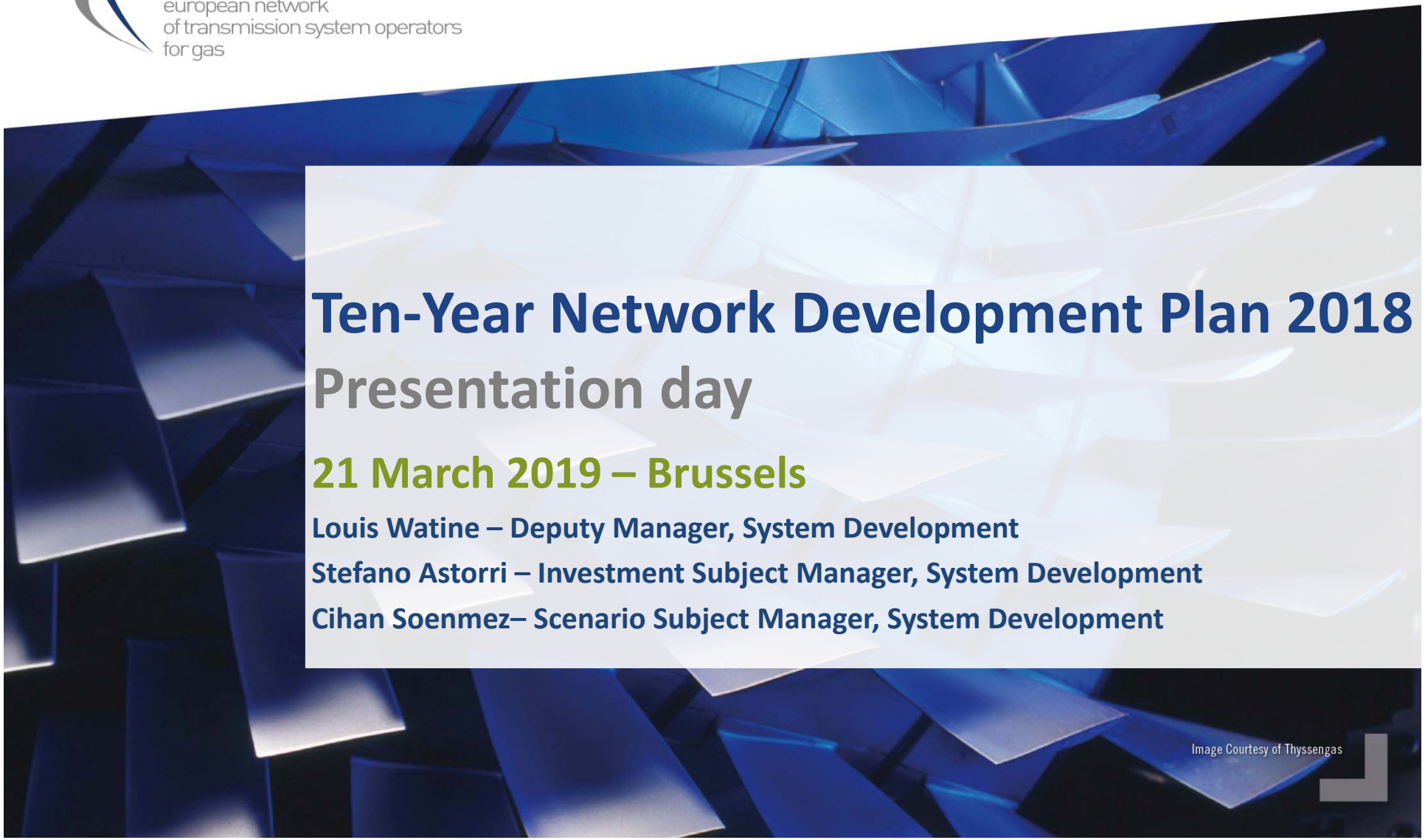
entsog

european network
of transmission system operators
for gas

Brussels – 21 March 2019



Ten-Year Network Development Plan 2018

Presentation day

21 March 2019 – Brussels

Louis Watine – Deputy Manager, System Development

Stefano Astorri – Investment Subject Manager, System Development

Cihan Soenmez– Scenario Subject Manager, System Development

TYNDP 2018 Presentation

1. Role of TYNDP
2. ENTSOG and ENTSO-E TYNDP 2018 scenarios
3. Assessing the needs for the future
4. Achieving the internal gas market is at hand

Role of TYNDP

Planning the future energy system

3rd Package regulatory framework for Gas

Directive 2009/73/EC

Unbundling –
separation of transmission from supply to customers

Regulation EC No 715/2009
(or "Gas Regulation")

ENTSOG

European Network of Transmission Operators for Gas

Regulation EC No 714/2009

ACER

Agency for the Co-operation of European Energy Regulators

TYNDP: an ENTSOG regulatory task

TYNDP is developed bi-annually

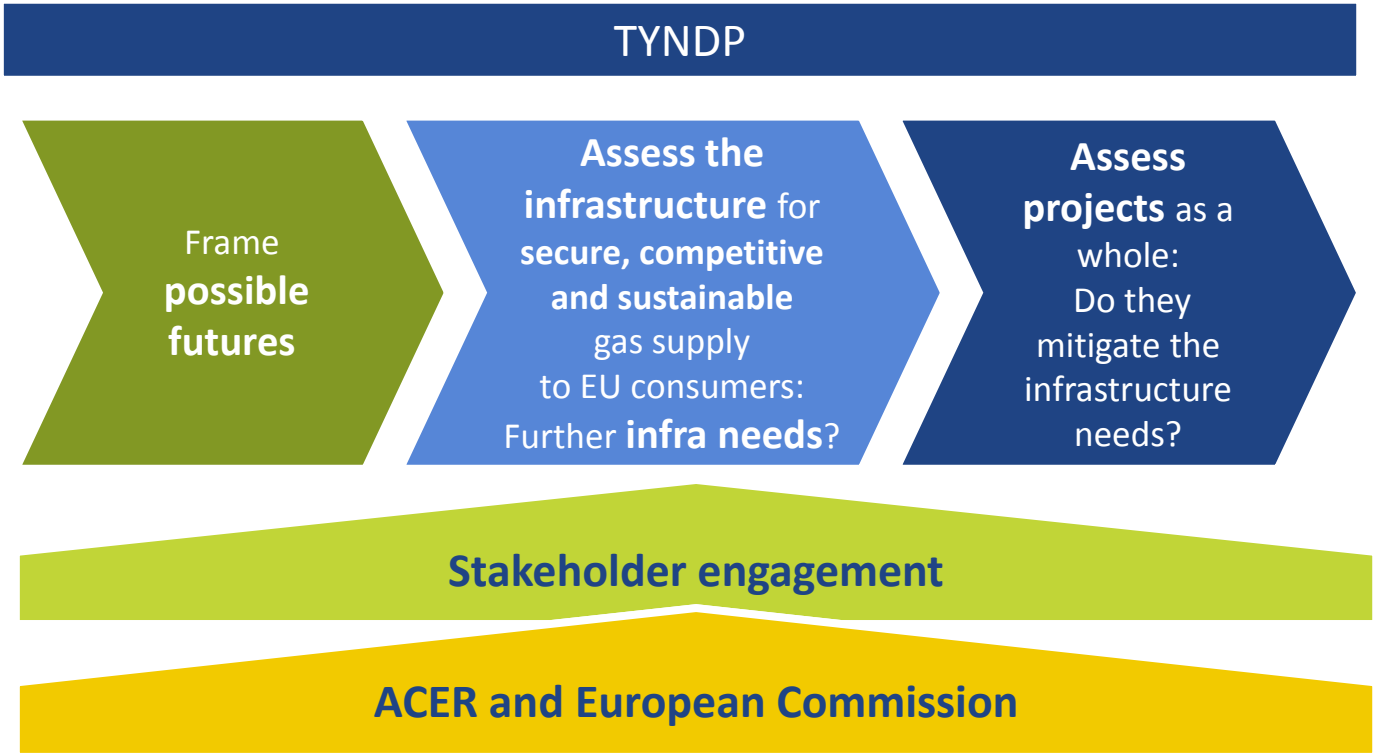
> Task defined by **Reg. (EU) 715**, **Reg. (EU) 347** and **Reg. (EU) 2015/703**

> European Commission approved the **Cost-Benefit Analysis Methodology** applied to TYNDP

> ACER monitors TYNDP and issues a formal **Opinion** on TYNDP

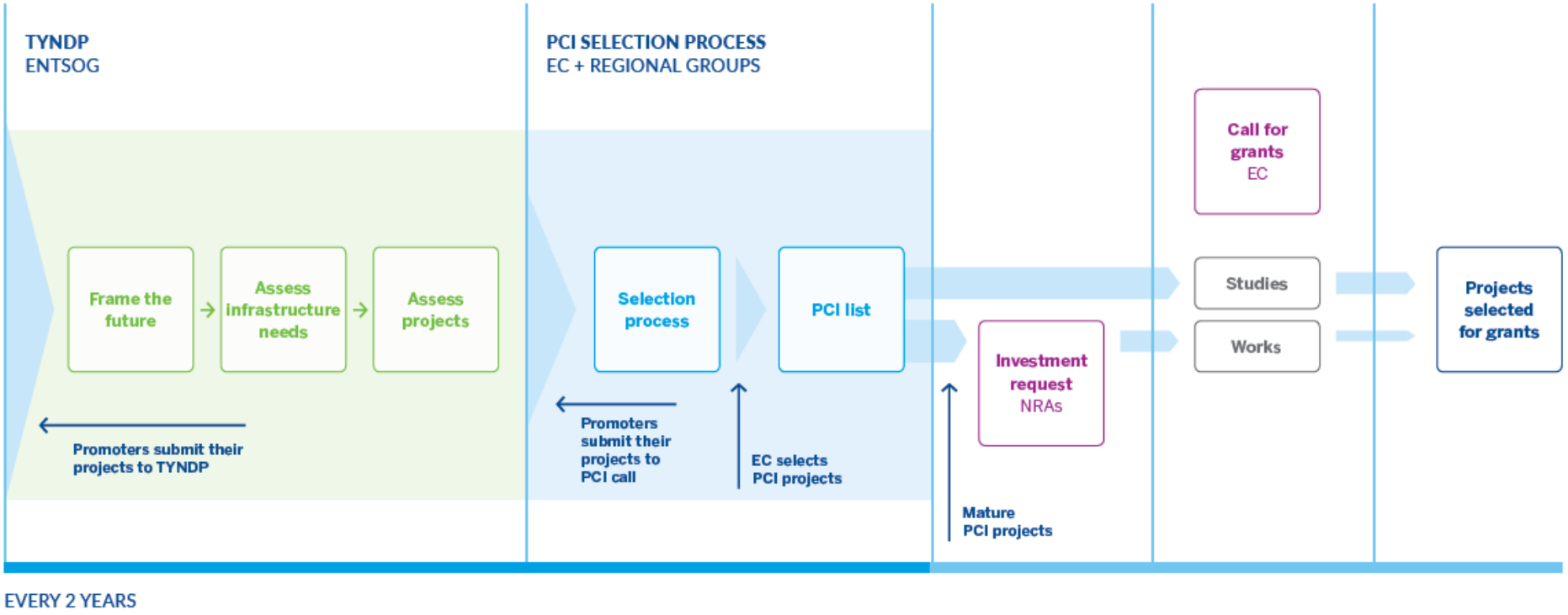
Role of TYNDP

Third Package



TEN-YEAR NETWORK DEVELOPMENT PLAN

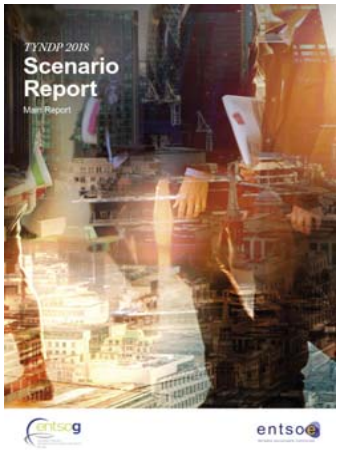
EU TYNDP is built on **TEN-E Regulation** and plays a role as a starting point in the wider process of **PCIs selection**, managed by the European Commission and Regional Groups.



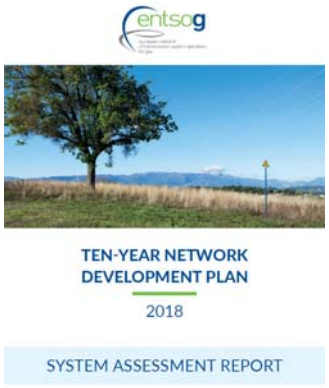
Every two years ENTSOG (together with ENTSO-E) **plan, assess and test** the infrastructure against possible future scenarios to **secure energy demand** for the next decades. TYNDP is a **highly inclusive** and **transparent** process, building on input from numerous stakeholders.

TYNDP process

Scenario Report



TYNDP Report

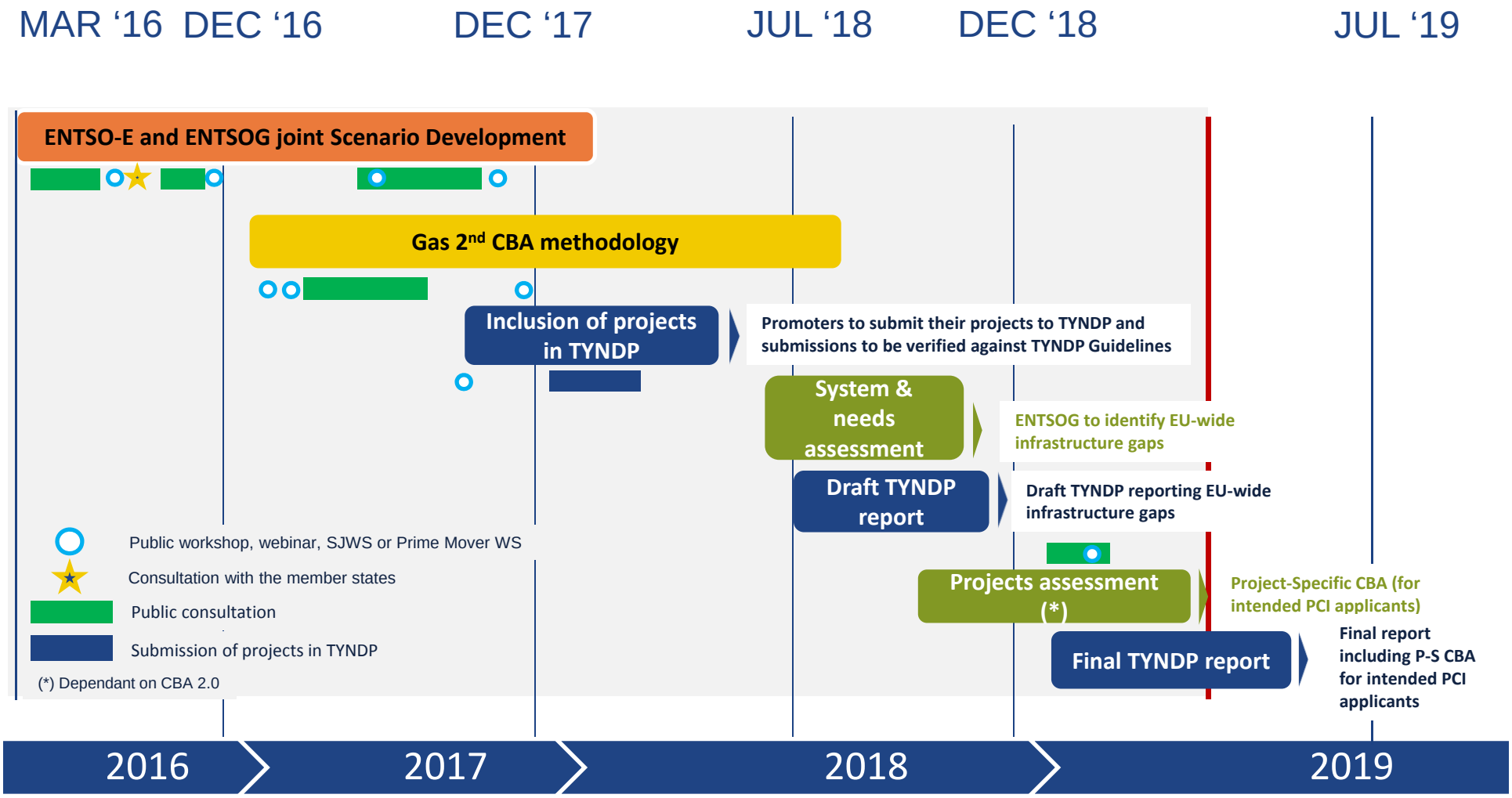


Project Fiches

Frame the future of the energy sector → Assess Infrastructure needs → Assess Projects

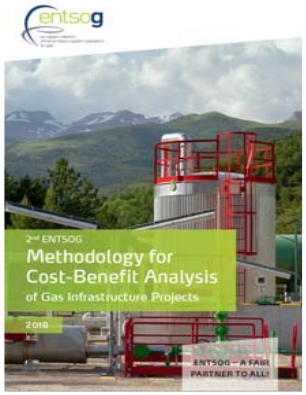
In collaboration with ENTSOE

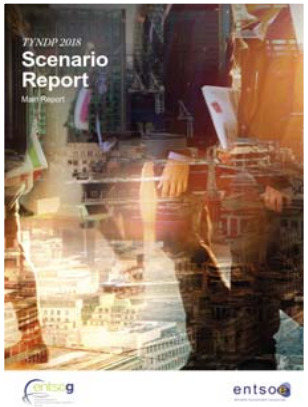
TYNDP 2018 timeline

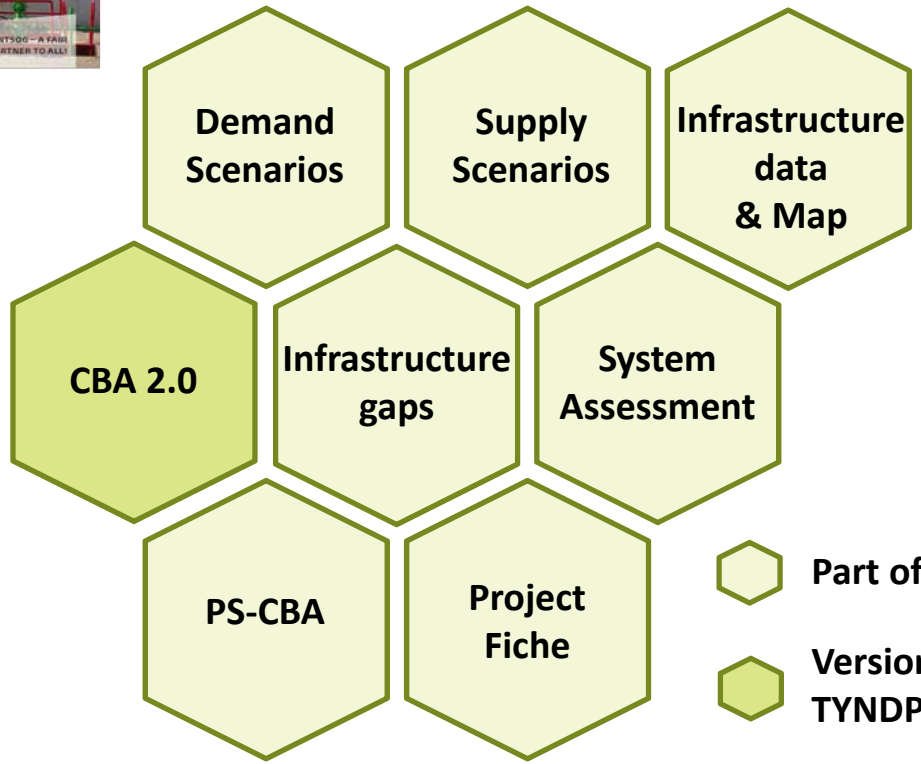


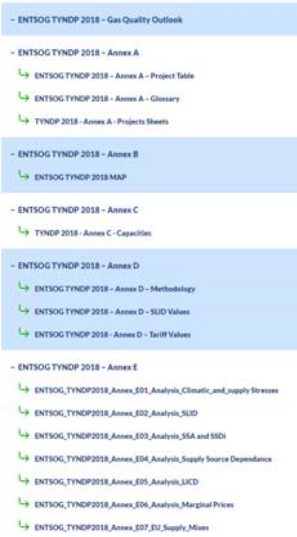
TYNDP is a highly inclusive and transparent process

TYNDP 2018 Report Main elements









2nd ENTSOG CBA Methodology

Approved by EC in January 2019

Main improvements:

> more streamlined methodology

> increased transparency

> refined supply and supply price methodology

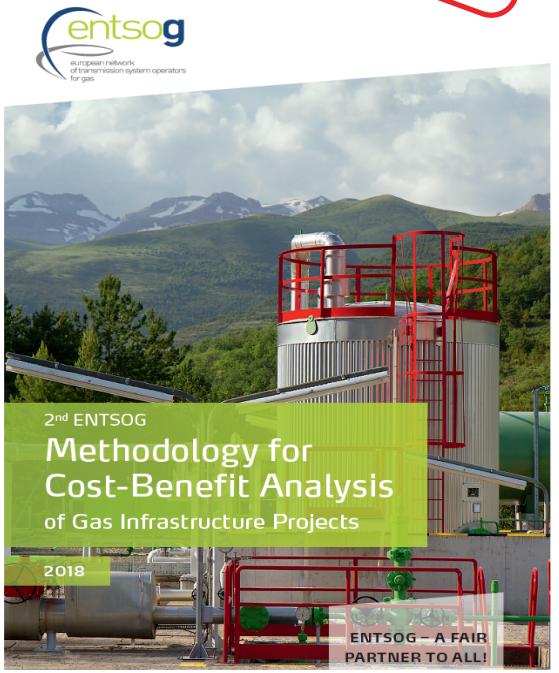
> refined market modelling assumptions

> indicators simplification

> project grouping guidelines

> compulsory cost provision

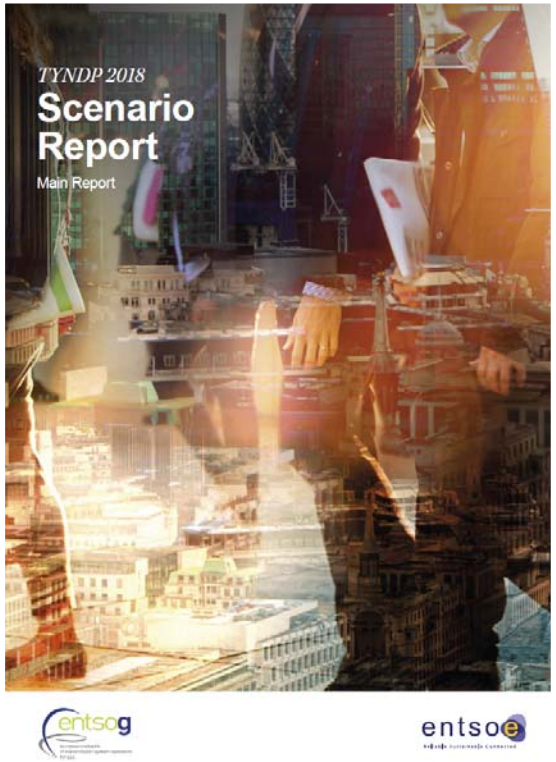
> improved sensitivity analysis



ENTSOG and ENTSO-E TYNDP 2018 scenarios

Joint ENTSOs TYNDP scenarios

TYNDP 2018 scenarios built in a consistent and comprehensive way by ENTSOG and ENTSO-E

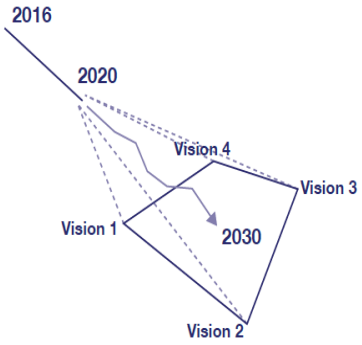


> The expertise of gas and electricity TSOs also ensures that the scenarios are broadly technically feasible; for instance, making it possible to maintain the energy balance at all time in each country.

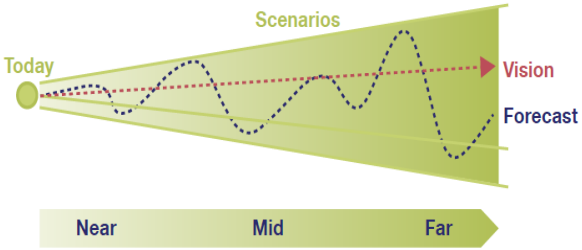
> **<u>This is key to test the need and performance of possible future infrastructure in challenging but realistic situations.</u>**

Joint ENTSOs TYNDP scenarios

from TYNDP 2017….

