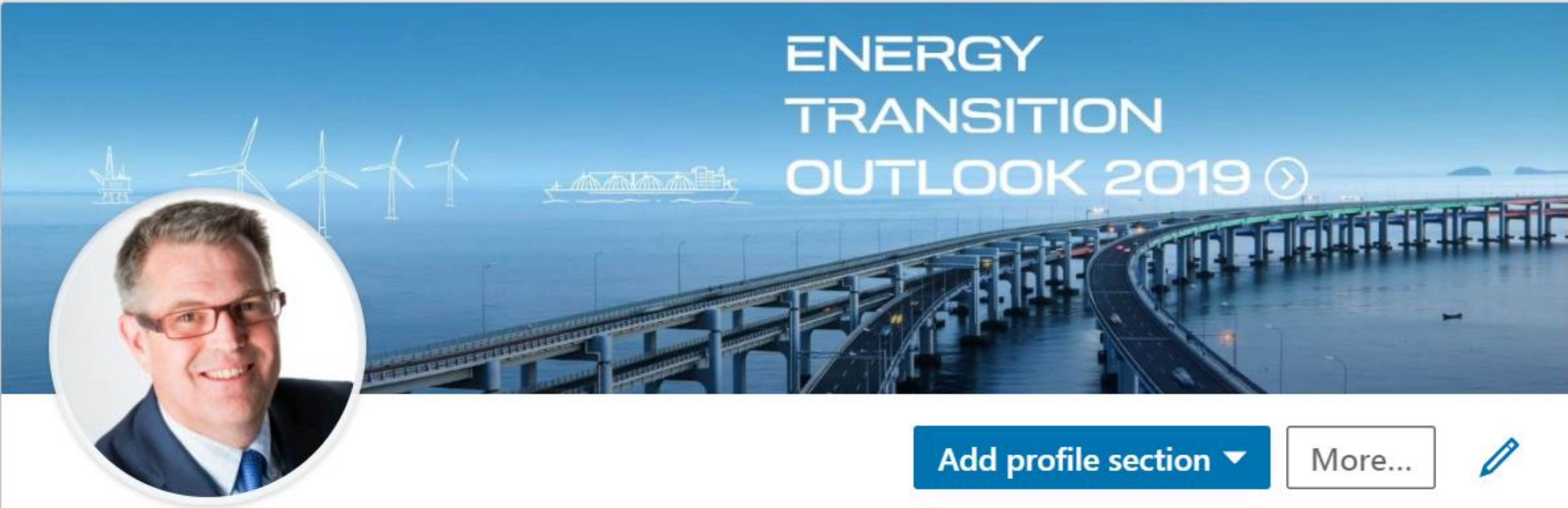
CIGRE B5 – Energy Transition Outlook



Bas Kruimer

Business Director Intelligent Networks & Communication at DNV GL Netherlands

DNV GL

Delft University of Technology

bas.kruimer@dnvgl.com

Bas Kruimer

Business Director Intelligent Networks & Communication at DNV GL Netherlands

DNV GL

Delft University of Technology

bas.kruimer@dnvgl.com

- Digital Grid Operations
- SCADA & Situational Awareness
- T&D Processes + Automation
- Smart Grid – Smart Metering
- Cybersecurity + Resilience

- ABB
- KEMA
- Eneco/Joulz
- Quanta Technology
- Accenture

DNV·GL

Agenda

01	Energy Transition Outlook 2020
02	Digitalization
03	Conclusion

a quality assurance + risk management company

to safeguard life, property and our environment

transitioning to a safer, smarter and greener energy future

Climate change and extreme weather

Increasing global demand for energy and electrification

Renewables growth and need for energy efficiency

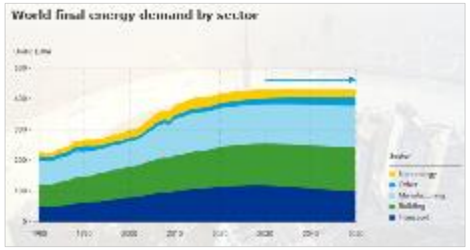
Integration of energy markets across borders

Security and ageing assets


70% of DNV GL's business
is related to energy

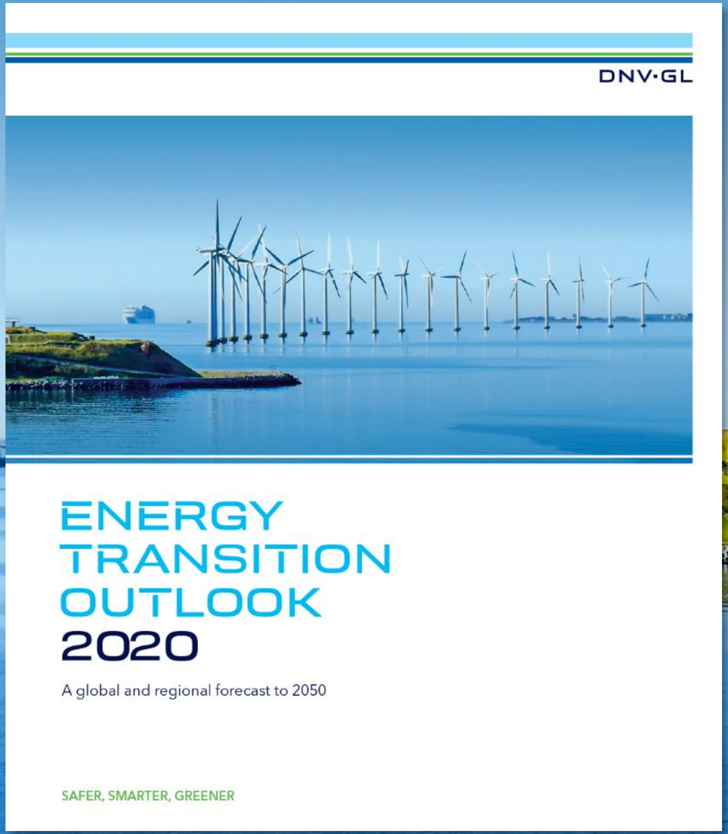
Our Outlook publications

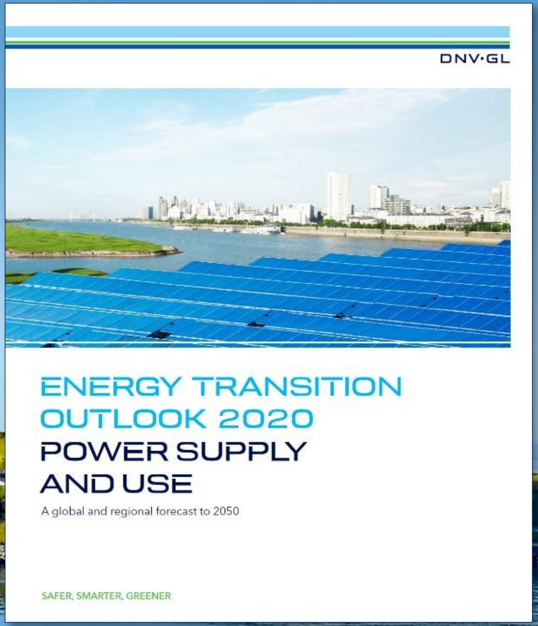
2020	2025	2030	2050
Global Opportunity Report The GPS system directing you to opportunities	**Technology Outlook** The technology landscape of the next decade	**Future of Spaceship Earth** The stress test for our planet	**Energy Transition Outlook** The independent forecast of energy demand and supply

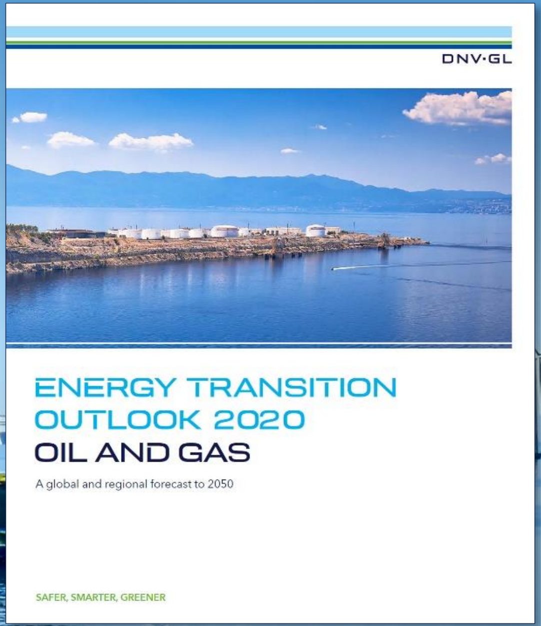


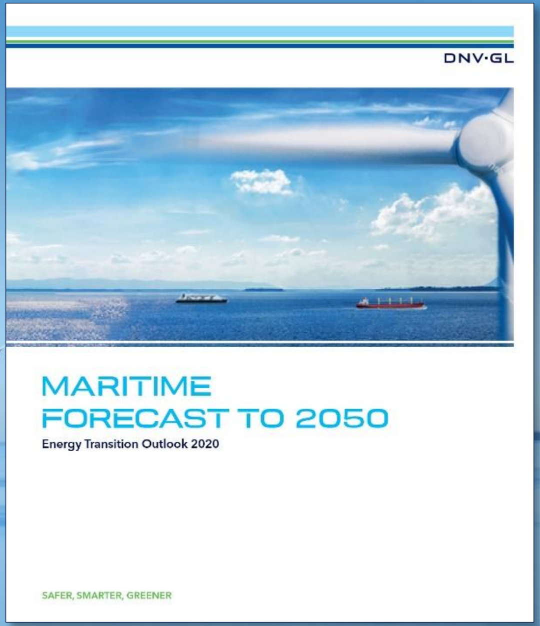
DNV·GL

Suite of publications available on eto.dnvgl.com









eto.dnvgl.com/forecast-data

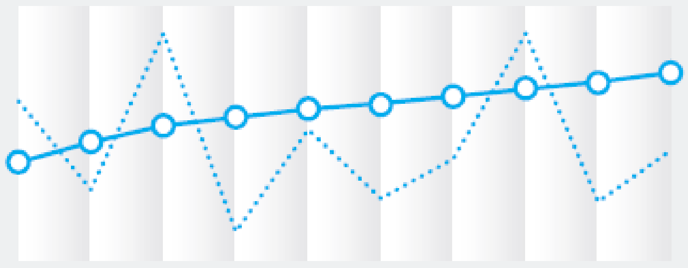
THE 2018 SERIES:

> 100,000 downloads

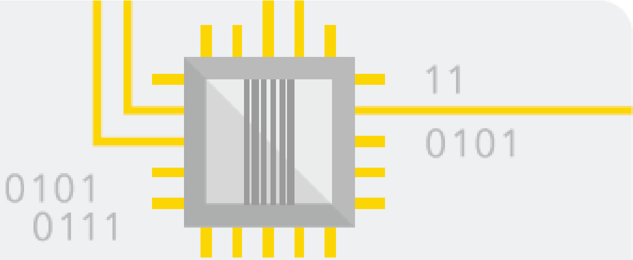
Our approach

Our **best estimate**,
not the future we want

A single forecast, not scenarios



Long term dynamics,
not short-term imbalances



Continued development
of proven **technology**, not
uncertain breakthroughs

Main **policy** trends included;
caution on untested *
commitments, e.g. NDCs, etc.

