Brussels – 7 November 2016

TYNDP 2017 - identification of problems

Contribution to the 3rd PCI process

Preliminary results

NSI East and SGC Regional Groups – 7 November 2016

ENTSOG System Development Team

Image Courtesy of Thyssengas

Infrastructure gap under TYNDP 2017

1. TYNDP 2017 - overview
2. The TYNDP Scenario framework
3. The TYNDP assessment frame
4. Identification of problems

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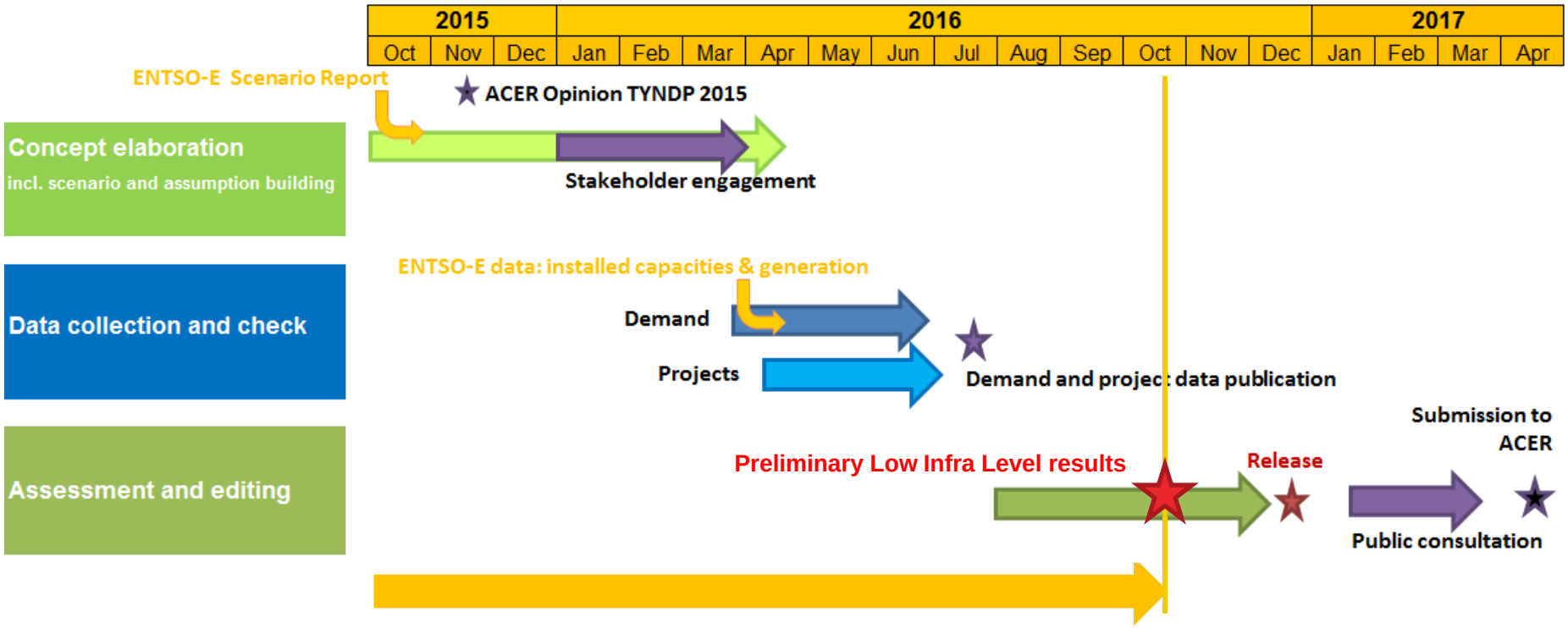
Where are we in the TYNDP process?

- **Strong cooperation with ACER and European Commission** all along the process
- An **intense interaction with Stakeholders**
- **Dialogue with ENTSO-E on TYNDP Scenarios**



TYNDP identifies problems and needs

Infrastructure gap under TYNDP 2017

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4 Demand Scenarios

Scenario		Slow Progression	Blue Transition	Green Evolution	EU Green Revolution
Category	Parameter				
Macroeconomic trends	EU on track to 2050 target?	Behind	On track	On track – National ambitions	On track / beyond – EU level ambitions
	Economic conditions	Limited growth	Moderate growth	Strong growth	Strong growth
	Green ambitions	Lowest	Moderate	High	Highest
	CO2 price	Lowest	Moderate	Highest	Highest
	Fuel prices	Highest	Moderate	Lowest	Lowest
Heating sector	Energy Efficiency improvement	Slowest	Moderate	Fastest	Fastest
	Competition with electricity	Limited gas displacement by elec. (new buildings)	Limited gas displacement by elec. (new buildings)	Gas displaced by electricity (district heating, heat pumps)	Gas displaced by electricity (district heating, heat pumps)
	Electrification	Lowest	Moderate	High	Highest
Power sector	Renewables develop.	Lowest	Moderate	High	Highest
	Gas vs Coal	Coal before Gas	Gas before Coal	Gas before Coal	Gas before Coal
Transport sector	Gas in transport	Lowest	Highest	Moderate	Moderate
	Elec. in transport	Lowest	Moderate	Highest	Highest

