ENTSOs TYNDP 2020 Scenarios

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ENTSOG / ENTSO-E Perimeter

ENTSO-E

- EU28
- Switzerland
- Bosnia and Herzegovina
- Serbia
- North Macedonia
- Norway
- Albania
- Turkey
- Ukraine

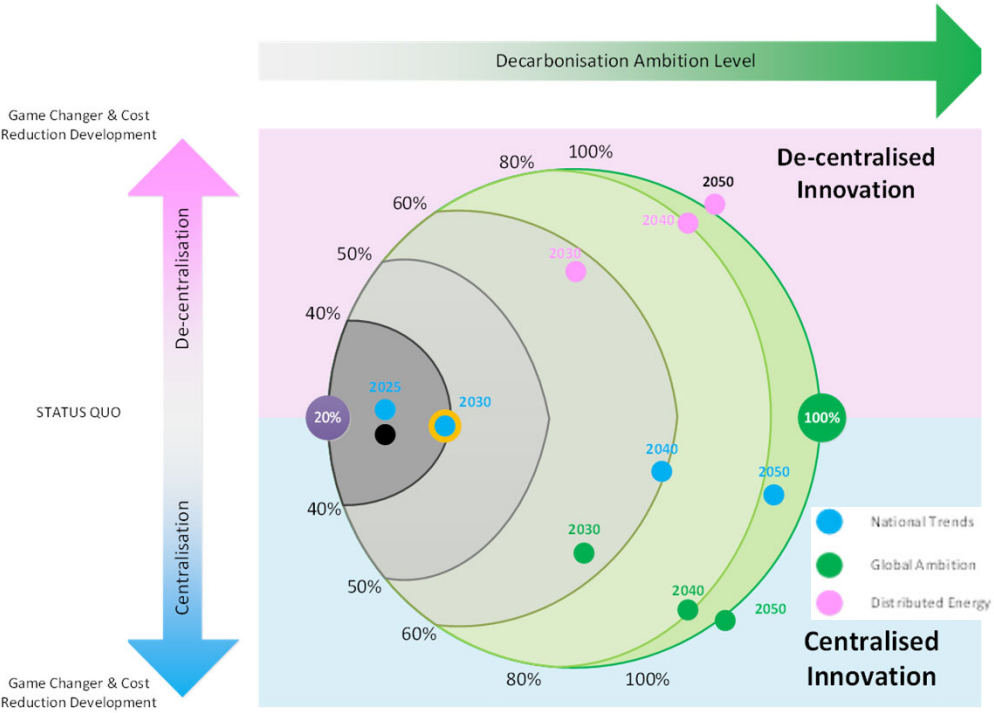
ENTSOG

- EU28
- Switzerland
- Bosnia and Herzegovina
- Serbia
- North Macedonia

Results shown in this presentation only relate to EU28.
Important: Import demand for gases include gas from Norway.

Three Storylines to test Europe's gas and electricity infrastructure

TYNDP 2020 Scenario Storylines



National Trends (NT)

- **Policy** Scenario based on draft EU National Energy and Climate Plans (NECPs)
- EU 2030 Energy and Climate Framework (32 % RES, 32.5 % energy efficiency)
- EC 2050 Long-Term Strategy: 80 – 95 % CO_2 reduction

Distributed Energy (DE)

- De-centralised approach to the energy transition: active customers, small-scale solutions, circular approach.
- **COP 21**: +1.5°C target with 66.7 % probability
- Carbon neutrality by 2050

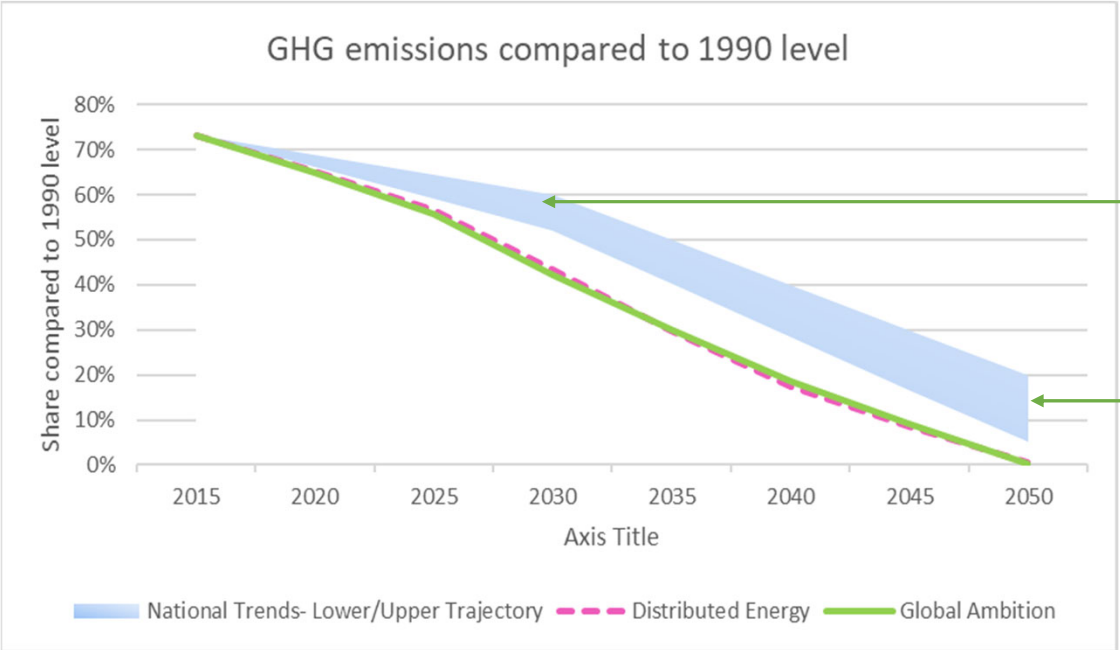
Global Ambition (GA)

- Future is led by economic development in centralised generation, with large-scale renewables and decarbonisation.
- **COP 21**: +1.5°C target with 66.7 % probability
- Carbon neutrality by 2050

Contrasted scenarios reflecting very different pathways to reach EU targets

Note: TYNDP 2020 GA and DE storylines are a continuation of TYNDP 2018 *Global Climate Action* and *Distributed Generation* storylines

(Full-)Decarbonisation

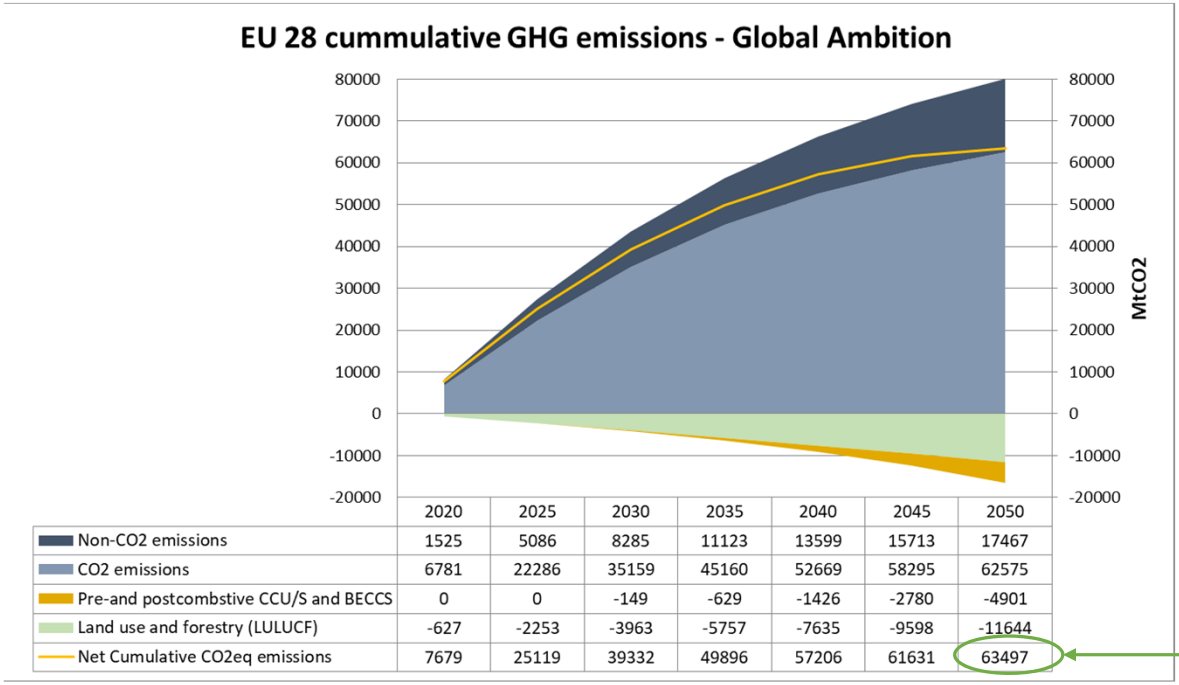


By 2030, National Trends will reach at least 40 % CO2 reduction. According to EC's Long Term Strategy 48% decarbonisation is possible with the new targets for RES and Efficiency.

In 2050, National Trends is in line with EU's current target of 80 – 95 % decarbonisation.

To comply with the 1.5°C targets of the Paris Agreement, carbon neutrality must be achieved by 2040 in the electricity sector and by 2050 in all sectors together. Additional measures to reach net negative emissions after 2050 are necessary.

Carbon Budget



	2020	2025	2030	2035	2040	2045	2050
Non-CO2 emissions	1525	5086	8285	11123	13599	15713	17467
CO2 emissions	6781	22286	35159	45160	52669	58295	62575
Pre-and postcombstive CCU/S and BECCS	0	0	-149	-629	-1426	-2780	-4901
Land use and forestry (LULUCF)	-627	-2253	-3963	-5757	-7635	-9598	-11644
Net Cumulative CO2eq emissions	7679	25119	39332	49896	57206	61631	63497

Advised by RGI and CAN Europe, ENTSOs consider a carbon budget of 48,5 $GtCO2_{eq}$ for EU28.

The budget considers:

- **The global carbon budget stated by IPCC in its Special Report**
- **Target of staying below 1,5°C by the end of the 21st century**
  - **66,7% probability**
- **EU's population share in the world**

EC's 1,5TECH/1,5LIFE scenarios consider around 65 $GtCO2_{eq}$ of cumulative GHG emissions.

How to comply with the 1,5°C target of the Paris Agreement, if by 2050 more carbon is emitted than allowed by the carbon budget?

Further measures are needed after 2050!

