

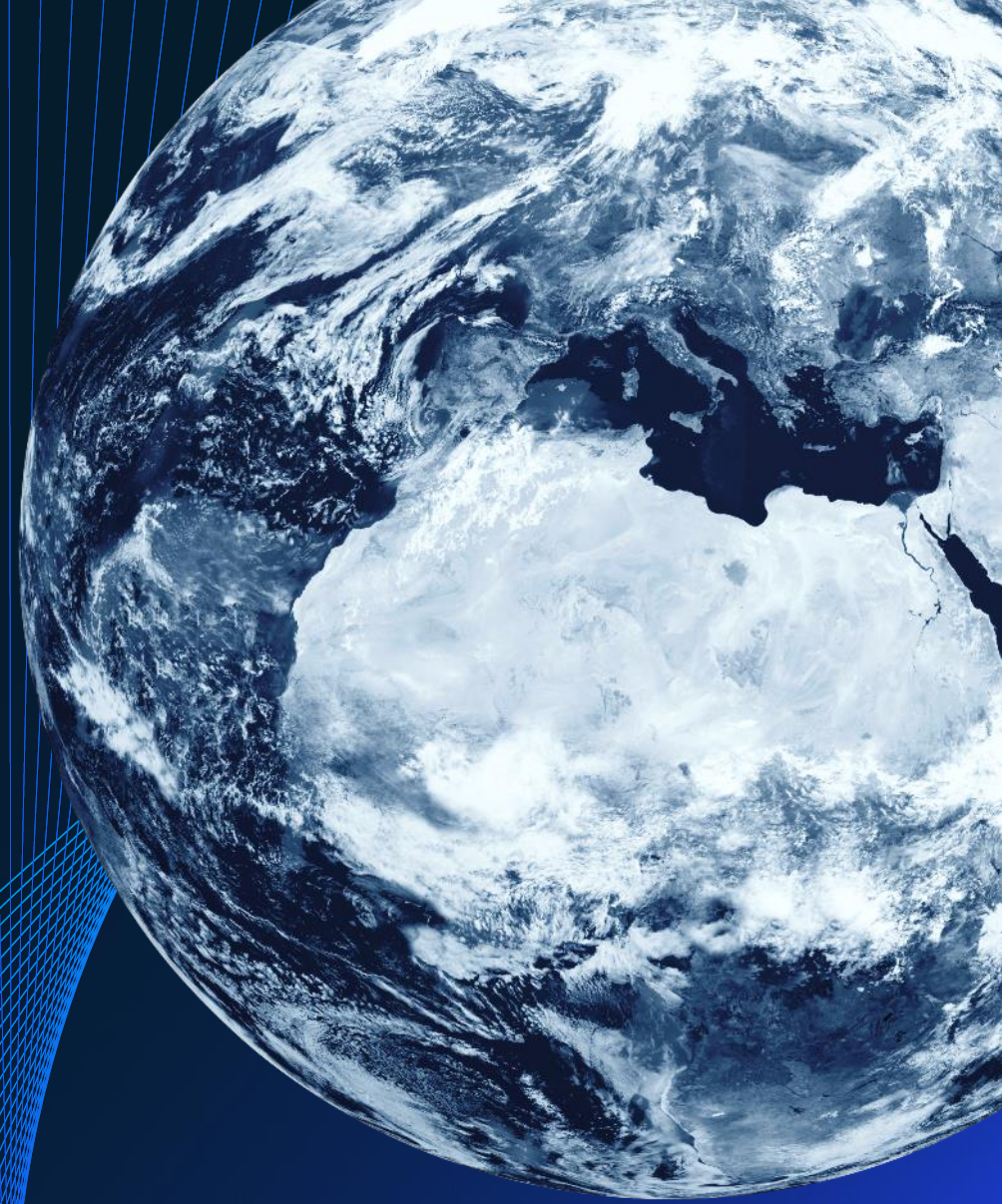
McKinsey
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Global Energy Perspective 2021

April 2021

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Key insights from the Global Energy Perspective Reference Case

1



Long-term demand impact of
COVID-19 is modest

2



Power wins and hydrogen changes
the landscape

3



Peaks in fossil fuel demand keep
coming closer

4



Change is too slow to reach a 1.5°C
pathway

5



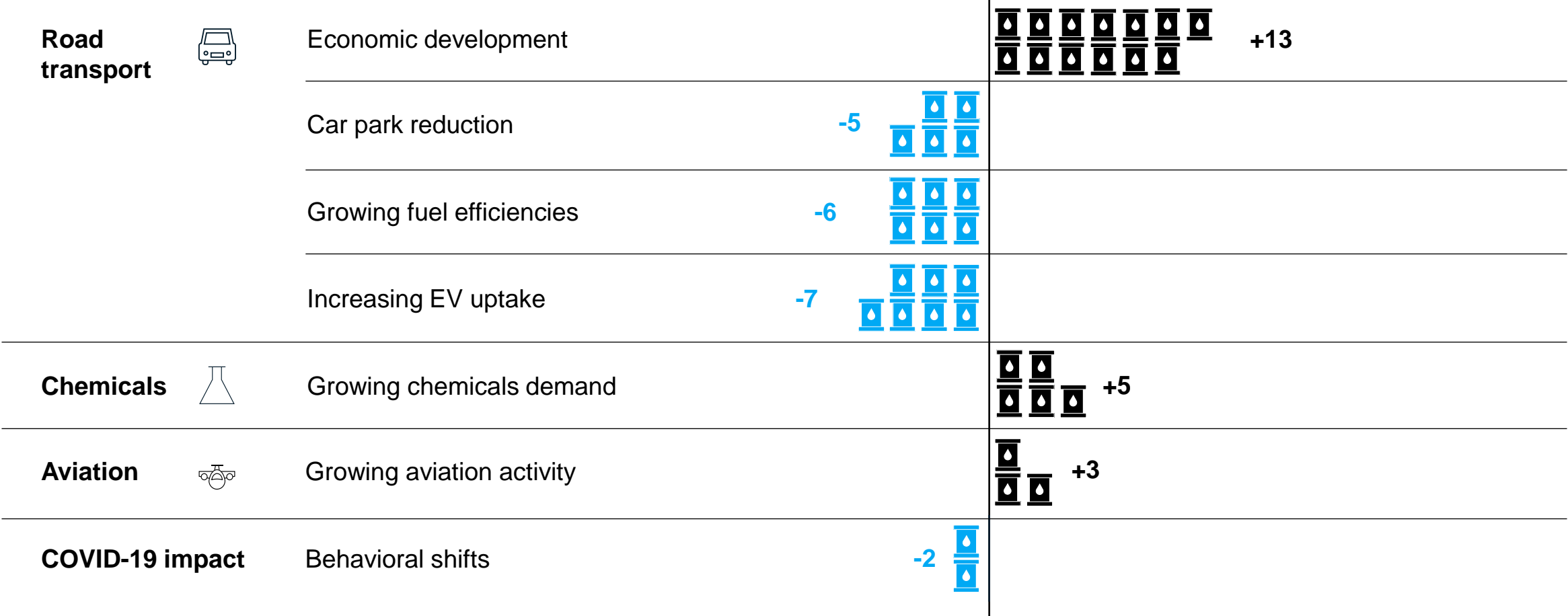
Investment flows remain stable over
the next 15 years

