



Picture courtesy of Gas Connect Austria

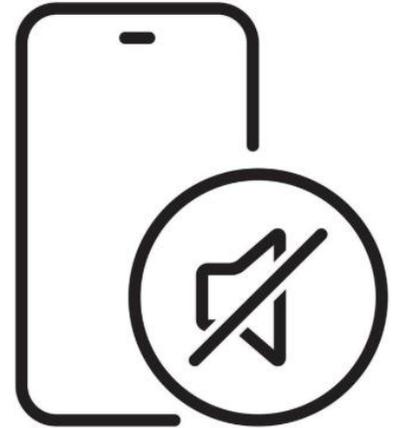
# Workshop Mid-Term Analysis

11/03/2026

# Housekeeping information for Workshop

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- ✓ **Event Wi-Fi network/password:**
  - Network: ENTSOG-Guest
  - Password: 123guest456
  
- ✓ **We welcome questions: Please raise your hand in the room and /or on SLIDO!**
  - **SLIDO code: ENTSOG11MARCH**
  
- ✓ **Workshop Teams session will be recorded, and uploaded to ENTSOG website**
  
- ✓ **Slides will be available on ENTSOG website after the workshop**
  
- ✓ **Photos will be taken during the workshop proceedings for social media**
  
- ✓ **Thank you for keeping your phone on silent**
  
- ✓ **Networking session after the workshop!**



# Introduction

- Established under EC 715/2009 to:
  - Develop network codes for market and system operation
  - Create Ten-Year Network Development Plan (TYNDP) for gas
  - Provide information on gas security of supply
  - Ensure operational network security and reliability
  - Prepares for gas grids transition to hydrogen, biomethane and CCUS system

# A selection of our activities

TYNDP

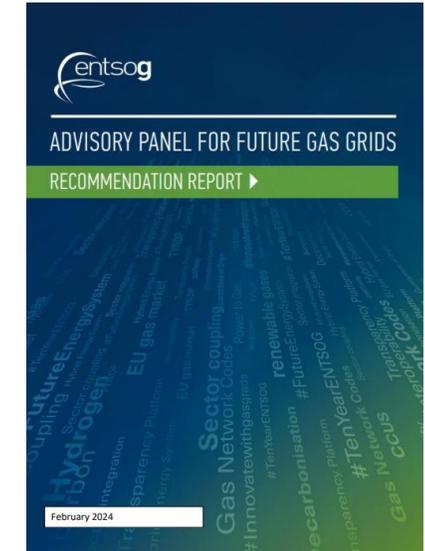
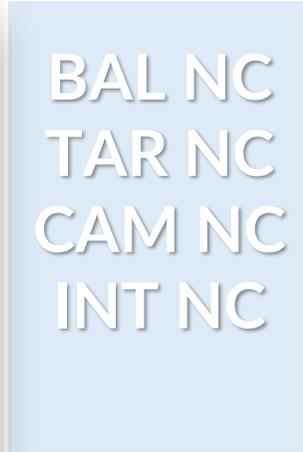
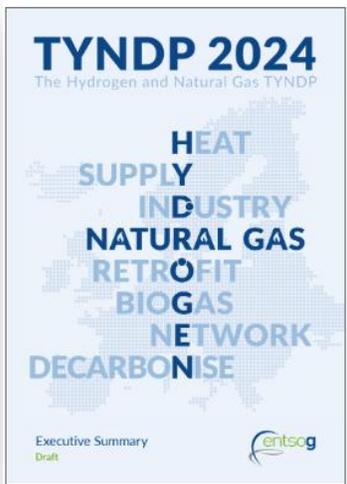
Outlooks

Network Codes

Implementation

Transparency

Future Energy System



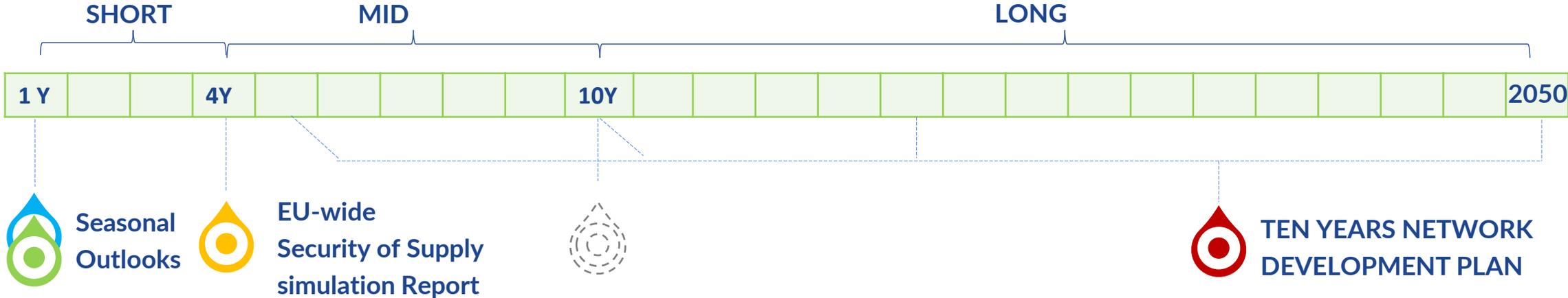
Assessing the functionality and operation of European gas markets

Development of TYNDP and Scenarios

Delivering operational tools to ensure network security and reliability

Decarbonising gas grids

# Current short, mid- and long-term analysis grasping SOS dimension



- Forecasted demand (+cold)
- Existing infrastructure
- Actual storage levels



- Cold winter demand
- Existing infra + timestamp
- Historically low storage levels



- TYNDP scenarios
- Existing infrastructure + projects
- Fully target compliant

Space for the mid term analysis

# Proposal of new analysis under reviewed SOS Regulation

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Mid-term analysis looking at next 10 years

Possibility to address other factors and situation that could be useful in the context of gas storage needs, reserves, demand aggregation

Tailor made simulation cases reflecting increasing share of RES in power generation and role of gas in providing flexibility



Providing **complementary information to the electricity adequacy assessment**

Allowing to more explicitly investigate adequacy between supply, demand in the context of gas grid and actual stage of energy transition

Gradual repurposing and current state of grid evolution could be represented

# Scenario

Regulation (EU) 2022/869 requires that ENTSOE and ENTSOG jointly develop scenarios for the future European energy system in the context of their respective Ten-Year Network Development Plans (TYNDPs)

- The scenarios are intended to project the **long-term** energy demand and supply for the drafting of ENTSOG's and ENTSOG's Ten-Year Network Development Plans within the context of the ongoing energy transition.
- They are designed in such a way that they specifically explore those **uncertainties** which are relevant for **future long term** infrastructure development.
- They primarily focus on aspects which determine the infrastructure utilization
- The scenarios draw extensively on the current European political and economic consensus and attempt to follow a logical **trajectory to achieve future** energy and climate targets.

