TotalEnergies

TotalEnergies
Energy Outlook 2022
Long term view on Energy Demand

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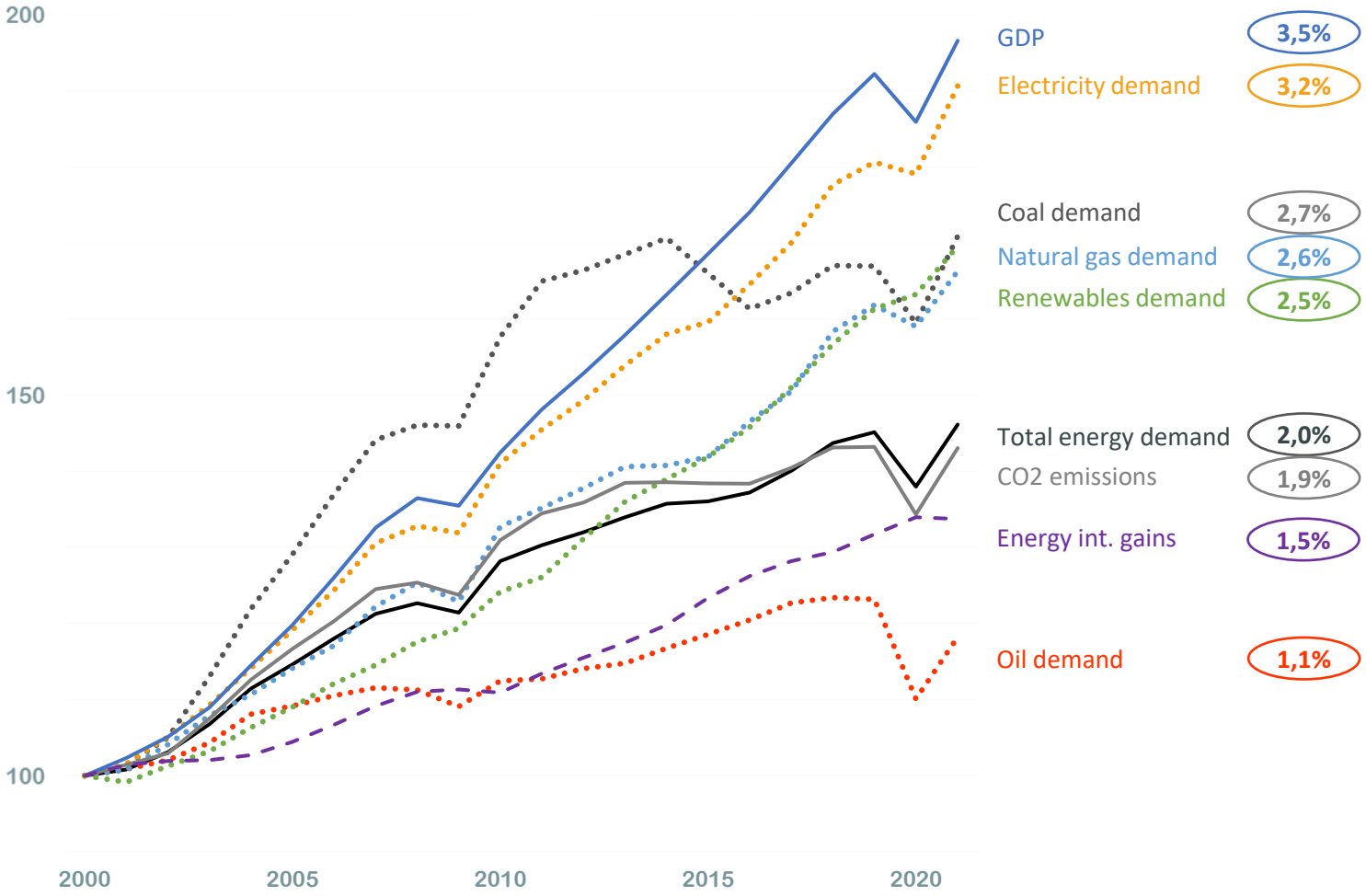
Strategy & Market Analysis

Energy trends since 2000: transition has started

GDP growth decoupled from total energy demand and CO_2 emissions growth

Index of key indicators

2000=100



CAGR 2000/2019

GDP	3,5%
Electricity demand	3,2%
Coal demand	2,7%
Natural gas demand	2,6%
Renewables demand	2,5%
Total energy demand	2,0%
CO2 emissions	1,9%
Energy int. gains	1,5%
Oil demand	1,1%

- → Power fastest growing energy, oil slowest one
- → Coal growth, triggered by China take-off since 2000, slowing since 2015
- → Natural gas and renewables growing at the same speed
- → Energy intensity gains explaining most of the decoupling between GDP and emissions growth

As in 2000, fossil fuels still make up 81% of the energy mix in 2019

TotalEnergies Energy Outlook 2022

Two demand scenarios to 2050

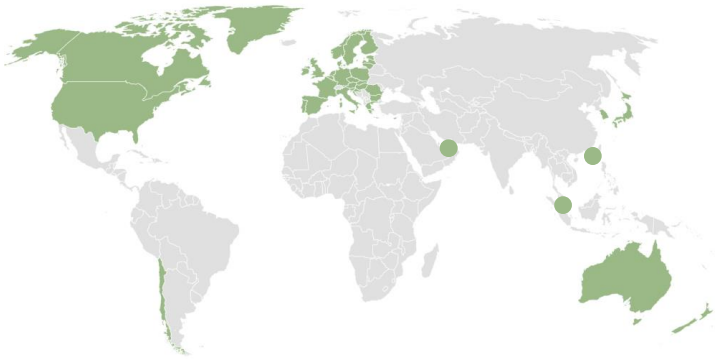
Momentum

A forward-looking scenario building on NZ50 commitments

40 Net-Zero by 2050 countries included in our scenario

Announced targets and NDCs of other countries, in particular China (2060), Russia (2060) and India (2070)

Same framework as IEA APS



Temperature rising by 2.1-2.3°C* in 2100

Rupture

A back-casting approach

Paris agreement well-below 2°C target achieved, based on IPCC emissions scenarios

Meeting this target requires **a concerted effort** to **rebuild the energy system** at a global scale

Temperature increase limited to 1.7°C*

with a Rupture+ sensitivity resulting in a 1.5°C scenario**

* *At P66, temperature ranges ascertained by comparing energy-related CO_2 emissions trajectories with the IPCC AR6 scenarios.*