1. In the longer term, the impacts of behavioral shifts due to COVID-19 are minor compared to “known” shifts

Feb 09, 2020

 1 MMb/d

Growth/decline in oil demand 2019-35, by underlying driver MMb/d

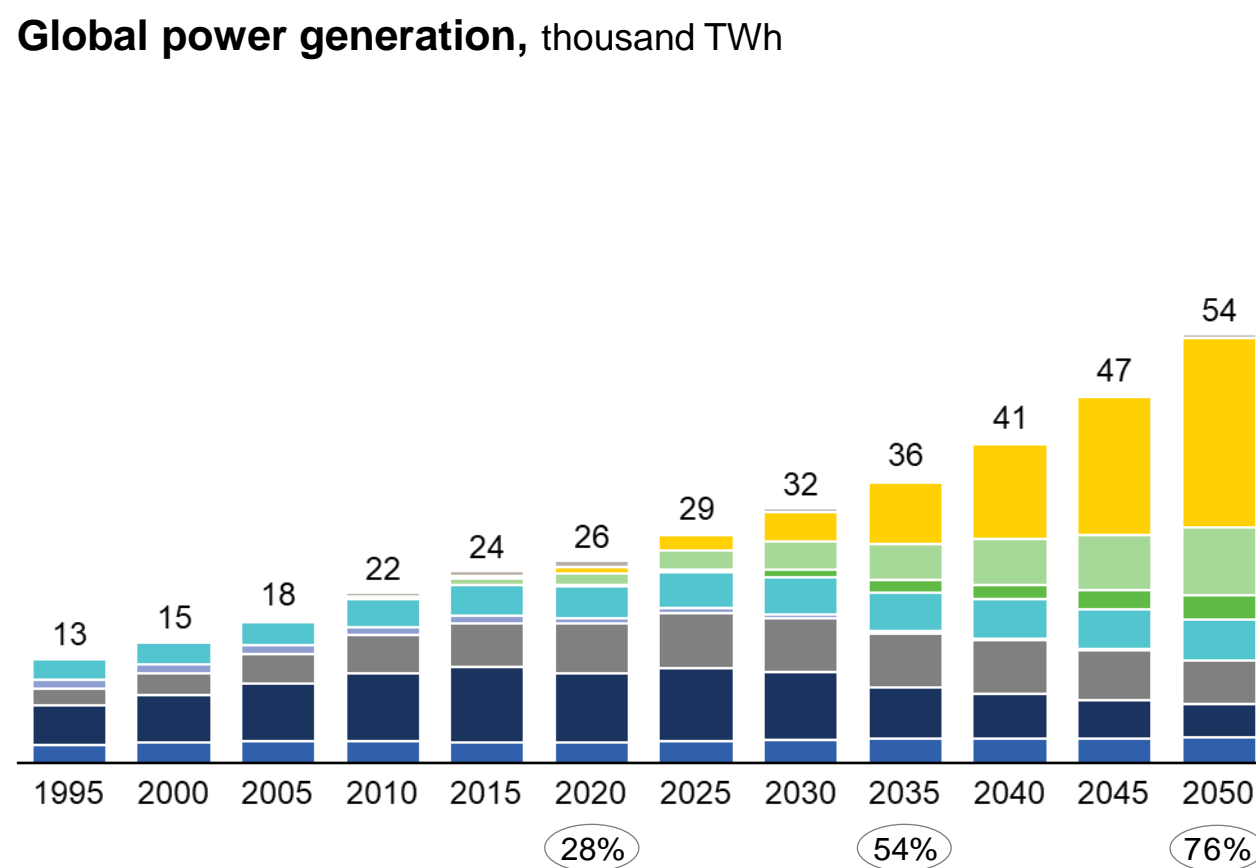


2. In the Reference Case, renewables account for half of the power supply by 2035

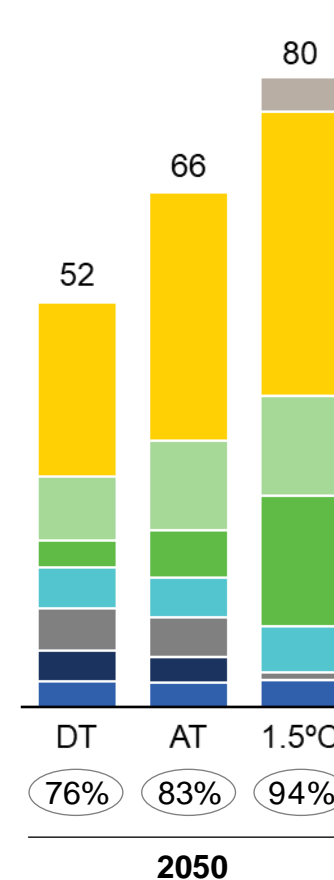
In the 1.5°C scenario, more offshore wind and solar are required