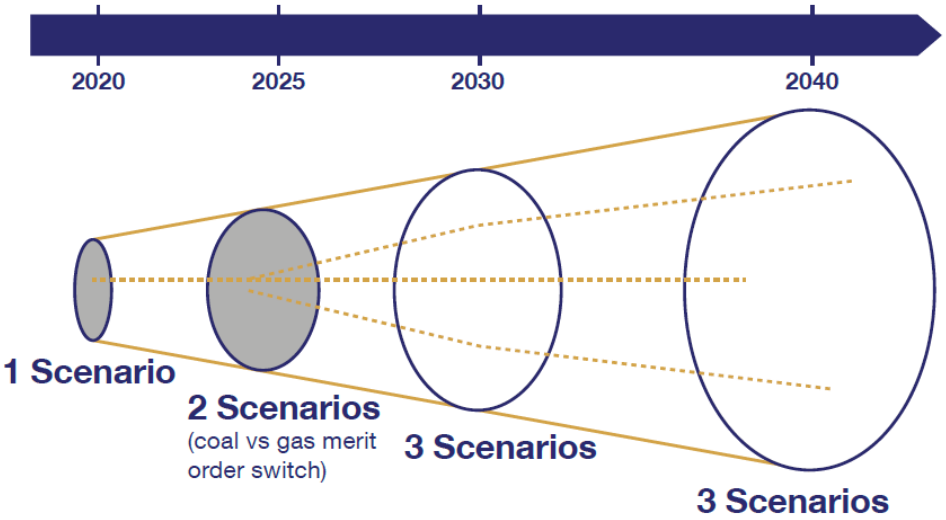


ENTSO-E: TYNDP 16



ENTSOG: TYNDP 17

… to TYNDP 2018

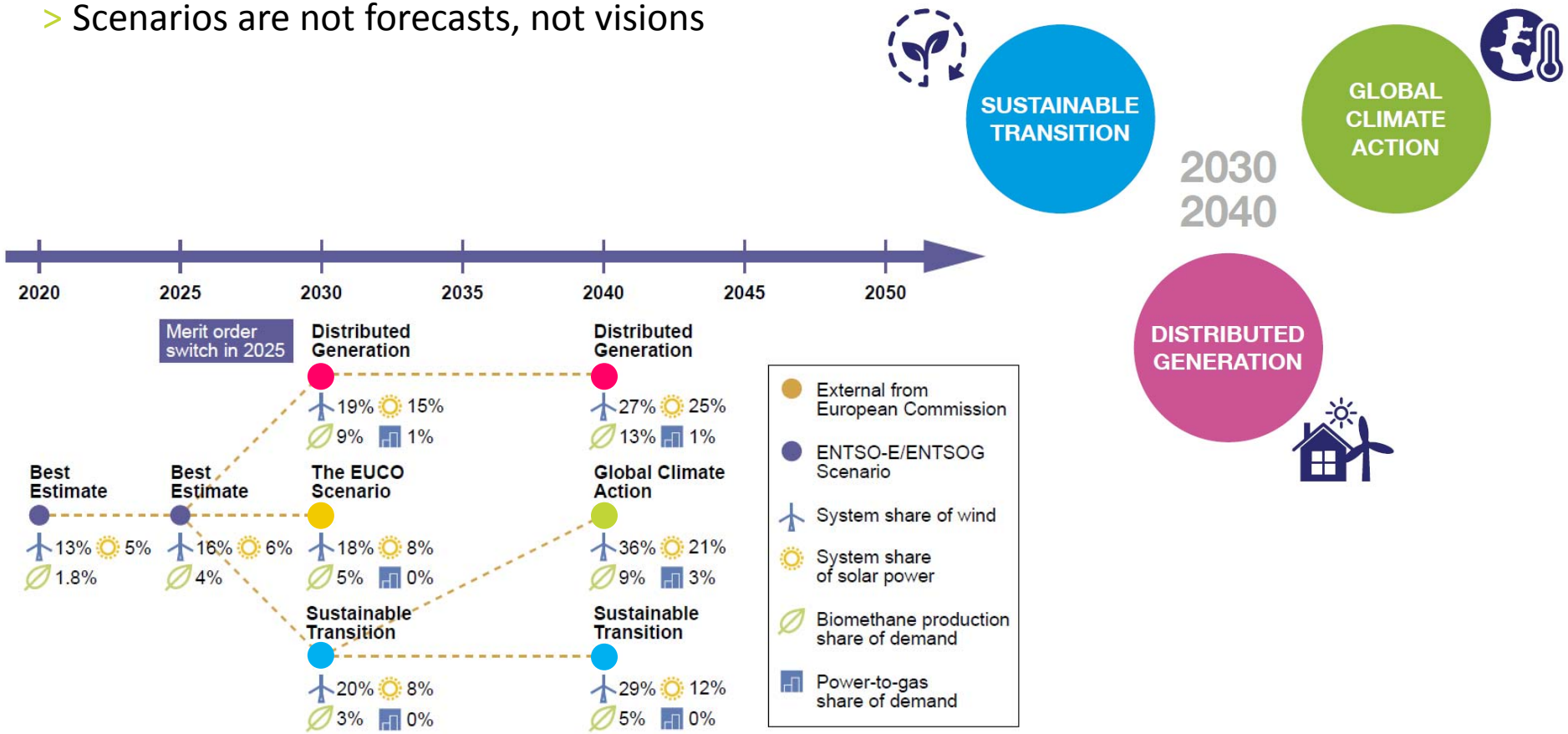


Common scenarios ensure consistent assessment of System needs and Infrastructure Projects

Scenarios frame the possible futures

Stakeholder feedback supported a range of demand scenarios

> Scenarios are not forecasts, not visions



Scenarios Characteristics

EUCO 30

EUCO 30: Models the achievement of the 2030 climate and energy targets as agreed by the European Council in 2014, but including an energy efficiency target of 30%.

ST

Sustainable Transition: Targets reached through national regulation, emission trading schemes and subsidies, maximising the use of existing infrastructure.

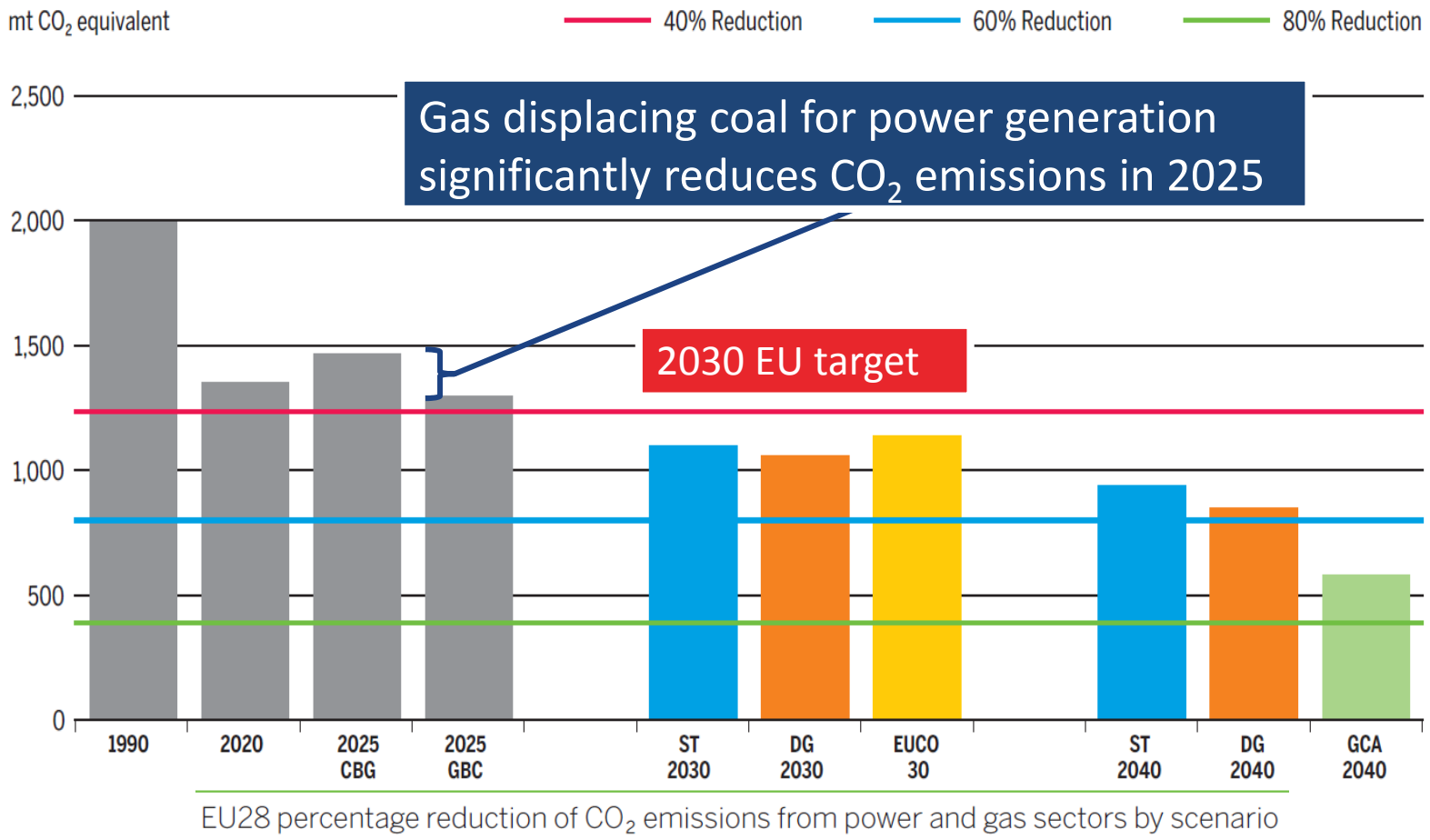
DG

Distributed Generation: Prosumers at the centre – small-scale generation, batteries and fuel switching society engaged and empowered.

GCA

Global Climate Action: Full speed global decarbonisation, large-scale renewables development in both electricity and gas sectors.

CO_2 reduction: meeting EU targets



All scenarios have been built as realistic and technically sound, aiming at reducing emissions by 80 to 95% in line with EU targets for 2050

Energy Efficiency

Multiple energy mixes achieve the EU Energy efficiency target

The target can be met both with…

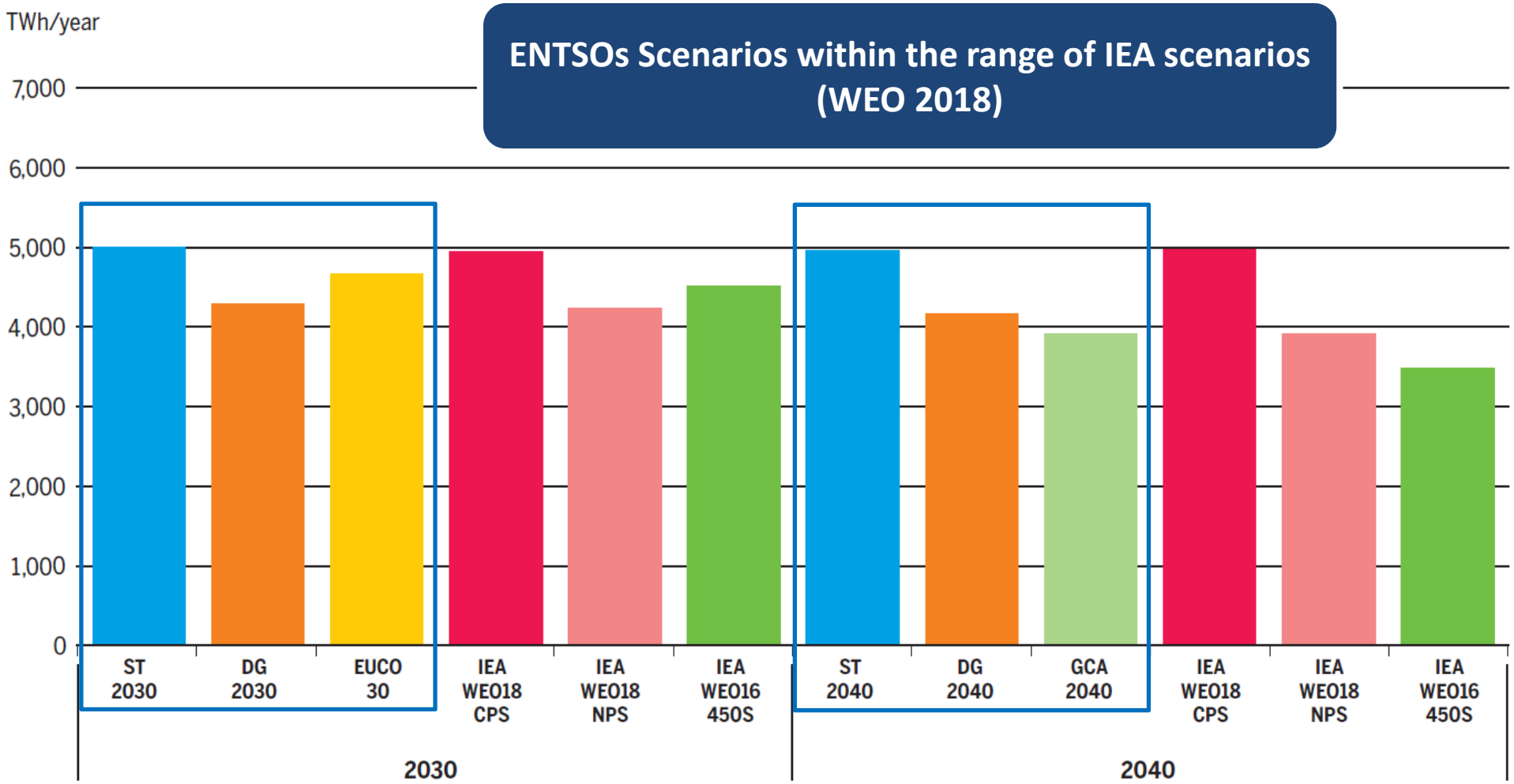
…Decreasing gas demand

> Better efficiency of gas heating
> Electrification of heating

…Increasing gas demand

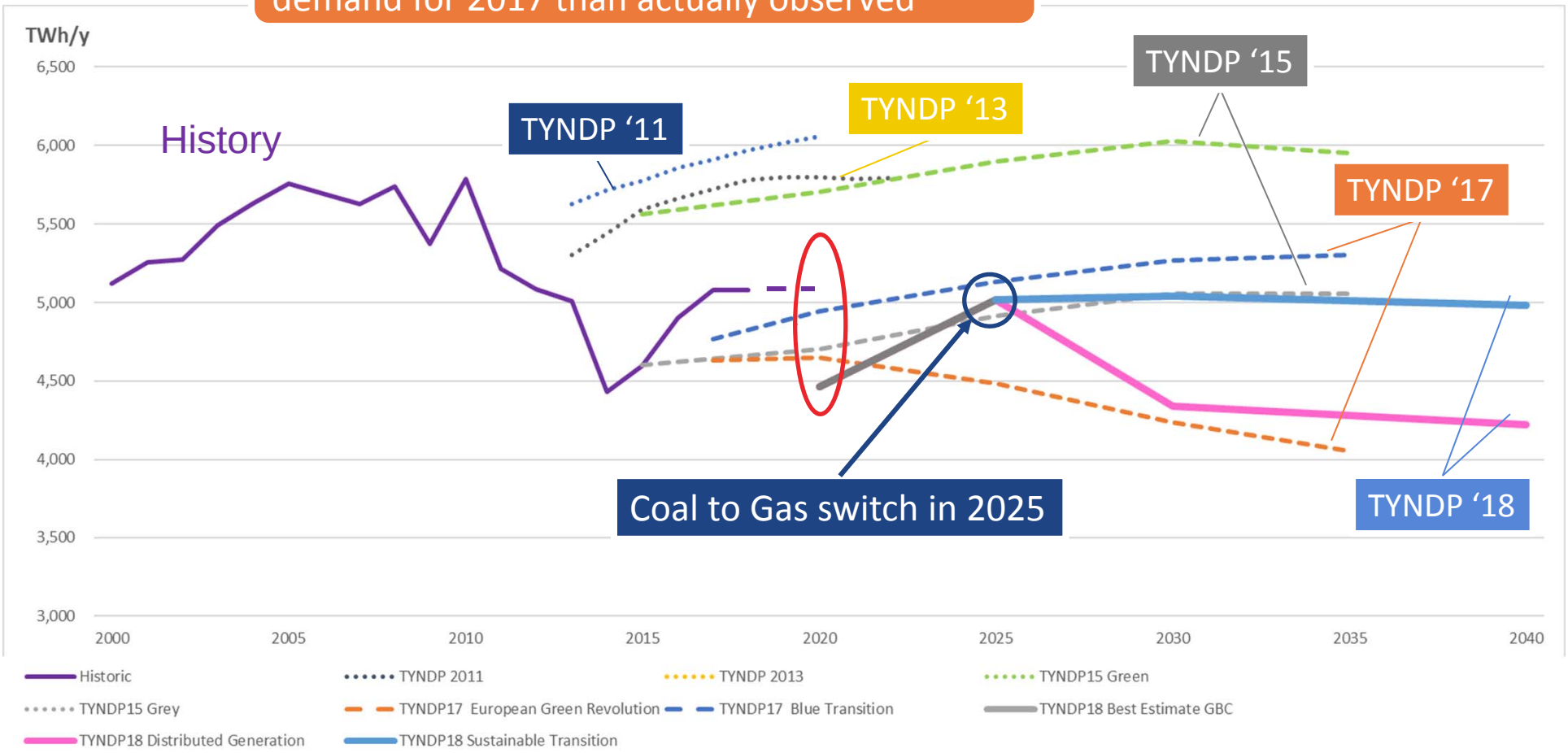
> More efficient gas-fired generation replacing coal generation
> Gas mobility displacing oil demand
> Highly efficient gas condensing boilers

Gas demand in 2030 and 2040 in line with external scenarios



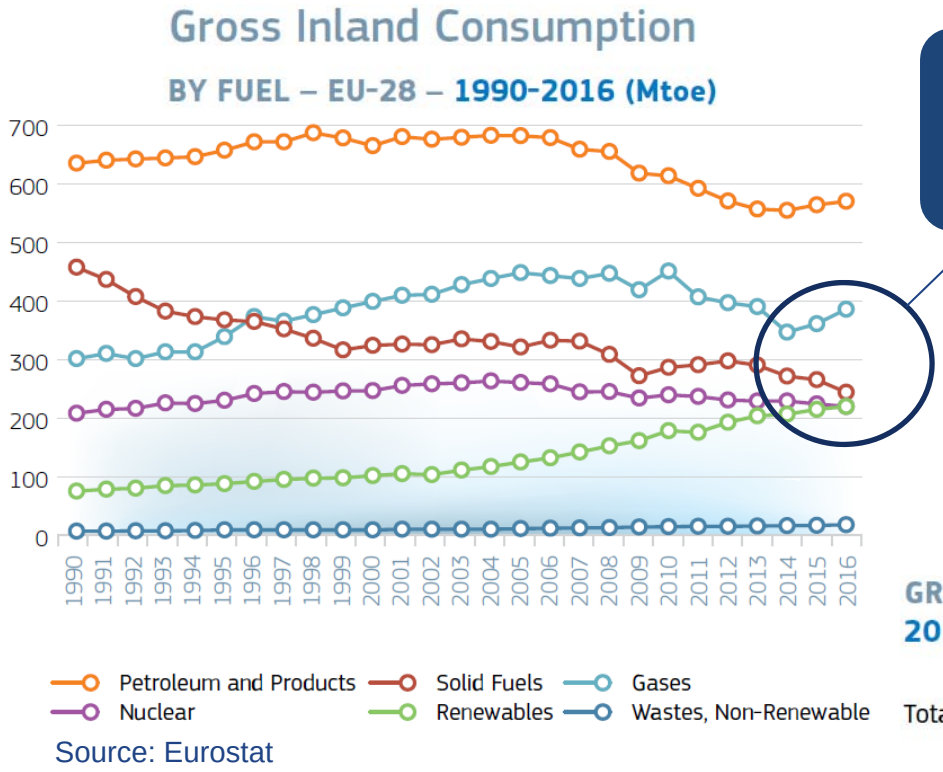
TYNDP scenarios since 2011

TYNDP 2017 scenarios were considering lower demand for 2017 than actually observed



TYNDP 2018 scenarios start with a lower demand than any of TYNDP 2017 scenarios in 2020

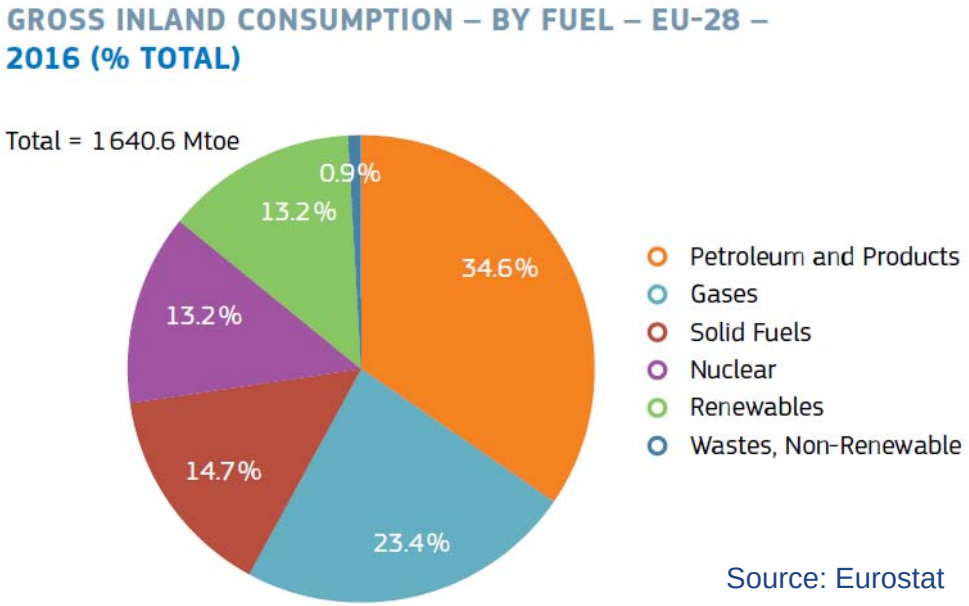
EU Energy consumption



Source: Eurostat

Fuel switch since 2014: Solid decreasing, gas increasing

Gas provides >20% EU Energy Consumption



Source: Eurostat

Heating and cooling is **50%** EU Final Energy Demand, significantly covered by **Gas**

Gas and electricity demand in TYNDP 18

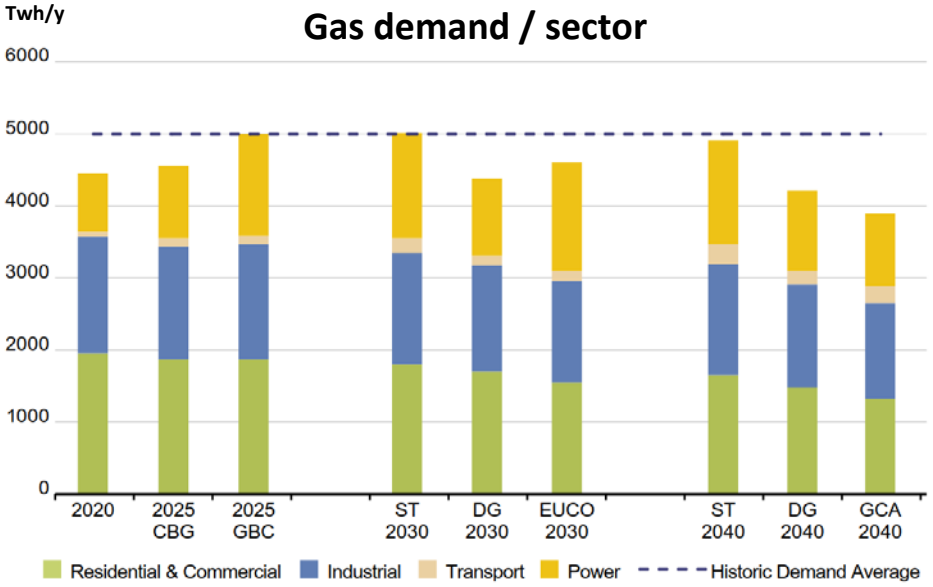
ENTSOs interlinked model

> Energy demand for Europe until 2040

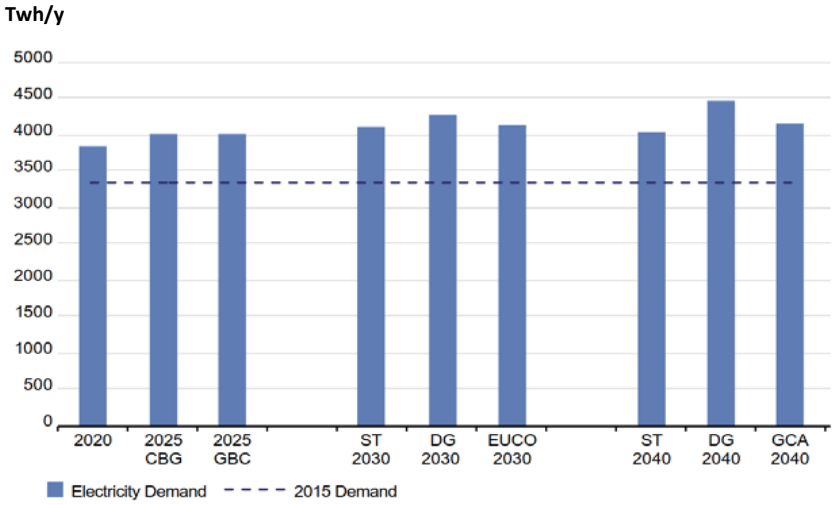
> Gas to power demand stemming from power generation mix