Related ENTSO-E 2030 Visions

Vision 1 | Vision 3 | Vision 4 | Vision 4

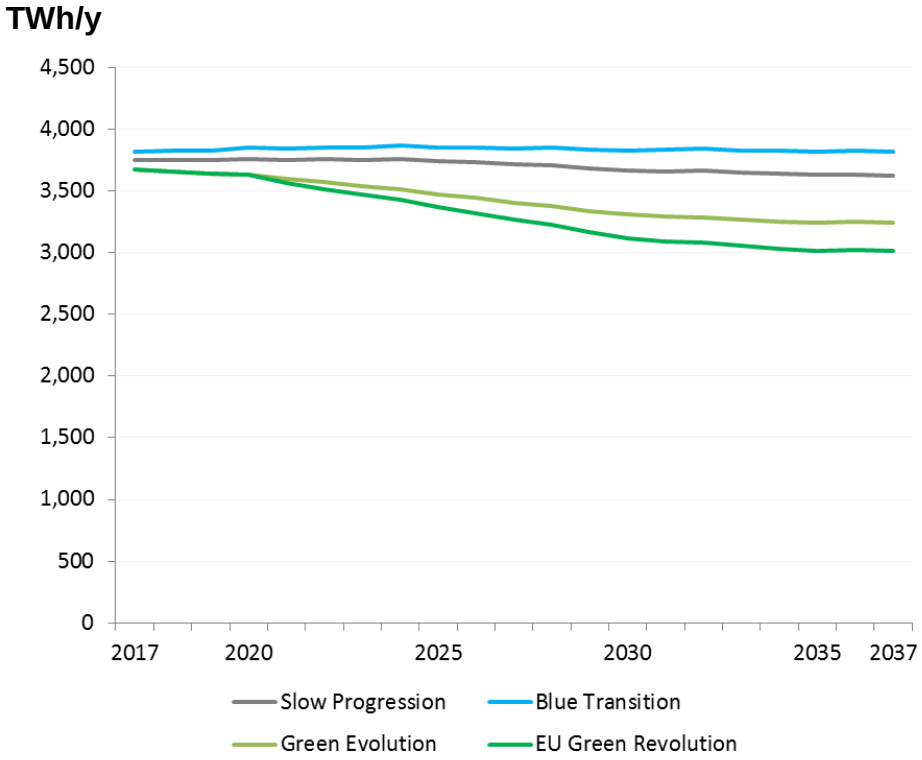
Sectoral gas demand

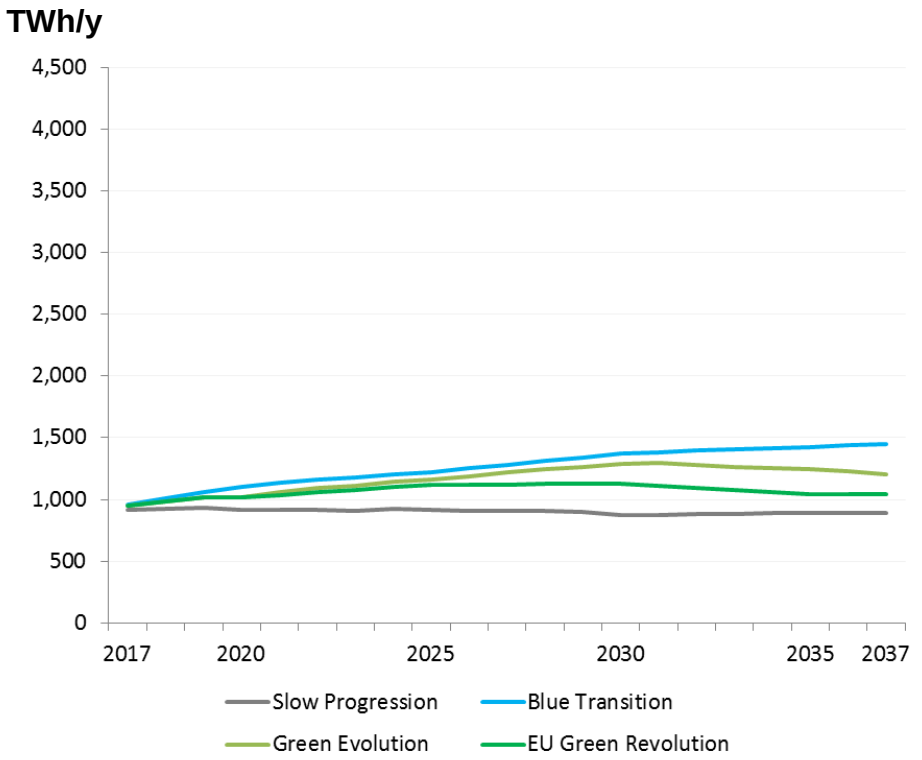
End-user demand

Stable to decreasing demand depending on **energy efficiency gains** and **electrification** of the heating sector