Cummulative emissions and required net negative emissions in Global Ambition

	<2050	2050	>2050	Total
Energy and non-energy related CO_2 emissions	62.4	Carbon-Neutrality	Additional measures needed, e.g.: LULUCF BECCS CCS DAC	
Non-CO_2 GHG emissions (including methane and Fluorinated gases)*	17.5			
Carbon sinks**	-16.5			
Net cumulative emissions	63.5		-15	EU28 carbon budget share based on its population 48.5 $GtCO_2$

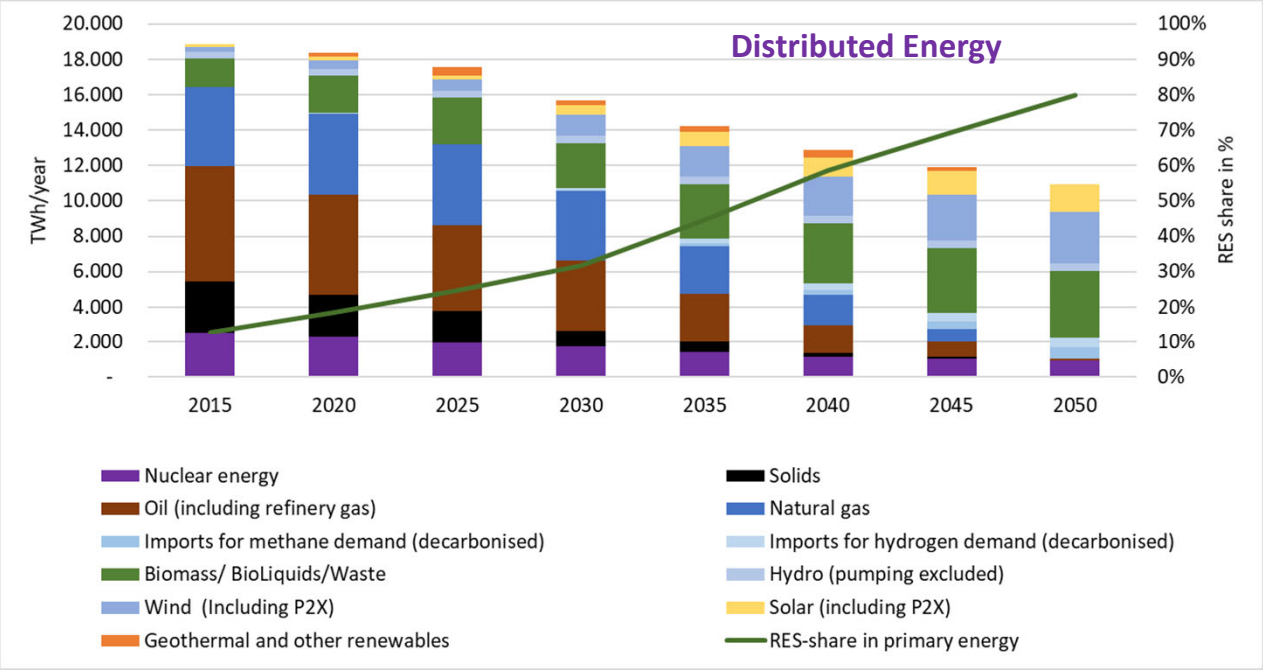
Negative emissions of 15 GtCO2 have to be achieved between 2050 and 2100 in case of Global Ambition. For Distributed Energy, due to lower cumulative emissions until 2050, 14.1 GtCO2 of net negative emissions are needed to comply with the 1.5° C target by 2100.

* Data for methane and fluorinated gases emissions is taken from the European Commission's most ambitious 1.5Tech and 1.5Life scenarios (average) as published in the "A Clean Planet for all"- Study (link).

** Data for LULUFC is taken from the European Commission's most ambitious 1.5Tech and 1.5Life scenarios (average) as published in the "A Clean Planet for all"- Study (link).

Primary and Final Energy Demand

Primary Energy

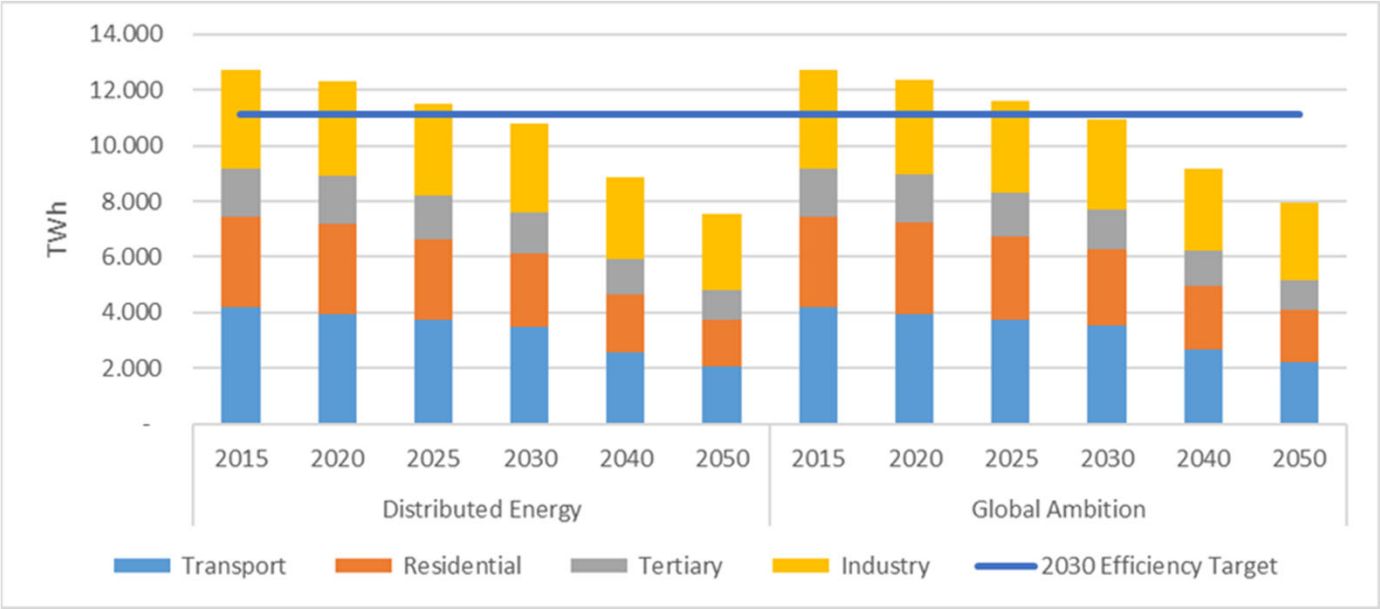


The RES share in Global Ambition reaches 64 % by 2050 but is still outbid by Distributed Energy with a RES share of 80 %.

For gas in particular, import shares increase in all scenarios until 2030 due to the declining natural gas production in the EU.

Today, the EU28 imports most of its primary energy (ca. 55 %). Decarbonisation will also change this pattern. In a way, the "insourcing" of energy production will reduce the import dependency to ca. 20 % to 36 %. However, imports remain an important vector in the future energy supply making use of competitive natural resources outside the EU territory.

Final Energy Demand and Energy Efficiency



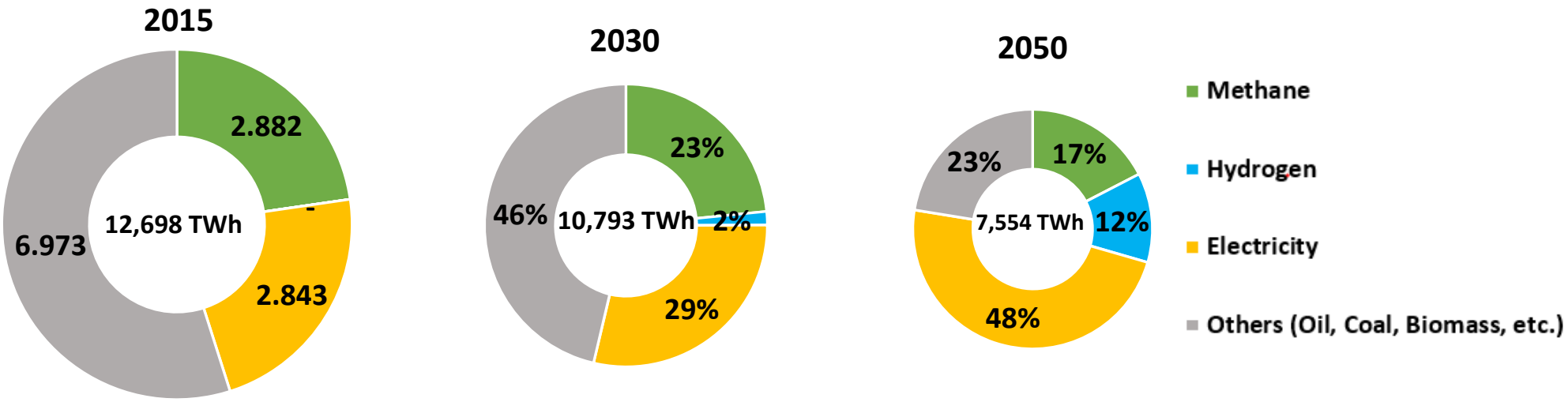
To achieve net-zero emissions, innovation in new and existing technologies is required to:

- Reduce the levelised cost of energy from renewable energy sources
- Increase the efficiency and type of end user appliances
- Support renewable and decarbonised gas
- Develop technologies that will support negative emissions

The final use demand for the EU28 according to DEE2012/27/EU(10309/18) should be around 11,100 TWh. Both top-down scenarios are target compliant with 10,800 TWh 2030 for Distributed Energy and 10,900 TWh for Global Ambition.

Final Energy Demand – Fuel Split

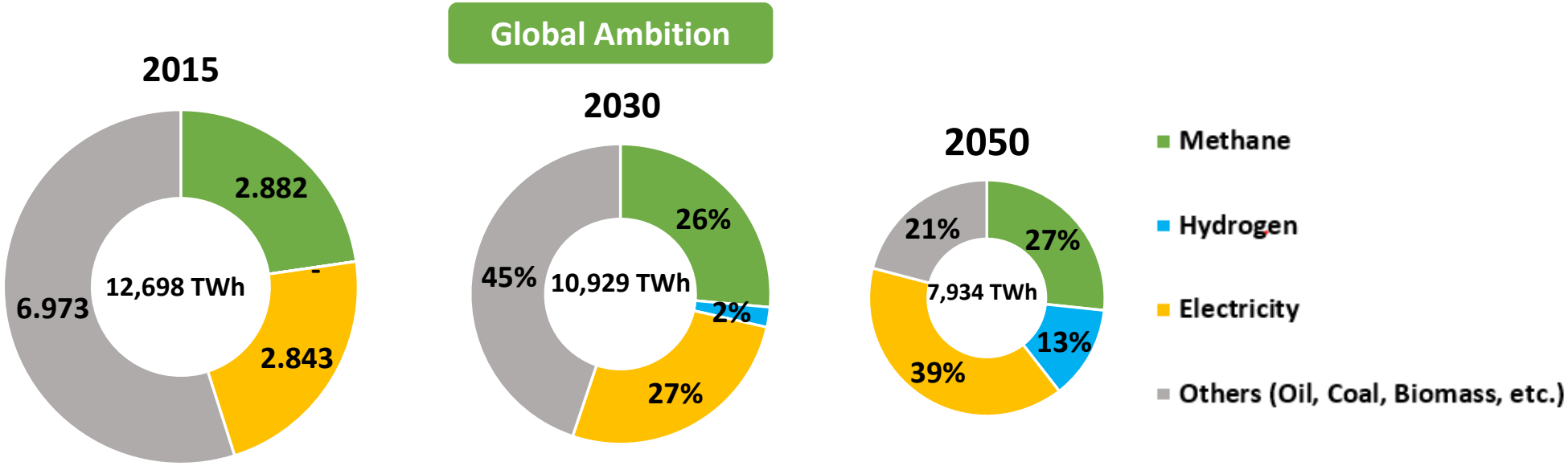
Distributed Energy



By 2050, 48% of final demand is met by electricity and 29% by gaseous fuels like methane or hydrogen.

