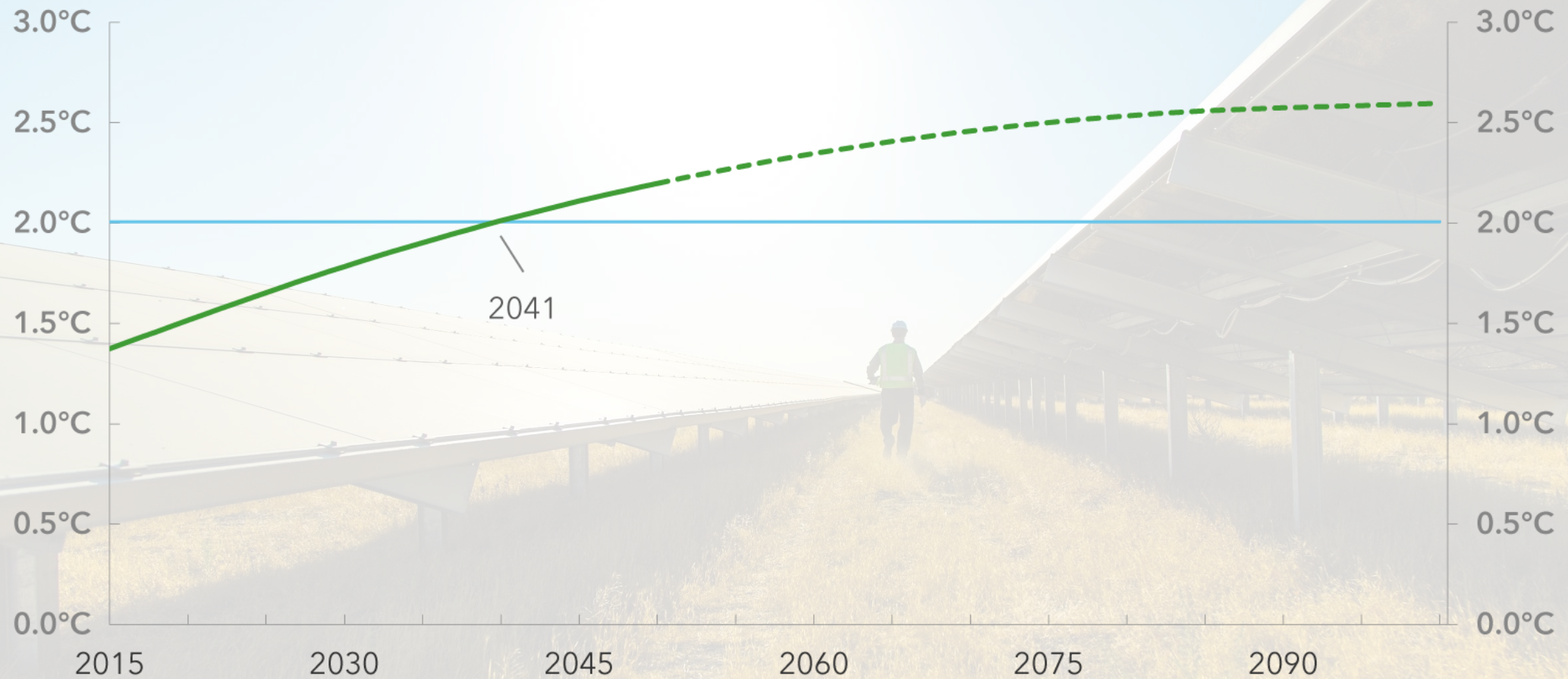


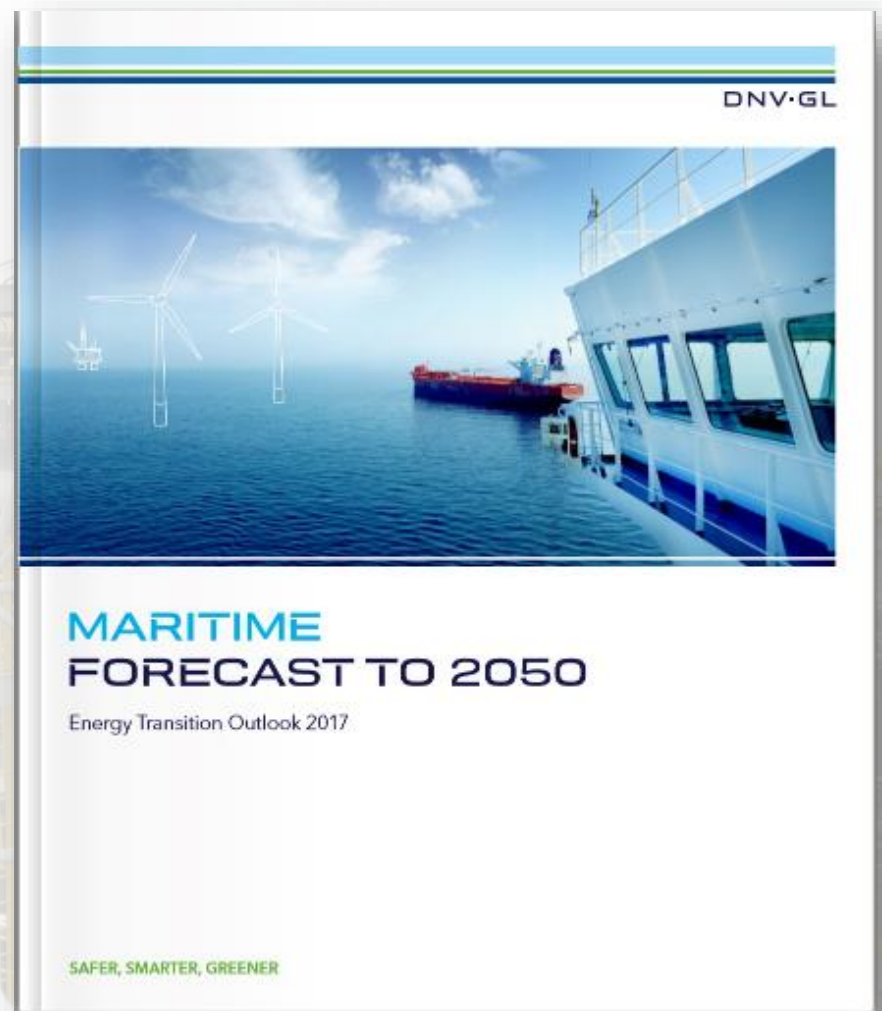
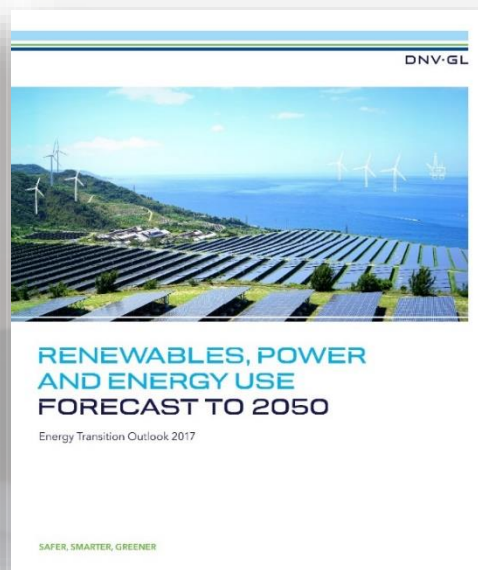