XX Share of renewables Other Solar Wind onshore Wind offshore Hydro Oil Gas Coal Nuclear

Global power generation, thousand TWh



Scenarios¹



6x

more renewable generation (incl. hydro) by 2050

10%

share of gas-fired generation in the 2050 mix (vs ~25% today)

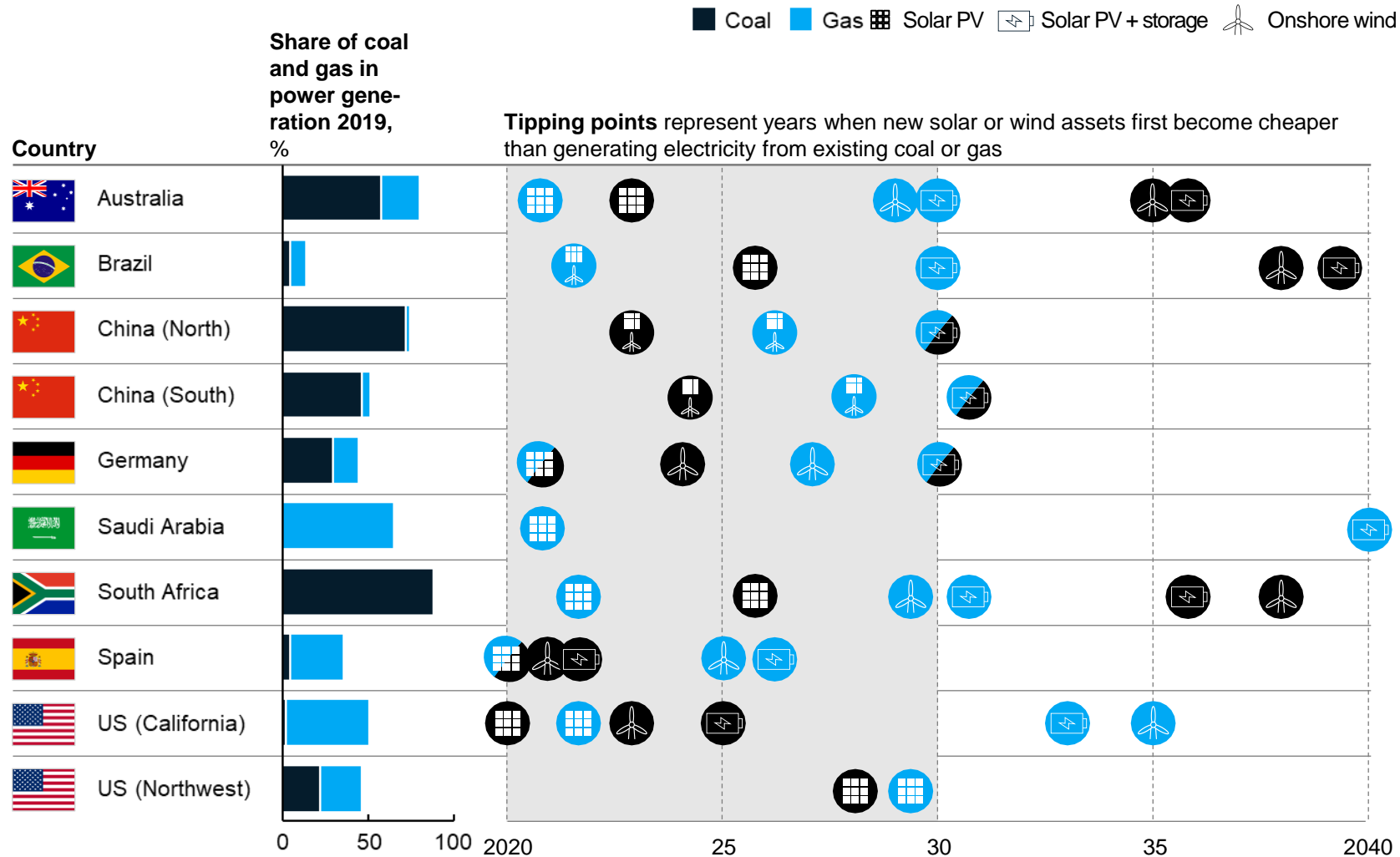
-50%

reduction of coal fired power generation by 2050

1. DT refers to the Delayed Transition; AT refers to the Accelerated Transition

2. Renewables become cheaper than existing fossil plants in most locations

New renewables can compete with the marginal cost of fossil power by 2030



Power from newly built renewables becomes cost-competitive with power generation from existing coal and gas assets