> Coordinated approach on heating and transport sectors

Gas demand / sector



Electricity demand



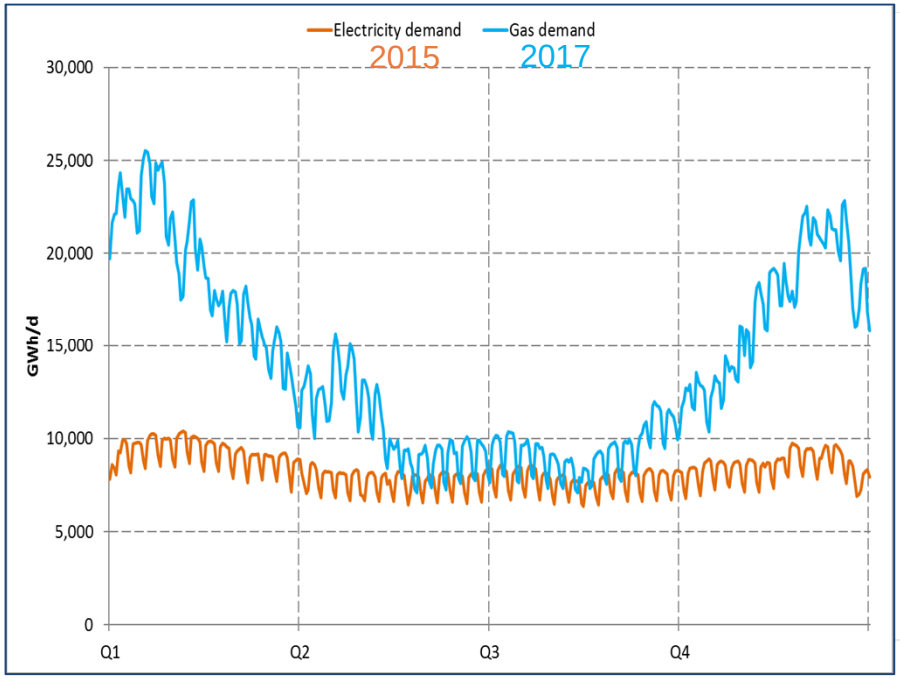
Decarbonisation and energy efficiency reshape energy demand

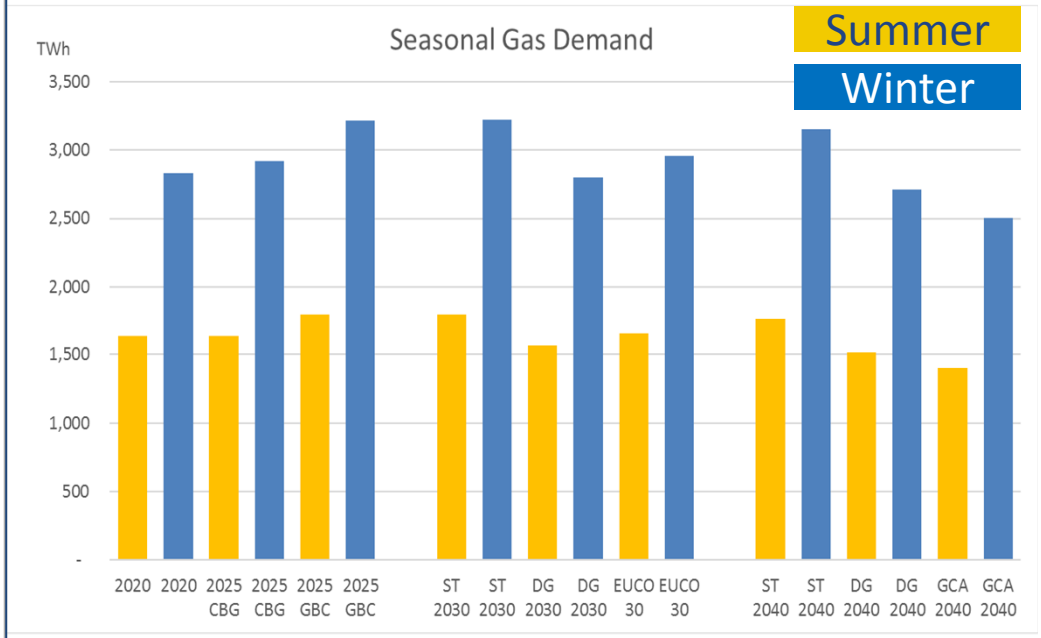
Gas plays an essential role in decarbonisation

Gas demand decrease in some scenarios, natural gas partially compensated by renewable gas

Gas system to cope with seasonality

Gas and Electricity consumption



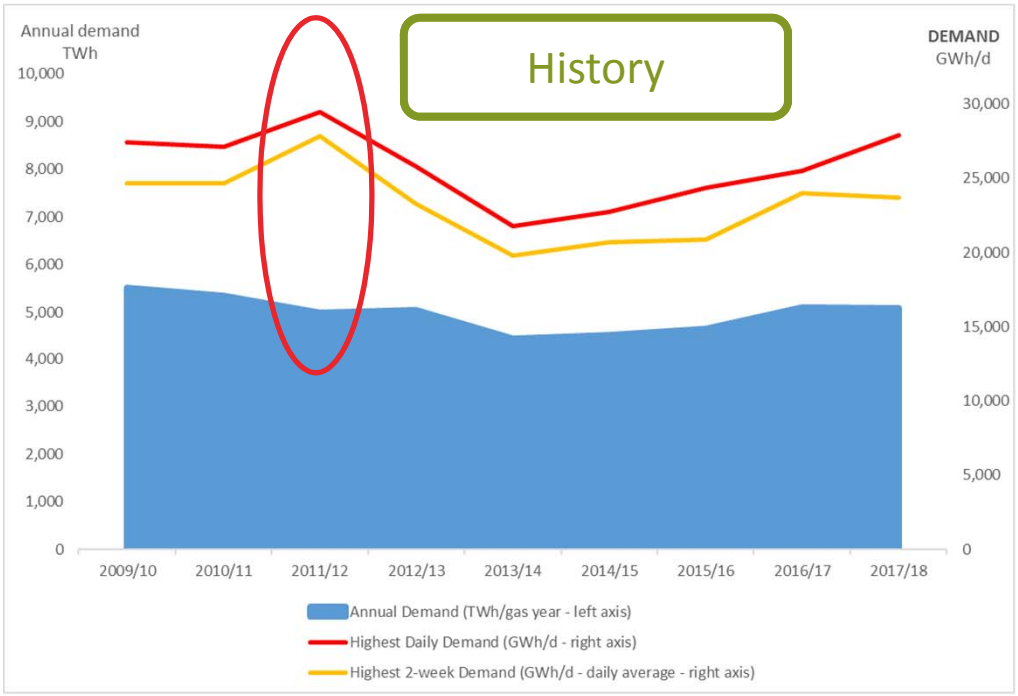


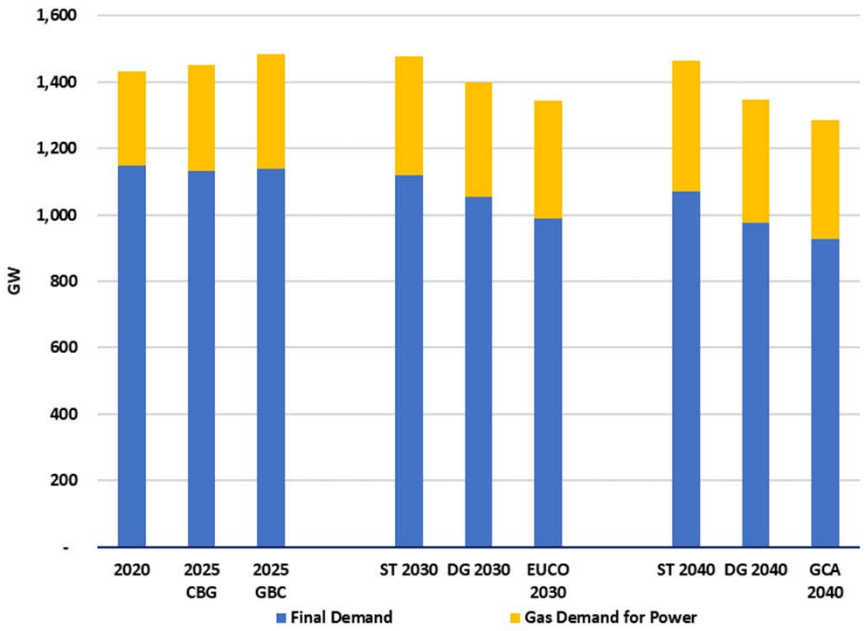
> Gas demand in TYNDP 2018

Gas system to ensure the seasonal supply and demand adequacy

Climatic stress - gas consumption

Demand during cold spells does not follow annual volume trends.
The gas infrastructure is designed to cope with peak demand situations.

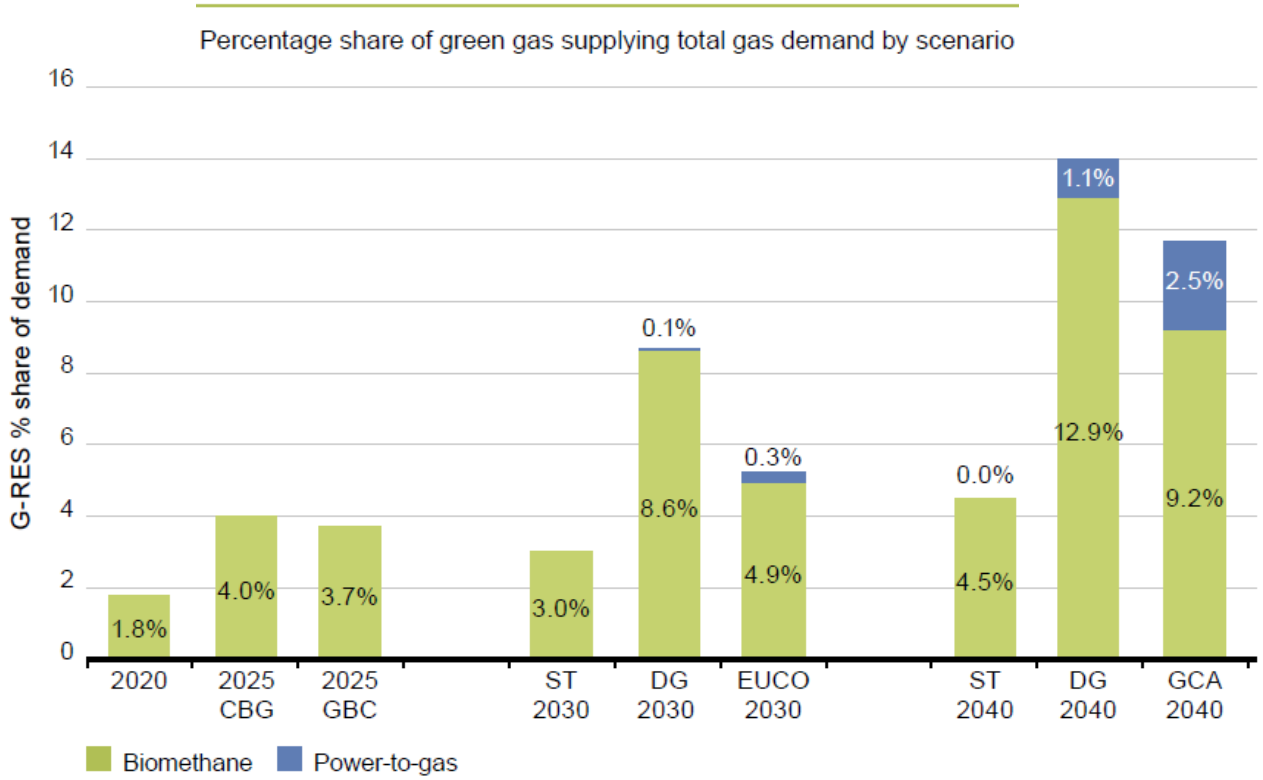




Gas peak demand TYNDP 2018

Peak demand is a key element of infrastructure design.
Gas peak demand is mostly maintained over time, especially for power generation

Decarbonisation of gas supply



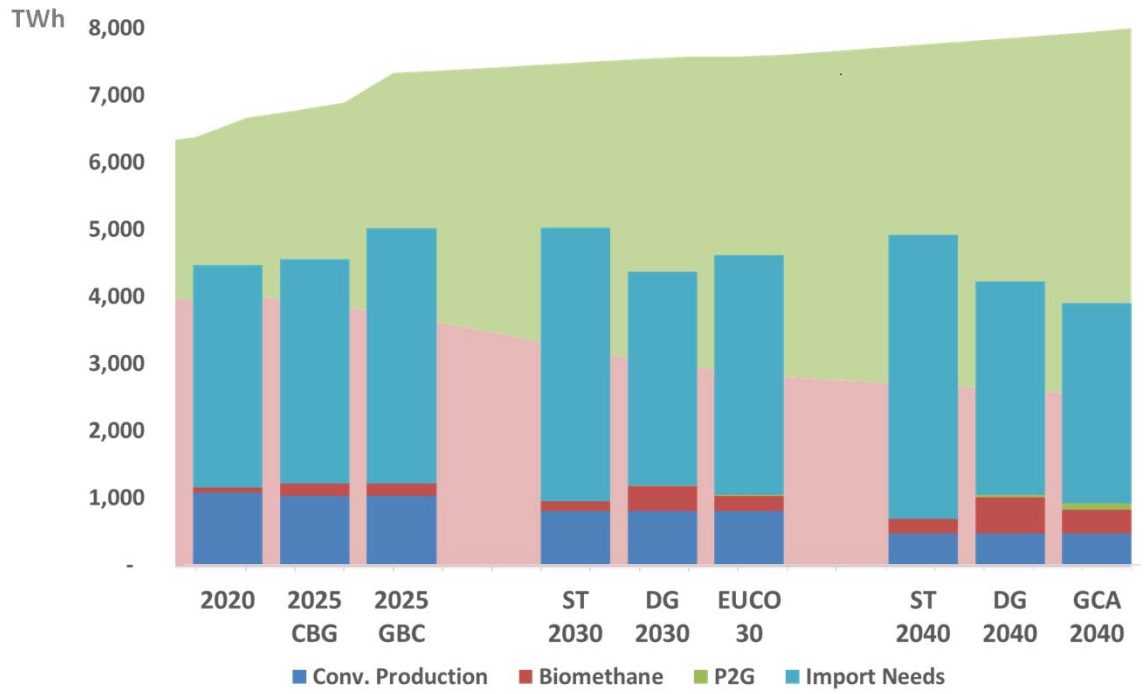
Different scenarios considering different levels of renewable gas penetration

Gas infrastructure can further support CO_2 reduction and integration of renewable and decarbonised gases

Supply needs over time

Renewable gases can compensate the decline of the EU indigenous production depending on the scenarios

In the different scenarios, import needs remain significant



Maximum imports potential

Minimum imports potential

Access to new supply sources – indigenous or extra-EU - would contribute to maintain supply diversification and flexibility

Outlook: TYNDP 2020 Scenarios

ENTSOG & ENTSO-E are currently developing 2020 scenarios:

> 1 bottom-up scenario in compliance with National Energy and Climate Plans

> 2 top-down Full-energy scenarios compliant with the targets of the Paris Agreement

> Key aspects:

- Decarbonisation
- Centralization/de-centralization
- Deep investigation of decarbonisation of gas supply: Biomethane, P2G, Blue Hydrogen

Next events:

> 18.04.2019: Webinar on Storyline Release

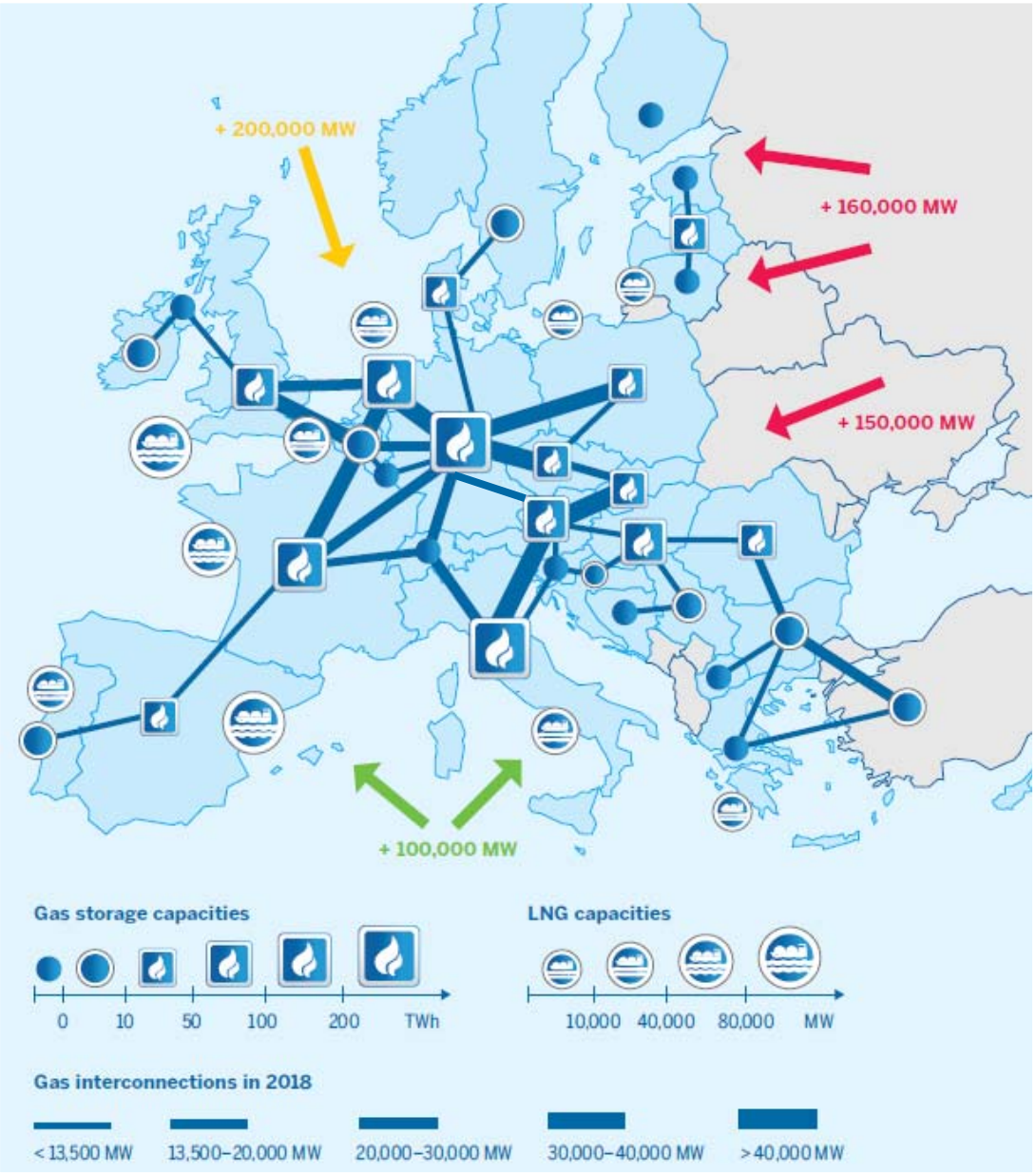
> Beginning of July: Publication of draft Scenario Report

We need and appreciate your contribution. Please contact **sysdev@entsog.eu** and sign in ENTSOG's TYNDP distribution list to receive the latest info and invitations to our events

TYNDP 2018 Assessment

Assessing the needs for the future

The existing infrastructure



At EU level

- Diversified pipeline imports
- A well-developed transmission network
- LNG terminals all around Europe
- Underground storages in most EU countries

Highly resilient existing gas infrastructure

1 100 TWh

High storage capacity

20% of the annual demand

850 GW

High import capacities

800 GW

High storage deliverability

Key asset to cover winter demand and to provide flexibility

What the EU gas infrastructure already achieves

Security of supply

- *Resilience to extreme temperature*
- *Resilience to many supply and infrastructure disruptions*

Market integration and competition

- *Most of Europe has access to diversified supply sources*
- *Hub prices converge most of the time – especially in Western Europe*

Sustainability

- *The existing EU gas infrastructure is generally already able to contribute to significant CO_2 reduction and to complement renewable generation and integrate renewable gases*

In specific areas further infrastructure needs remain

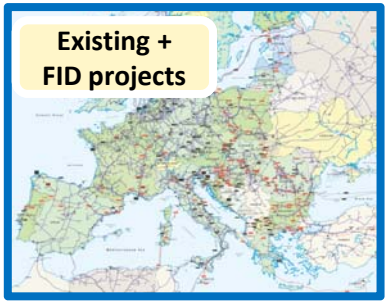
Needs assessment methodology

Is further infrastructure needed?

TYNDP assesses the gas infrastructure against the Union energy policies

Sustainability | Security of Supply | Competition | Market Integration

Are they achieved with the existing infrastructure and FID projects?

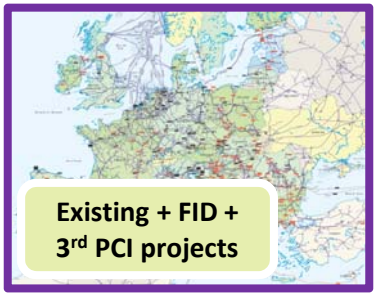


Low infrastructure level

No

Advanced infra. level

+



PCI infra. level

Yes

No further infrastructure needs

TYNDP assesses further infrastructure development

> FID projects + advanced projects

> FID projects + 3rd PCI list projects

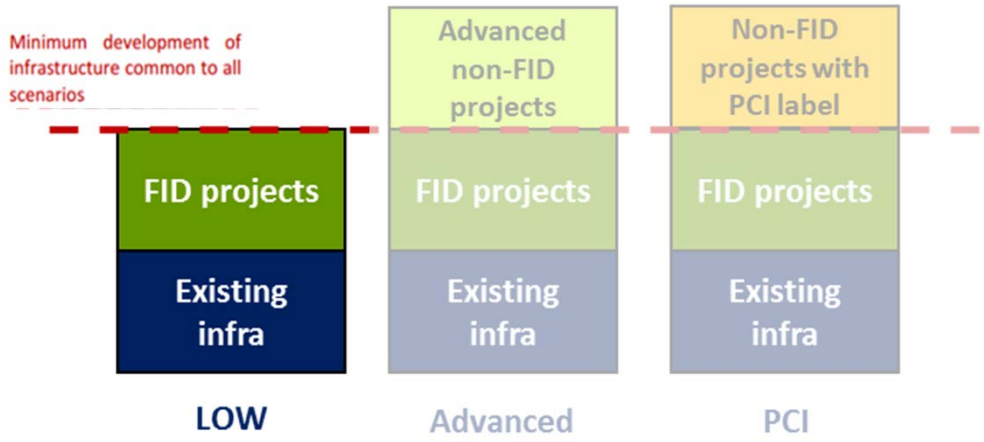
Low Infrastructure level

Reference infrastructure development for identification of infrastructure gaps:

> Existing infrastructure

+

> Projects having made their Final Investment Decision (FID projects)



Advanced Infrastructure level

Advanced infrastructure level is considered to assess the impact of

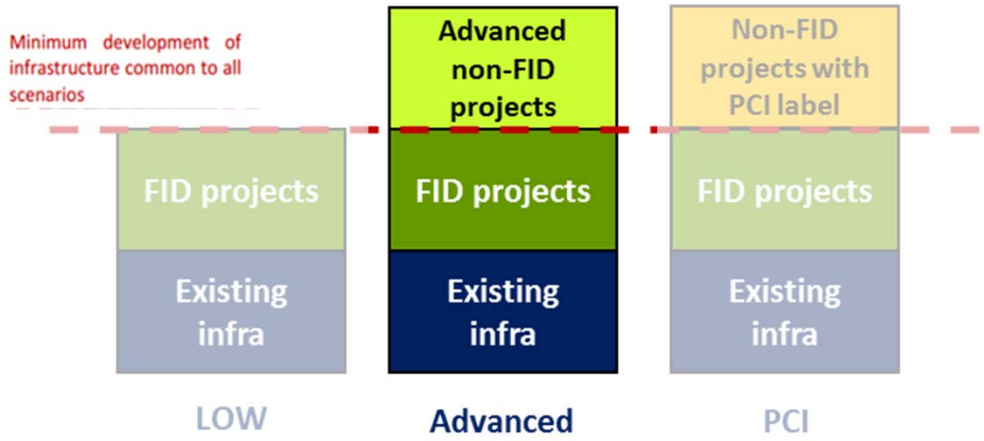
> Existing infrastructure

+

> Projects having made their Final Investment Decision (FID projects)

+

> Projects to be commissioned by 2024 having initiated their permitting process or FEED studies (or having been granted CEF funding for FEED)



