### 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

#### 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

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

**Temperature increase limited to 1.7°C**

with a sensitivity for a 1.5°C scenario

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* 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

- 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

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

Rupture: how to reach well-below 2°C

- 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…)

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

* 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

- 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

World energy demand per capita in 2019

- 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

*C. Annual Growth Rate
How to curb emissions?
A collective engagement, from suppliers to consumers

Global anthropogenic GHG emissions in 2018
GtCO2e

Energy-related CO2

- Methane from the oil & gas industry
- Methane from coal, bioenergy
- Methane from agriculture, waste
- CO2 from non-energy (industrial processes, land-use change…)
- Other greenhouse gases (N₂O…)

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

- More energy in all scenarios
- Oil plateaus before 2030 and declines thereafter
- Gas enabler of the energy transition in power & industry
- Greener liquids & gases
- Carbon sinks (CCS*, NBS**) key for the Net Zero journey
- H2 increased penetration in industry and transportation
- Renewables decarbonizing the power sector
- Radical electrification, with storage playing a key role

* Carbon Capture & Storage **Nature-based solutions
### Key drivers for energy transition in each sector

#### How to decarbonize

<table>
<thead>
<tr>
<th>Driver</th>
<th>Industry</th>
<th>Transport</th>
<th>Residential &amp; Commercial</th>
<th>Power</th>
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</thead>
<tbody>
<tr>
<td>Energy efficiency</td>
<td>⚫⚫⚫</td>
<td>⚫</td>
<td>⚫⚫⚫</td>
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<td>⚫⚫</td>
<td>⚫</td>
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<tr>
<td>Recycling / Re-use</td>
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</table>

**Impact level:**
- ⚫ Low
- ⚫⚫ Medium
- ⚫⚫⚫ High
## Key modeling drivers of our scenarios

### Sector-based assumptions

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

* 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

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

Light Vehicles fleet (Momentum)
Billion

- 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

<table>
<thead>
<tr>
<th>Year</th>
<th>H2-based**</th>
<th>Electricity</th>
<th>Biofuels</th>
<th>Biogas</th>
<th>Natural gas</th>
<th>Oil</th>
</tr>
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<tbody>
<tr>
<td>2019</td>
<td></td>
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<tr>
<td>2030</td>
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<tr>
<td>2050</td>
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</tbody>
</table>

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

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

* HDV = Trucks + Buses + Coaches

** Includes H2, 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)
- 2019: 25 PJ/d
- 2030: 50 PJ/d
- 2050: 50 PJ/d

Marine final consumption (Momentum) (PJ/d)
- 2019: 25 PJ/d
- 2030: 50 PJ/d
- 2050: 50 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 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)

- 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

Power demand by sector (Momentum)

- ~7 500 TWh elec for H2
- ~500 Bcm gas for H2
- ~1 Gt CCS

- Other
- Res. & Com.
- Power
- Industry
- Transport

~0
~30
~300
~1/3
~2/3

2019 2030 2050

MtH2

90 180

TWh

60 000

30 000
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

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

CO2 emissions
Gt

- 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

Population
Billion people

GDP
2010=100

Energy demand
PJ/d

CO2 emissions
GtCO2

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>GDP</th>
<th>Energy demand</th>
<th>CO2 emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>14%</td>
<td>41%</td>
<td>34%</td>
<td>30%</td>
</tr>
<tr>
<td>2050</td>
<td>12%</td>
<td>28%</td>
<td>22%</td>
<td>3%</td>
</tr>
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</table>

2019: 400
2050: 400
2019: 1,000
2050: 2,000
2019: 20
2050: 20

September 2021 - TotalEnergies Energy Outlook
Net Zero by 2050 countries
At the forefront of the energy transition

NZ 2050 countries 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

Total primary energy demand
PJ/d

- 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
%
100%

- 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**

- 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**

- 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**

<table>
<thead>
<tr>
<th>PJ/d</th>
<th>2019</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>Momentum</td>
<td>Rupture</td>
</tr>
<tr>
<td>500</td>
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**CO2 emissions by sector**