Behavioural changes: some
assumptions made, e.g. linked
to a changing environment

* NDCs = Nationally Determined Contributions

Dedicated research unit
focusing on the energy transition

100+ internal experts
across oil and gas, renewables and transport infrastructure

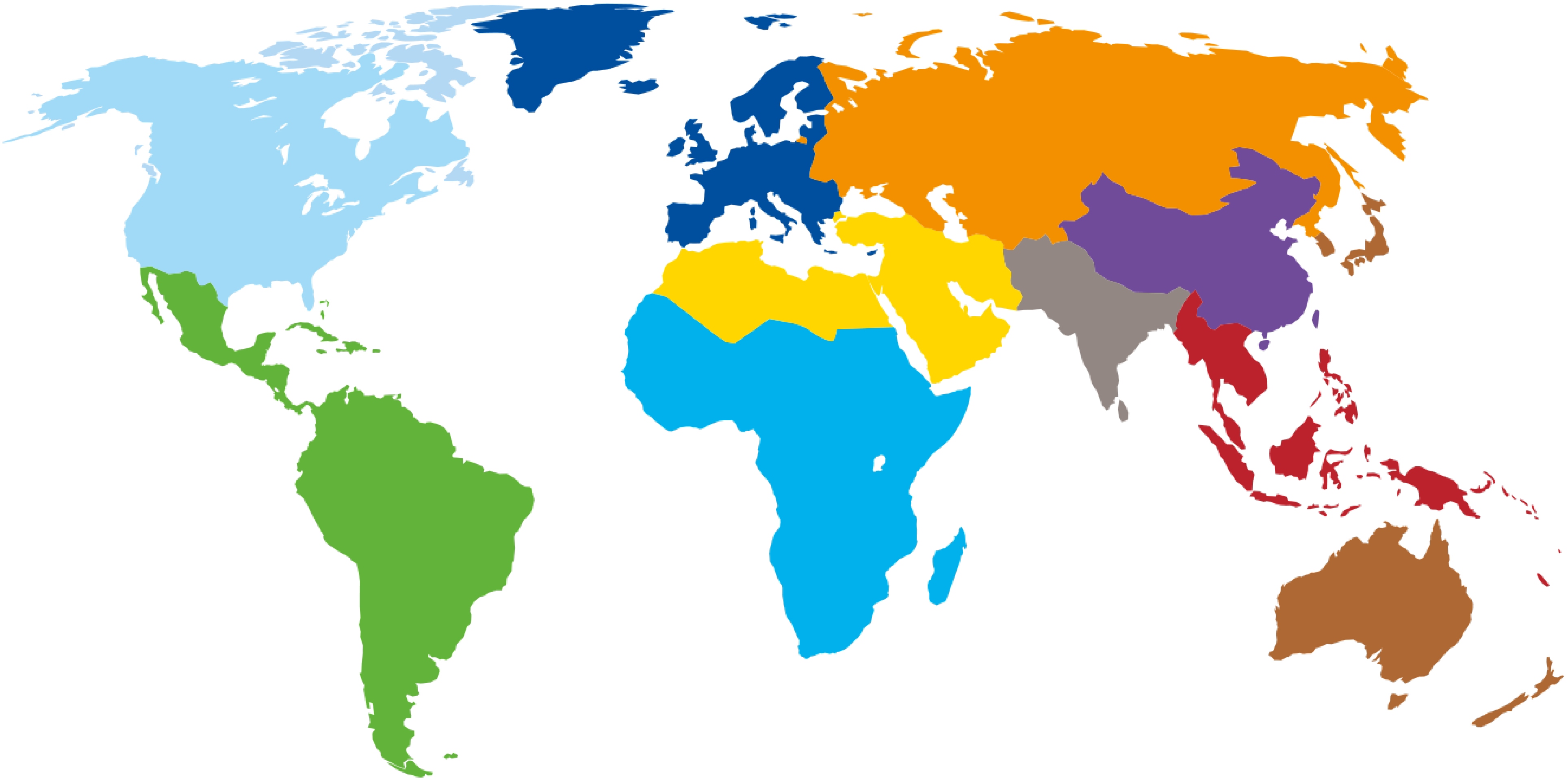
~30 external collaboration partners
in business and academia

THE APPLIED
METHODOLOGY

DNV GL has designed a model of the world's energy system encompassing demand and supply of energy globally, and the use and exchange of energy within and between ten world regions