PCI Infrastructure level

PCI infrastructure level is considered to assess the impact of

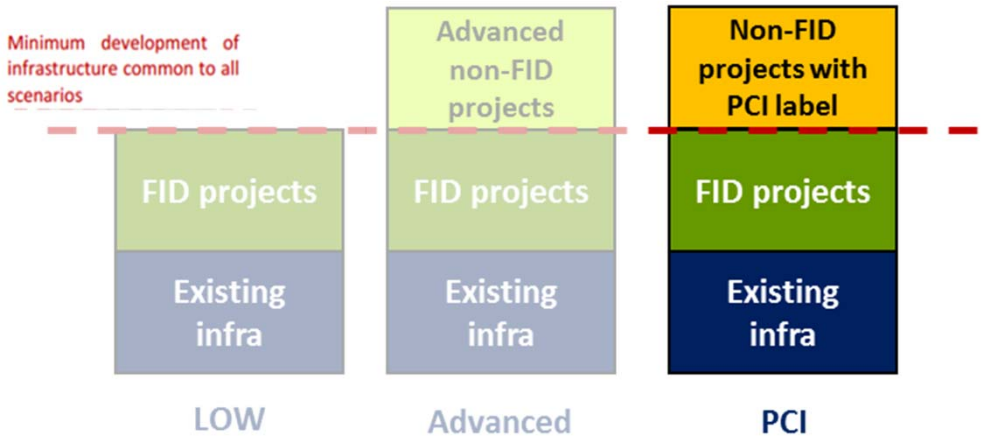
> Existing infrastructure

+

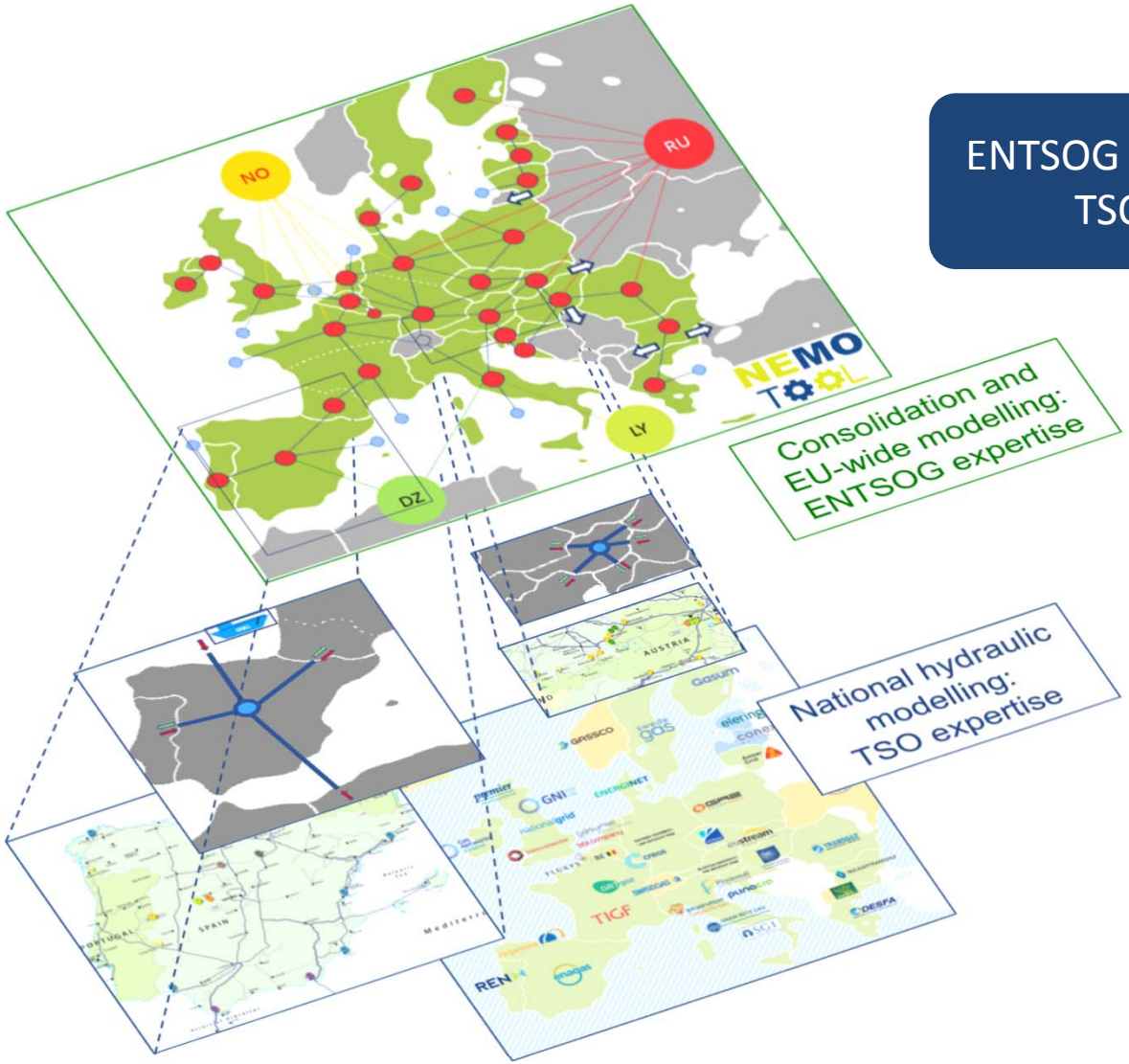
> Projects having made their Final Investment Decision (FID projects)

+

> Additional projects of the 3rd PCI list not having made their FID yet



ENTSOG EU network modelling



ENTSOG European model builds on TSOs national expertise

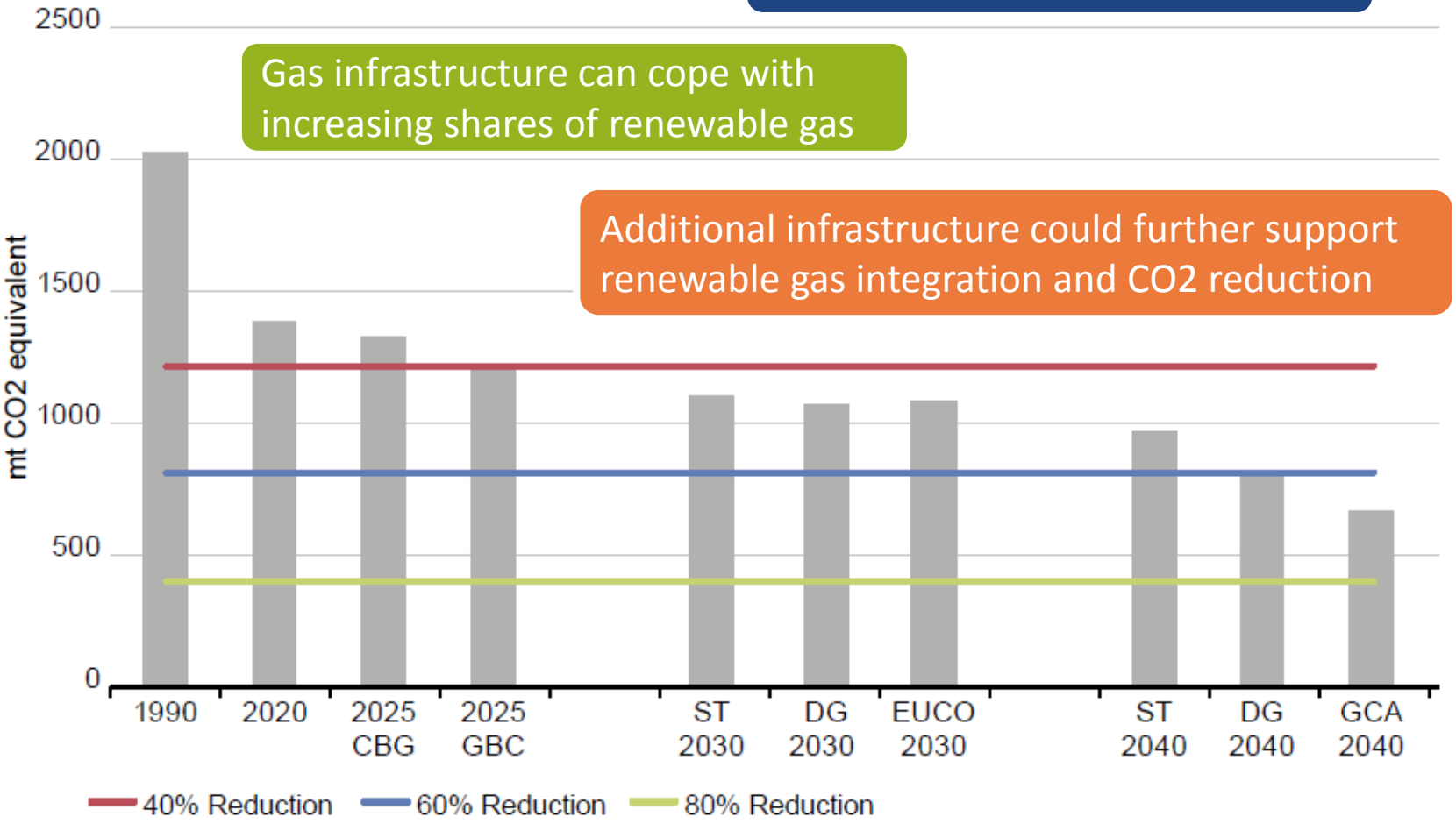
Sustainability

Reaching EU's climate targets with the gas infrastructure

Hybrid system allows significant CO2 reductions at low cost

Gas infrastructure can cope with increasing shares of renewable gas

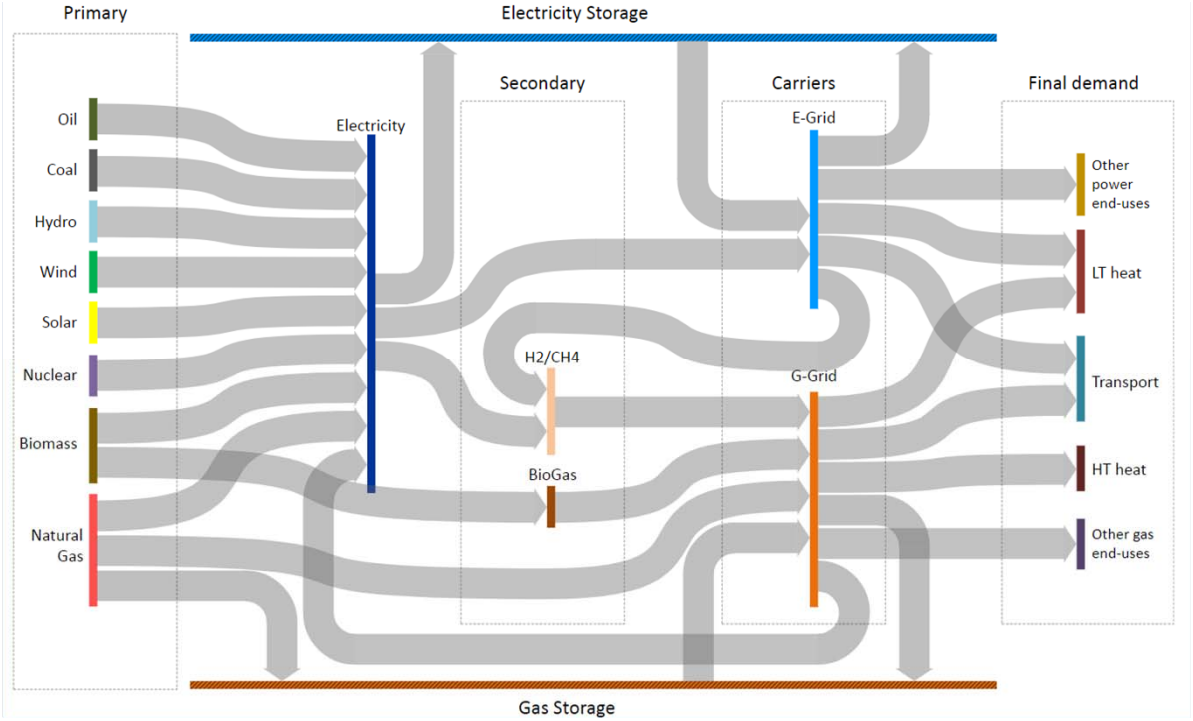
Additional infrastructure could further support renewable gas integration and CO2 reduction



Sustainability

Developing and integrating renewable sources of energy further contributes to a low-carbon future

> Today's EU gas infrastructure - with existing power plants - is already able to complement and **support renewable electricity generation and integrate renewable gases.**



It is fundamental to take a holistic approach to the energy system

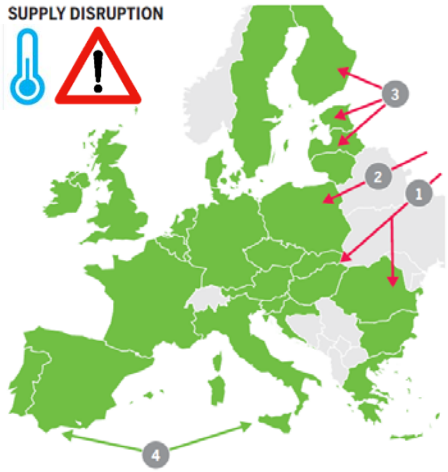
Security of Supply

Security of Supply

Assessment of the resilience of the European gas system to cope with various stressful events

> Climatic stress
- Peak day demand
- 2-week cold spell

> Supply route disruptions in case of climatic stress*
1. Ukraine route
2. Belarus route
3. Imports to Baltic states and Finland
4. Algerian import pipelines



> Infrastructure disruption
- Single Largest Infrastructure disruption of each country, during a peak day

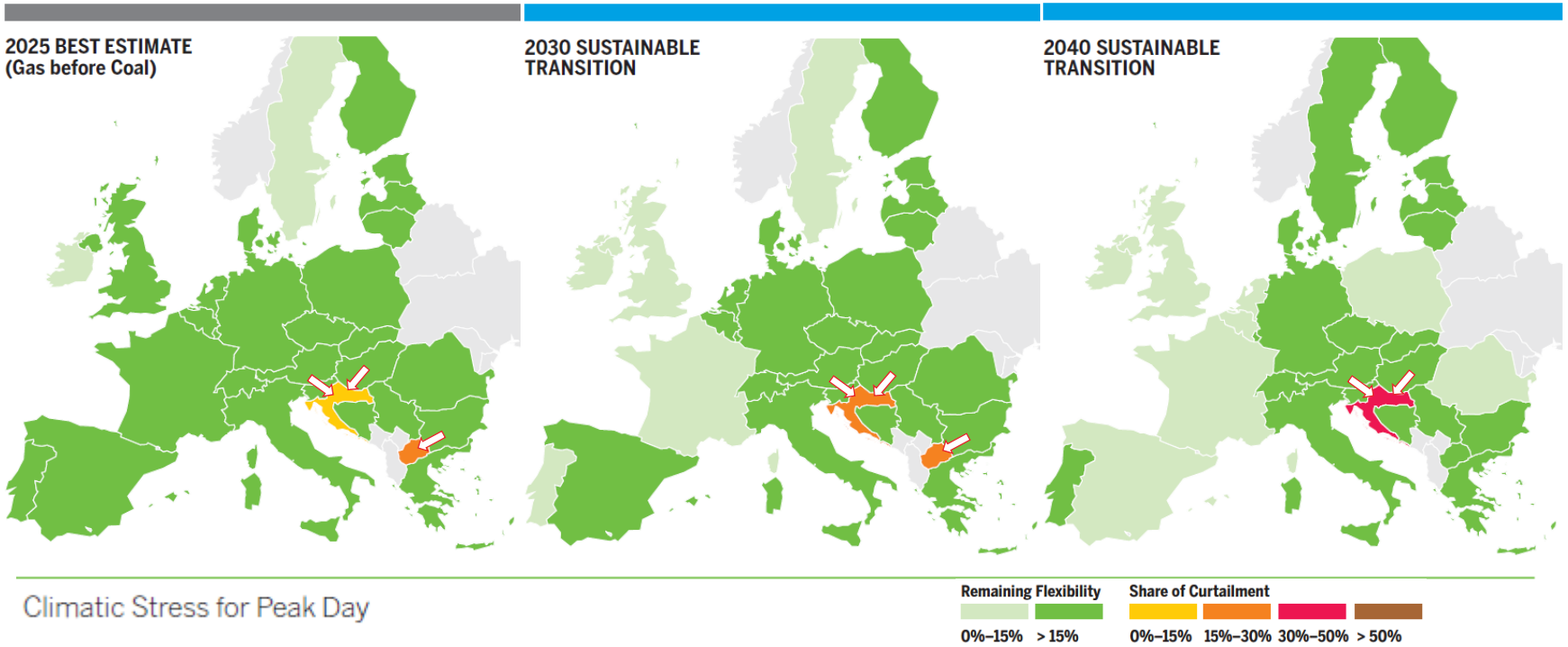
Results generally shown for peak day unless specified differently

*Based on risk groups defined by SoS regulation 2017/1938 (Annex I)

Climatic stress

Assessment of 1-in-20 peak day and 1-in-20 2-week cold spell

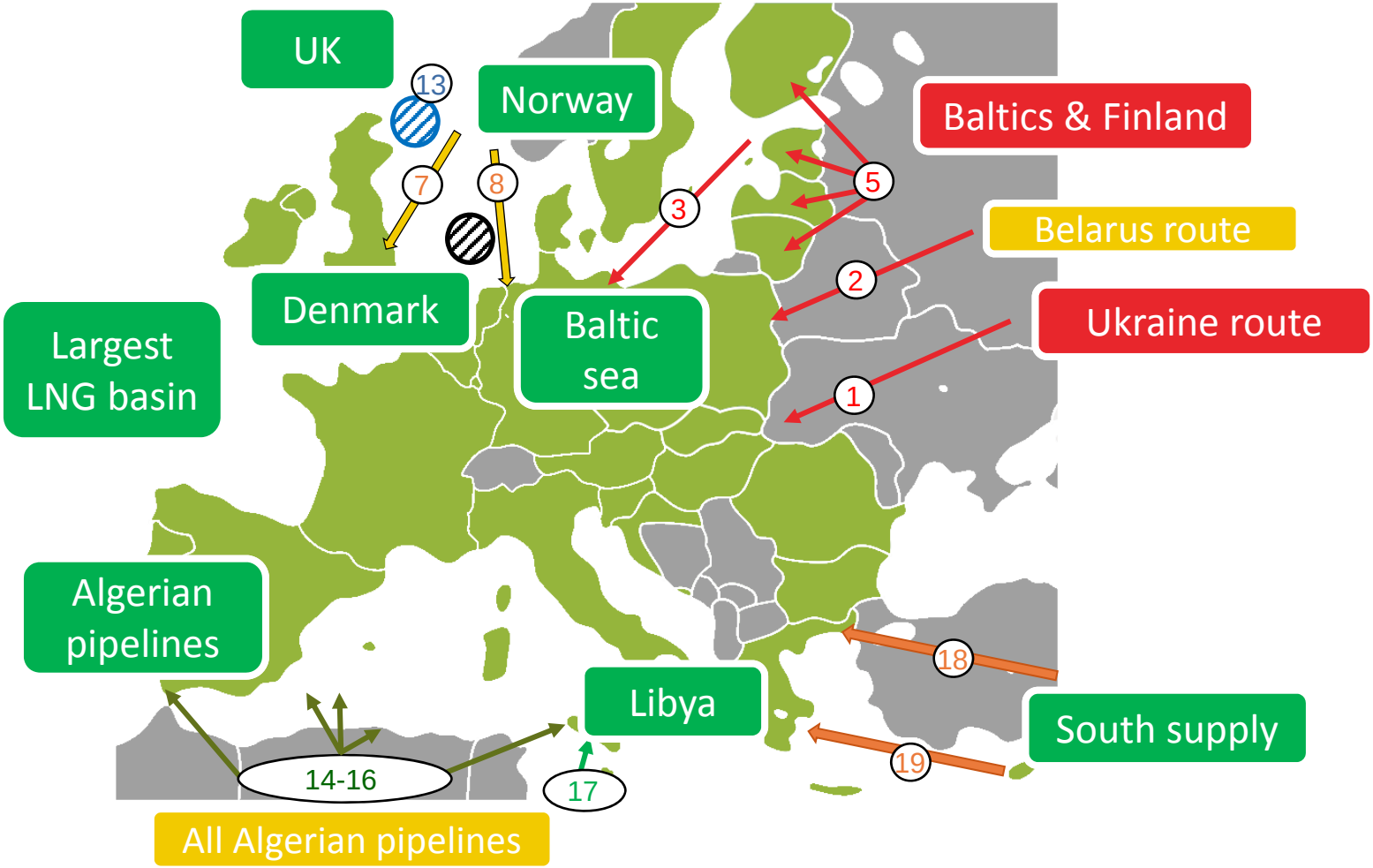
- The European gas system is resilient to extreme climatic stresses in all scenarios (1-in-20 peak day and 1-in-20 2-week cold spell)
- Exposure to demand curtailment is limited to Croatia in all scenarios (and to North-Macedonia in some instances)



Infrastructure bottleneck

Supply disruption

Resilience to supply route disruptions in climatic stress conditions

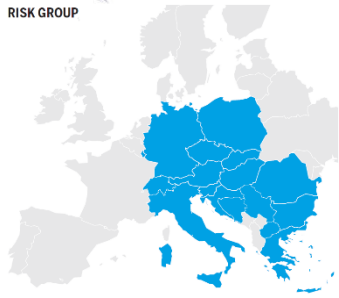


Disruptions scenarios defined in SoS regulation 2017/1938

Ukraine transit route disruption

Peak day conditions

RISK GROUP



FID projects mitigate the situation in 2020

2020

Remaining Flexibility: 0%–15% > 15%

Share of Curtailment: 0%–15% 15%–30% 30%–50% > 50%

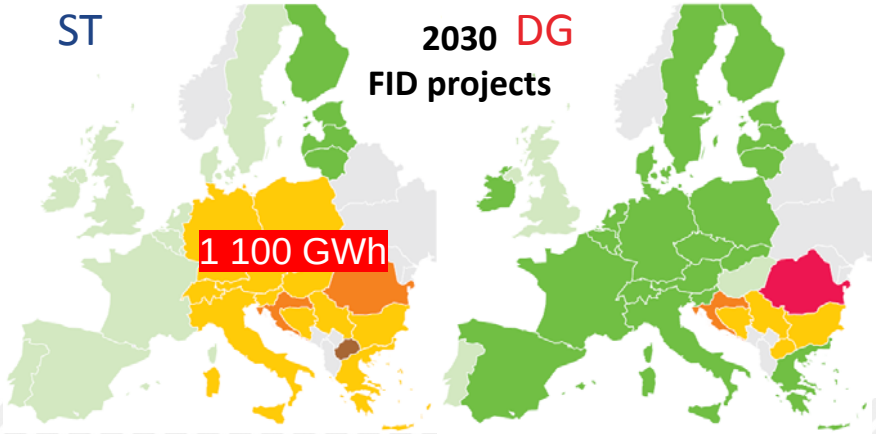
However, some remaining gaps are identified after 2020…

FID projects

ST

2030 DG

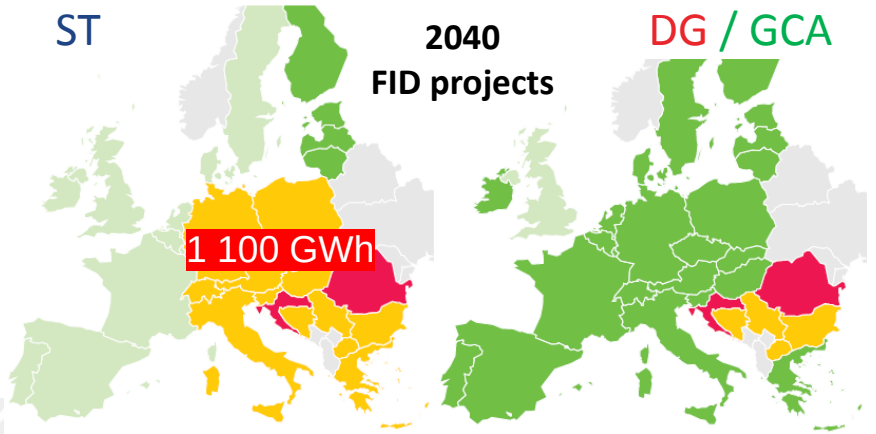
FID projects



ST

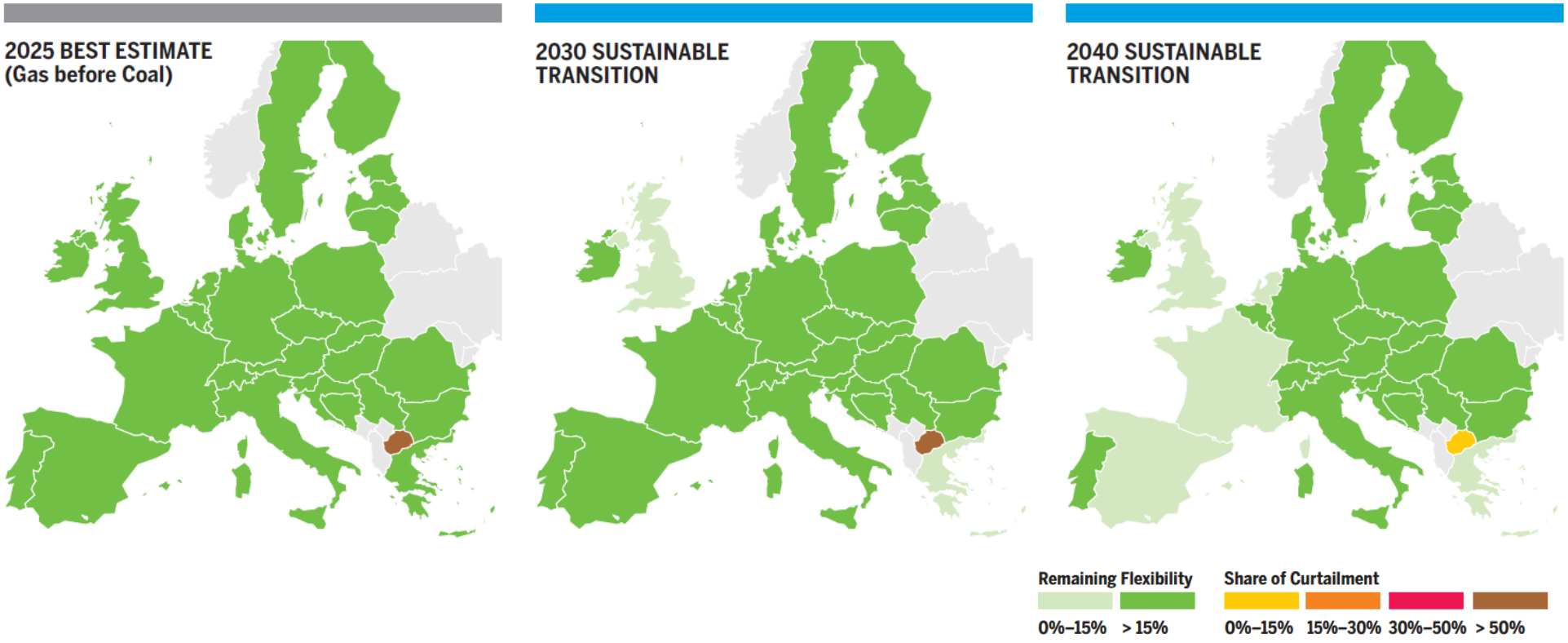
2040 DG / GCA

FID projects



Ukraine transit route disruption

FID + Advanced projects



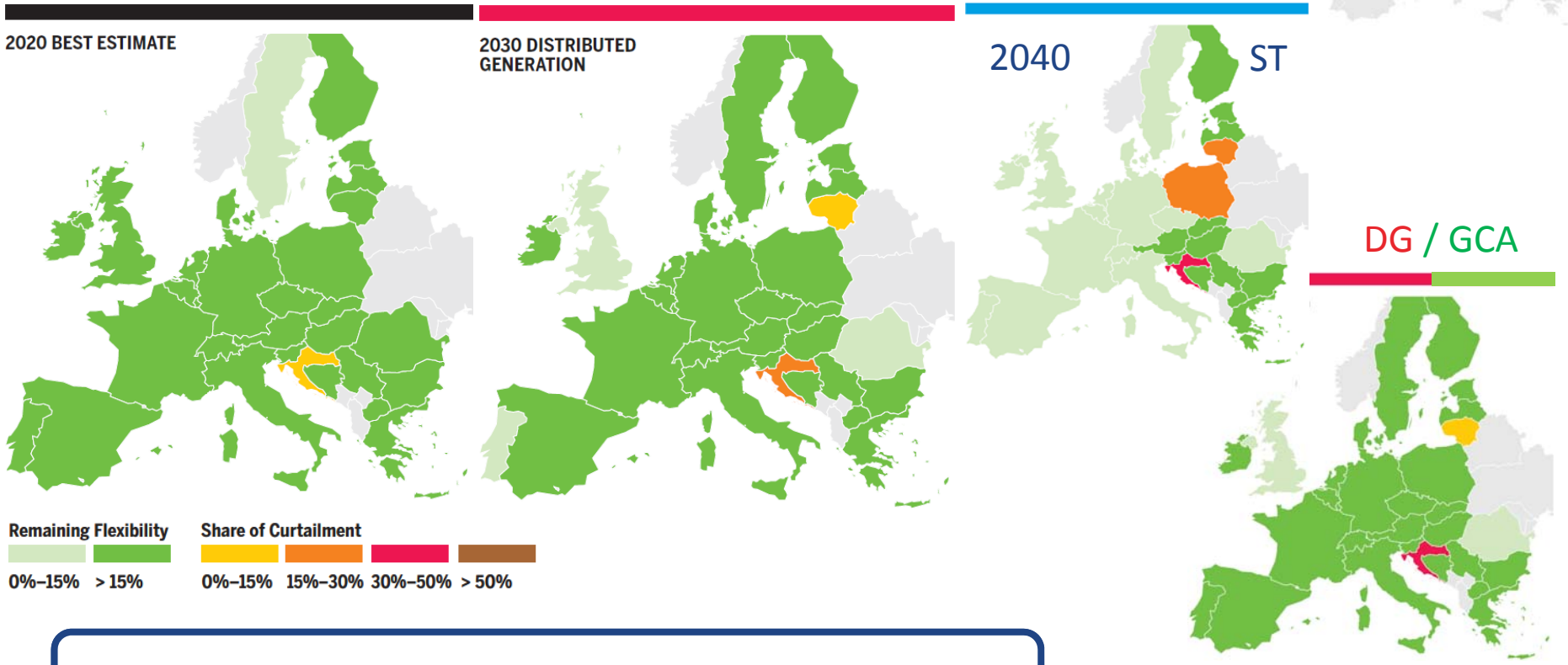
Advanced projects mitigate the situation after 2020 in <u>all scenarios</u>