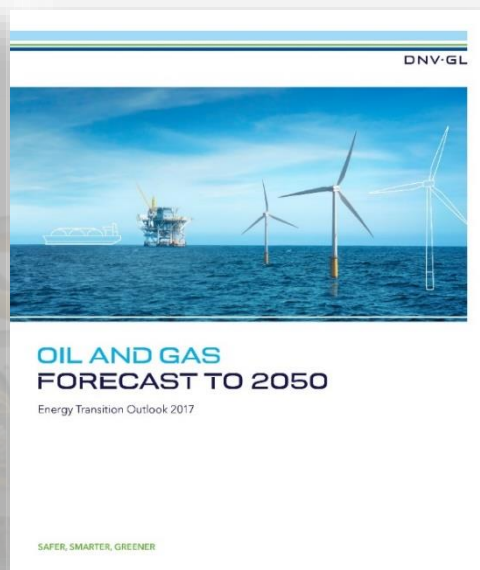
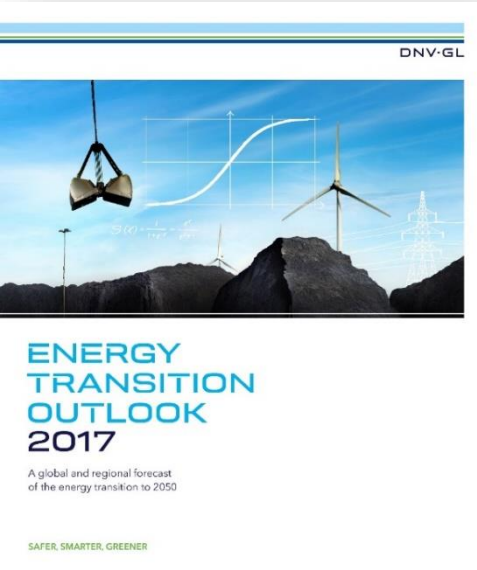
Global energy expenditure as a fraction of Global GDP