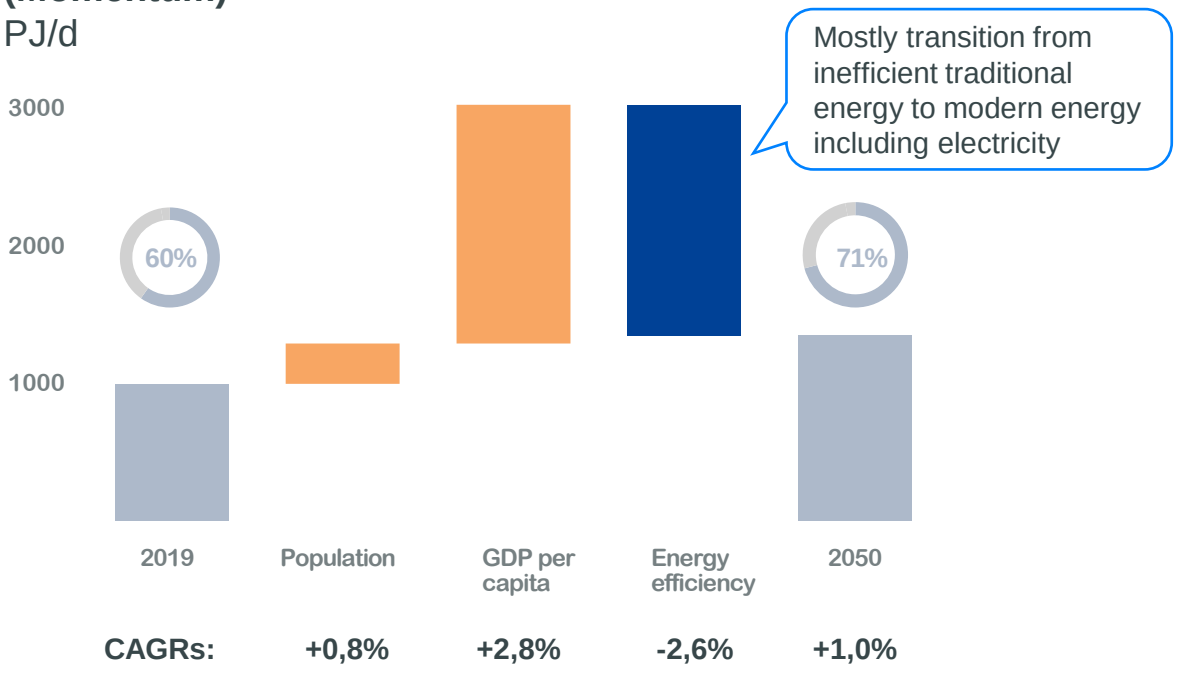
** *At P50 (same as IEA NZE)*

The energy transition must be just

Meeting the needs of growing populations in developing economies

Changes in Non-OECD primary energy demand 2019-2050 (Momentum)

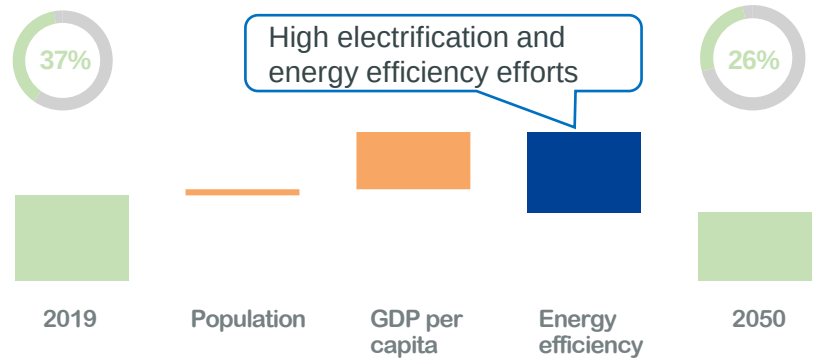
PJ/d



CAGRs:	+0,8%	+2,8%	-2,6%	+1,0%

Changes in OECD* primary energy demand 2019-2050 (Momentum)

PJ/d



CAGRs:	+0,2%	+1,6%	-2,5%	-0,7%

- Global energy demand growth of +0.4% p.a. from 2019 to 2050 reflects 2 opposite trends: non-OECD +1.0% p.a. and OECD -0.7% p.a.
- OECD countries need to support the clean transition in developing countries through financing and technology transfers

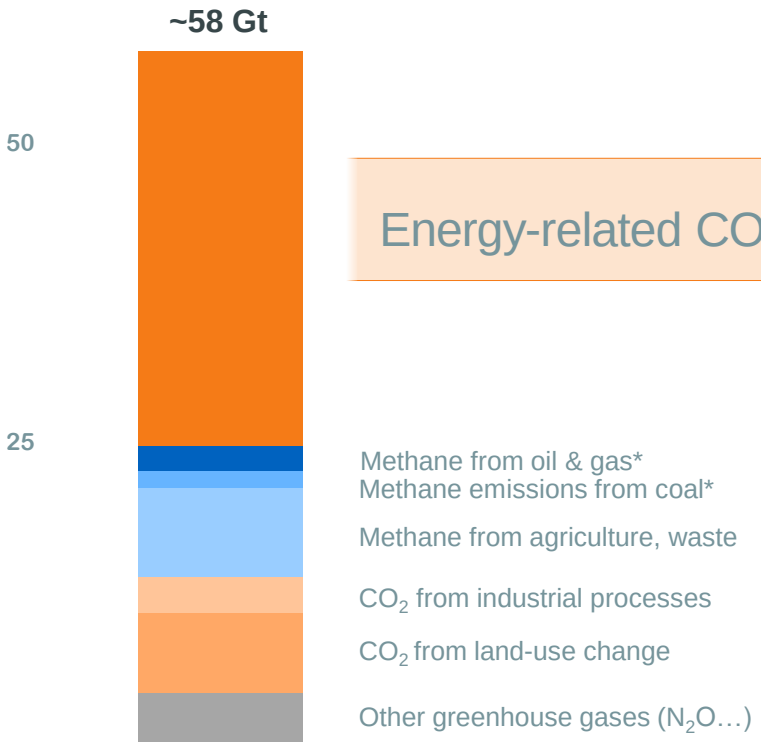
* *Sum of OECD and non-OECD demands not equal to total demand as international transport (bunkers) not reallocated*

How to curb emissions?

