TYNDP 2024
Scenario Building

1st public consultation on input parameters & methodologies

ENTSO-E & ENTSOG Webinar

Brussels, 13 July 2023 10:00 – 12:00 CEST

Introduction

Alan Croes, TenneT, Steering Group Convenor from ENTSO-E
10 minutes

Agenda

No	Subject	TIME	WHO
1.	Introduction	10.00-10.10 10 min	Alan Croes, ENTSO-E and TenneT, Steering Group
2.	TYNDP 2024 Stakeholder Engagement	10.10-10.20 10 min	Gideon Saunders, ENTSOG
3.	Scenarios Strategy & Storylines & Targets	10.20-10.30 10 min	Nalan Buyuk, ENTSO-E & Alexander Kättlitz, ENTSOG
	Q&A Session	10.30-10.35 5 min	All
4.	Draft Supply Parameters	10.35-11.00 25 min	Nalan Buyuk, ENTSO-E & Alexander Kättlitz, ENTSOG
	Q&A Session	11.00-11.05 5 min	All
5.	Draft Demand Parameters	11.05-11.20 15 min	David Radu, ENTSO-E
	Q&A Session	11.20-11.25 5 min	All
6.	Modeling Methodologies & Draft Assumptions	11.25-11.45 20 min	Dante Powell, ENTSOG
7.	Draft Carbon Budget Methodology	11.45-11.50 5 min	Alexander Kättlitz, ENTSOG
	Q&A Session	11.50-11.55 5 min	All
8.	Next Steps & Closing Remarks	11.55-12.00 5 min	Thilo von der Grün, ENTSOG, Steering Group
	End of the webinar	12.00	

Get involved in the Workshop!

Throughout the workshop you can ask questions and leave comments.

What to do:

1. Go to **slido.com**
2. Enter the event code "**#3541875**"
3. Enter your name
4. Start asking questions

Please note that physical participants should submit their questions via slido and anonymous questions will not be answered.

2. TYNDP 2024 Stakeholder Engagement

Gideon Saunders, Stakeholder Engagement Team Leader, ENTSOG,
10 minutes

What are our goals for stakeholder engagement?

Utilise and maximise expertise of external stakeholders

Timely and successful completion of the TYNDP Scenarios

Promote confidence in the scenario building process

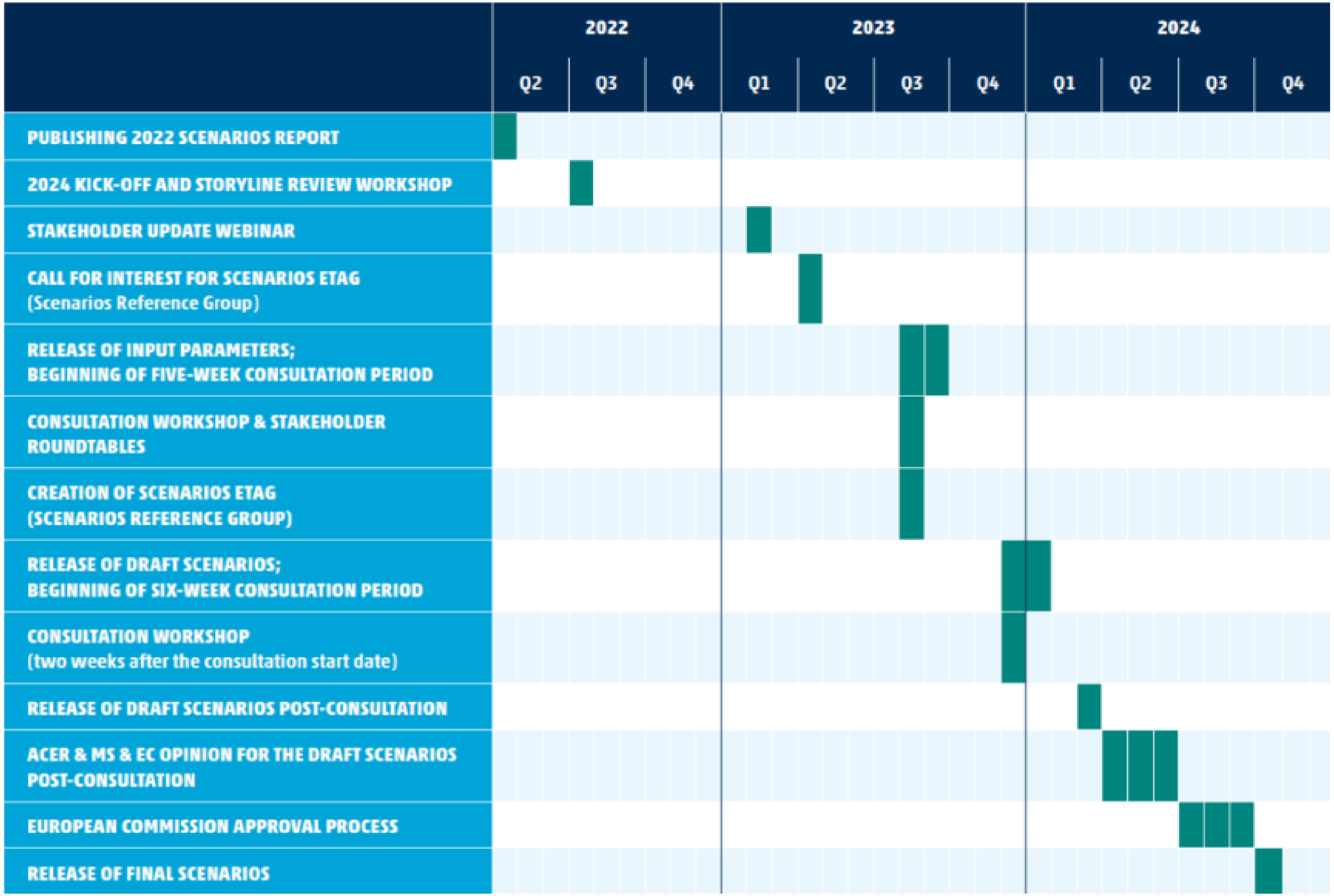
Investigate how low- and high scenarios could be used in 2026 cycle

Ensure fulfilment of regulatory obligations

Transparency in the Scenario Development Process

- New 2024 Scenarios website now online!
- Previous websites will not be de-activated – for historical reference and transparency – but will clearly be marked as no longer the latest scenario data.
- The new website will include:
  - Storyline Report
  - (Draft) Scenario Report
  - Methodologies for scenario quantification, Scenario Building Guideline and Innovation Roadmap
  - List of bilateral meetings and consultation and workshop responses
  - Datasets and assumptions published in both aggregated and disaggregated format (in line with confidentiality requirements of data providers)
  - Data Visualisation Platform
- Coming up soon: central scenarios webpage, with access to material of current and past scenario cycles

TYNDP 2024 Scenarios Timeline



Scenarios External Technical Advisory Group

Tasks and Format:

- Proposal developed from TEN-E Regulation EU 2022/869 Art. 12.3 and ACER's Scenario Framework Guidelines with the aim of formally enhancing stakeholder inclusion in the scenario development process.
- Participate in the scenarios development process, in particular on key elements such as development of assumptions and how they are reflected in the scenarios data.
- Organise itself to act independently from ENTSO-E and ENTSOG, with the aim of providing timely, expert input to the development of scenarios by ENTSOG and ENTSO-E in accordance with the scenario development timeline.

Scenarios External Technical Advisory Group

What is the current status?

- Call for candidates 5 May – 5 June
  - Applications for stakeholder categories outlined in TEN-E Regulation EU 2022/869 and ACER's Scenario Framework Guidelines
- Subsequent second call for candidates launched 12 June – 19 June after some categories remained unfilled.
- List of successful applications submitted to ACER/EC for feedback on 11 July
- Candidates will be informed of the success of their application by mid-August

How can stakeholders contact us at any time?

All stakeholders are invited at all times to provide written feedback to our activities.

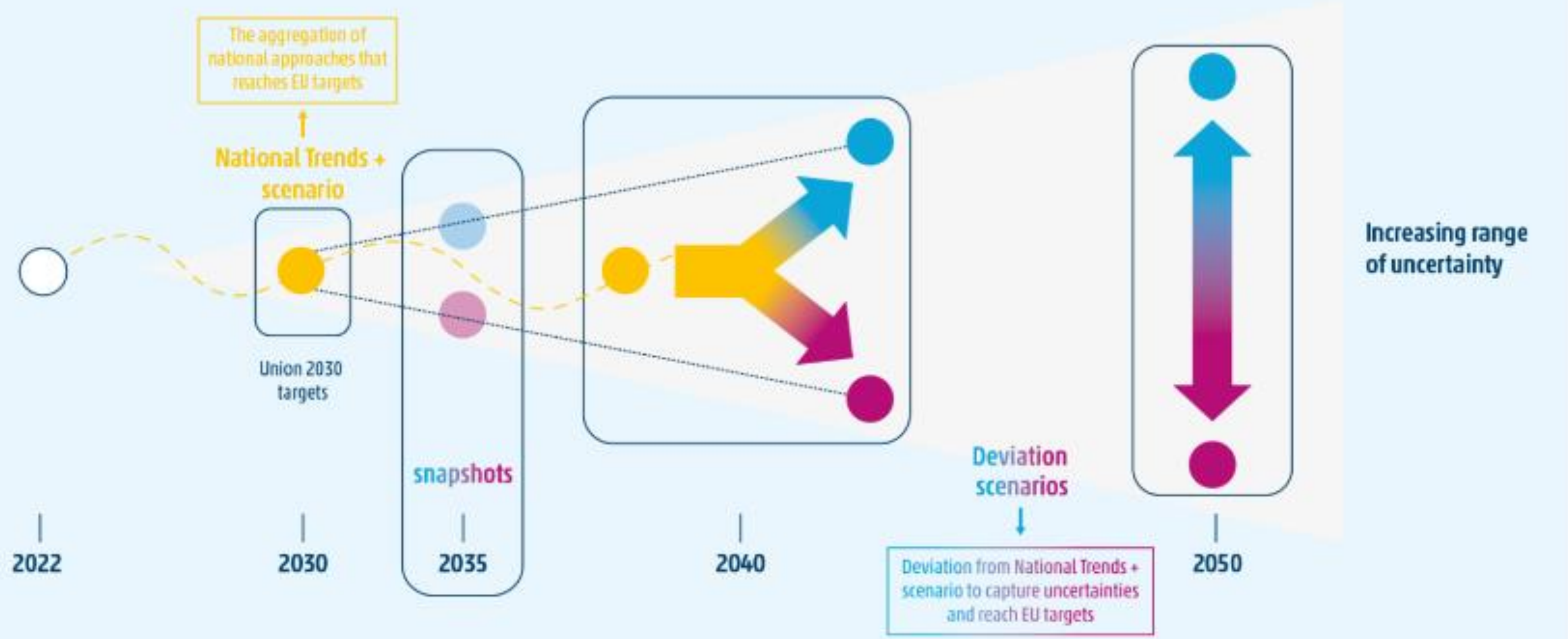
Where specific information is required, ENTSOG and ENTSO-E may reach out to specific stakeholders.

All correspondence and all bilateral interactions will be documented on the Scenarios website.

3. Scenarios Strategy & Storylines & Targets

Nalan Buyuk, Scenario Building Project Manager, ENTSO-E
Alexander Kättlitz, Scenario Subject Manager, ENTSOG
10 minutes

TYNDP 2024 SCENARIOS STRATEGY



TYNDP 2024 Storylines

	Distributed Energy Higher European autonomy with renewable and decentralised focus	**National Trends +** The aggregation of national pathways to reach EU targets	**Global Ambition** Global economy with centralised low carbon and RES options
Green Transition	Fully in line with the energy efficiency first principle and with the Union's 2030 targets for energy and climate and its 2050 climate neutrality objective		
Driving force of the energy transition	Transition initiated at a local/national level (prosumers)		Transition initiated at a European/international level
	Aims for EU energy-independence and strategic independence through maximisation of RES and smart sector integration (P2G/P2L/P2M)		High EU RES development supplemented with low carbon energy and diversified Imports
Energy efficiency	Reduced energy demand through circularity and better energy consumption behaviour	**Deviation extent will depend on "National Trends +" setting resulting from national perspectives**	Reduced energy demand with priority is given to decarbonisation and diversification of energy supply.
	Digitalisation driven by prosumer and variable RES management		Digitalisation and automation reinforce competitiveness of EU business.
Technologies	Focus of decentralised technologies (PV, batteries, etc.) and smart charging		Focus on large scale technologies (offshore wind, large storage)
	Focus on electric heat pumps and district heating	Dummy deviations	Focus on a wide range of heating technologies e.g. hybrid heating technology
	Higher share of EV, with e-liquids and biofuels supplementing for heavy transport		Wide range of technologies and energy carriers across mobility sectors (electricity, hydrogen, e-liquids and biofuels)
	Minimal CCS and nuclear		Integration of nuclear and CCS

Compliance with EU energy and climate targets

All scenarios will be aligned with the Union's 2030 targets for energy and climate and its 2050 climate neutrality objective and will include a carbon budget assessment.

2030 targets

- 55% GHG reduction (compared to 1990)
- Energy efficiency first principle is reflected with 11.7% reduction final energy demand
  resulting in a upper limit of 8873 TWh (763 Mtoe)
- 42.5% RES share
- Offshore targets -- MS non-binding agreements
- Specific targets for transport or industry sector according to the provisional agreements in March, 2023

2050 targets

- Net-zero emissions
- Offshore targets -- MS non-binding agreements

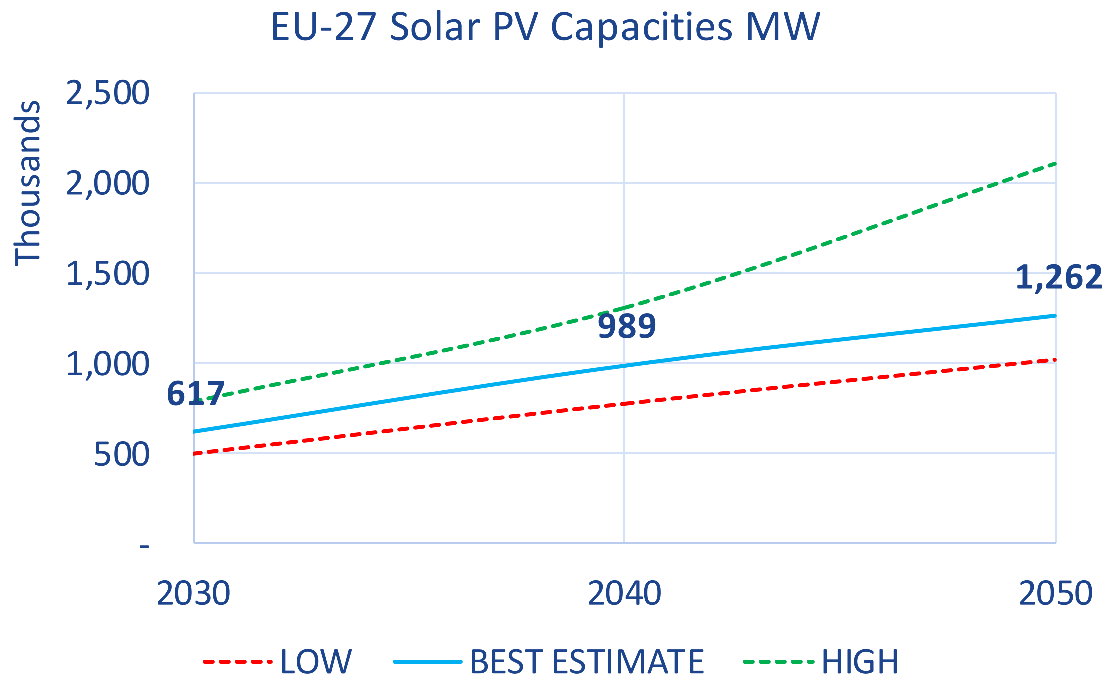
Q&A

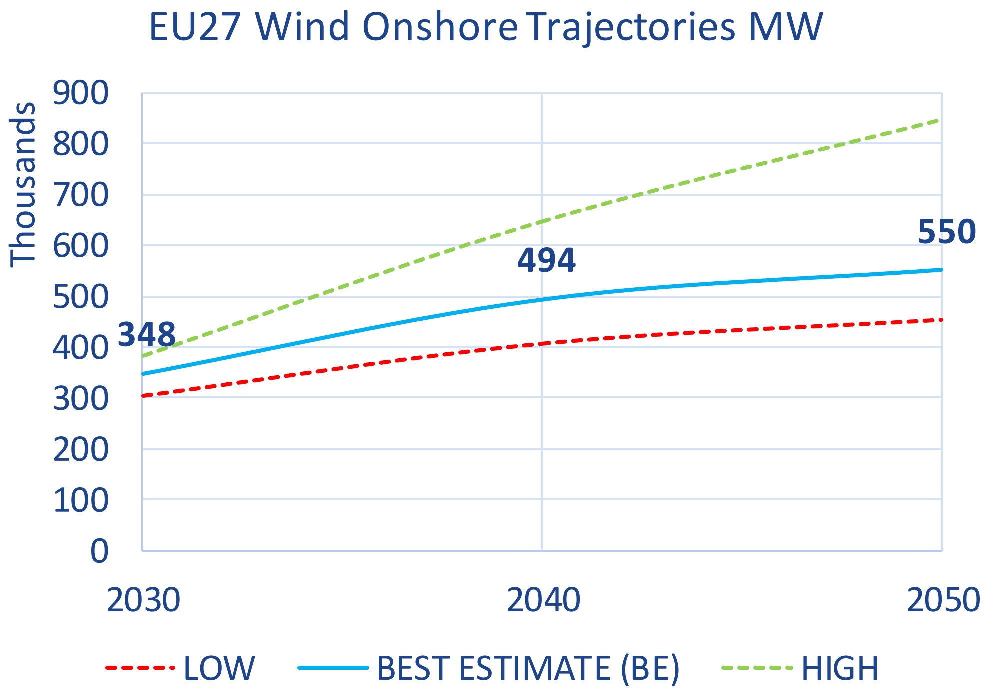
Participants can join at **slido.com** with **#3541875**
5 minutes