Belarus disruption

Peak day conditions

Most of European gas system is resilient

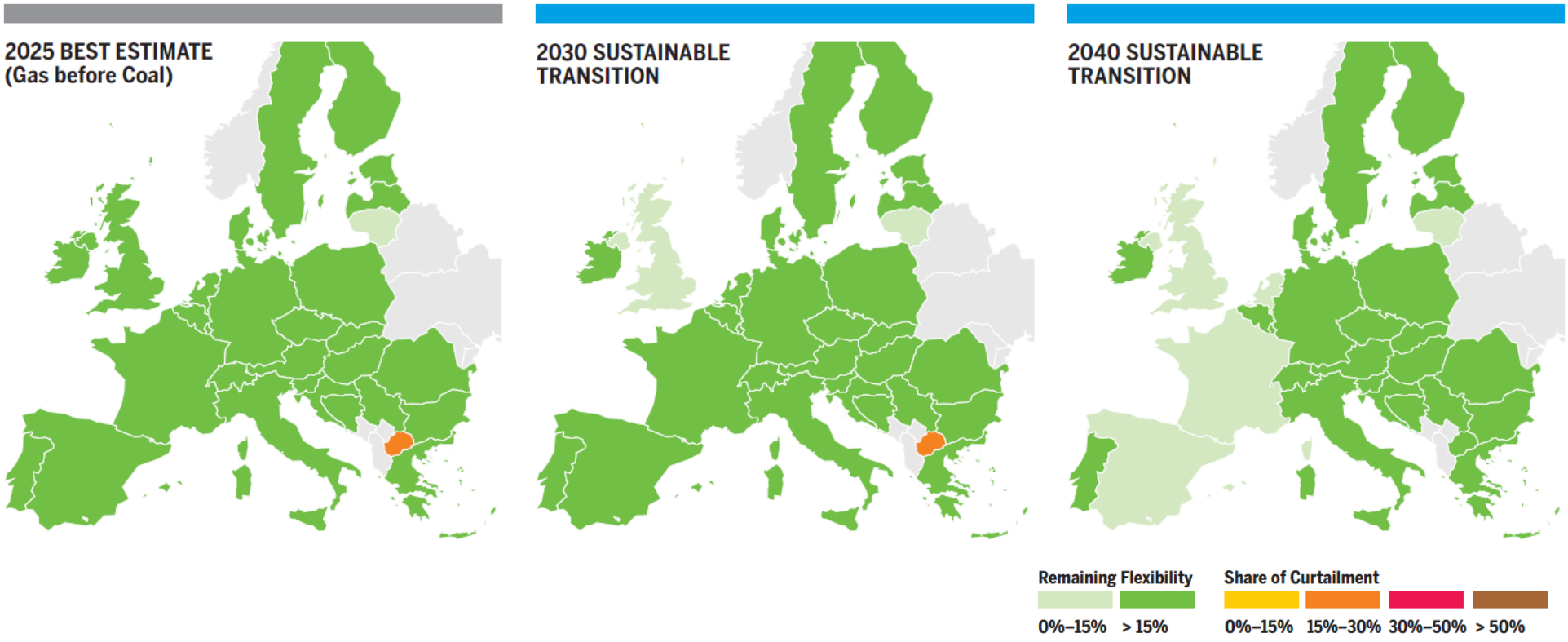
FID projects



Lithuania and Poland can be exposed in the longer term

Belarus disruption

FID + Advanced projects



Advanced projects mitigate the situation after 2020 in all scenarios

Baltic States and Finland disruption

Peak day conditions

Finland and Estonia exposed to demand curtailment in all scenarios

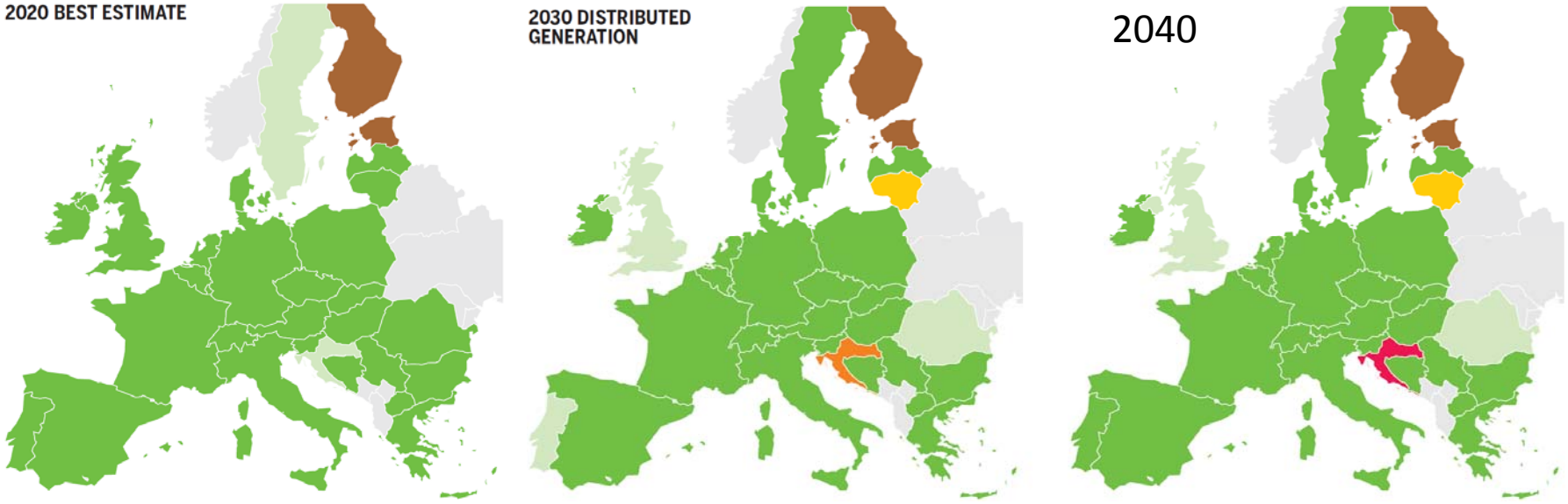
FID projects

DG / GCA

2020 BEST ESTIMATE

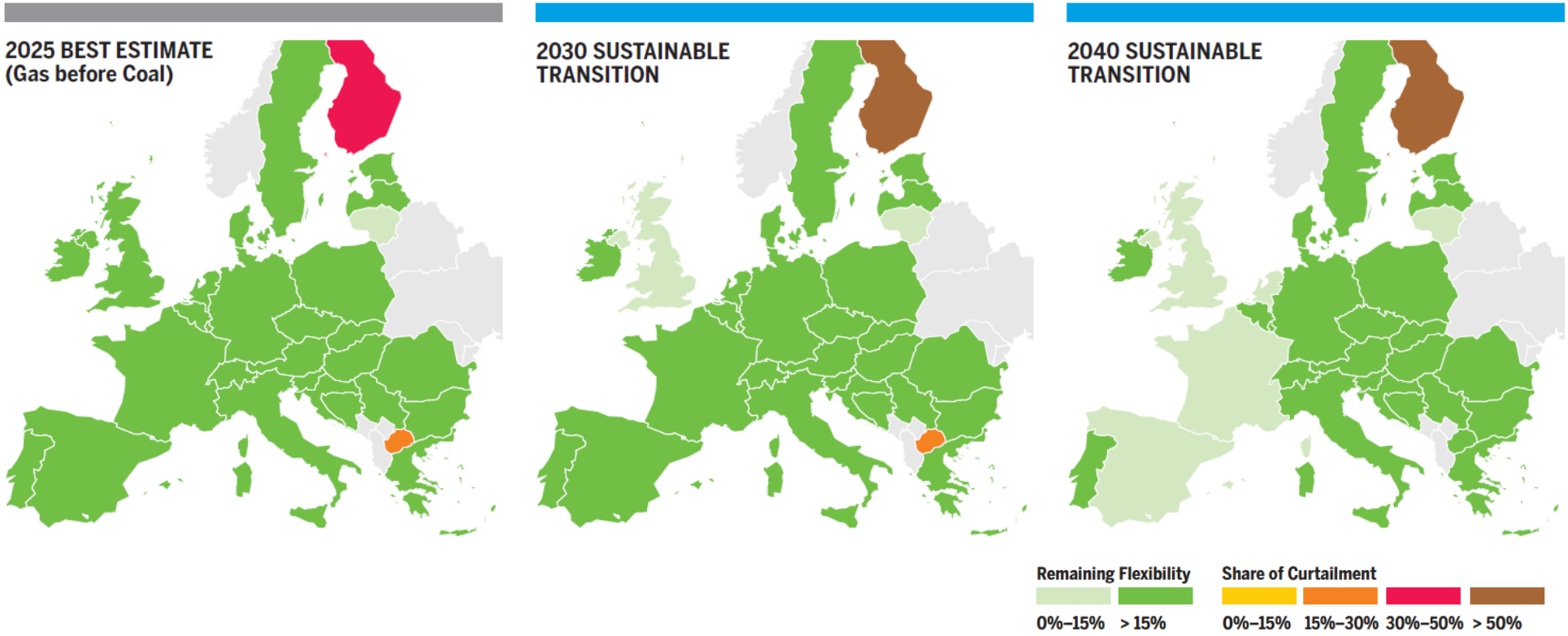
2030 DISTRIBUTED GENERATION

2040



Baltic States and Finland disruption

FID + Advanced projects



Advanced projects mitigate the situation for Estonia after 2020 in all scenarios, but Finland remains exposed to significant demand curtailment

Algeria pipeline imports disruption

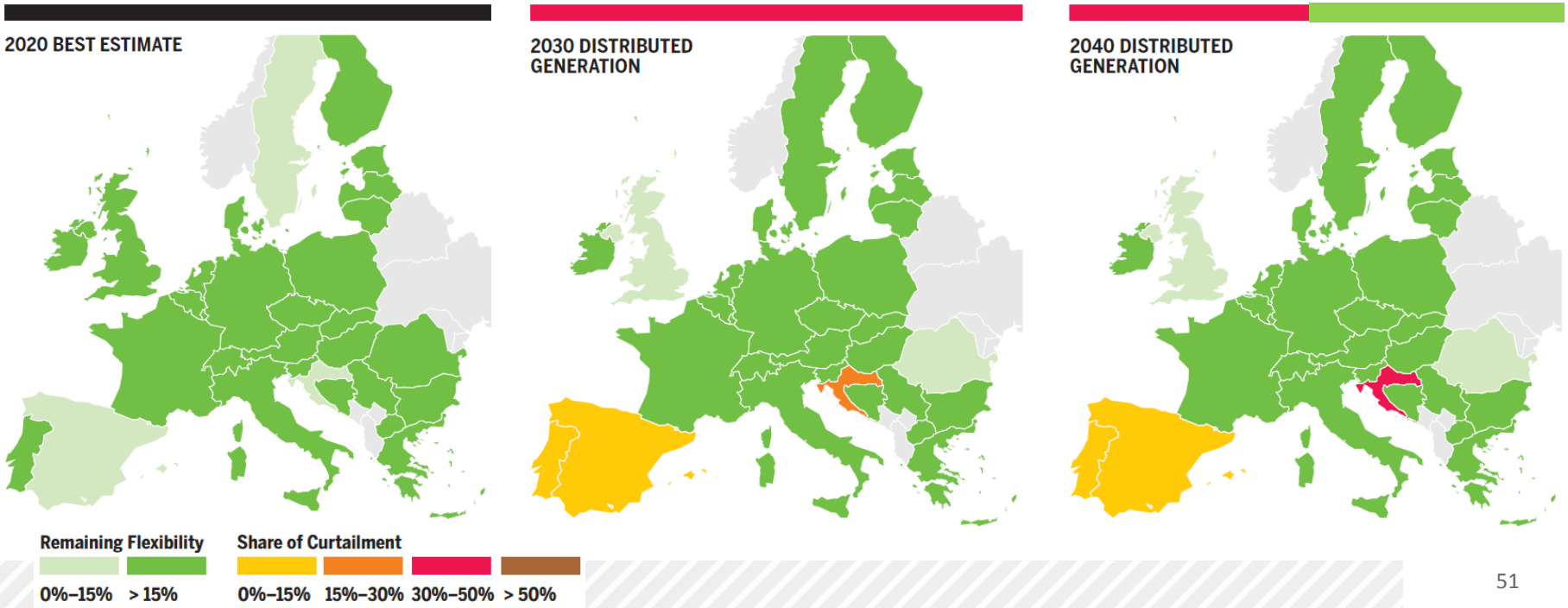
Peak day conditions

Iberian peninsula is exposed to limited demand curtailment (≤10%) in all scenarios

> in ST 2040, the exposure to demand curtailment is higher (20%), showing a potential infrastructure bottleneck.

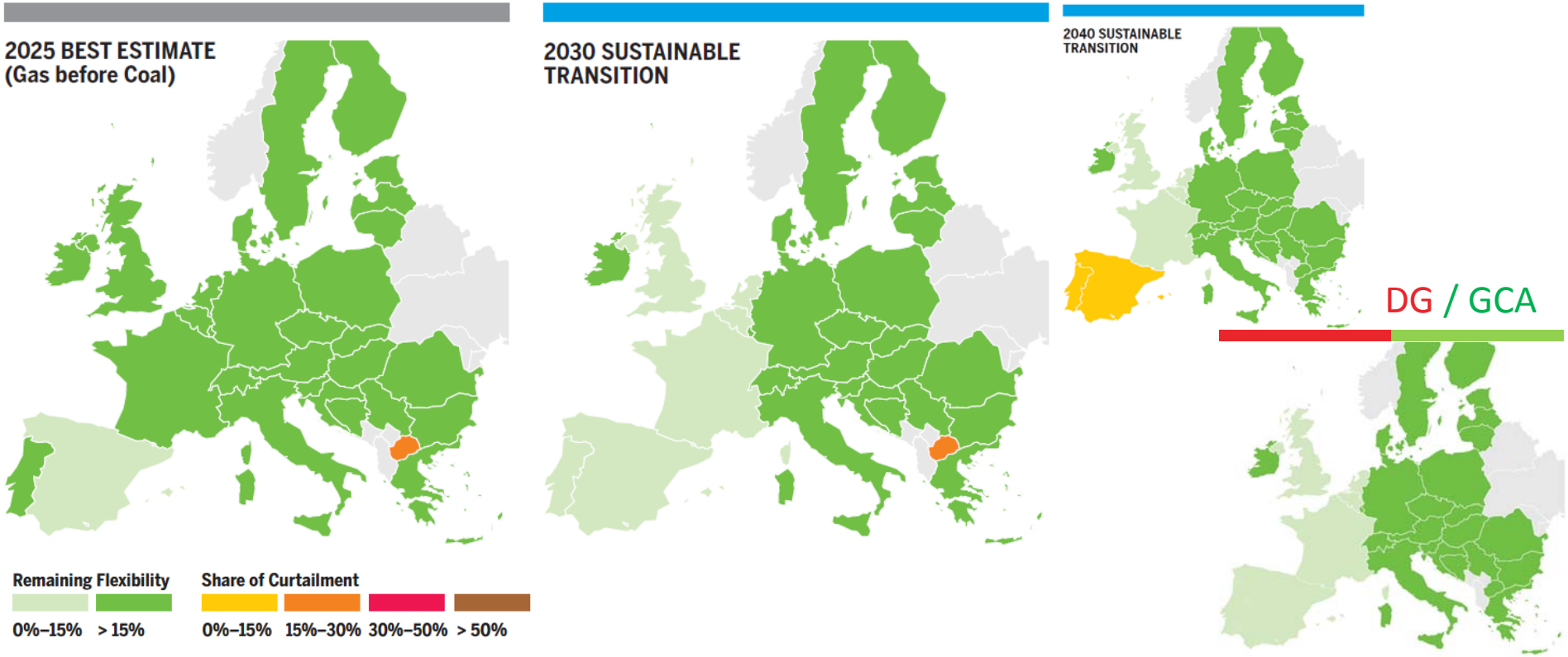
FID projects

DG / GCA



Algeria pipeline imports disruption

FID + Advanced projects



Advanced projects mitigate the situation for Iberian peninsula after 2020 in all scenarios but Sustainable transition in 2040

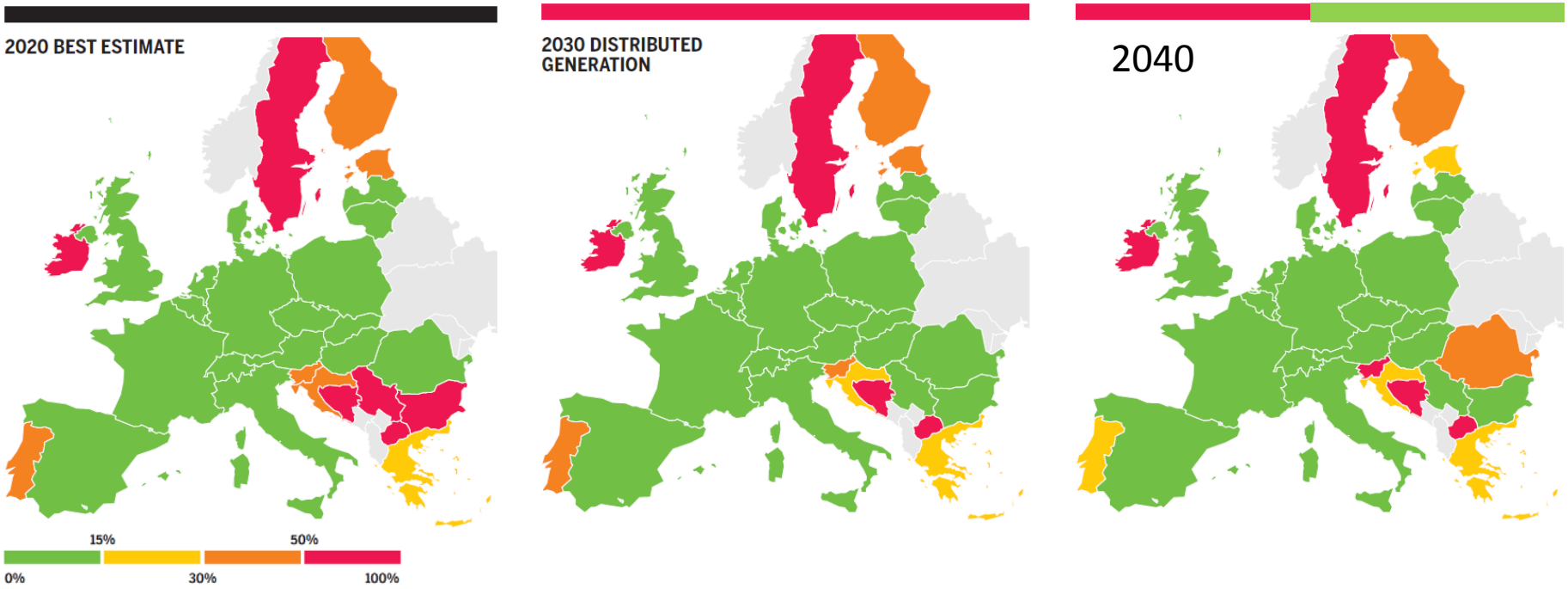
Single Largest Infrastructure Disruption

FID projects

> Countries at the border of the EU with limited interconnections to neighbouring countries rely on their largest infrastructure to satisfy their demand

> South-Eastern Europe is also exposed in the shorter term

DG / GCA

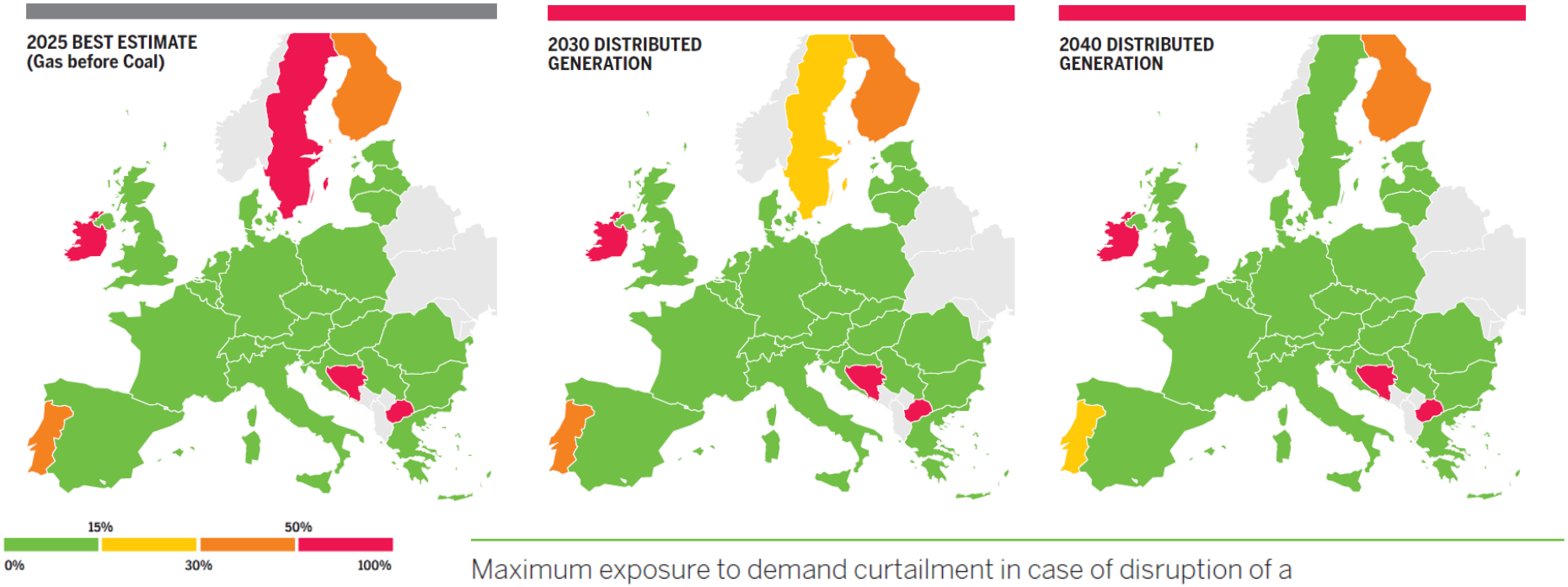


In ST (2030-2040), SLI disruption in Slovakia can expose Europe to an overall gas shortage (≈400 GWh on a peak day)