in late 2020s

in most countries

Solar PV

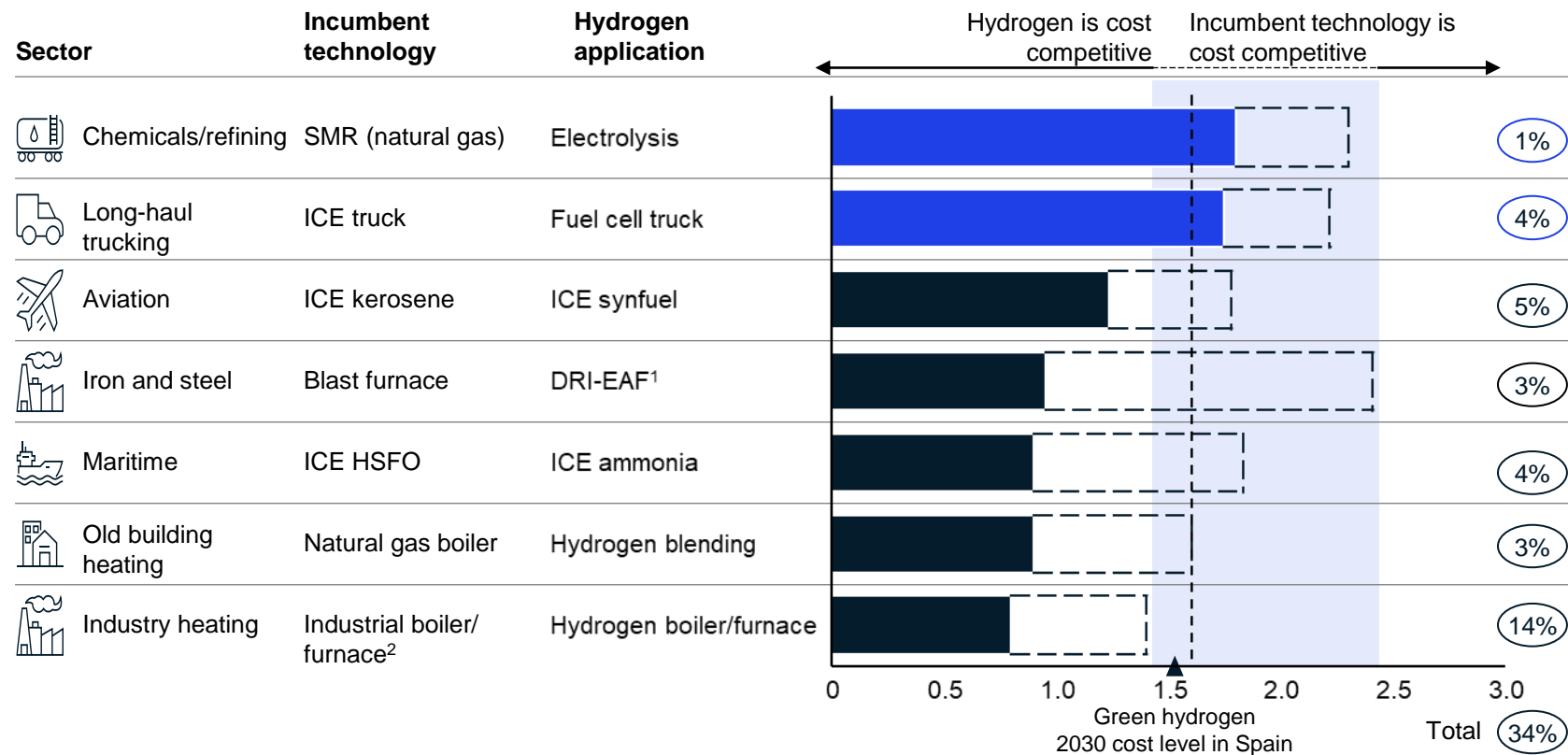
becomes economical first in all regions as a result of lower levelized cost of electricity

2. With additional support, clean hydrogen becomes competitive in large-volume sectors

By 2030, low-cost hydrogen is cost competitive in around 5 percent of the European Union's energy demand



Break-even production cost of clean hydrogen against competing incumbent technology,
hydrogen production cost for TCO parity in 2030 based on average EU commodity prices, \$/kg



By 2030

low-cost clean hydrogen) is set to become cost competitive in chemicals or refining and long-haul trucking

\$100/tCO₂

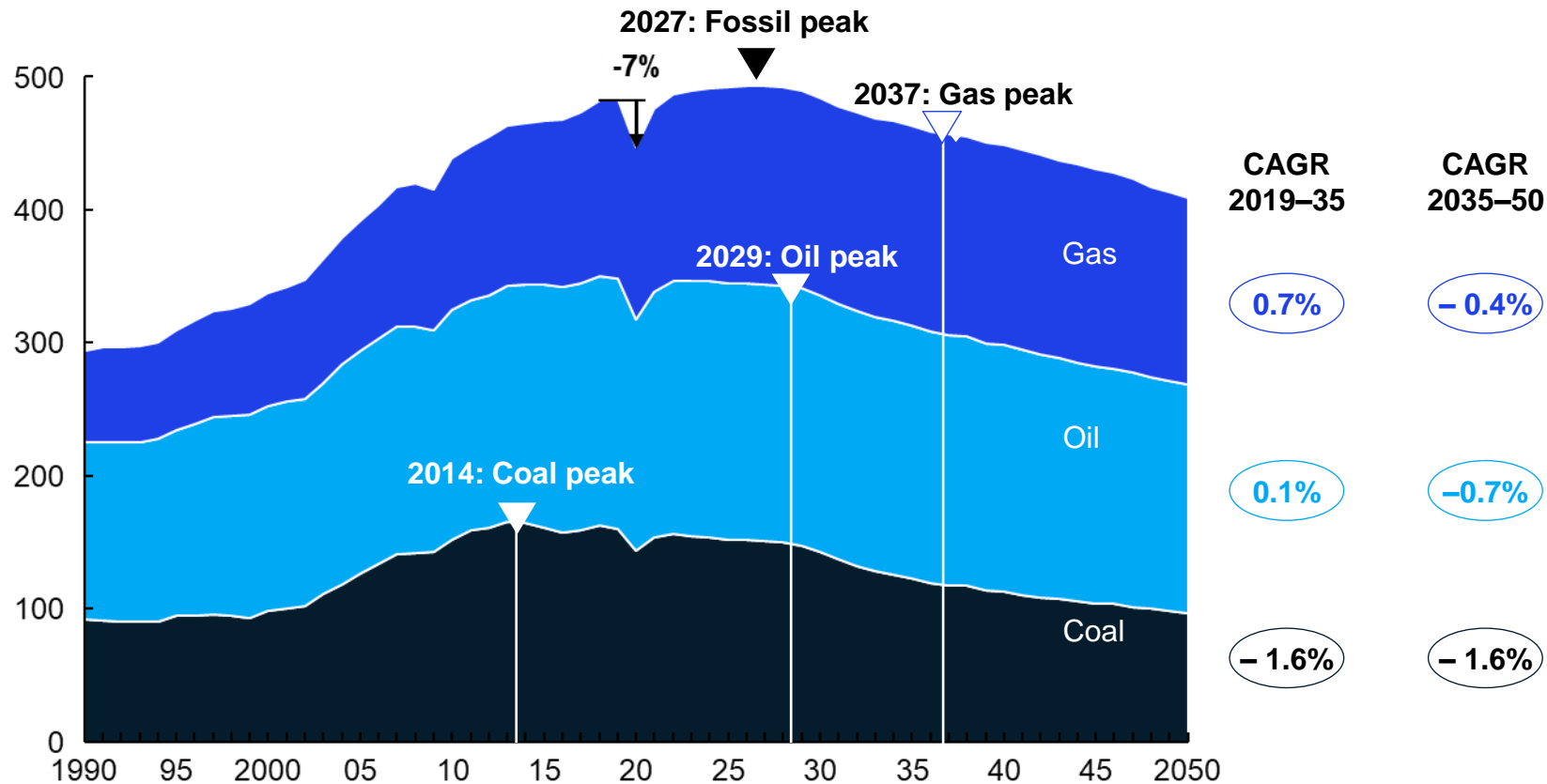
carbon tax can unlock ~20% of total energy demand by 2030 for hydrogen