# Scenario Framework

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## Expectation placed on TYNDP Scenario process and output:

- Application of the ACER framework guidelines;
- Follow-up of the SRG recommendations;
- Reflection of the opinions including European Scientific Advisory Board on Climate Change (if provided);
- Scenarios fit for purpose:
  - NT+ to become a full-fledged central scenario;
  - Coherent variants – understandable rationale behind the parameters used in economic variants;
  - Flexibility and sensitivities to reflect the uncertainties and dynamic environment;
  - Robust analysis of 2035 and 2040 time-horizon;
  - Scenarios that could and are used in the subsequent deliverables of the TYNDP and beyond
    - clear definition of the indicators and indication of data sources;
    - proper explanation of the methodology;
    - aggregates at country level.

- Policy driven and policy compliant scenario
- Set of criteria for policy compliant scenario
- Focus on electricity and hydrogen
- Methane and other energy carriers as a “side effect”

## TYNDP 2024 Scenarios Package

### TYNDP 2024 Scenarios Report

Main report of the scenarios package, explaining the purpose, context and key findings as well as stakeholders' engagement steps taken. The report also includes a description of the main results and a benchmark against other scenarios.

### Annex to the Final TYNDP 2024 Scenarios Report

Annotations to the final version of the TYNDP 2024 Scenario Report.

### TYNDP 2024 Scenarios Methodology Report

Describes the methodology applied to build the 2024 scenarios. It includes a description of the overall process, detailed explanations of modelling principles and an overview of modelling parameters.

### TYNDP 2024 Scenarios Report Data Figures

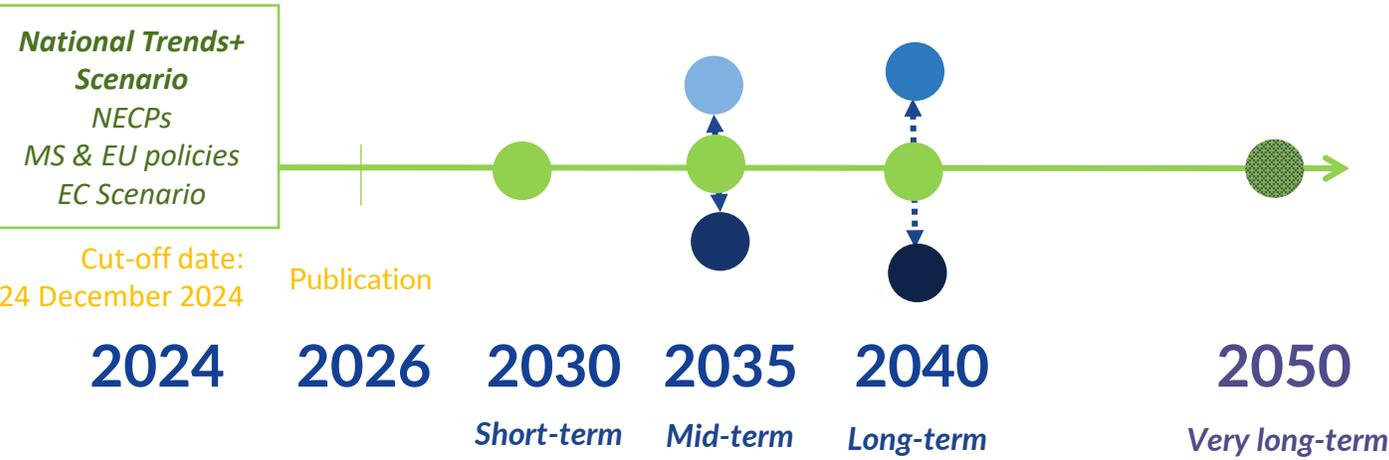
Calculation of the figures in the Scenarios Report.

### TYNDP 2024 Scenarios Storyline Report

Describes the storylines and how they were developed.



# TYNDP 2026 Scenario Framework



## Higher economic growth

- ✓ Higher GDP (higher than NECPs)
- ✓ Higher sectorial activity
- ✓ More purchasing appetite / more willingness to spend
- ✓ More focus on innovation & risky investments
- ✓ More focus on sustainability, long-term view for investment/purchasing decision

**Central scenario (National Trends+) reflecting latest updated NECPs, national and EU policies**

## Lower economic growth

- ✓ Lower GDP (lower than NECPs, close to 0 growth)
- ✓ Moderate/less sectorial activity
- ✓ Moderate/Less purchasing / spending possibilities
- ✓ Less focus on innovation & more business as usual
- ✓ More focus on cost and affordability, short-term view for investment/purchasing decision

### Economy variants scenarios

- ✓ Not a stand-alone product → stress test of central scenario
- ✓ Deviates from the NT+ scenario in a balanced way

# Scenario Input and Output (TYNDP 2026 cycle)



## Input

- TSO's data reflecting NEPCs and national and EU policies
- hydrogen and electricity demand provided via ETM dashboard tool – sectorial and energy carrier breakdown or as a fall-back solution average of the DE and GA scenario from 2024 cycle
- Hydrogen and electricity production capacities including hydrogen import capacities – pipeline, ammonia
- Supply side assumptions – commodity prices, import prices for synthetic fuels, technology costs

## Output

- Scenario NT+ (NECP based)
- Economic variants - limited stress test of the NT + scenario for 2035, 2040

**Does the TYNDP 2026 Scenario provides sufficient input into the mid-term analysis?**

**Which aspects do you propose to elaborate more to capture interrelationships / influences between methane and electricity ?**

# Targets checking strategy for TYNDP 2026 scenarios



- TEN-E requires all scenarios to be aligned with:
  - the energy efficiency first principle
  - with the Union's 2030 targets for energy and climate objective and
  - its 2050 climate neutrality objective
  - And shall e.g., be the latest available Commission scenarios, as well as, when relevant, the NECPs
- According to the ACER guideline, Scenario Report should justify how scenarios are aligned with targets.
- Upon ACER and Scientific Board opinions, the EC will confirm scenarios or request for amend.
- There are no specific targets for 2035 and 2040. For 2050 only a climate neutrality target check. Therefore, targets justification has to be performed only on NT+2030 and NT+ e.g., horizon (climate neutrality)
- Condition for 2035 and 2040 scenario: no overshoot of 2030 targets (e.g., regarding energy efficiency principle)

