TotalEnergies

# TotalEnergies
# Energy Outlook 2021

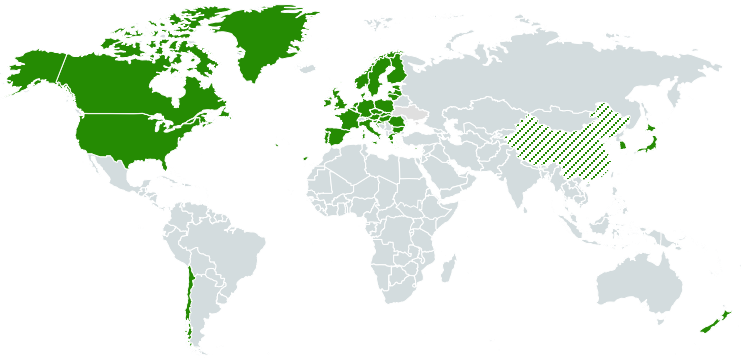
# TotalEnergies Energy Outlook 2021

## Two demand scenarios to 2050

### Momentum
**A forward-looking scenario**

Based upon decarbonization strategies of **Net-Zero 2050** (NZ 2050) **countries**, with China on-track to achieve carbon neutrality by 2060

Announced targets & NDCs of other countries

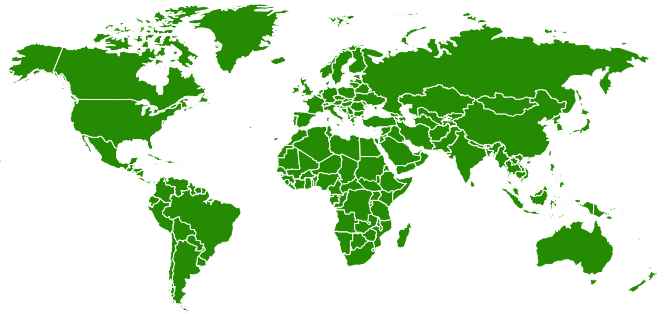


**Temperature rising by 2.2-2.4°C in 2100**

### Rupture
**A back-casting approach**

Achievement of **Paris agreement well-below 2°C target** based on IPCC emissions scenarios*

Assumes **strong shifts in non NZ 2050 countries' public policies, large scale cleantech advancements** and **rebuilding a new energy system** at a global scale



**Temperature increase limited to 1.7°C**

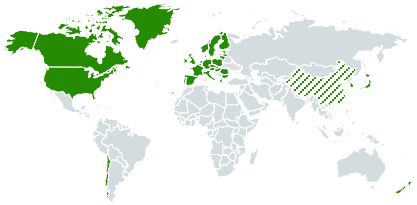
with a sensitivity for a 1.5°C scenario



** Temperature ranges ascertained by comparing energy-related CO2 emissions trajectories from the IPCC P66 scenarios.*

# What's new in our 2021 scenarios?

## Momentum: market trends acceleration & NZ 2050 countries' commitments



GDP growth : +3.0%/yr
**Energy growth: +0.5%/yr**

**Ban on new ICE* sales** in NZ 2050 countries in 2035 spurring a **revolution** in **transport**:

- **Electrification** of light vehicles
- Increased adoption of **H2, H2-based fuels** and bioenergies** in other transport segments

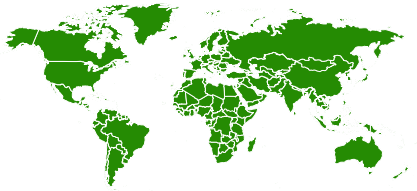
**Broad end-use electrification** with increasing demand for **renewable power (solar & wind)**

Large scale use of **natural gas** as a **transition fuel** especially in power & industry

**Single-use plastic ban** in NZ 2050 countries & China from 2040 and increased plastics recycling

**China's** emissions to peak in the mid 2020's, with **~60% decarbonization by 2050**

## Rupture: how to reach well-below 2°C



GDP growth : +3.0%/yr
**Energy growth: +0.3%/yr**

**Extension to all emerging economies** of NZ 2050 countries decarbonization trends

**Amplification of energy transition levers** allowed by **innovation diffusion**:

- Increased **energy efficiency**
- Further development of **electricity & renewables**
- Higher penetration of **new energy carriers** (clean H2 in industry & transport, e-fuels, biofuels and biogas…)



** Internal Combustion Engine*

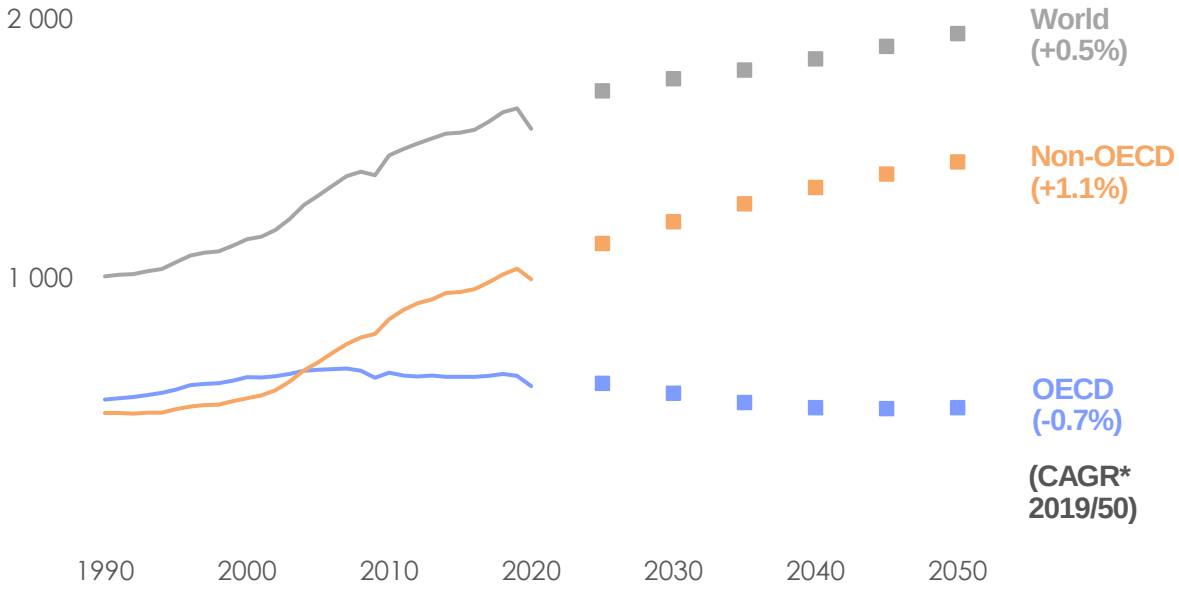
*** Includes H2, e-fuels (H2 + CO2), methanol, ammonia…*

# Meeting the energy needs of a growing population

## Necessity of a just transition

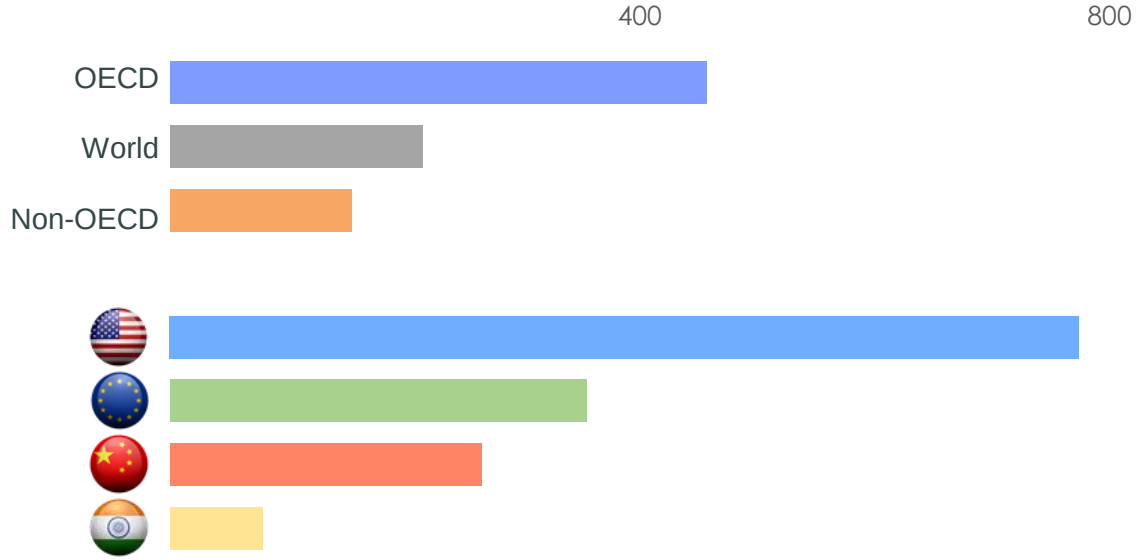
**World total energy demand in Momentum**

PJ/d




**World energy demand per capita in 2019**

MJ/d/capita




- World population will grow from 8bn today to 10bn people by 2050, driven by non-OECD countries: + 2bn
- Growing population and improving living standards will increase energy demand, again driven entirely by emerging countries

- The evolution of energy demand per capita over the next 30 years is critical for non-OECD countries
- Without these countries the global Net-Zero goal cannot be achieved

**The challenge: reconciling growing energy demand with decarbonization and broader sustainable development goals**



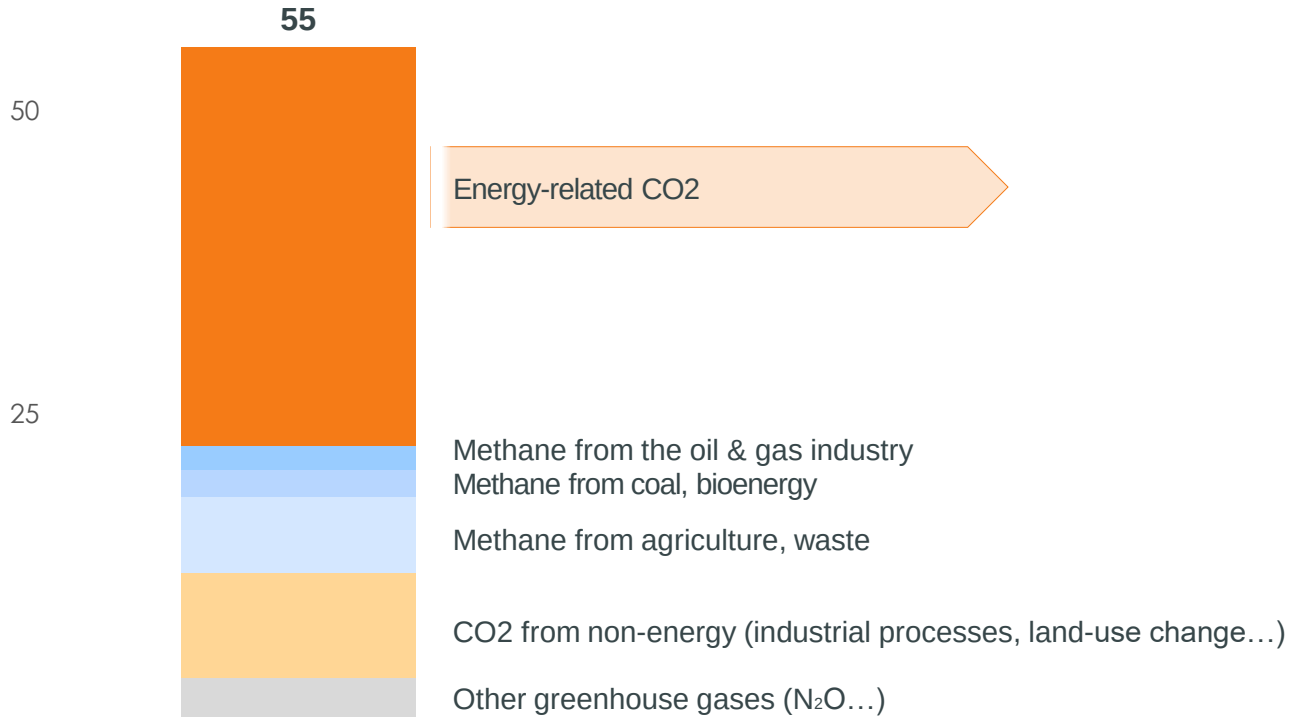
** Compounded Annual Growth Rate*

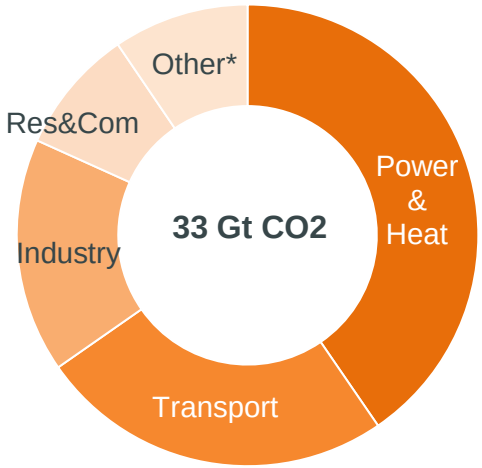
# How to curb emissions?

## A collective engagement, from suppliers to consumers

**Global anthropogenic GHG emissions in 2018**

GtCO2e



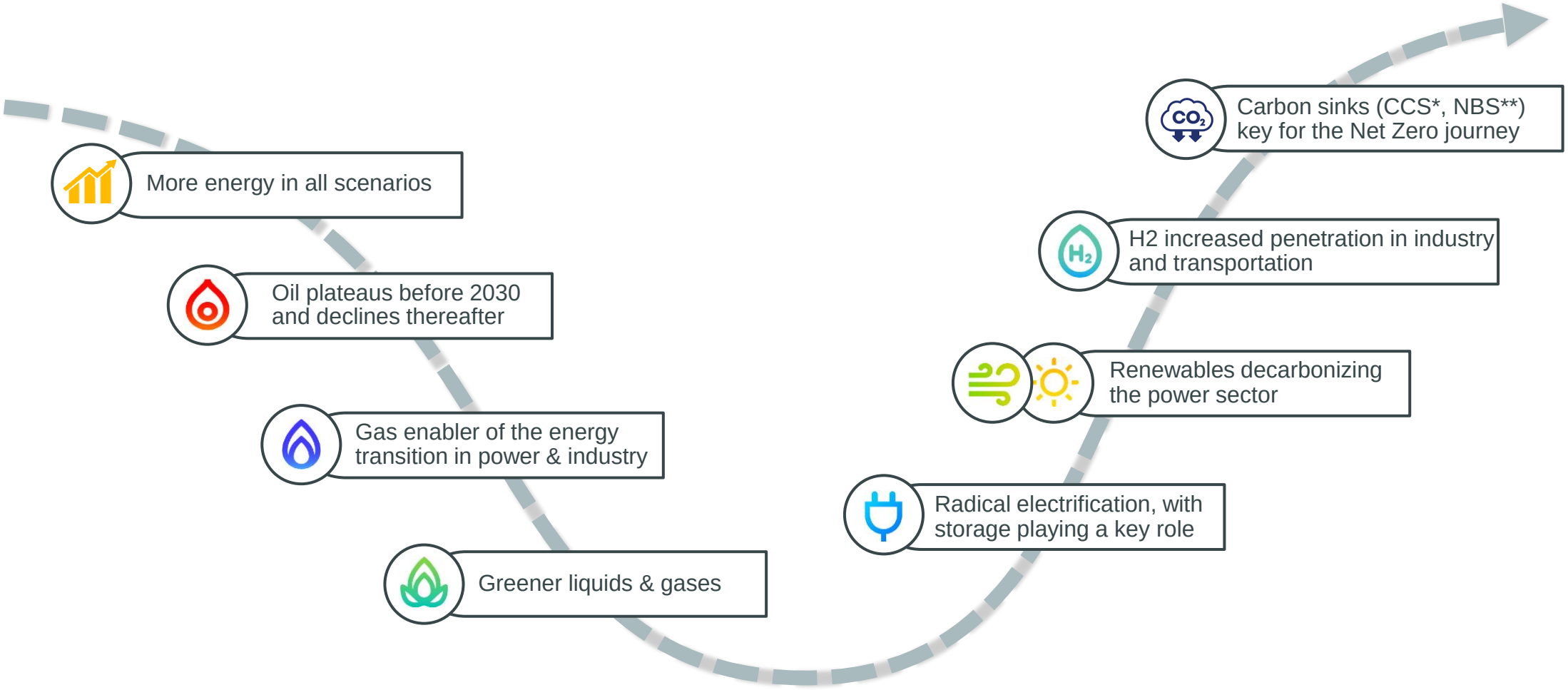

**The climate challenge requires action on all greenhouse gases and the decarbonization of energy**



** Energy sector own use, agriculture…*

# More energy & less emissions

## Energy transition pathway






** Carbon Capture & Storage **Nature-based solutions*

# Key drivers for energy transition in each sector

## How to decarbonize

| Driver | Industry | Transport | Residential & Commercial | Power |
|---|---|---|---|---|
| Energy efficiency | ●●● | ●● | ●●● | ● |
| Behavior | ● | ●● | ● | |
| Electrification | ●● | ●●● | ●●● | |
| Switch Coal/Oil-to-Gas | ●● | ● | ● | ●●● |
| Solar & Wind / Storage | ● | | ● | ●●● |
| Biofuels / Biogas | ● | ●● | ● | |
| Hydrogen | ●● | ●● | ● | ● |
| CCS | ●● | | | ●● |
| Recycling / Re-use | ●●● | ● | ● | |

Impact level: ● Low ●● Medium ●●● High

# Key modeling drivers of our scenarios

## Sector-based assumptions

| | 2019 | Momentum 2050 | Rupture 2050 |
|---|---|---|---|
| **Strong electrification of end-use** | ~20% of final demand | ~30% | ~40% |
| **Deep decarbonization of power supply** | solar+wind: ~110 GW/yr capacity additions since 2010 | Pace x3.5 (380 GW/yr) | Pace x6 (620 GW/yr) |
| **Gas going greener** | <1% green gases in gas supply | ~20% | ~30% |
| **Sustainable mobility** | < 1% BEV & FCEV* in light vehicles fleet | ~65% | ~80% |
| | ~100% kerosene fueling aircrafts | Sust. aviation fuels @ ~30% of demand | SAF @ ~60% |
| **Optimizing plastics demand** | 7% recycled | 40% recycled<br>SUP** ban Net Zero countries & China in 2040 | ~50% recycled<br>Worldwide SUP** ban in 2040 |
| **CCS to abate remaining emissions** | ~35 Mt (0.1% CO2 emissions) | 3 Gt (~10%) | 7 Gt (~45%) |
| **Energy efficiency acceleration** | 1.5%/yr energy intensity improvement since 2000 | +2.4%/yr | +2.6%/yr |

** Battery-Electric Vehicles and Fuel-cell Electric Vehicles*

*** SUP: single-use plastic*

# Momentum

## Key energy transition levers:

- Electrification and energy mix diversification in transport
- Increased penetration of clean H2
- Massive growth in power demand