4. Draft Supply Parameters

Nalan Buyuk, Scenario Building Project Manager, ENTSO-E
Alexander Kättlitz, Scenario Building Project Manager, ENTSOG
25 minutes

Solar & Wind Onshore Trajectories





Best Estimate: NT+ capacities
LOW & HIGH: Low and high boundaries for DE & GA

Wind Offshore Trajectories

*Portugal will be added 10 GW for 2030/2040/2050

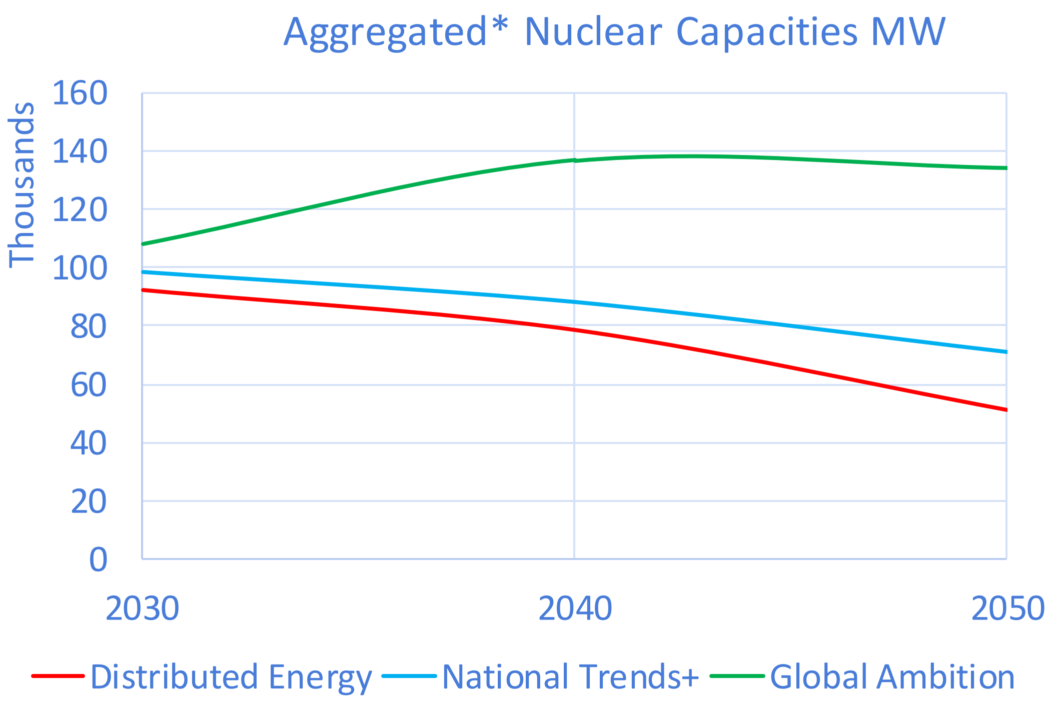
MS non-binding agreements

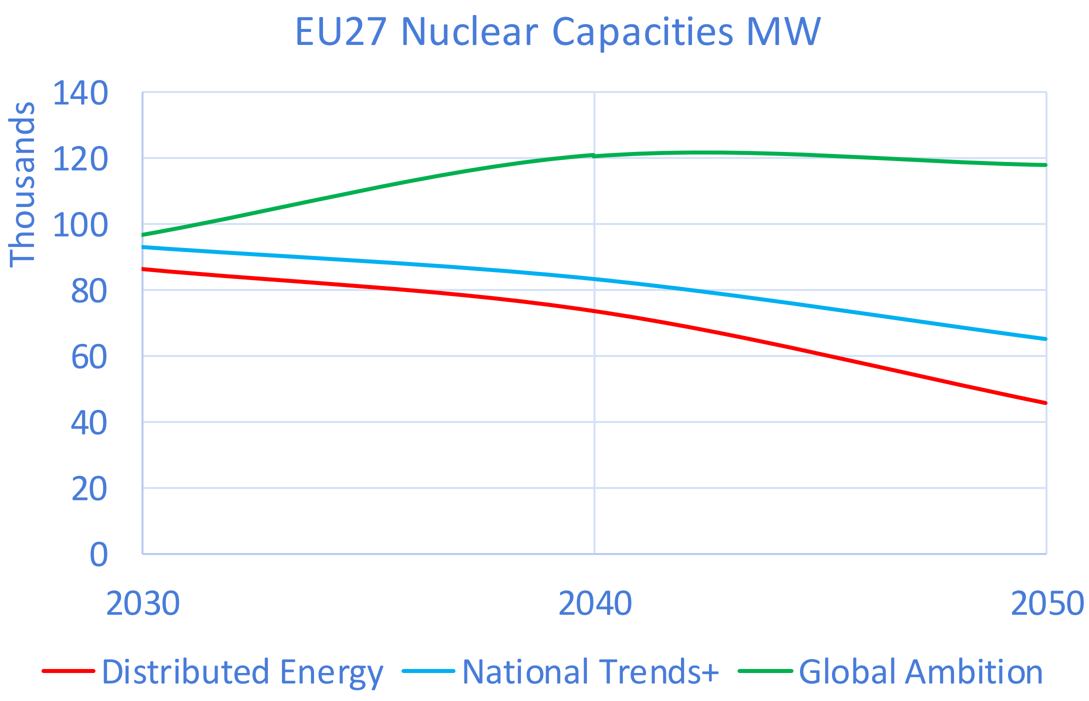
	2030		2040		2050	
	min	*max*	*min*	*max*	*min*	*max*
NSOG	60.3	60.3	134.9	158	171.6	218
BEMIP	22.5	22.5	34.6	34.6	46.8	46.8
AOG	12.74	14.26	21.74	26.06	29.74	43.06
SWOG	5.15	6.15	6.7	12.6	6.7	20.1
SEOG	8.81	8.81	16.8	16.8	25.9	25.9
Total	**109.5**	**112.02**	**214.74**	**248.06**	**280.74**	**353.86**

HIGH according to the TSO data
BE = LOW according to the MS non-binding agreements (according to the datasets received from Offshore Network Development Plan Project 'ONDP')**

***might require an update to align with the ONDP dataset and capture latest updates (e.g.; Portugal)*

Nuclear Capacities

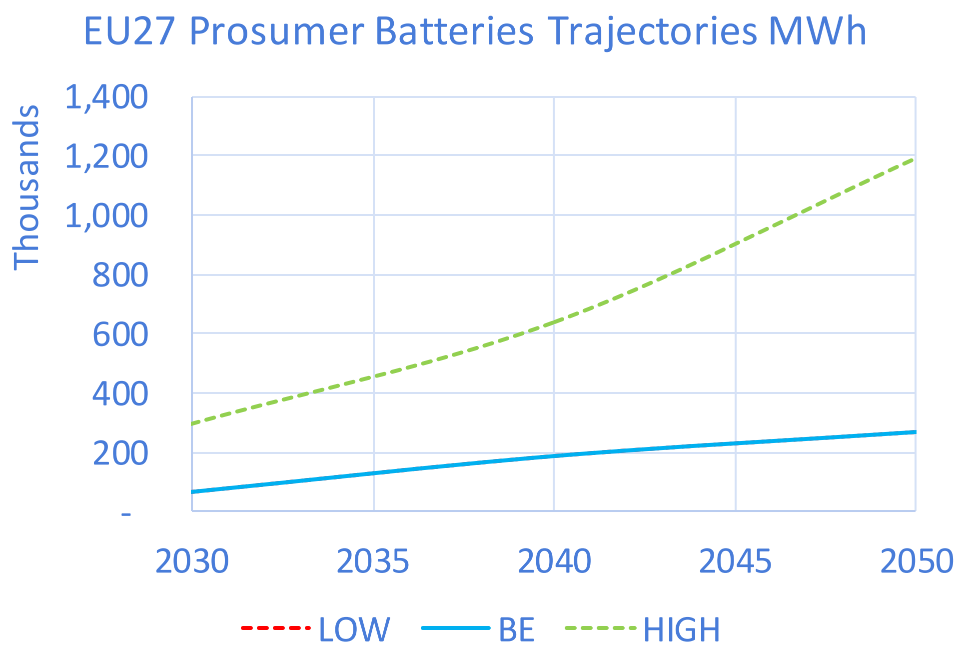


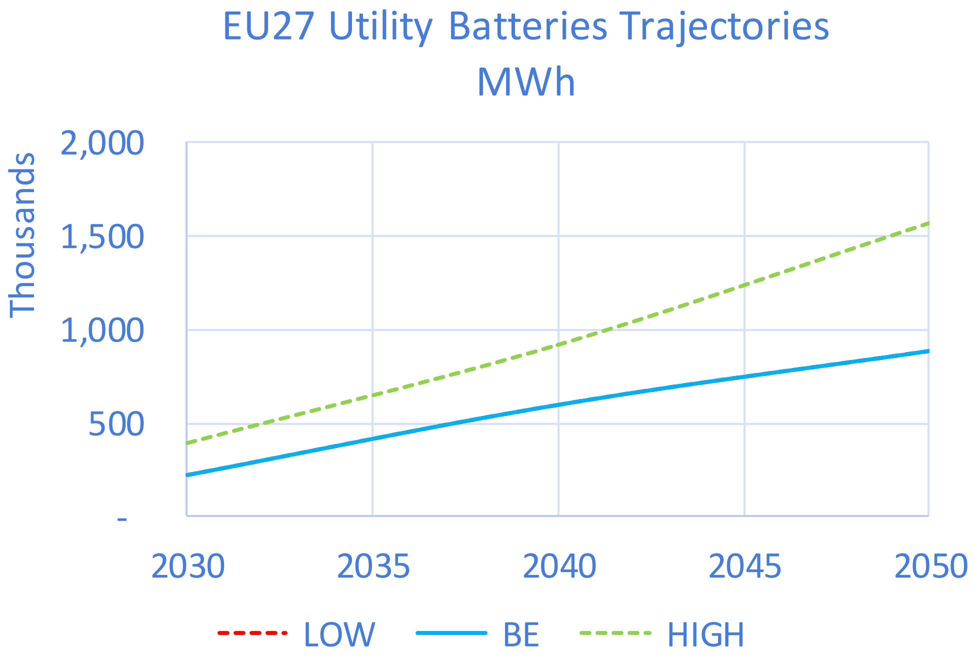


**The aggregation covers all ENTSO-E countries (EU27 + AL, BA, CH, ME, MK, NO, RS, UK)*

Datasets collected from TSOs

Battery Trajectories





HIGH linked to the PV Rooftop High Trajectory
BE = LOW according to the TSOs data

HIGH linked to the PV Farm High Trajectory
BE = LOW according to the TSOs data

Technology Costs

- Presented costs are the base
- Differentiation between scenarios:

2040

DE	15%	GA
↓ PV+ Batteries		↑ PV+ Batteries
↓ Onshore		↑ Onshore
↑ Offshore		↓ Offshore

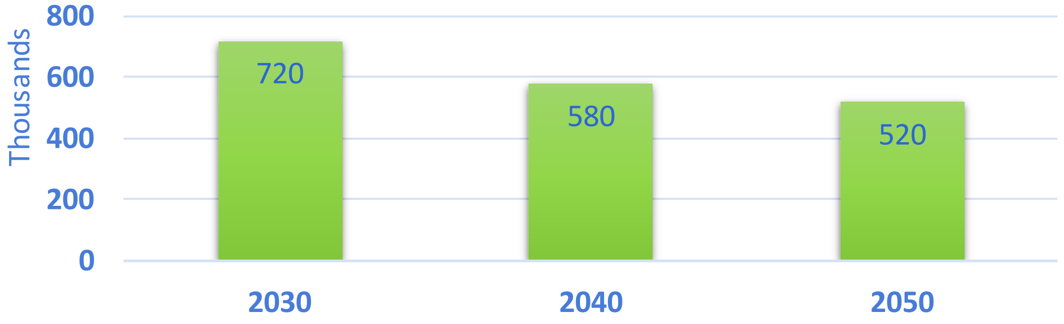
2050

DE	20%	GA
↓ PV+ Batteries		↑ PV+ Batteries
↓ Onshore		↑ Onshore
↑ Offshore		↓ Offshore