A comprehensive transformation of our energy production and usage

Global anthropogenic GHG emissions in 2019

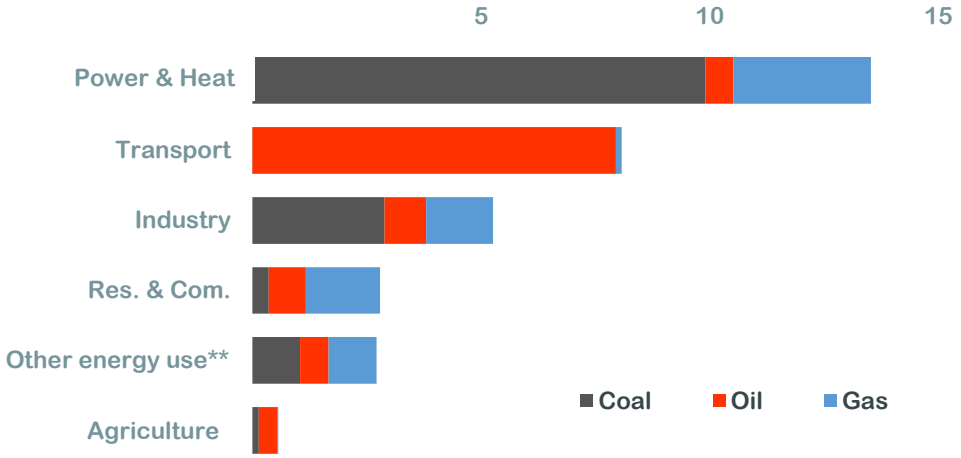
$GtCO_2e$



Energy-related CO_2 : **33 Gt**

Global energy-related CO_2 emissions in 2019

$GtCO_2$



Decarbonization of power and transport are the key priorities

Reducing methane emissions is also mandatory

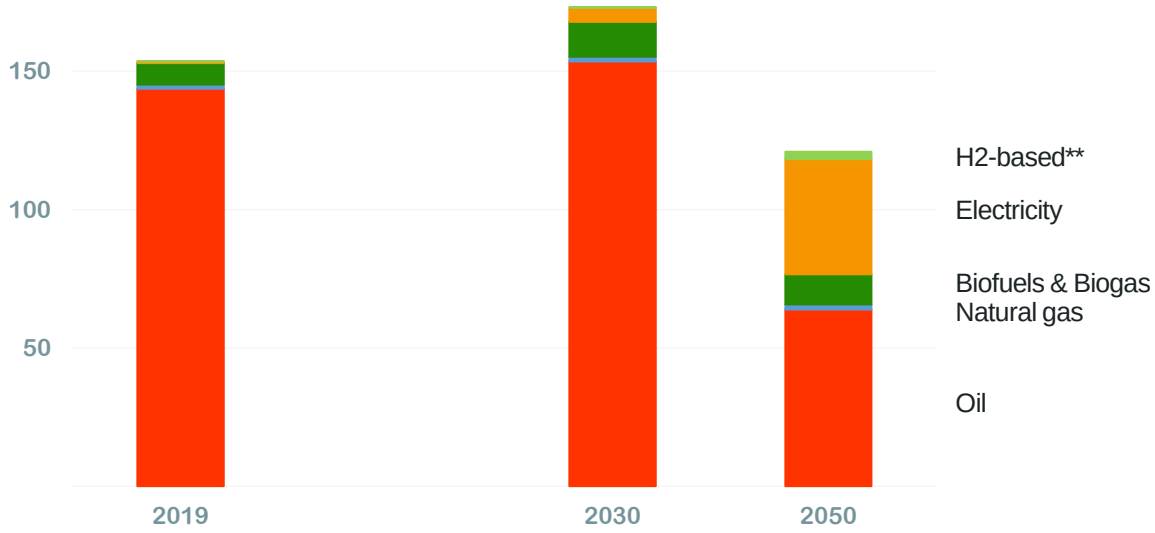
* *Production & transport of fossil fuels*
** *Includes energy sector own use, transport losses, and energy transformation*

Electrification of Light Duty Vehicles

Widespread penetration in China and NZ 2050 countries

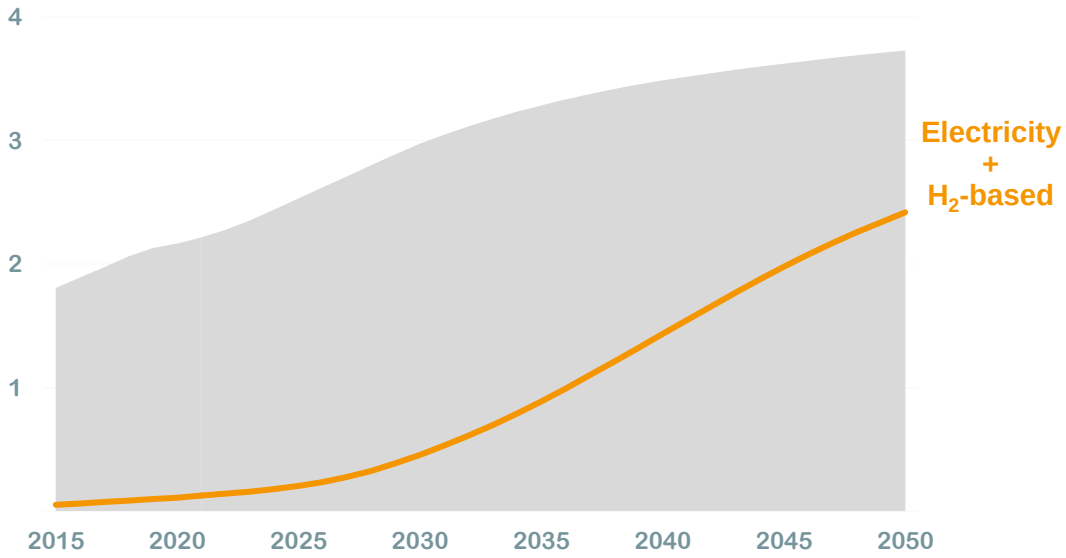
Light Duty Vehicles* final consumption (Momentum)

PJ/d



Light Duty Vehicles fleet (Momentum)

Billion



- LDV: 47% of 2019 transport final energy demand and CO_2 emissions
- Electricity confirmed as the primary decarbonization driver
- ~ 5 PJd / ~ 1 Mbd oil displaced in 2021, mainly for 2-3 wheelers
- Supplying the additional power required for mobility will require significant infrastructure investments

- Massive Electric Vehicles (EV) penetration supported by Internal Combustion Engine sales ban in 2035 in Europe and part of the US, together with ambitious EV targets in China
- By 2050, ~ 100% of fleet converted to electricity or H_2-based fuels in Net-Zero countries, and ~ 55% elsewhere (China ~90%)

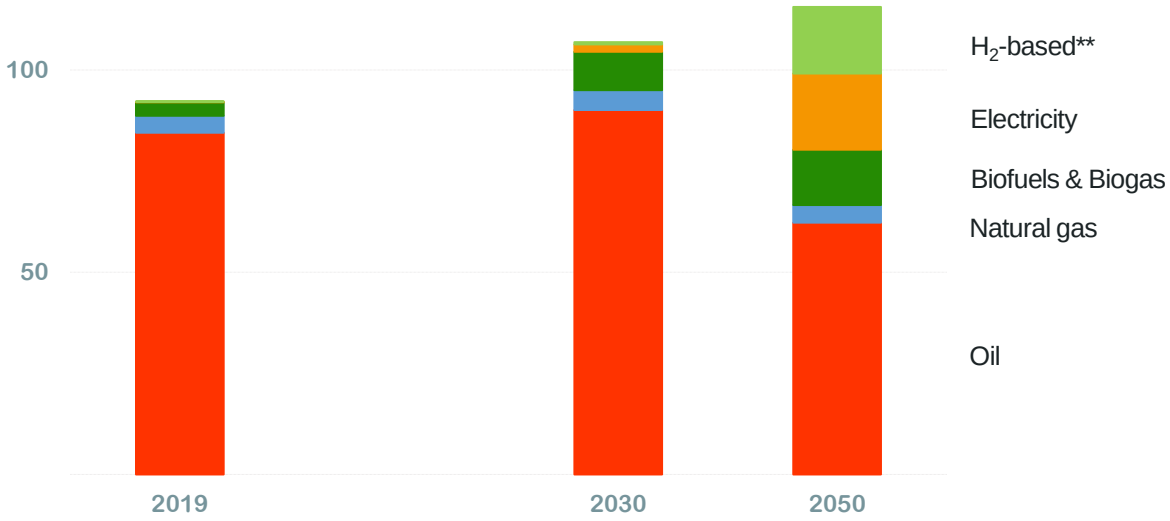
* *LDV = Light Vehicles (Passenger cars + Light Commercial Vehicles) + 2-3 wheelers*
** *Includes H2, e-fuels (H2 + CO2)*