**In case of significant gaps between the 2030 targets and reality, do you see added value to work with the behind-the-2030-targets reality?**

# TYNDP 2026 Scenario Report structure



Executive summary

Content of the scenario package

Purpose of the TYNDP scenario

TYNDP 2026 Scenario framework

ACER Framework Guideline Compliance

How Stakeholder Engagement Shaped the Scenarios

Improvements of the TYNDP 2026 Scenarios

TYNDP 2026 Scenario Results

Demand – Final Energy Demand, Demand per Sector ( Built environment, Industry, Mobility, Agriculture), Demand per carrier (Electricity, Methane, Hydrogen, Biomass, Heat)

Supply and flexibility (electricity generation, methane supply, hydrogen supply, biomass supply, energy imports)

Compliance with 2030 European energy and climate targets and carbon neutrality in 2050

GHG emissions, carbon budget assessment, carbon footprint of energy

TSO Survey

Benchmark

Annex – TSO survey outcomes, SRG Opinion on TYNDP 2026 Scenario

## Conclusions

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### *TYNDP Scenario represents*

Potential outcomes derived from a specific set of assumptions, including compliance with legal requirements focused primarily on Hydrogen & Electricity

### *What a TYNDP scenario does not represent*

A prediction or forecast of future events

**A new Mid-Term analysis focused on Molecule sector (methane) is essential to ensure different approaches are fit for purpose for the gas infrastructure and its future development.**

# Infrastructure and grid

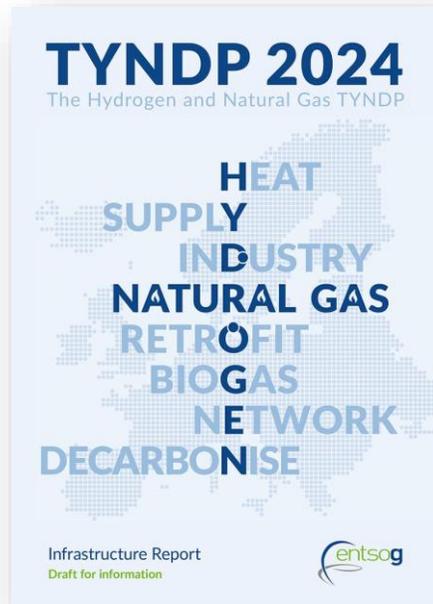
# What is the TYNDP in practice?

The TYNDP is composed of:

- **3 main reports:**



(1). Scenarios



(2). Infrastructure



(3). System-level assessments  
H2 and CH4

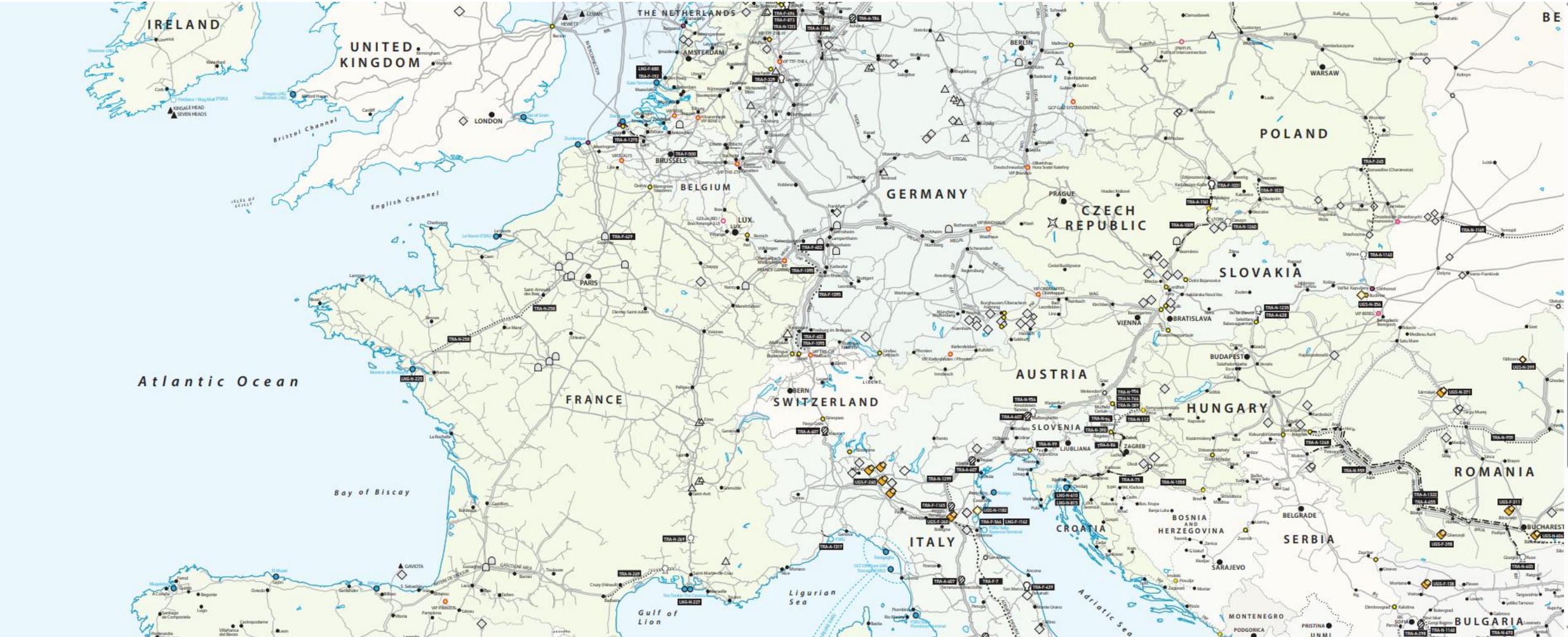
- **5 annexes:**

- Annex A – Project details
- Annex B – Infrastructure Maps
- Annex C – Topology & Capacities
- Annex D – Methodologies
- Annex E – Analysis tables