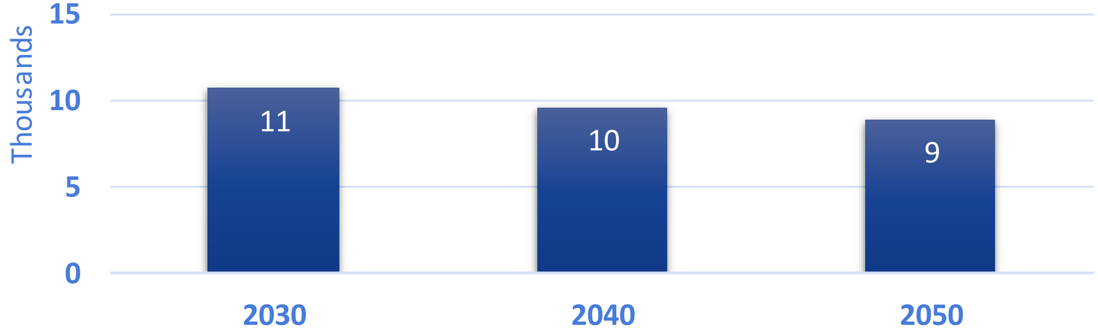
Solar PV Cost

Source: Danish Agency Tech. Catalogue

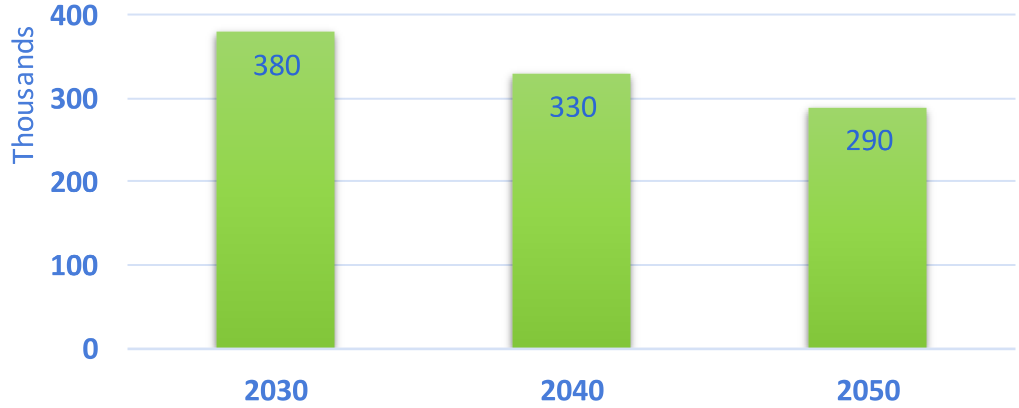
Rooftop PV - CAPEX €/MW



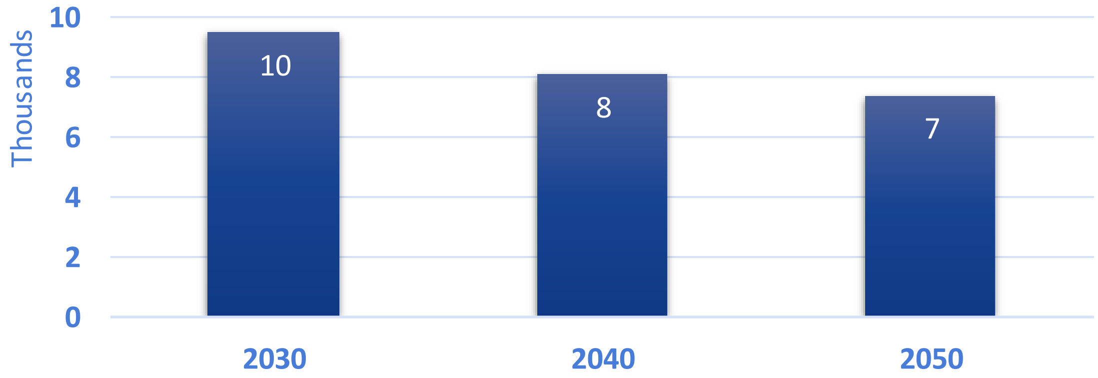
Rooftop PV (residential) OPEX €/MW/a



Utility-scale PV - CAPEX €/MW

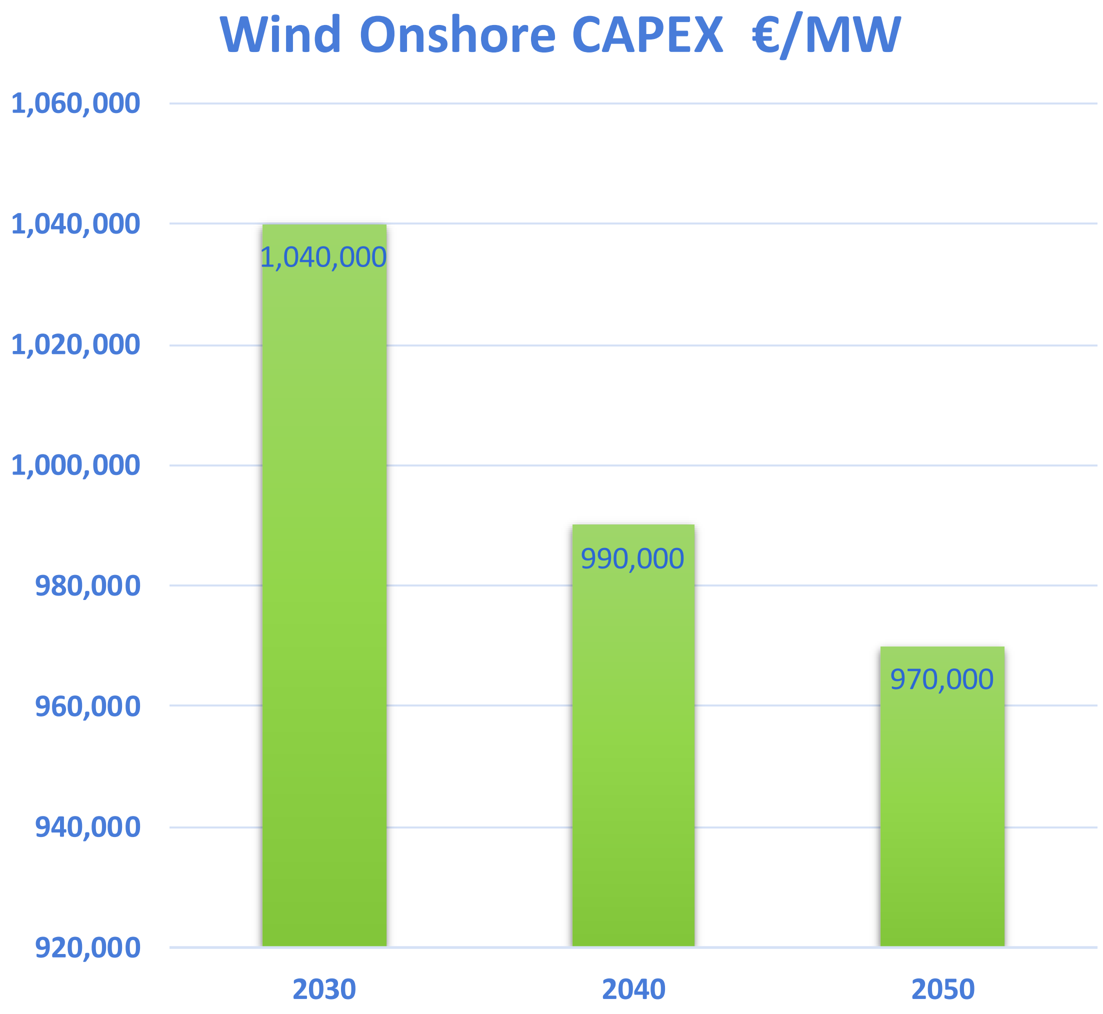


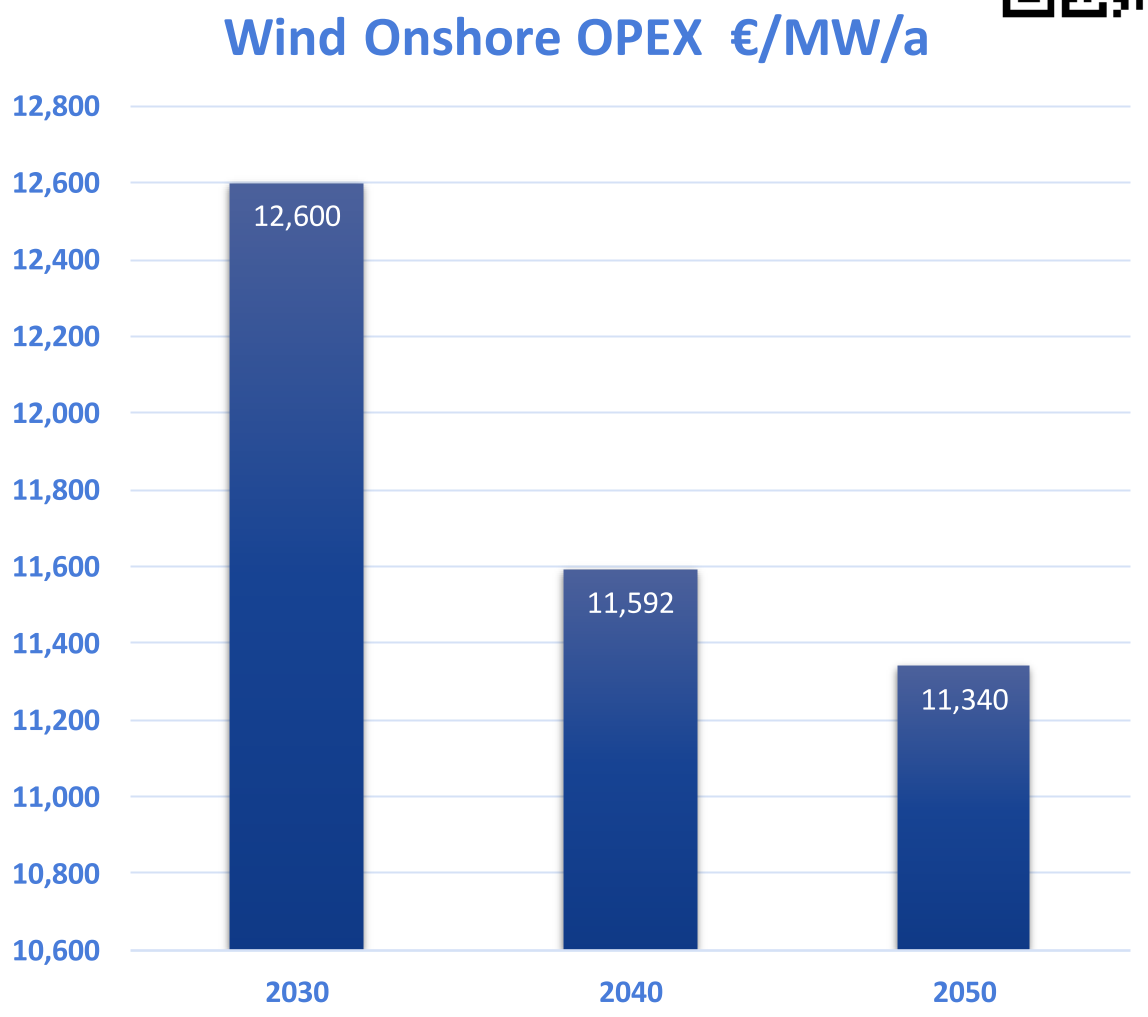
Utility-scale PV (residential) OPEX €/MW/a