Momentum

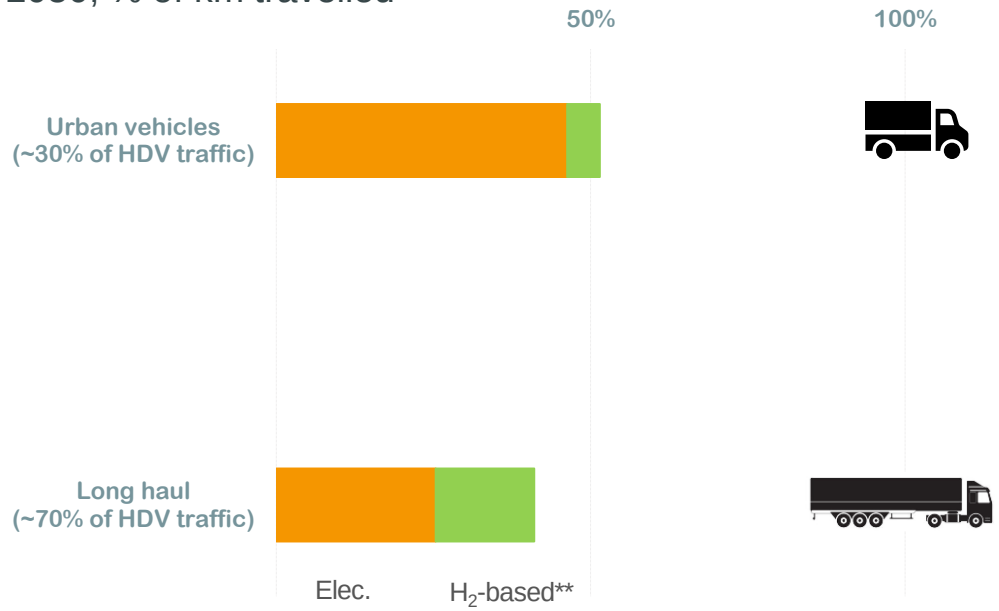
Mix diversification in Heavy Duty Vehicles

A full set of clean energies will contribute to trucking decarbonization

Heavy Duty Vehicles * final consumption (Momentum)
PJ/d



Zero Emissions Vehicles share of HDV traffic (Momentum)
2050, % of km travelled



- HDV: 28% of 2019 transport final energy demand and CO_2 emissions
- A mix of clean energies (electricity, hydrogen and bioenergies) required to decarbonize trucking; electric powertrains leading the way.
- Even though HDV slower to decarbonize than Light Vehicles, oil share decreased to about half of the energy demand by 2050

- Urban and some regional/long haul application see a rapid battery-based EV trucks development
- Fuel-cells penetration rate more progressive, nonetheless taking an important share especially for long haul trips

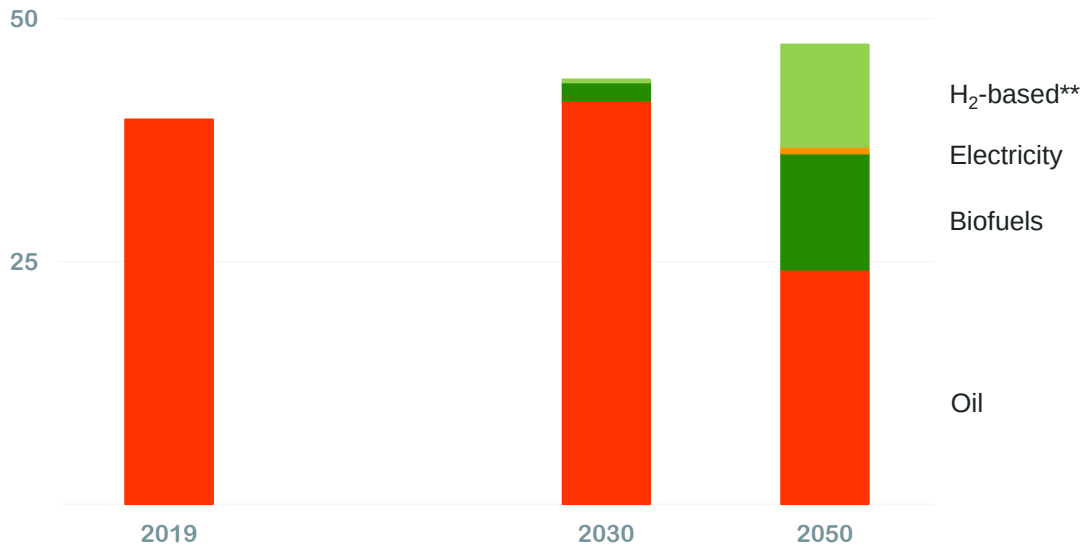
* *Trucks + Buses + Coaches*
** *Includes Fuel cells and H_2, e-fuels (H_2 + CO_2)*

Momentum

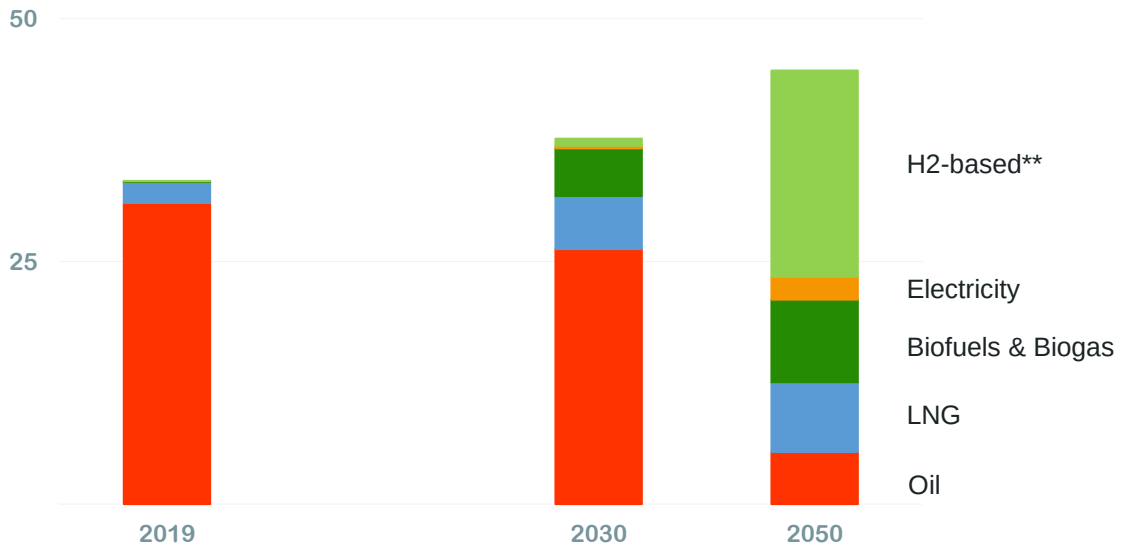
Multiple decarbonization paths for Aviation & Marine