1. Direct reduced iron (reduction process can be done with hydrogen) and electric arc furnace production route (cost estimates)
2. Excluding steel production and ammonia or methanol production. Ammonia production is covered by chemicals/refining

3. In the Reference Case, fossil fuels continue to play an important role, despite a peak in 2027

Oil demand peaks in the late 2020s, gas in the 2030s, whereas coal declines steadily

Primary energy demand per fossil fuel
million TJ



1. Compared to 2019 levels

Source: McKinsey Energy Insights Global Energy Perspective 2021, December 2020

Compared to 2019, by 2050 we will see:

4% higher
gas demand

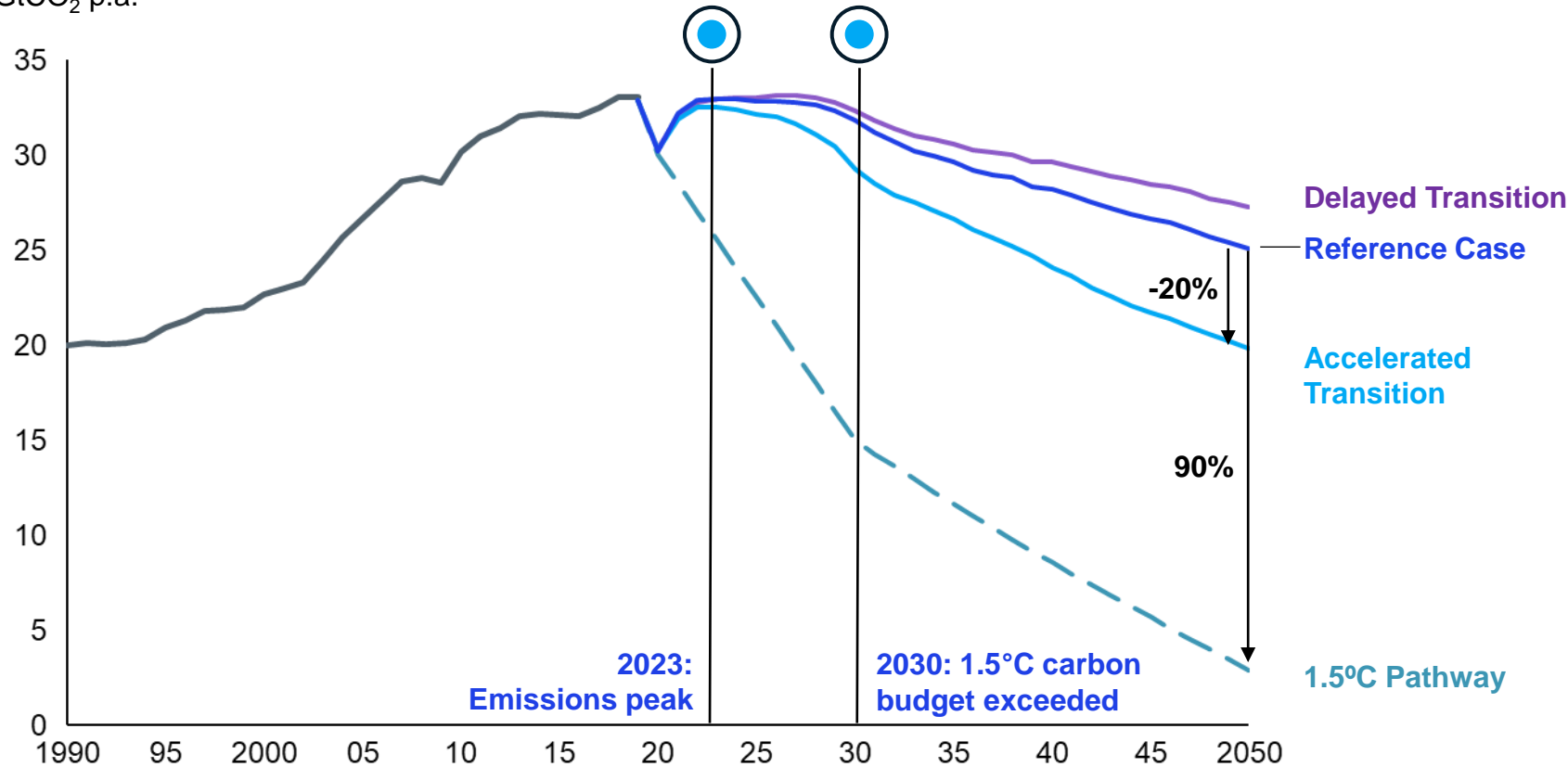
9% lower
oil demand

40% lower
coal demand

4. Global CO₂ emissions peak at around 33 GtCO₂ in 2023, far from the 1.5°C Pathway trajectory

In the Ref. Case, the global carbon budget for 1.5°C Pathway is exhausted by 2030

Global gross energy-related CO₂ emissions, GtCO₂ p.a.