Final Energy Demand – Fuel Split

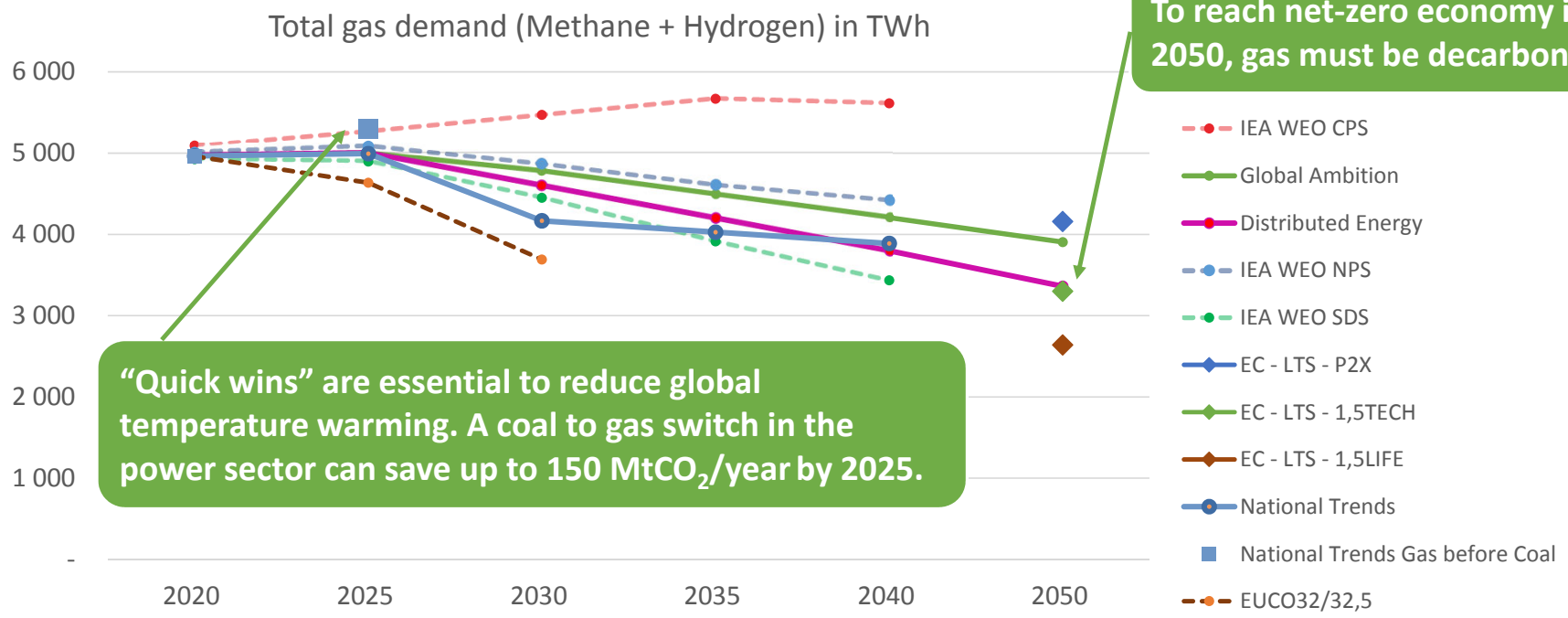
Global Ambition



By 2050, both electricity and gaseous fuels make up ca. 40% of final energy demand.

Gas Demand

Gas Demand in TYNDP 2020 Scenarios



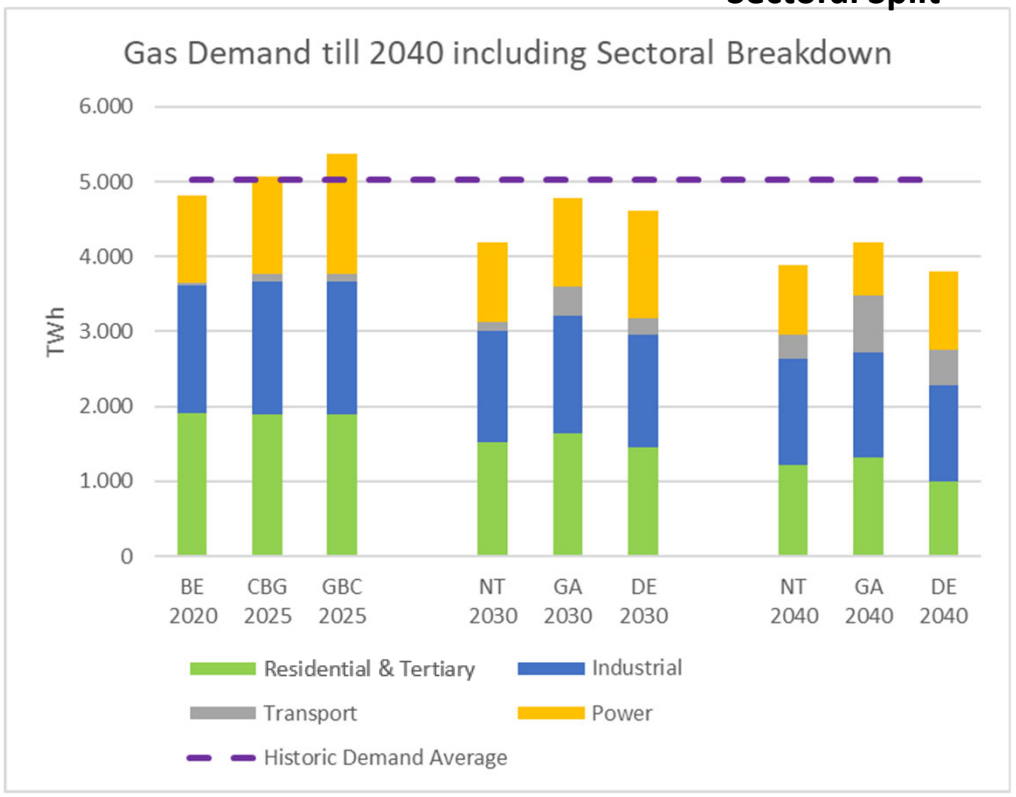
To reach net-zero economy in 2050, gas must be decarbonised

"Quick wins" are essential to reduce global temperature warming. A coal to gas switch in the power sector can save up to 150 $MtCO_2$/year by 2025.

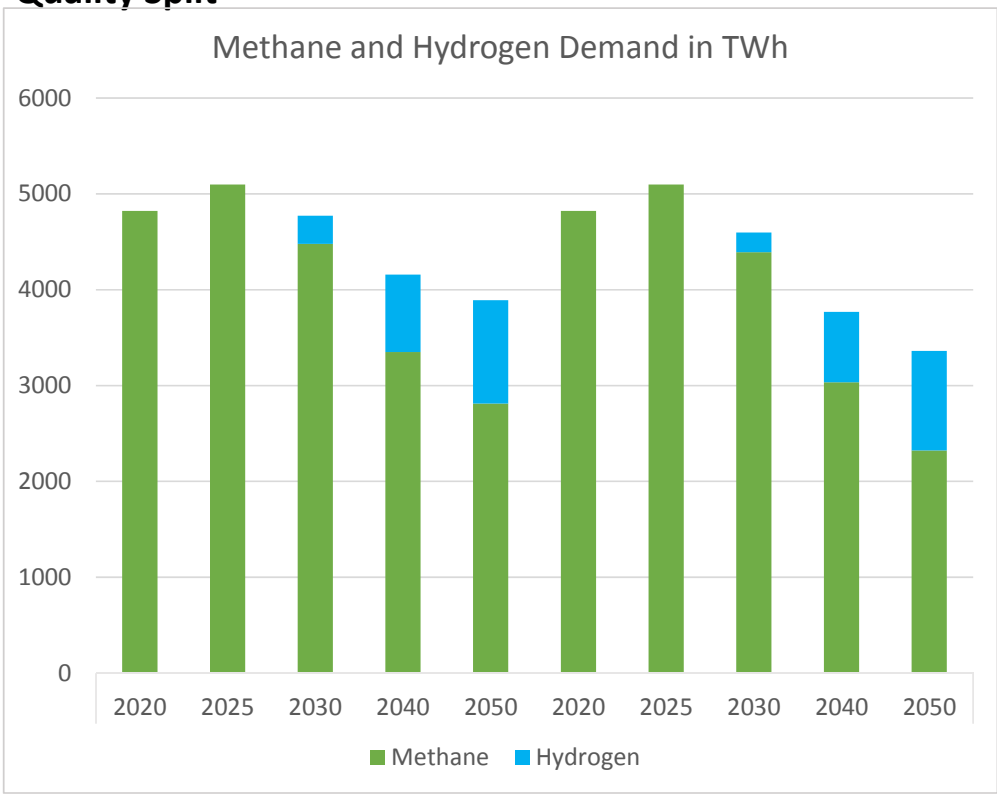
All scenarios are in the range of the IEA NPS and SDS scenarios (World Energy Outlook 2018).
For 2050, Distributed Energy is in line with the Commission's 1,5TECH scenario, whereas Global Ambition ranges between Commission's 1,5TECH and P2X scenarios.

Gas Demand – Sectoral and Quality Split

Sectoral Split



Quality Split



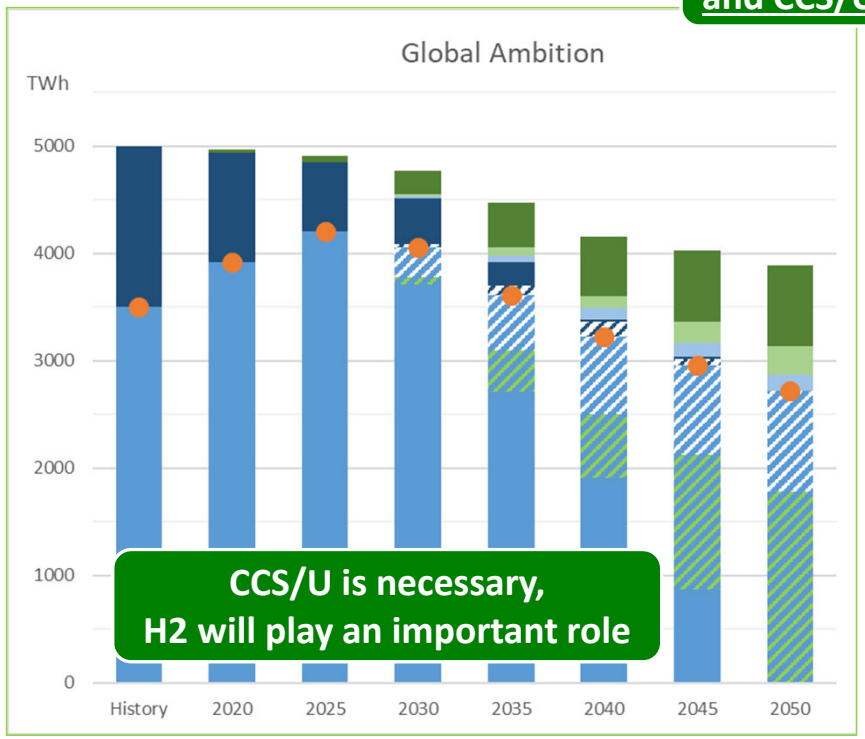
At present gas as an energy carrier is mainly based on methane, as the main component of natural gas. However, in the longer term hydrogen could become an equally important energy carrier towards full decarbonisation of the gas carriers in 2050.