Units: Percentages



Global warming and carbon budget





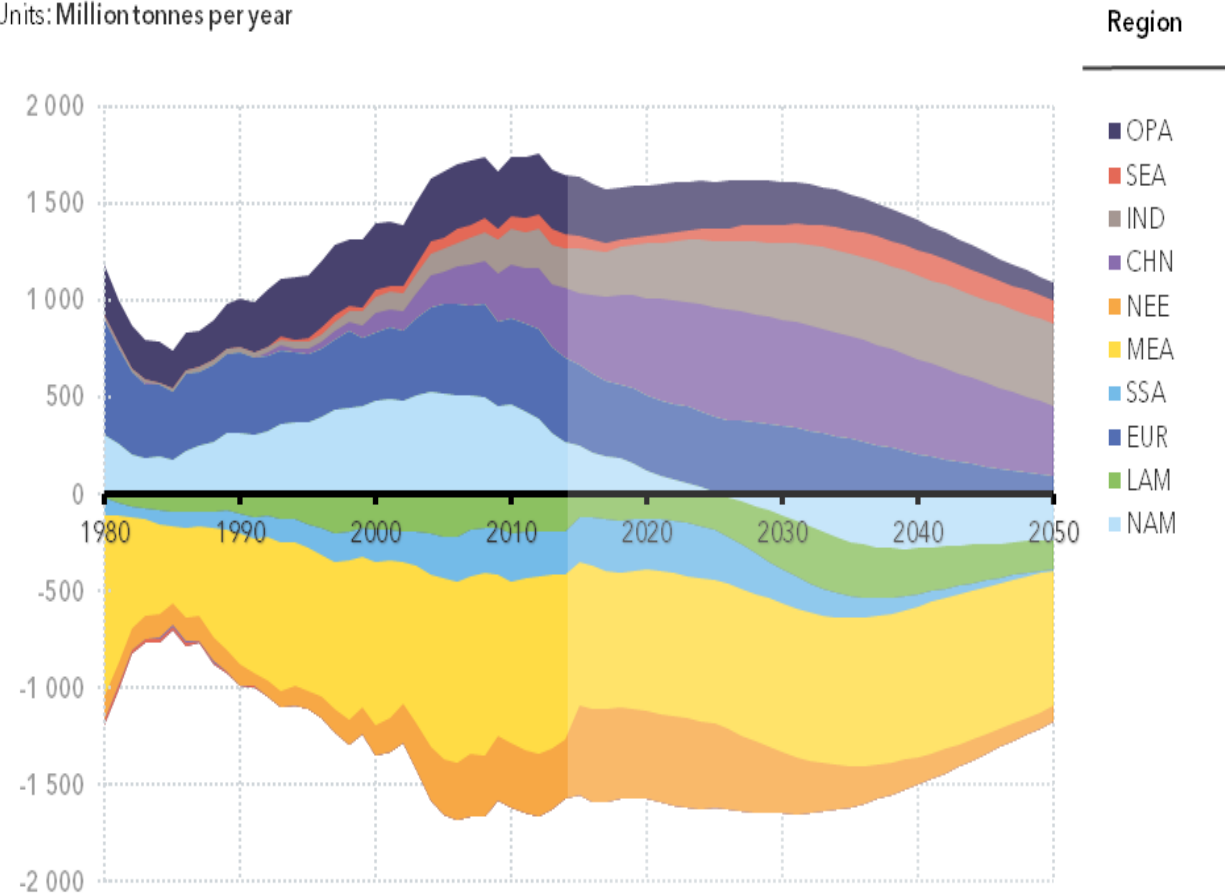
eto.dnvgl.com

The ETO study gives us an unique insight into...