Gas for power demand

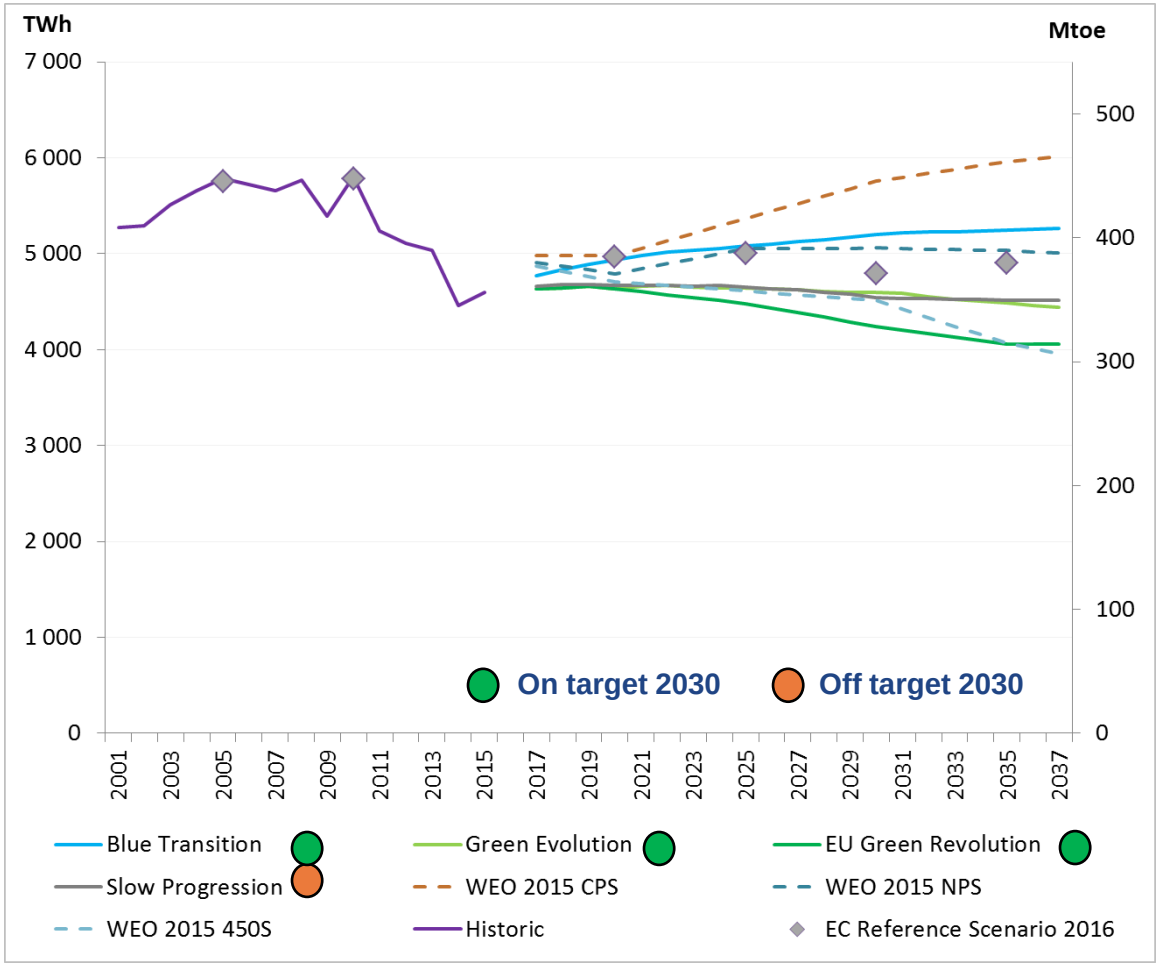
Stable to increasing demand depending on role of gas in **RES back-up** and **subsituting coal-fired generation**





End-user demand consist of the following demand: residential & commercial, industrial and transport

Overall gas demand

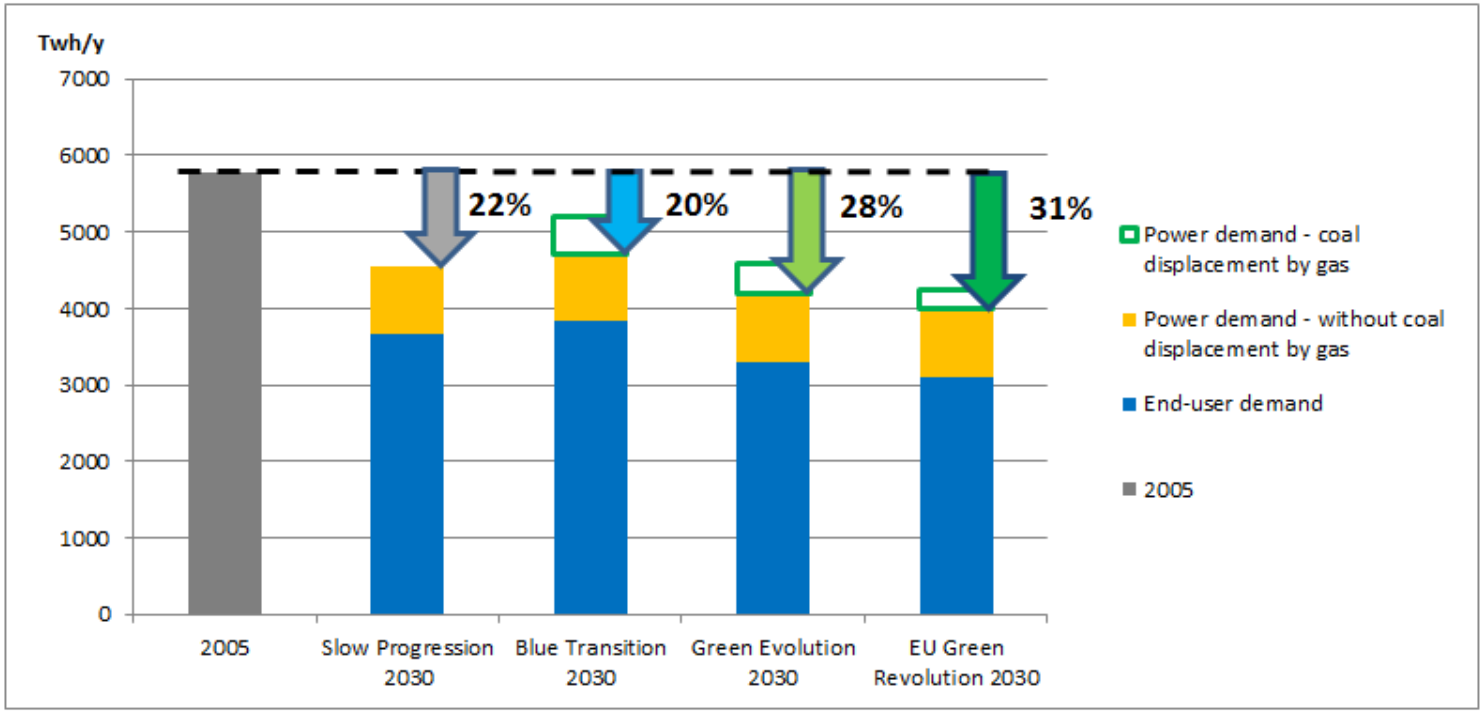


TYNDP assessment performed for the 3 on target scenarios

Several paths to achieving the EU targets

Energy Efficiency

- 27% (resp. 30%) targets set against the 2007 PRIMES baseline for 2030 (total primary energy). In reference to the **2005 level**, it corresponds to **20% gains** (resp. **23%**)
- Standard usages of gas already allow to achieve the EE target
- Gas displacing other fuels, such as for power generation, further increases the gains