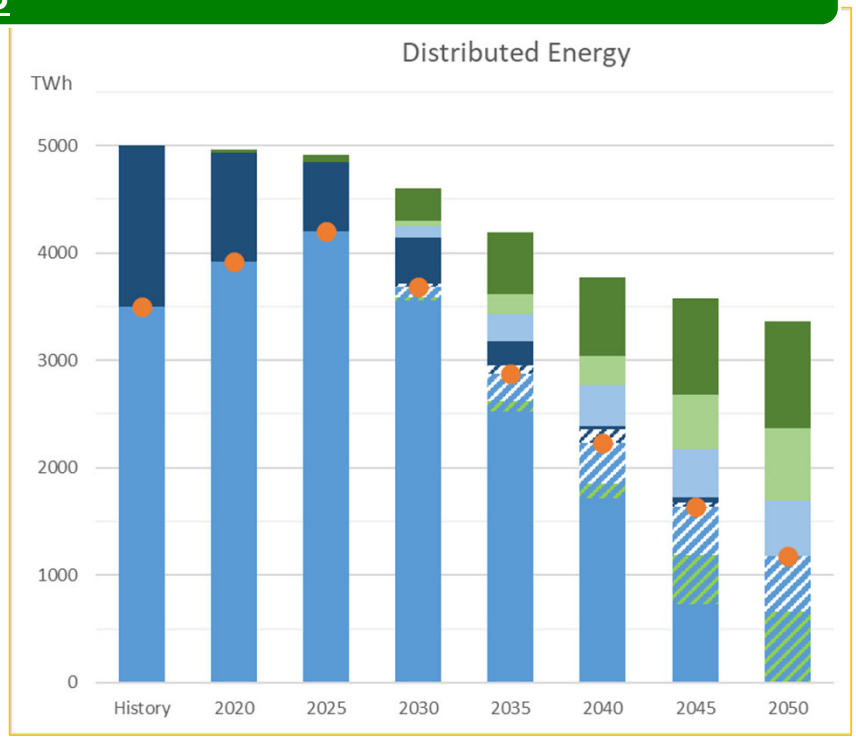
Gas Composition, Renewable Gas Production and Imports

Gas Composition in COP 21 Scenarios

Source neutrality for EU imports:
Decarbonisation of imports can be outside EU or within EU

Technology neutrality for decarbonised (blue) Hydrogen and CCS/U

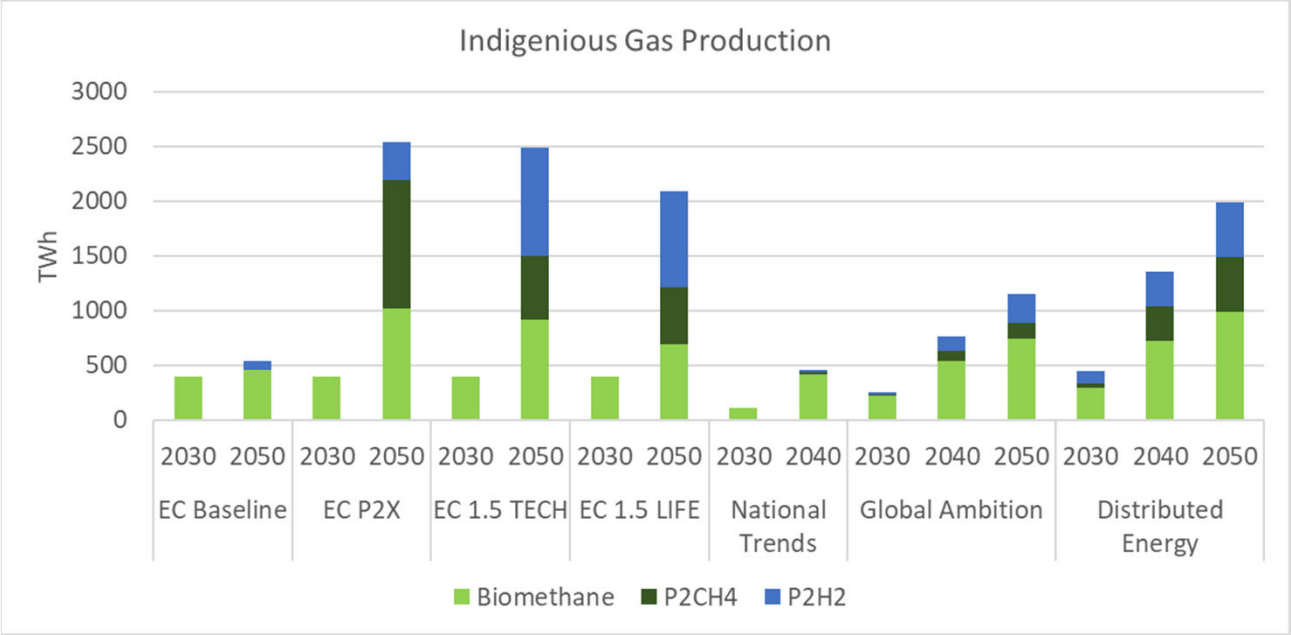




CCS/U is necessary,
H2 will play an important role

- Biomethane
- P2Methane
- P2Hydrogen
- Unabated Indigenous Natural Gas
- Abated Indigenous Natural Gas
- Imports for Hydrogen Demand (natural gas converted to hydrogen at import point/city gate or direct hydrogen imports)
- Imports for Methane Demand (decarbonised, either by natural gas imports with post-combustive CCU/s or any other technology)
- Unabated Natural Gas Imports
- Imports (incl. Norway)

Renewable Gas Production



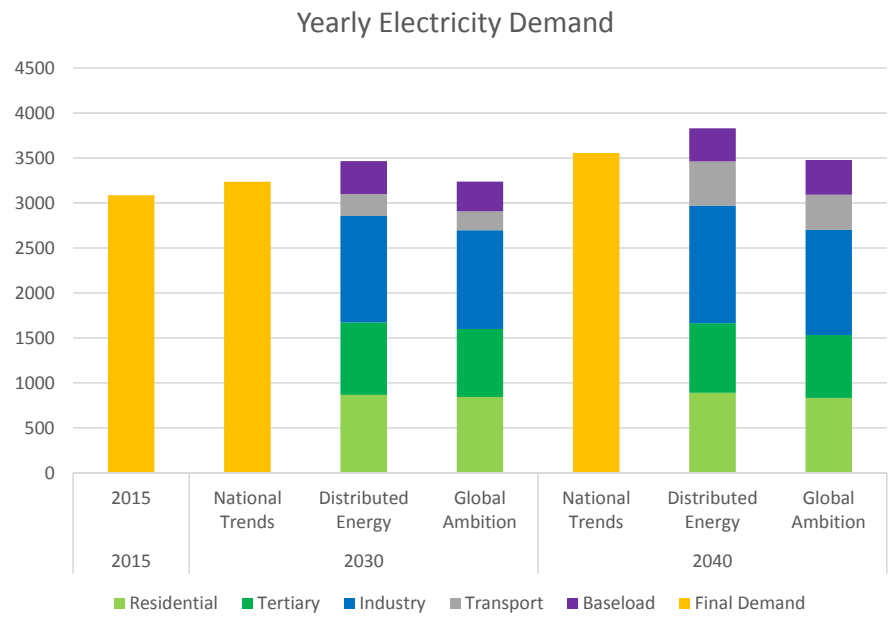
In 2040, P2G production in Distribution Energy hits the upper boundaries for built-out rates for Wind/Solar.

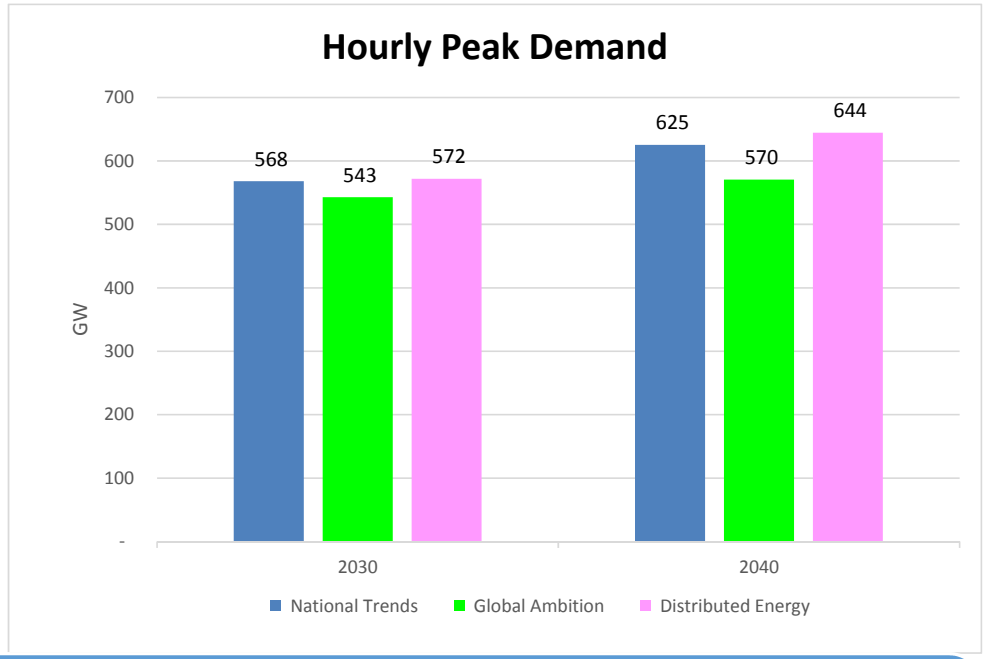
For Biomethane, an in-house tool was developed jointly with Navigant on the basis of their study "Gas for Climate".

Production of renewable gases in ENTSOs Scenarios matches total values given by EC's 1,5Life scenario, but lower than 1,5TECH/P2X scenarios.
Compared to TYNDP2018 Scenarios, renewable gas production increased significantly.