- Trade between and within 10 regions to 2050.
- The 2050 maritime outlook is provided for:
 - Crude trade
 - Oil products
 - Gas tankers
 - Bulk cargo
 - Containerized cargo
 - Offshore

FIGURE 4.7 REGIONAL NET CRUDE OIL IMPORTS

Units: Million tonnes per year

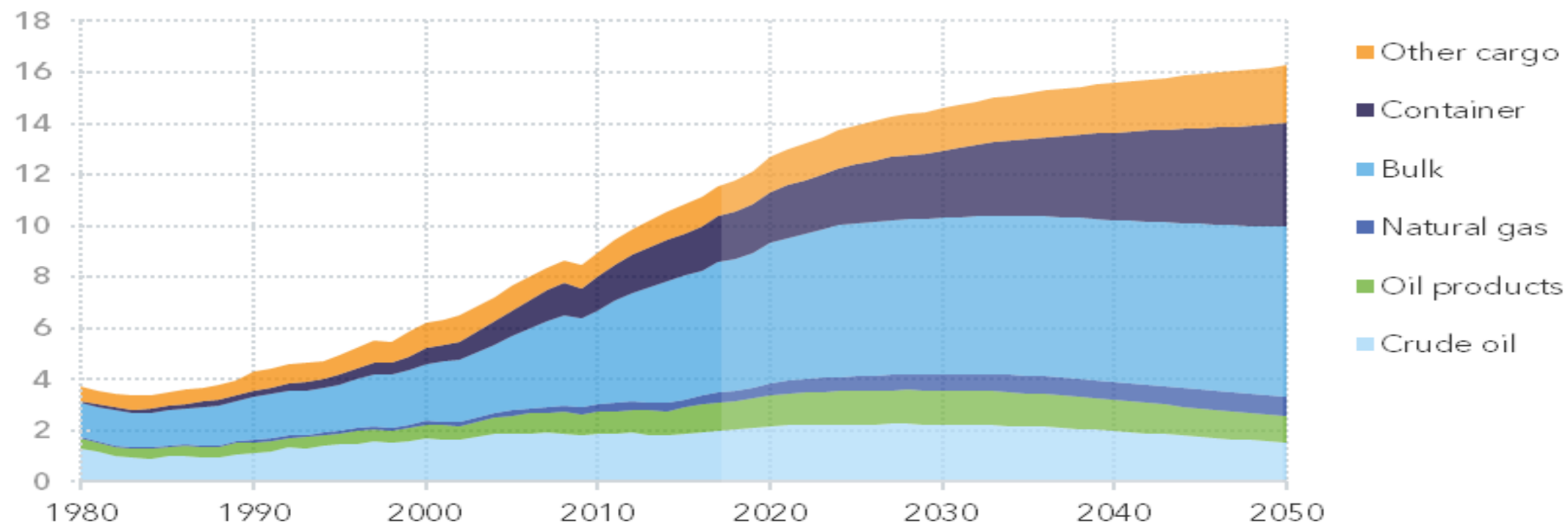


Sources: forecast - DNV GL; historical data - IEA, 2016

Ton-miles will grow 60% to 2050

FIGURE 4.4 WORLD SEABORNE TRADE: TONNAGE

Units: **Billion tonnes per year**



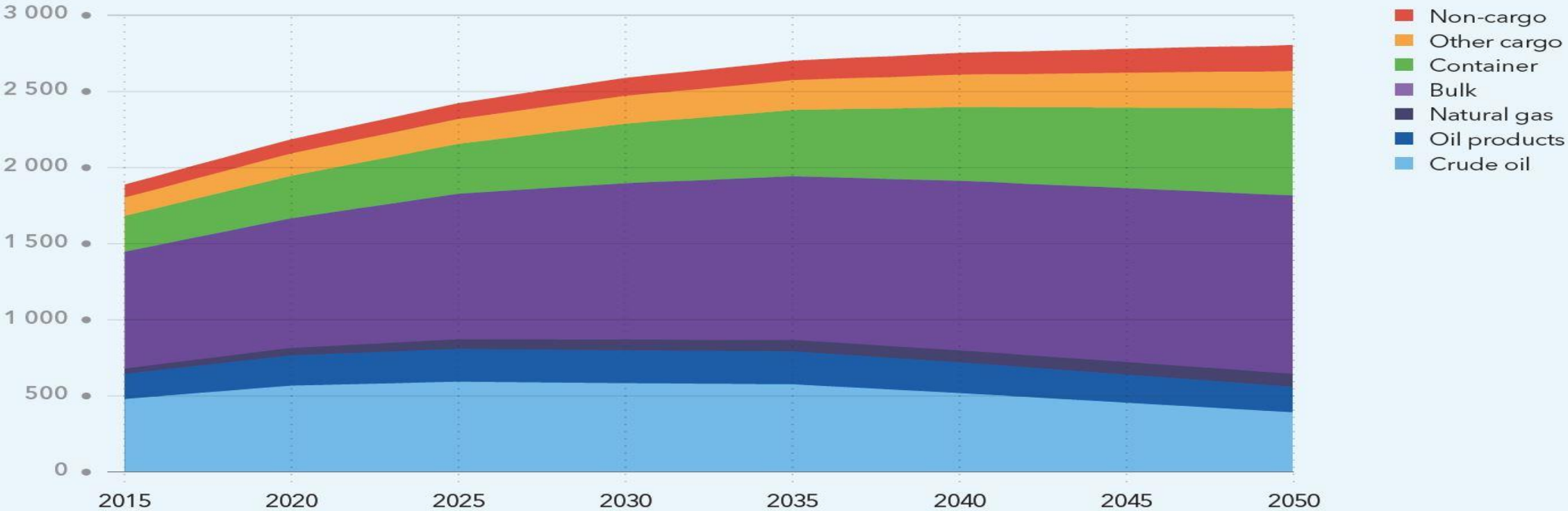
Sources: forecast - DNV GL; historical data - Clarkson Research, 2017