Source: Danish Agency Tech. Catalogue

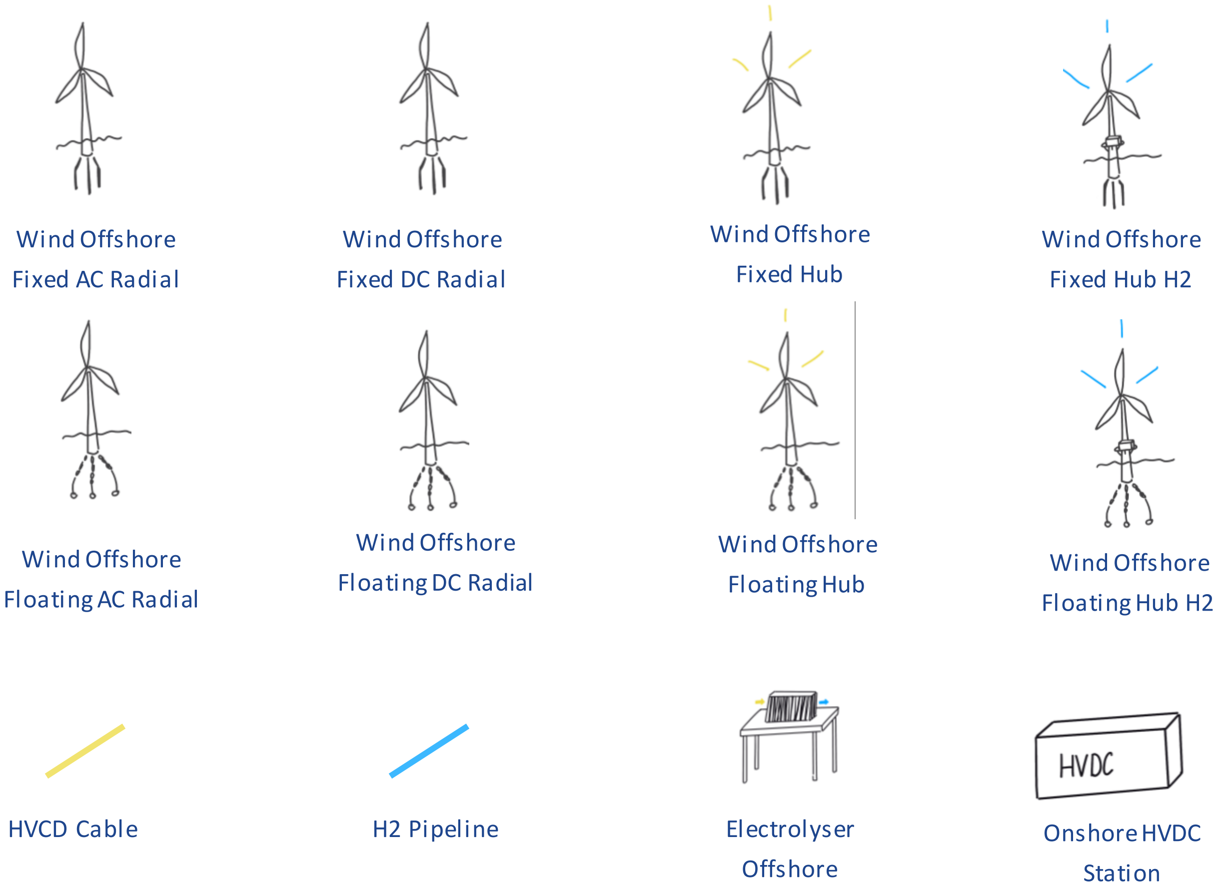
Wind Onshore Cost



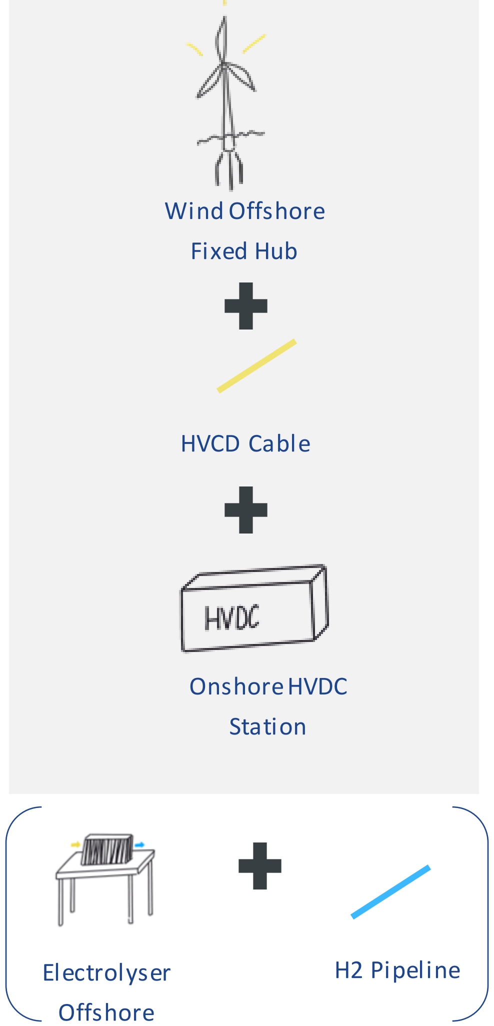


Wind Offshore

Components



Example



Includes turbine, foundation, installation, array cables, platform

Cable cost M€/MW/km

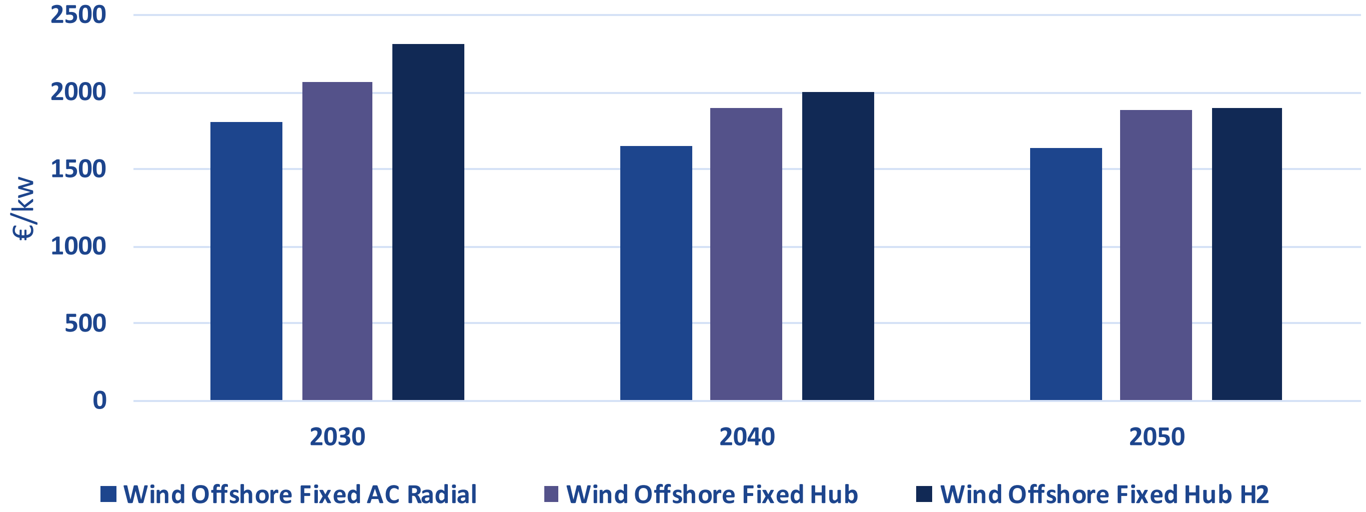
Expansion possible

Compressor costs in pipeline included

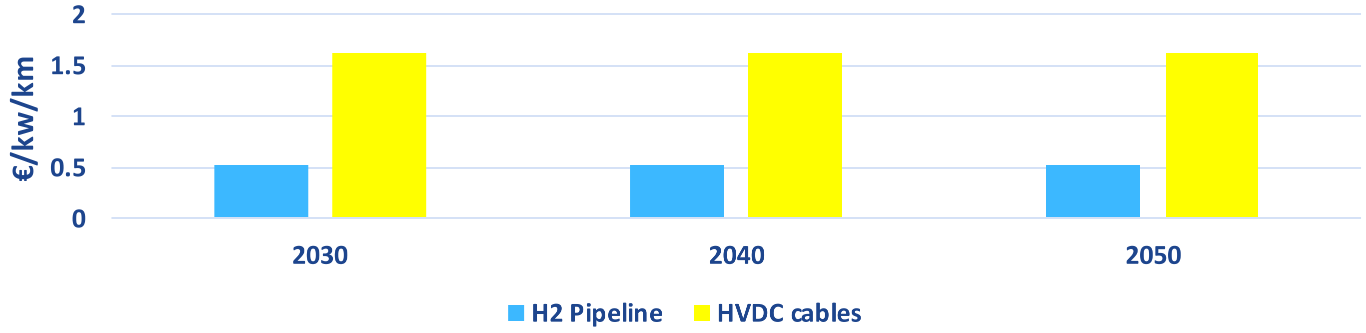
Sources: Multiple sources

Wind Offshore Cost

CAPEX– AC Radial Wind vs Hub Connected Wind vs Hub Connected Wind H2



Cable vs pipeline



Onshore HVDC Station

		2030	2040	2050
CAPEX	€/MW	250,000	250,000	250,000

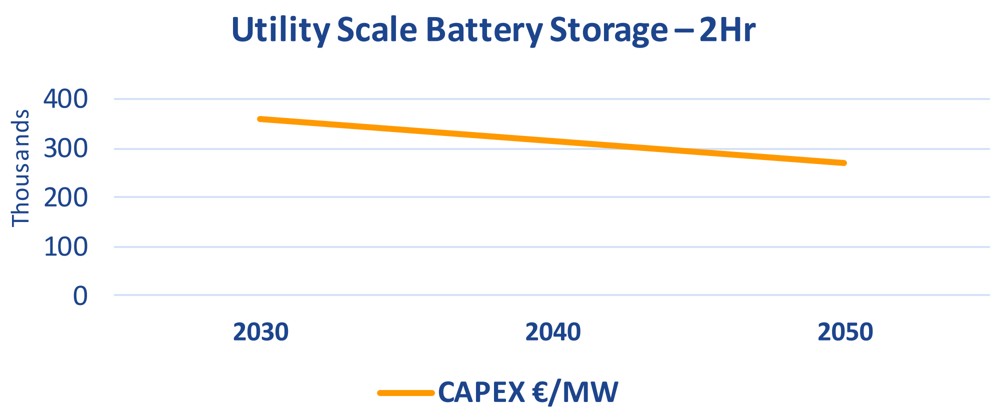
Electrolysis Offshore*

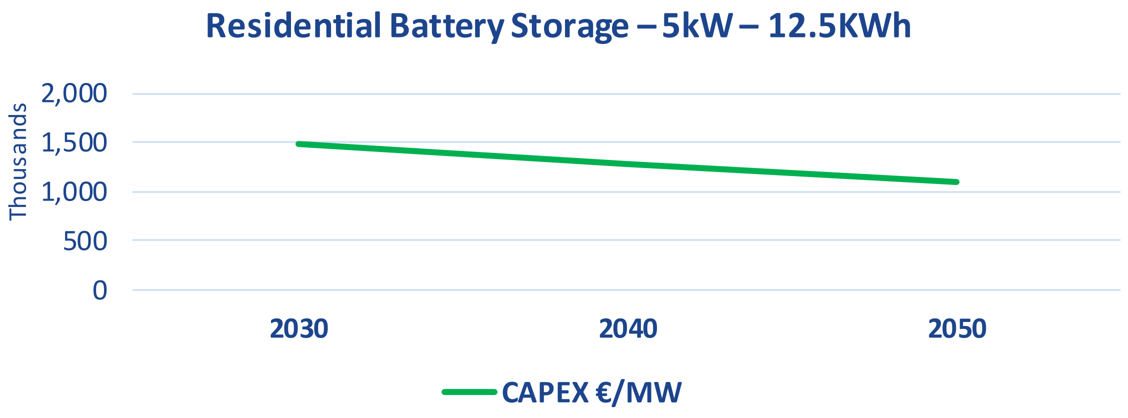
		2030	2040	2050
CAPEX	€/MW	850,000	680,000	630,000
OPEX	€/MW/a	18,000	15,000	14,000

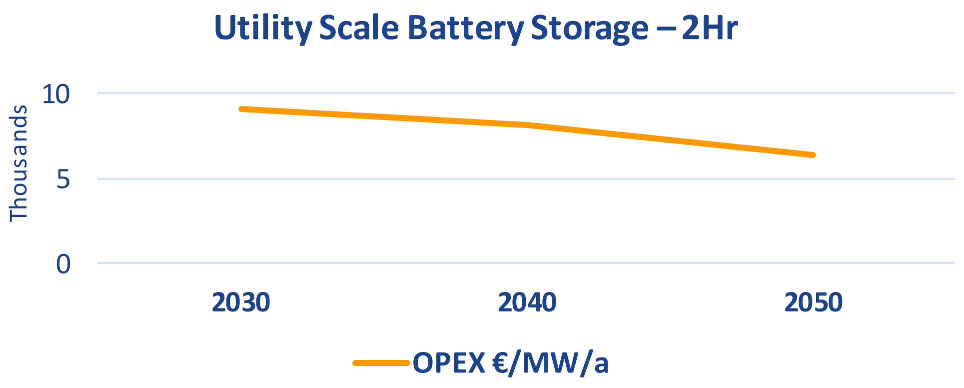
* 50% market share of AEC and PEM electrolysis
* Includes Offshore installation addition, water treatment, substation, platform, initial compression

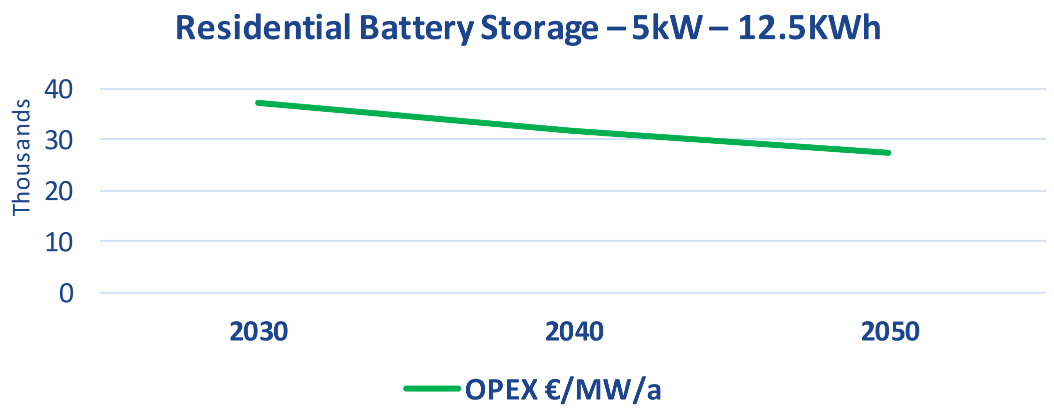
Sources: Annual Technology Baseline

Battery Storage Costs





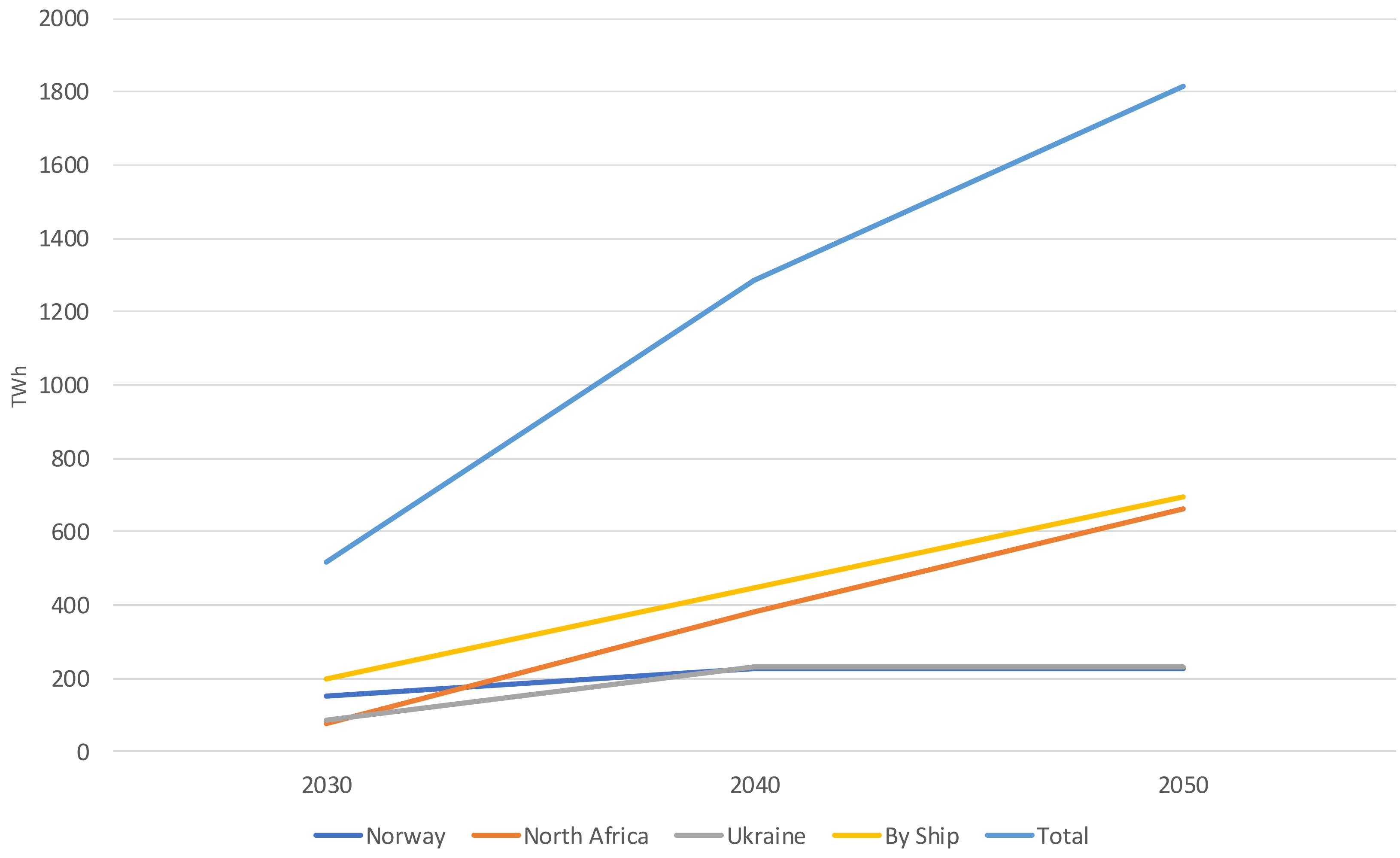




Commodity & CO_2 Prices

Fuel	Unit	2030	2040	2050	Source
Nuclear	€/GJ	1.7	1.7	1.7	EIA (2022) – fuel cost only
Lignite G1	€/GJ	1.4	1.4	1.4	Booze&co same as 2022 - (BG - MK - CZ)
Lignite G2	€/GJ	1.8	1.8	1.8	Booze&co same as 2022 - (SK - DE - RS - PL - ME - UKNI - BA - IE)
Lignite G3	€/GJ	2.4	2.4	2.4	Booze&co same as 2022 - (SL - RO - HU)
Lignite G4	€/GJ	3.1	3.1	3.1	Booze&co same as 2022 - (GR - TR)
Hard coal	€/GJ	1.8	*1.6*	1.5	IEA 2022 (APS)
Natural Gas	€/GJ	6.3	*5.7*	5.0	IEA 2022 (APS)
Crude oil	€/GJ	9.2	*8.9*	8.6	IEA 2022 (APS)
CO_2 price	€/ton	113.4	147.0	168.0	IEA 2022 (APS)
Hydrogen (blue)	€/GJ	17.6	15.1	15.1	IEA 2022 (APS) - SMR with CCUS (full capture)
Biomethane	€/Gj	18.8	*18.0*	17.3	Costs from Danish Technology catalogue and shares from Guidehouse: 2030: anaerobic digestion 93%, thermal gasification 7% and in 2050 respectively 61% to 39%.
Synthetic Methane	€/Gj	27.6	25.0	23.5	IEA 2022 (APS) - renewable electricity, 70%, 55% and 50% of biogenic CO_2.
Light oil	€/GJ	11.7	*11.4*	11.0	Modelled from crude oil price (+28%) – *WEO STEPS forecast*
Heavy oil	€/GJ	9.6	*9.3*	9.0	Modelled from crude oil price (+5%) – *WEO STEPS forecast*
Oil shale	€/GJ	1.9	2.7	3.9	Value from last cycle - no updates from TSOs available
Ammonia imports prices	€/GJ	38.3	30.1	24.1	EWI tool calculation (100% reconverted to H_2 and import location is Germany)
Methane price for NT+	€/GJ	7.5	9.0		(2030: Natural Gas 90% & Biomethane 9%) & (2040: NG 76% & Biomethane 20%, e-methane 4%)
Methane price for DE	€/GJ		11.0	16.9	(2040: NG 59% & Biomethane 36%, e-methane 5%) & (2050: NG 9% & Biomethane 79%, e-methane 12%)
Methane price for GA	€/GJ		10.3	16.0	(2040: NG 65% & Biomethane 31%, e-methane 4%) & (2050: NG 16% & Biomethane 74%, e-methane 11%)
			Interpolation		

H2 import potentials



Import potentials			
Region	**2030**	**2040**	**2050**
Norway	151	224	224
North Africa	77	381	662
Ukraine	88	231	231
By Ship	200	448	696
Total	**516**	**1285**	**1813**

Sources:

- *TYNDP 2022 projects*
- *European Hydrogen Backbone*
- *IEA*
- *IRENA*
- *Morocco H2 strategy*

H2 import prices

Base prices

H2 costs (€/MWh)				
Eksporter	Importer	2030	2040	2050
Algir	IT	63	42	42
NO	DE	48	48	48
UA	RO, HU, SK	78	51	51
Amonia	BE, DE, FR, NL	138	108	87