Maximum exposure to demand curtailment in case of disruption of a Single Largest Infrastructure

Single Largest Infrastructure Disruption

FID + Advanced projects

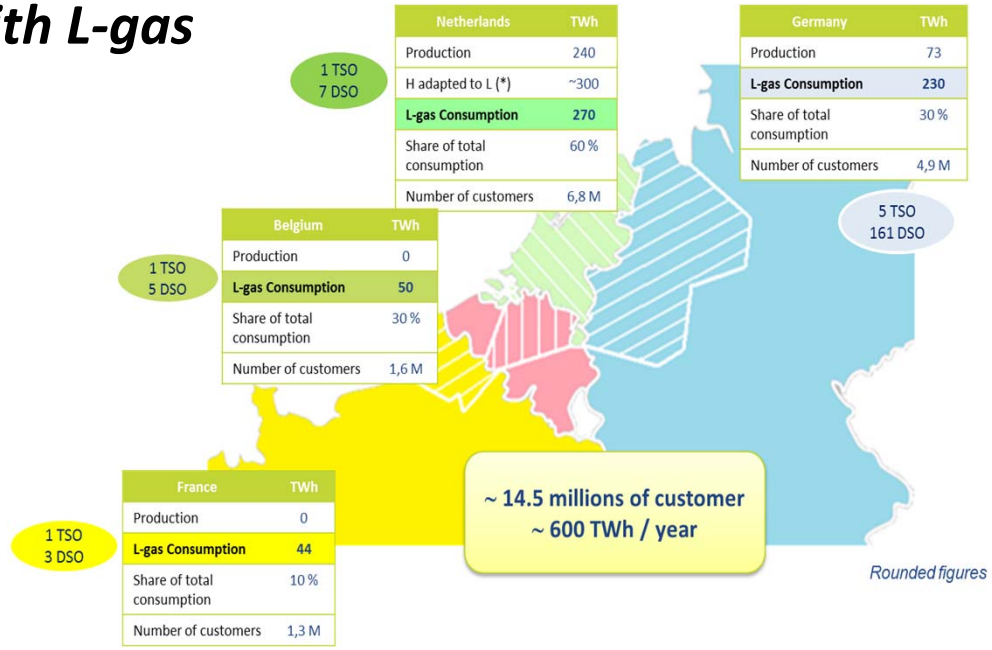


Maximum exposure to demand curtailment in case of disruption of a Single Largest Infrastructure

Advanced projects mitigate the situation in South-Eastern Europe as of 2025 in all scenarios

Adaptation of L-gas to H-gas

Netherlands, Germany, Belgium and France markets are partly supplied with L-gas



> Starting from 2020, part of the local gas demand in ***BE***, ***FR*** and ***DE*** will be converted from L-gas to H-gas

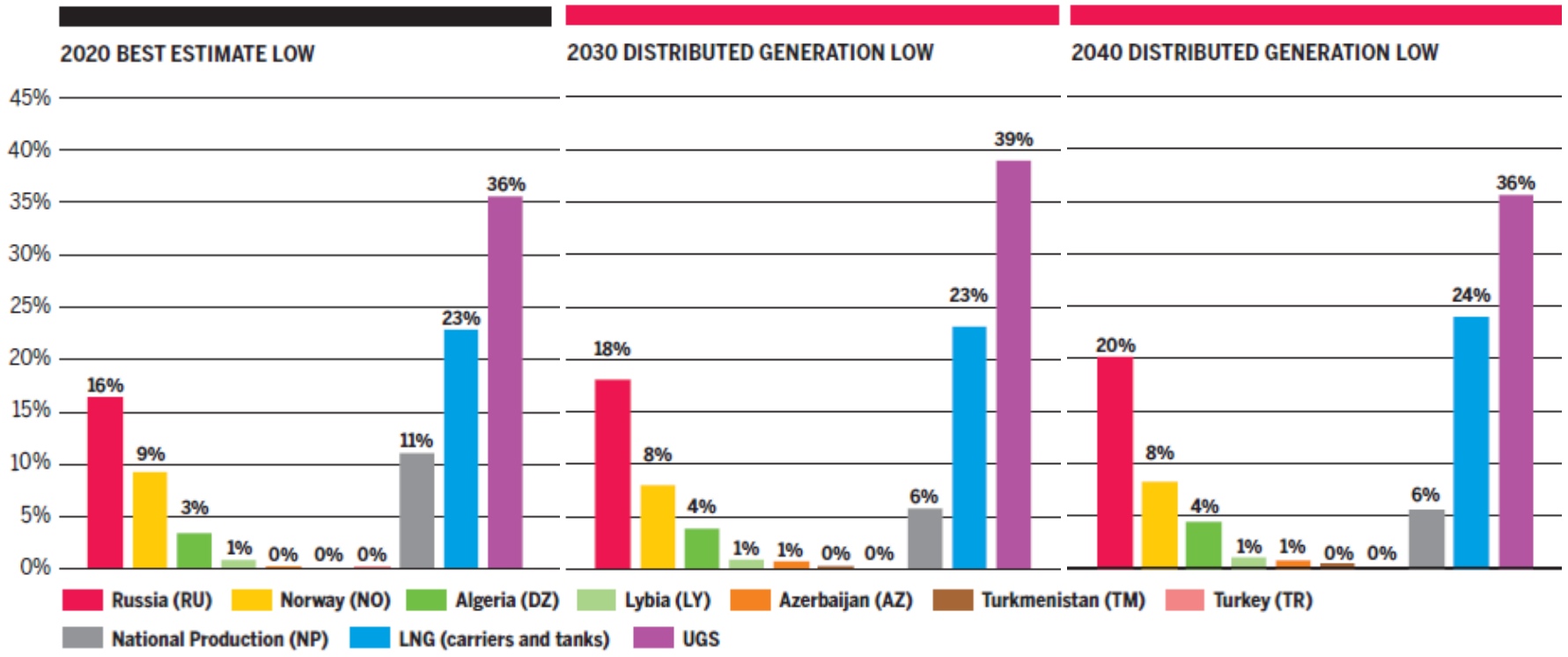
> **L-H gas conversion is already considered in the Low Infrastructure assessment**

> ENTSOG has run PS-CBAs for L-H gas conversion projects in Belgium and France

Security of Supply – Supply flexibility

Low infrastructure level ensures the necessary flexibility to cope with a peak day

> **Gas storages** and **LNG terminals** provide most of the extra supply flexibility



Security of supply

Already achieved

- *Resilience to climatic stresses (1-in-20 conditions)*
- *Resilience to a large number of supply and infrastructure disruptions*

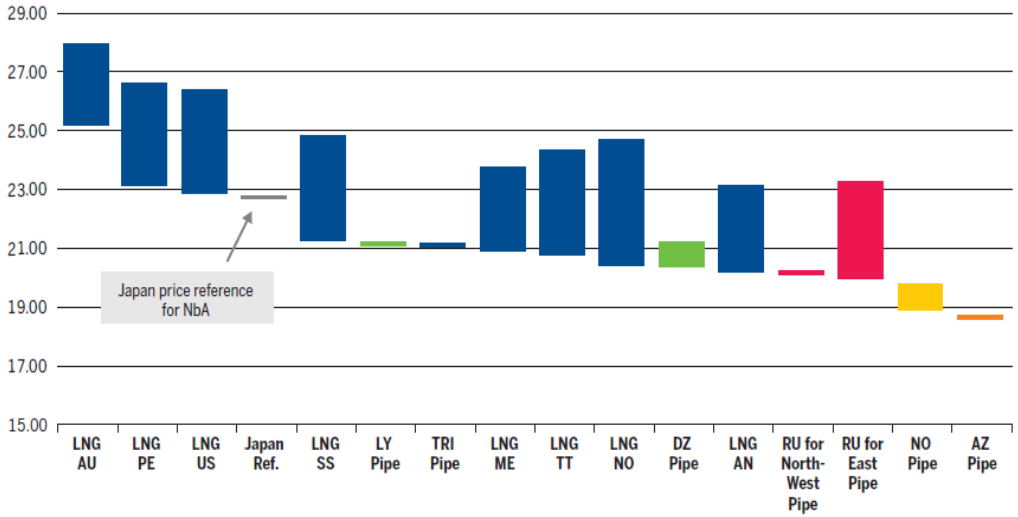
Further infrastructure needs

- *Mitigating the impact of Ukraine route disruption in South-Eastern Europe*
- *Mitigating the impact of Belarus route and Russian imports disruption in North-Eastern Europe*
- *To mitigate impact of national largest infrastructures disruptions in specific countries*

Competition & Market Integration

Market modelling assumptions

Supply prices



Example of the merit order of the supply sources in the Reference case (Japan reference price purely indicative)

- The range of each supply is depending on the entry costs to EU and shipping cost for LNG
- Differentiated supply prices embedded in the reference price configuration

5 price configurations to assess the sensitivity to each supply source

Russia maximisation	Low price
Russia minimisation	High price
LNG maximisation	Low price
LNG minimisation	High price
South gas supply maximisation	Low price

Note: Supply assumptions consulted with stakeholders on 13 February 2018 working session on modelling and market related assumptions

Market layer

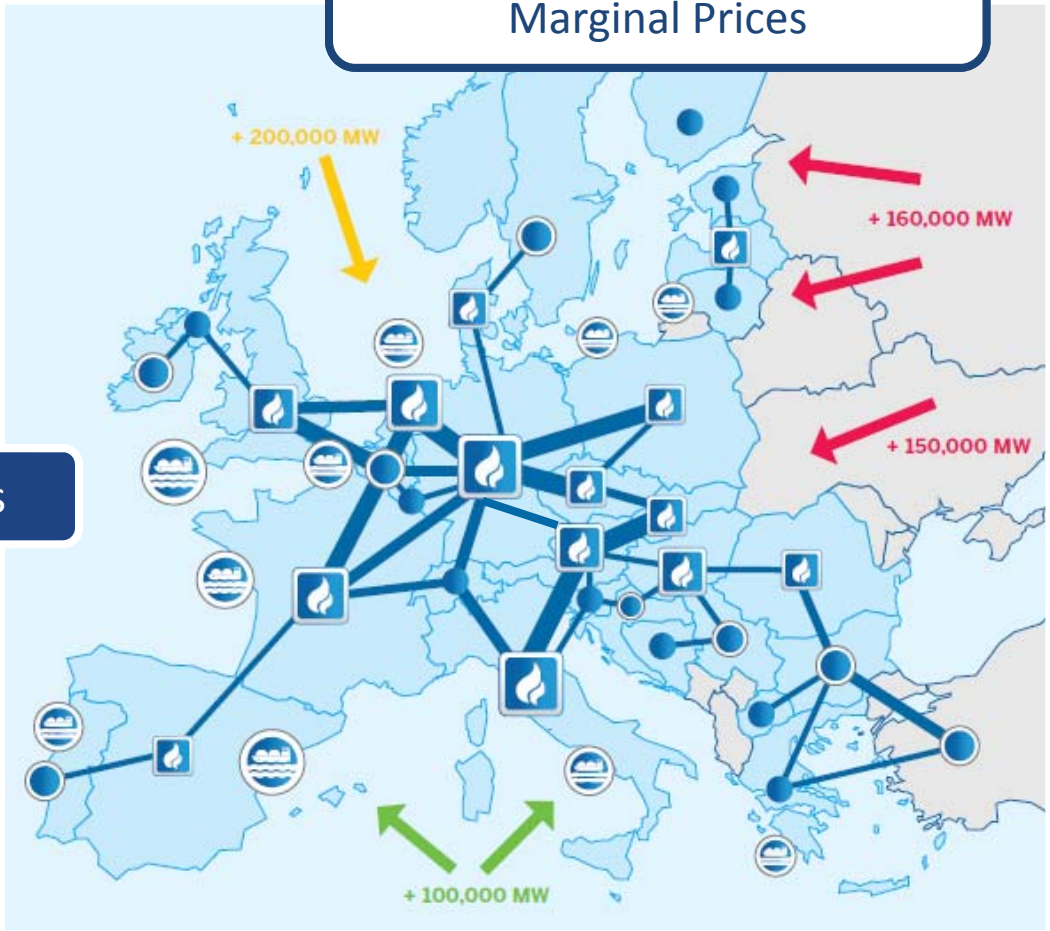
Infrastructure tariffs

Interconnections

LNG Terminals

Storages

Supply Source Access and Marginal Prices



Marginal Prices considering infrastructure costs

Supply Source “commercial” Access

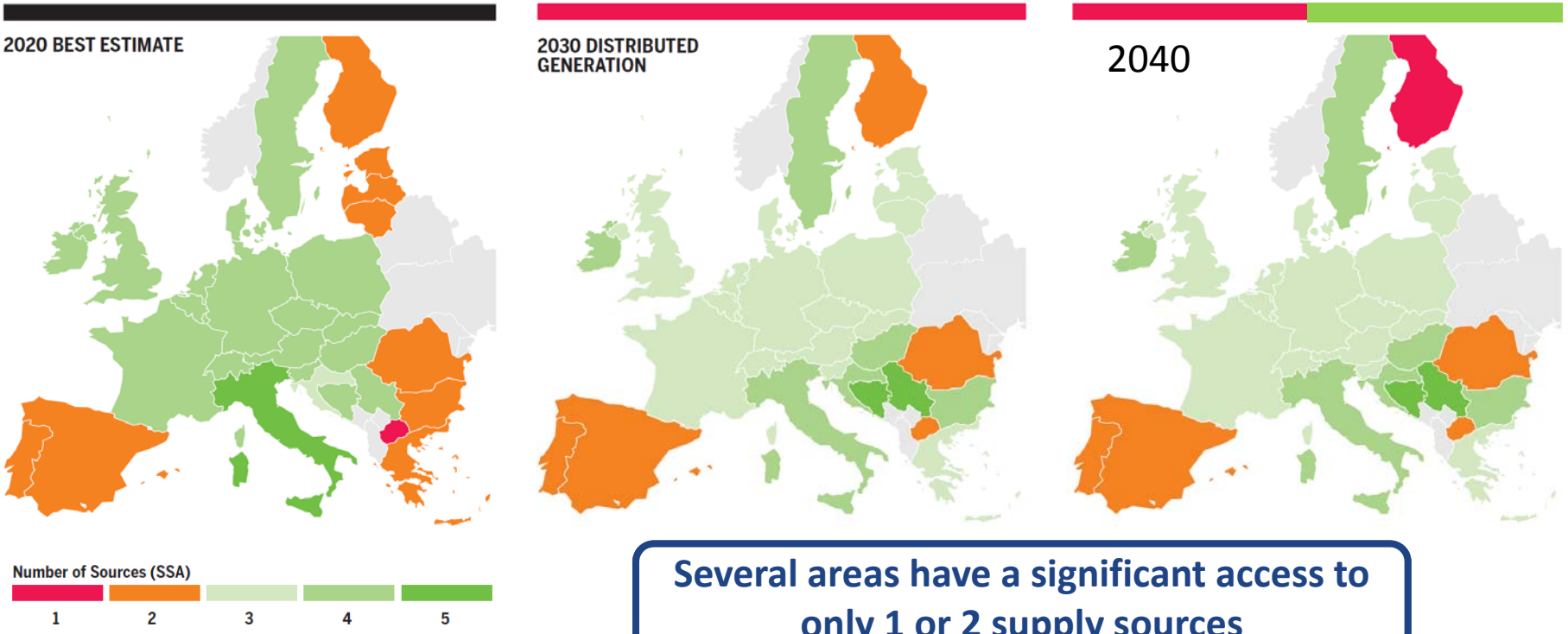
- **Supply Source Access indicator (SSA)** measures the number of supply sources an area can access
- This supply source diversification ability is calculated from a market perspective, as the ability of each area to benefit from a decrease in the price of the considered supply source (**such ability does not necessarily mean that the area has a physical access to the source**)
- Tariffs pancaking effect allows for more realistic source spread among countries
- SSA indicates the number of sources for which a **decrease in price can benefit to more than 20% of the demand** of a country

Supply Source “commercial” Access

FID projects

Most countries access 3 sources but several areas have a significant access to only 1 or 2 supply sources

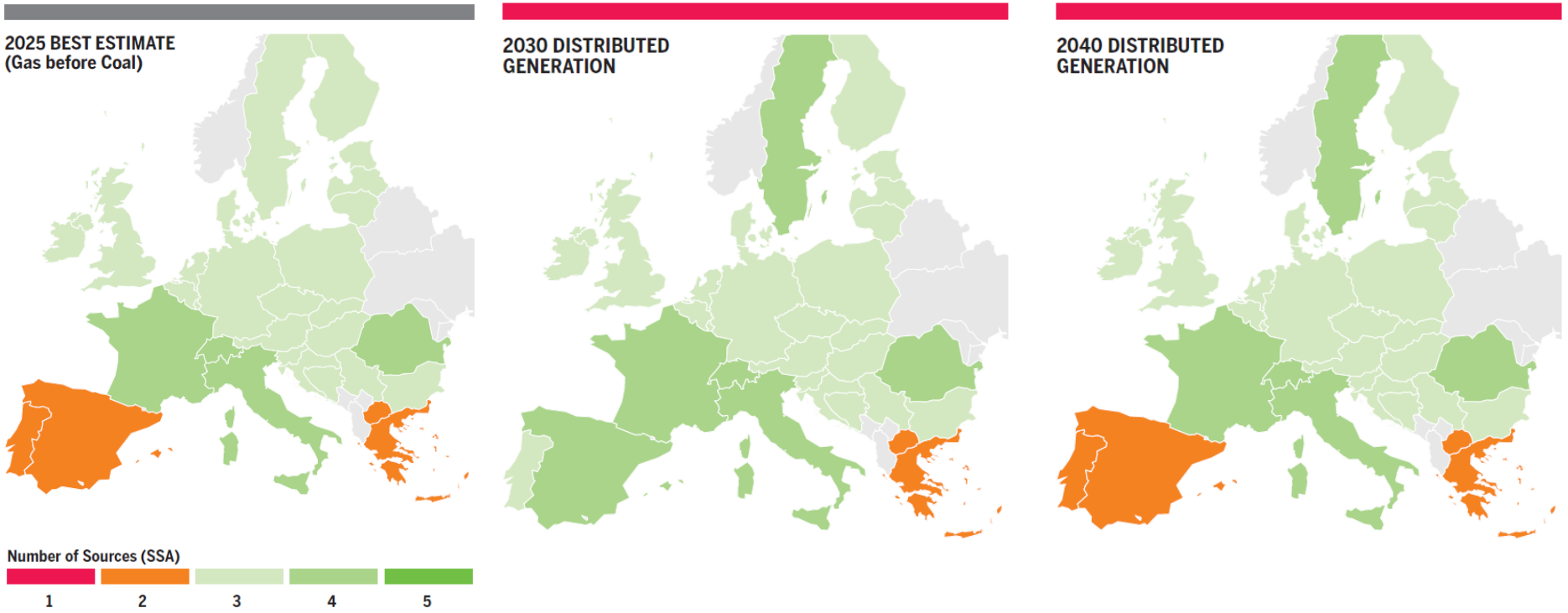
DG / GCA



Several areas have a significant access to only 1 or 2 supply sources

Supply Source “commercial” Access

FID + Advanced projects



Advanced projects ensure access to 3 and more sources to almost all of the EU in 2030 except for Greece and the Iberian peninsula in some scenarios

Competition – Supply Source Dependence

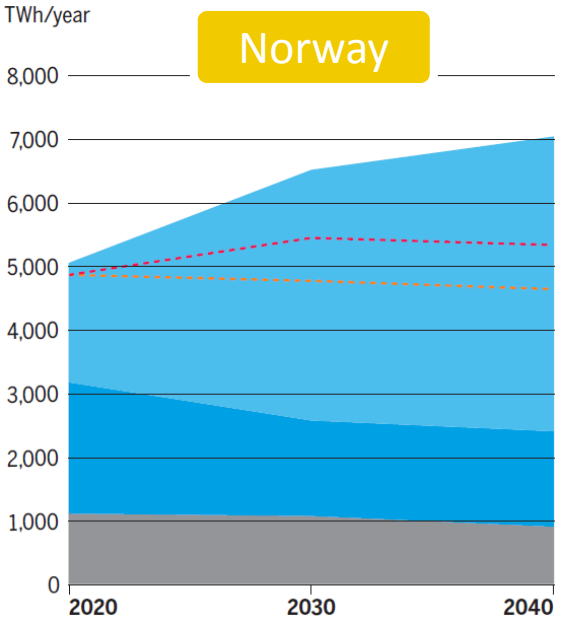
- **Supply Source Dependence (SSD)** measures the Unreducible share of this source necessary for a country to cover its demand on a yearly basis

- Under **cooperative behavior**: countries will align their dependence level as long as infrastructures allow for it
  - Countries will align their minimum source share if infrastructure allows for it
  - **Non-alignment** between countries indicate an **infrastructure bottleneck**

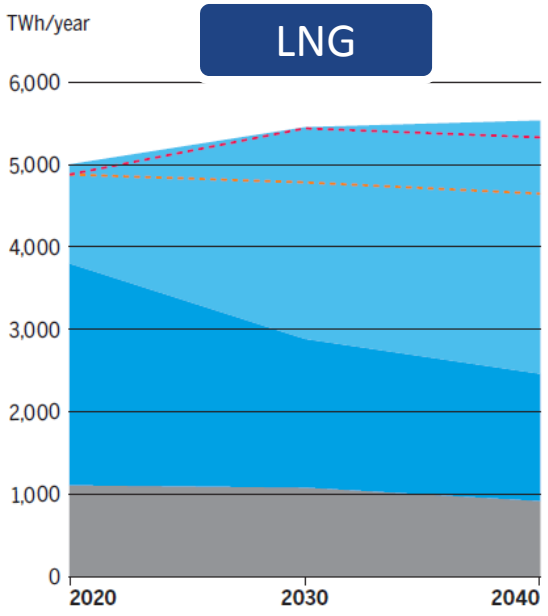
- Dependence > 25% indicates that at least one quarter of the demand need to be supplied from this source

Supply Source Dependence

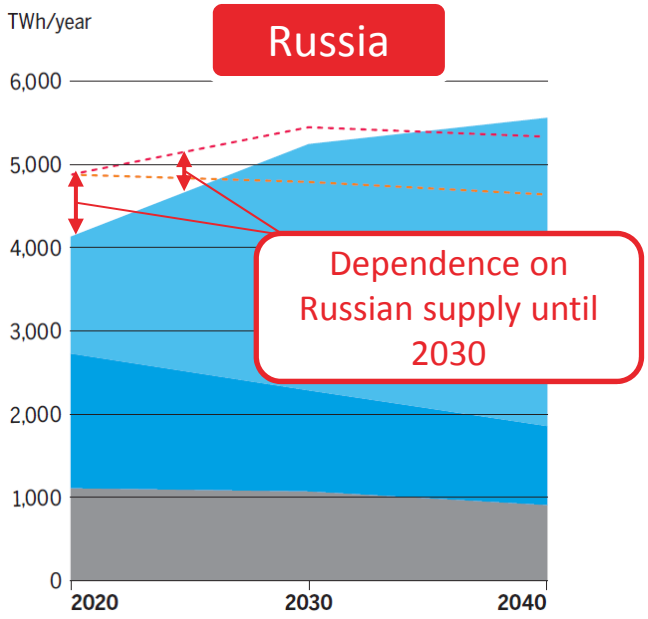
> Europe relies on a minimum share of Russian gas to achieve its supply and demand adequacy in 2020 and 2025



European Level Supply and Demand Adequacy with no supply from Norway



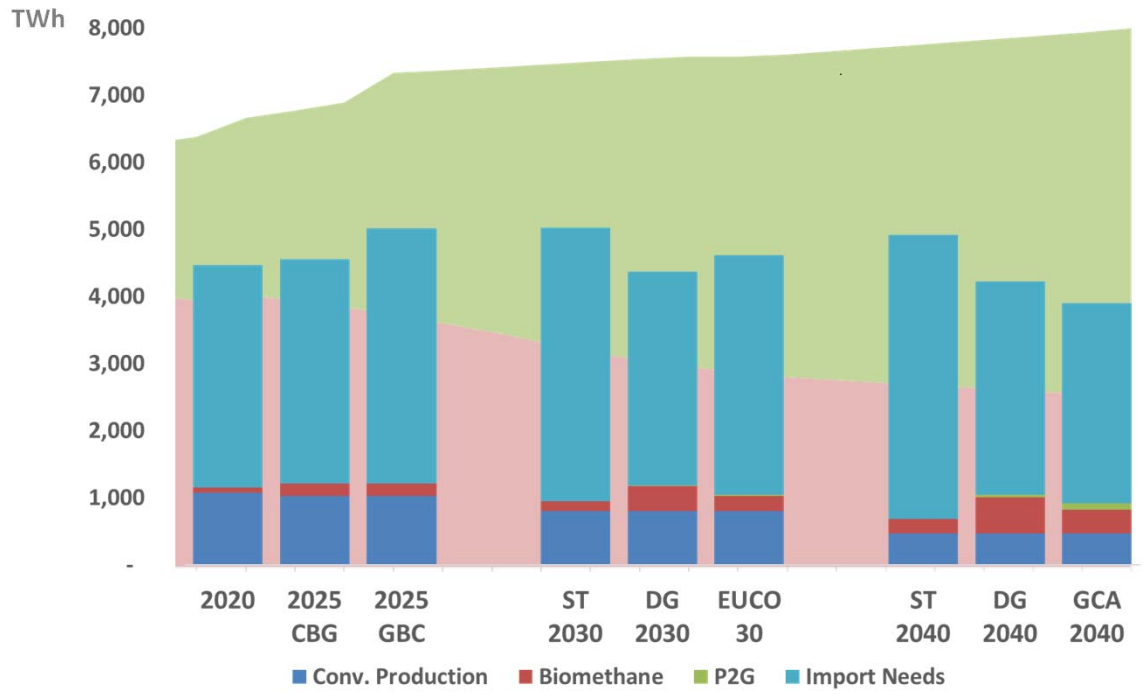
European Level Supply and Demand Adequacy with no supply from LNG