Average annual growth of 2,2% to 2030, thereafter 0.6%

Fleets grow less, due mainly to improved logistical efficiencies from digitalization

FIGURE 1.3 FLEET DEVELOPMENT 2015-2050 BY SEGMENT

Units: Million DWT



Source: DNV GL

Trade growth will be strongest in the Asian regions

4.10 INTER- AND INTRA-REGIONAL SEABORNE NATURAL GAS TRADE

2015

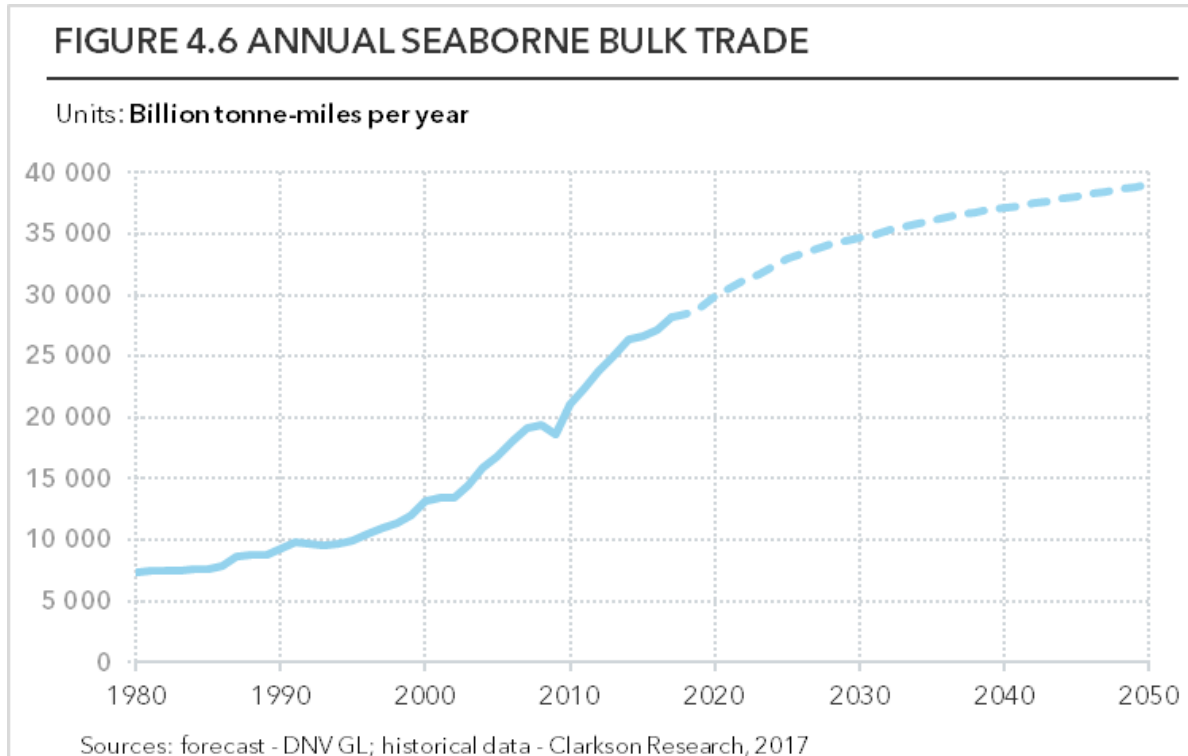


2050



- Trade growth is strongest in the Asian regions: China, India, South-East Asia, plus Africa
- New trade patterns will emerge such as oil and gas trade from the shale developments in North America
- Trade patterns can be analyzed in detail, as shown here for gas.