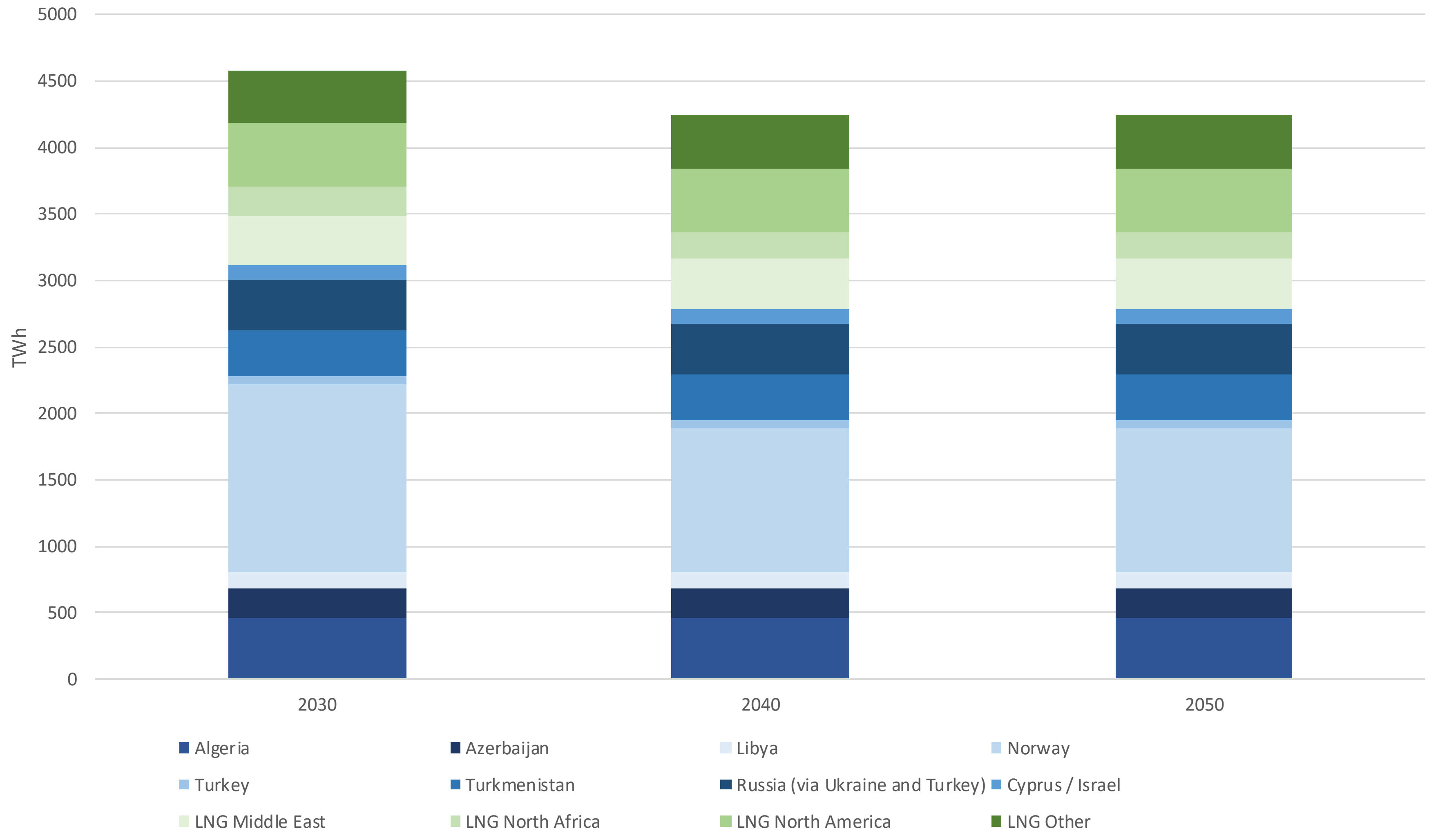
Interpolation is used for 2035 and 2045

Price scenario differentiation:

- DE + 15% in 2040 and + 20% in 2050
- GA – 15% in 2040 and – 20% in 2050

Source for H2 price: European Hydrogen Backbone study - link (May 2022)
Source for NH3 price: EWI H2 tool

CH4 import supply potentials



LNG import potentials (TWh/year)

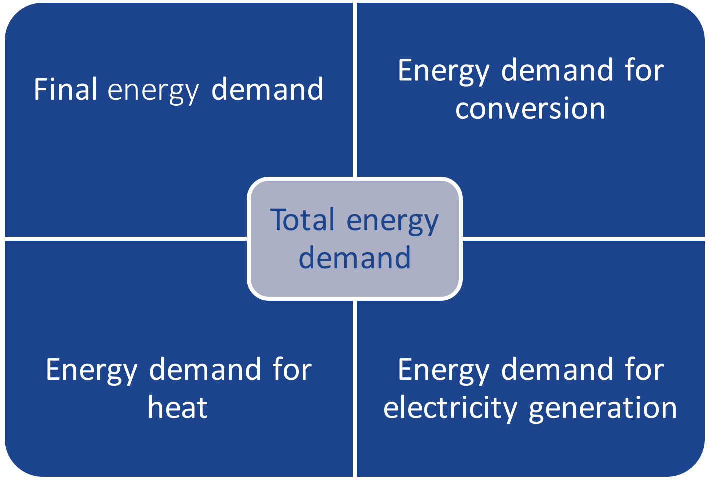
Region	2030	2040	2050
LNG Middle East	379	387	387
LNG North Africa	221	200	200
LNG North America	479	473	473
LNG Other	386	403	403
Total LNG based	**1466**	**1464**	**1464**

Pipeline import potentials (TWh/year)

Country	2030	2040	2050
Algeria	457	457	457
Azerbaijan	228	228	228
Libya	117	117	117
Norway	1421	1089	1089
Turkey	63	63	63
Turkmenistan	336	336	336
Russia (via Ukraine and Turkey)	380	380	380
Cyprus / Israel	110	110	110
Total Pipeline based	**3112**	**2780**	**2780**

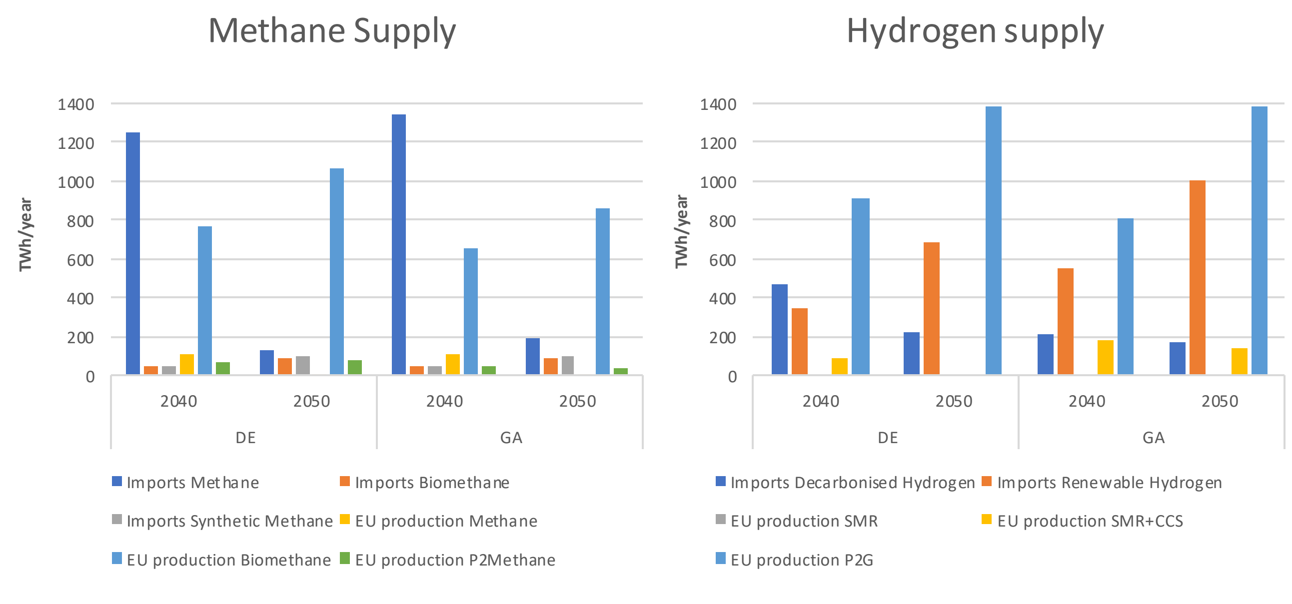
Source: TYNDP 2022

Supply tool



Supply tool used to develop the supply part:

- For all scenarios (NT+, DE,GA)
- For all time-horizons (2030,2040,2050)
- For all main energy carrier on EU27 level
- For Methane, Hydrogen and Liquids on a country-level



https://2024.entsos-tyndp-scenarios.eu/download/

Q&A

Participants can join at **slido.com** with **#3541875**
5 minutes

5. Draft Demand Parameters

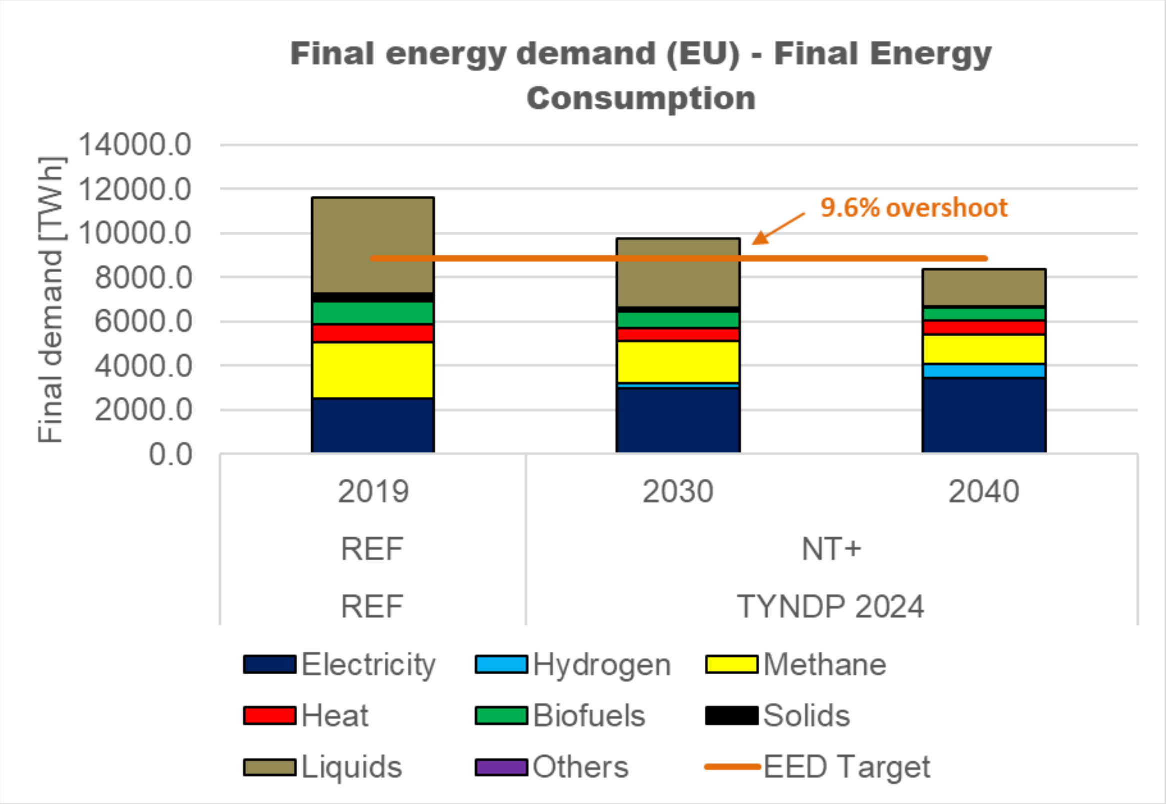
David Radu, Scenario Building Technical Lead, ENTSO-E
15 minutes

The National Trends (+) scenario built based on TSOs input

A final energy demand (FEC*) binding **reduction target of 763 Mtoe in 2030 at EU27 level** drives demand reduction – in line with the EED agreement reached in Mar 23, represents min. 11.7% reduction compared to the EC Reference Scenario.

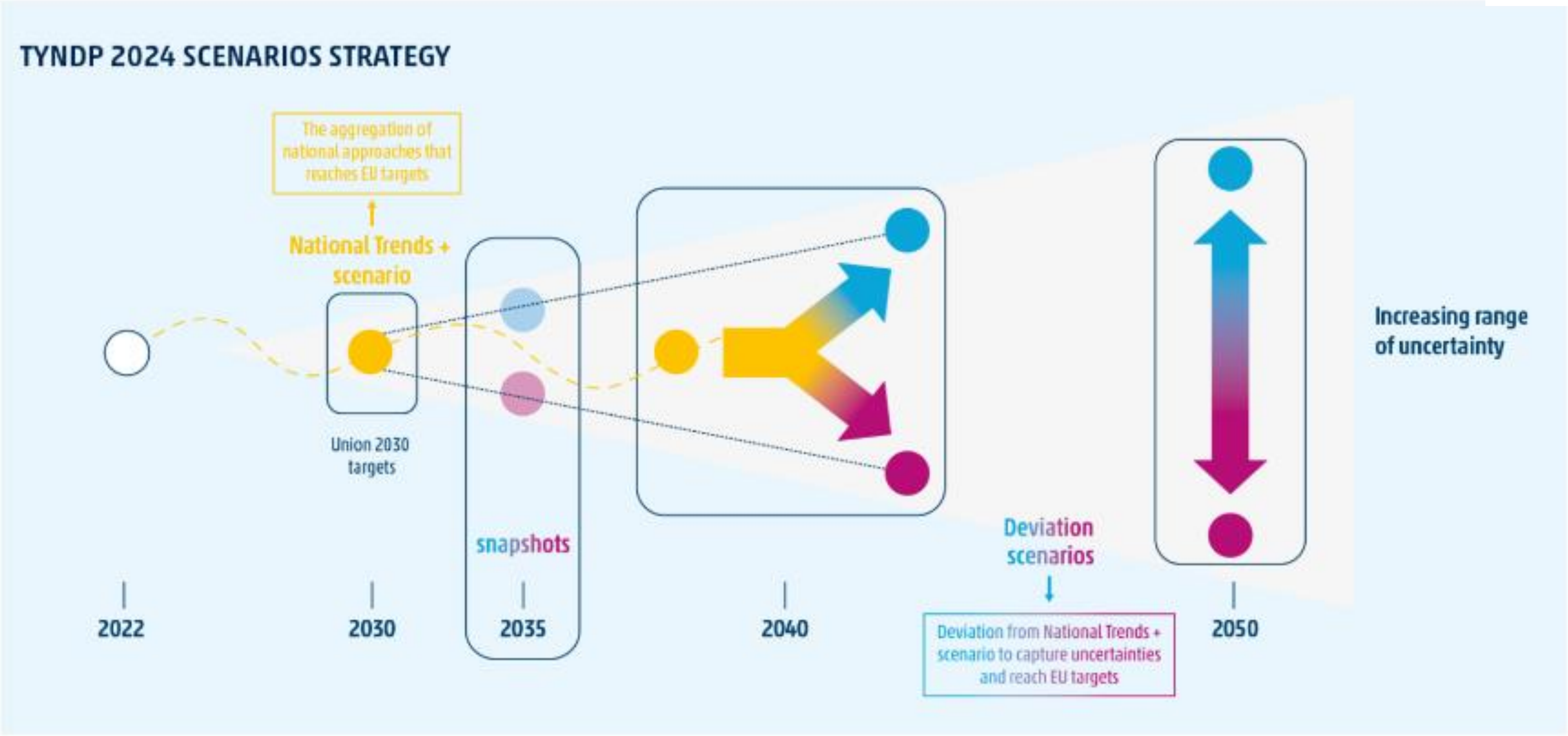
NECP-based data was **collected from electricity and gas TSOs** and spanned a variety of economic sectors and energy carriers. Results of the joint collection reflects **an overall overshoot of ~10%.**

In this context, a gap closing methodology is developed to **further reduce the demand for highly-polluting fuels** (solids, crude) proportional to the country- and fuel-specific numbers. This methodology is shared within the consultation package.