DNV·GL

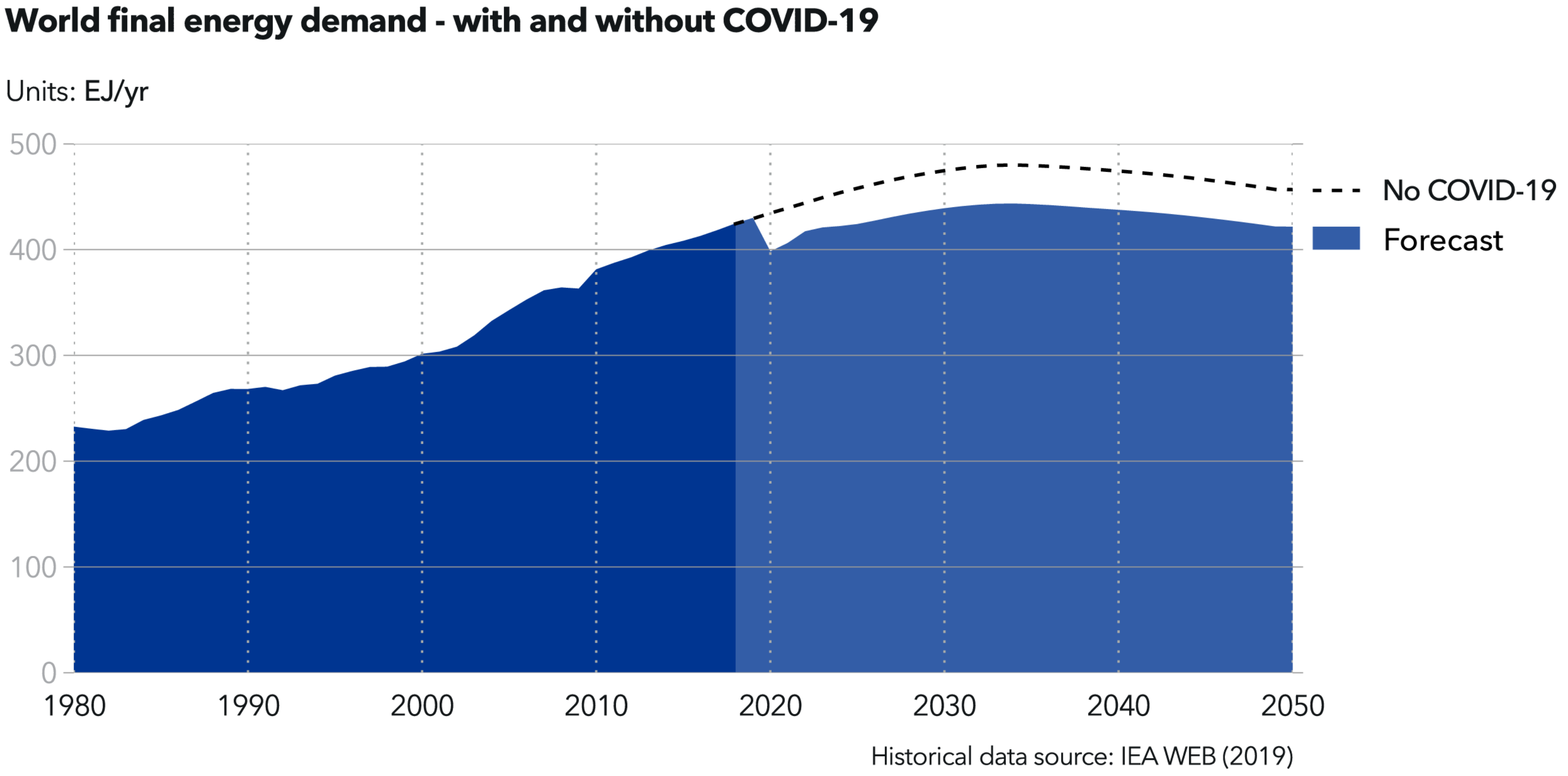
A global and regional forecast



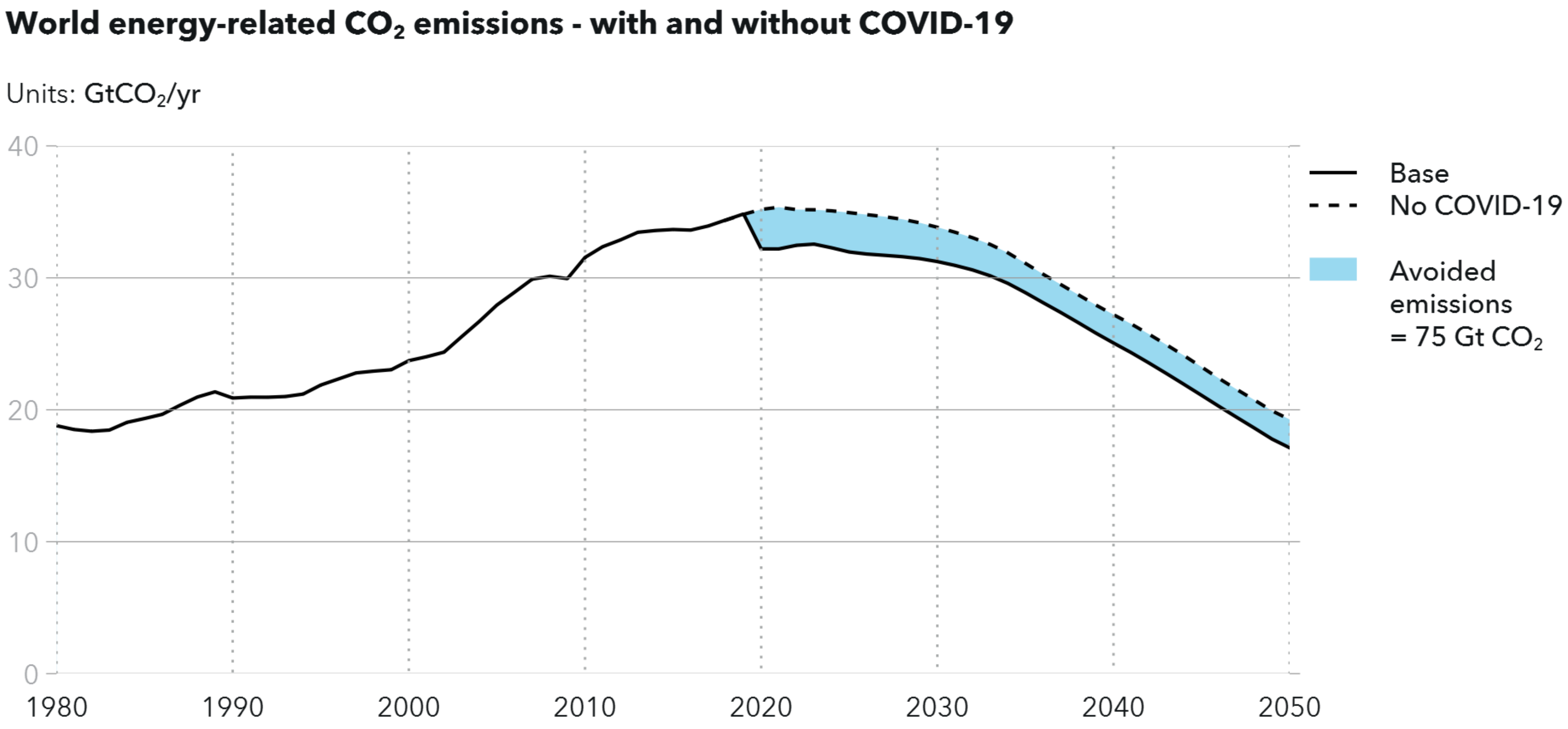
DNV·GL


WEST SIDE STORY
TUES 2/

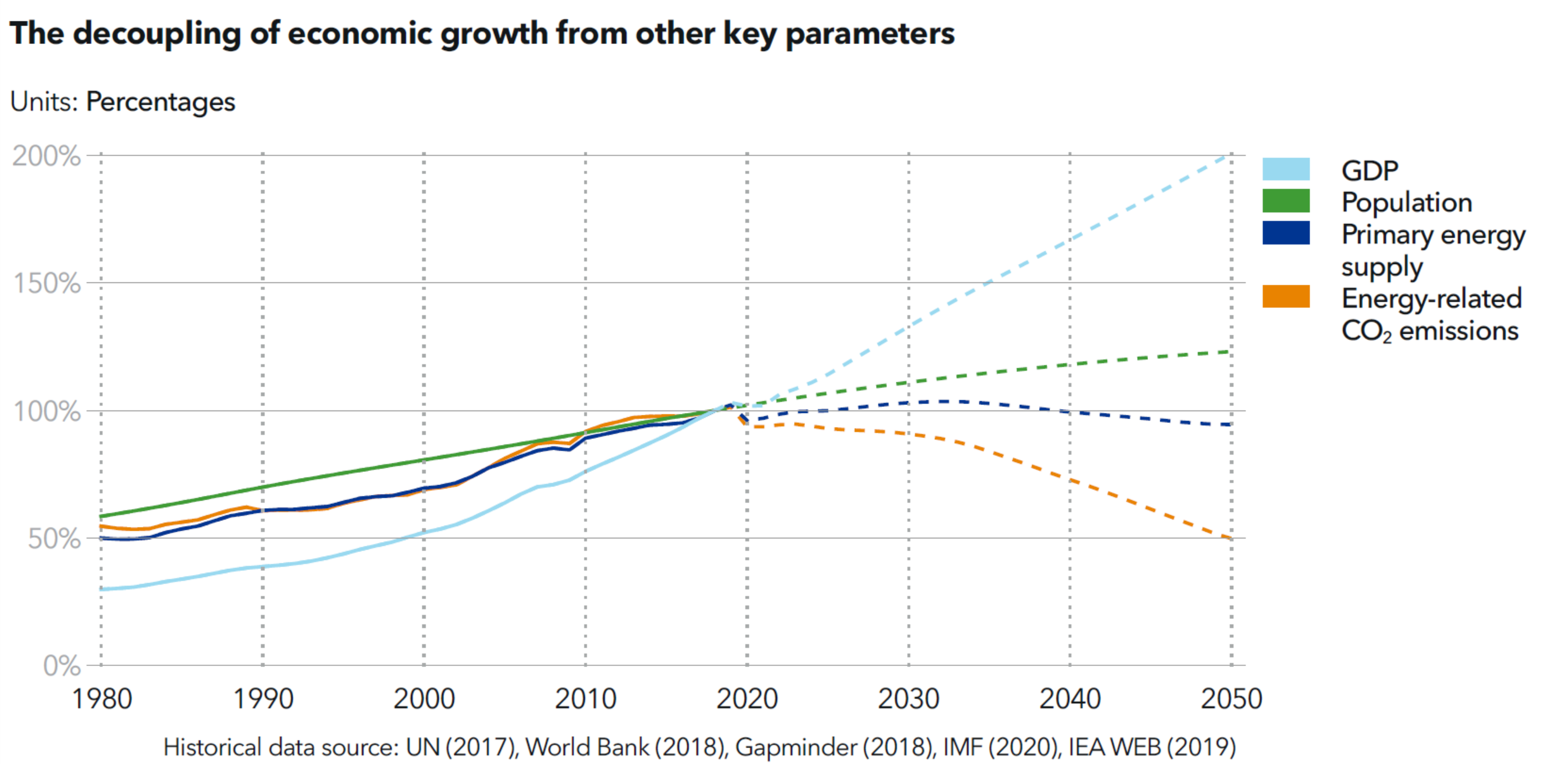
COVID-19 reduces global energy demand by 8%