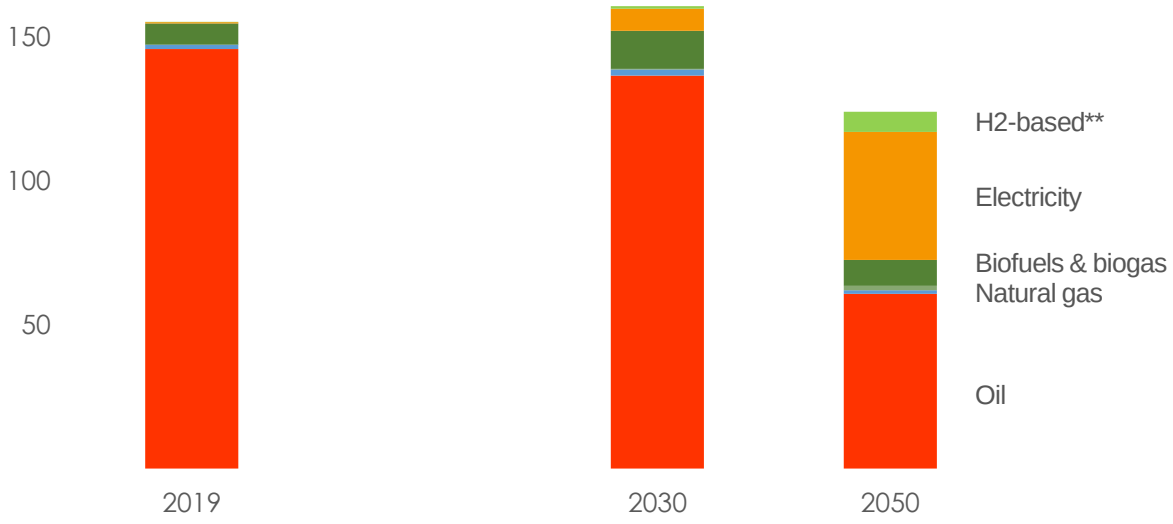
## Momentum wrap-up

## Zoom on NZ 2050 countries

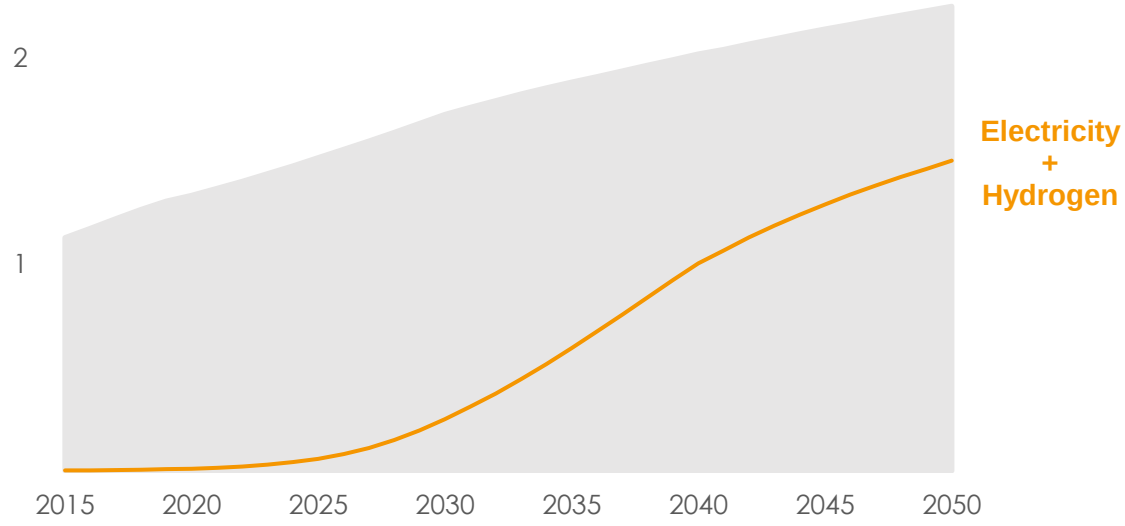
# Electrification in Light Vehicles

## 2035 ICE sales ban in NZ 2050 countries to accelerate LV fleet electrification

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




**Light Vehicles fleet (Momentum)**
Billion




- LDV accounting for 47% of 2019 Transport CO2 emissions
- EV fleet accelerating after 2030, displacing oil
- Oil below 50% in 2050

- Aggressive assumptions on EV penetration, with 2035 ICE sales ban in NZ 2050 countries
- In NZ 2050 countries, 100% of fleet converted to electricity or fuel-cells by 2050 (vs. ~90% in China)
- Such development will require massive new infrastructures (charging points and power network)



** LDV = Light Vehicles (Passenger cars + Light Commercial Vehicles) + 2-3 wheelers*

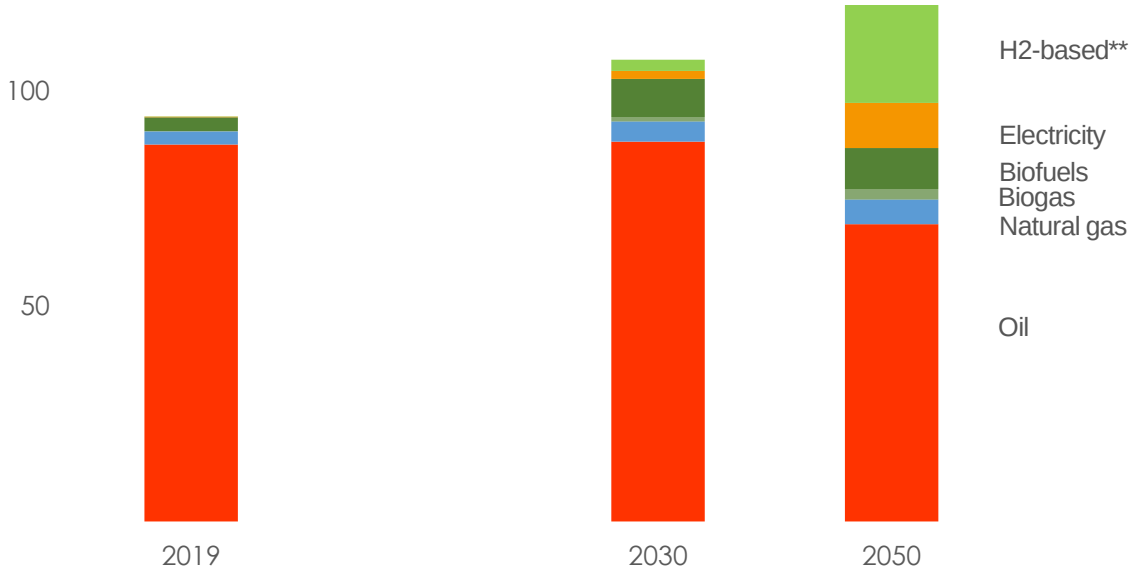
*** Includes H2, e-fuels (H2 + CO2), methanol, ammonia…*

# Mix diversification in Heavy Duty Vehicles

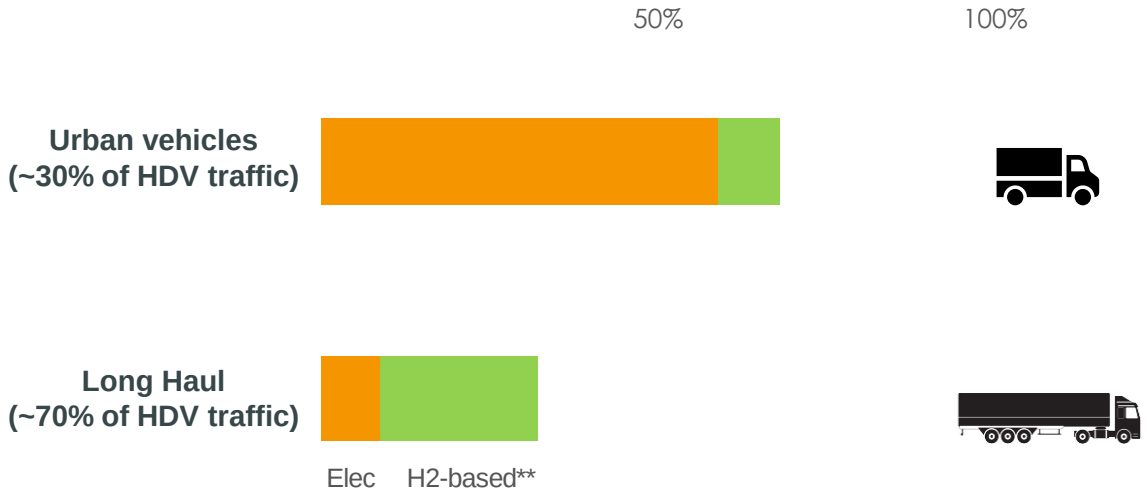
## Electricity and hydrogen to allow for decarbonization of trucking

**Heavy Duty Vehicles* final consumption (Momentum)**

PJ/d




**HDV zero emissions share in traffic in 2050 (Momentum)**




- HDV accounting for 28% of 2019 Transport CO2 emissions
- Fuel-cells, clean hydrogen-based fuels and bioenergies are key to decarbonize HDV, together with electricity

- Rapid increase of battery electric share for urban and some medium/long haul trucks
- Progressive penetration of fuel-cells and e-fuels in trucking after 2035 for long haul trips



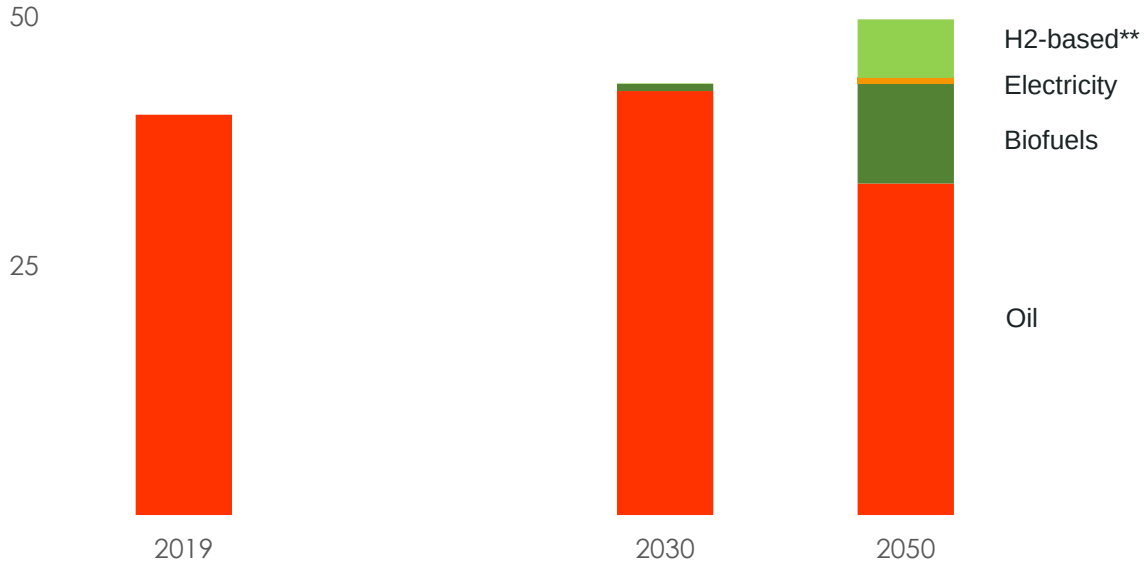
** HDV =Trucks + Buses + Coaches*

*** Includes $H_2$, e-fuels (H2 + CO2), methanol, ammonia…*

# Multiple decarbonization paths in Aviation & Marine

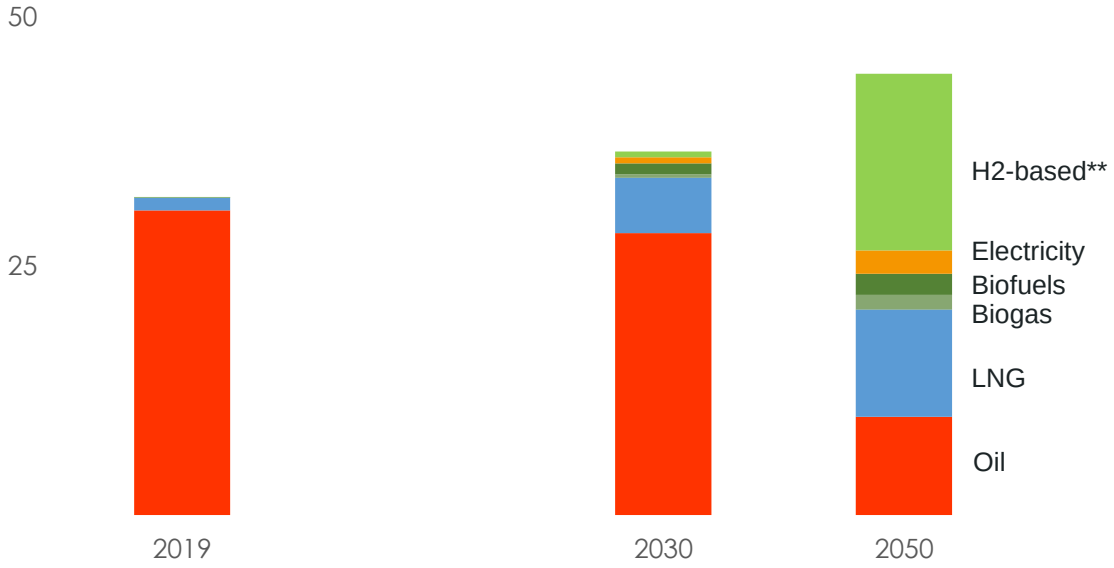
## Bioenergies and H2-based fuels to decarbonize these hard-to-abate sectors

**Aviation final consumption (Momentum)**
PJ/d




- Aviation accounting for 13% of 2019 Transport CO2 emissions
- To be decarbonized, aviation needs large scale low-carbon liquids (Sustainable Aviation Fuels*), as electricity will remain marginal

**Marine final consumption (Momentum)**
PJ/d




- Marine accounting for 10% of 2019 Transport CO2 emissions
- LNG, moving to bio-LNG, part of the transition pathway together with clean H2-based fuels (methanol, ammonia,…)



** Sustainable Aviation Fuels = biofuels + e-fuels*

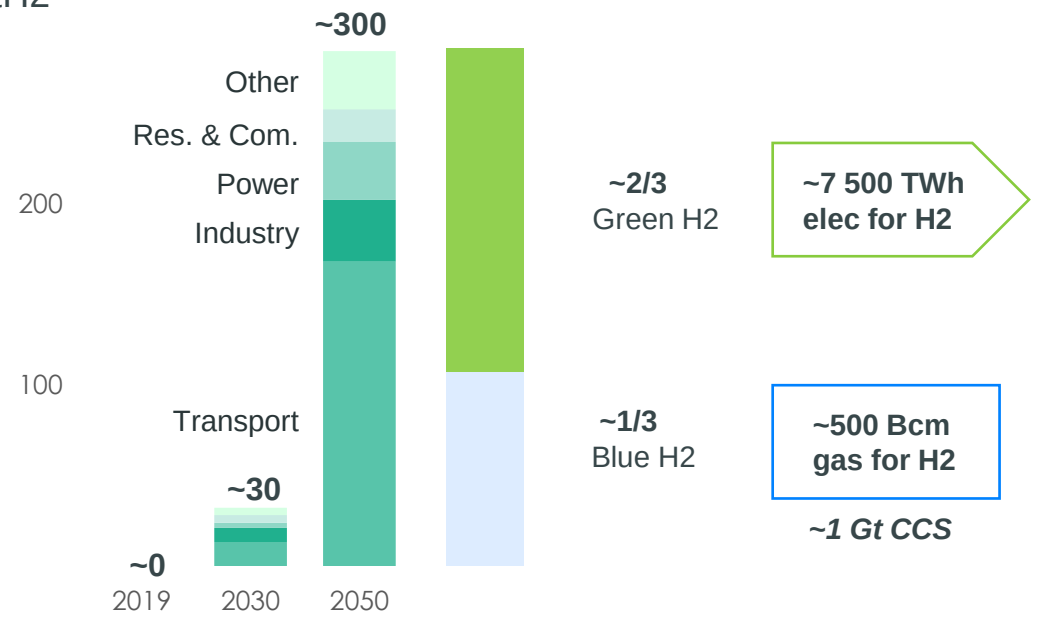
*** Includes H2, e-fuels (H2 + CO2), methanol, ammonia…*

# Increased penetration of clean hydrogen

## A new driver of electricity demand

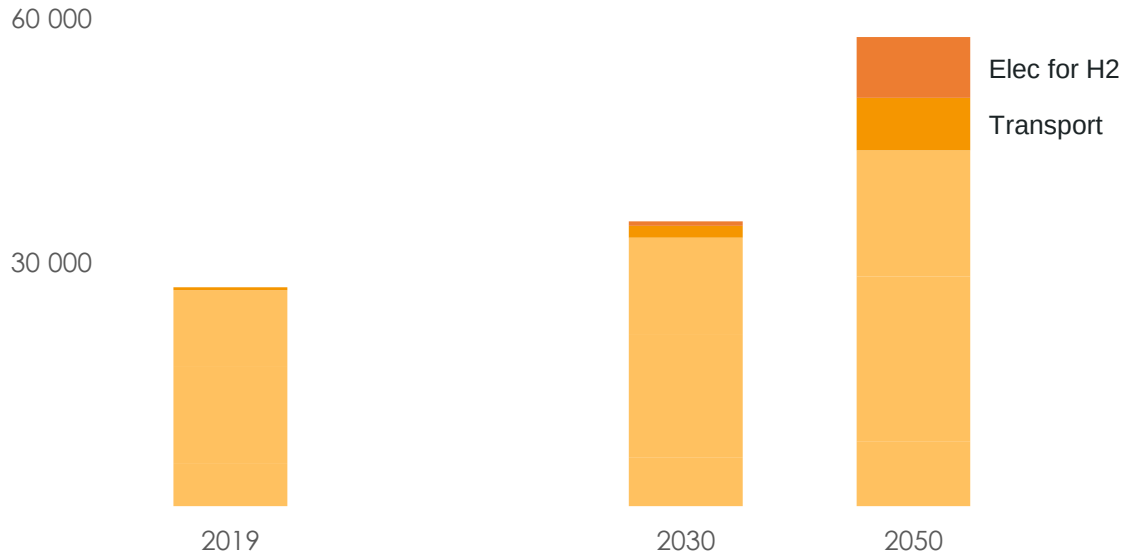
### Clean H2 balance (Momentum)

MtH2




### Power demand by sector (Momentum)

TWh




- Transport & Industry are the main users of H2 (incl. e-fuels) in Momentum, driven by NZ 2050 countries:
  - Scaling up clean H2 takes time
  - By 2050, clean H2 accounts for 4x today's (grey) H2 production