Bioenergies and H_2-based fuels to decarbonize these hard-to-abate sectors

Aviation final consumption (Momentum)
PJ/d



Marine final consumption (Momentum)
PJ/d



- Aviation: 12% of 2019 Transport final energy demand and CO_2 emissions
- Drop-in decarbonation solutions (Sustainable Aviation Fuels*) required to decarbonize aviation as electricity and hydrogen will remain limited
- Aviation to capture an increasing share of biofuels supply after 2030 at the expense of road

- Marine: 10% of 2019 Transport final energy demand and CO_2 emissions
- LNG and bioenergies will play a key role as part of the energy transition
- Clean H2-based fuels (e-methanol, e-ammonia,…) deployed after 2035 to substitute oil

* *Sustainable Aviation Fuels = biofuels + e-fuels*
** *Includes H2, e-fuels (H2 + CO2), methanol, ammonia…*

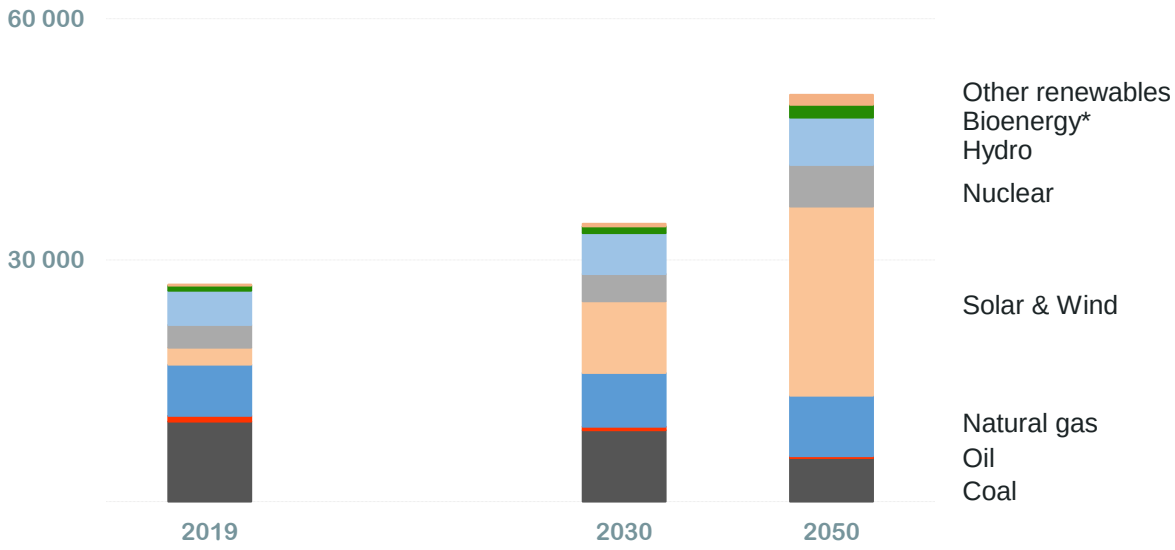
Momentum

Significant growth of low carbon power generation

Led by solar & wind

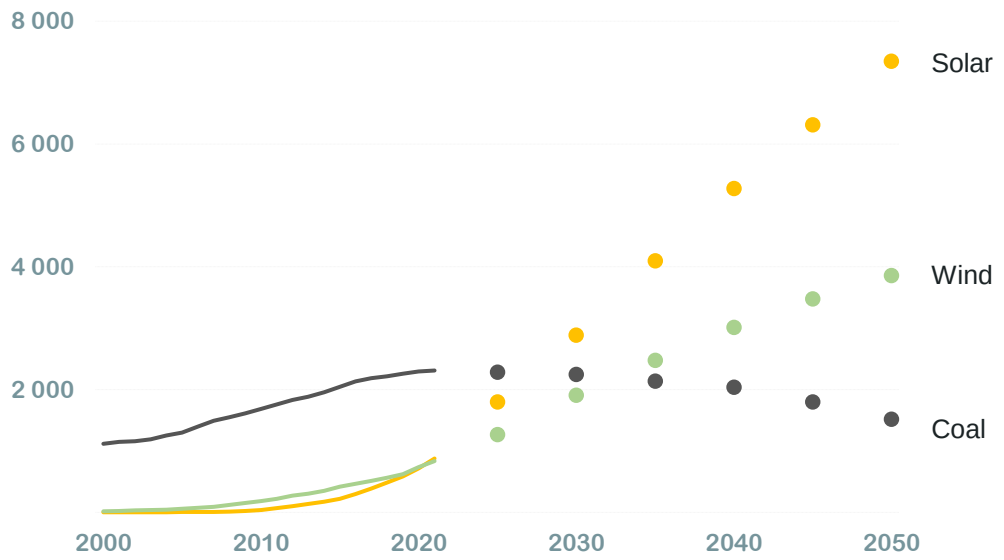
Power generation, excluding power for Green H_2 (Momentum)

TWh



Power capacities, excluding for Green H_2 (Momentum)

GW



- Power demand and generation almost doubling by 2050 (+2% p.a.), with wind & solar representing ~90% of new generation
- Huge decrease of coal-fired generation, complete phase-out in NZ countries
- Despite strong gas-to-REN switch, gas grows in absolute terms to manage variability of solar & wind and demand seasonality
- Renewed investment in nuclear

- Solar & wind capacities multiplied by ~7 in 30 years, representing 60% of all power capacities in 2050
- Coal capacities starting to decrease in the late 20's
- Average power emission factor reduced by ~75% by 2050 (net of CCS)

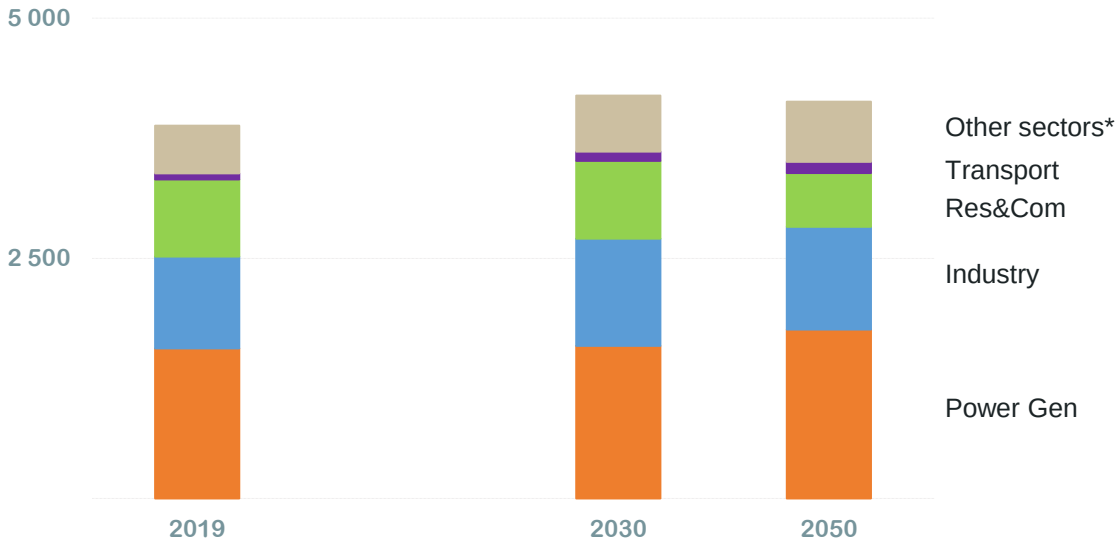
* *Includes traditional use of biomass, waste, biofuels, biogas…*