Electricity Demand

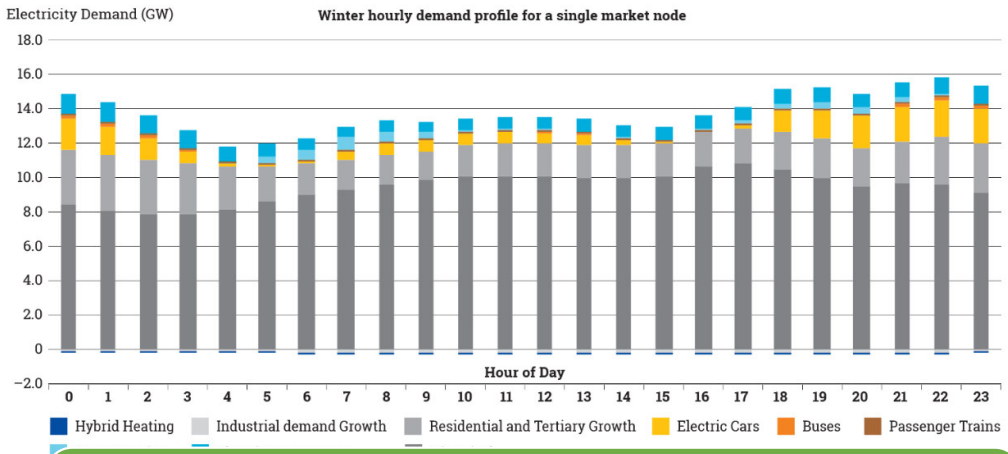
Electricity Demand



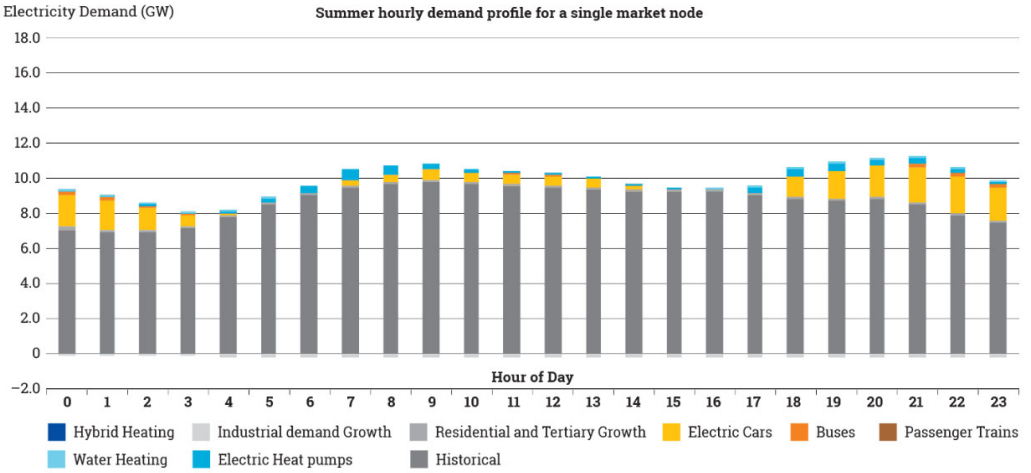


The direct electrification of the sectors results in the increase of final electricity demand. The highest growth is seen in Distributed Energy. There is an increase in peak demand, but the increase is subsided by demand side management e.g. smart charging and batteries in the distributed network.

Demand Profiles



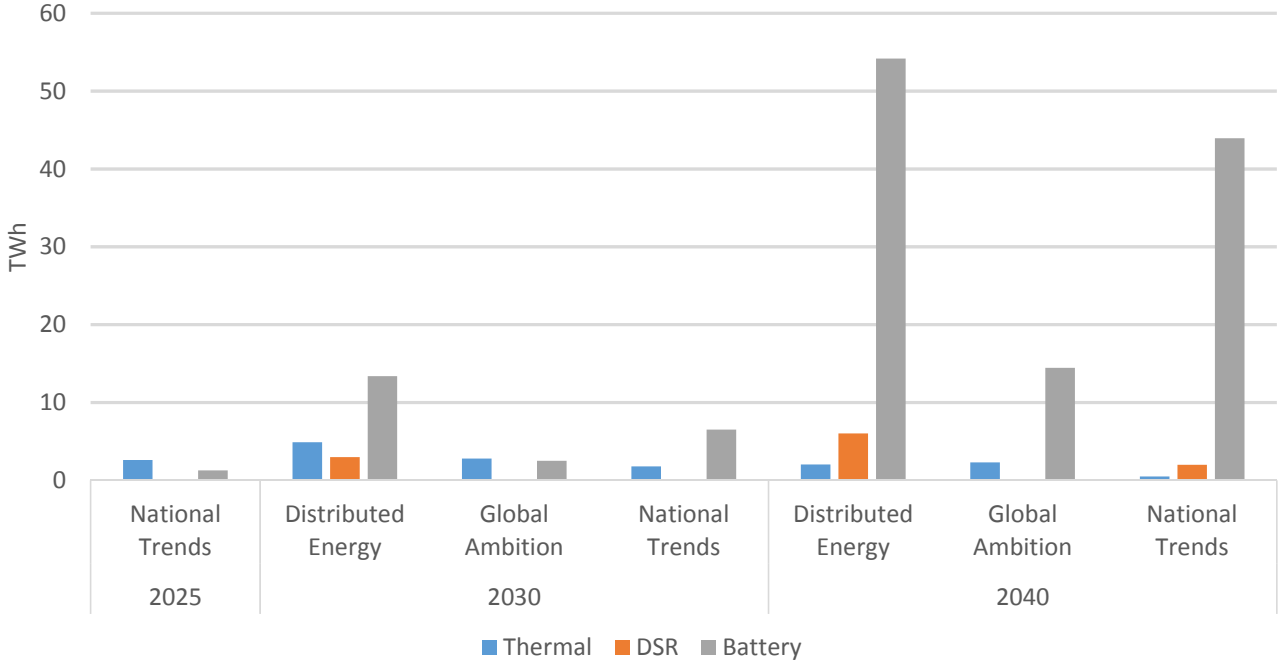
Hybrid heat pumps are switching from Electricity to Gas below temperatures of 5°c, as seen in winter.
Demand for transport is constant throughout the year.



Demand profiles are developed based on changes in heating, transport and new base load and batteries.

The image shows an indicative demand profile based on a summer and winter day in a country in Europe. As heating becomes more electrified there is a large growth in winter demand, but hybrid heat pumps are a useful technology to support the system during cold temperatures.

Flexibility

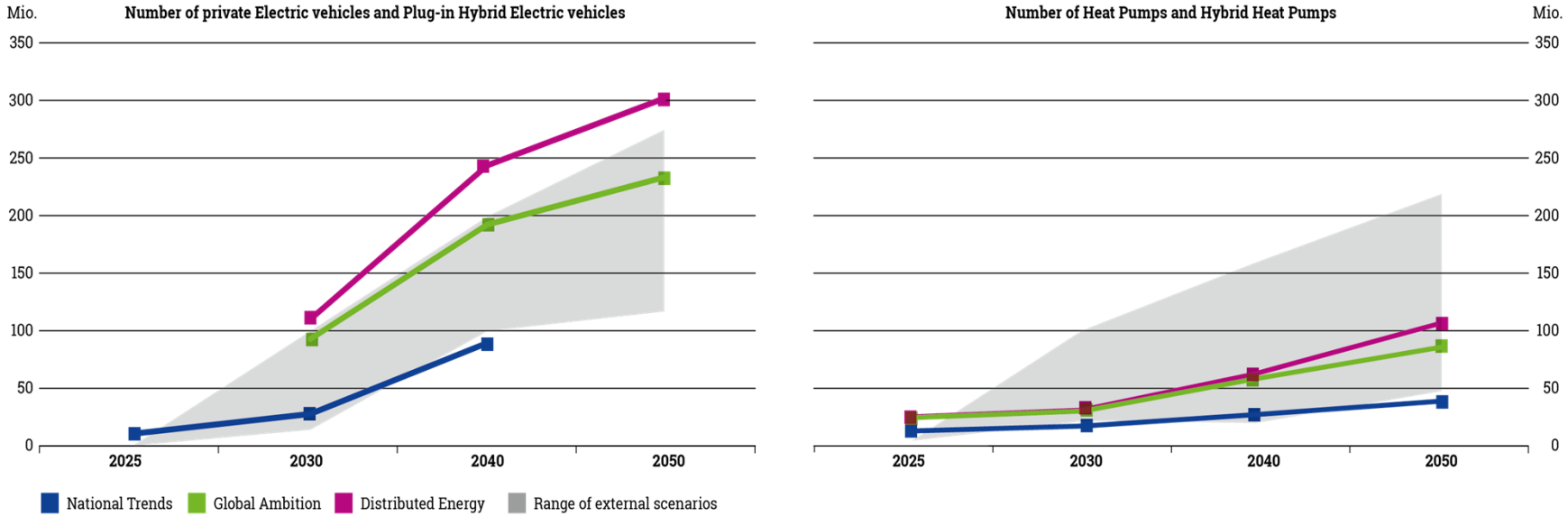


Demand side technologies and batteries increasing take part in the market and help to smoothen demand peaks and level prices.

Distributed Energy shows the highest increase in usage of these. In 2040, there is a significant increase in the use of batteries.

As peak demand increases in all scenarios, the uptake in demand side technologies and batteries will be essential to aiding system management. Greater DSO – TSO cooperation will be required.