Emissions have peaked, but COVID-19 has limited long-term effects on the climate

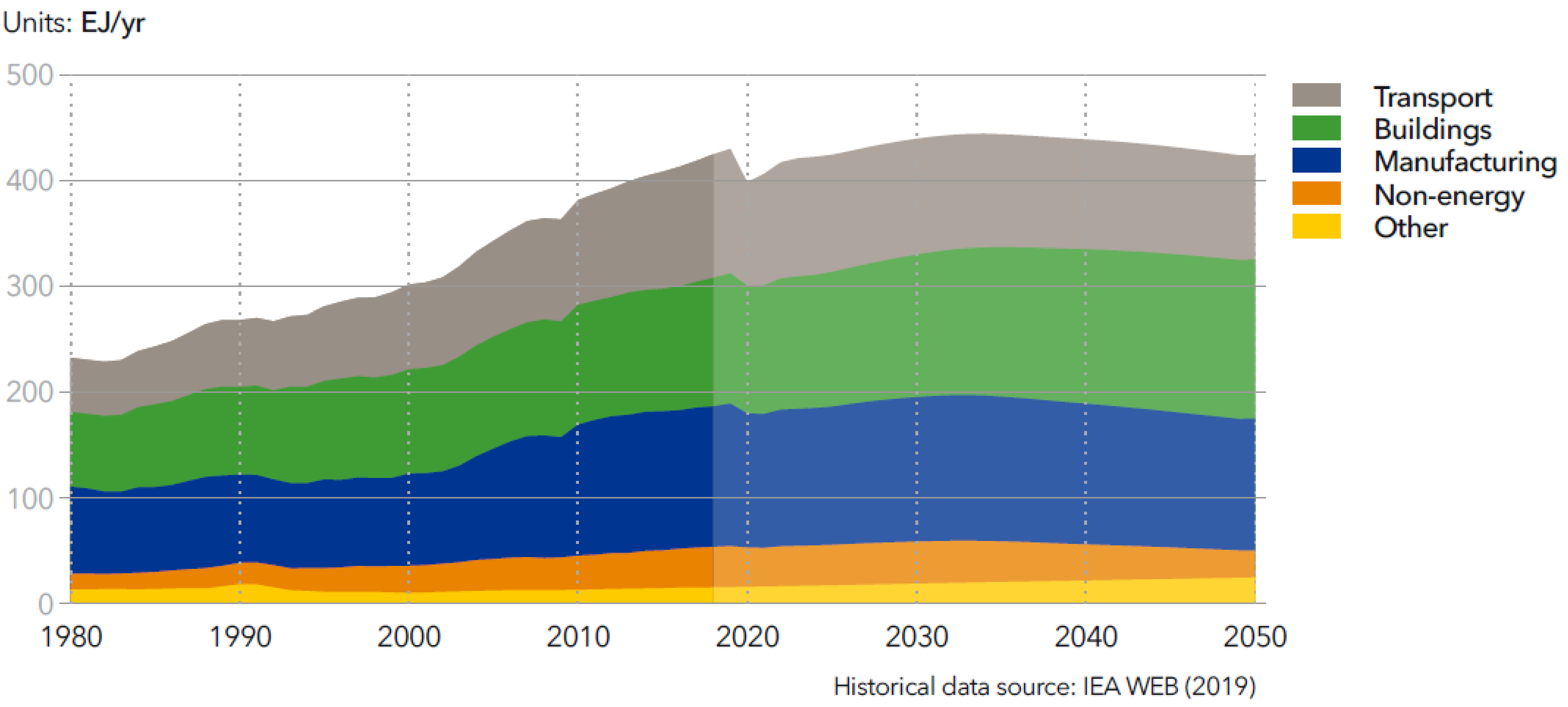


Population and economic growth is decoupling from energy use and emissions



Final energy demand peaks in 2034

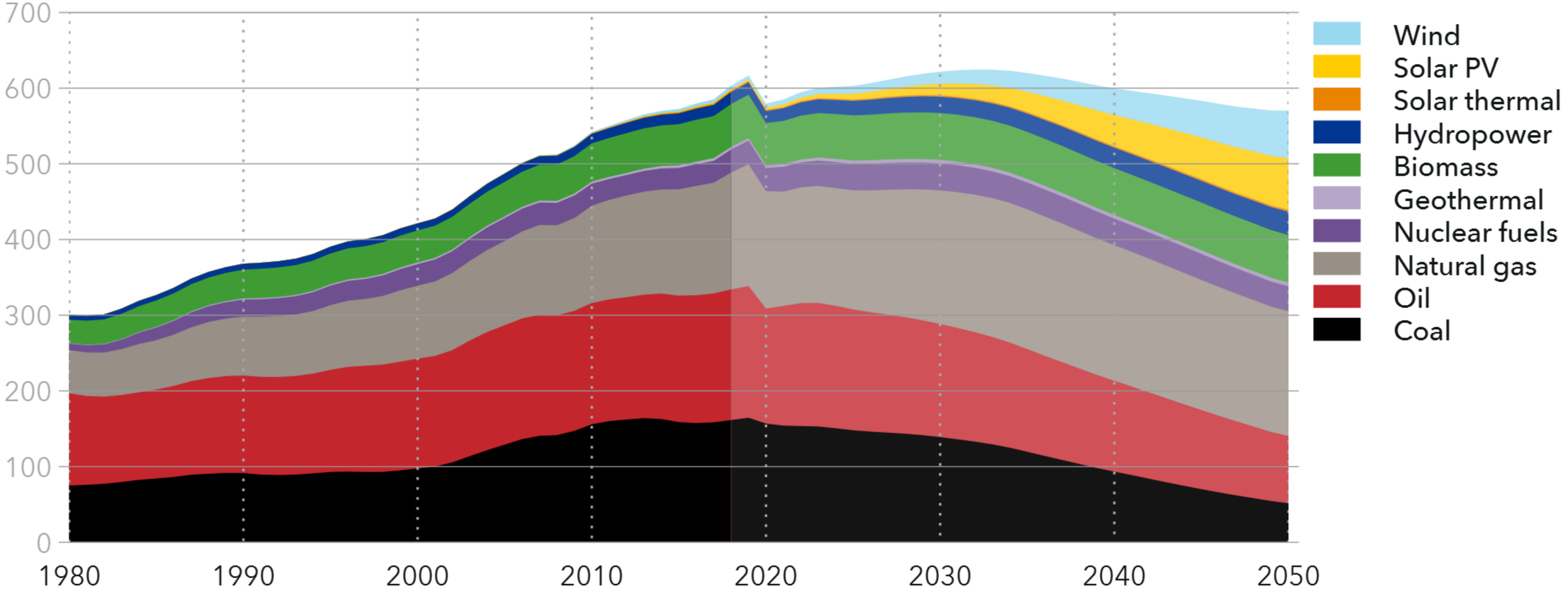
World final energy demand by sector



Primary energy supply peaks in 2032

World primary energy supply by source

Units: EJ/yr



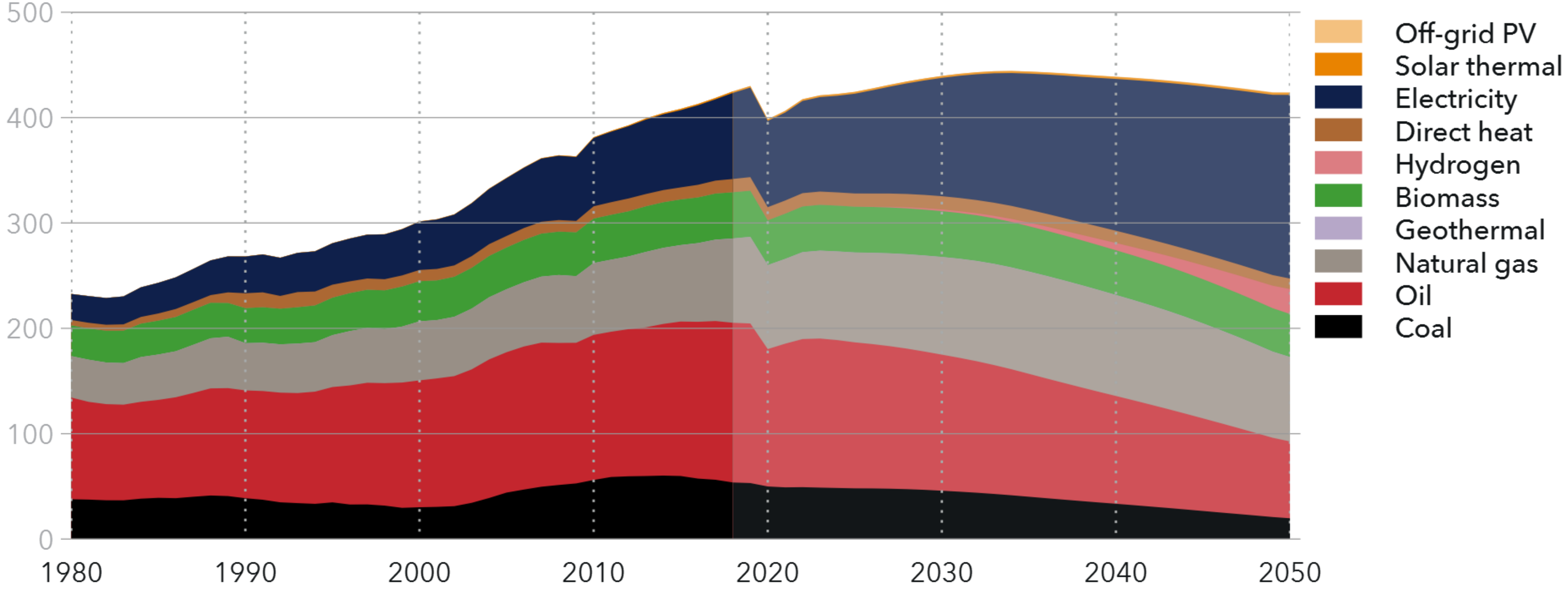
Historical data source: IEA WEB (2019)