Bulk transport continues to grow, but with notable cargo differences

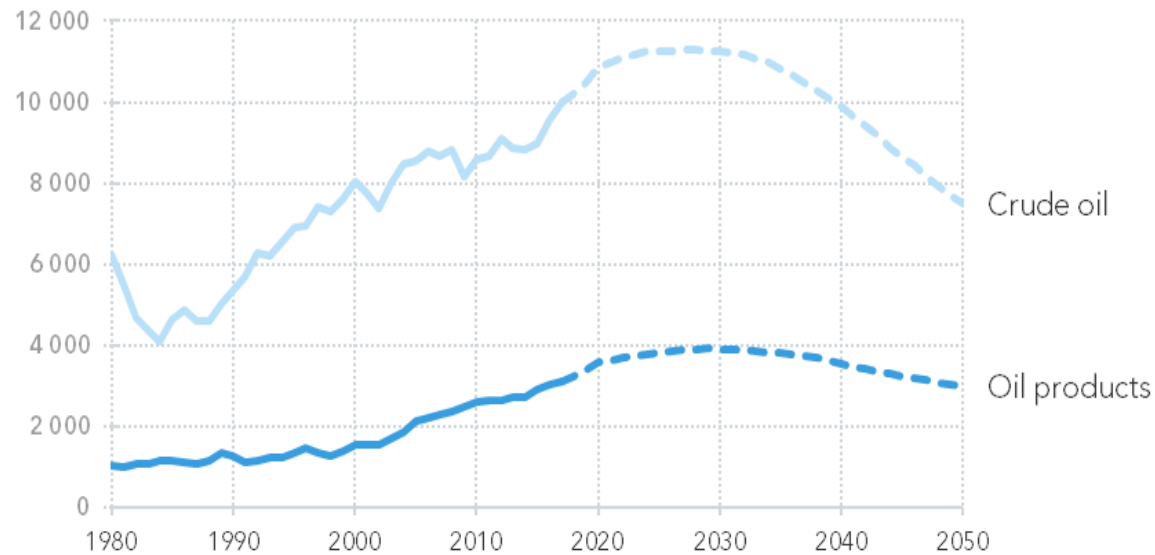


- World coal consumption to decrease, shipping will follow, but as a small fraction is shipped demand/supply mismatches in China and India are crucial to coal trade
- Iron ore and minor bulk growth slows after 2030, but electrification will give rise to increased transport of copper, lithium and other related materials
- Grain will grow significantly

Oil transport will grow to 2030, and thereafter decline

FIGURE 4.8 GLOBAL SEABORNE CRUDE OIL AND OIL PRODUCTS TRADE

Units: Billion tonne-miles per year



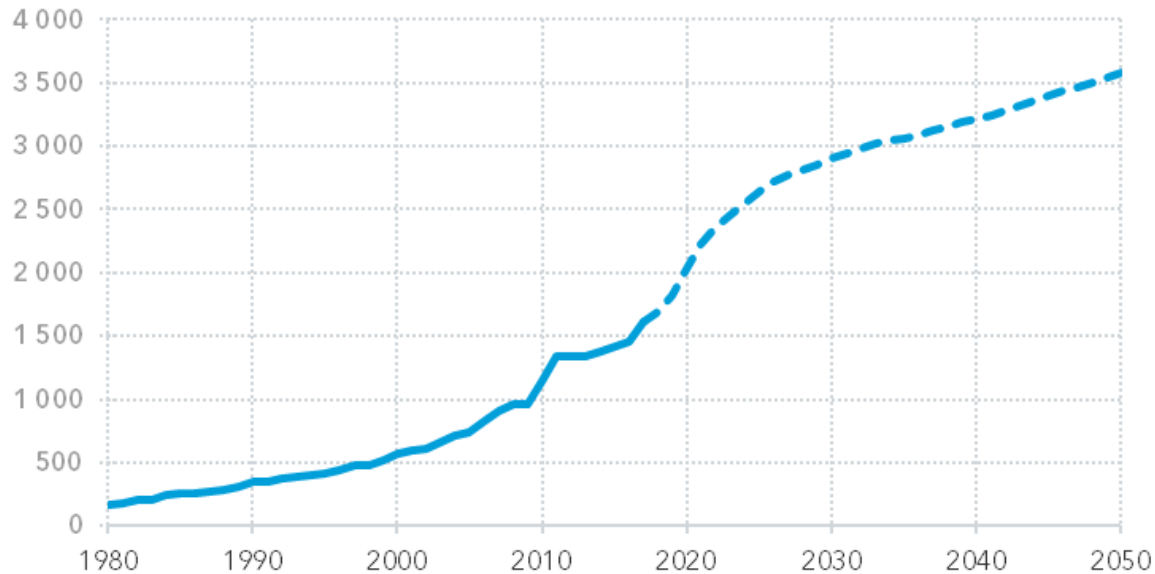
Sources: forecast - DNV GL; historical data - Clarkson Research, 2017