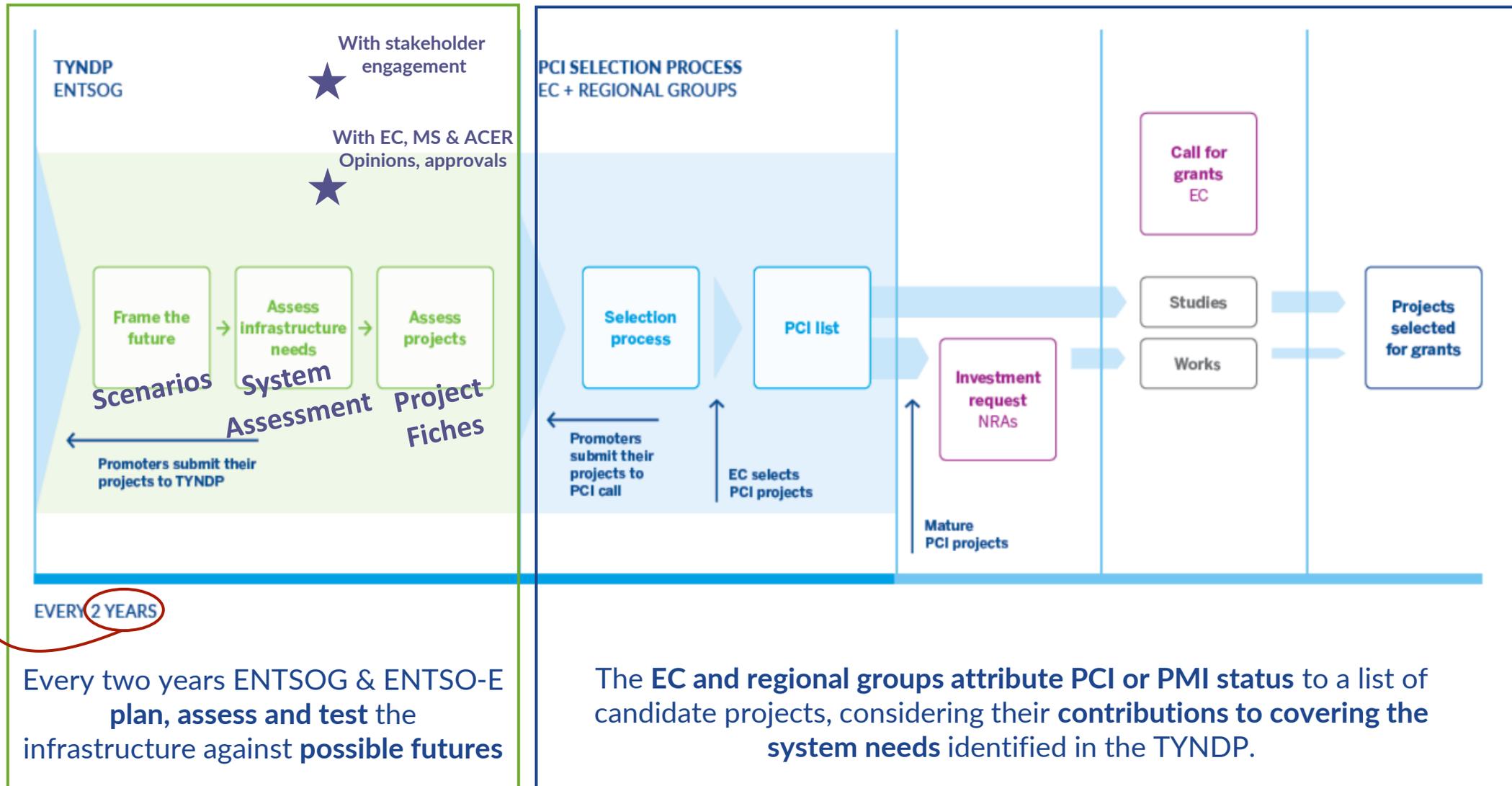
- **Project fiches** (project assessment)

- **A visualisation platform**

# Maps



# The TYNDP process in the wider TEN-E framework

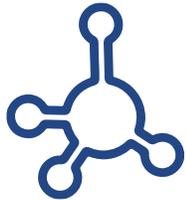


Note: Scenarios cycles and remaining TYNDP cycles both last about 2 years and overlap each other by 1 year.

# Project Collection

Head categories

## Natural gas      Hydrogen      Renewable gases (SGG)      Other



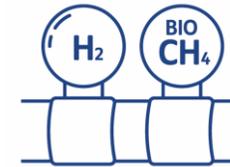
### 3 sub-categories

- TRA NG Transmission
- LNG LNG terminals
- UGS NG Storage



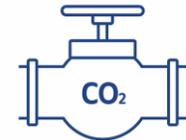
### 5 sub-categories

- H2T H2 Transmission    H2M H2 Mobility in TS
- H2S H2 Storage            H2E H2 Electrolyser
- H2L H2 Reception terminals



### 3 sub-categories

- RET Retrofitting
- BIO Biomethane
- SYN Synthetic methane



### 2 sub-categories

- CO2 CO2 transport
- OTH Other

- Additional technical capacity/ Expected decrease per IP and year (GWh/d)
- Date of commissioning/decommissioning, project schedule
- Technical information of the infrastructure : length (km), maximal operating pressure (bar), working gas volume (Gwh), compressor power (MW)

*Is there available report containing this specific data for CO2 and Biomethane projects?*