<table>
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<tr>
<th>Gt</th>
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<th>2010</th>
<th>2020</th>
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<td>Transportation</td>
<td>Industry</td>
<td>Res&amp;Com</td>
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- 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

- 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

Average power emission factor
gCO2/kWh

- 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

2.5 x current world Wind & Solar capacities
11 600 TWh elec for H2
660 Bcm gas for H2

17% of world power in 2050
16% of world natgas in 2050
Rupture: World demand in Transport
Expansion of transport revolution to emerging markets

Transport total final consumption
PJ/d

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

Share of electricity and fuel cells in 2050
%

- 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

<table>
<thead>
<tr>
<th>Year</th>
<th>2019</th>
<th>2050</th>
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<tr>
<td>600</td>
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<td>300</td>
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Oil demand for petrochemicals
Mb/d

<table>
<thead>
<tr>
<th>Year</th>
<th>2019</th>
<th>2050</th>
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<tr>
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<td>20</td>
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<tr>
<td>10</td>
<td>10</td>
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</tbody>
</table>

- 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

- 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

World urbanization and Res&Com electrification rates

- 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*

Gases demand by type
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

- 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

• 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

Liquids demand by sector
Mb/d

Sustainable liquid fuels demand in transport
Mb/d

<table>
<thead>
<tr>
<th>Sector</th>
<th>2019</th>
<th>2050 Momentum</th>
<th>2050 Rupture</th>
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<tbody>
<tr>
<td>Biofuels and other SLF</td>
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<tr>
<td>Res&amp;Com</td>
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<table>
<thead>
<tr>
<th>Transportation Mode</th>
<th>2019</th>
<th>2050 Momentum</th>
<th>2050 Rupture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aviation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Rupture: World Primary Energy Demand
Greening the energy system will enable sustainable growth for all

Total primary energy demand
PJ/d

2 000
1 000

2019
2050

Momentum
Rupture

Total primary energy demand
PJ/d

Momentum
Rupture

+0.5%/yr
+0.3%/yr

2 000
1 000

2019
2050

NZ 2050
countries
RoW
NZ 2050
countries
RoW

- 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

- 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

Oil demand

* Includes traditional use of biomass, waste, biofuels, biogas …
Appendix
# World primary energy demand and power generation

## World primary energy demand (PJ/d)

<table>
<thead>
<tr>
<th>Year</th>
<th>2019</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>CAGR 19/50</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>CAGR 19/50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>434</td>
<td>388</td>
<td>361</td>
<td>322</td>
<td>-1.0%</td>
<td>305</td>
<td>177</td>
<td>96</td>
<td>-4.8%</td>
</tr>
<tr>
<td>Oil</td>
<td>523</td>
<td>495</td>
<td>392</td>
<td>334</td>
<td>-1.4%</td>
<td>465</td>
<td>313</td>
<td>214</td>
<td>-2.8%</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>383</td>
<td>433</td>
<td>479</td>
<td>508</td>
<td>0.9%</td>
<td>431</td>
<td>438</td>
<td>418</td>
<td>0.3%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>84</td>
<td>100</td>
<td>120</td>
<td>154</td>
<td>2.0%</td>
<td>106</td>
<td>135</td>
<td>189</td>
<td>2.7%</td>
</tr>
<tr>
<td>Hydro</td>
<td>42</td>
<td>50</td>
<td>55</td>
<td>59</td>
<td>1.1%</td>
<td>56</td>
<td>65</td>
<td>72</td>
<td>1.8%</td>
</tr>
<tr>
<td>Solar</td>
<td>11</td>
<td>44</td>
<td>94</td>
<td>143</td>
<td>8.7%</td>
<td>66</td>
<td>160</td>
<td>244</td>
<td>10.6%</td>
</tr>
<tr>
<td>Wind</td>
<td>14</td>
<td>53</td>
<td>105</td>
<td>150</td>
<td>7.9%</td>
<td>70</td>
<td>159</td>
<td>224</td>
<td>9.4%</td>
</tr>
<tr>
<td>Bioenergy*</td>
<td>154</td>
<td>182</td>
<td>204</td>
<td>228</td>
<td>1.3%</td>
<td>183</td>
<td>215</td>
<td>267</td>
<td>1.8%</td>
</tr>
<tr>
<td>Other Renewables</td>
<td>12</td>
<td>24</td>
<td>35</td>
<td>45</td>
<td>4.5%</td>
<td>36</td>
<td>58</td>
<td>75</td>
<td>6.2%</td>
</tr>
<tr>
<td>Total</td>
<td>1655</td>
<td>1770</td>
<td>1846</td>
<td>1944</td>
<td>0.5%</td>
<td>1718</td>
<td>1719</td>
<td>1799</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