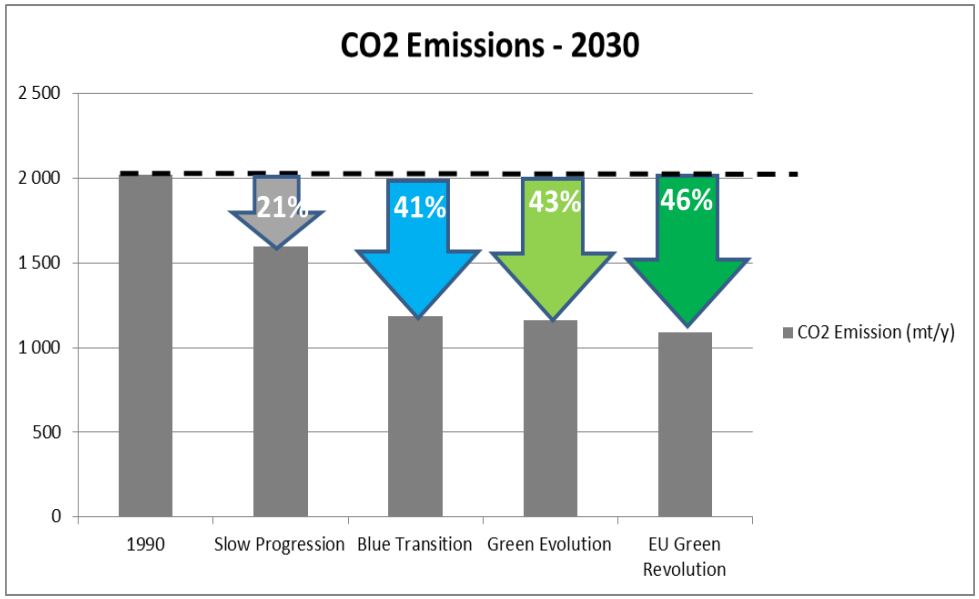


When looking at targets' achievement in the gas and power sectors it shoud be kept in mind that targets are set globally accross all sectors

Several paths to achieving the EU targets

CO2 emissions

> The on-target scenarios achieve the target of 40% CO2 reduction compared to 1990



CO2 emissions in 2030 – overall power demand and gas end-user demand

Renewables

> TYNDP 2017 scenarios for power generation are based on ENTSO-E TYNDP 2016 Visions which comply with the **EU RES-E target**

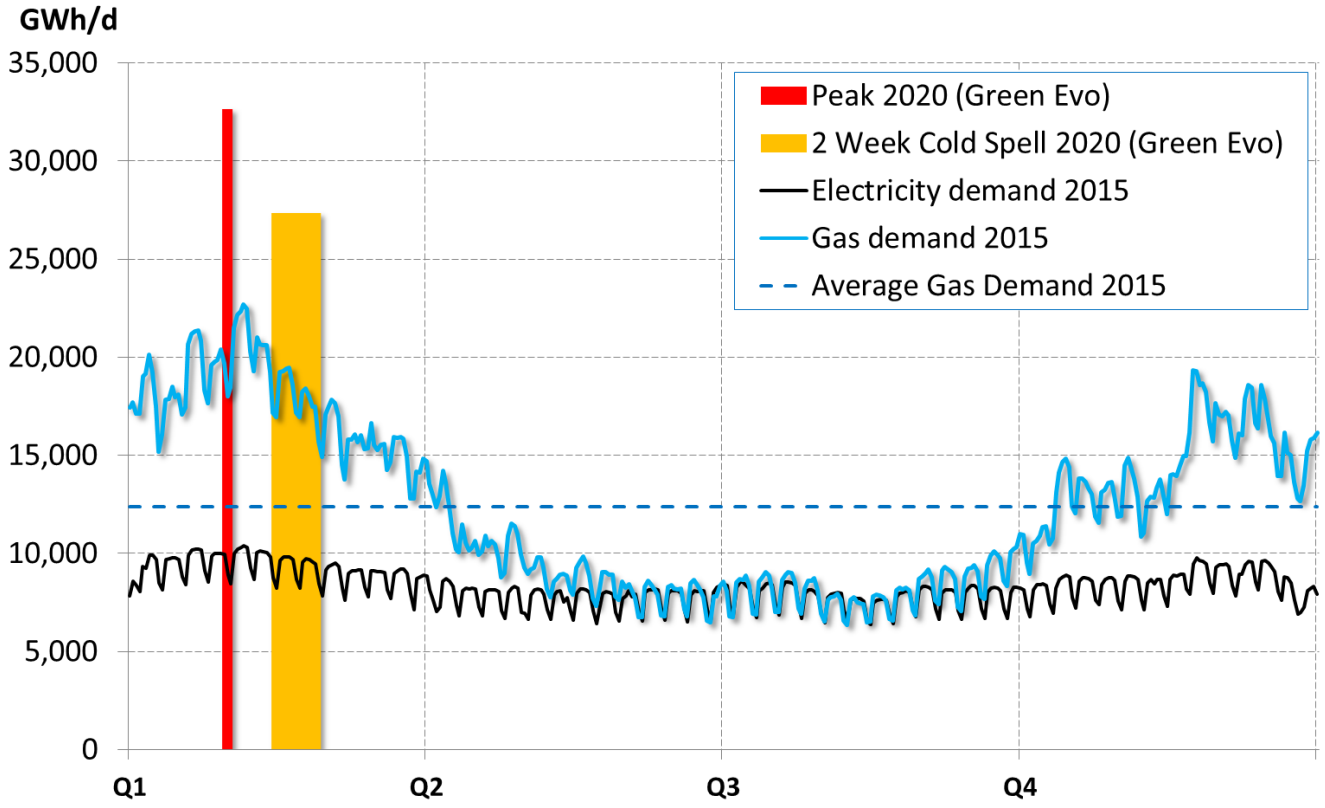
> TYNDP 2017 scenarios incorporate **biomethane,** a renewable gas source