- Majority of world oil is transported on keel
- World oil consumption to peak in 2020s
- Trade patterns will change, shale oil transport from Americas grows, Middle East remains a large exporter and Asian imports increase

Gas transport will grow throughout the forecast period, as gas takes over as the largest energy source

FIGURE 4.9 GLOBAL SEABORNE NATURAL GAS TRADE

Units: Billion tonne-miles per year



Sources: forecast - DNV GL; historical data - Clarkson Research, 2017

- World gas demand to grow until 2035, and takes over as the largest energy source
- Share of gas that is transported on keel is increasing, driven by changing geographical patterns and energy security considerations
- New patterns add to existing trade, US exports grow and imports into India and China increase

Container growth is solid, closely following GDP growth



- Main drivers are manufacturing and increased containerisation, over time also influenced by 3D Printing and automation
- Trade multiple of 1.1 times GDP projected
- Trade across all world regions is expected to increase. Strongest growth is inter-Asia trade, with India having the highest export growth

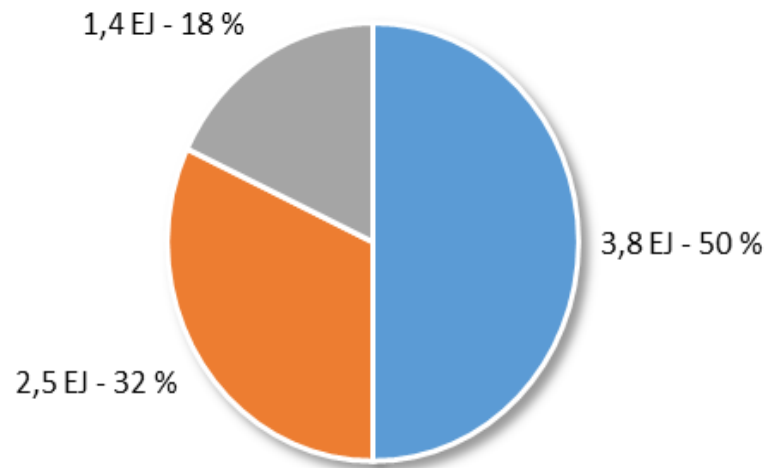
Offshore shipping activity will decline in the forecast period



- Offshore shipping activity related to new oil and gas field developments will halve
- Reduced activity for also existing oil and gas fields
- Offshore wind will grow strongly
- Aquaculture, decommissioning and other emerging marine activities will stimulate new shipping activity