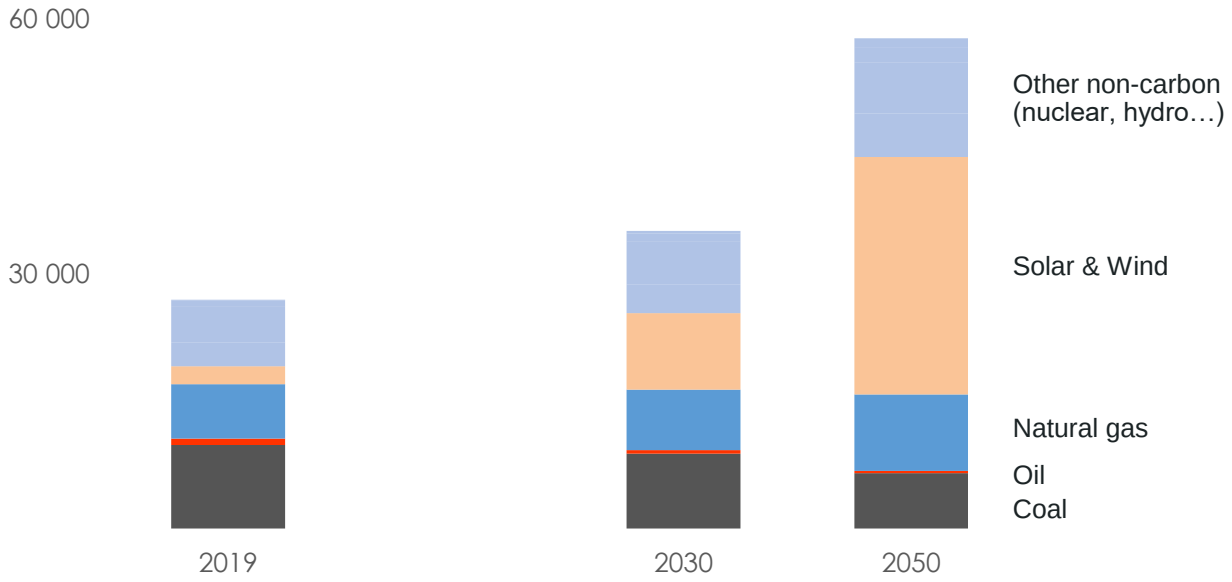
- H2 production through electrolysis significantly increases electricity demand
- Electricity for H2 and in Transport represent 1/4 of 2050 demand
- Total power demand up by 2.5% p.a. over next 30 years

# Massive growth in power generation

## Led by solar & wind

### Power generation (Momentum)

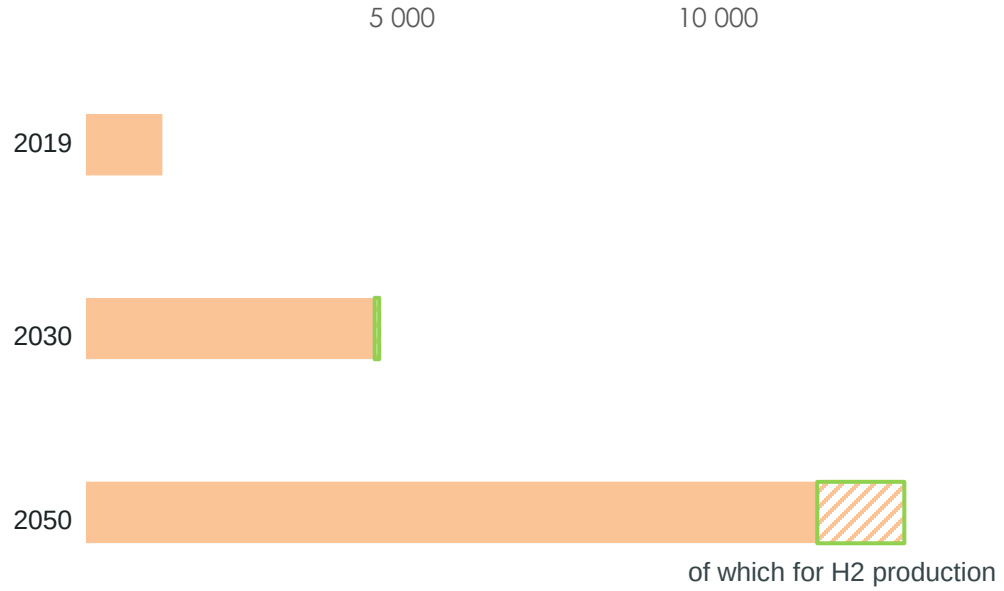
TWh




- Generation more than doubles by 2050, with wind & solar representing ~85% of new generation
- Gas is the only fossil fuel to grow in absolute terms to manage intermittency of solar & wind and demand seasonality (base-load, firm power)

### Solar & Wind capacities (Momentum)

GW

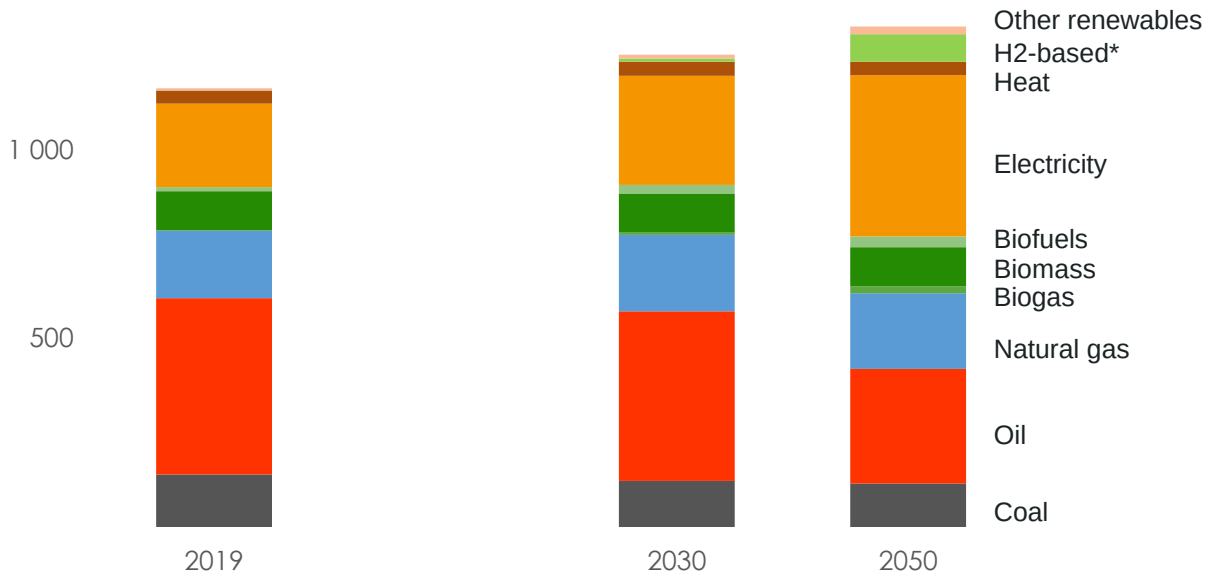



- Solar & wind capacities multiply by 10 in 30 years
- ~10-15% dedicated to green H2 production in 2050 (> today's solar & wind capacities)
- In addition, ~1500 GW of batteries are needed to ensure constant delivery of electricity

# Momentum: World Total Final Consumption

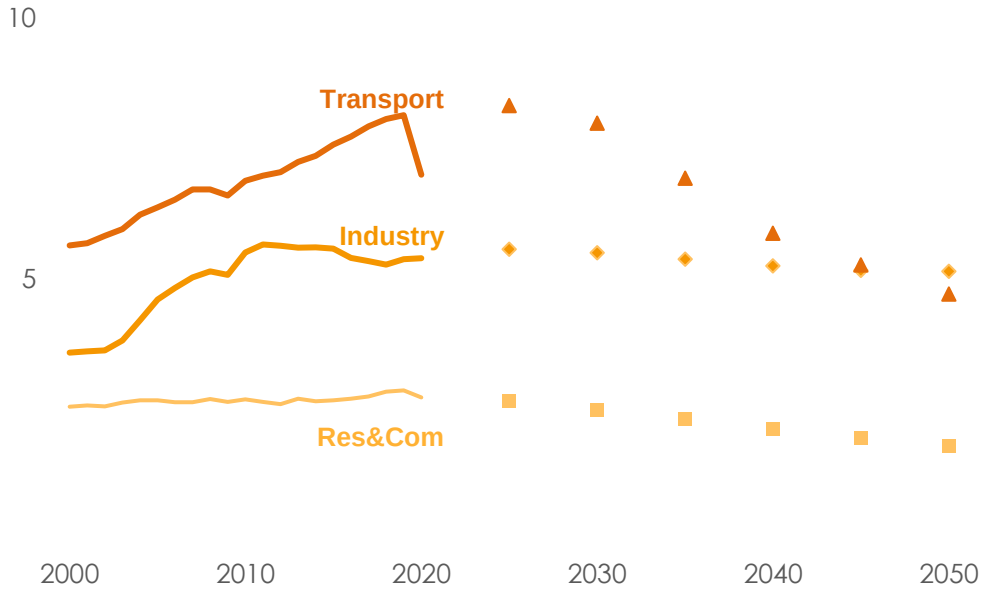
## Electricity becomes the #1 source of end-user energy in the early 2040s

**Total final consumption**
PJ/d




- Steady growth of end-use energy demand by 2050 (0.4% p.a.) with a strong change of the energy mix
- Fossil fuels share down from 2/3 to less than half

**CO2 emissions by sector**
Gt



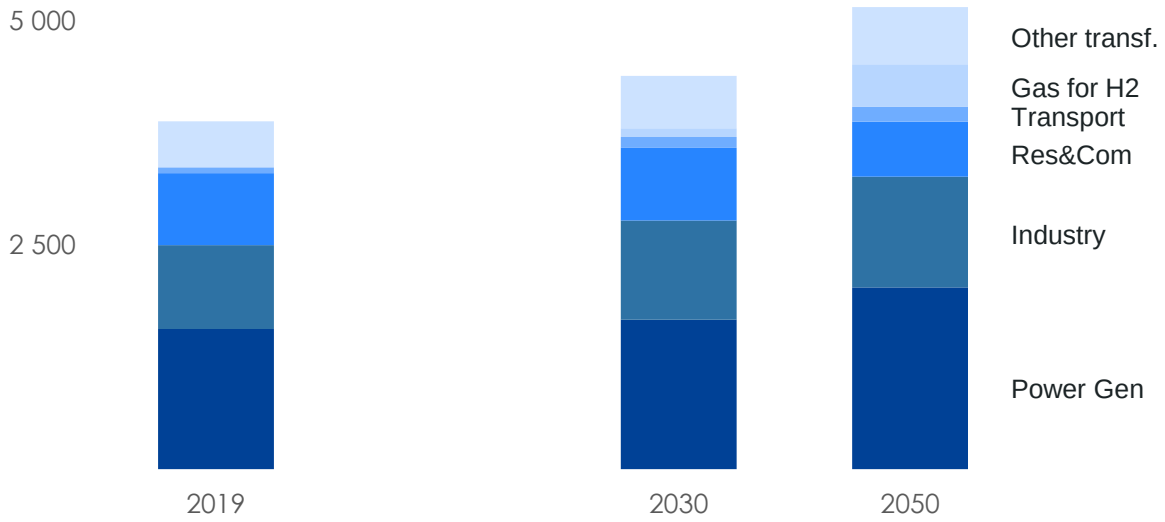

- Transport, n°1 end-user emitting sector today, accounts for the bulk of CO2 abatements by 2050

** Includes H2, e-fuels (H2 + CO2), methanol, ammonia…*

# Momentum: World Oil & Natural Gas

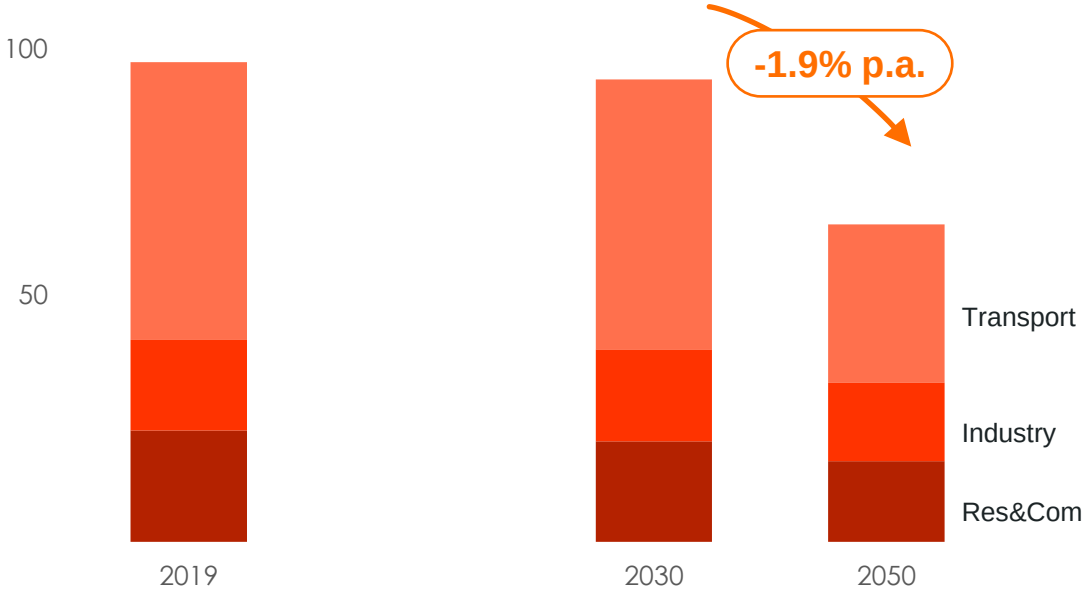
## Natural gas key for energy transition, while oil starts decreasing after 2030

**Natural gas demand by sector**
Bcm




- Natural gas is a key transition fuel, growing by ~+1%/yr to 2050
- Natural gas to displace coal in Power and Industry
- Power generation accounts for >1/3 of gas demand growth, as does gas for blue H2 production

**Oil demand by sector**
Mb/d

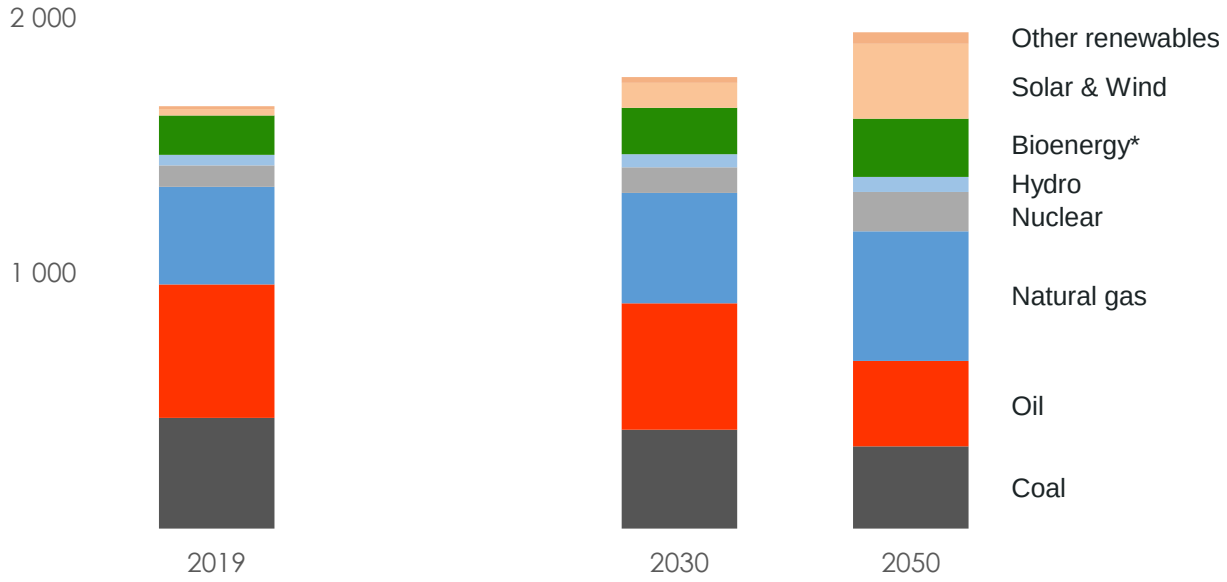



- Acceleration of transport revolution drives oil decrease after 2030
- NZ 2050 countries regulations and SUP ban further reduce demand
- Decrease in demand post-2030 lower than the natural decline of producing oil fields

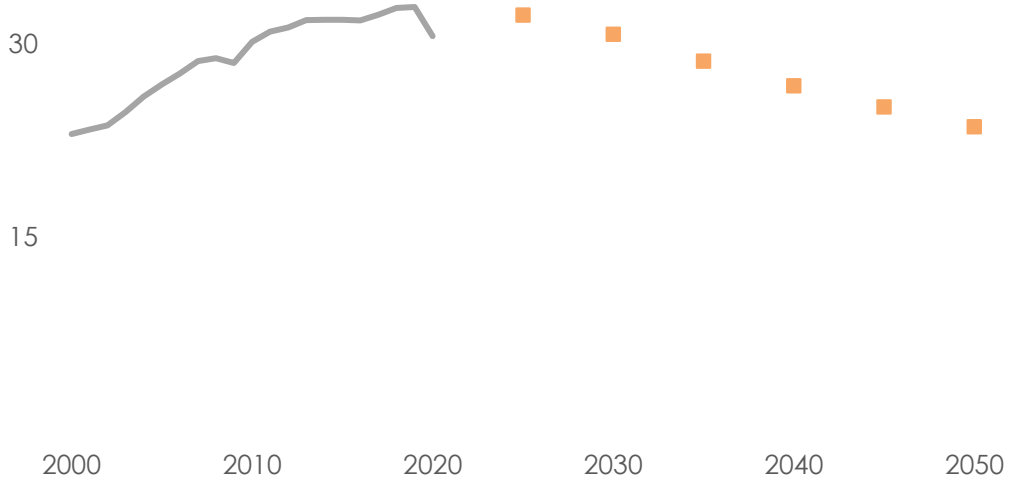
# Momentum: World energy demand and CO2 emissions