Momentum

World Oil & Natural Gas

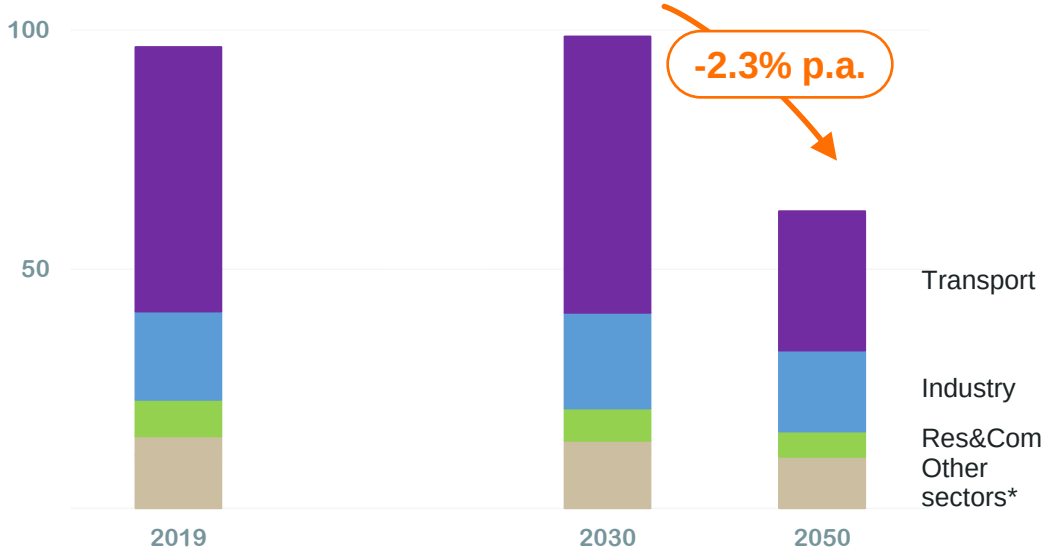
Natural gas key for energy transition; oil starts decreasing after 2030

Natural gas demand by sector, excluding gas for Blue H_2 (Momentum)
Bcm



- Natural gas is a key transition fuel, growing by +0.2% p.a. to 2050, with a plateau from the 2030's
- Natural gas to displace coal in Power and Industry
- Gas use in transport remains mainly focused on Marine

Oil demand by sector (Momentum)
Mb/d



- Slight oil demand increase until early 2030
- Decrease post-2030 slower than the natural decline of producing oil fields, requiring continued investment

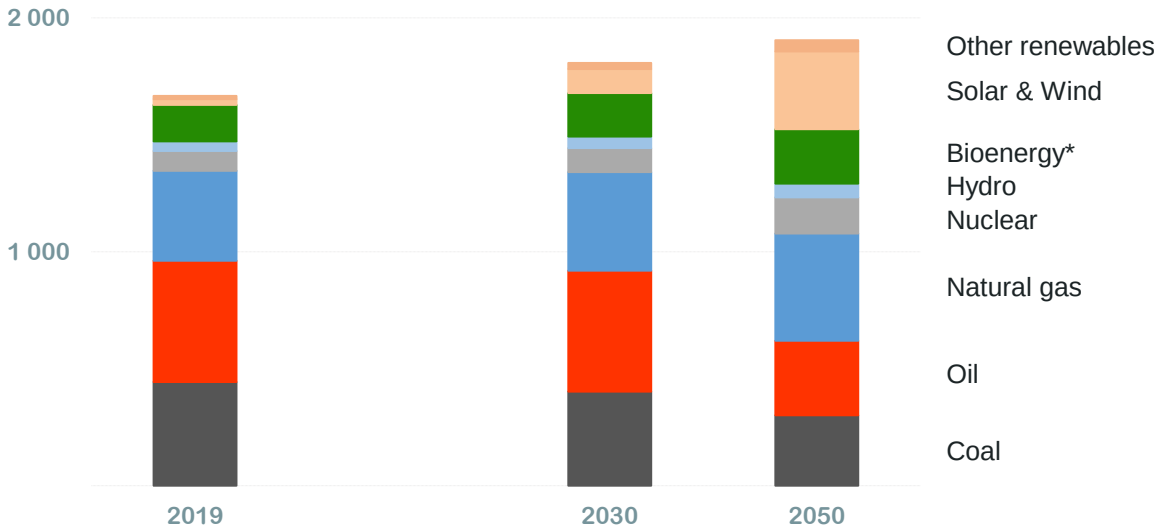
* *Other energy use, non-energy use and agriculture…*

Momentum

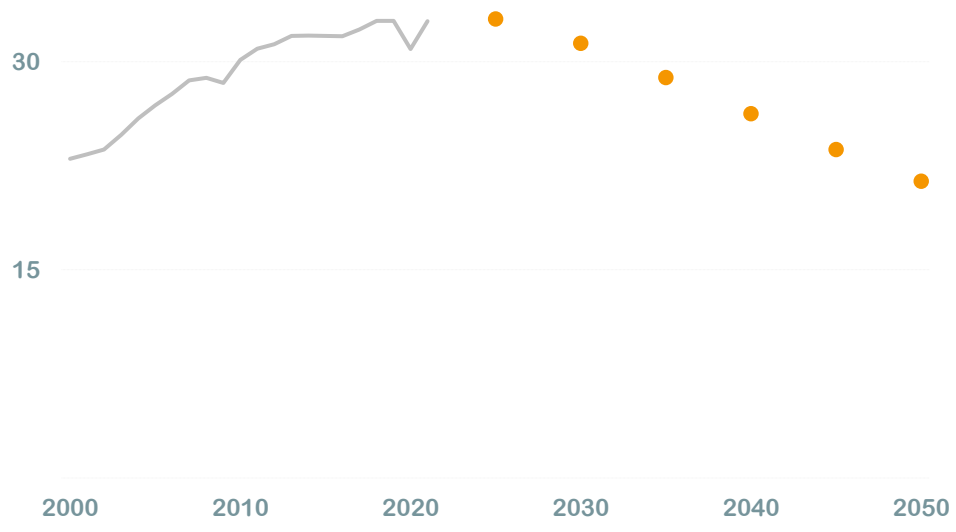
World energy demand and CO_2 emissions

Great effort towards energy transition but insufficient to meet global targets

Total primary energy demand
PJ/d



Energy-related CO_2 emissions
Gt



- Primary energy demand up by ~15% by 2050
- Renewables & natural gas both growing, playing key complementary roles