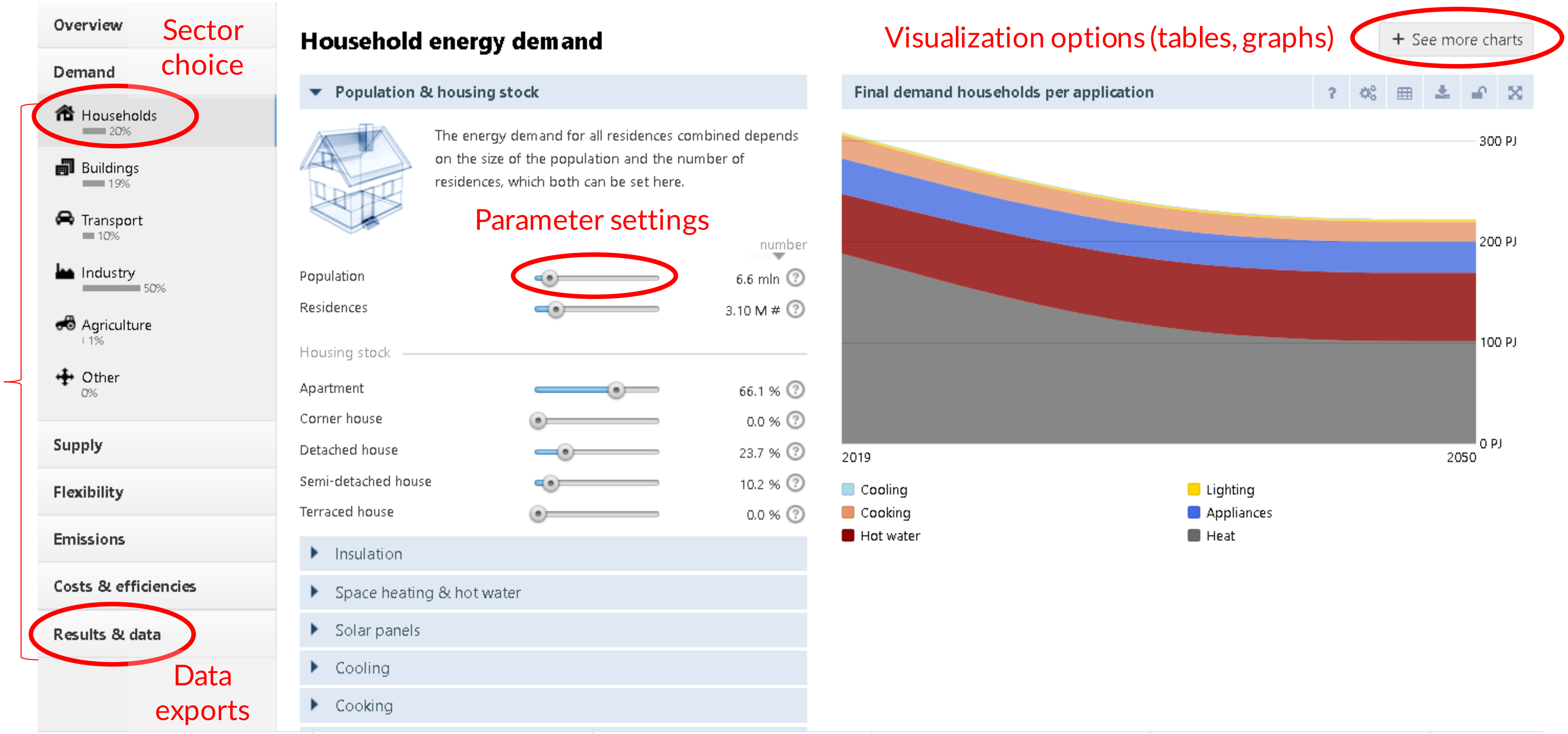
*FEC = all energy supplied to industry, transport (incl. international aviation), households, services, agriculture & forestry and other end-users. Excludes international shipping, ambient heat, non-energy use and energy branch.

DE/GA built as deviations from the NT+ scenario

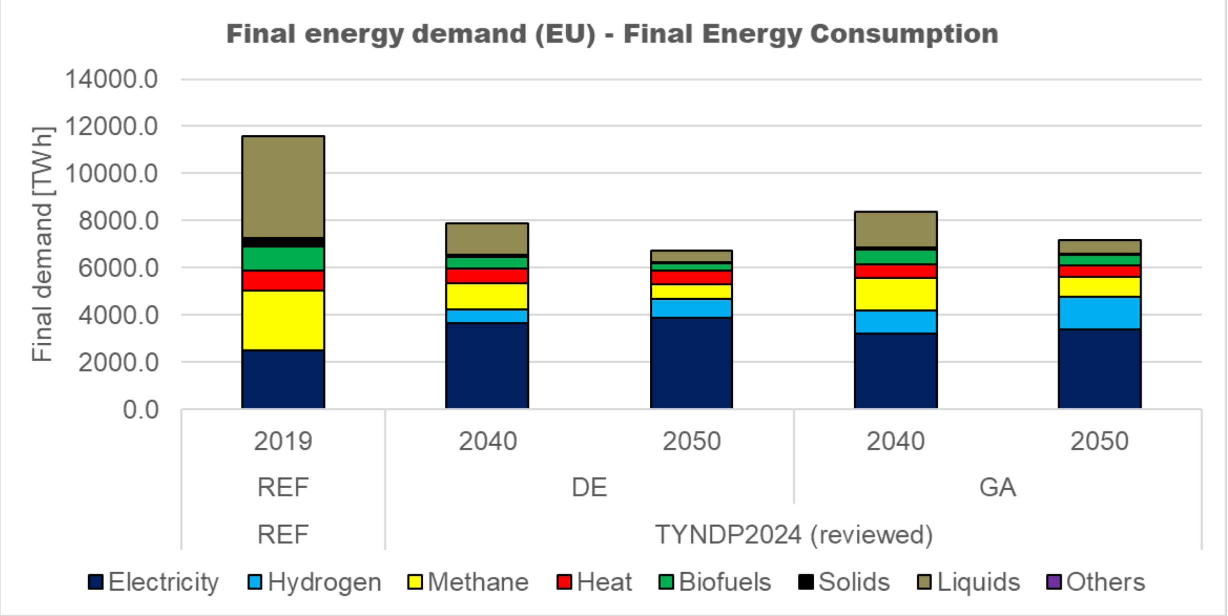


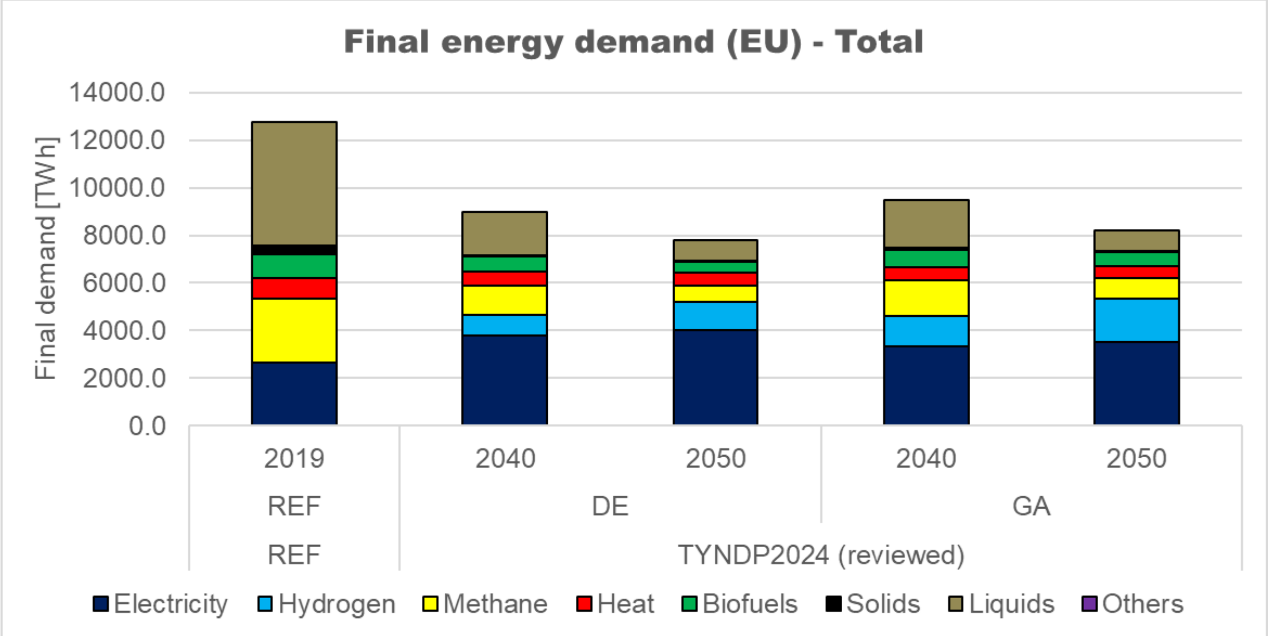
The deviation scenarios were built in an open-source tool – the Energy Transition Model – starting from Eurostat & TYNDP22 data

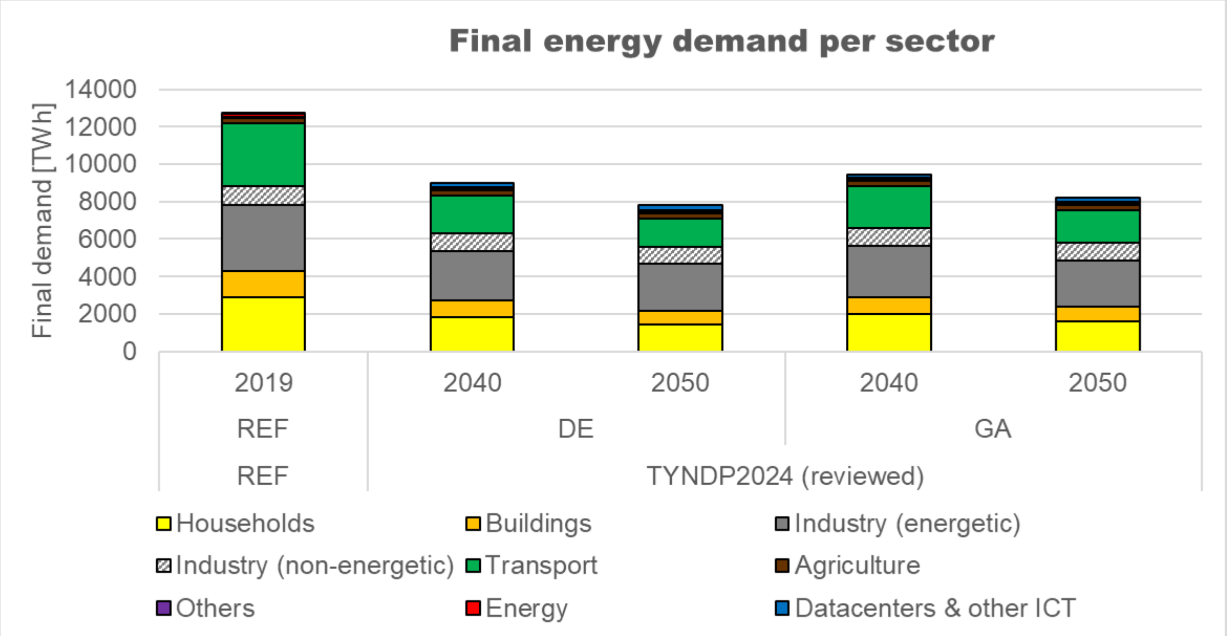
Categories & (sub) sectors



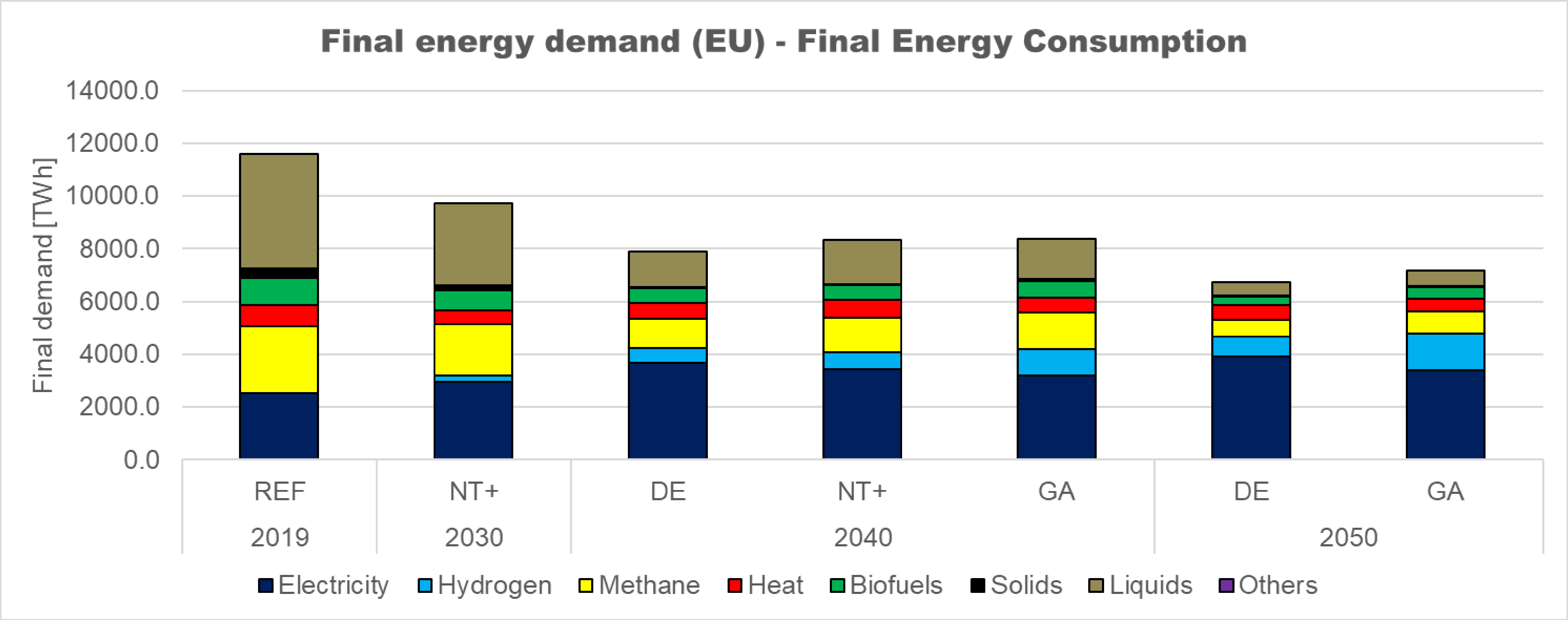
Overall, increased electrification leads to a slightly lower energy demand in DE 2040 and 2050 compared to GA, even though industrial demand is on-par or greater than in GA because of the strategic independence element







DE and GA demand numbers across all energy carriers do reveal them as deviations from the NECP-based NT+ scenario



Q&A

Participants can join at **slido.com** with **#3541875**
5 minutes

6. Modelling Methodologies & Draft Assumptions

Dante Powel, Innovation Manager, ENTSOG

20 minutes

Overview of 2024 Innovations

1

Hydrogen Modelling

H_2 zones modelled considering a market and dedicated production.
Domestic production of synthetic fuels.
Explicit hydrogen to power modelling.

5

Expansion Modelling

New approach that enhances run times over previous cycle, and allows for a larger model to be run

2

EV Modelling

Improvement of 2022 scenarios.
Transport modelling will include demand side shifting and Vehicle to grid.

4

Heat Modelling

Hybrid heat pumps as heating that use energy produced by three carriers (electricity, hydrogen and methane).

3

Offshore Modelling (*)

Hub modelling wind farms, electricity grid, hydrogen pipelines and electrolysers.
Hubs interconnect with each other and mainland Europe.

(*) implemented in NT+ Scenario with no expansion. See slide 7.

Electricity and Hydrogen Reference Grids

Electricity Reference Grid

Projects have been selected according to the criteria set in the 4th CBA Guideline as part of TYNDP. Projects (at submission) should be in construction phase or have completed the environmental assessment for inclusion in 2030.

The cut-off for the planned commissioning date is 31 December 2030.

Hydrogen Reference Grid

Includes cross-border transmission (or, interconnector) capacities across Europe, according to the data that member TSOs or project promotors have submitted for 2030.