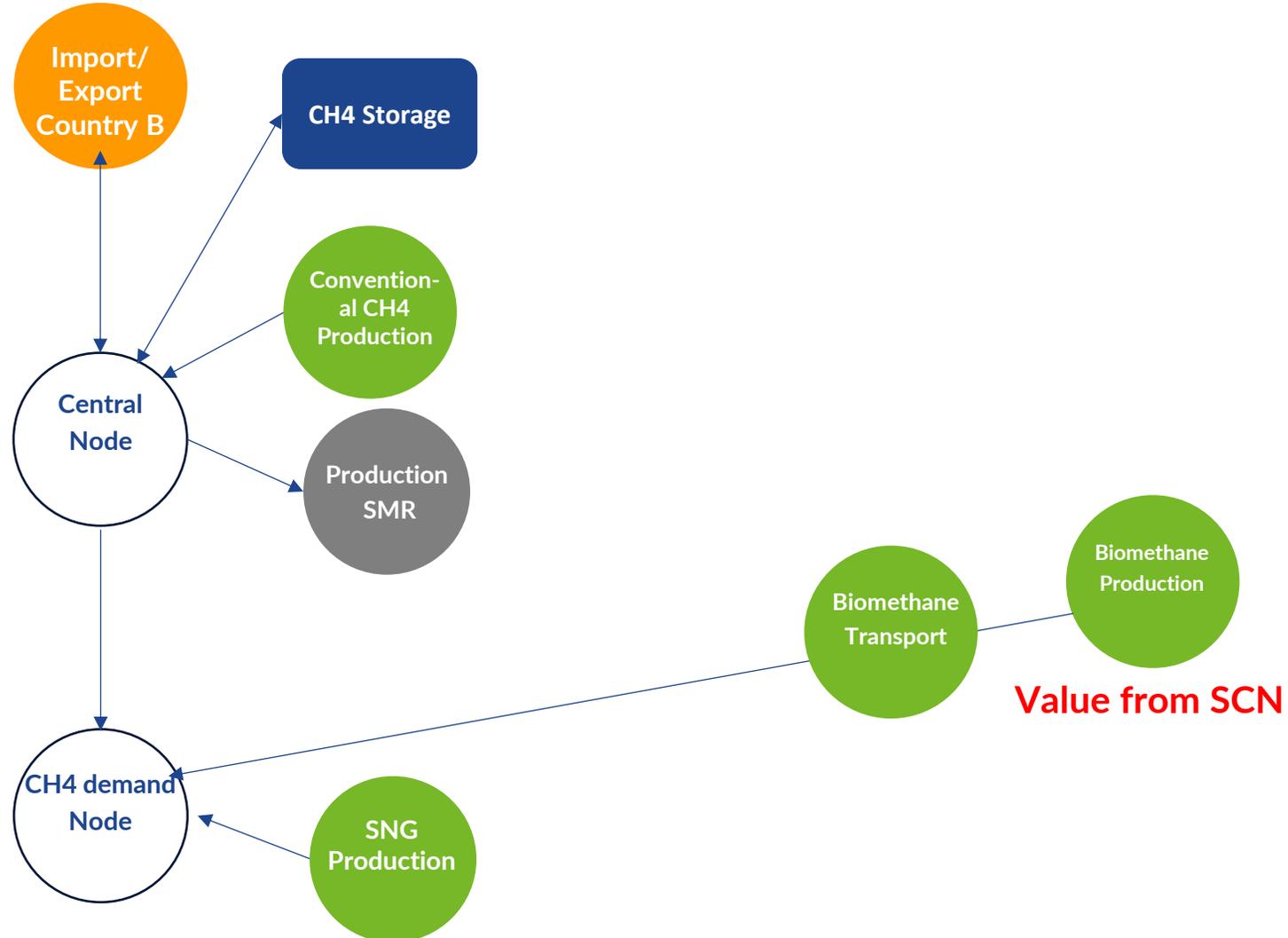
# CH<sub>4</sub> Data source

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- ❑ **Interconnection + import route capacities (Yearly + Peak)**
  - TSO data collection for existing capacities and seasonal modifications
  - Increments and decrement (ex: repurposed capacities) from TYNDP project data collection
- ❑ **LNG information (Yearly + Peak)**
  - TSO Send-out capacity: TSO data collection + increments from project data collection
  - LSO Send-out capacity: GLE map / ALSI + increments from project data collection
  - LSO Tank capacity: GLE map + tank increments from project data collection
  - LSO Tank capacity percentage available
- ❑ **Storage information (Yearly + Peak)**
  - TSO injection/withdrawal capacity: TSO data collection + increments from project data collection
  - SSO injection/withdrawal capacity : GSE map / AGSI + increments (including repurposing) from project data collection
  - SSO Working Gas Volume: AGSI + WGV increments (including repurposing) from project data collection
  - SSO injection/withdrawal curves: GSE
- ❑ **Demand production, supply, emissions:** scenario data, with monthly profiles for demand and production

# CH4 Topology

Simple example CH4 country A topology



# Modelling

# ENTSOOG simulation horizons (today)

## Where does mid-term system adequacy fit?

- Seasonal Outlooks (months): deterministic infrastructure feasibility under defined supply/demand assumptions
- Security of Supply (1–3 years): resilience of the European gas system under severe supply disruption scenarios
- TYNDP (10–20 years): scenario-based infrastructure planning and project assessment
- All focus on the **most relevant and impactful scenarios** rather than on probabilistic concerns
- **Would a mid-term adequacy perspective be useful from a gas system perspective?**



# ENTSOG Seasonal Outlook: deterministic adequacy assessment

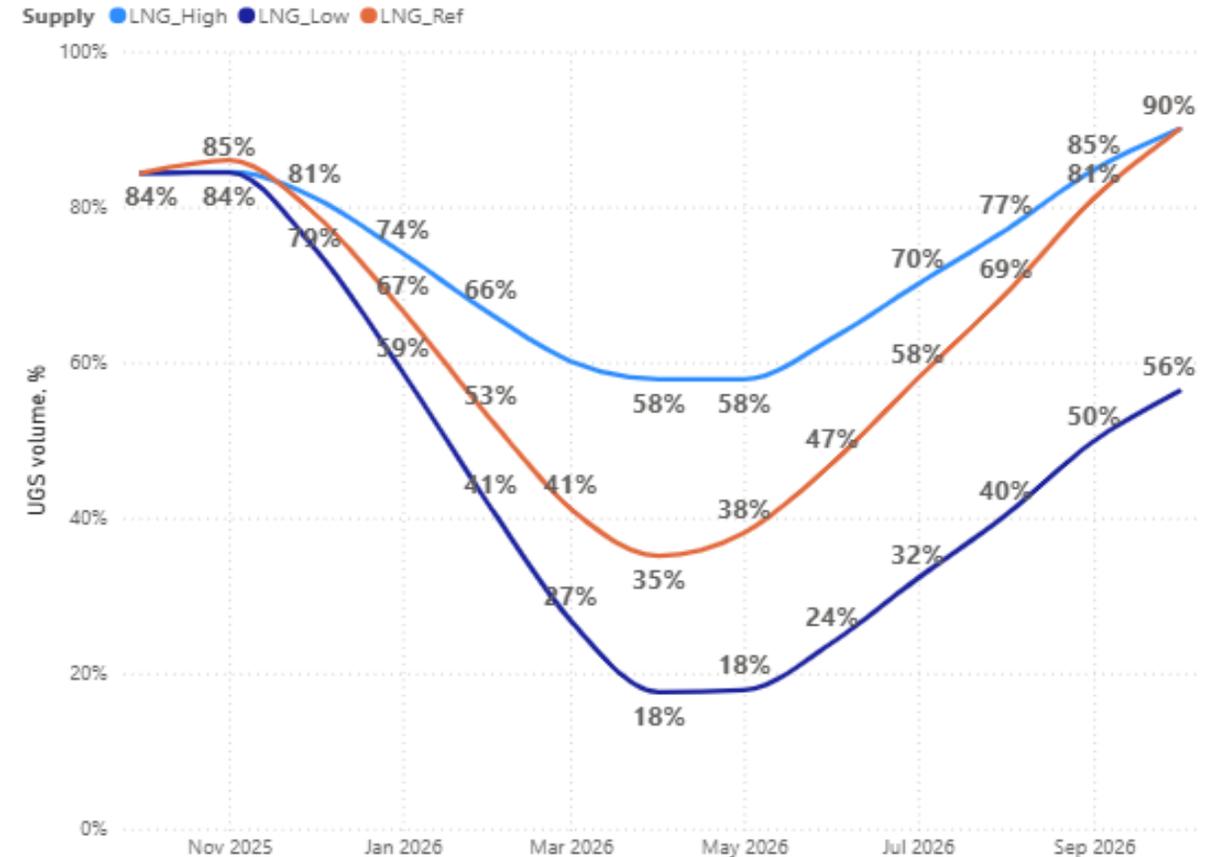


Seasonal Outlook simulations test whether the European gas system can meet demand during the coming season