The gas grid is to be assessed for the different paths

When looking at targets' achievement in the gas and power sectors it shoud be kept in mind that targets are set globally accross all sectors

Gas network designed for peak situation

Gas grid assessed both from an annual volume and high demand situation perspective



European gas and electricity demand – over the year and peak perspectives

Infrastructure gap under TYNDP 2017

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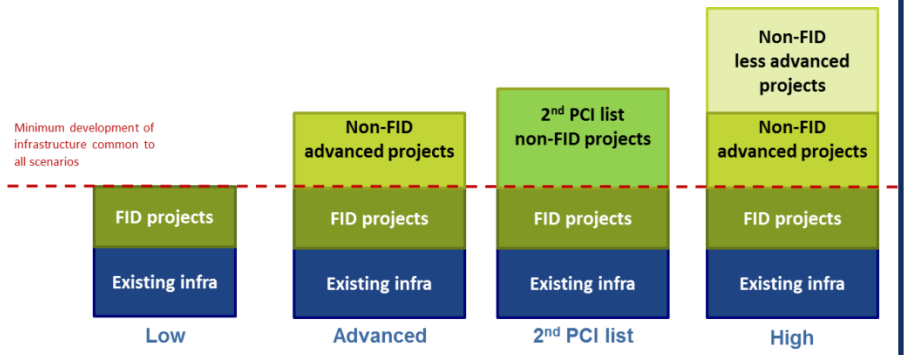
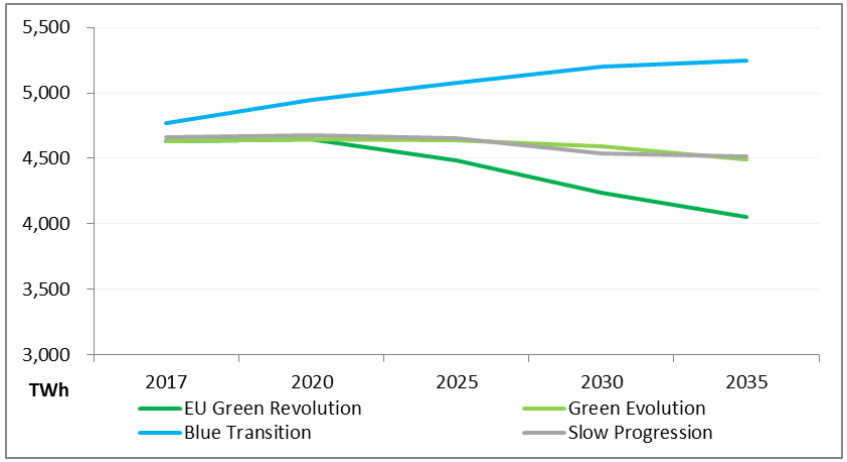
The TYNDP 2017 assessment frame