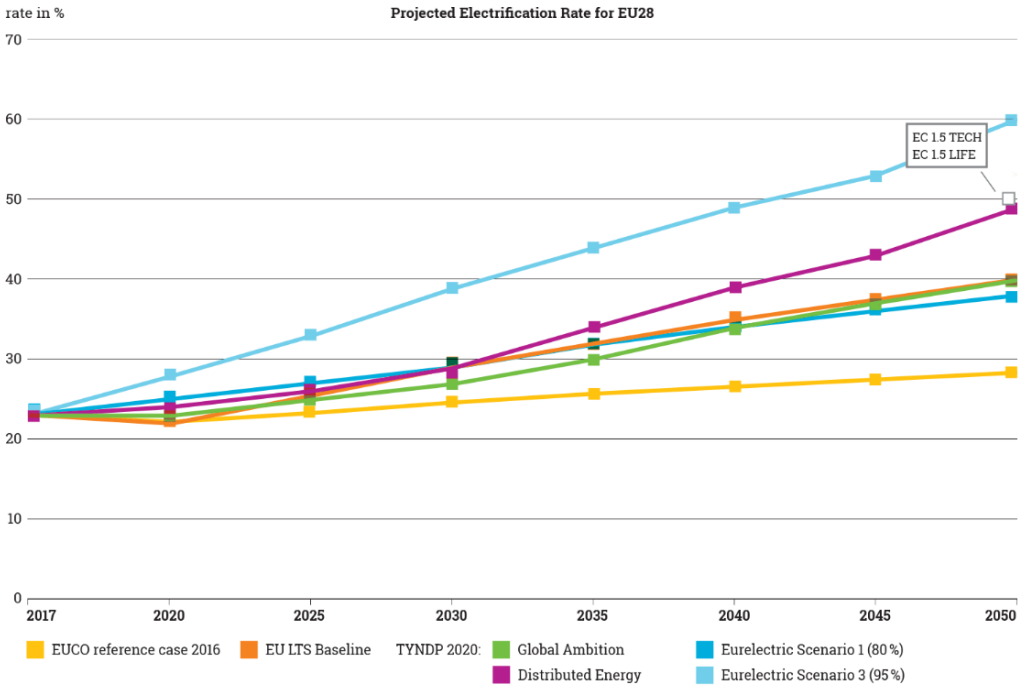
EVs and (Hybrids) Heat Pumps

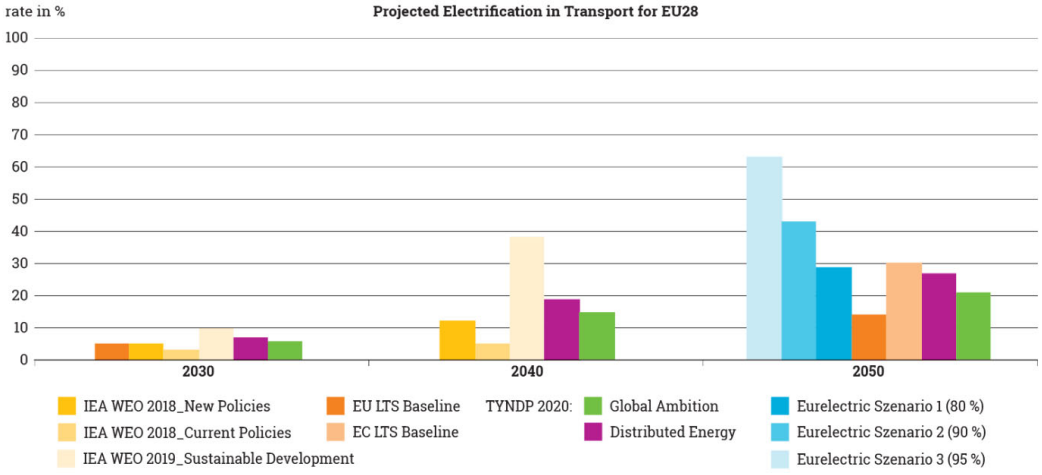


2040	Electric vehicles (million)	Heat Pumps (million)
Distributed Energy (DE)	240	50
Global Ambition (GA)	200	25
National Trends (NT) (TSOs)	100	60

The scenarios show a potential large growth in EVs and moderate growth in heat pumps as compared to other scenarios

Electrification

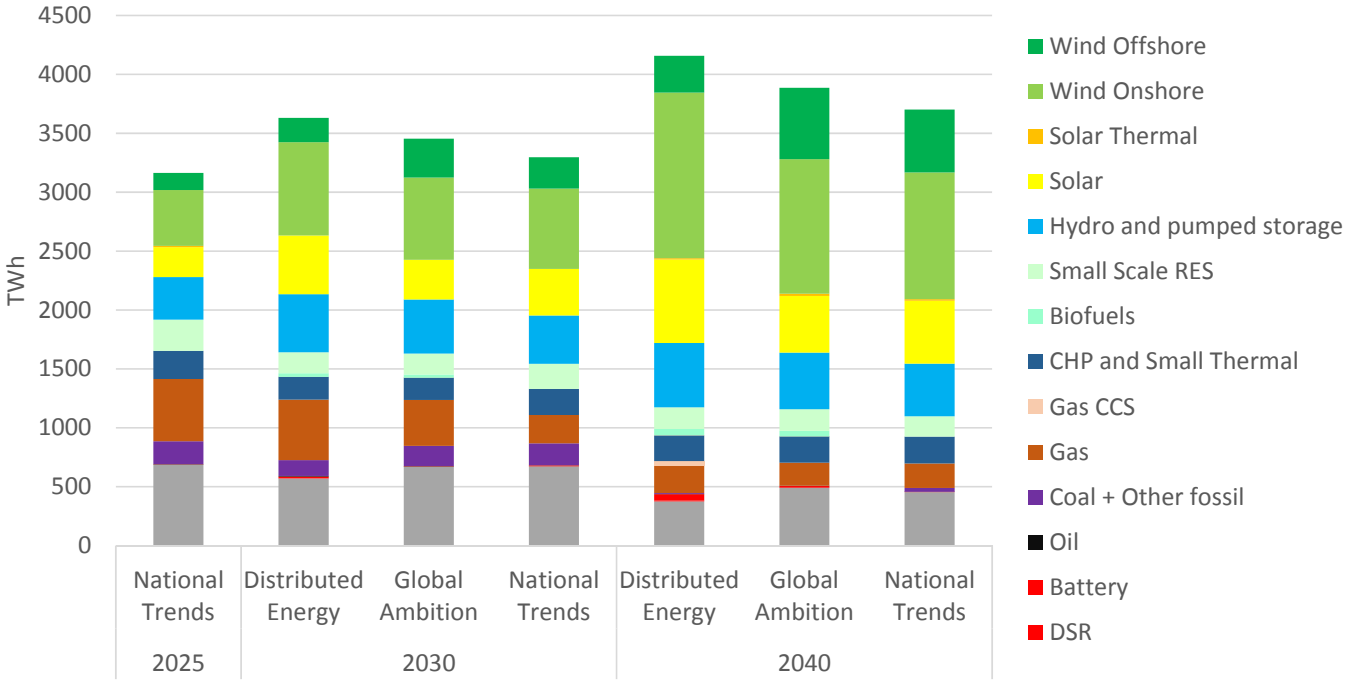




Electrification in transport in line with EC LTS 1.5TECH and 1.5LIFE scenarios, however Eurelectric shows higher electrification in all scenarios (wider perimeter and probably including longer distances and heavy freight)

Electricity Generation

Electricity Generation Mix

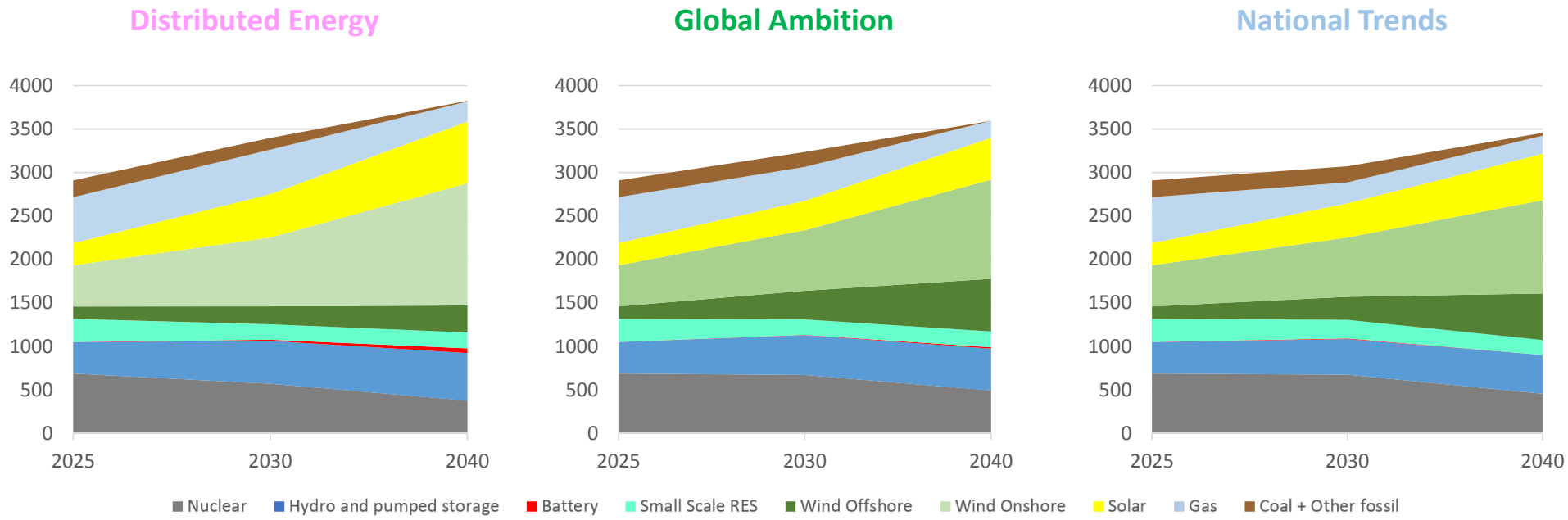


Both renewable and decarbonized gases are needed (especially for small-scale CHP)

By 2040, to fully decarbonize the power system, CCS starts becoming a necessary measure.

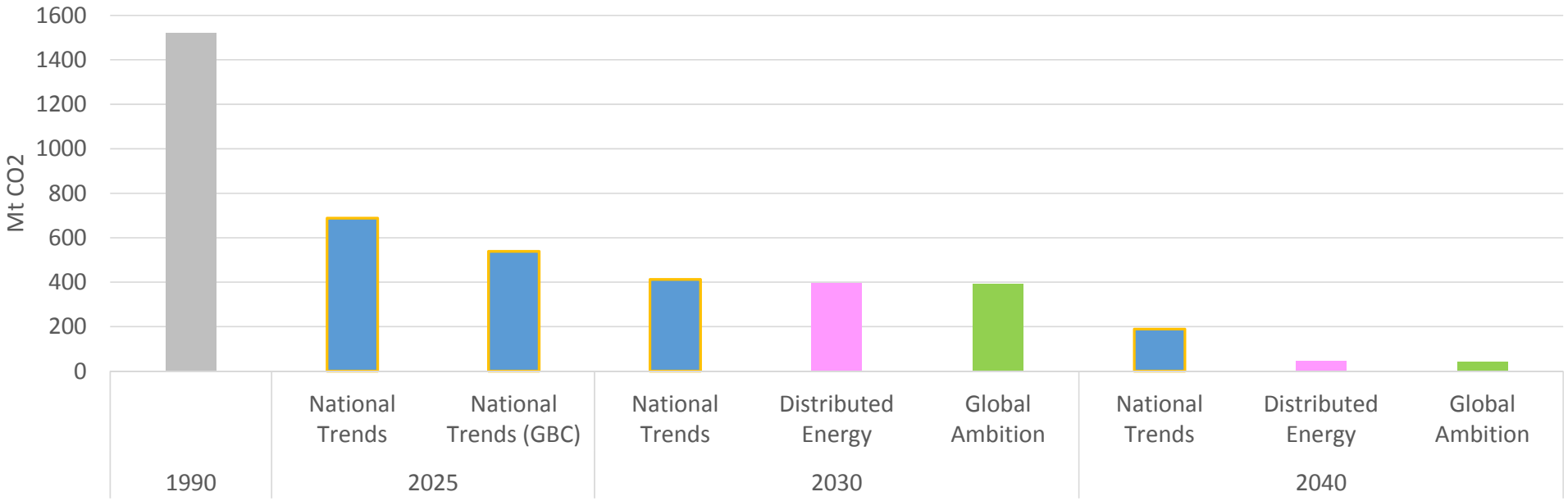
Distributed Energy and Global Ambition assume a full decarbonisation in the electricity generation by 2040. Wind and Solar are key to decarbonize the power system. But to fully decarbonise, also gas needs to reduce its emissions.