European Level Supply and Demand Adequacy with no supply from Russia

Supply needs over time

Access to new supply sources – indigenous or extra-EU - would contribute to maintain supply diversification and flexibility and supply dependence limited



Maximum imports potential

Minimum imports potential

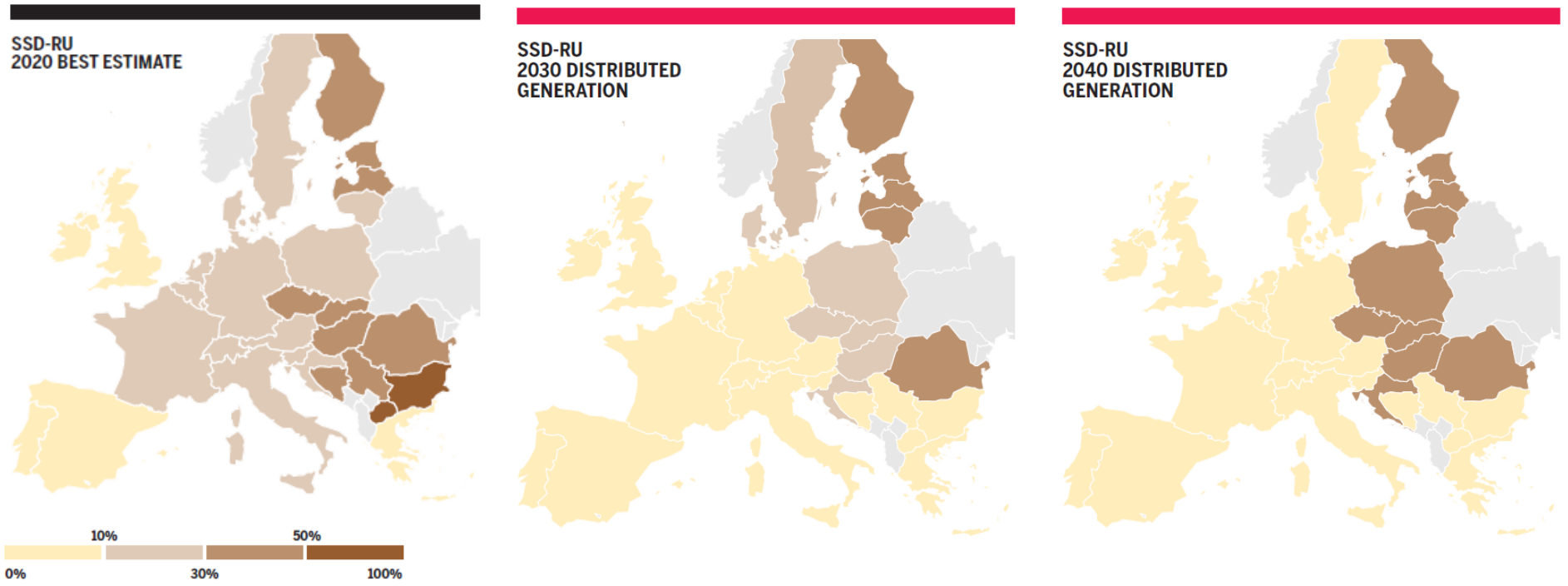
Competition – Supply Source Dependence

Russia

FID projects

> The gas system allows for efficient cooperation between countries so that most of them can share the same dependence

> Eastern Europe has limited alternative to Russian supply

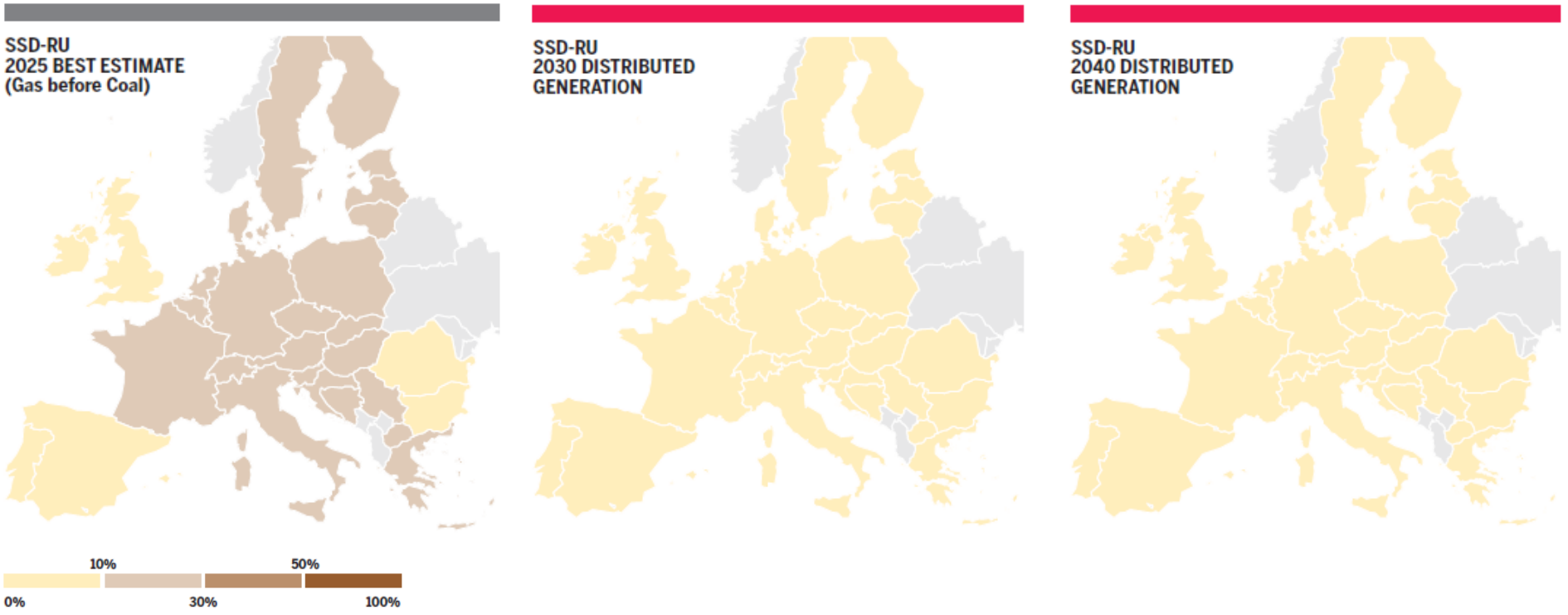


Competition – Supply Source Dependence

Russia

FID + Advanced projects

Advanced projects ensure cooperation for all Europe to share the same level of dependence from 2025 onwards



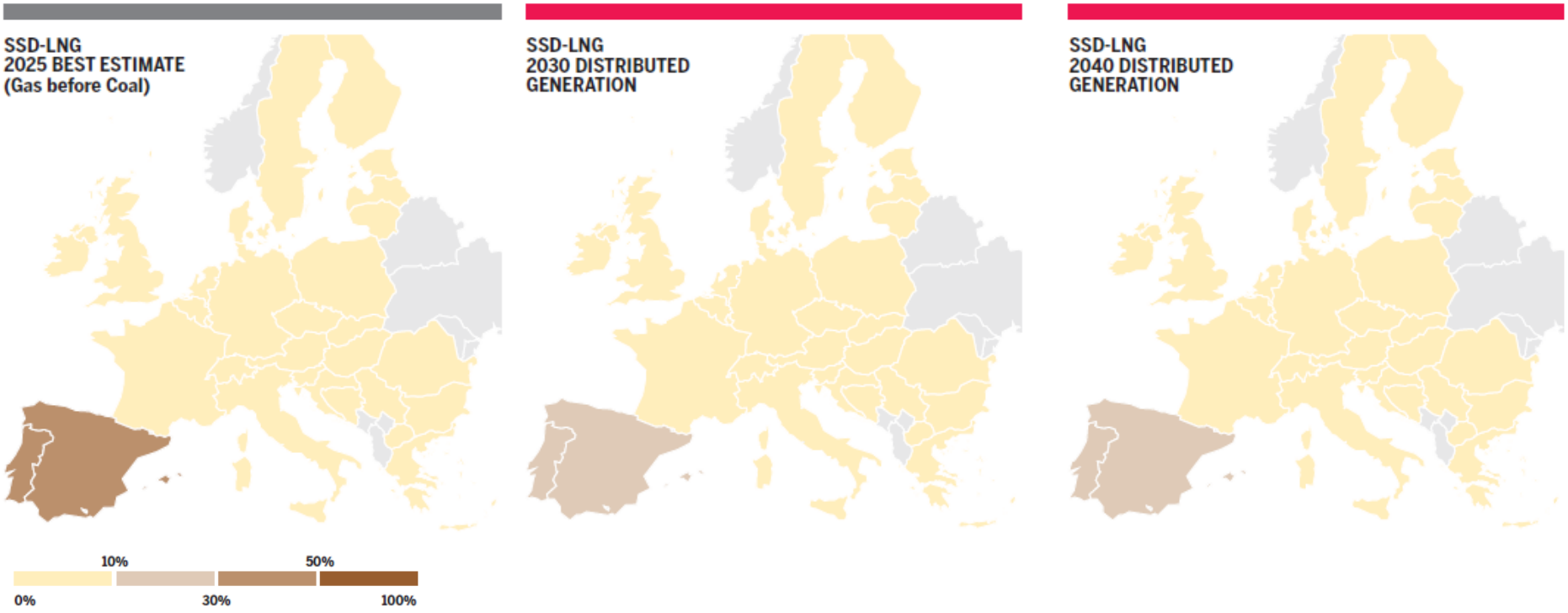
Competition – Supply Source Dependence

LNG

FID projects

> The gas system allows for efficient cooperation between countries in all Europe

> Iberian peninsula has limited alternative to LNG supply

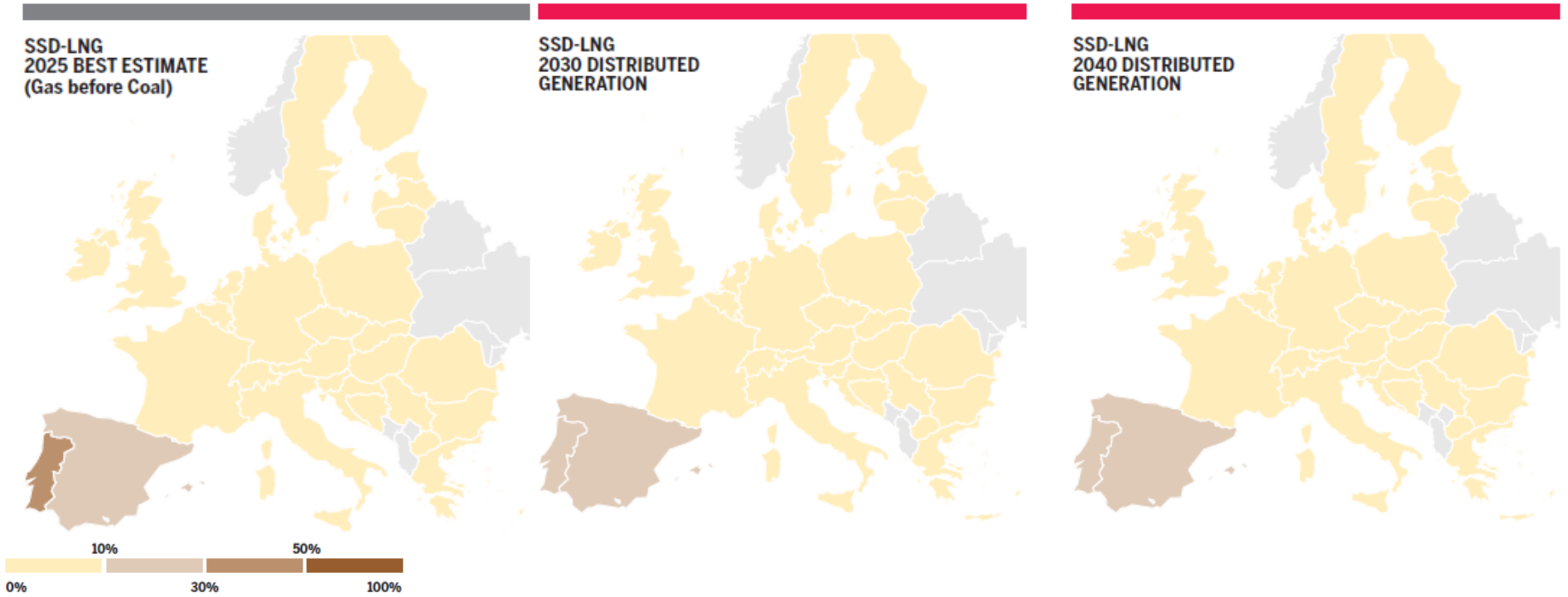


Competition – Supply Source Dependence

LNG

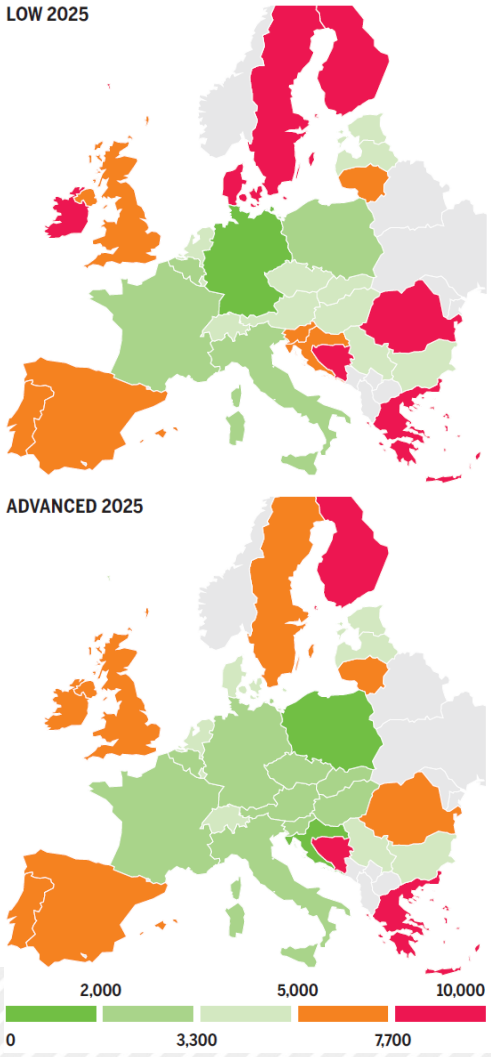
FID + Advanced projects

Advanced projects reduce the dependence of the Iberian peninsula to LNG supply, especially in 2025



LICD LNG and Interconnection Capacity diversification

LICD focuses on connections to the EU market



FID projects

FID + Advanced projects

LICD is an HHI indicator

> The lower the more diversified

> Geographical location related:

- Countries with 2 borders cannot score below 5000
- Countries with 3 borders cannot score below 3333

> Most European countries have an indicator below 5 000

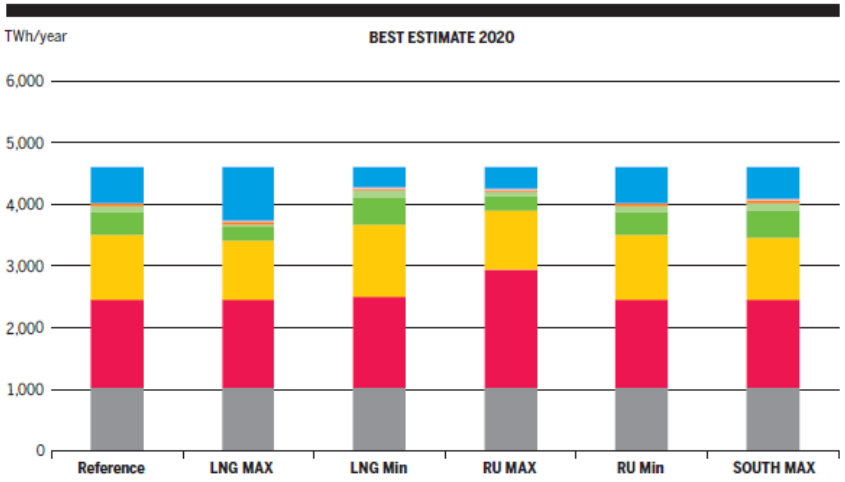
> Countries with a limited number of borders have a LICD higher than 5 000.

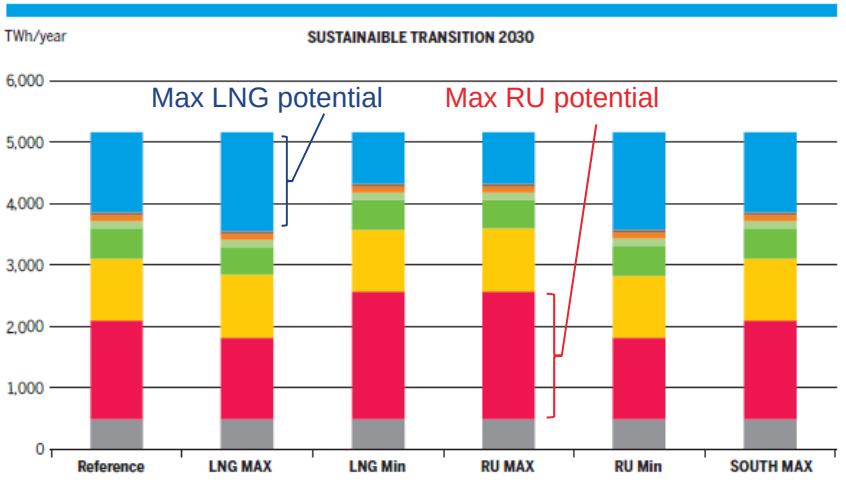
> Advanced projects improve the situation in South-Eastern Europe, Ireland, Denmark and Sweden

Supply mix

The Low infrastructure level allows Europe to access the maximum potential of each supply source

FID projects



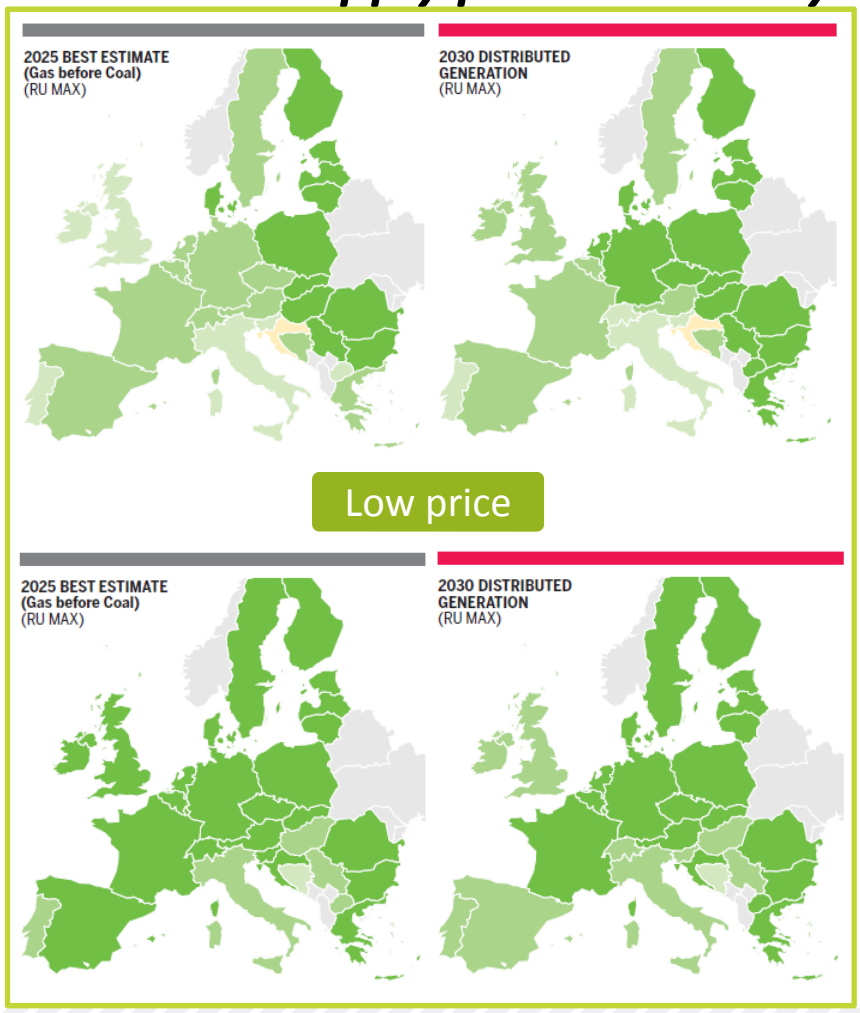


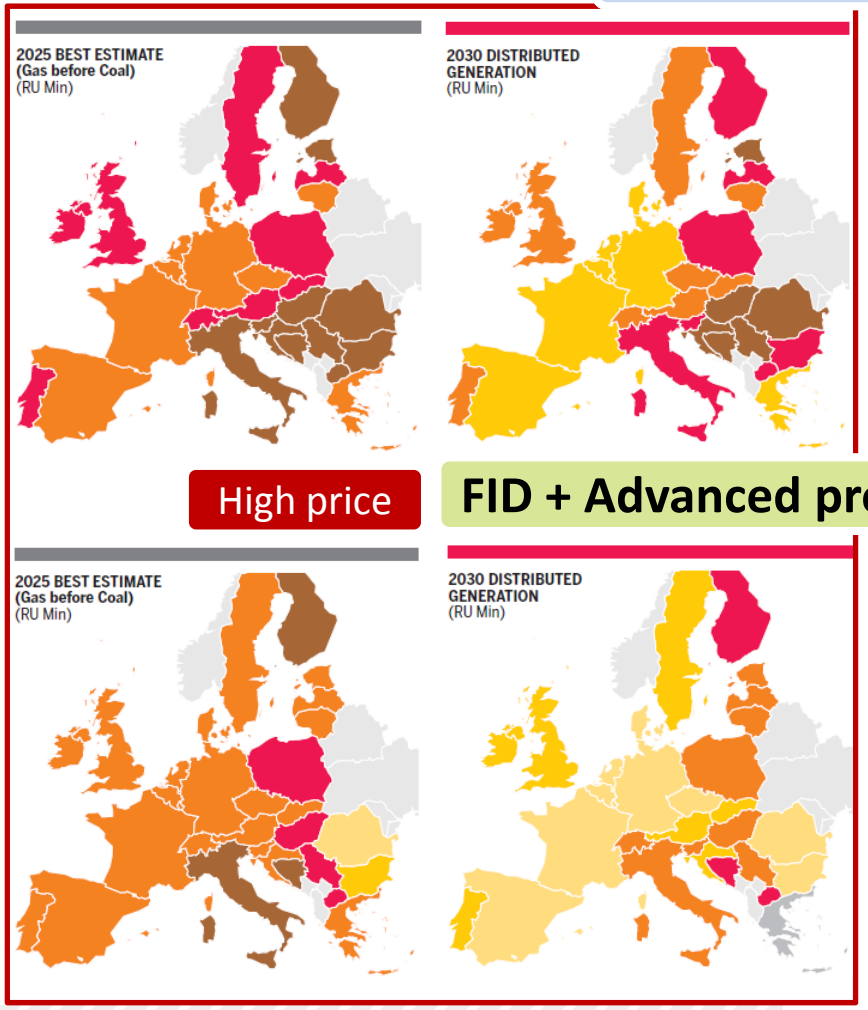
> Some projects bring access to new supply sources or increase the potential of existing sources