4 infrastructure levels

Dynamic over time based on projects commissioning date



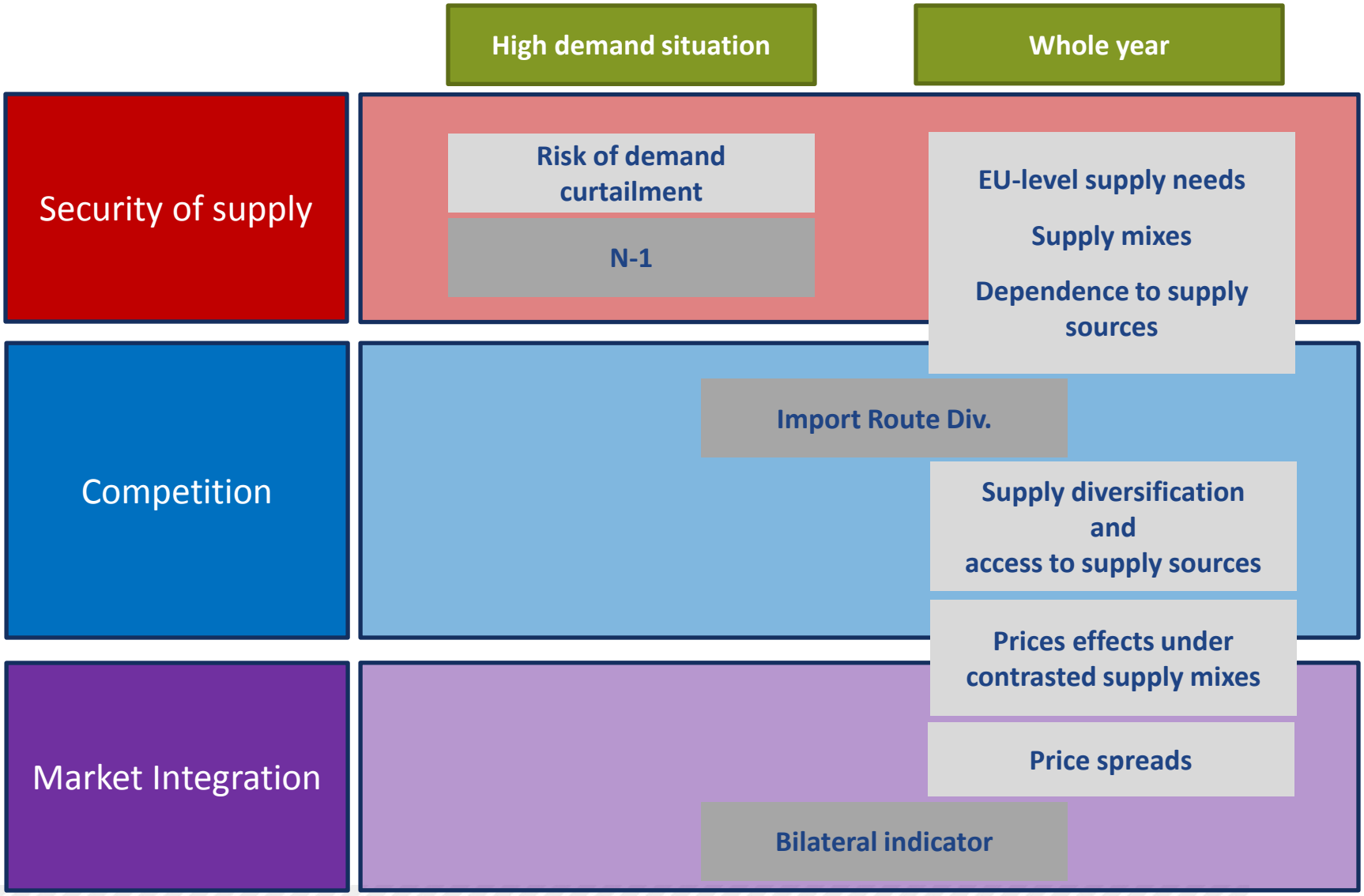
3 scenarios assessed



	Low	Advanced	2nd PCI list	High
Blue Transition				
Green Evolution		Multi-criteria analysis		
EU Green Rev				

Low infra level analysis:
Focus of today presentation

A multi-criteria analysis



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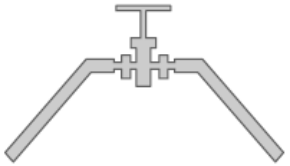
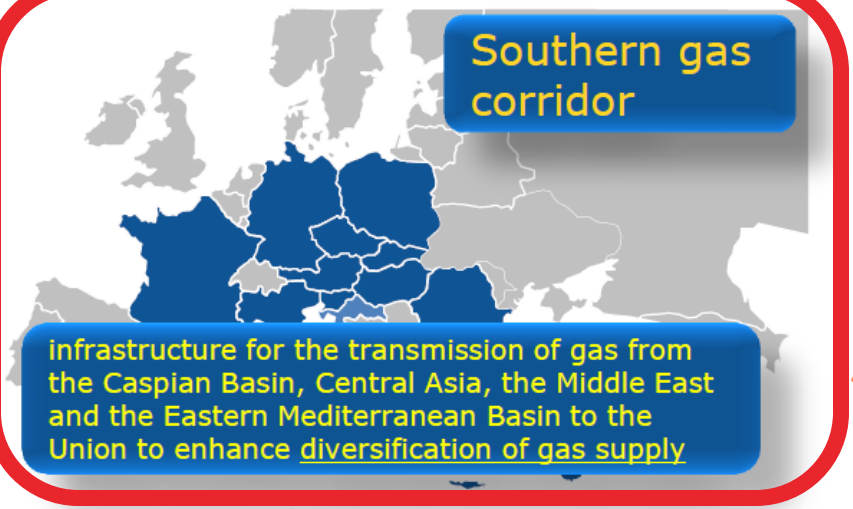
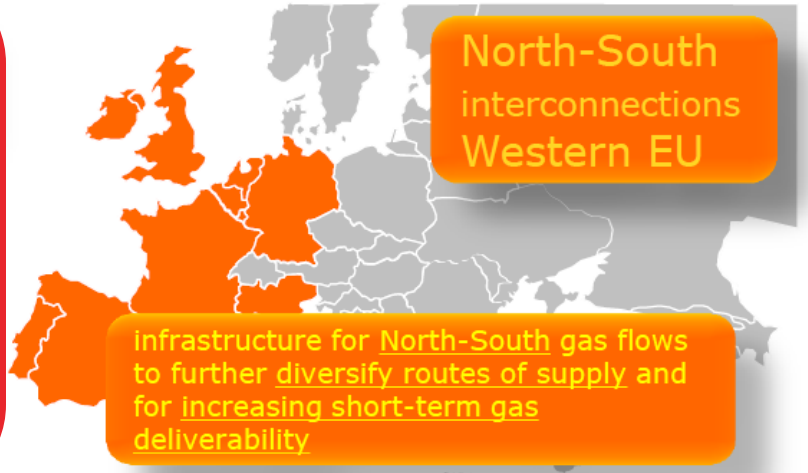
Priority corridors: gas