The Accelerated Transition case shows emissions

only 20%

below Reference Case, despite rapid acceleration of the energy transition across multiple sectors

-90%

emissions reduction required to comply with 1.5°C Pathway

4. There are ten key requirements to stabilize the climate and limit the temperature rise to 1.5°C

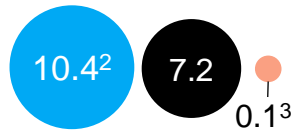
Renewables power and electrification drive the most significant reductions

Gt abated by 2050 vs. 2016 emissions ■ CO₂ ■ CH₄ (in CO₂e²) ■ N₂O (in CO₂e²)

Reduce demand



Reduce demand through process optimization, energy efficiency, and a “circular economy”



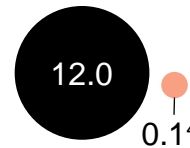
Change how we power and fuel our lives



Electrify road transport, building consumption, and industrial processes



Deploy renewables at scale and speed



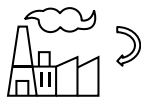
Grow the hydrogen market many times over



Expand the use of biomass, biofuels, and bioenergy into other sectors



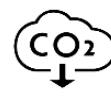
Scale up a “carbon management” industry



Scale **carbon capture, storage, and utilization**



Stop deforestation



Develop **CO₂ removal** markets



Tackle other GHG emissions



Reform **agriculture and food systems**



Eliminate **fugitive methane emissions**



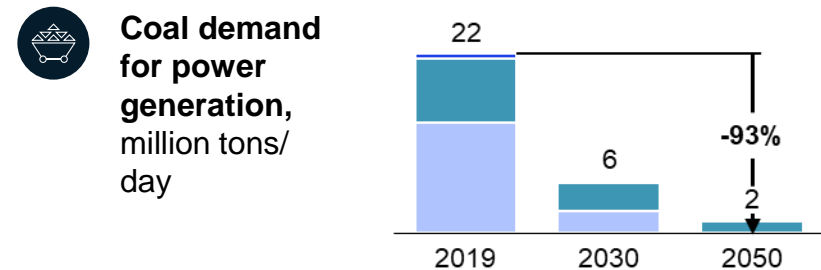
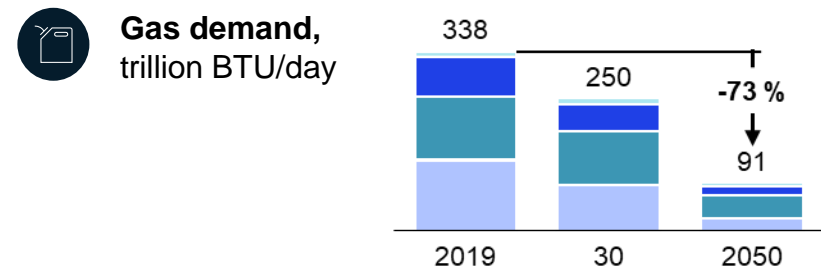
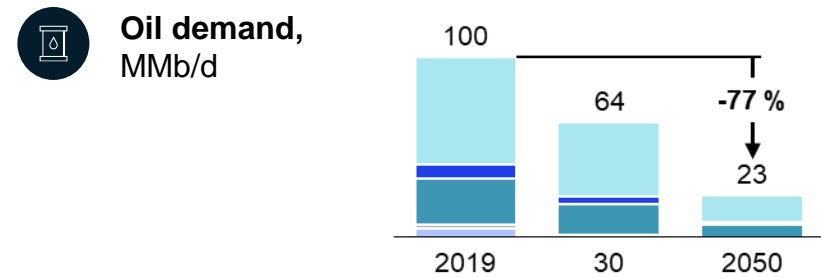
1. Converted using GWP-20 years from IPCC's AR5 report
2. Demand reduction abates most of the methane emissions from the O&G and mining industry as the activity is avoided at the source
3. Demand reduction of chemical production
4. Nitrous oxide emissions from stationary combustion sources
5. Flaring of natural gas

4. The 1.5°C Pathway requires rapid demand decline for fossil fuels and high RES growth

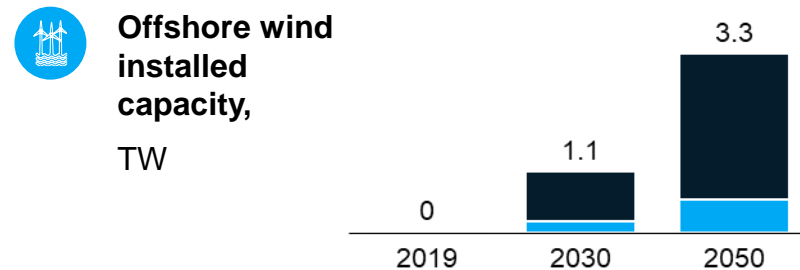
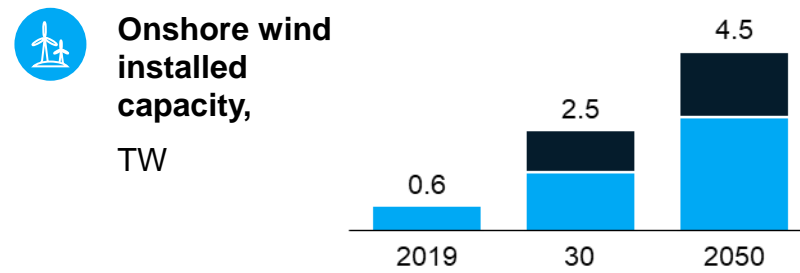
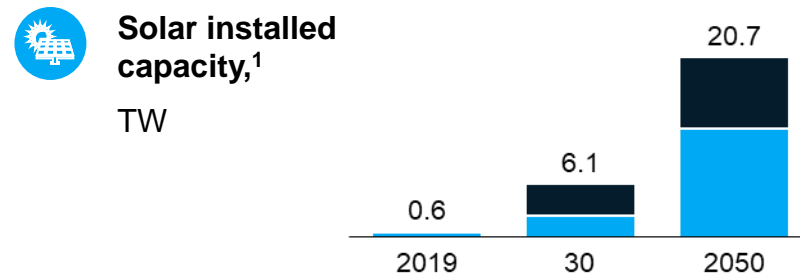
Demand reduction and RES uptake alone can reduce ~50% of CO₂ emissions by 2050

■ Transport
 ■ Buildings
 ■ Industry
 ■ Agriculture
 ■ Power
 ■ Additional for 1.5C scenario
 ■ Reference Case 2021

Demand for oil, gas, and coal decline rapidly...