DNV·GL

The share of electricity in the final energy demand mix will more than double

World final energy demand by carrier

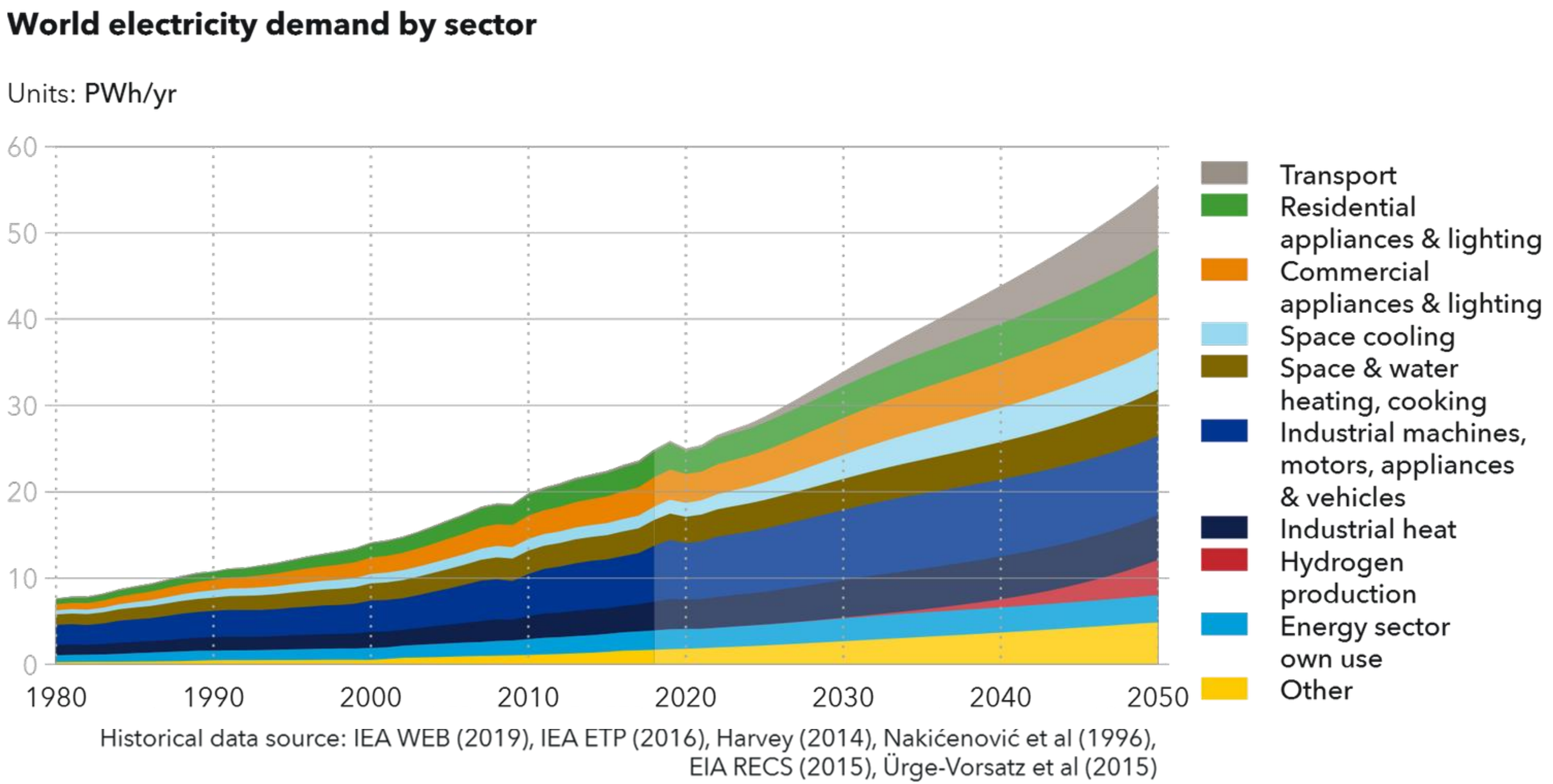
Units: EJ/yr



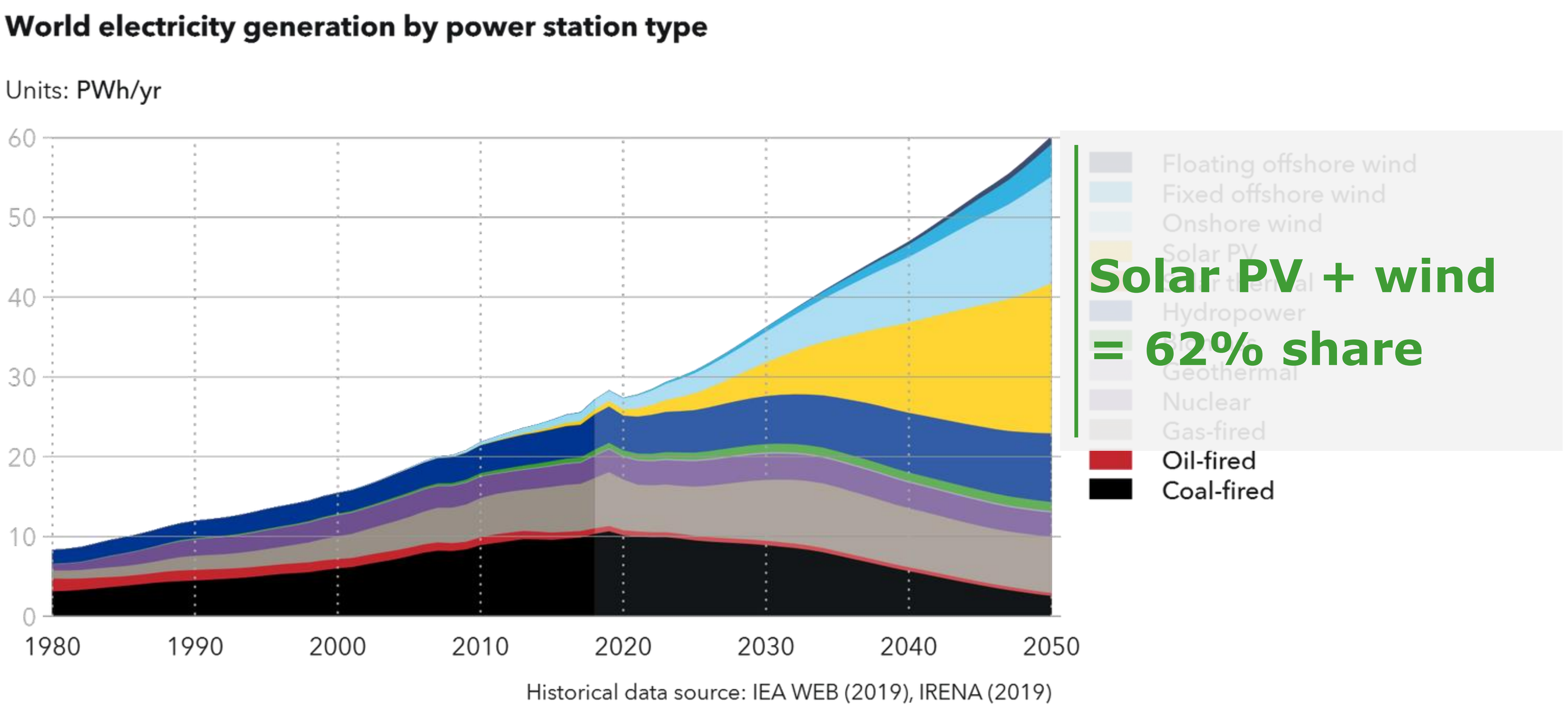
Historical data source: IEA WEB (2019)

DNV·GL

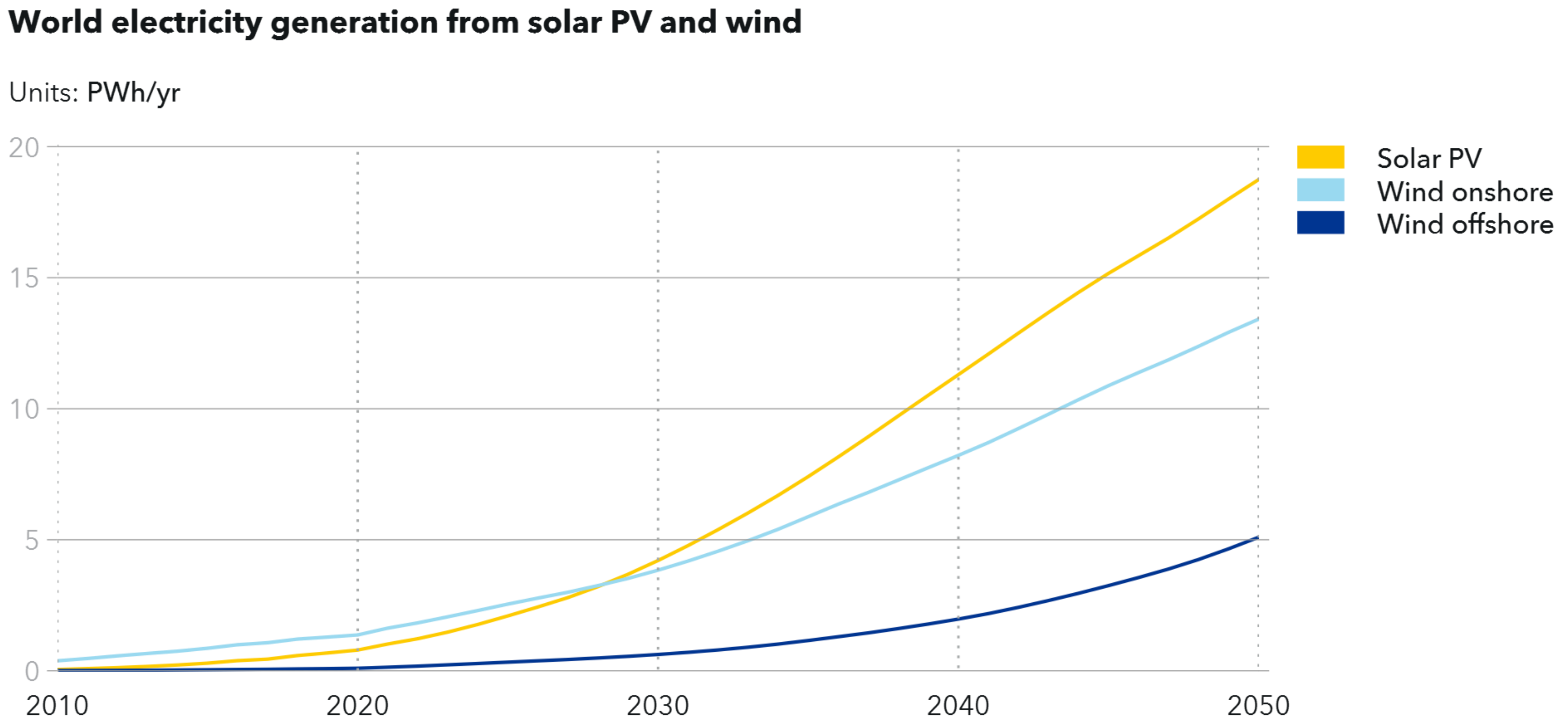
Sources of increasing electrification



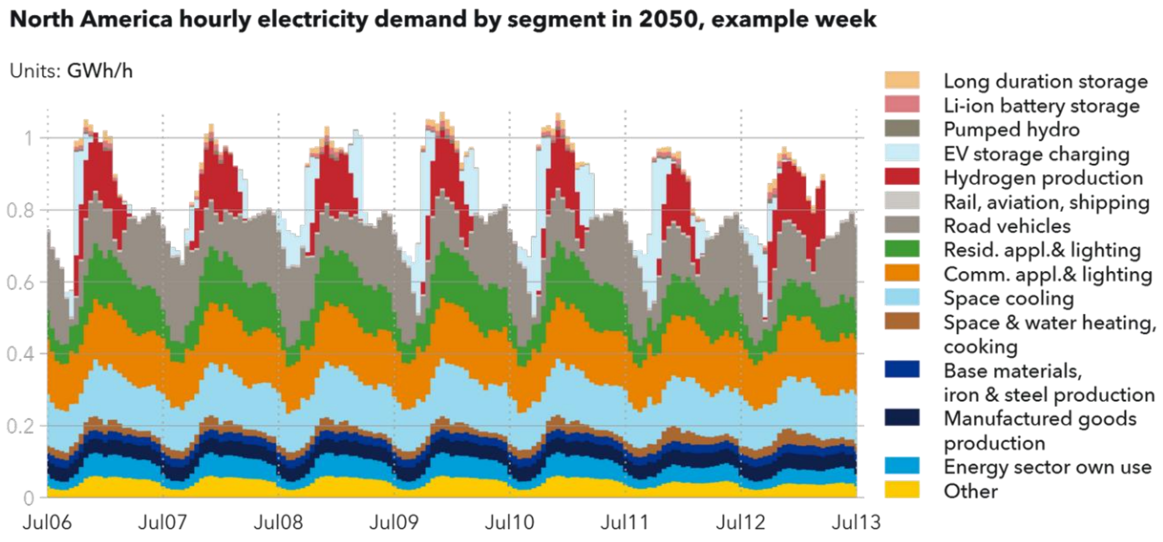
Solar PV and wind will dominate electrical generation