Key characteristics:

- **Infrastructure feasibility** analysis across the **whole** European network
- **Deterministic scenarios** based on defined supply and demand assumptions
- Explicit representation of **pipeline imports, LNG supply, and storage**
- Focus on **storage trajectories** and **supply balance** during the season
- Short-term operational horizon (**months**)

Example: storage trajectory under different supply scenarios



# ENTSOG SoS simulations: system resilience under disruption

Security of Supply simulations assess the resilience of the European gas system under severe supply disruption scenarios

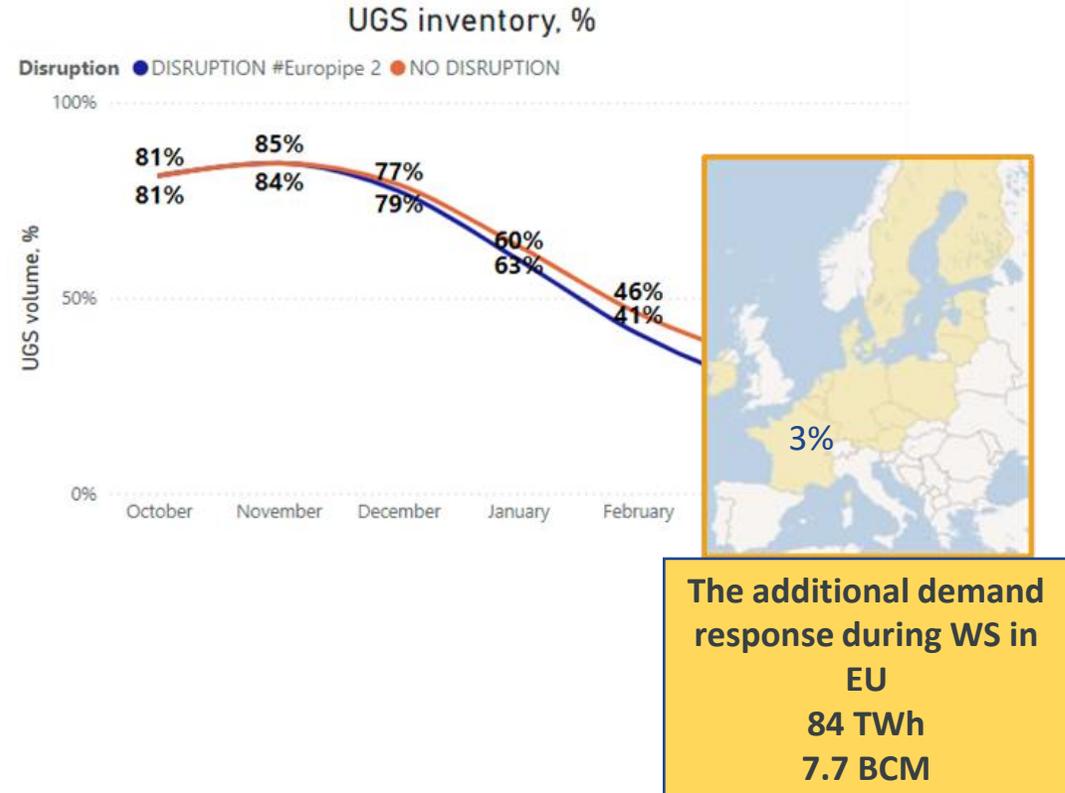
Key characteristics:

- Performed under the **EU Security of Supply Regulation (EU) 2017/1938**
- **Union-wide** disruption scenarios (e.g. major supply route interruptions or main infra disruptions)
- **Extreme demand** conditions such as cold winter situations
- Network flow simulations across the European gas infrastructure
- Assessment of cross-border **cooperation**
- Identification of regional **vulnerabilities** and **infrastructure constraints**