... as renewables quickly gain ground



+70%

solar capacity by 2050

+60%

onshore wind capacity by 2050

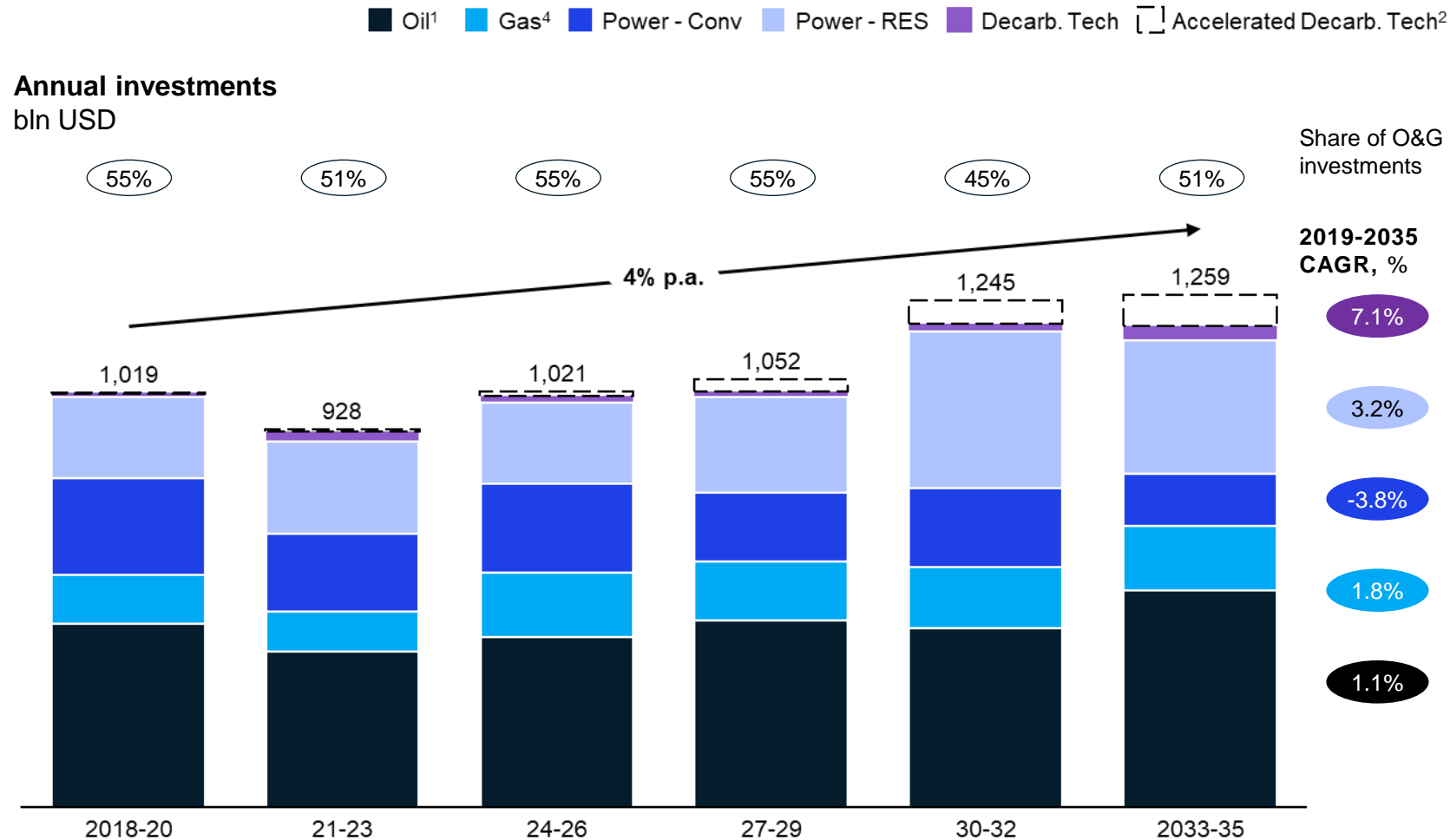
x5

offshore wind capacity by 2050

1. Includes Solar PV and concentrated solar power

5. Even with electrification and H₂ growth, half of energy investments in 2035 still go into O&G

Renewables power grows 4% p.a. while conventional decreases by 4% p.a. in 2020–35



1. Subsectors included: Oil – Oil Upstream, Oil Refining and Petrochemicals; Gas – Gas Upstream and LNG; RES – Geothermal, Marine, Solar PV, CSP, Wind Onshore, Wind Offshore, Storage, Biomass and Hydro an Decarbonization Technologies – biofuels and hydrogen
 2. Only hydrogen accelerated (from Muted Recovery)