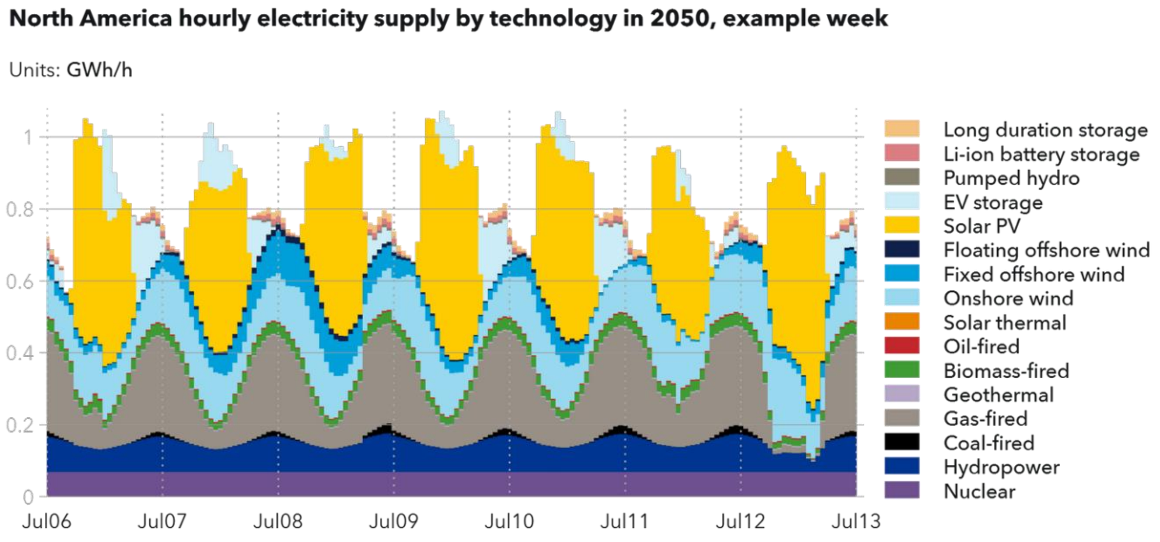


Fast expansion of solar PV and wind, but starting from a low base



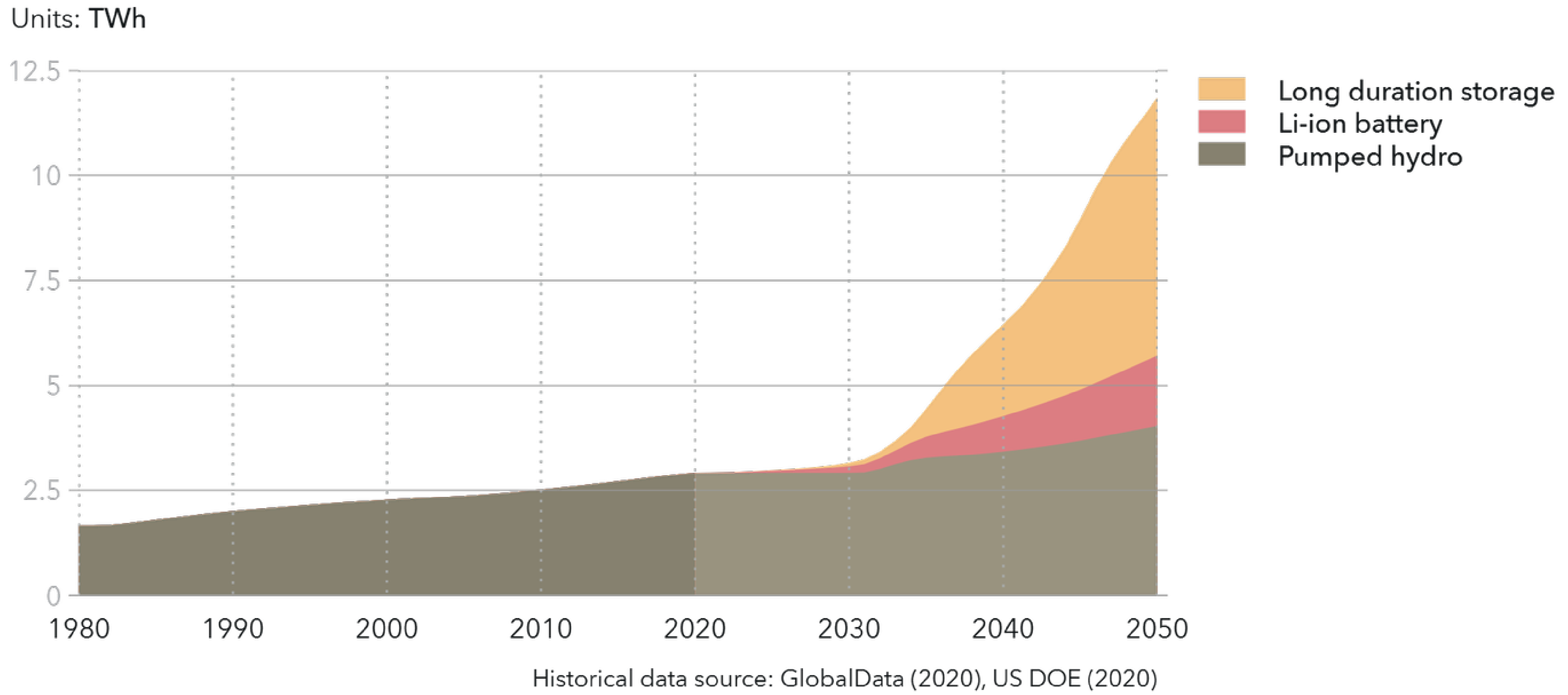
Energy storage will play an increasingly important role in future power systems





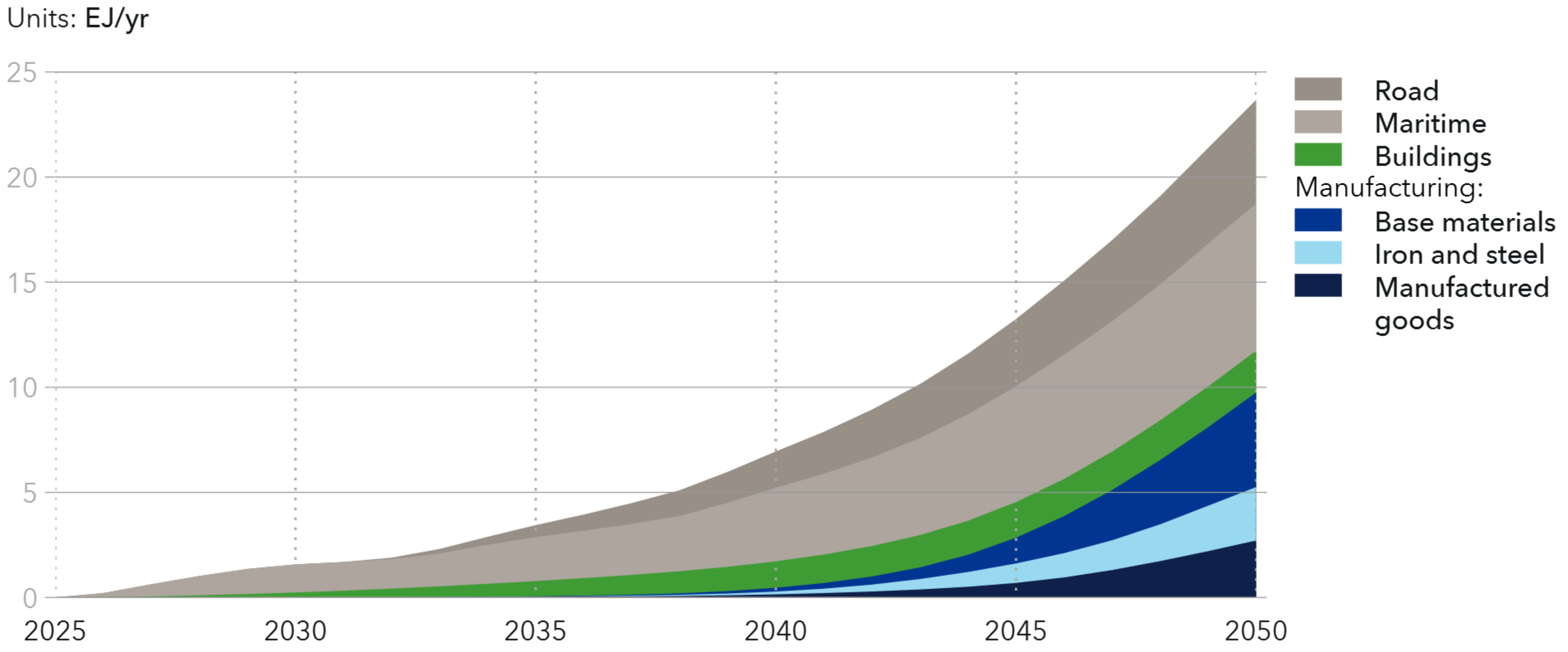
We predict significant growth in energy storage

World utility-scale storage capacity



Hydrogen growth comes late, but reaches over 5% of global energy demand in 2050

World hydrogen demand by sector



Only includes hydrogen as energy carrier. Maritime sythetic fuels are counted as hydrogen.