## Net-Zero pledges instrumental but insufficient to meet global targets

**Total primary energy demand**
PJ/d




**CO2 emissions**
Gt



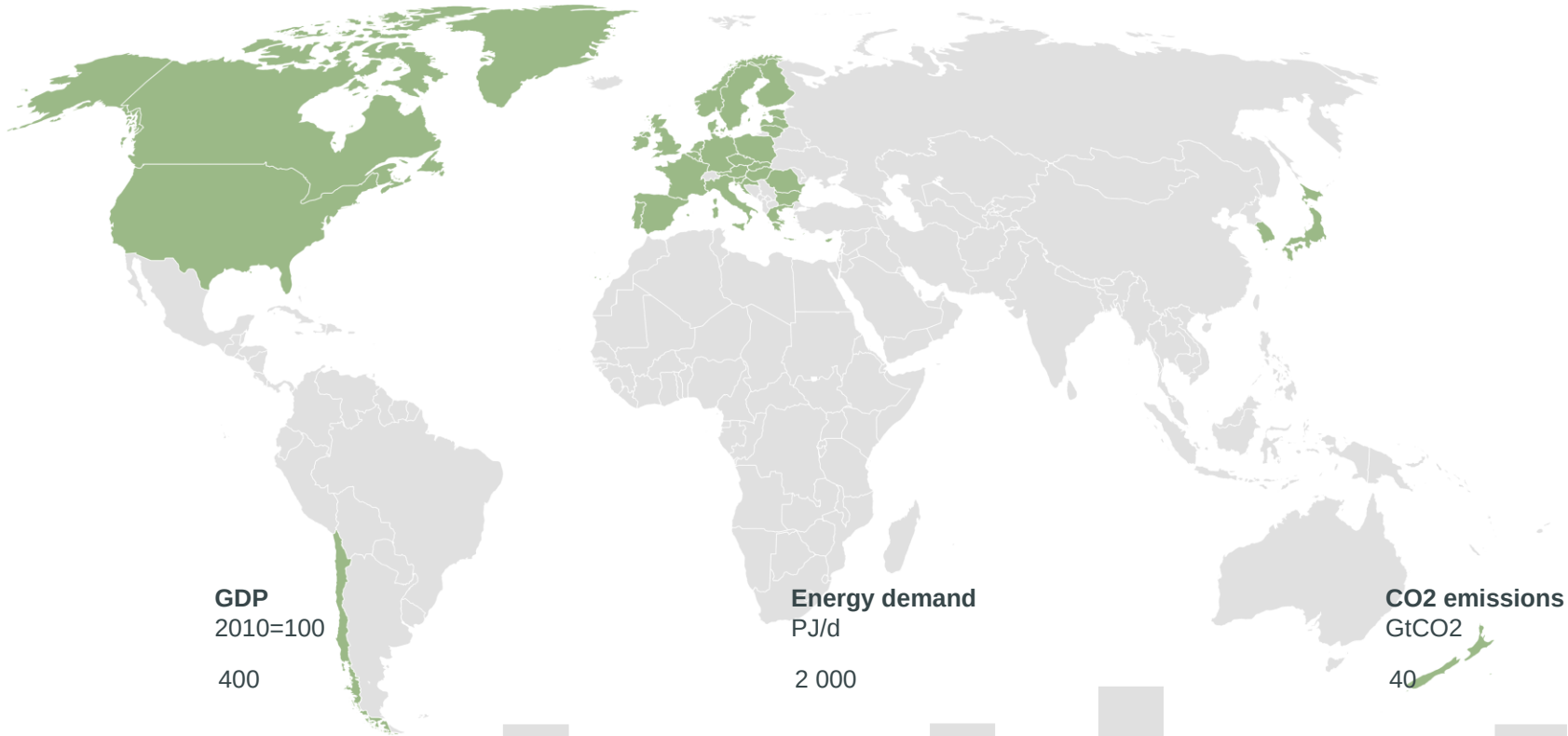

- Primary energy demand up by less than 20% by 2050
- Renewables & natural gas playing key complementary roles

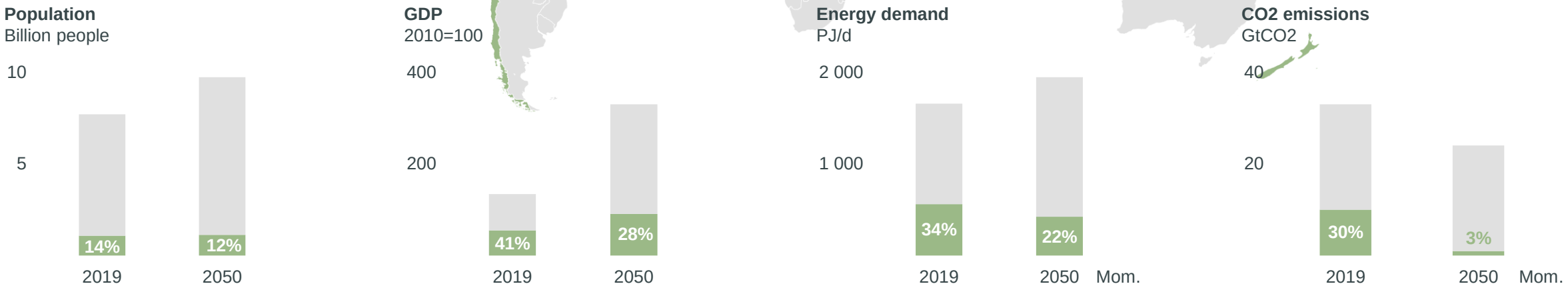
- Energy-related CO2 emissions only drop by ~30% to reach 24 Gt in 2050 (net of ~3 Gt CCS, mainly in power, blue H2 and industry)
- Temperature would rise by +2.2-2.4°C by 2100

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

# A closer look at Net Zero 2050 countries

## Paving the way to carbon neutrality



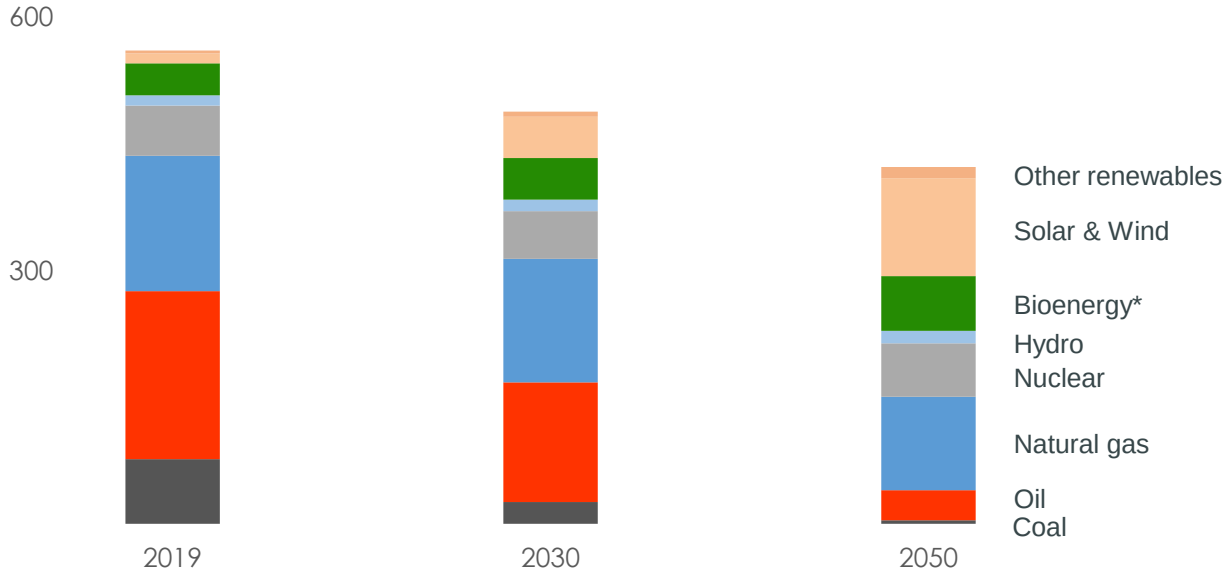


# Net Zero by 2050 countries

## At the forefront of the energy transition

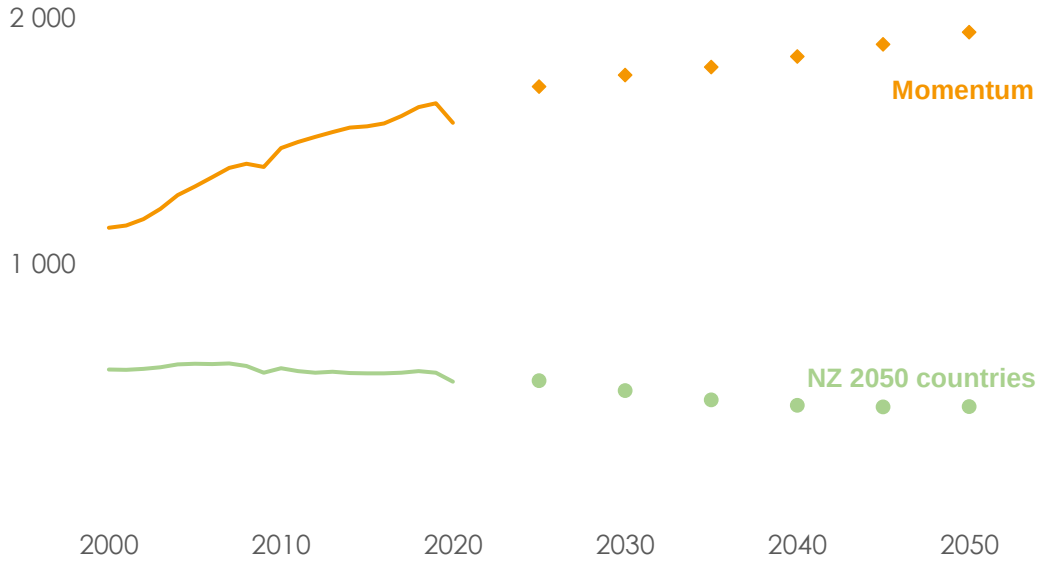
### NZ 2050 countries Primary energy demand

PJ/d




### Total primary energy demand

PJ/d




- Primary energy down -25% by 2050 (-0.9% p.a.)
- Fossil fuel share in overall mix falls from ~80% to ~1/3
- Coal completely phased out by 2050, while natural gas still accounting for ~1/4 of energy demand

- Contained energy demand in NZ 2050 countries leaving room for economic development & improved living standards in emerging countries

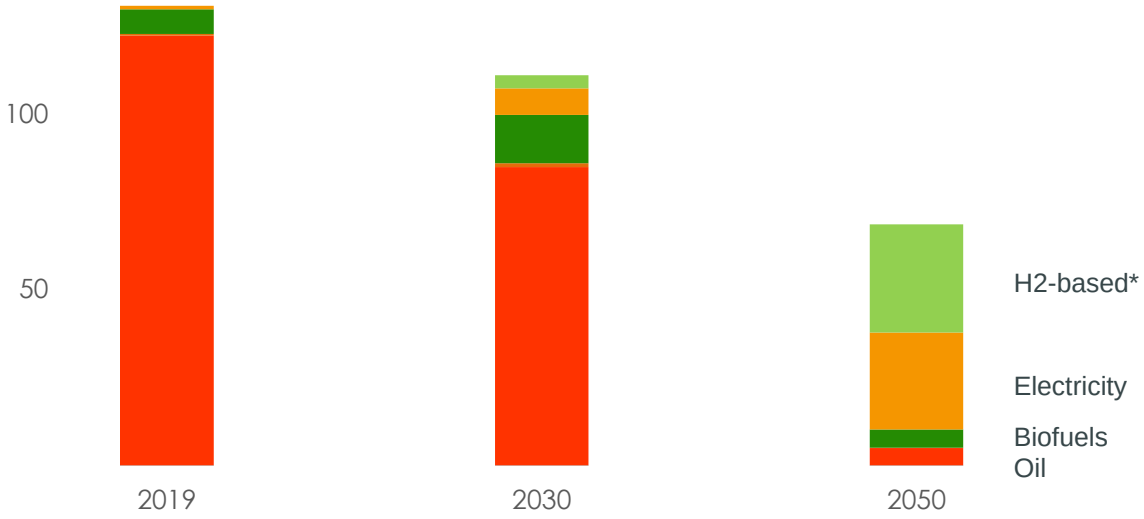
** Includes traditional use of biomass, waste, biofuels, biogas …*

# Net Zero by 2050 countries

## Amplification of transport revolution

### NZ 2050 countries Transport energy mix

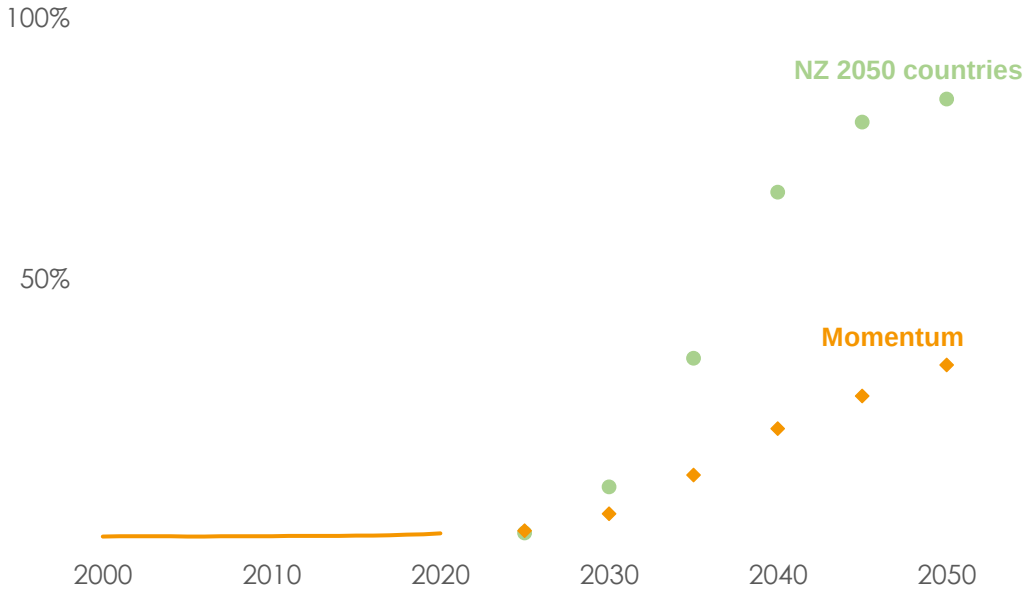
PJ/d




- Collapse in Oil in Transport energy final use thanks to 2035 ICE sales ban

### Electricity and H2-based fuels in Transport demand

%




- Massive deployment of electricity (LV) and H2-based fuels (HDV, aviation) after 2030

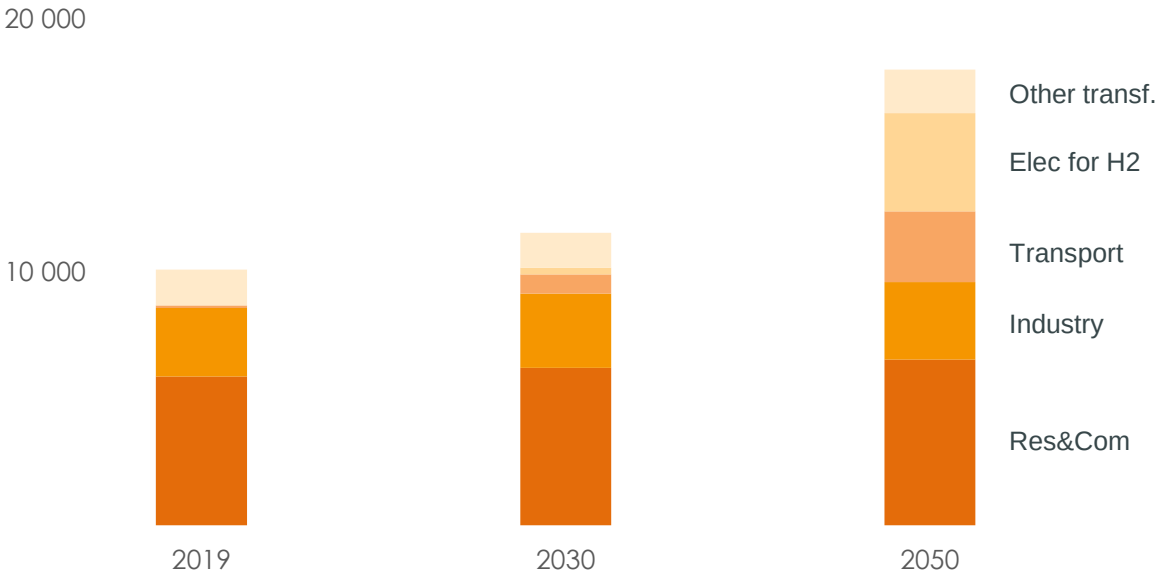
** Includes H2, e-fuels (H2 + CO2), methanol, ammonia…*

# Net Zero by 2050 countries

## Deep electrification across the board, reaching 45%

### NZ 2050 countries Power demand

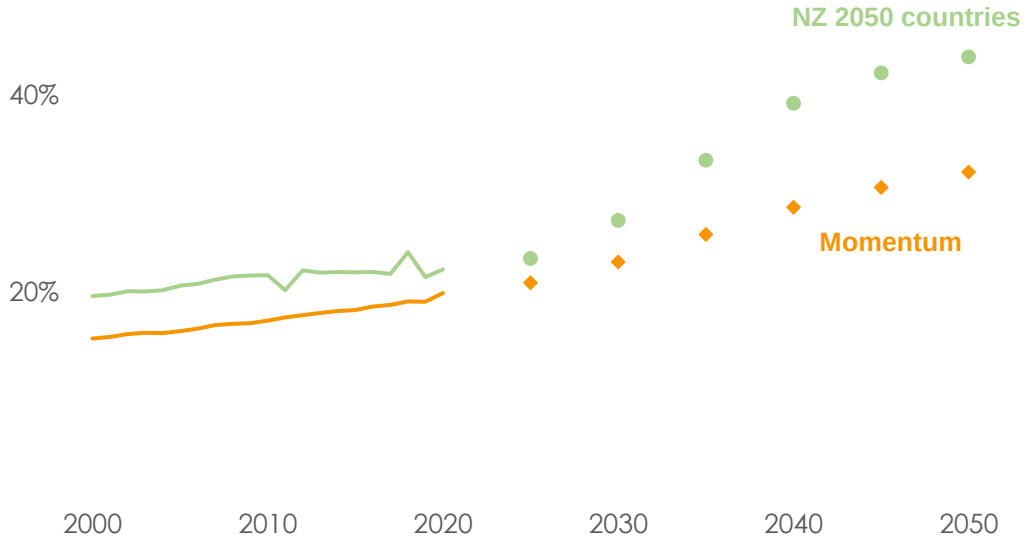
TWh




- Transport and green H2 accounting for >80% of power demand increase
- In Res&Com, strong efficiency gains and saturation of appliances ownership result in relative stability of demand in absolute terms