Example: supply disruption scenario

Disruption of Europe2 for 6 Months

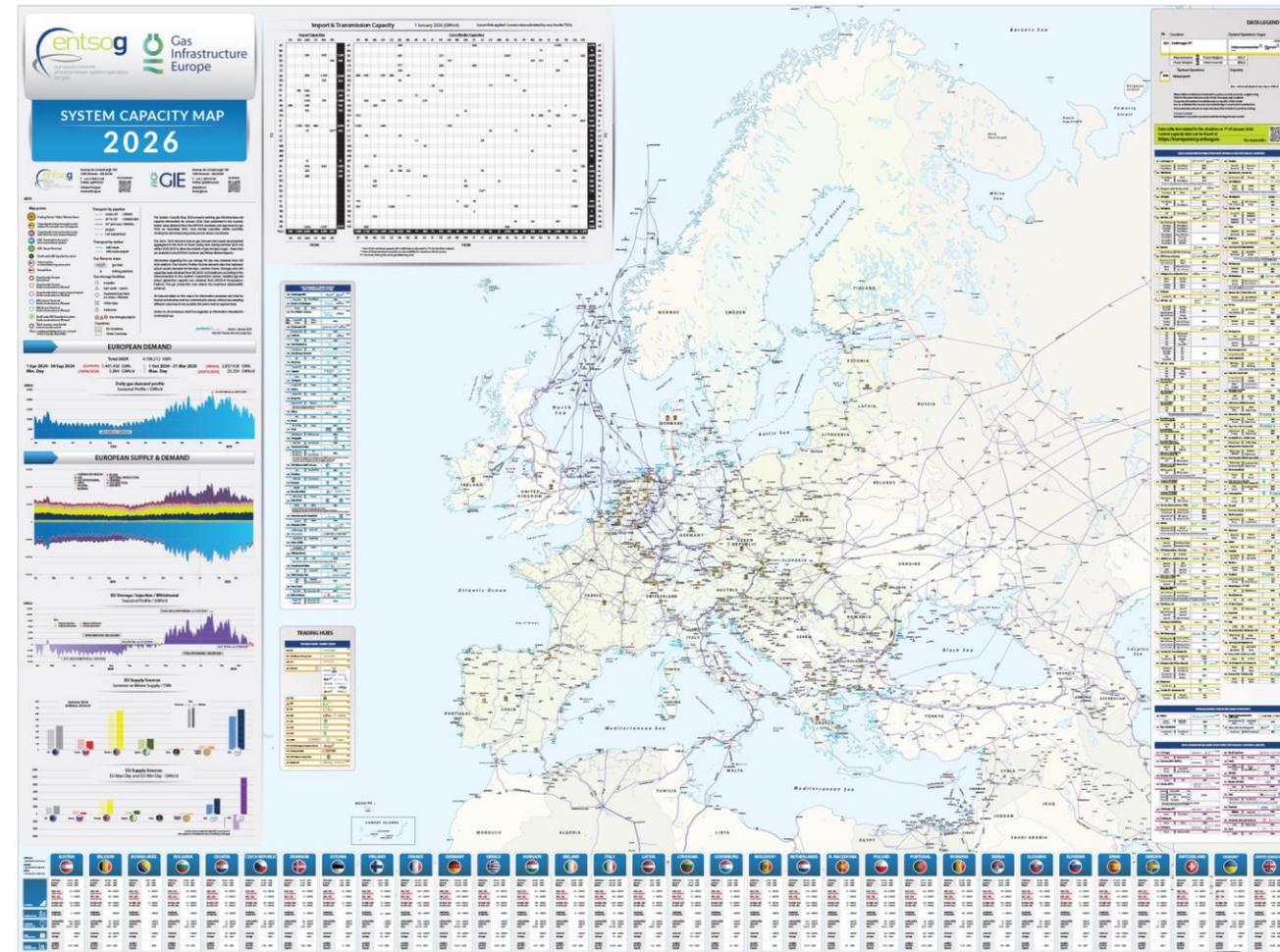
Simulation  WS Initial storage volume  82% Demand Scenario  COLD MONTHLY -10%



# ENTSOE TYNDP simulations: long-term infrastructure planning

## Key characteristics:

- Scenario-based modelling of future energy system developments
- Network flow simulations across the European gas infrastructure
- Evaluation of infrastructure projects and system bottlenecks
- Identification of infrastructure needs under different supply and demand scenarios



# A potential mid-term adequacy perspective

- ENTSOG modelling focuses on short-term operational outlooks and long-term infrastructure planning
- This raises the question of whether system adequacy could also be analyzed at an intermediate time horizon



- In the electricity sector, this horizon is addressed through the European Resource Adequacy Assessment (ERAA)
- Are there elements of the ERAA modelling framework that could be useful for gas system analysis?

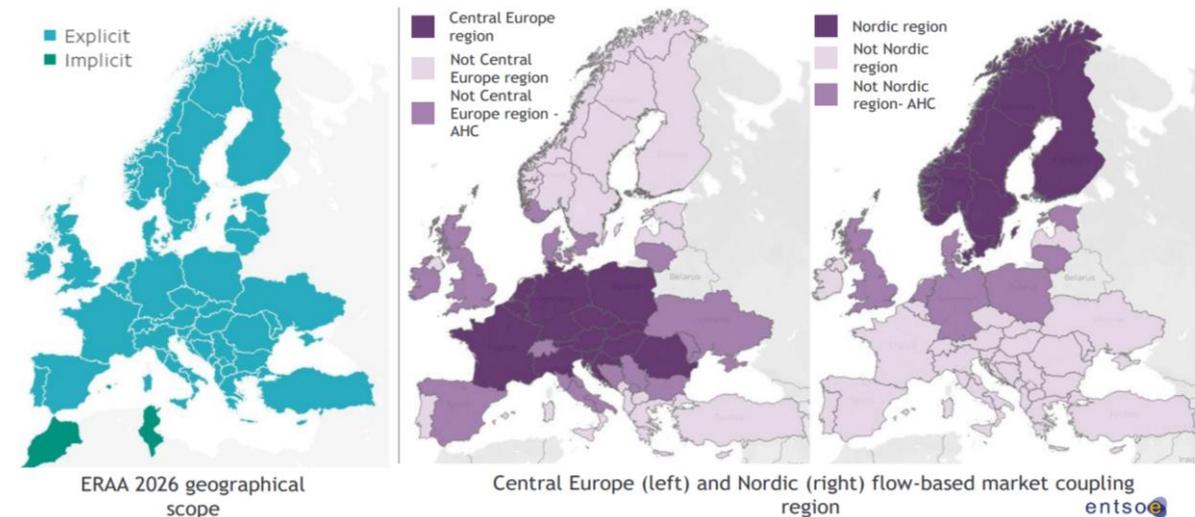
# European Resource Adequacy Assessment (ERAA)

ERAA assesses mid-term adequacy risks of the European electricity system

Key characteristics:

- Pan-European system modelling of the interconnected power system
- Assessment horizon of up to 10 years
- Adequacy evaluated primarily at **bidding-zone/national level**
- Outputs include **LOLE and EENS adequacy indicators** compared with national reliability standards
- **Focus differs from ENTSOG assessments**, which evaluate security of supply at **Union-wide system level**
- **Gas-fired generation remains an important flexibility resource in adequacy assessments**