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

## World power generation ('000TWh)

<table>
<thead>
<tr>
<th>Year</th>
<th>2019</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>CAGR 19/50</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>CAGR 19/50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>9.9</td>
<td>8.8</td>
<td>8.1</td>
<td>6.6</td>
<td>-1.3%</td>
<td>6.7</td>
<td>3.3</td>
<td>1.3</td>
<td>-6.4%</td>
</tr>
<tr>
<td>Oil</td>
<td>0.7</td>
<td>0.4</td>
<td>0.3</td>
<td>0.3</td>
<td>-3.2%</td>
<td>0.3</td>
<td>0.2</td>
<td>0.2</td>
<td>-5.0%</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>6.4</td>
<td>7.1</td>
<td>8.0</td>
<td>9.0</td>
<td>1.1%</td>
<td>7.2</td>
<td>6.9</td>
<td>6.6</td>
<td>0.1%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>2.8</td>
<td>3.4</td>
<td>4.0</td>
<td>5.2</td>
<td>2.0%</td>
<td>3.5</td>
<td>4.5</td>
<td>6.3</td>
<td>2.7%</td>
</tr>
<tr>
<td>Hydro</td>
<td>4.3</td>
<td>5.1</td>
<td>5.6</td>
<td>6.0</td>
<td>1.1%</td>
<td>5.7</td>
<td>6.6</td>
<td>7.3</td>
<td>1.8%</td>
</tr>
<tr>
<td>Solar</td>
<td>0.7</td>
<td>3.6</td>
<td>8.2</td>
<td>12.8</td>
<td>9.9%</td>
<td>5.5</td>
<td>13.7</td>
<td>20.9</td>
<td>11.6%</td>
</tr>
<tr>
<td>Wind</td>
<td>1.4</td>
<td>5.4</td>
<td>10.7</td>
<td>15.2</td>
<td>7.9%</td>
<td>7.1</td>
<td>16.1</td>
<td>22.7</td>
<td>9.4%</td>
</tr>
<tr>
<td>Bioenergy*</td>
<td>0.6</td>
<td>0.9</td>
<td>1.3</td>
<td>1.7</td>
<td>3.2%</td>
<td>1.1</td>
<td>1.7</td>
<td>2.4</td>
<td>4.3%</td>
</tr>
<tr>
<td>Other Renewables</td>
<td>0.1</td>
<td>0.3</td>
<td>0.6</td>
<td>1.1</td>
<td>7.3%</td>
<td>0.4</td>
<td>1.0</td>
<td>1.8</td>
<td>9.0%</td>
</tr>
<tr>
<td>Total</td>
<td>27.0</td>
<td>35.1</td>
<td>46.8</td>
<td>57.8</td>
<td>2.5%</td>
<td>37.4</td>
<td>54.0</td>
<td>69.4</td>
<td>3.1%</td>
</tr>
</tbody>
</table>

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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.

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(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.

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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.

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