### Share of electricity in total final consumption

%



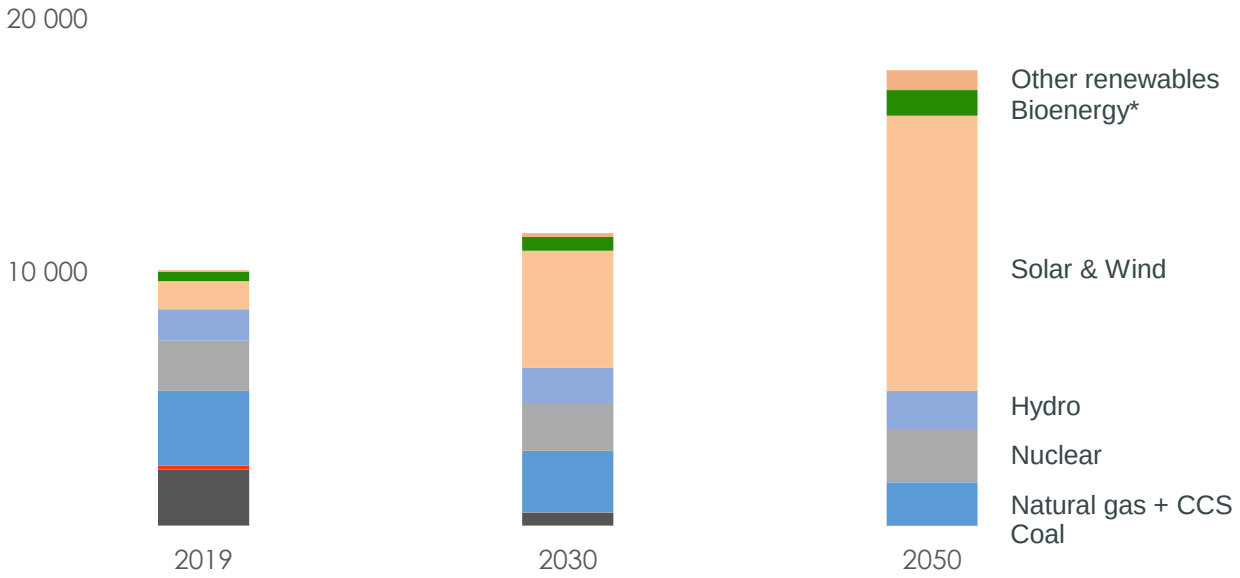

- Electrification strongly accelerates after 2030 in NZ 2050 countries, mostly due to the ICE sales ban
- NZ 2050 countries reach ~45% share of electricity in total final consumption by 2050 (vs. ~30% in Momentum)

# Net Zero by 2050 countries

## Thorough decarbonization of power generation

### NZ 2050 countries Power generation

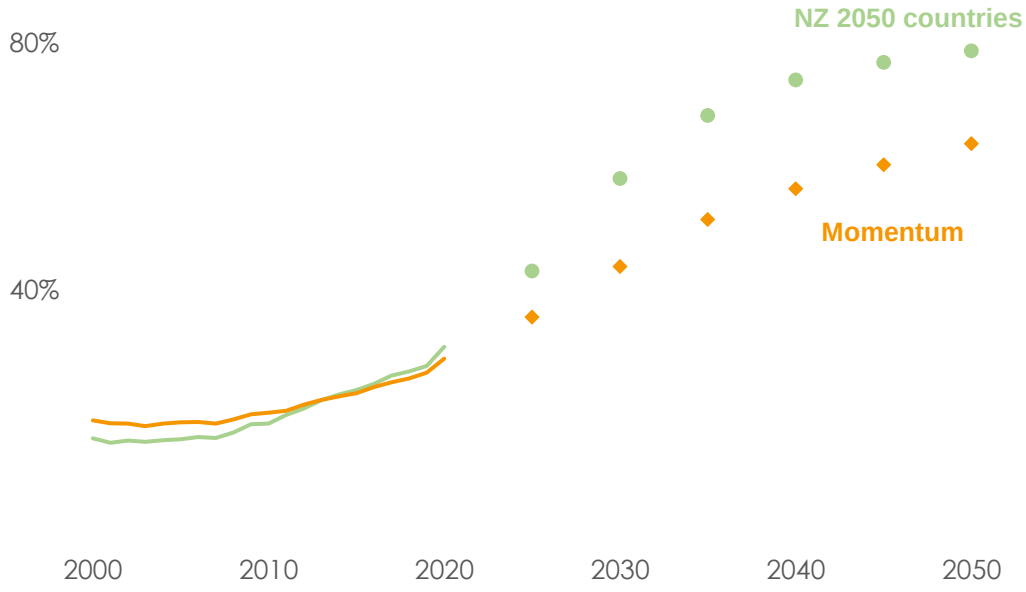
TWh




- Fossil fuels decline in power generation, but natural gas + CCS remains instrumental to accompany intermittent renewables penetration and ensure firm power together with nuclear and hydro

### Share of Renewables** in Power generation

%




- Renewables share reach ~80% in NZ 2050 countries, driven by solar & wind with 60% penetration (vs. 48% in Momentum)
- US and EU power grids almost reach carbon neutrality by 2035



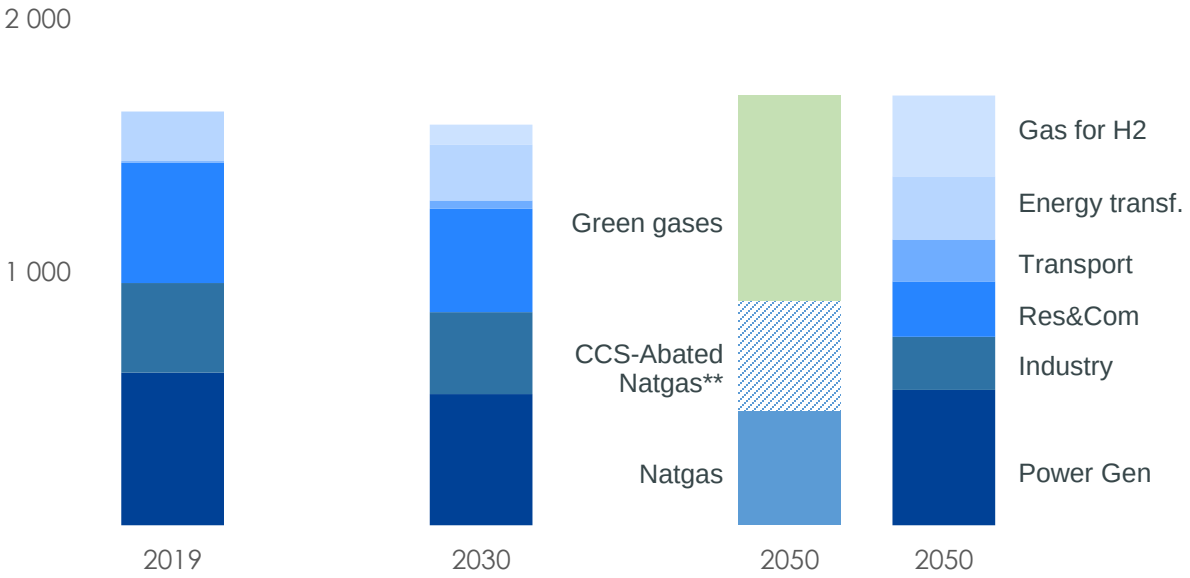
** Includes traditional use of biomass, waste, biofuels, biogas …  ** Hydro, Bioenergy, Solar, Wind and other renewables*

# Net Zero by 2050 countries

## Natural gas + CCS and green gases to play a pivotal role

### NZ 2050 countries Gases demand by sector

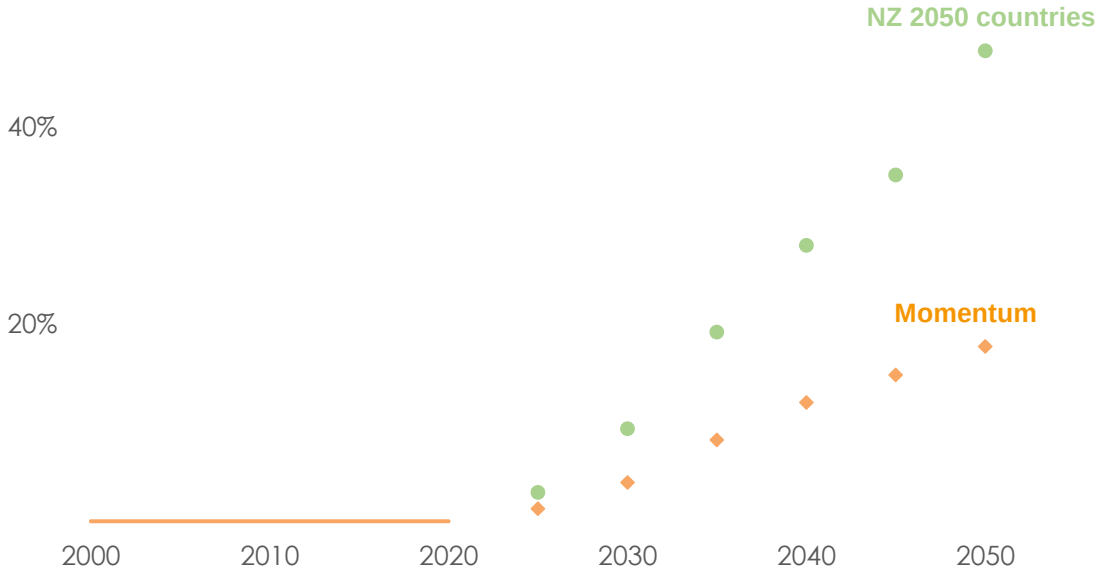
Bcm*




- Demand to remain as strong as today in 2050 thanks to decarbonization
- 1/5 of gases demand for blue H2 production in 2050
- Growing clean H2 use in transport

### Share of Green Gases in total gases demand

% (Biomethane, Clean H2, etc.)




- Extensive decarbonization of gas demand in NZ 2050 countries, reaching almost 50% of aggregate gases
- CCS abates roughly half of remaining gases (natural gas)

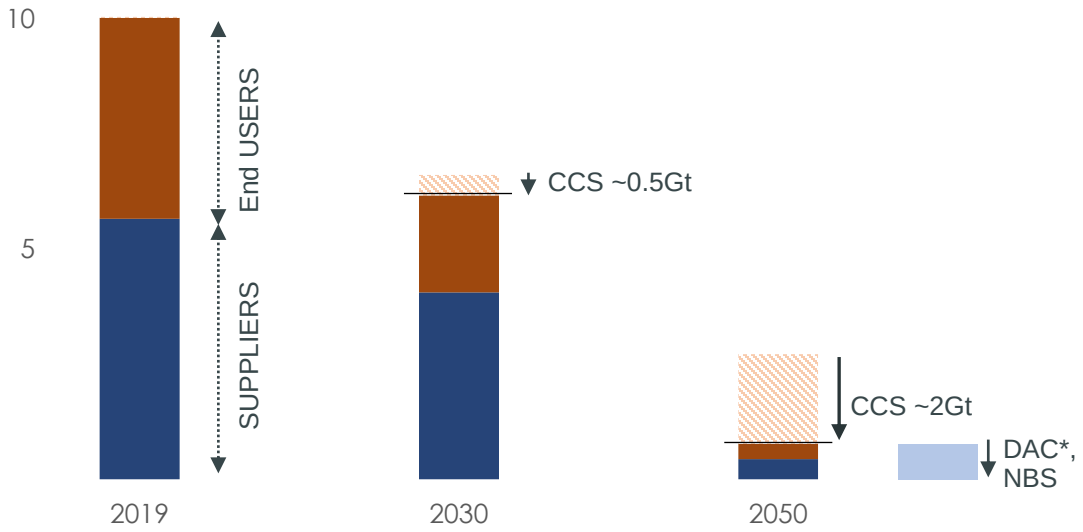
** For hydrogen: volumetric equivalence of natural gas in energy terms; H2 supply for liquid e-fuels production is excluded*
*** CCS-abated natural gas demand excl. the portion used to produce hydrogen through SMR+CCS*

# Net Zero by 2050 countries

## Leading the net-zero emissions pathway

### NZ 2050 countries CO2 emissions and CCS

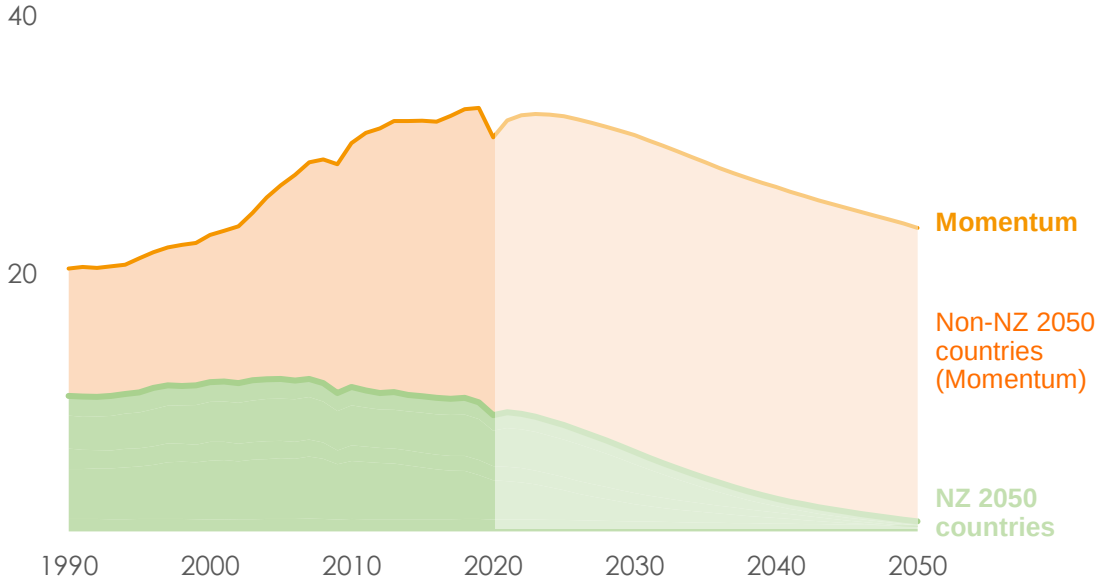
Gt




- All sectors contribute to meeting the NZ 2050 target
- Carbon pricing contributes to enable massive CCS scale-up after 2030
- Remaining CO2-energy emissions (< 1 GtCO2) will have to be abated using either other technologies (DAC*...) or Nature-Based Solutions

### World CO2 emissions

Gt




- Emissions from NZ 2050 countries peaked in 2005
- Power generation becomes carbon-neutral by 2040, followed by transport by 2045



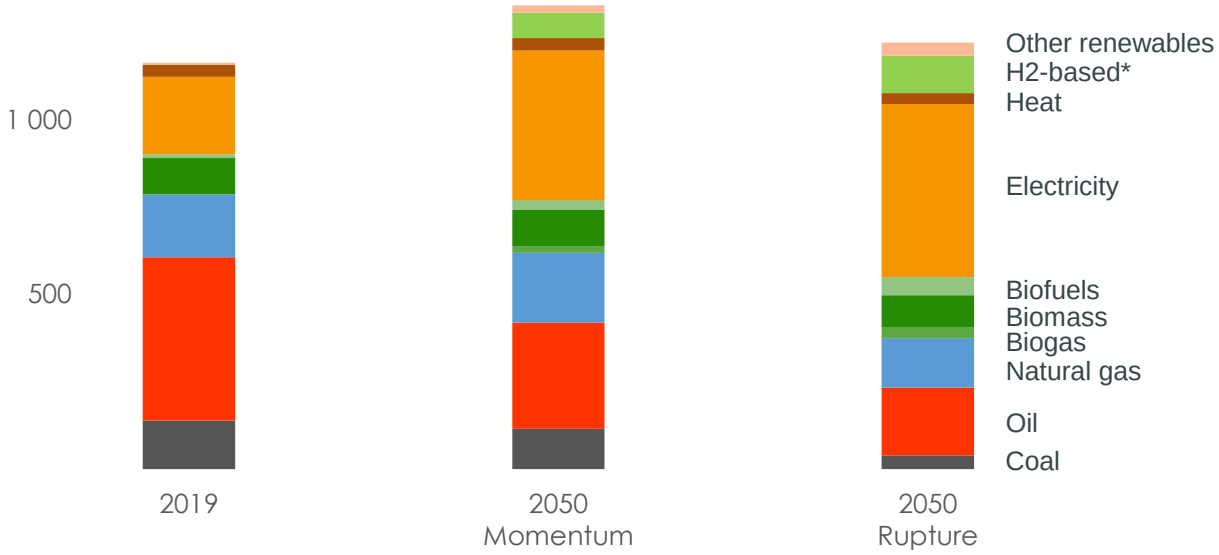
** Direct Air Capture*

# Rupture

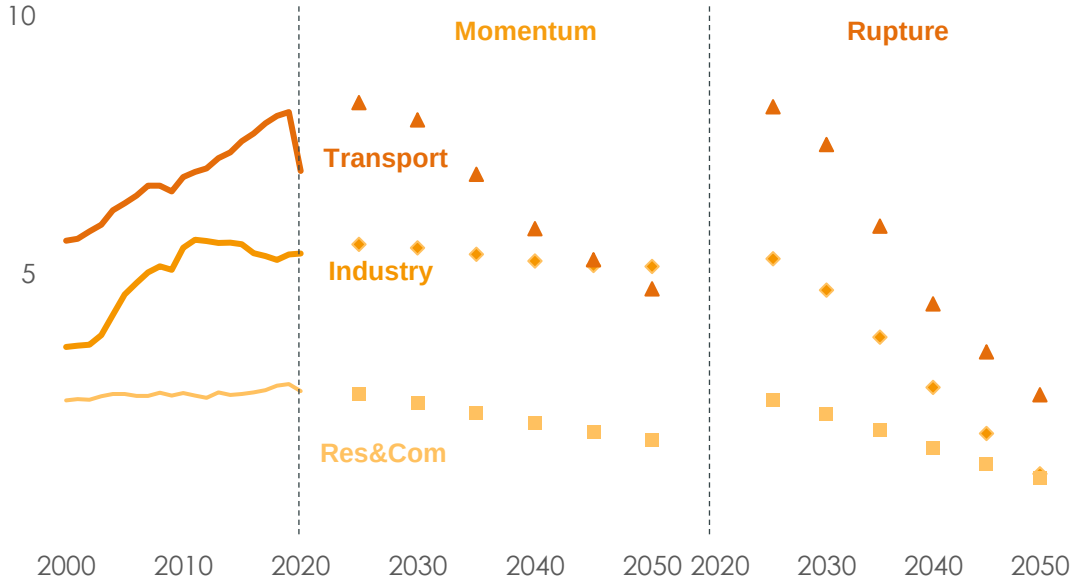
# Rupture: World Total Final Consumption

## Even more radical transformations in end-user energy consumption

**Total final consumption**
PJ/d




**CO2 emissions by sector**
Gt




- Massive electrification of end-user demand
- Collapse in oil, continued role for gas (natural gas, green gases)

- Industry and Transport see the largest drop in CO2 emissions in Rupture
- More difficult for Res&Com, although emissions still dropping by around 2/3