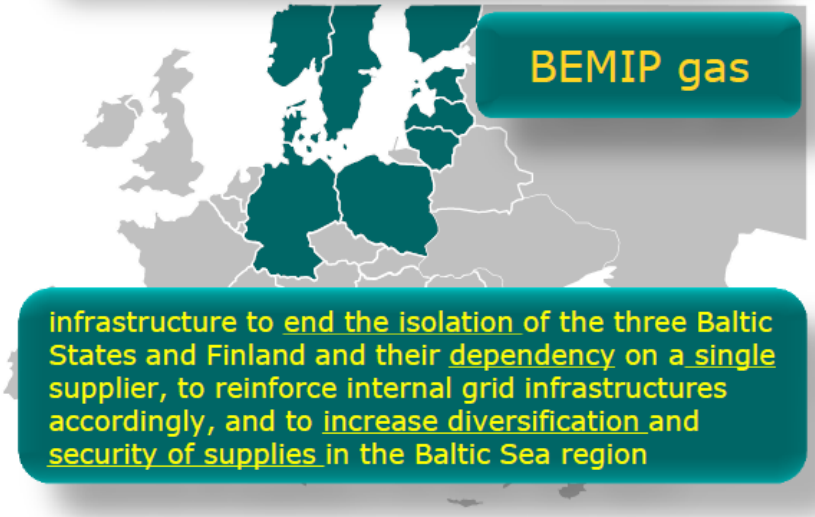
Southern gas corridor

infrastructure for the transmission of gas from the Caspian Basin, Central Asia, the Middle East and the Eastern Mediterranean Basin to the Union to enhance diversification of gas supply



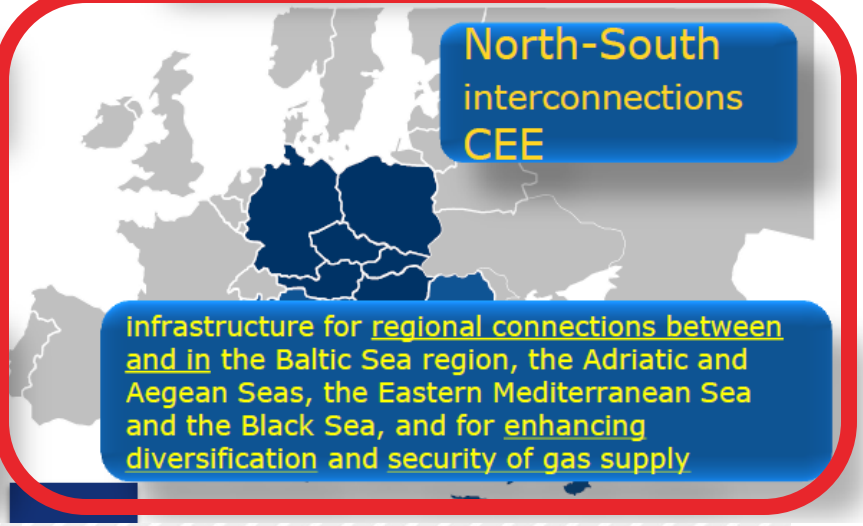
North-South interconnections Western EU

infrastructure for North-South gas flows to further diversify routes of supply and for increasing short-term gas deliverability



BEMIP gas

infrastructure to end the isolation of the three Baltic States and Finland and their dependency on a single supplier, to reinforce internal grid infrastructures accordingly, and to increase diversification and security of supplies in the Baltic Sea region



North-South interconnections CEE

infrastructure for regional connections between and in the Baltic Sea region, the Adriatic and Aegean Seas, the Eastern Mediterranean Sea and the Black Sea, and for enhancing diversification and security of gas supply

Identication of problems

Objective: share the TYNDP identification of problems

> TYNDP assessment performed under an assumption of perfect market functioning
  - To avoid identifying needs where better market functioning would solve the issue
  - The assessment focuses on the **infrastructure needs**