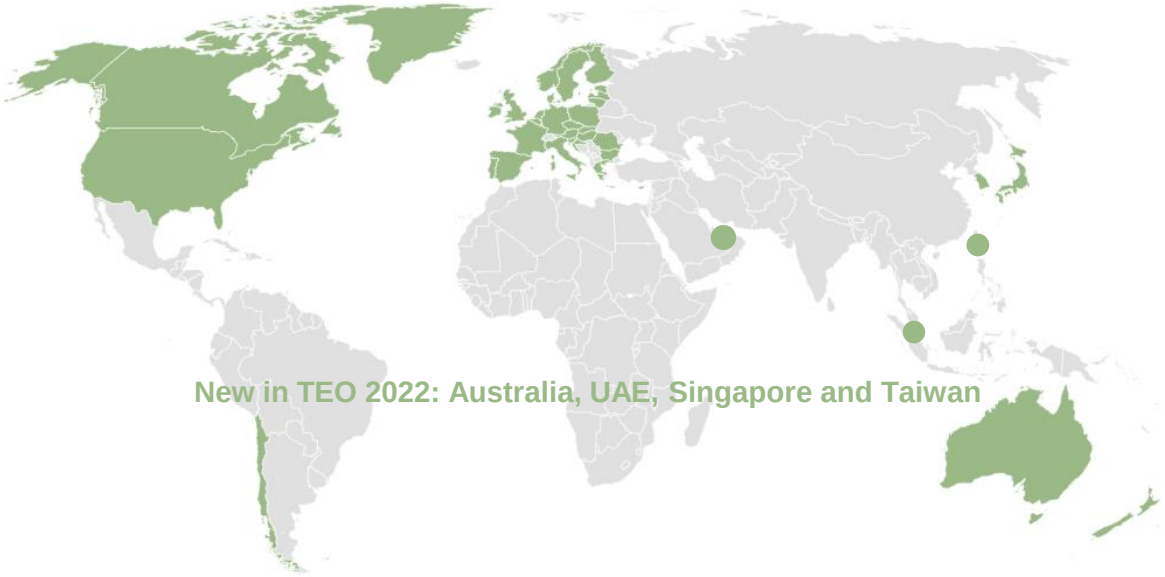
- Energy-related CO_2 emissions drop by ~35% to reach 21 Gt in 2050 (net of ~3 Gt CCS, mainly in power, blue H_2 and industry)
- Temperature would rise by +2.1-2.3°C by 2100 (P66)

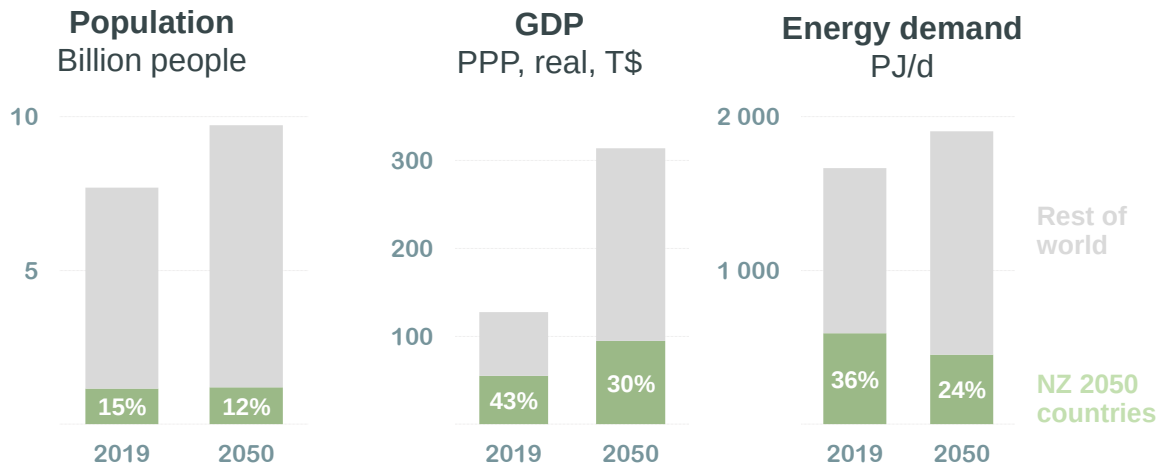
* *Includes traditional use of biomass, waste, biofuels, biogas…*

Momentum

Net Zero by 2050 countries

At the forefront of the energy transition





Main game changers in Net-Zero 2050 countries

- Power generation carbon-neutral by 2040 (net of CCS)
  Renewables @80% of 2050 power generation, natural gas to manage variability
- Road Transport carbon-neutral by 2050
  ~ 100% of fleet converted to electricity or hydrogen by 2050
- Electrification with clean power
  Electricity @46% of 2050 final consumption (World: 33%)
- Leading in clean H_2 and green gases penetration
  40% of green gases in 2050 total gases demand