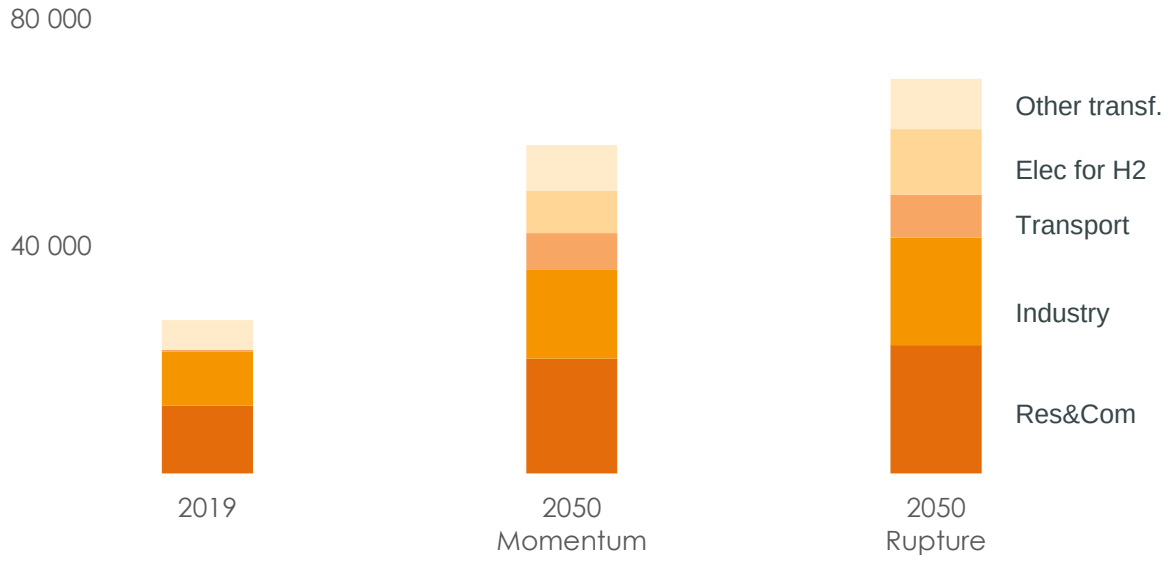
** Includes H2, e-fuels (H2 + CO2), methanol, ammonia…*

# Rupture: World Power demand

## Electrification becomes a key lever for decarbonization in all sectors

### Power demand by sector

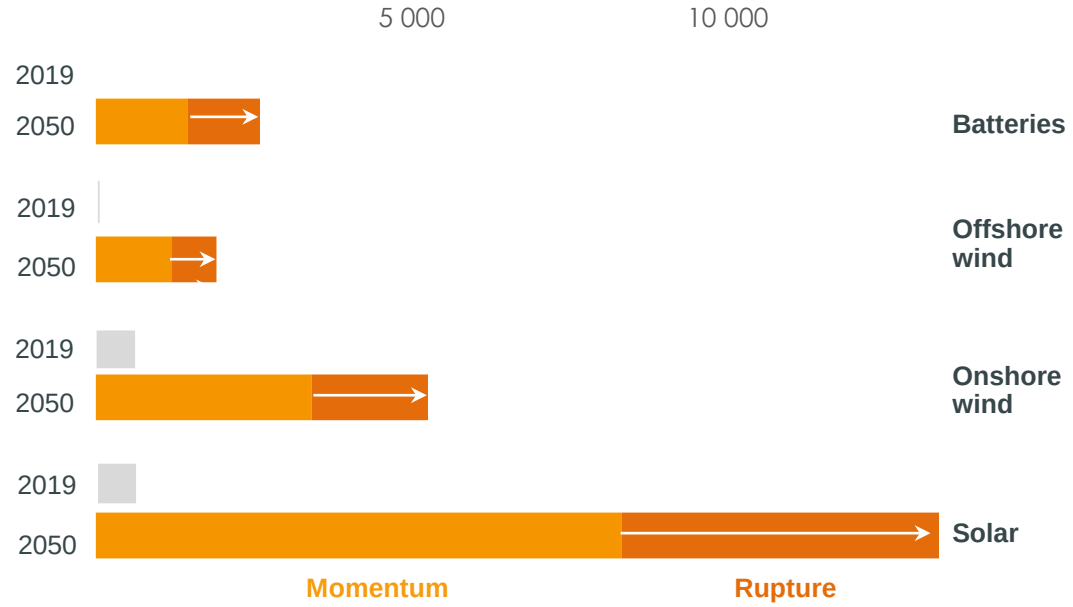
TWh




- Rupture power in 2050 needs 2.5 x today's
- 20% more power demand in Rupture 2050 vs. Momentum:
  - Electricity for green H2 significantly increasing (+50% vs. Momentum)
  - Similar contributions from other sectors

### Renewable and battery capacities in 2050

GW

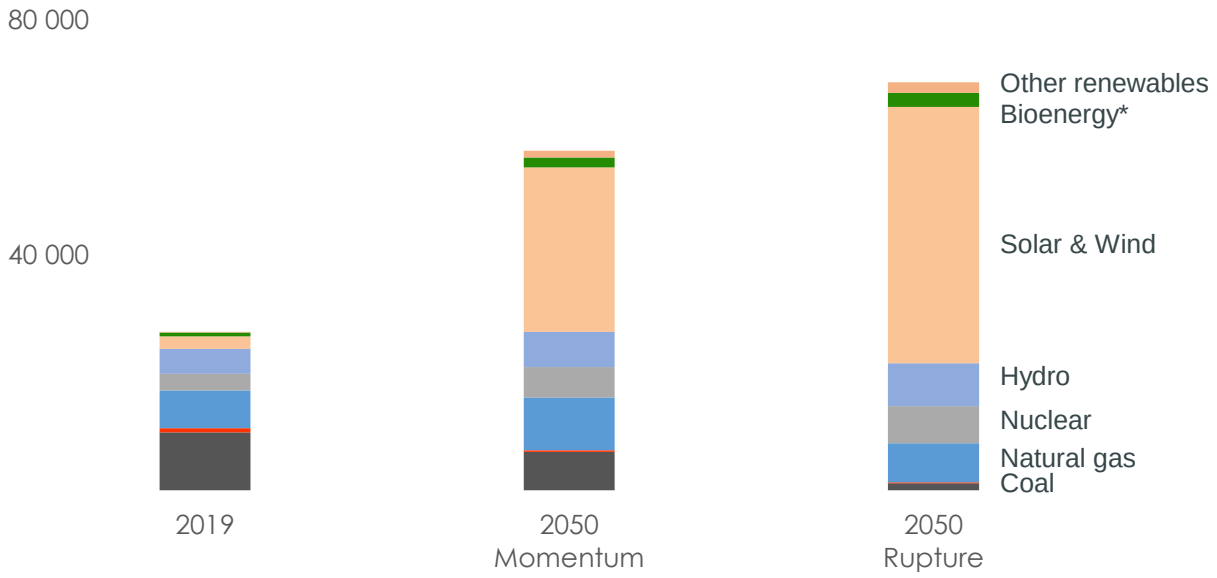



- Rupture entails adding every year to 2050 today's existing solar (or wind) capacity
- Any massive renewable penetration cannot happen without battery expansion and using green H2 to store power

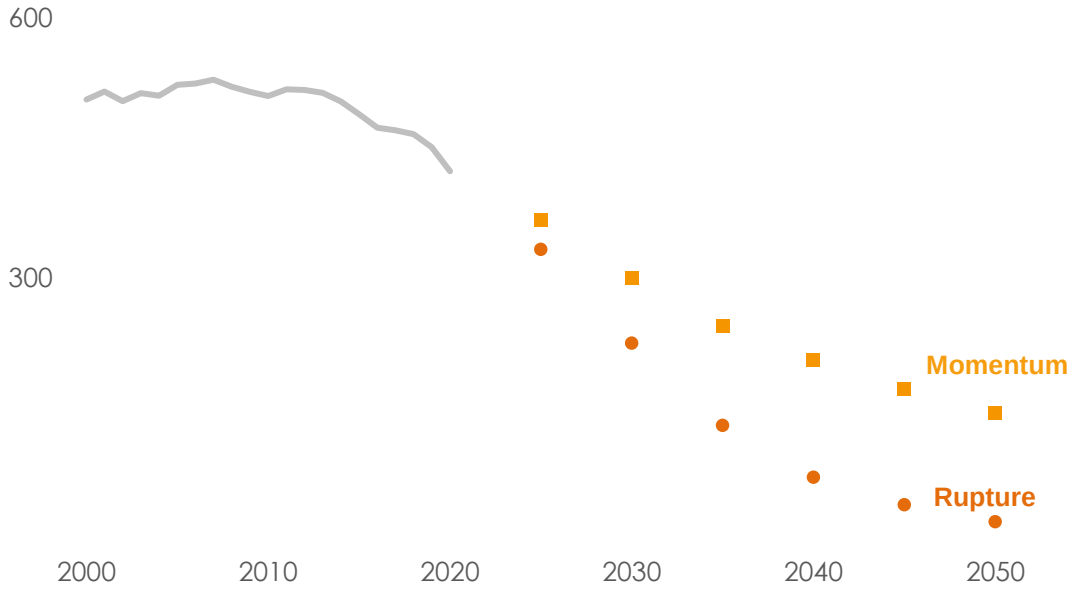
# Rupture: World Power generation

## Accelerated penetration of renewables decarbonizing electricity

**Power generation**
TWh




**Average power emission factor**
gCO2/kWh




- Decarbonization requires a new power system
- Solar & Wind representing 100% of global net incremental demand by 2050 in Rupture
- Coal disappears in Rupture, while natural gas still needed for flexible firm power

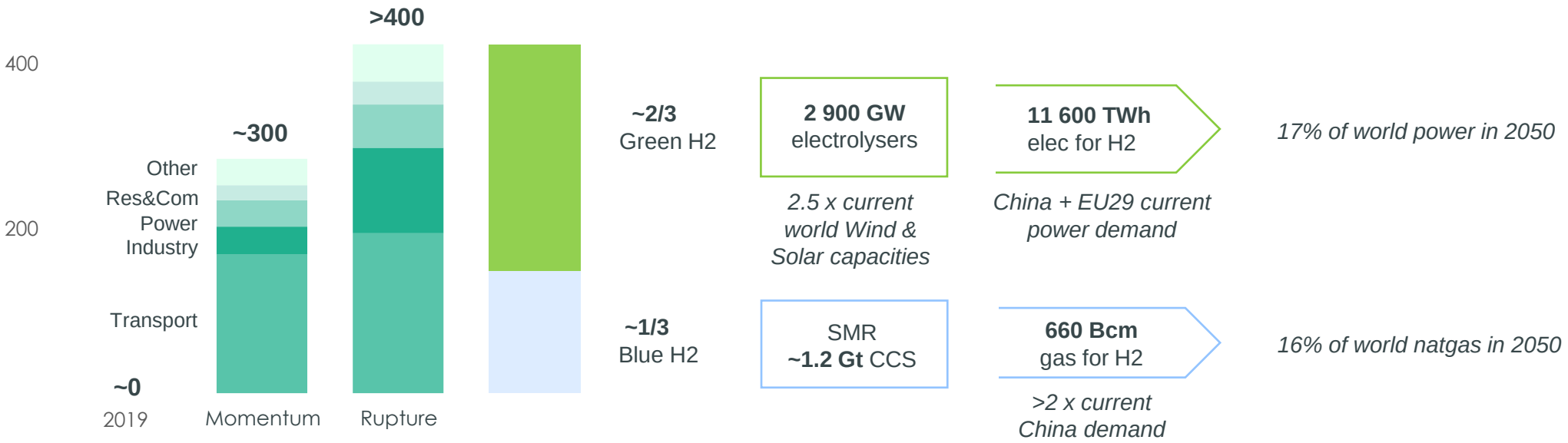
- Carbon intensity of power more than halved in Momentum
- Power sector becomes almost carbon neutral in Rupture, with the US and EU leading the way

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

# Rupture: World Clean Hydrogen

## Emerging as a promising contributor to Net-Zero

**Clean H2 balance in 2050**
MtH2




- H2 production drives up electricity & gas demand, as well as CCS & electrolysis development
- Transport & Industry are the main users of H2:
  - In Industry, H2 deployment will take place in steel, petrochemicals and cement
- Costs must come down in order to support H2 adoption and industrial scale up

# Rupture: World demand in Transport

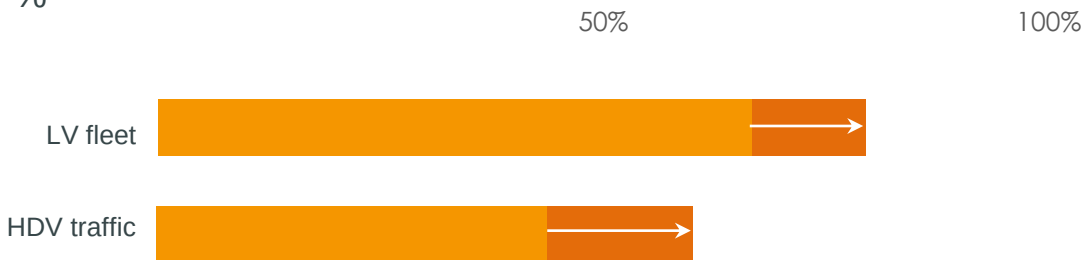
## Expansion of transport revolution to emerging markets

### Transport total final consumption

PJ/d


### Share of electricity and fuel cells in 2050

%




### Non-fossil fuels share of energy demand in 2050

%


- In Rupture, oil marginalized by increasing penetration of alternatives in all transport modes
- Advanced biofuels to play major role in decarbonizing remaining liquids

- Acceleration in Rupture with non-fossil solutions share becoming > 50% in all transport modes

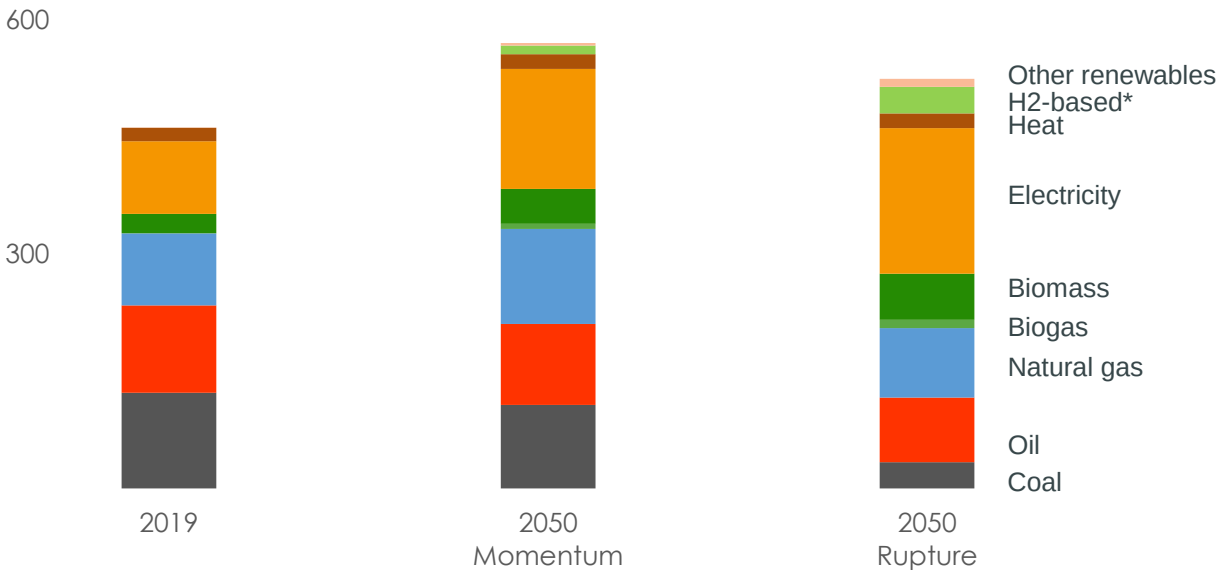
** Includes H2, e-fuels (H2 + CO2), methanol, ammonia…*

# Rupture: World demand in Industry

## Mobilizing all levers to decarbonize industry

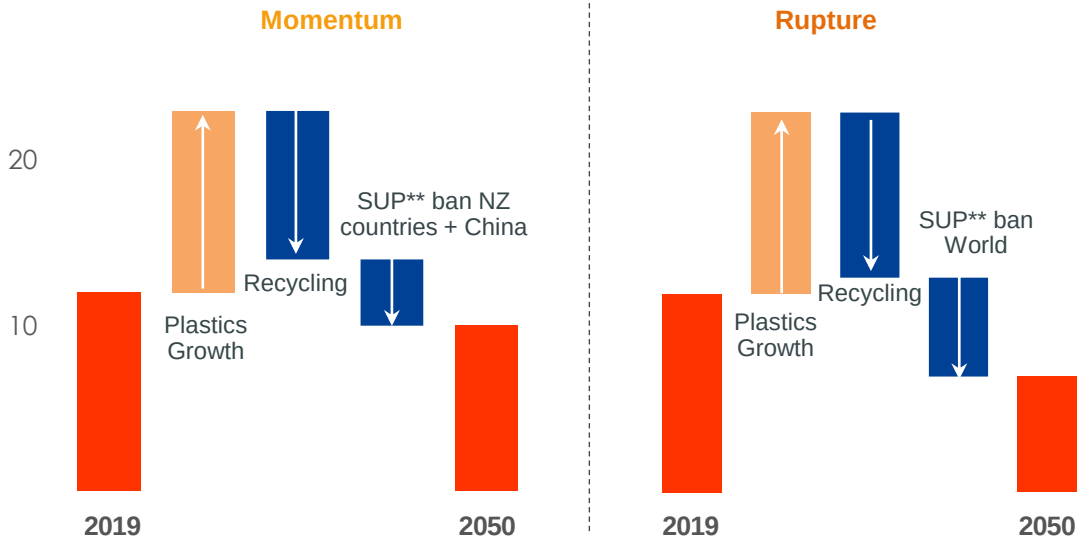
### Industry total final consumption

PJ/d




### Oil demand for petrochemicals

Mb/d




- Industry faces a major decarbonization challenge, which will require:
  - Coal-to-gas substitution wherever possible, then gas-to-electricity
  - Switching to H2 whenever the technology is available (ex: DRI)
  - Massive CCS deployment (~2 Gt)
  - Recycling raw materials (“scrap steel”…)

- In Momentum, recycling offsets ~80% of plastics demand growth by 2050. Together with SUP** ban in NZ 2050 countries and China, it lowers oil demand for petrochemicals by ~15%
- In Rupture, combined effects of worldwide SUP** ban and higher recycling rate (~50%) in 2050 drive down oil demand for petrochemicals by 40%