Electricity and Hydrogen Project Candidates and Costs

ENTSO-E's Draft Methodology

TYNDP project candidates: CBA projects. Consulted with ACER and European NRAs.

TYNDP projects for the new cycle: CAPEX includes the costs of internal reinforcements. TSOs could add additional costs associated with internal reinforcements for projects submitted by 3rd party organizations.

Conceptual projects: TSOs investigation of potential new interconnections. Economic parameters are less certain but technically justifiable. Some based on preliminary technical studies to identify potential new connections.

ENTSOG's Draft Methodology

The "Low Infrastructure Level" is a collection of projects submitted to the 1st hydrogen TYNDP in 2022.

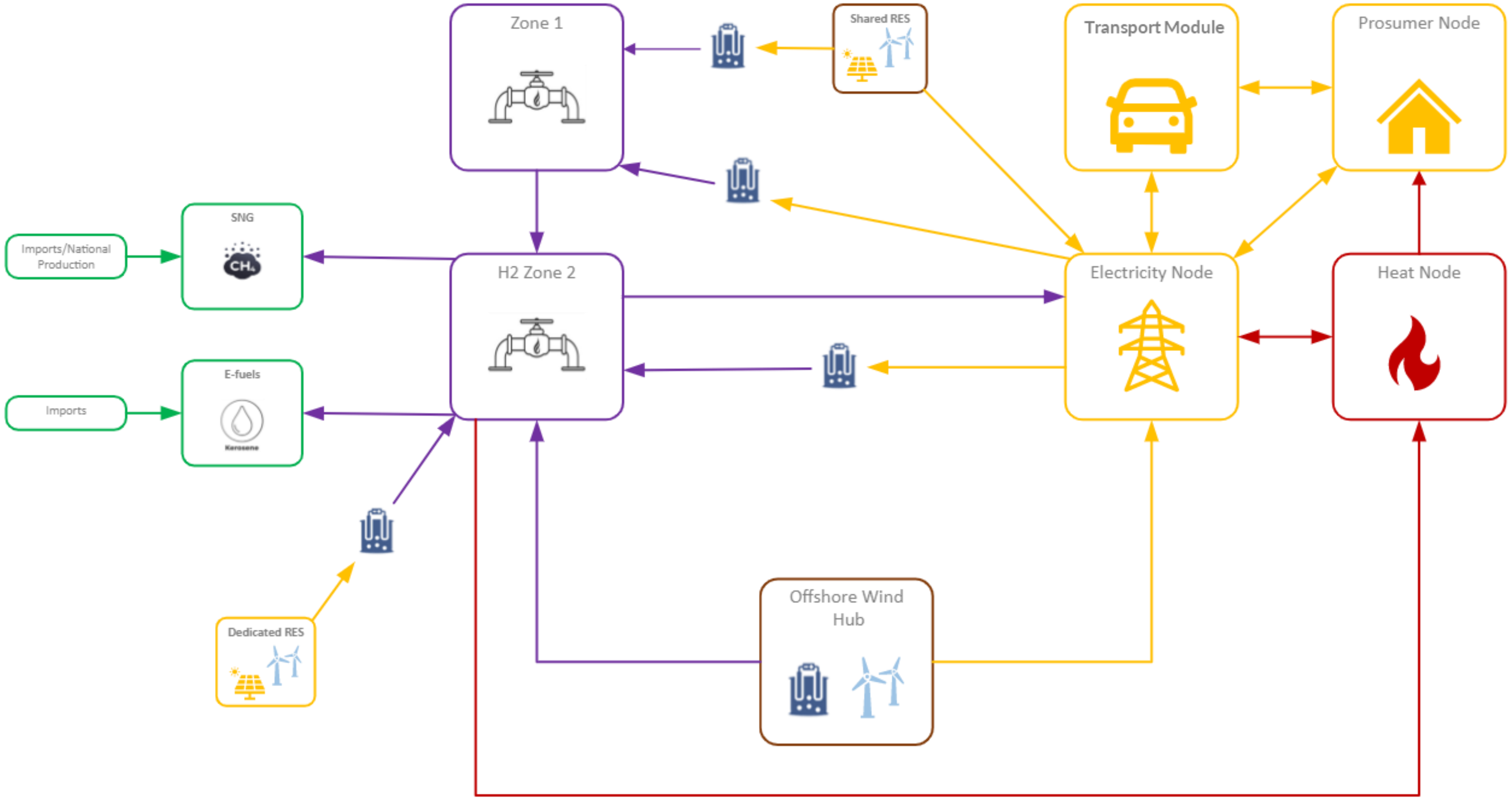
The "High Infrastructure Level" includes additional cross border capacities submitted by TSOs.

Hydrogen pipelines expansion candidates derived from difference in pipeline capacities of the Low and High infrastructure levels for each target year.

Costs based on external studies, mainly the EHB. CAPEX is split between repurposed (75%) and new (25%) pipelines.

Distance considered, is 15% of the distance from capital to capital (ref EWI study on the cost of H2 imports to the EU)

TYNDP 2024 Deviation Scenarios Topology

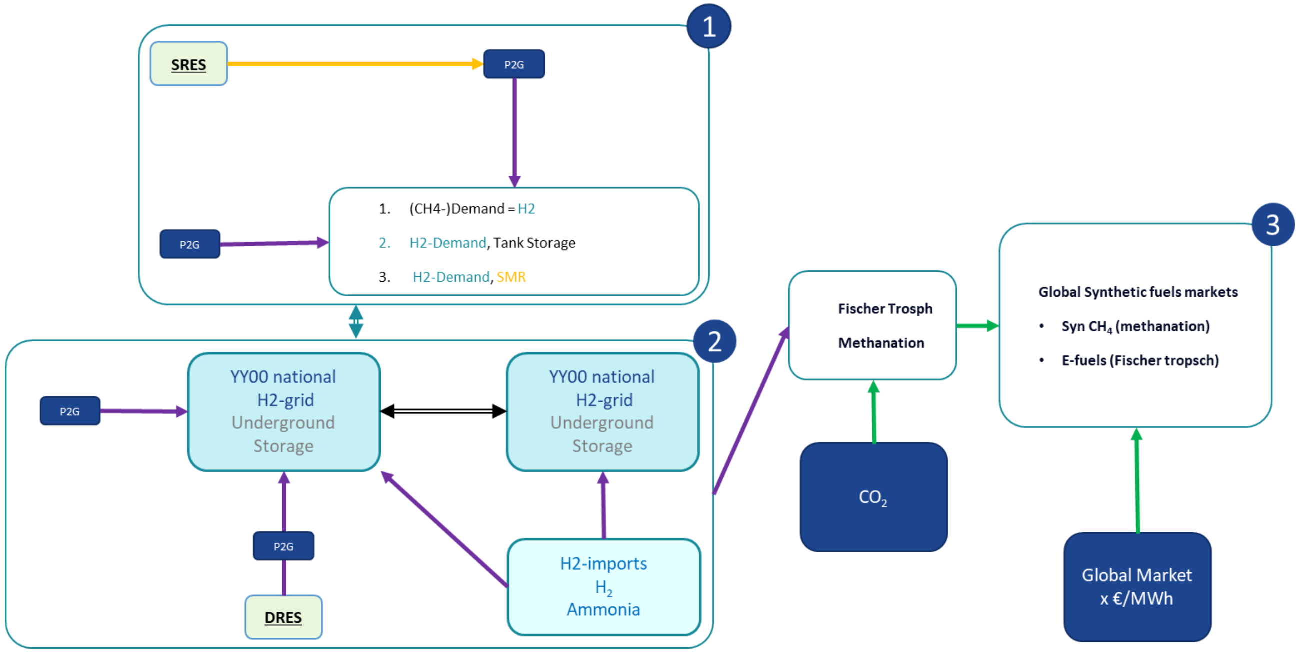


Hydrogen Configurations

TYNDP 2022 Scenarios considered 4 different configurations for P2G and H2 grid. However, TYNDP 2024 Scenarios aggregate them into 2 zones:

- **Zone 1** includes:
  - Direct H2 demand
  - Steel Tank H2 Storages
  - Steam Methane Reformers
  - Shared RES

- **Zone 2** follows the same approach as Configuration 4 in 2022 Scenarios:
  - Salt Cavern Storages
  - H2 grid
  - Imports (H2 and ammonia)
  - Dedicated RES



Synthetic Fuels are also explicitly modelled as a new development.

Demand Split

H2 node	Sector	2025	2030	2040	2050
Zone 1	Feedstock	75	60	30	10
	Industry – Energetic	50	50	30	15
	Transport	75	50	25	15
Zone 2	Feedstock	25	40	70	90
	Industry – Energetic	50	50	70	85
	Prosumer Heat	100	100	100	100
	Transport	25	50	75	85

The hydrogen demand split into the 2 Zones.

They will be split by the 4 sectors

- Feedstock
- Process heat
- Prosumer heat
- Transport
- Synthetic fuel connect to zone 2

Hydrogen Steel Tanks – Zone 1

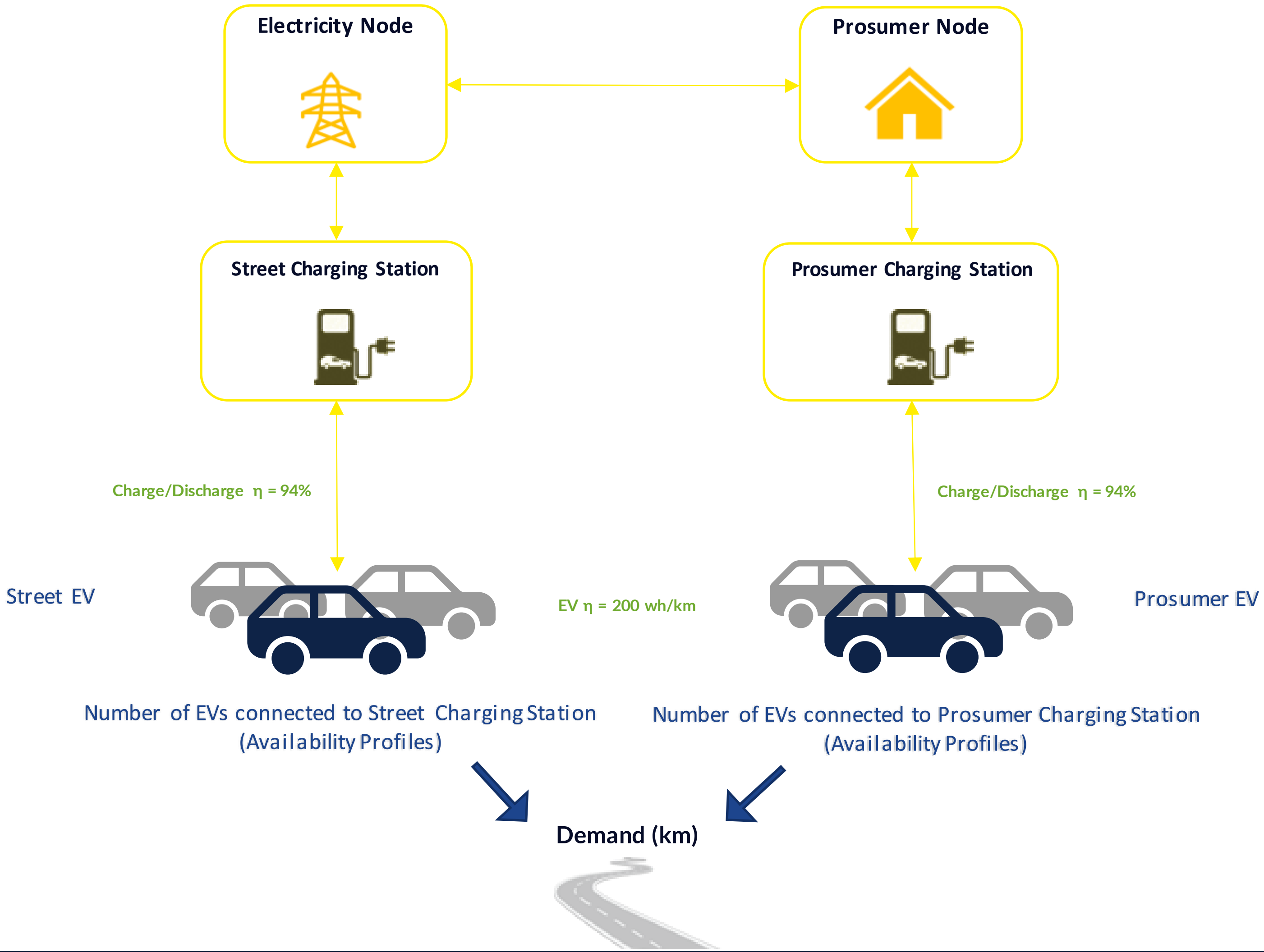
Industrial process buffer (RES intermittency). Capacity calculation follows:

- Share of industrial customers in Zone 1 (30% 2040, 15% 2040)
- 25% of customer assumed to have steel tanks
- Steel tanks will be able to cover 1 days demand

I.e.

- In 2040, 7.5% of industrial demand will have steel tanks associated
- In 2050, 3.25% of industrial demand will have steel tanks associate

Electric Vehicle topology



Electric Vehicle & Charging Station Properties

- Representation of average European EV owner.
- Using publicly available data on battery capacities of EV models, a weighted average is calculated for 2030, based on the EVs sold in Europe in 2022.
- Higher capacities in DE
- Assumes home and street charging stations is an average of what is currently on the market.
- Capacities are limited to 22 kW (fast chargers in power profiles)

Electric Vehicle

Parameter		Value				
Number of EVs	ETM values per country and Target Year					
Capacity (kWh/Vehicle)		2030	2035	2040	2045	2050
	DE	60	72	83	92	100
	GA		66	72	81	90
Efficiency (Wh/km)	200					
Demand (km/Vehicle)	ETM values					
Max Charge/Discharge Rate (kW/Vehicle)	7.2					
Initial SoC (%)	50					
Min SoC (%)	20					
Home Charger Share (%)	Availability profiles (ii) based on platform used by ETM (iii)					
Street Charger Share (%)	Availability profiles (ii) based on platform used by ETM (iii)					

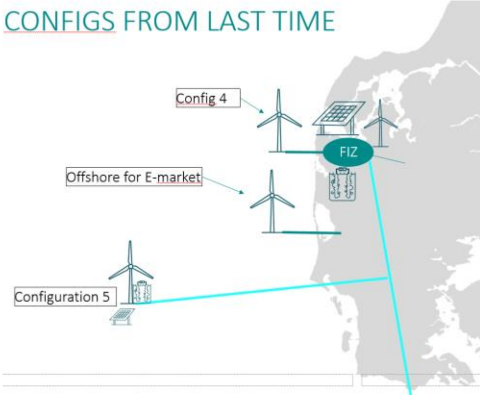
Charging Stations

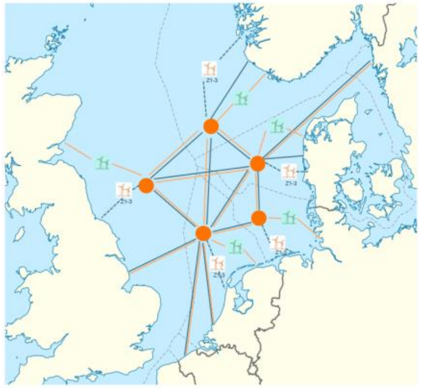
Parameter	Home	Street
Max Charge/Discharge Rate (kW/Vehicle)	5	16
Use of System Charge (€/MWh)	30	35
Charge/Discharge Efficiency (%)	94	94

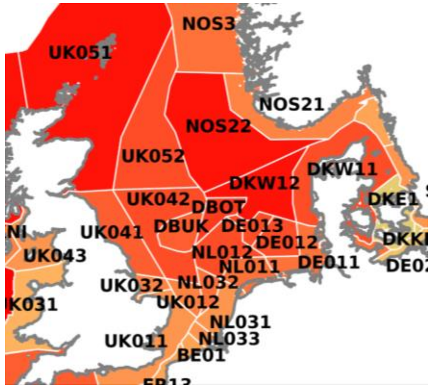
Offshore energy and infrastructure build-out