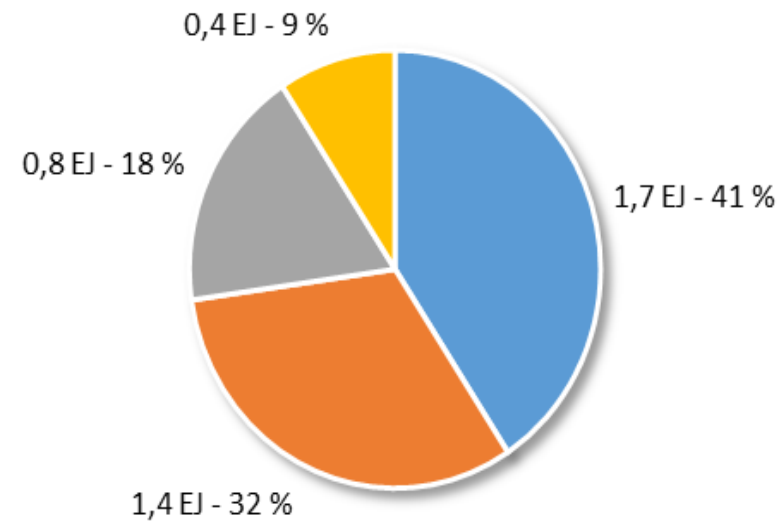
Shipping's fuel mix will diversify

Energy mix 2050
Deep Sea



■ HFO/MGO ■ LNG ■ Biofuel

Energy mix 2050
Short Sea

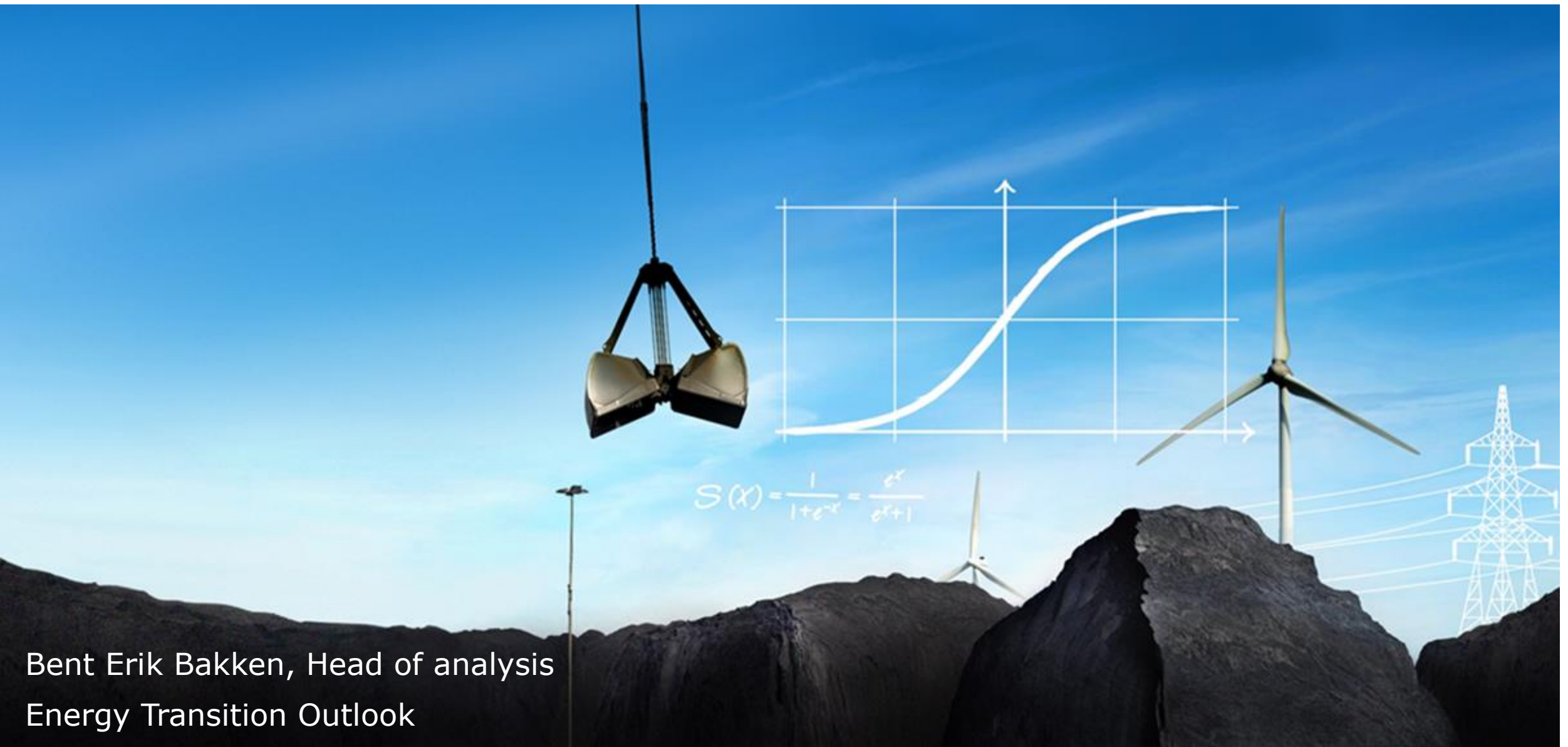


■ HFO/MGO ■ LNG ■ Biofuel ■ Electricity

Maritime ETO Key conclusions

- The world energy transition towards 2050 will impact shipping
- Overall the demand for seaborne transport will increase by 60% by 2050, with slower growth after 2030
- Growth to 2050 varies significantly between segments:
 - Bulk transport will grow, but with notable cargo differences
 - Oil transport will grow to 2030, and thereafter decline
 - As gas use will grow and be the single largest energy source after mid-thirties, gas transport will grow throughout
 - Container growth, closely linked to manufacturing growth, with GDP trade multiple of 1.1, a very healthy growth
- Seaborne transport growth will be strongest in the Asian regions





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Energy Transition Outlook

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