** Includes H2, e-fuels (H2 + CO2), methanol, ammonia…*

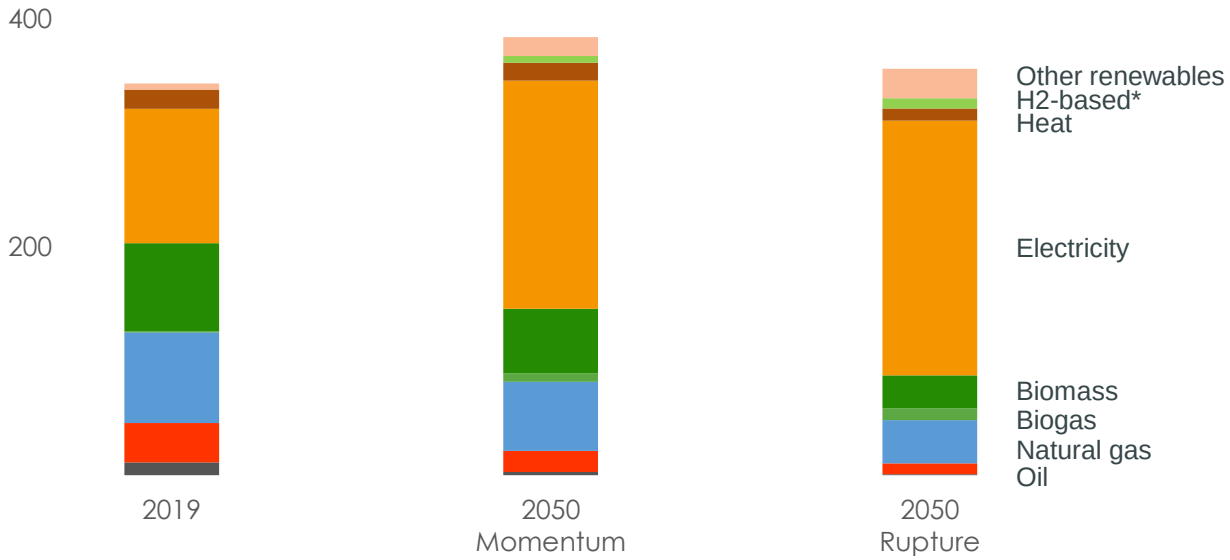
*** Single-Use Plastic*

# Rupture: World demand in Res&Com

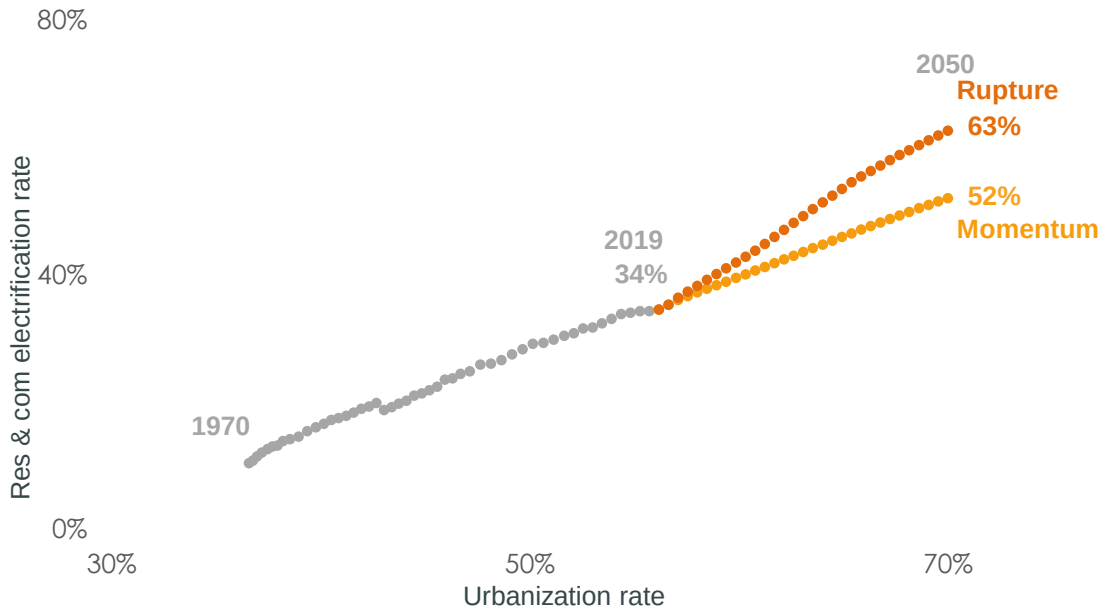
## Urbanization is a catalyst for power demand

### Residential & Commercial total final consumption

PJ/d




### World urbanization and Res&Com electrification rates




- Rupture Res&Com demand is almost flat by 2050 but sees radical electrification amplified by urbanization
- Strong energy efficiency gains from refurbishment of buildings and higher standards for appliances, lighting and cooling
- More a socioeconomic than a technical challenge

- Urbanization rate to rise from 55% to 70% in 2050, driven by non-OECD countries
- Res&Com sector characterized by high electrification due to link between urbanization and power demand

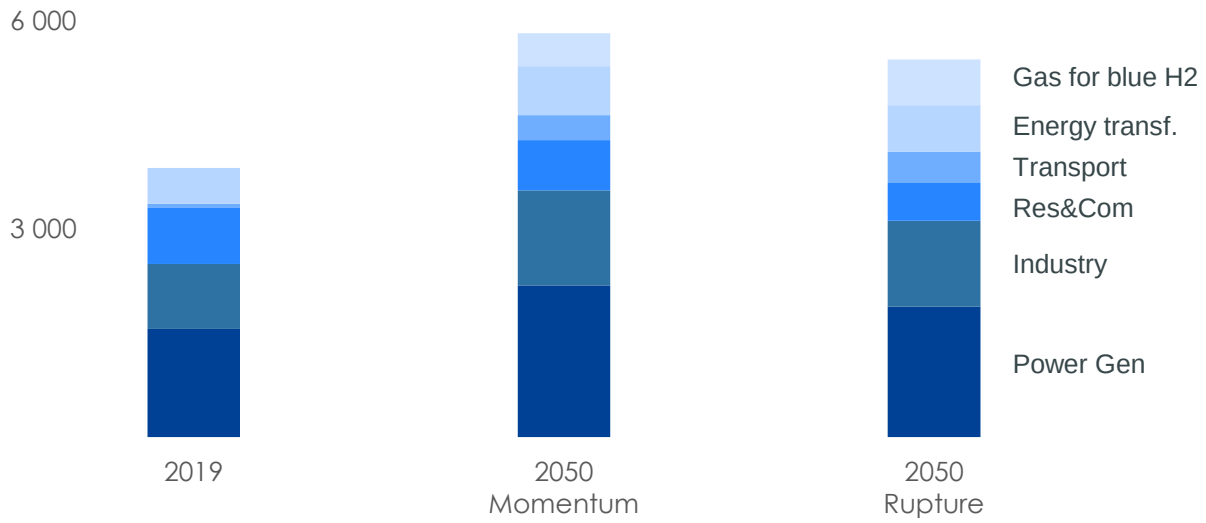
** Includes H2, e-fuels (H2 + CO2), methanol, ammonia…*

# Rupture: World Gases demand

## Gases becoming predominantly low-carbon

### Gases demand by sector

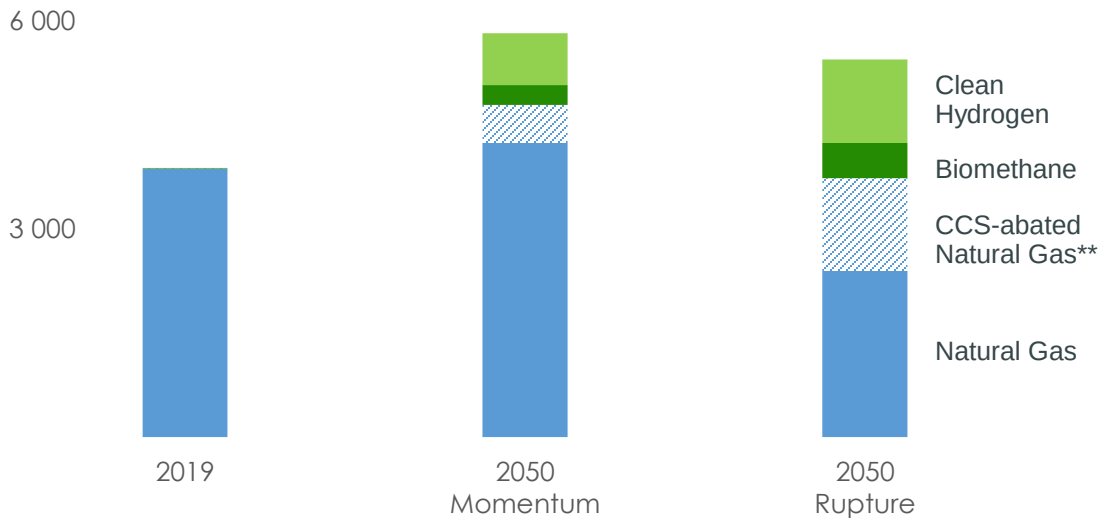
Bcm*




- Gaseous energy remains a key transition lever in all sectors in both scenarios, growing by > 1%/yr to 2050
- Green gases + CCS-abated natural gas in 2050 represent 80% of today's gas demand

### Gases demand by type

Bcm*



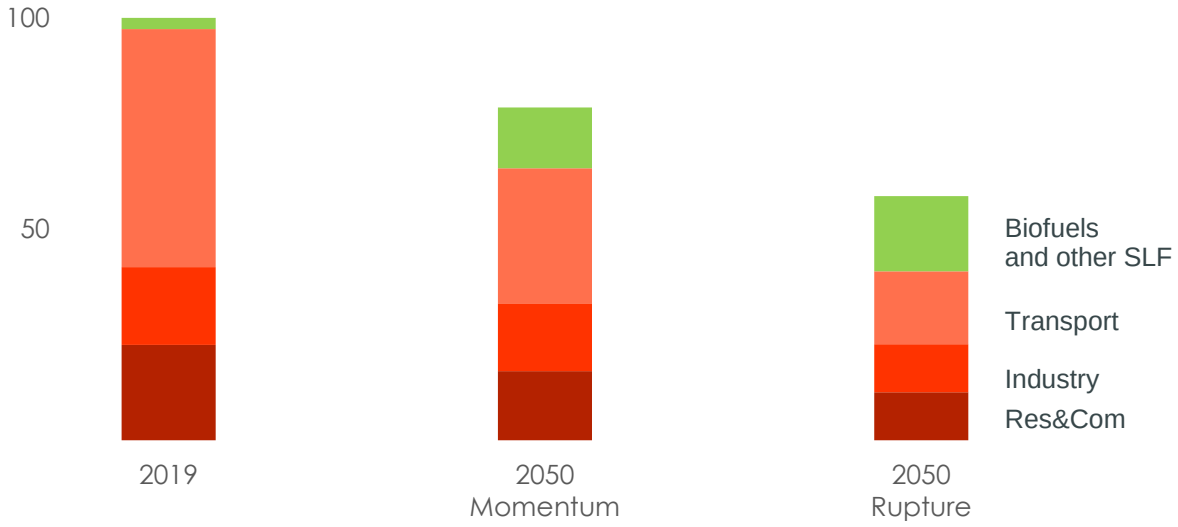

- In Rupture, more than half of global gases demand is low-carbon by 2050, almost equally shared between:
  - Clean H2 and biomethane
  - Natural gas decarbonized through CCS (excluding natural gas used for H2 production)

** For hydrogen: volumetric equivalence of natural gas in energy terms; H2 supply for liquid e-fuels production is excluded*
*** CCS-abated natural gas demand excl. the portion used to produce hydrogen through SMR+CCS*

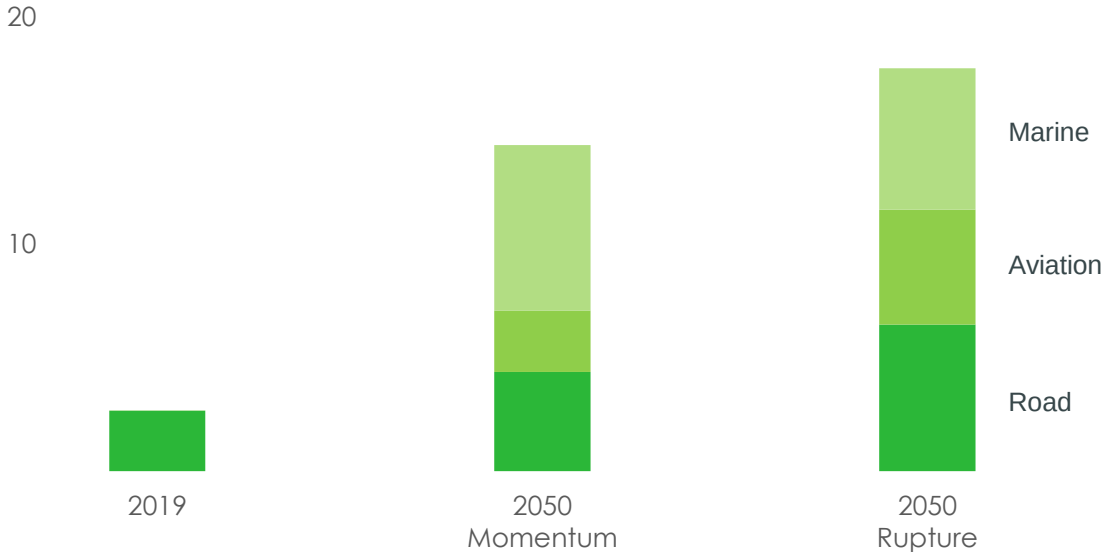
# Rupture: World Liquids demand

## Oil demand to plateau before 2030

**Liquids demand by sector**
Mb/d




**Sustainable liquid fuels demand in transport**
Mb/d

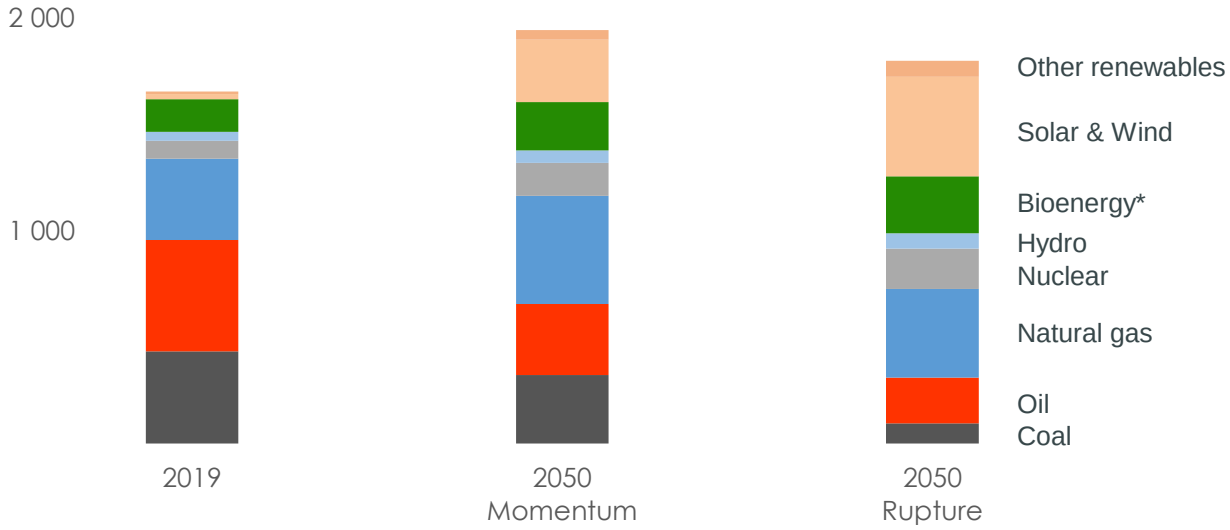



- Oil demand plateaus before 2030, with a strong decline thereafter, reaching 64 Mb/d in Momentum and 40 Mb/d in Rupture in 2050
- Net Zero requires massive adoption of sustainable liquid fuels (biofuels first, then H2-based fuels) in all transport modes, reaching 30% of liquids demand in Rupture

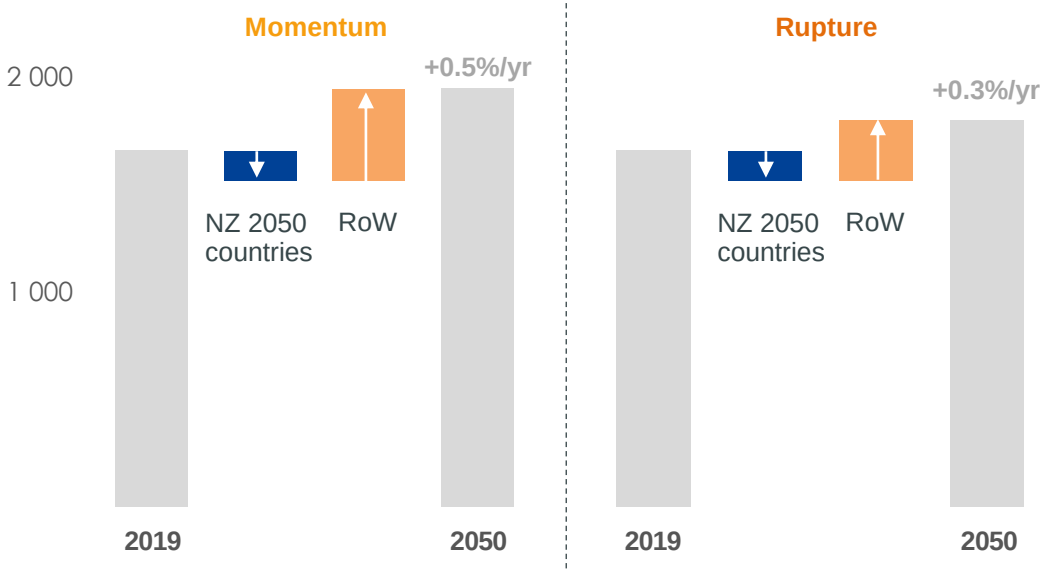
# Rupture: World Primary Energy Demand

## Greening the energy system will enable sustainable growth for all

**Total primary energy demand**
PJ/d




**Total primary energy demand**
PJ/d




- In Rupture:
  - Coal almost disappears while oil peaks within 10 years
  - Solar & Wind >25% of the primary mix by 2050
  - Natural gas (largely abated by CCS) still key in power, industry and for blue H2

- Primary energy demand up in both scenarios ensuring access to energy in non-NZ 2050 countries with increasing living standards