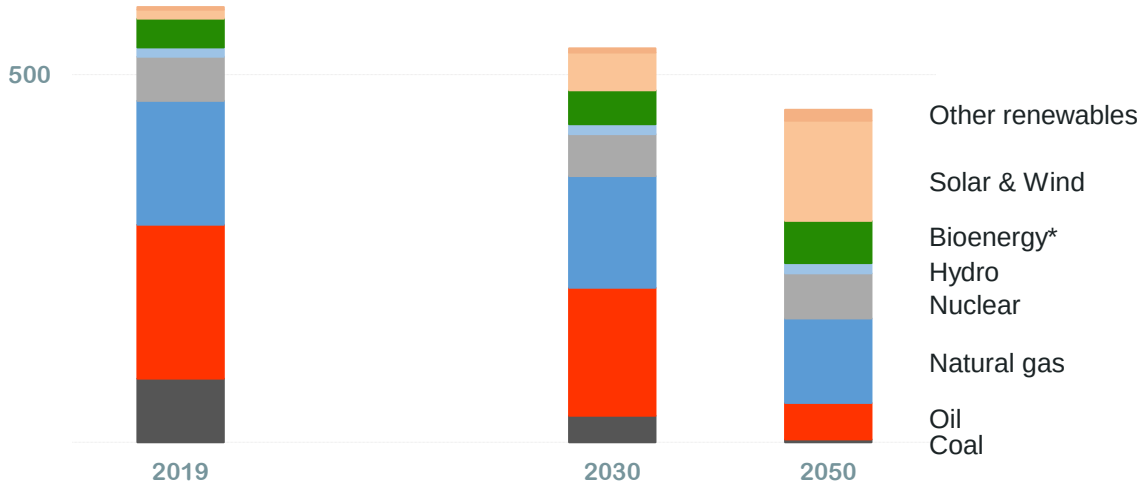
Zoom

Net Zero by 2050 countries

Forging the net-zero emissions pathway

NZ 2050 countries primary energy demand

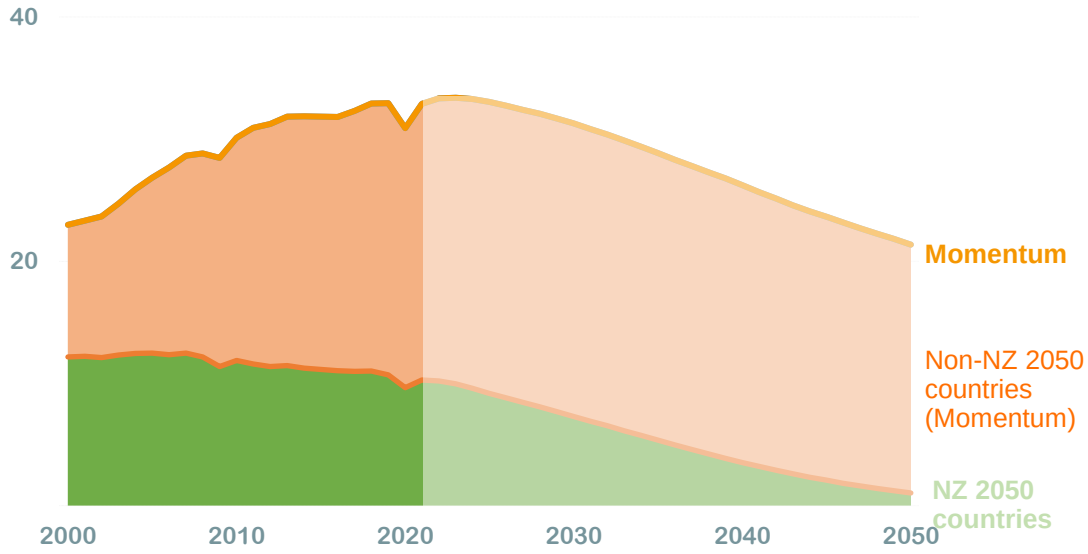
PJ/d



- NZ 2050 countries energy demand to fall by ~25% in 30 years
- Fossil fuels share fall from almost 80% to less than 40% in 2050
- Residual oil demand mainly in transport and petrochemicals
- Natural gas keeping a strong role in power and for blue H_2 production

World energy-related CO_2 emissions

Gt



- After 2 Gt of CCS, 1 Gt of emissions remaining in 2050
- Net-Zero countries' efforts far from sufficient
- Full decarbonization of non-OECD countries will not happen without cooperation and support from NZ countries

* *Includes modern use of bioenergy such as biofuels, biogas…*

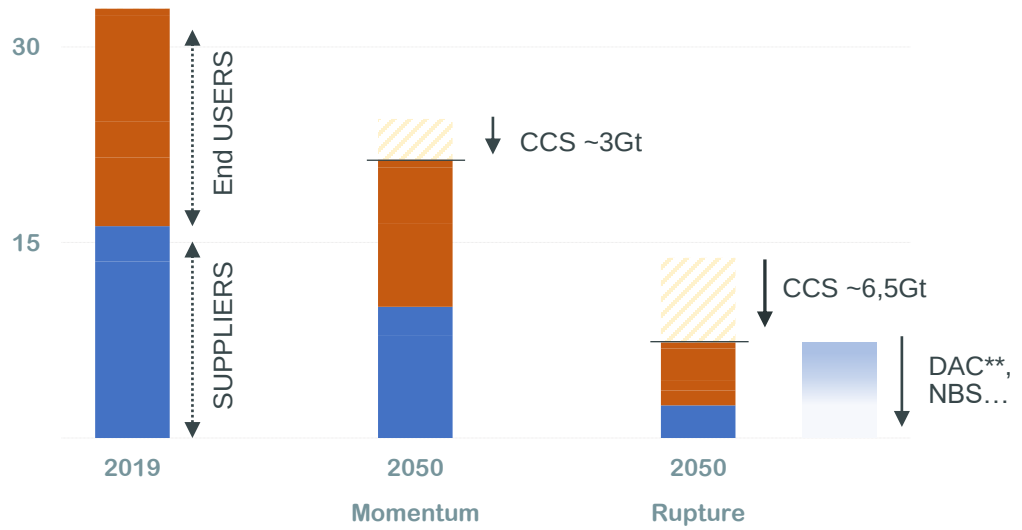
Zoom

World energy-related CO_2 emissions

Strong abatements to expect from non-OECD; CCS & NBS* needed for Net-Zero

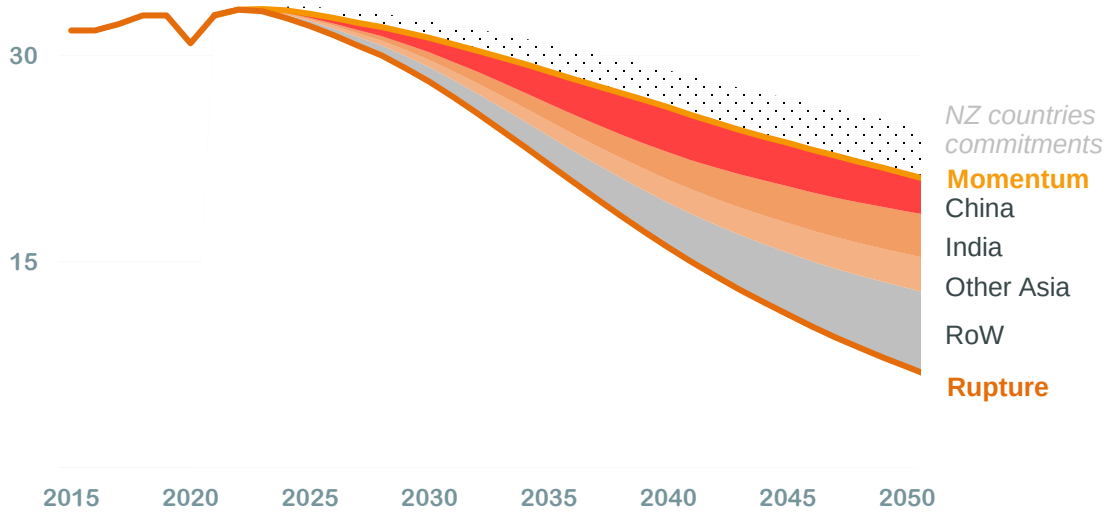
Energy-related CO_2 emissions

Gt



Energy-related CO_2 emissions abatements

Gt



- All sectors hugely decreasing CO_2 emissions in Rupture 2050 (Power -90%, Industry -80%, Res&Com and Transport -70% vs. 2019)
- 6,5 Gt of CCS mainly in power generation (50%) and industry (25%)
- Scaling up yet-to-be-industrialized technologies such as DAC*, as well as nature-based solutions, required to lower residual emissions (7 Gt in 2050)

- NZ2050 countries' pledges decreasing 2050 emissions by 3 Gt, requiring strong abatements from non-OECD countries
- Asia represents 70% of cumulative abatements needed to reach well-below 2°C Rupture scenario
- Technical and financial support from OECD countries necessary to reach Net-Zero globally

* *Nature-Based Solutions*
** *Direct Air Capture*

Rupture

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Q&A

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