Price convergence

Russian supply price sensitivity

FID projects

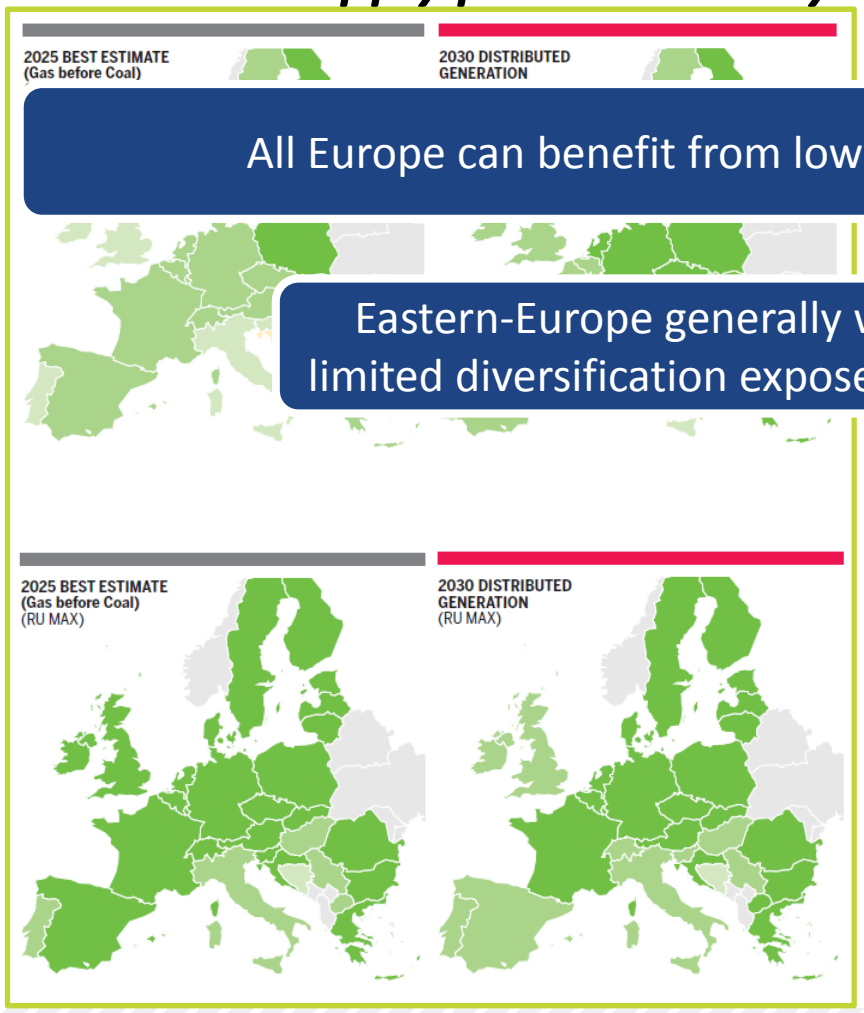




Price convergence

Russian supply price sensitivity

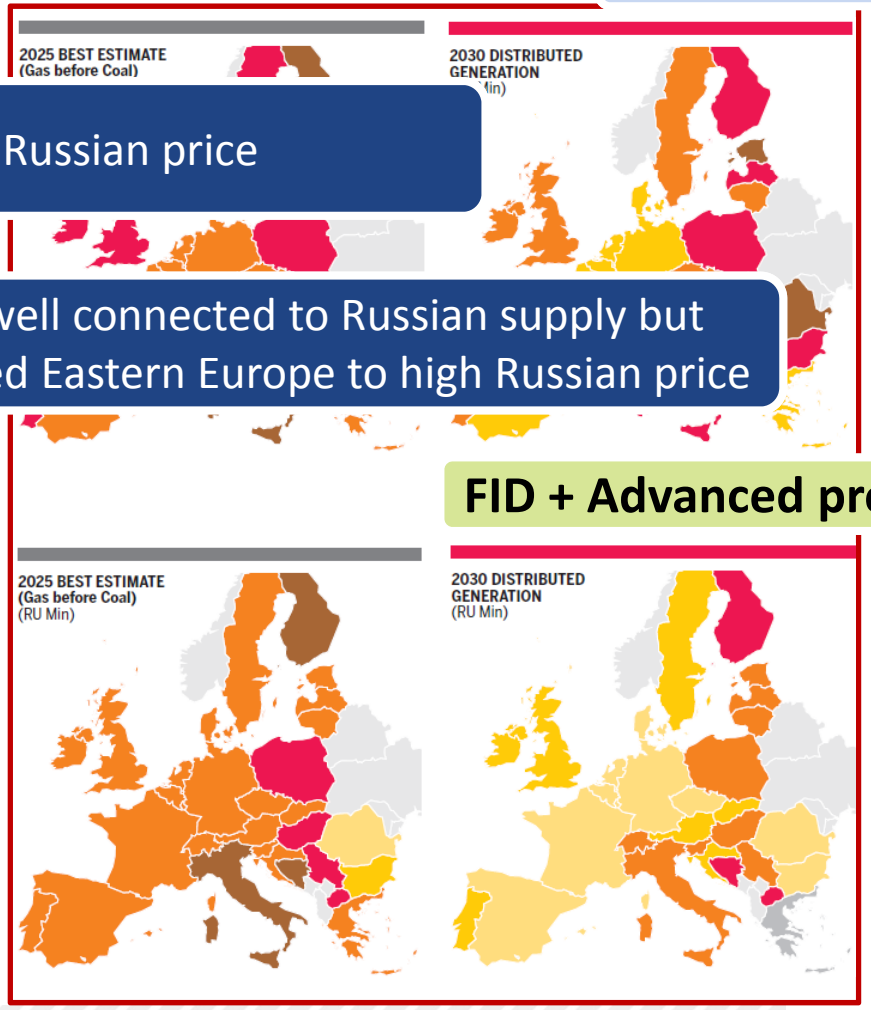
FID projects



All Europe can benefit from low Russian price

Eastern-Europe generally well connected to Russian supply but limited diversification exposed Eastern Europe to high Russian price

FID + Advanced projects



Price convergence

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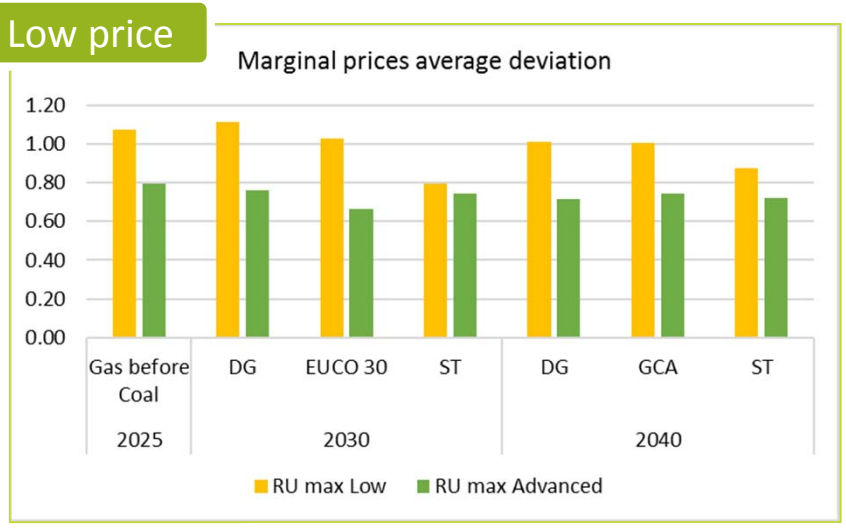
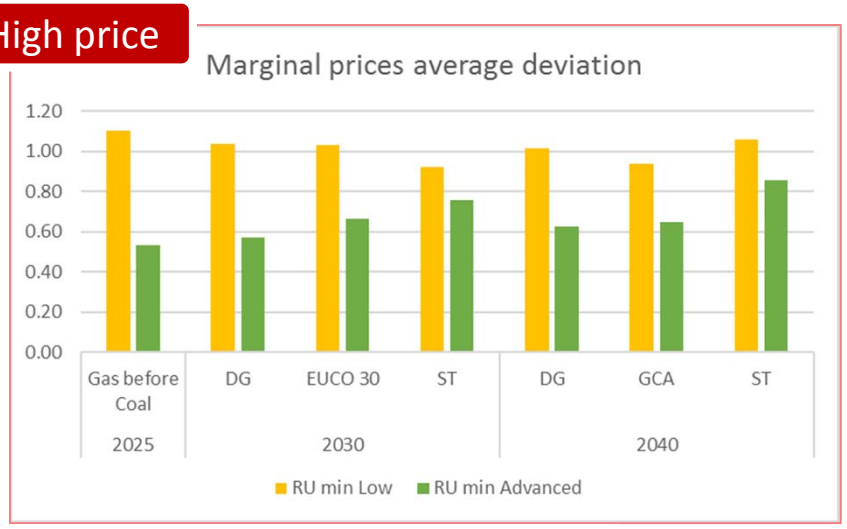
Low price



High price

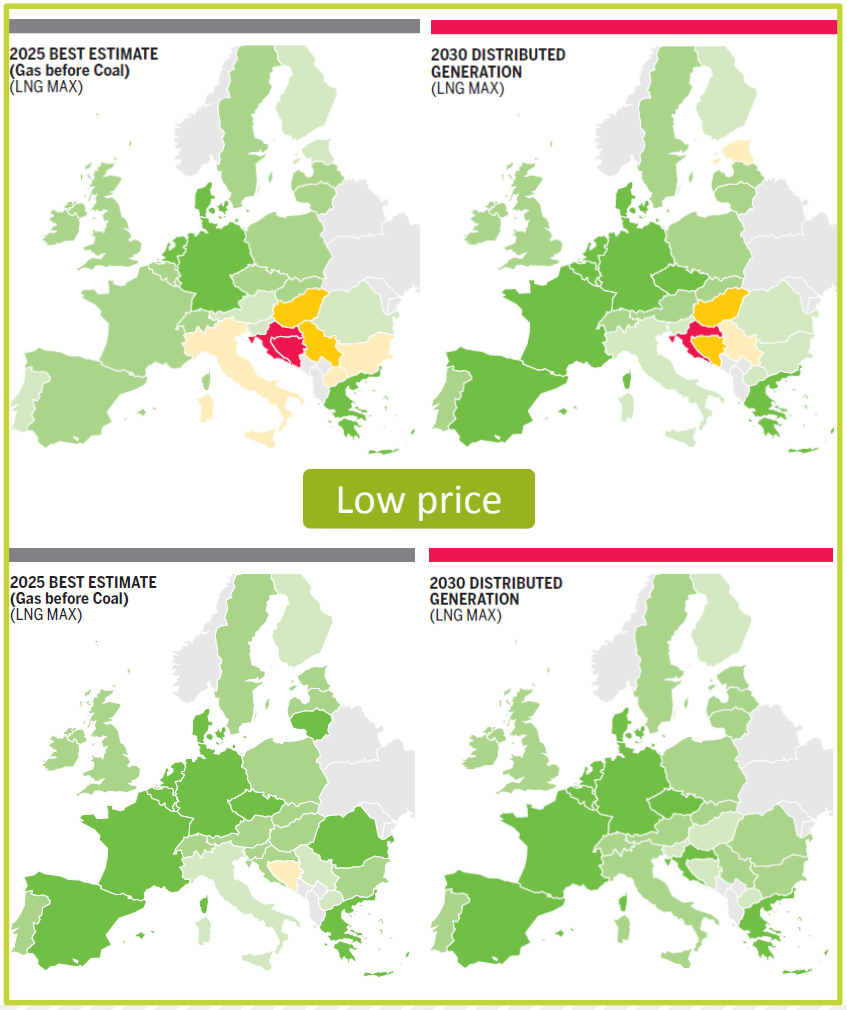


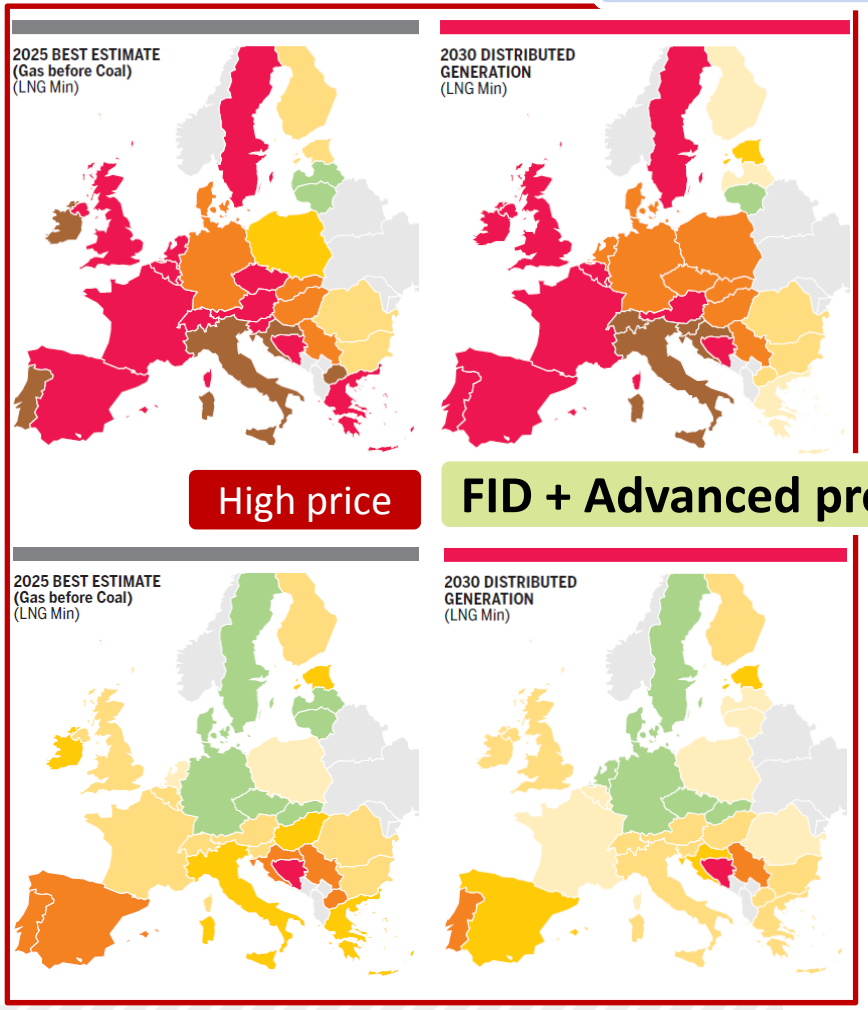
Advanced projects improve price convergence in all scenarios

Price convergence

LNG supply price sensitivity

FID projects

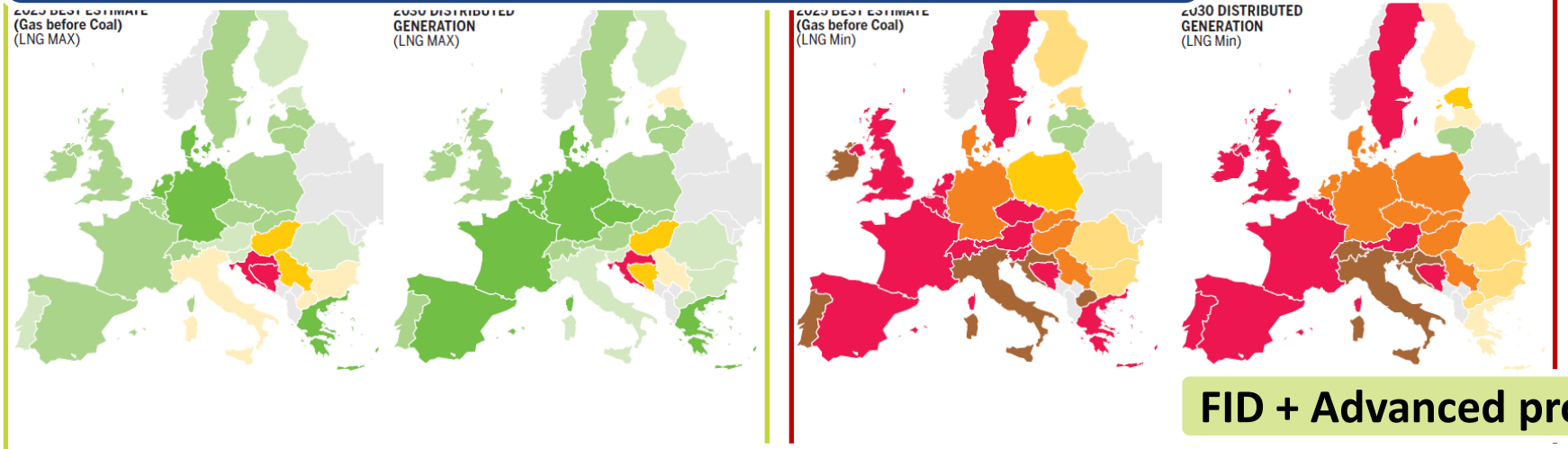




Price convergence

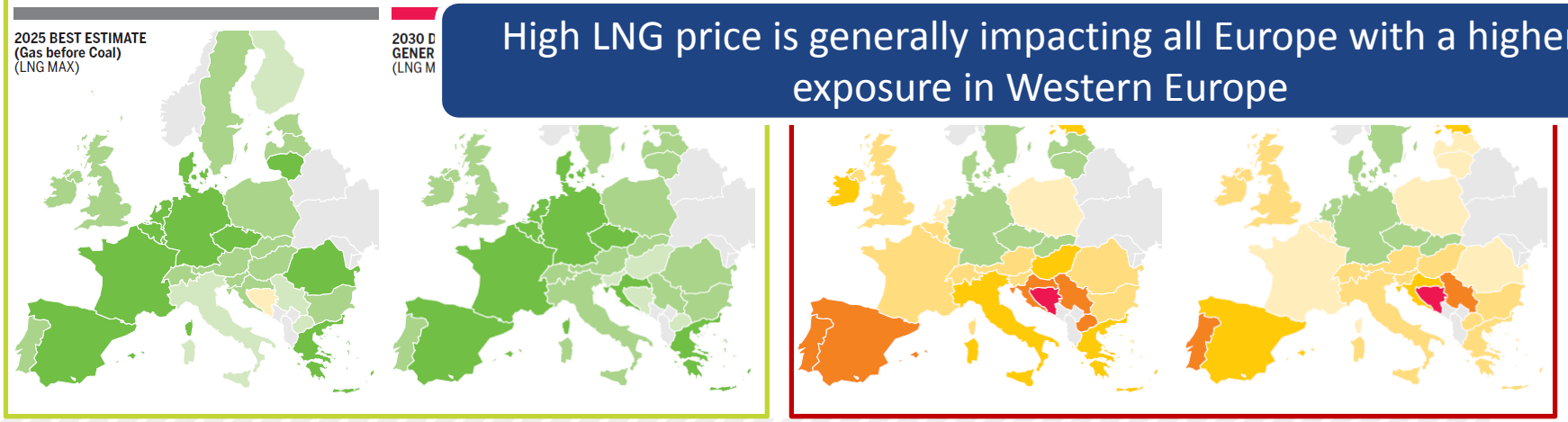
Most of Europe can benefit from low LNG price, with some limitations in Eastern Europe

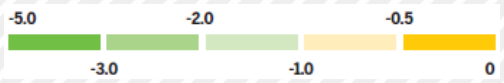
FID projects

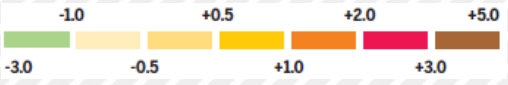


FID + Advanced projects

High LNG price is generally impacting all Europe with a higher exposure in Western Europe





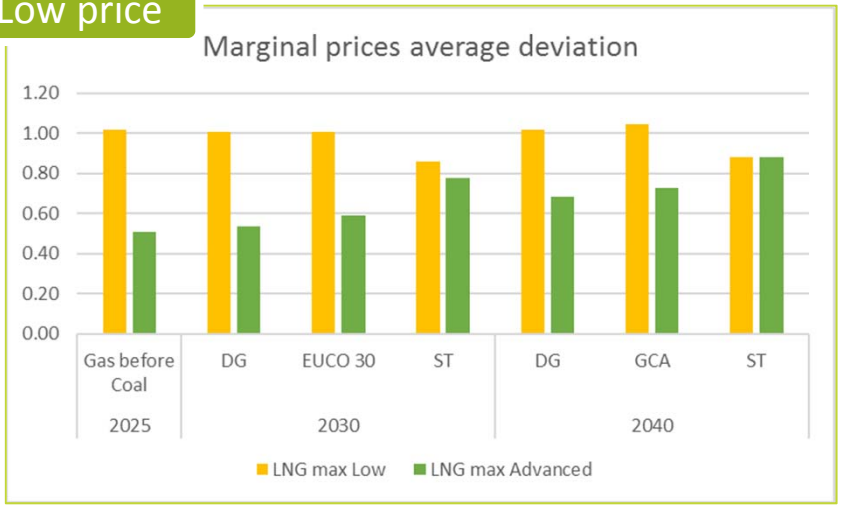


Price convergence

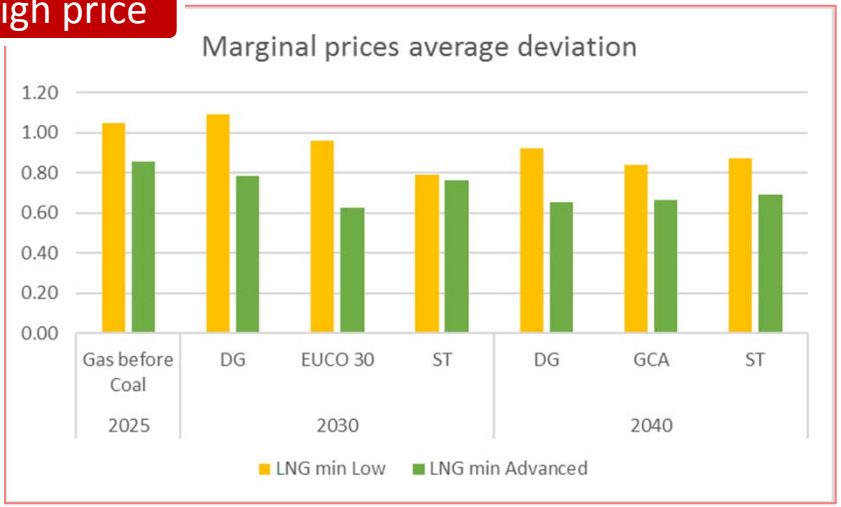
Most of Europe can benefit from low LNG price, with some limitations in Eastern Europe

High LNG price is generally impacting all Europe with a higher exposure in Western Europe

Low price



High price



Advanced projects improve price convergence in all scenarios

Competition & Market Integration

Already achieved

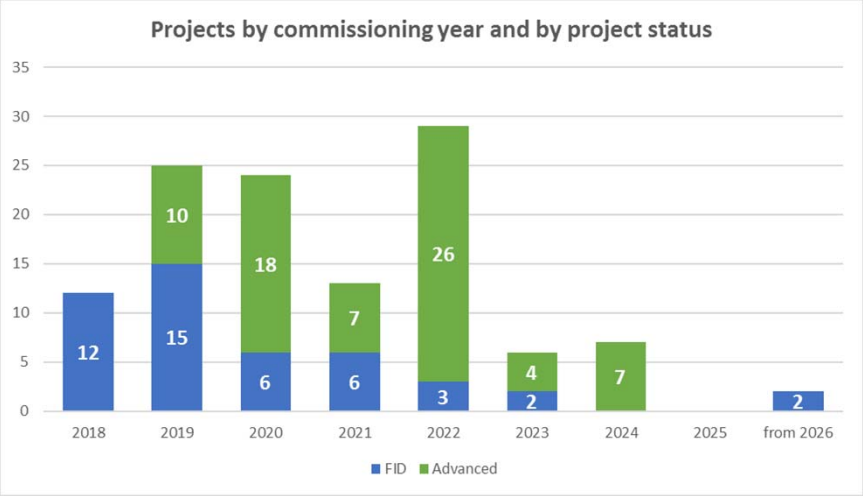
- *Most of Europe can access diversified supply sources*
- *The infrastructure allows for efficient cooperation between countries showing low level of dependence on LNG and Russian supply*
- *Infrastructure allows for hub price convergence, especially in Western Europe*
- *Most countries have balanced entry capacities in comparison to their geographical location*

Further infrastructure needs

- *To ensure more diversified access to supply sources – in the Baltics, South-East Europe and Iberian Peninsula*
- *To lift high dependence to a specific supply source*

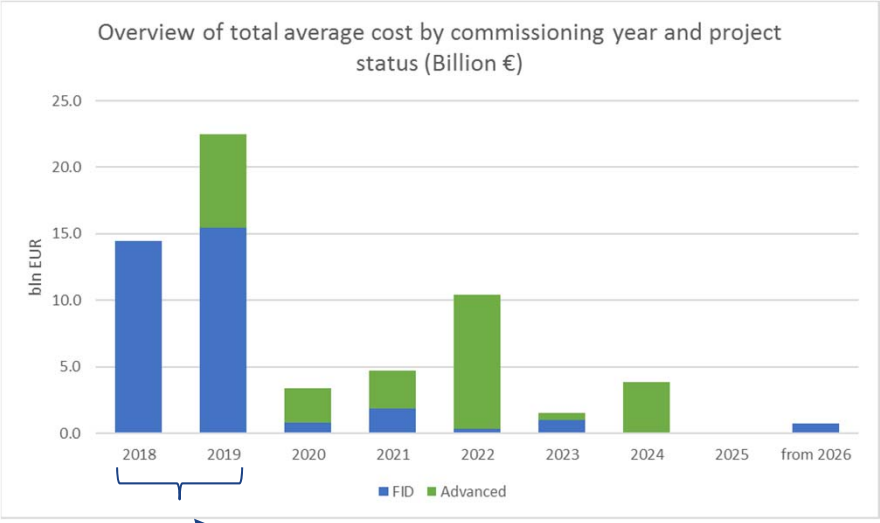
Achieving the internal gas market is at hand

Projects overview



The necessary projects are to be commissioned in the coming years

80% of FID and Advanced projects are expected to be commissioned by 2022



Large-scale import projects

Conclusion

Assessing infrastructure needs for the future requires energy scenarios covering the range of possible futures

The gas infrastructure is already well developed and
- Close to achieving the EU internal gas market
- Ready to further support a low-carbon future

The energy situation is not the same all over Europe
- In specific areas, further infrastructure is still needed
- The necessary projects are to be commissioned in the coming years

Conclusion

- ***Stakeholder are welcome to take part to the TYNDP public consultation (until 29 March).***

https://www.surveymonkey.com/r/VDQDHD2

- ***More on TYNDP 2018:***

https://www.entsog.eu/tyndp#entsog-ten-year-network-development-plan-2018

Have your say!

On the way to TYNDP 2020

TYNDP 2020

May – June 2019

TYNDP 2020 Project collection

Open to renewable and decarbonisation projects

Summer 2019

> Publication and public consultation

TYNDP 2020 draft scenario report

- 3 scenarios
- Carbon budget approach towards 2050
- Holistic approach to the energy system

Thank You for Your Attention

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