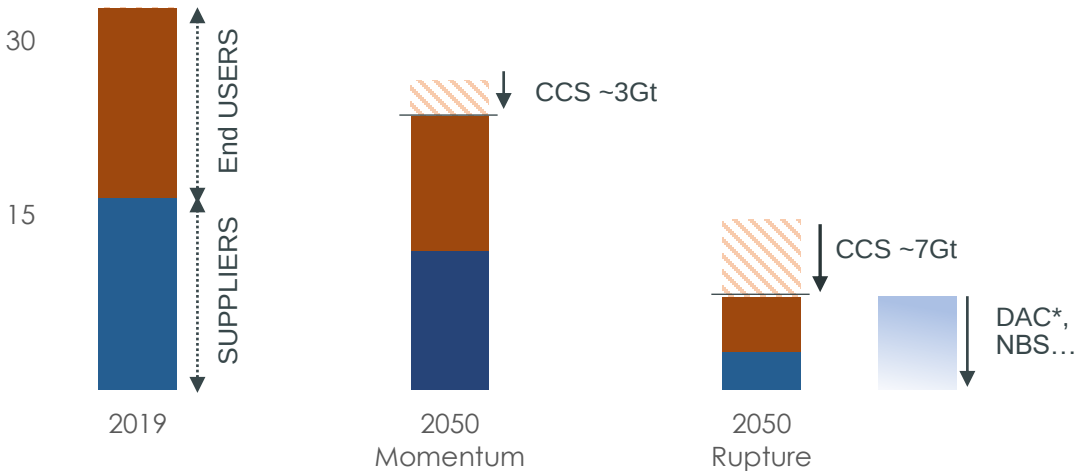
** Includes traditional use of biomass, waste, biofuels, biogas …*

# Rupture: World CO2 emissions

## CCS and NBS both needed to reach Net Zero

### Energy-related CO2 emissions

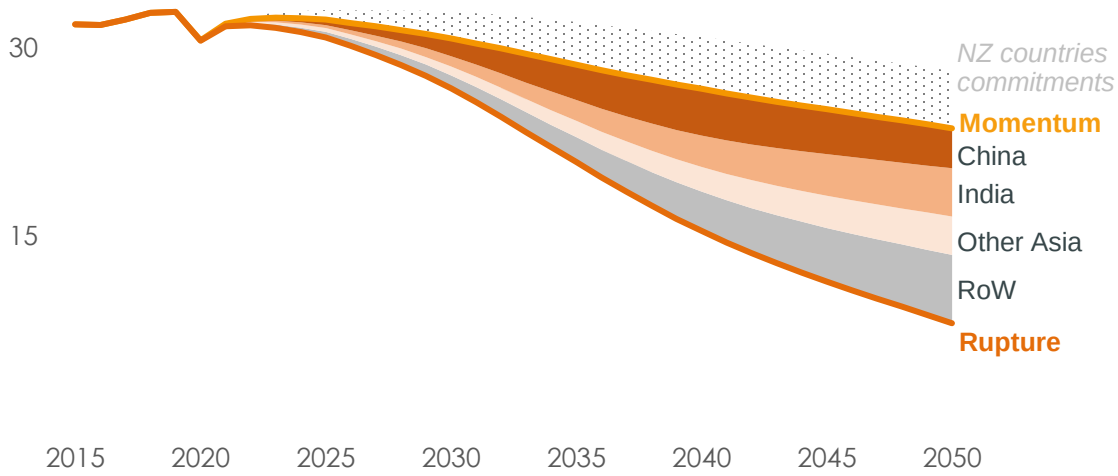
Gt




- CCS mainly on power generation (50%) and industry (25%)
- Scaling up yet-to-be-industrialized technologies such as DAC* required to lower residual emissions
- Reaching Net Zero also requires nature-based solutions

### Energy-related CO2 emissions abatements

Gt




- Emissions' decrease in Momentum thanks to NZ 2050 pledges…
- …but far from being enough
- Asia represents 70% of cumulative abatements needed to reach well-below 2°C Rupture scenario

** Direct Air Capture*

# From well-below 2°C to 1.5°C

## Rupture+ sensitivity

### Rupture+: how to reach 1.5°C

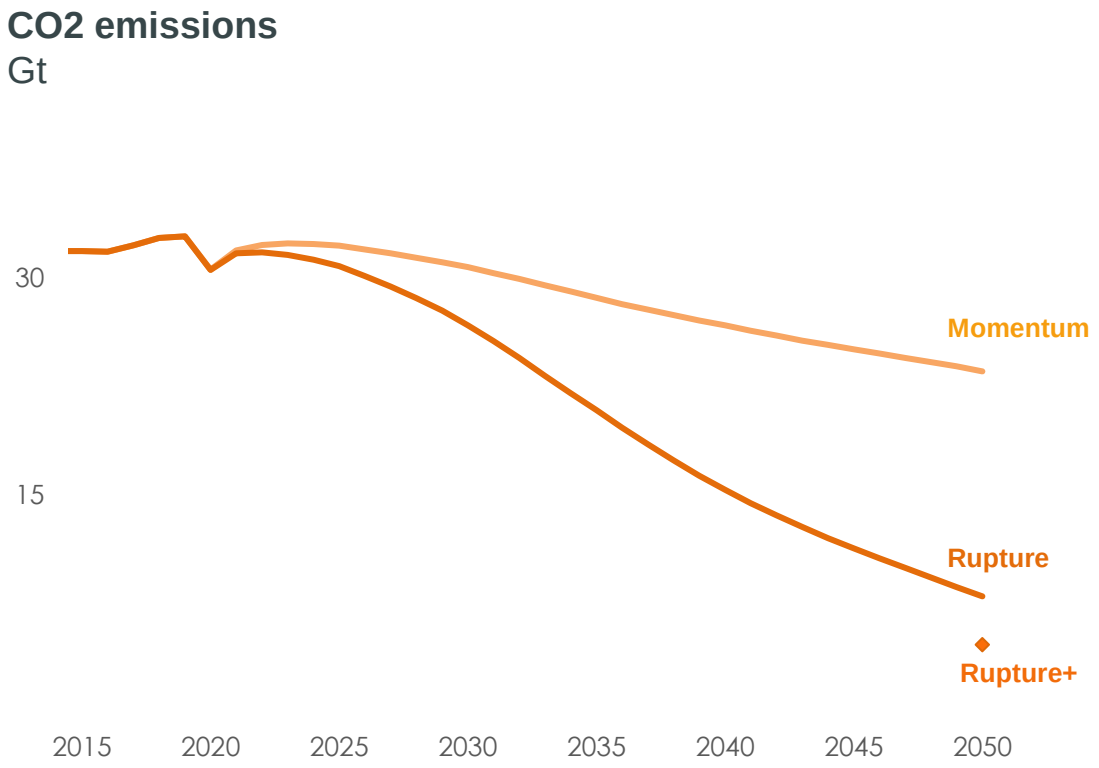
- Sensitivity to **remove ~2 Gt CO2** :

  A **worldwide ICE sales ban in 2035**

  Reducing oil demand by 14 Mb/d in 2050

- Rupture+ also assumes **8 Gt CO2 of CCS**

- **CO2 emissions** fall below **5 Gt in 2050**, making Rupture+ consistent with 1.5°C target in 2100

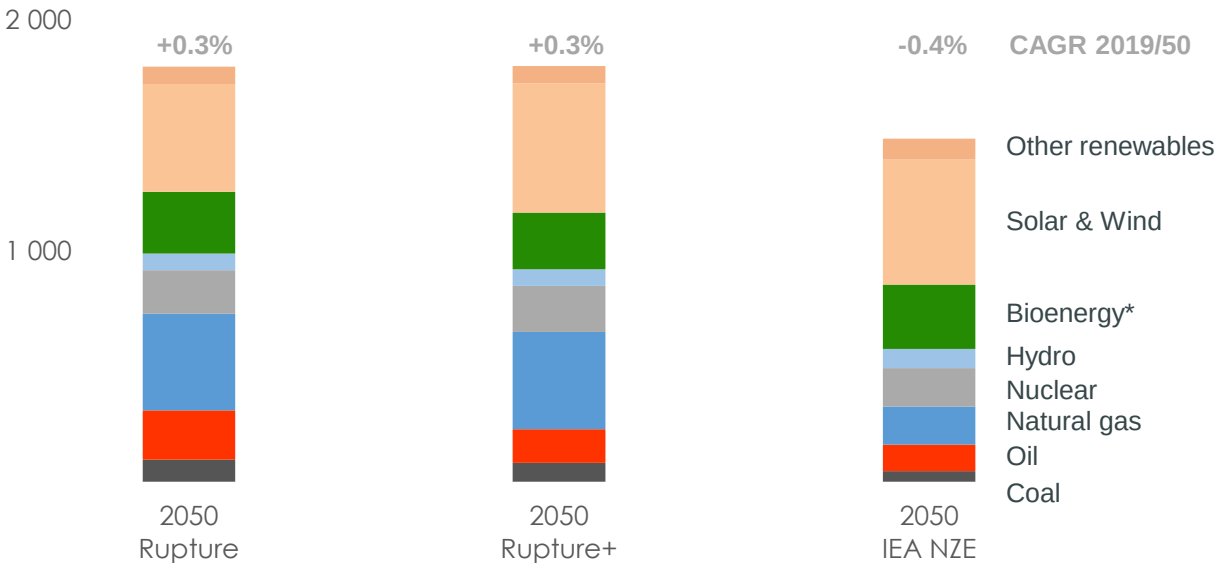



**Meeting 1.5°C requires another set of step changes in energy supply & demand, driven by regulation, technology and behaviors**

# From well-below 2°C to 1.5°C

## Selected impacts of Rupture+ sensitivity

**Total primary energy demand**
PJ/d




**Oil demand**
Mb/d


- Energy demand is up in Rupture+, as in Rupture
- Oil drops significantly to reach 26 Mb/d in 2050, close to IEA NZE (24 Mb/d), but with a different trajectory (85 Mb/d in 2030)
- Electricity and H2 take over in Transport, also increasing Power Gen for Green H2

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

# Appendix

# World primary energy demand and power generation

World primary energy demand (PJ/d)

| | | MOMENTUM | | | | RUPTURE | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2019 | 2030 | 2040 | 2050 | CAGR 19/50 | 2030 | 2040 | 2050 | CAGR 19/50 |
| Coal | 434 | 388 | 361 | 322 | -1,0% | 305 | 177 | 96 | -4,8% |
| Oil | 523 | 495 | 392 | 334 | -1,4% | 465 | 313 | 214 | -2,8% |
| Natural Gas | 383 | 433 | 479 | 508 | 0,9% | 431 | 438 | 418 | 0,3% |
| Nuclear | 84 | 100 | 120 | 154 | 2,0% | 106 | 135 | 189 | 2,7% |
| Hydro | 42 | 50 | 55 | 59 | 1,1% | 56 | 65 | 72 | 1,8% |
| Solar | 11 | 44 | 94 | 143 | 8,7% | 66 | 160 | 244 | 10,6% |
| Wind | 14 | 53 | 105 | 150 | 7,9% | 70 | 159 | 224 | 9,4% |
| Bioenergy* | 154 | 182 | 204 | 228 | 1,3% | 183 | 215 | 267 | 1,8% |
| Other Renewables | 12 | 24 | 35 | 45 | 4,5% | 36 | 58 | 75 | 6,2% |
| **Total** | **1655** | **1770** | **1846** | **1944** | **0,5%** | **1718** | **1719** | **1799** | **0,3%** |

World power generation ('000TWh)

| | | MOMENTUM | | | | RUPTURE | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2019 | 2030 | 2040 | 2050 | CAGR 19/50 | 2030 | 2040 | 2050 | CAGR 19/50 |
| Coal | 9,9 | 8,8 | 8,1 | 6,6 | -1,3% | 6,7 | 3,3 | 1,3 | -6,4% |
| Oil | 0,7 | 0,4 | 0,3 | 0,3 | -3,2% | 0,3 | 0,2 | 0,2 | -5,0% |
| Natural Gas | 6,4 | 7,1 | 8,0 | 9,0 | 1,1% | 7,2 | 6,9 | 6,6 | 0,1% |
| Nuclear | 2,8 | 3,4 | 4,0 | 5,2 | 2,0% | 3,5 | 4,5 | 6,3 | 2,7% |
| Hydro | 4,3 | 5,1 | 5,6 | 6,0 | 1,1% | 5,7 | 6,6 | 7,3 | 1,8% |
| Solar | 0,7 | 3,6 | 8,2 | 12,8 | 9,9% | 5,5 | 13,7 | 20,9 | 11,6% |
| Wind | 1,4 | 5,4 | 10,7 | 15,2 | 7,9% | 7,1 | 16,1 | 22,7 | 9,4% |
| Bioenergy* | 0,6 | 0,9 | 1,3 | 1,7 | 3,2% | 1,1 | 1,7 | 2,4 | 4,3% |
| Other Renewables | 0,1 | 0,3 | 0,6 | 1,1 | 7,3% | 0,4 | 1,0 | 1,8 | 9,0% |
| **Total** | **27,0** | **35,1** | **46,8** | **57,8** | **2,5%** | **37,4** | **54,0** | **69,4** | **3,1%** |

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

# Disclaimer

The entities in which TotalEnergies SE directly or indirectly owns a shareholding are separate and independent legal entities. The terms "TotalEnergies", "TotalEnergies company" and "Company" used in this document are generic and used for convenience to designate TotalEnergies SE and the entities included in its scope of consolidation. Likewise, the words "we", "us" and "our" may also be used to refer to these entities or their employees.

This document may contain forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995, notably with respect to the financial condition, results of operations, business activities and industrial strategy of TotalEnergies. This document may also contain statements regarding the perspectives, objectives, areas of improvement and goals of TotalEnergies, including with respect to climate change and carbon neutrality (net zero emissions). For the definitions of non-financial performance indicators, refer to the latest TotalEnergies's Universal Registration Document. An ambition expresses an outcome desired by TotalEnergies, it being specified that the means to be deployed do not depend solely on TotalEnergies. These forward-looking statements may generally be identified by the use of the future or conditional tense or forward-looking words such as "envisions", "intends", "anticipates", "believes", "considers", "plans", "expects", "thinks", "targets", "aims" or similar terminology. Such forward-looking statements included in this document are based on economic data, estimates and assumptions prepared in a given economic, competitive and regulatory environment and considered to be reasonable by TotalEnergies as of the date of this document.

These forward-looking statements are not historical data and should not be interpreted as assurances that the perspectives, objectives or goals announced will be achieved. They may prove to be inaccurate in the future, and may evolve or be modified with a significant difference between the actual results and those initially estimated, due to the uncertainties notably related to the economic, financial, competitive and regulatory environment, or due to the occurrence of risk factors, such as, notably, the price fluctuations in crude oil and natural gas, the evolution of the demand and price of petroleum products, the changes in production results and reserves estimates, the ability to achieve cost reductions and operating efficiencies without unduly disrupting business operations, changes in laws and regulations including those related to the environment and climate, currency fluctuations, as well as economic and political developments, changes in market conditions, loss of market share and changes in consumer preferences, or pandemics such as the COVID-19 pandemic. Additionally, certain financial information is based on estimates particularly in the assessment of the recoverable value of assets and potential impairments of assets relating thereto.

Neither TotalEnergies nor any of its subsidiaries assumes any obligation to update publicly any forward-looking information or statement, objectives or trends contained in this document whether as a result of new information, future events or otherwise. The information on risk factors that could have a significant adverse effect on TotalEnergies' business, financial condition, including its operating income and cash flow, reputation, outlook or the value of financial instruments issued by TotalEnergies is provided in the most recent version of the Universal Registration Document which is filed by TotalEnergies SE with the French Autorité des Marchés Financiers and the annual report on Form 20-F filed with the United States Securities and Exchange Commission ("SEC").

Financial information by business segment is reported in accordance with the internal reporting system and shows internal segment information that is used to manage and measure the performance of TotalEnergies. In addition to IFRS measures, certain alternative performance indicators are presented, such as performance indicators excluding the adjustment items described below (adjusted operating income, adjusted net operating income, adjusted net income), return on equity (ROE), return on average capital employed (ROACE), gearing ratio, operating cash flow before working capital changes, the shareholder rate of return. These indicators are meant to facilitate the analysis of the financial performance of TotalEnergies and the comparison of income between periods. They allow investors to track the measures used internally to manage and measure the performance of TotalEnergies.

These adjustment items include:

(i) Special items

Due to their unusual nature or particular significance, certain transactions qualified as "special items" are excluded from the business segment figures. In general, special items relate to transactions that are significant, infrequent or unusual. However, in certain instances, transactions such as restructuring costs or asset disposals, which are not considered to be representative of the normal course of business, may be qualified as special items although they may have occurred within prior years or are likely to occur again within the coming years.

(ii) Inventory valuation effect

The adjusted results of the Refining & Chemicals and Marketing & Services segments are presented according to the replacement cost method. This method is used to assess the segments' performance and facilitate the comparability of the segments' performance with those of its competitors.

In the replacement cost method, which approximates the LIFO (Last-In, First-Out) method, the variation of inventory values in the statement of income is, depending on the nature of the inventory, determined using either the month-end price differentials between one period and another or the average prices of the period rather than the historical value. The inventory valuation effect is the difference between the results according to the FIFO (First-In, First-Out) and the replacement cost.

(iii) Effect of changes in fair value

The effect of changes in fair value presented as an adjustment item reflects, for some transactions, differences between internal measures of performance used by TotalEnergies' management and the accounting for these transactions under IFRS.

IFRS requires that trading inventories be recorded at their fair value using period-end spot prices. In order to best reflect the management of economic exposure through derivative transactions, internal indicators used to measure performance include valuations of trading inventories based on forward prices.

TotalEnergies, in its trading activities, enters into storage contracts, whose future effects are recorded at fair value in TotalEnergies' internal economic performance. IFRS precludes recognition of this fair value effect.

Furthermore, TotalEnergies enters into derivative instruments to risk manage certain operational contracts or assets. Under IFRS, these derivatives are recorded at fair value while the underlying operational transactions are recorded as they occur. Internal indicators defer the fair value on derivatives to match with the transaction occurrence.

The adjusted results (adjusted operating income, adjusted net operating income, adjusted net income) are defined as replacement cost results, adjusted for special items, excluding the effect of changes in fair value.

Euro amounts presented for the fully adjusted-diluted earnings per share represent dollar amounts converted at the average euro-dollar (€-$) exchange rate for the applicable period and are not the result of financial statements prepared in euros.

Cautionary Note to U.S. Investors – The SEC permits oil and gas companies, in their filings with the SEC, to separately disclose proved, probable and possible reserves that a company has determined in accordance with SEC rules. We may use certain terms in this press release, such as "potential reserves" or "resources", that the SEC's guidelines strictly prohibit us from including in filings with the SEC. U.S. investors are urged to consider closely the disclosure in the Form 20-F of TotalEnergies, File N° 1-10888, available from us at 2, place Jean Millier – Arche Nord Coupole/Regnault - 92078 Paris-La Défense Cedex, France, or at our website totalenergies.com. You can also obtain this form from the SEC by calling 1-800-SEC-0330 or on the SEC's website sec.gov.

**Corporate Communications**
**TOTAL SE**

2, place Jean-Millier
92400 Courbevoie, France
Tel.: +33 (0)1 47 44 45 46
Share capital: €6,601,073,322.50
Registered in Nanterre: RCS 542 051 180

TotalEnergies

For more information go to
totalenergies.com