2025

annual energy investments return to pre-COVID-19

3x higher

Investment in decarb technologies in 2025-35

\$130b

Investments in hydrogen in 2035

5. By 2040, E&P companies need to add 38MMb/d of new crude production from unsanctioned projects to meet demand

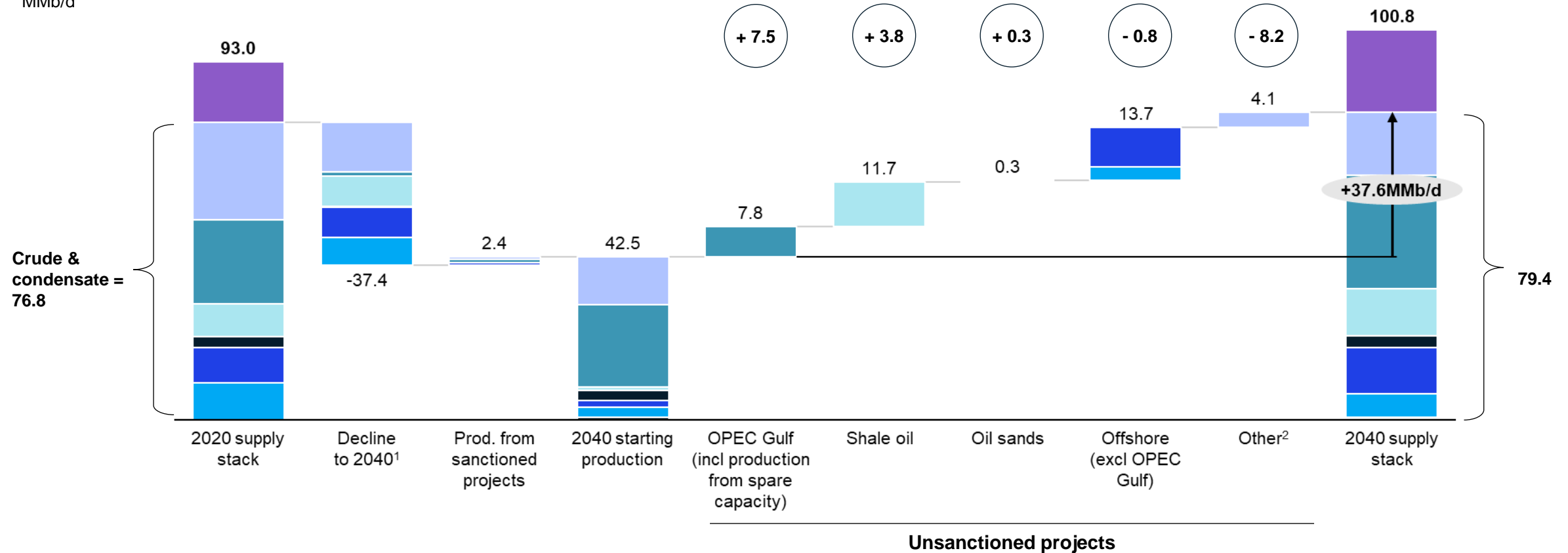
Renewables power grows 4% p.a. while conventional decreases by 4% p

OPEC Control Scenario

(x) Net change 2020-40 NGL and other liquids² Other³ OPEC Gulf Shale oil⁴ Oil sands Deepwater Shallow water

Global oil supply growth 2020-40

MMb/d



1 This decline is net of in-fill drilling, and other work done to fields that are not classified as major projects

3 Other includes onshore conventional and heavy oil, all outside of OPEC Gulf

2 Includes biofuels, processing gains, coal and gas to liquids, MTBE, and inventory movements

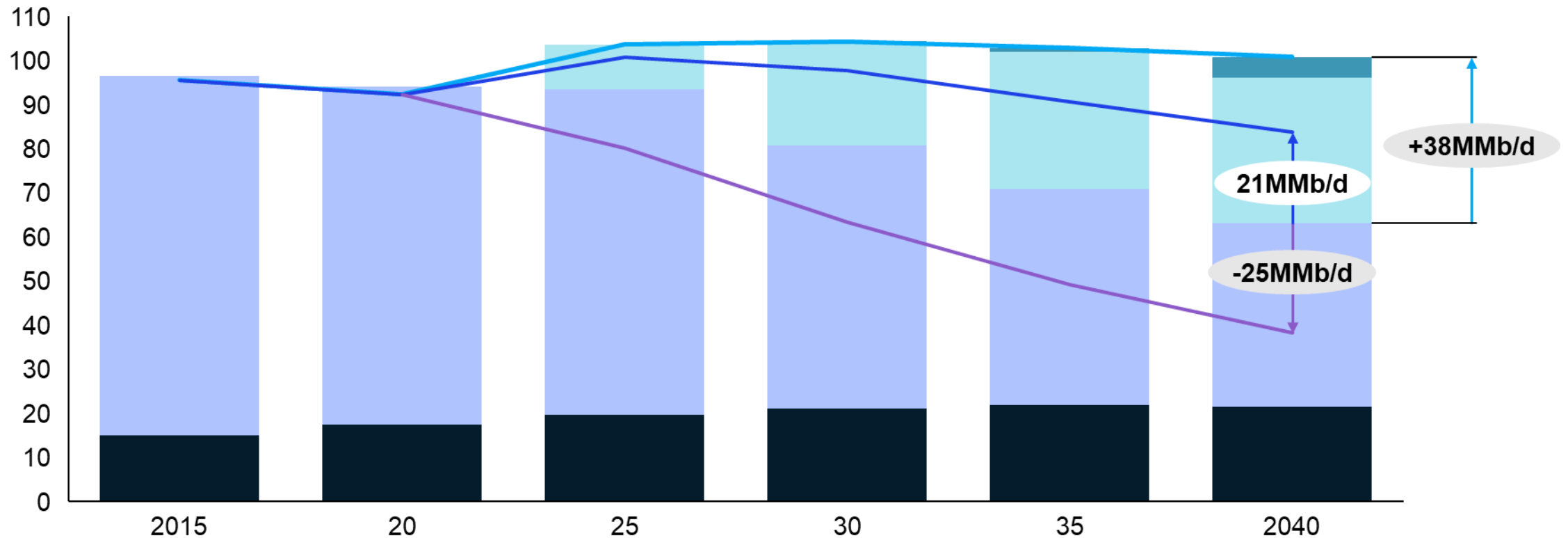
4 Shale oil includes associated oil from unconventional gas wells

5. New O&G projects will be needed under the Accelerated Energy Transition demand case, while 1.5C pathway would require shut-ins

— Reference demand
 — 1.5°C Pathway demand
 ■ Discovered pre-FID production
 ■ NGLs and other liquids
— Accelerated Energy Transition demand
 ■ Yet-to-find production
 ■ Post-FID production

Global liquids supply and demand outlook

MMb/d



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