In 2050, the electricity system will be dramatically different than today

45,000
utility scale PV plants

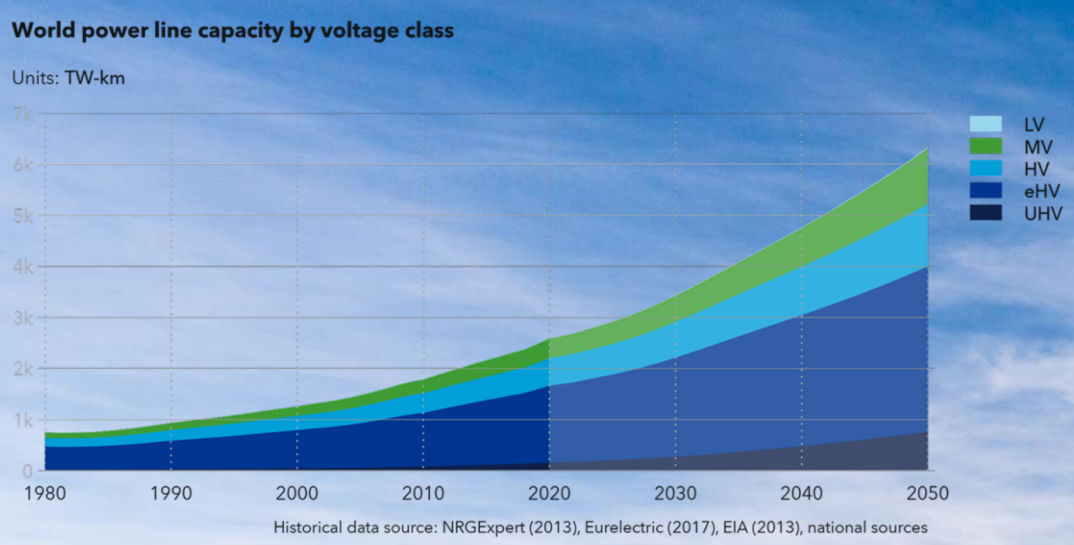
12,000
onshore wind farms

3,000
offshore wind farms

1.3 billion
passenger electric vehicles

DNV·GL

Huge increase in the capacity of electricity grids is needed



System operation will become more complex

Networks will need to operate closer to their thermal limits

Expansion of grids will move from interconnection to super grids

DNV·GL

The impact of energy storage on the grid

Storage needed to manage supply and demand, potentially delaying or avoiding grid upgrade requirements

The impact in wholesale energy markets depends on how much and how quickly fossil-based power generation is phased out

Adding new storage technologies to the grid may result in different fault conditions, moving from classical short-circuit currents to short high-current pulses

New technologies and trends impacting deeply future electricity grids

DNV·GL

DIGITAL TECHNOLOGY

COMPUTERS

Large and small

Distributed

Cloud

Edge

CONNECTIVITY

Internet

Mobile

5G

SENSORS & DATA

Proliferation of data

Decreasing cost of sensors

IoT

SOFTWARE

AI

Machine learning

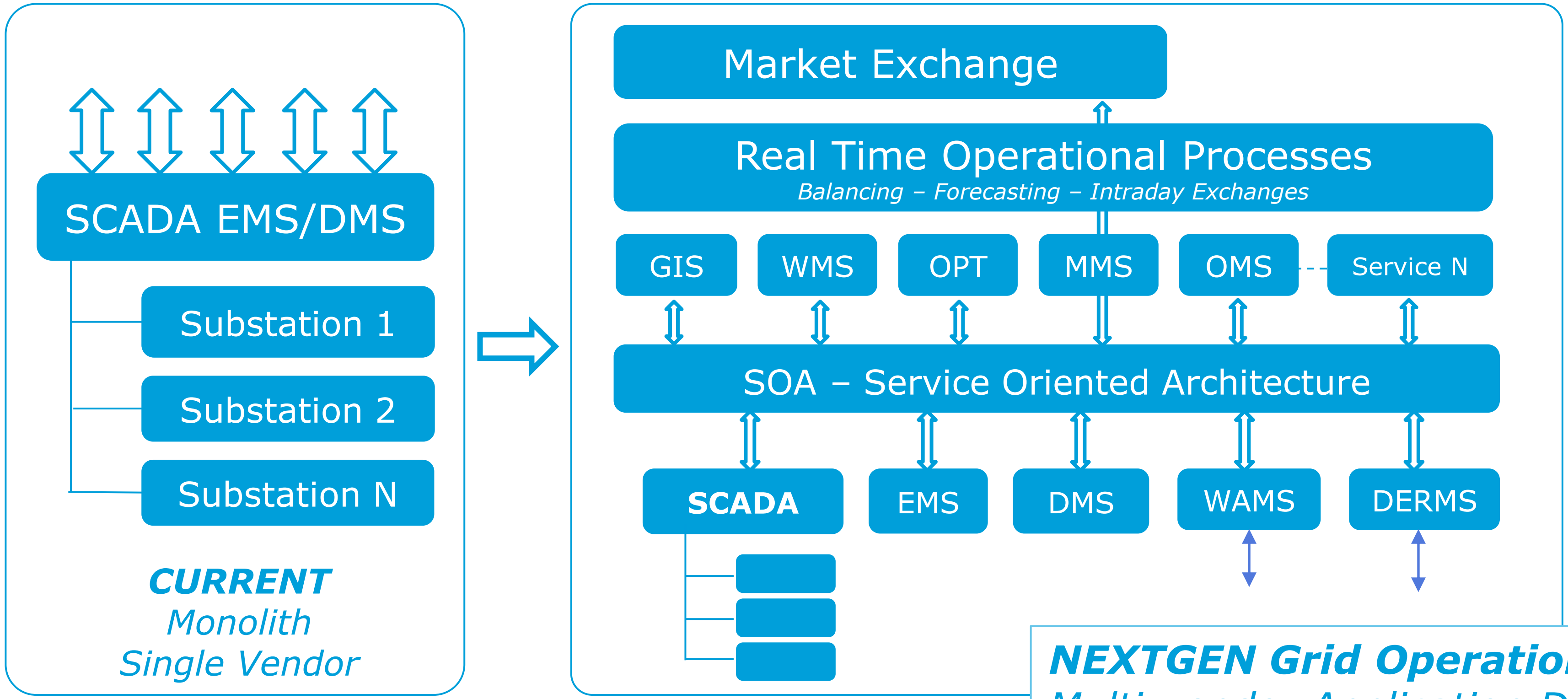
Big data

Blockchain

Change to **NEW DIGITAL GRID OPERATIONS MODEL → Building the MACHINE**

+++ Data – Complexity – Real Time

How to MIGRATE to – which steps to define

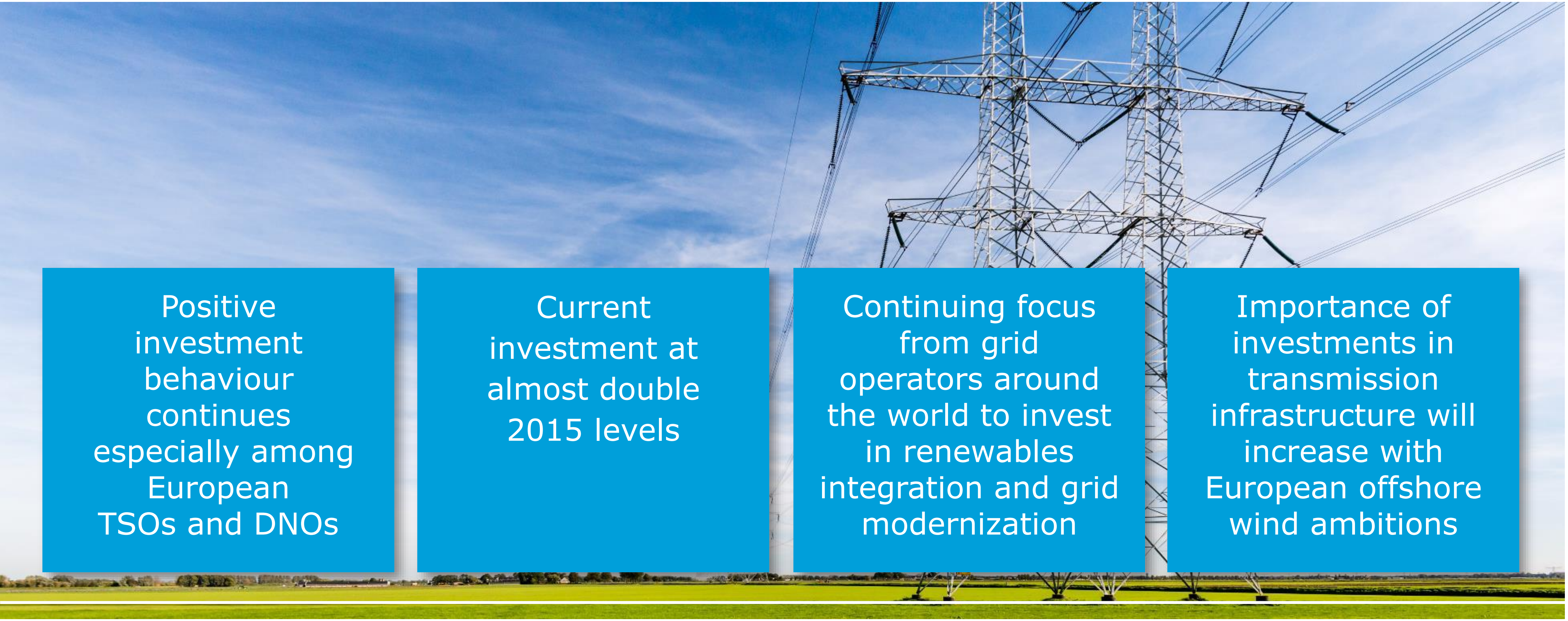


Data & information Security
Secure Architecture
Secure Applications
Secure Communications

Grid Edge Technologies

NEXTGEN Grid Operations
Multi-vendor Application Data Integrated System Architecture → Modular and Service Oriented

Investment in transmission and distribution infrastructure



Positive investment behaviour continues especially among European TSOs and DNOs

Current investment at almost double 2015 levels

Continuing focus from grid operators around the world to invest in renewables integration and grid modernization