Electricity Generation Mix (TWh)



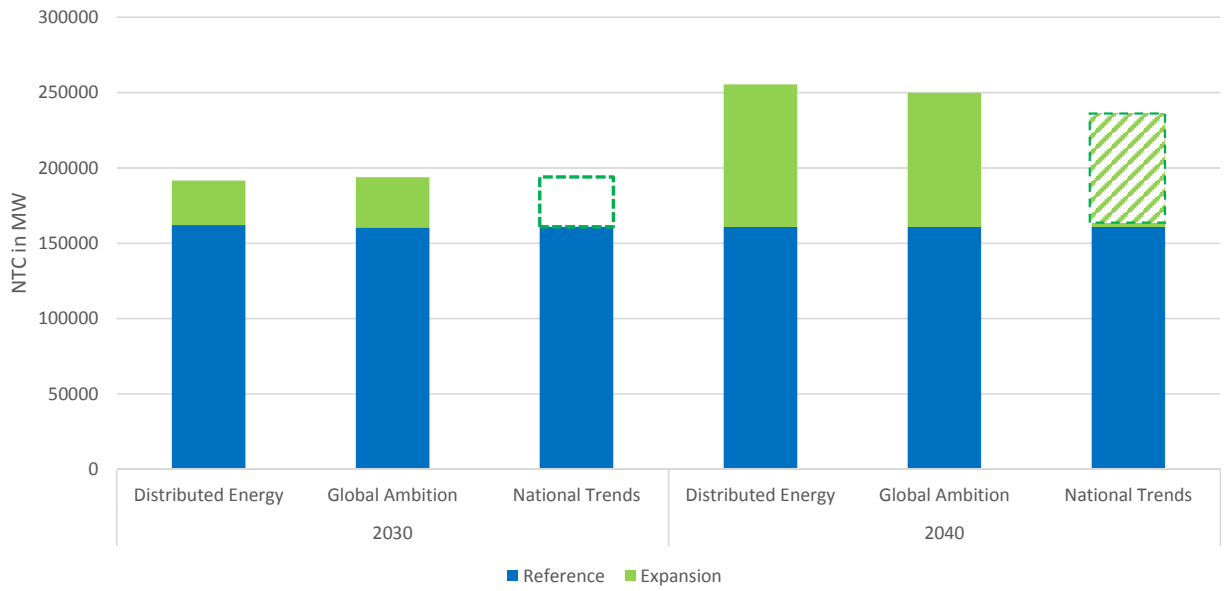
By 2040, Solar provides up to 17% of energy (DE), Wind provides up to 44% (GA). All thermal generation declines as more renewables enter the market, but Coal is phased out by 2040 in all scenarios.

Power Sector Emissions



The power sector is almost fully decarbonized by 2040. There is strong reliance on the decarbonization of gas, CHP and small thermal generators, as well as of course growth in renewable technologies.

Electricity Grid Transfer Capacity Expansion

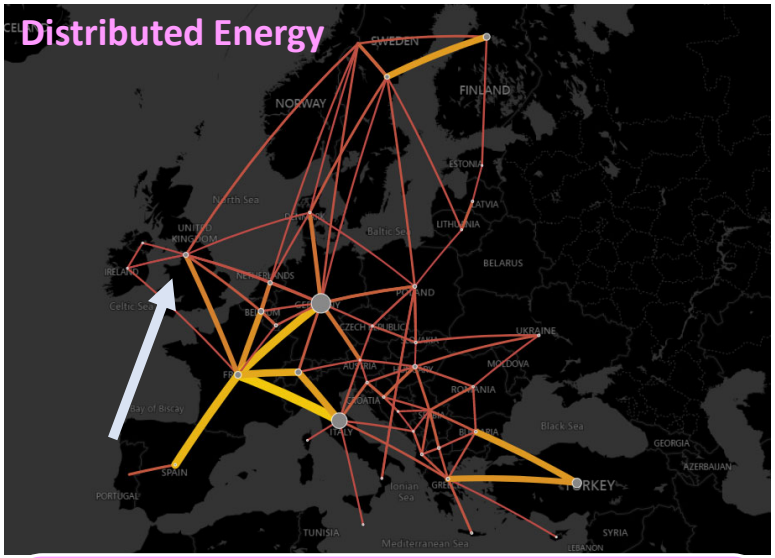


Electricity Interconnection expansion is essential for the energy transition. It allows the distribution of RES around Europe

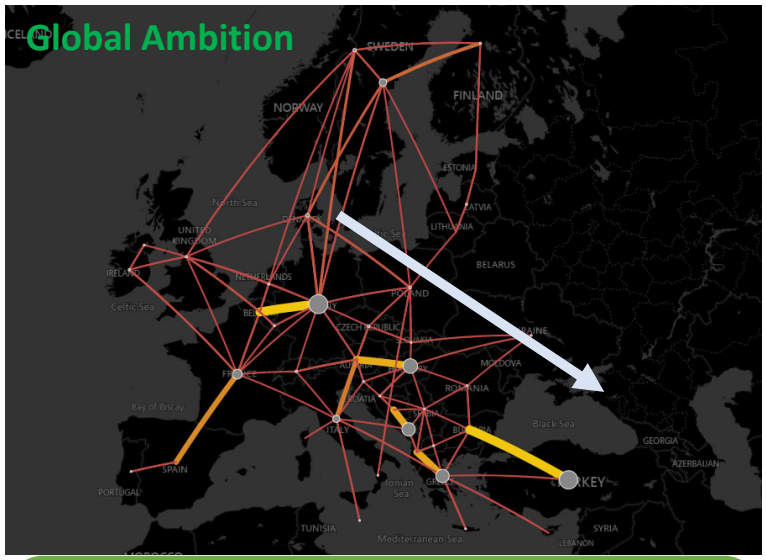
National Trends 2030 will be subject to the TYNDP 'Identification of system needs' process. This process will identify the necessary expansion to reduce system costs.

Further expansion of cross border transfer capacity between markets will contribute to ensuring renewable resources are efficiently distributed and dispatched in the European electricity market. In addition, interconnection capacity will be one of many options ensuring for flexibility in the overall energy system.

Flows in Europe 2040



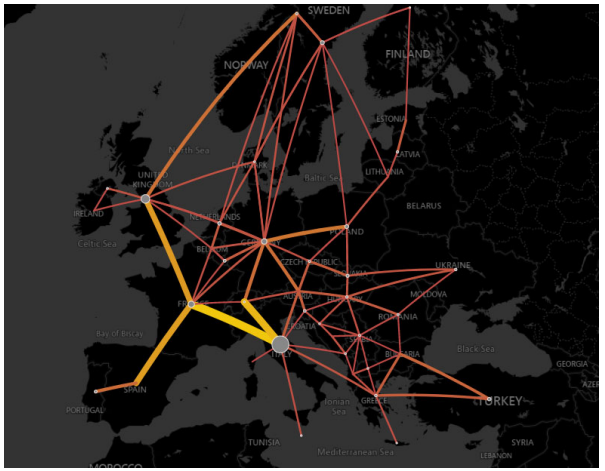
Distributed Energy shows strong growth in solar thus flows move from South to North. There is also notable flows between Sweden and Finland.



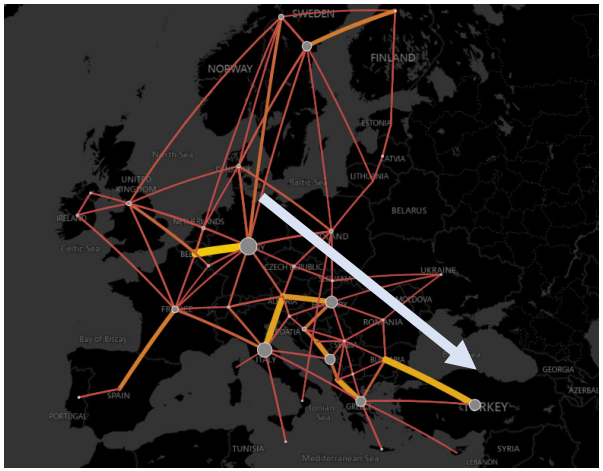
Global Ambition shows strong growth in Offshore Wind, thus flows move from West to South East, although Spain still exports wind northward.

Flows in Europe: National Trends

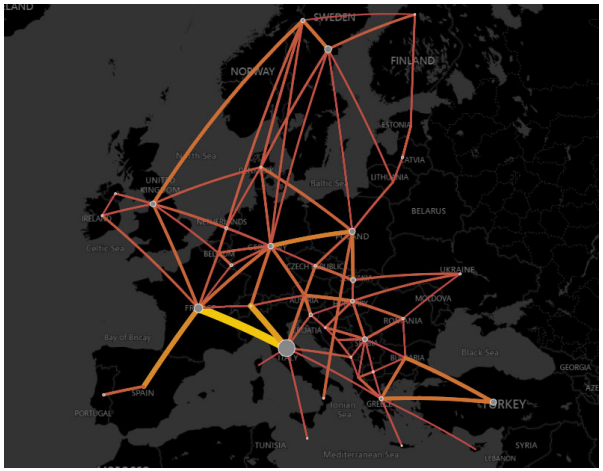
2025



2030



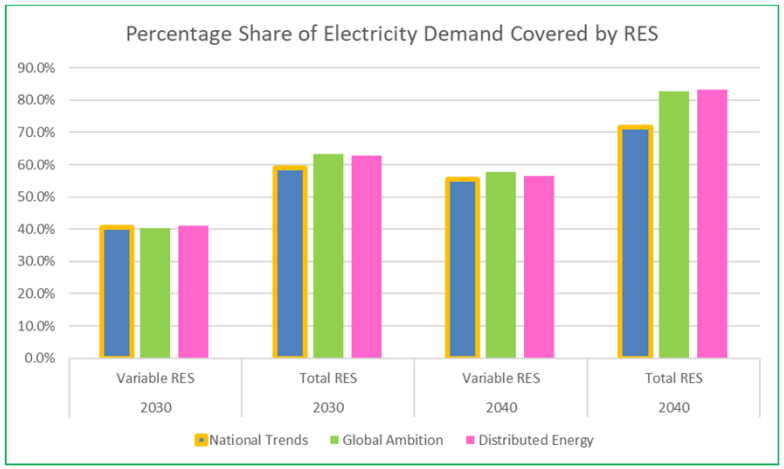
2040

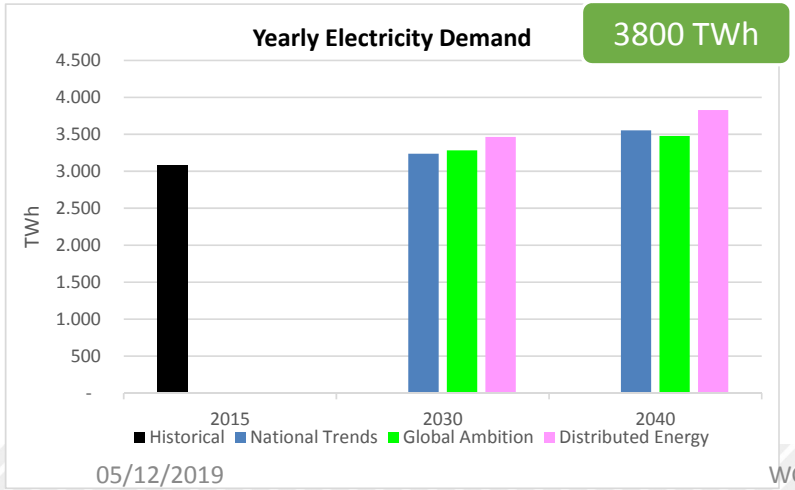


National Trends shows a similar picture to Global Ambition in 2030 with flows moving from West to South East, there is a strong uptake in Offshore Wind in this scenario. In 2040 the scenario shows more diverse flows around Europe, and the generation mix is a blend of Wind and Solar with capacities resting between in the Top Down Scenarios