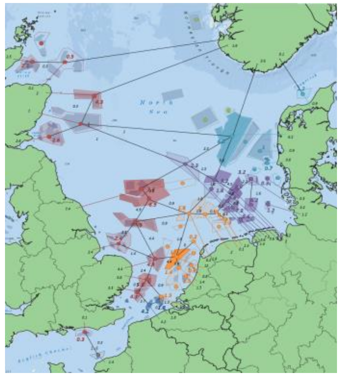
- In the TYNDP22 Scenarios all offshore capacity build out was connected radially to their respective home market
- TYNDP24 Scenarios will **jointly build out offshore capacity and infrastructure**
- Capacity and infrastructure will be built out aggregated in so-called "offshore hubs" as a trade-off between simplicity and accuracy
- Offshore hubs represent aggregated PECD areas within the model

SIMPLICITY







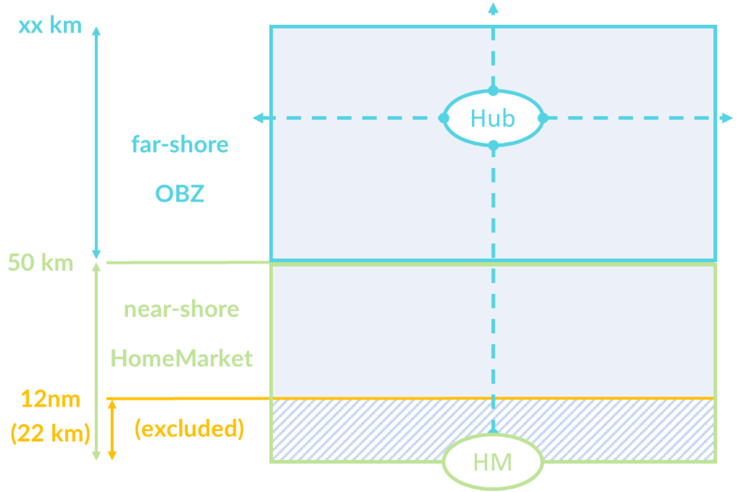


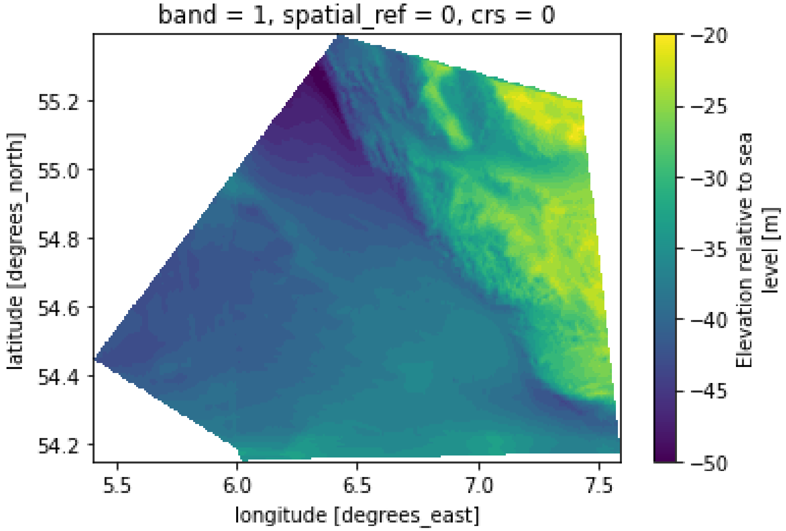
ACCURACY

Offshore Hubs - definition

Distinction between the **near-shore (<50 km)** and the **far-shore zone (>50 km)**

- **Offshore Bidding Zone** – Individual price area for each hub
- **Near shore zone -** Radially connected offshore to **Home Market**
- **Exclusion zone** - 12 nm (shoreline protection and NIMBY)



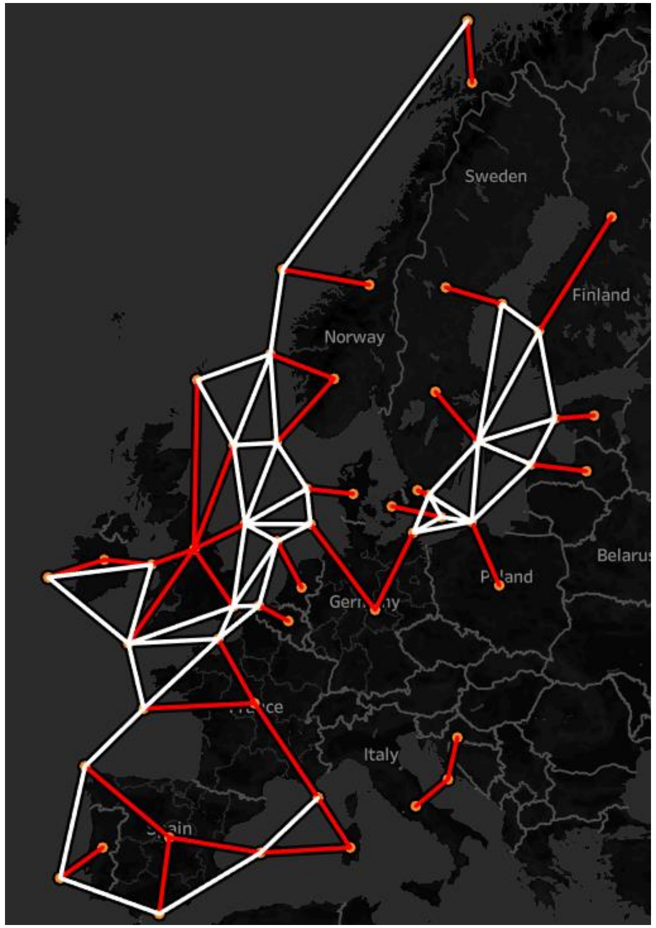


Fixed-bottom and Floating technology diffrentiation: cost difference

- **Differentiating factor: water depth**
  - CostBand 1 (0-200m): Fixed-Bottom & Floating (shallow)
  - CostBand 2 (200-1000m): Floating (deep)

Offshore Hubs - Assumptions

- **Interconnector options** are **neighbour Hub and Home Market**
- **Hub infrastructure** will be **connected** from **mid-point to mid-point + a 30 % cable routing factor** on top
- The length of the infrastructure to shore will be distance to shoreline + 30 km
- Hubs and their home markets can be connected via DC cables and pipelines
- Wind offshore capacity within the hubs can be build either connected to the electricity or H2 grid (via integrated offshore electrolysers). Additionally, platform-based electrolysers to link the electricity and H2 grid can be build out.



Heat Sectors Modelled

ETM provides annual **Flexible Space & Water Heating demand**, which is divided into 2 categories:

- **Prosumer Heating**: To be supplied by Hybrid Heat Pumps (explicitly modelled in PLEXOS for the first time in TYNDP 2024 Scenarios). The electricity/gas that HHP require are a result of the optimization of the model.

Climate and country dependant COP curves are calculated following ETM's formula:

$$COP_T = base\ COP + COP\ per\ degree * T$$

where

T is ambient temperature

base COP = 2.32333

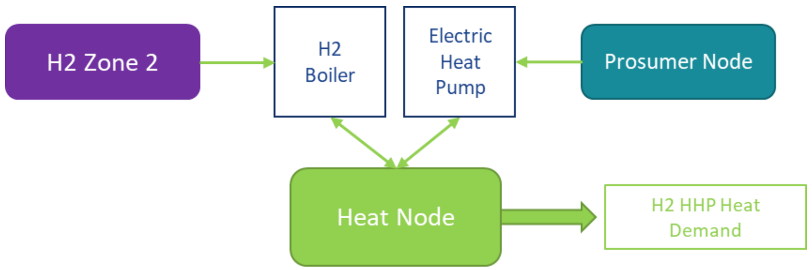
COP per degree = 0.05783

Hybrid Heat Pumps Modelling

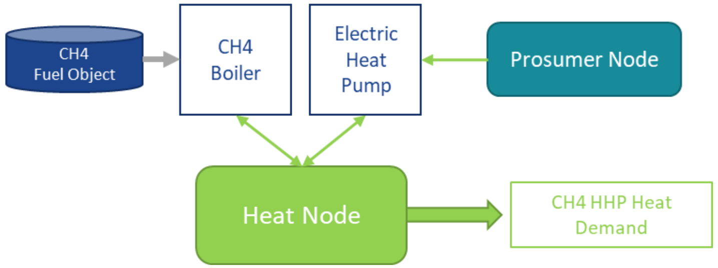
Hybrid Heat Pumps (HHP) combine an electric heat pump with a gas (H2 or CH4) boiler.

HHP capacities equal to the peak heat demand in the node they are connected to.

- H2 HHP:
  - The electric heat pump is connected to the Prosumer Node
  - The H2 boiler is connected to H2 Zone 2 Node
    - Heat Rate = 0.93 GJ/GJ



- CH4 HHP:
  - The electric heat pump is connected to the Prosumer Node
  - The CH4 boiler is fuelled with CH4 (non-modelled market)
    - Heat Rate = 0.93 GJ/GJ



7. Carbon Budget Methodology

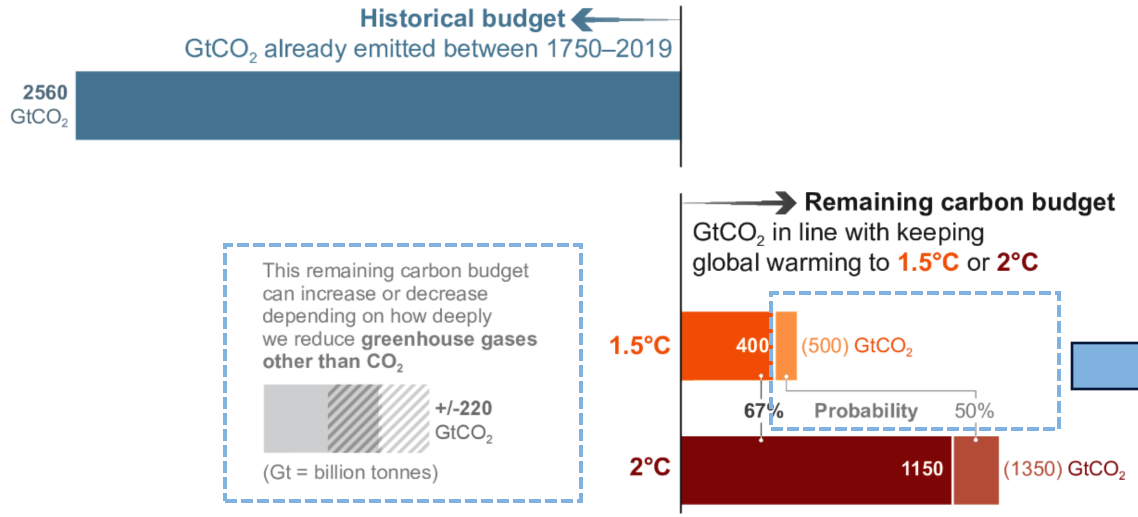
Alexander Kättlitz, Scenario Subject Manager, ENTSOG
5 minutes

Carbon Budget Methodology

From IPCC Sixth Assessment Report to TYNDP 2024 scenarios

FAQ 5.4: **What are Carbon Budgets?**

The term carbon budget is used in several ways. Most often the term refers to the total net amount of carbon dioxide (CO_2) that can still be emitted by human activities while limiting global warming to a specified level.



Following ESABCC report: 500 Gt CO2 global budget based on limiting global warming to 1,5 degrees with 50% probably (from 2020)

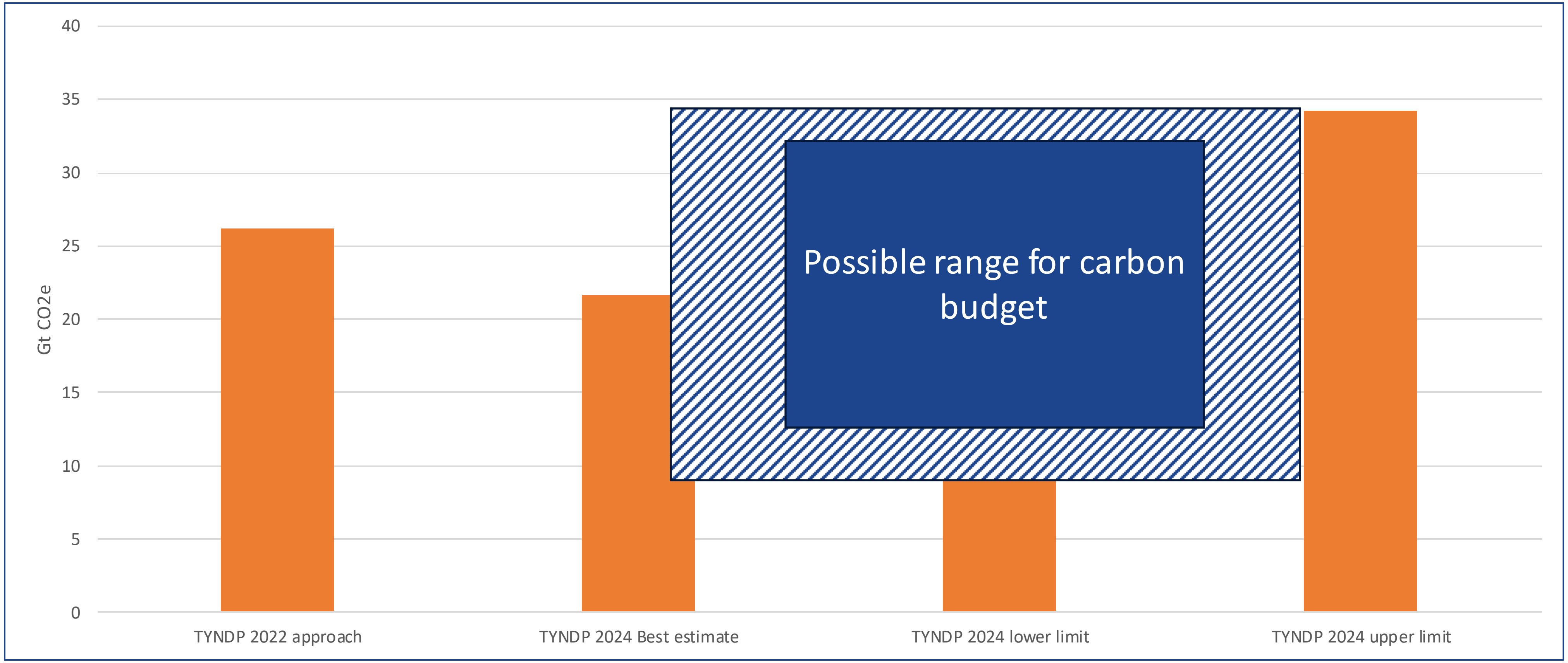
Uncertainty regarding non-CO2 greenhouse gases could define lower/upper limit

Several steps necessary to translate the IPCC Carbon Budget for the use of TYNDP 2024 scenarios

- Regional scope: Allocation of global CO2 budget to EU27 via population share (equity share currently not feasible for ENTSOs)
- Time-horizon: Historic emission in 2020 and 2021 needs to be accounted for

European share of global CO2 budget via population distribution key

Carbon budget 2022-2100 (in GtCO2)



Q&A

Participants can join at **slido.com** with **#3541875**
5 minutes

8. Next Steps & Closing Remarks

Thilo von der Grün, Steering Group Convenor from ENTSOG
5 minutes

Next steps

- Today: Physical stakeholder roundtables on demand, supply, methodology, carbon budget
- 8 August: Deadline for submissions to the public consultation's online survey
- August: Establishment of the Stakeholder Reference Group (ETAG)
- End-year: Second public consultation with focus on electricity and hydrogen modelling results

LUNCH ☺	12:00 – 13:00
INTRODUCTION FOR ROUNDTABLES	13:00 – 13:15
ROUNDTABLE 1st Sessions (Demand & Methodology)	13:15 – 15:10
Coffee Break ☺	15:10 – 15:25
ROUNDTABLE 2nd Sessions (Supply, Carbon Budget)	15:25 – 17:20

Thank you for your attention

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Location: online

Date: 13.07.2023