Importance of investments in transmission infrastructure will increase with European offshore wind ambitions

HIGHLIGHTS

COVID-19 reduces energy demand by 8% and places peak emissions behind us

Rapid electrification, dominated by solar PV and wind, transforms the energy mix

Decarbonization of hard-to-abate sectors remains too slow → we are set to miss the Paris Agreement targets

Existing technologies can deliver the **1.5°C ambition**, but stronger policies are needed to scale uptake

Solutions to close the gap

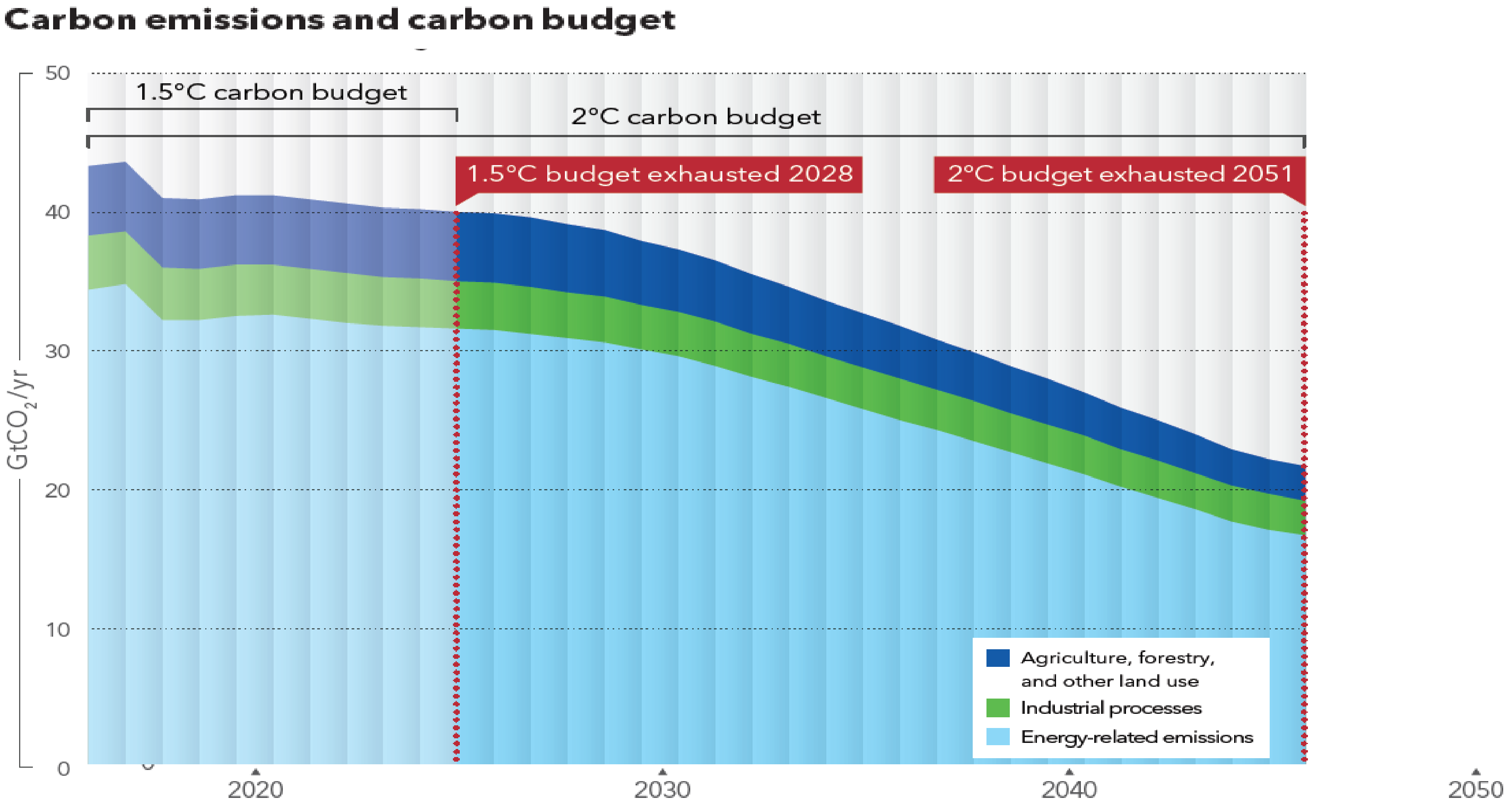
Improve
energy efficiency

Decarbonize
hard-to-abate sectors

Increase electrification
and renewable share

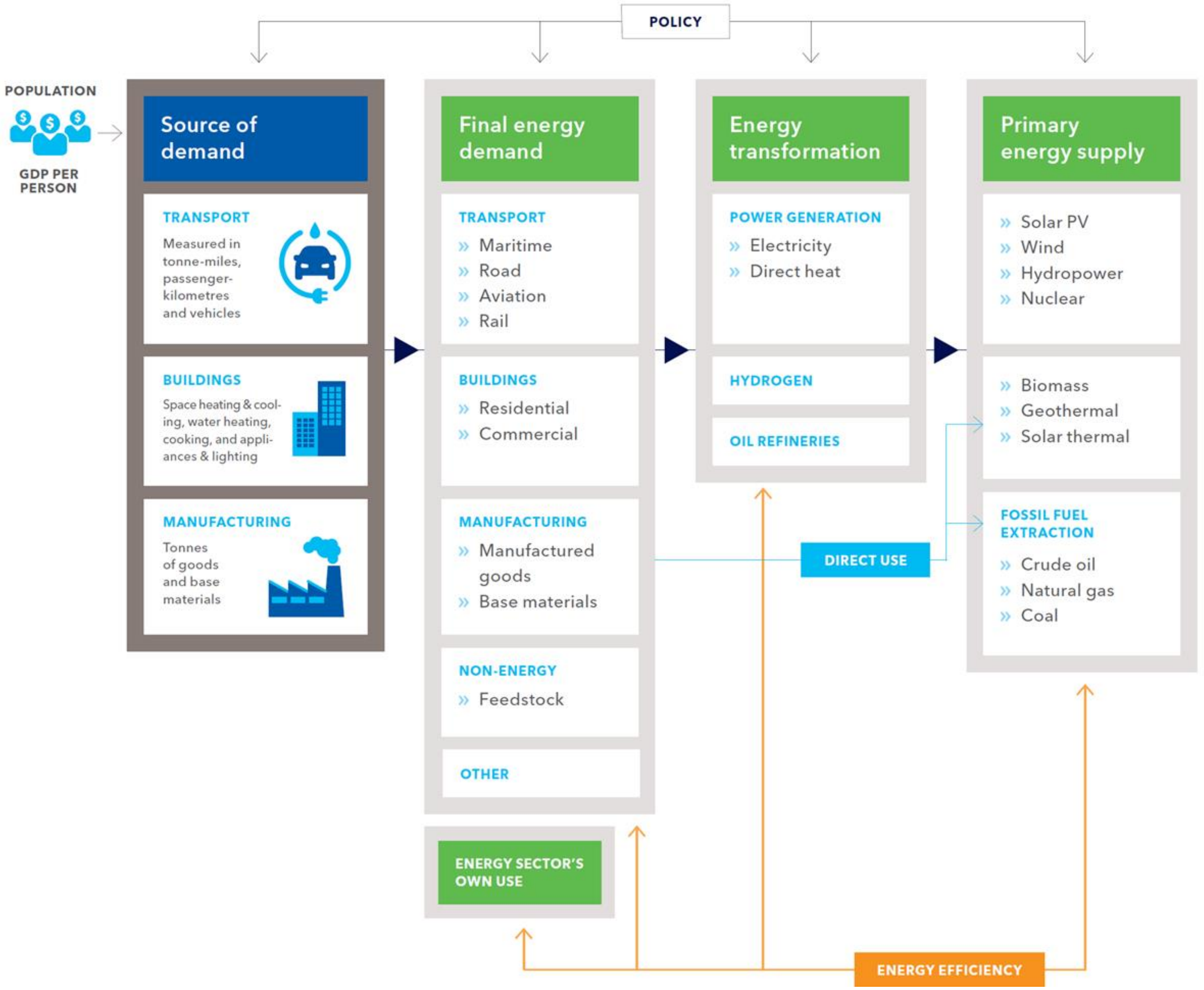
Deploy carbon capture
and storage

We exhaust the 1.5°C carbon budget already in 2028




cigré
30 september
2020
Impact fluctuerende energie-
bronnen op onze besturings- en
beveiligingssystemen
Beveiliging! Altijd en Overal
Home
Programma
Aanmelden
Locatie
Contact

ETO model framework



Key assumptions

Population

9.4 bn

Projected global population in 2050 of 9.4 billion

- 3.5% lower than the UN median population forecast at 9.8 billion

Economic growth

100%

Global economy will grow by 101% to 2050

- Reaching USD 270 trillion in 2050
- CAGR 2.2%/year from 2018-2050 (incl. 2020 COVID effects)

Learning Curves

16-28%

Average % cost reduction per doubling of installed capacity

- Solar panels 28%, reducing to 18%
- Wind turbines 16%
- Batteries 19%

Policy

<80 USD/t

Carbon prices will be regional and in 2050 range between $20-80/t (USD 2017)

Other policy examples:
- Air pollution measures
- RE power support
- EV support
- Maritime environmental regulations

DNV·GL

IMPLICATIONS FOR TNOs and DNO's

Major investments required

Increase in skilled staff & contractors required

Better demand control via real-time data

Much greater variations in power flow

Digitalization enables smart distribution substations

More sophisticated grid equipment required

TSO responsible for managing relations between generators, DSO & prosumers

Grids will become 'inverter rich'

IMPLICATIONS FOR TNOs and DNO's

Greater need for cyber secure systems

Digitalization & new business models allow greater interactions with consumers

Energy storage offers new solutions

Understanding network behaviour will become even more important

New operating and security skills, tools & procedures required

New competitive market mechanisms

Grid constraints limit expansion