Interaction of Gas and Electricity Sectors

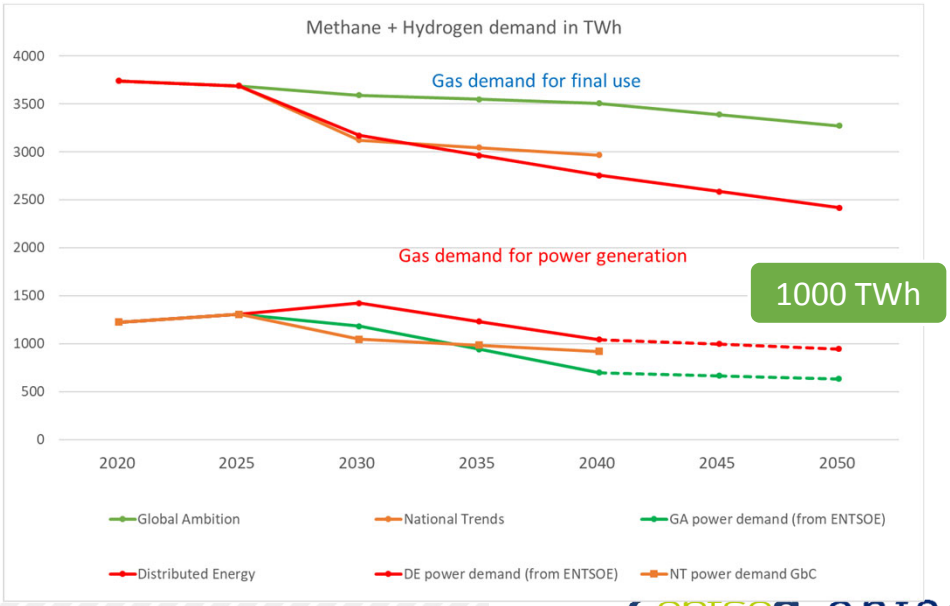
Gas in Electricity Generation





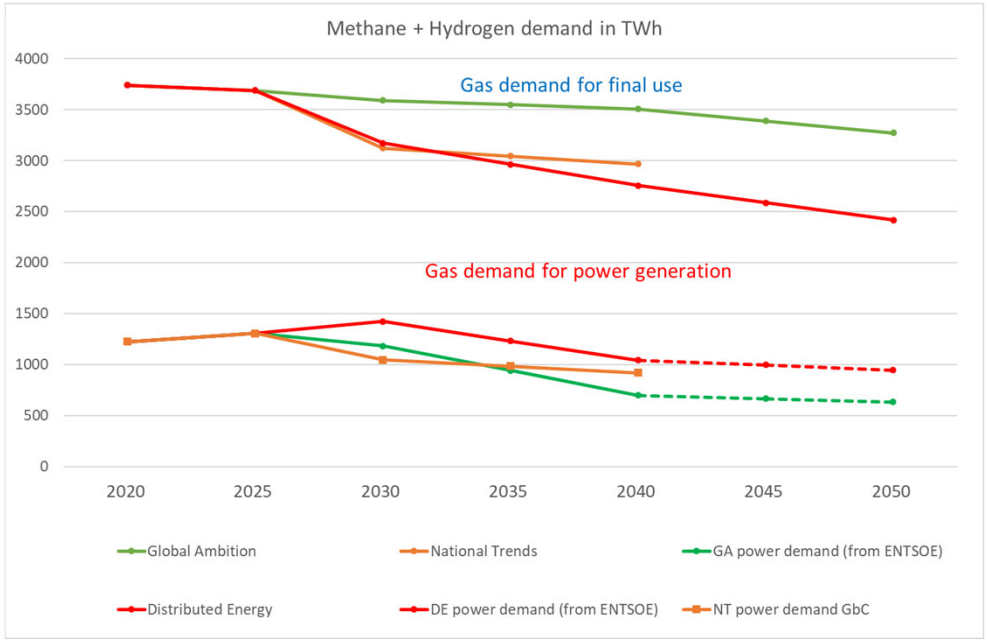
To reach 80 %+ decarbonisation of the electricity system by 2040, Power generation has to run on high shares of decarbonised gas.

Electrification and higher electricity demand comes with higher gas demand in power generation.

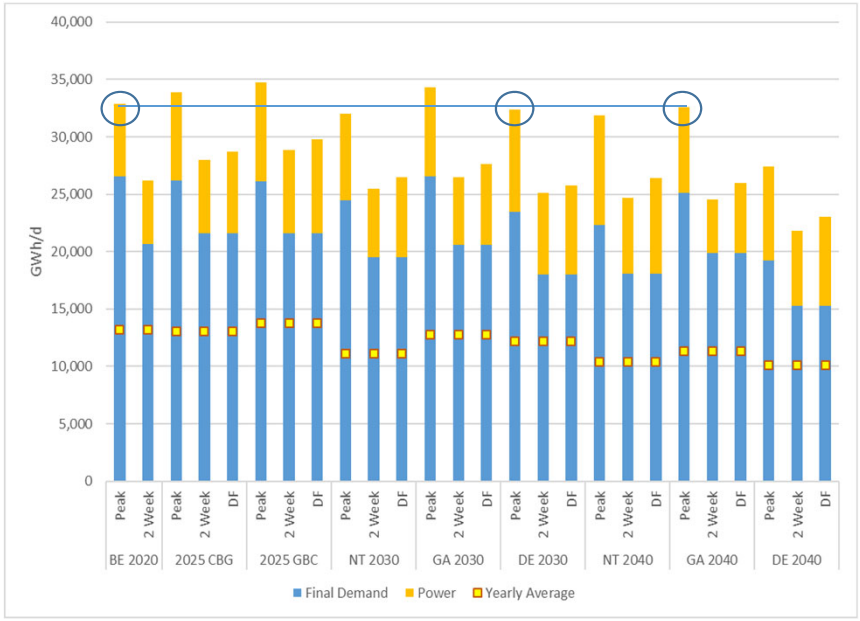


Gas flexibility

Scenarios with higher variable e-RES show the higher need for gas fired power generation

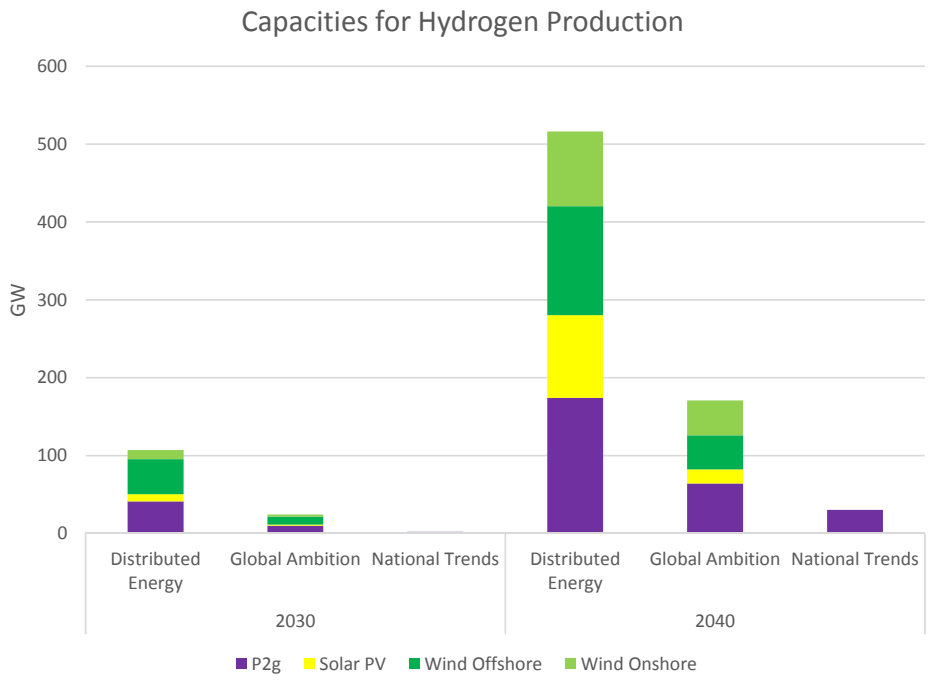


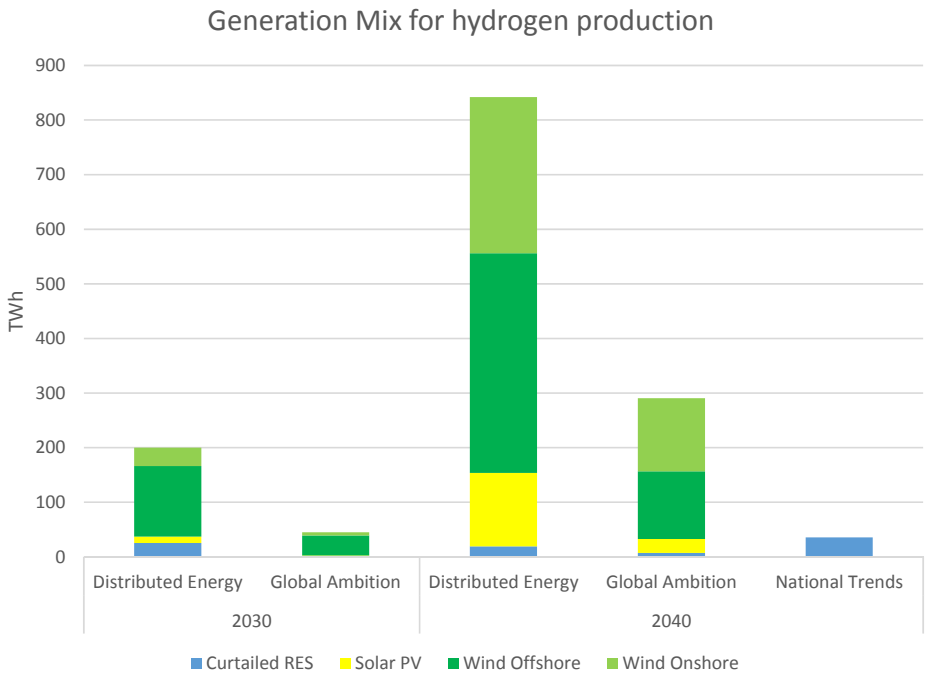
Gas peak demand does not follow the same decreasing trend as the annual demand
With the development of e-RES the infrastructure is exposed to new challenges.



…ENTSOG introduced a Dunkelflaute case for the first time in TYNDP 2020, reflecting the need for gas backup when e-RES show a significant level of penetration in the energy system

Capacities for Hydrogen Production





Sector Coupling enables a link between energy carriers and sectors, thus it becomes key in contributing to achieving the decarbonisation target. In the long-term, Power-to-Gas will play a key role in both the integration of excess electricity from variable renewables and decarbonising the gas supply.

Thank you for your attention!