The interconnected European power system modelled in ERAA 2026

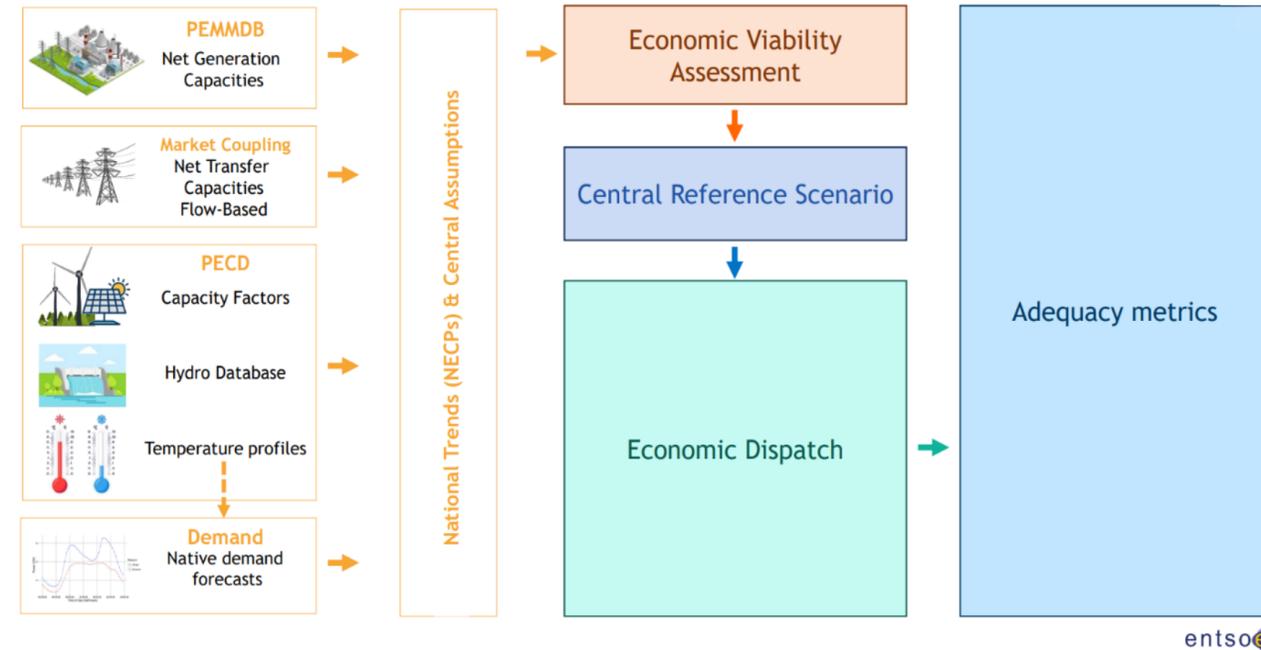


# ERAA modelling framework

## Key characteristics:

- Pan-European **Market Modelling Database** combining demand, generation and network constraints
- Pan-European **Climate database** with hourly weather-based time series for wind, solar, run-of-river hydro and temperature-driven demand
- **Monte Carlo** generation of (thousands) of system states, sampling weather years, generator outages and demand variations.
- Market-based simulations representing system operation
- Economic Viability Assessment (EVA) linking adequacy and investment signals
- Adequacy indicators derived from simulation results

## The framework of ERAA 2026



# ERAA vs ENTSOG modelling approaches



Aspect	⚡ ERAA (electricity)	🔥 ENTSOG simulations	🔥 Mid-Term
Simulation Tool	PLEXOS	PLEXOS	PLEXOS
Scope	Primarily bidding-zone/national level	EU-wide	EU-wide? Risk Group level?
System Characteristics	Limited storage, high short-term variability, generation	Large seasonal storage and infrastructure flexibility, imports	Seasonal storage + infra flexibility (+ ?)
Objective	Resource adequacy assessment	Infrastructure feasibility	?
Modelling approach	Probabilistic / stochastic	Deterministic scenarios	Deterministic scenarios (?) TYNDP Stressful Case Scenarios?
Simulation focus	Hourly Market dispatch	Monthly/Daily Gas flows	Monthly/Daily Gas flows?
Time horizon	Mid-term (up to ~10 years)	Seasonal Adequacy / long-term planning	5-10Y?
Key outputs	LOLE / EENS	Storage levels / curtailments / flows	?

**Discussion points – Inputs welcome!**

# Cooperation with ENTSO-E on Adequacy and Fuel Supply Risks



## 1. Gas-fired generation in ERAA adequacy analysis

- ERAA highlights the continued role of flexible thermal generation (gas/hydrogen-ready) in maintaining adequacy.
- Exchange of assumptions on generation fleet evolution and gas demand for power generation.

## 2. Electricity crisis scenarios involving fuel shortages

- Cooperation supporting ENTSO-E work on regional electricity crisis scenarios under EU electricity risk-preparedness rules.
- Scenarios include disruptions to fossil fuel supply chains affecting electricity generation.
- ENTSG contributes expertise on gas supply disruptions and infrastructure constraints.

## 3. Improved cross-sector modelling consistency

- Improved alignment of electricity adequacy modelling and gas security-of-supply analysis.
- Better representation of gas–power system interdependencies.

## 4. Further suggestions?

**Cooperation improves representation of fuel availability risks in electricity adequacy assessments**

# Potential inspiration for gas system analysis

## Possible areas of interest

- A **mid-term adequacy perspective** between seasonal outlooks and TYNDP
- **Structured data architecture, inputs and workflow**
- **Consistent scenario framework and sensitivities**
- Development of new adequacy **indicators** for gas system resilience

ERAA	Potential relevance for gas
Probabilistic adequacy modelling	Targeted deterministic scenarios
Detailed market-based simulations	Infrastructure feasibility simulations
LOLE / EENS metrics	Possible gas adequacy indicators

ERAA provides possible inspiration for mid-term analysis, despite gas modelling remaining infrastructure-driven. **Which elements of the ERAA framework could realistically be adapted to gas system analysis?**

# PLEXOS simulations: different modelling objectives

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## ERAA / ENTSOG

### Electricity adequacy modelling

- Market-based dispatch simulations
- Exploration of many possible system states
- Probabilistic adequacy indicators
- Focus on **short-term system balance**

### Gas infrastructure modelling

- Network flow balance and storage simulations
- Targeted deterministic scenarios
- Focus on **infrastructure feasibility**
- Seasonal storage and supply balance

Different modelling questions drive different simulation approaches  
**What level of interaction between electricity adequacy modelling and gas system analysis would be useful in practice?**

# Key takeaways

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1. A potential mid-term adequacy perspective could:
  - complement current ENTSOE analyses
  - assist ENTSOE in refining gas-fired supply generation studies by providing gas-side scenario assumptions and/or boundary conditions.
2. The ERAA framework provides a well-established example in defining a structured data architecture, adequacy indicators and a modelling workflow.
3. There are clear cooperation opportunities to be pursued.
4. **Deterministic scenario analysis remains well suited to gas systems, however.**

# Questions for discussion

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## Mid-term adequacy perspective

- How does a **mid-term adequacy perspective** complement current ENTSOG analyses between Seasonal Outlooks and TYNDP?

## Lessons from ERAA

- Which elements of the ERAA framework could be **useful for gas system analysis**? Structured datasets, adequacy indicators, modelling workflow?

## Modelling approaches

- Deterministic scenario analysis remains well suited to gas systems –what level of probabilistic analysis, **if any**, would be useful?

## Cooperation with ENTSO-E

- Where could gas system expertise best **support electricity** adequacy assessments?



Thank you for your attention

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