The results allow to identify

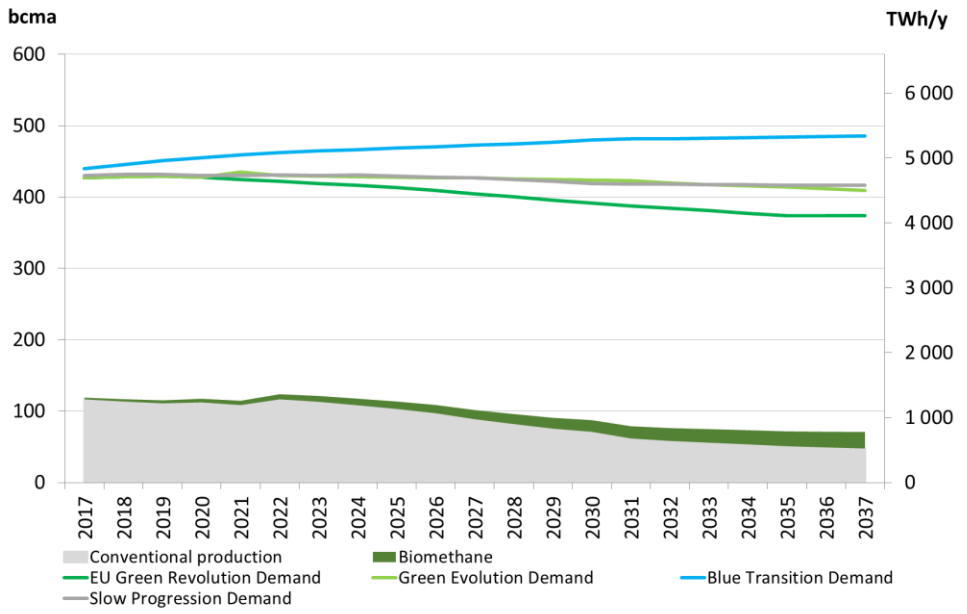
> The most impacted countries

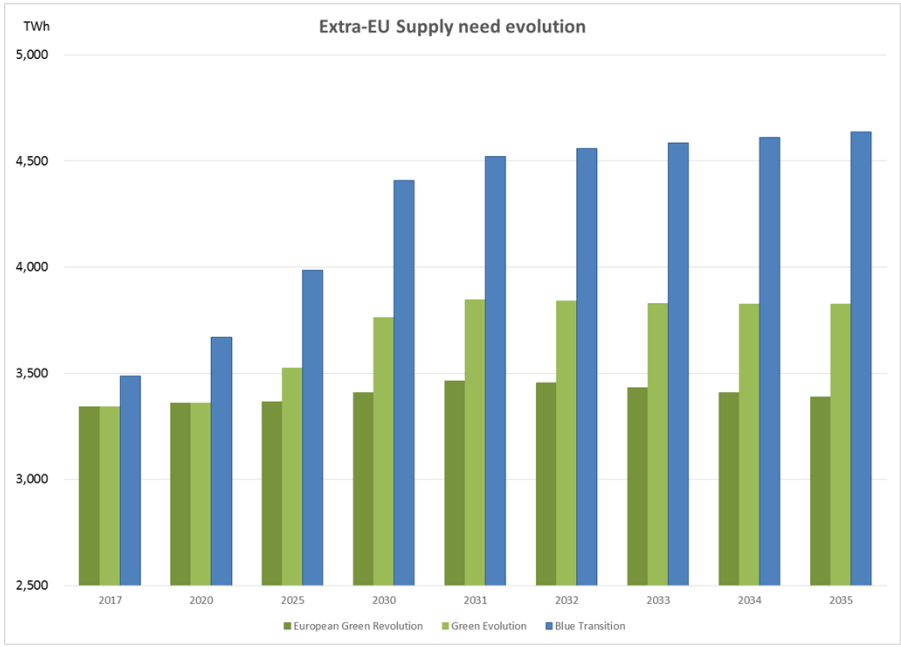
> The infrastructure limitations

> Identified issues may be mitigated by different types of gas infrastructure

EU supply needs

Whole year



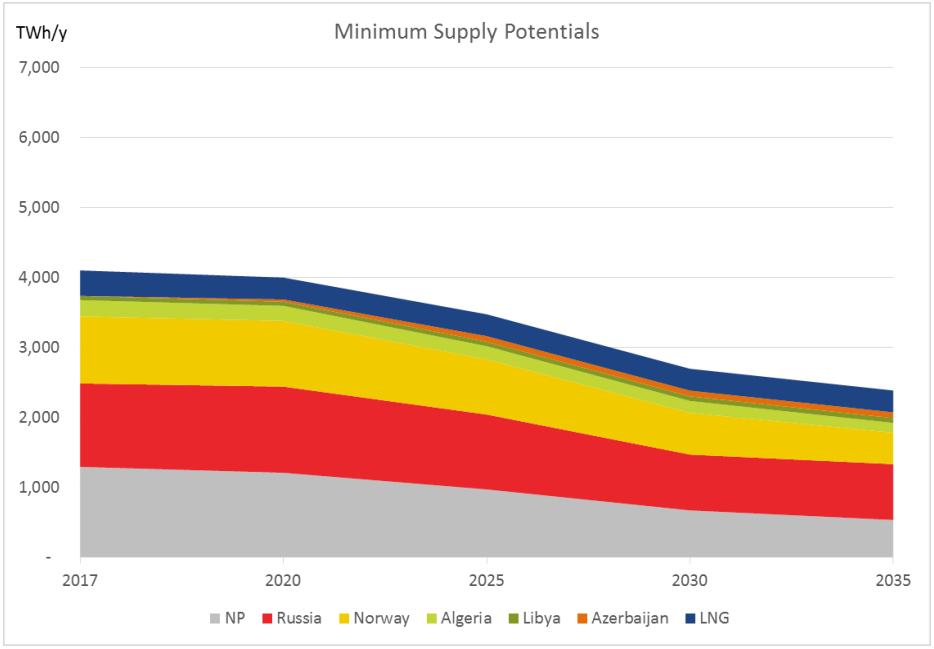


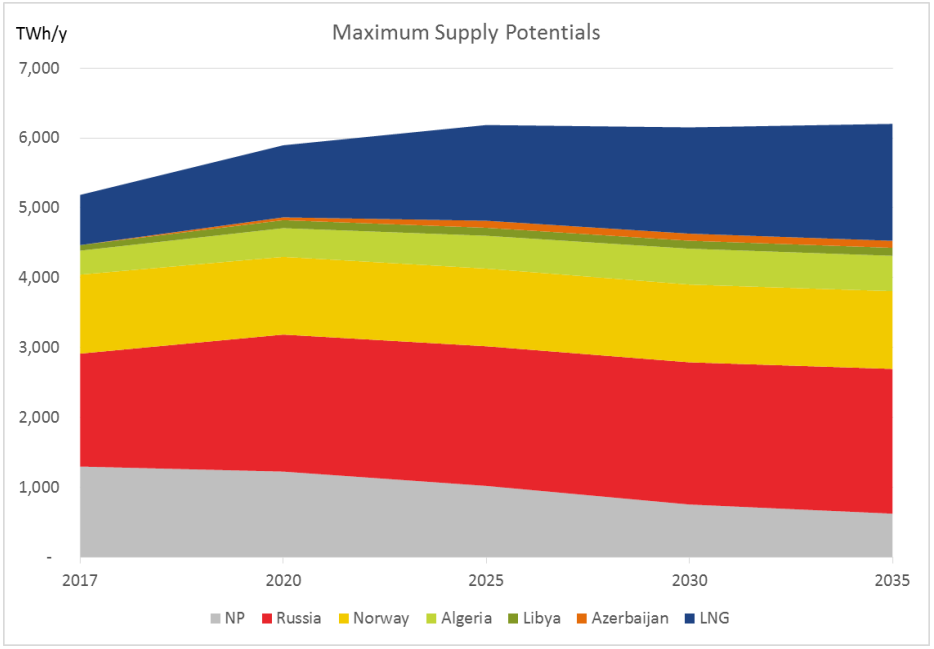
Decline of indigenous production leads to increased supply needs over time for 2 out of the 3 scenarios

EU supply mixes

Retained supply potentials

Whole year

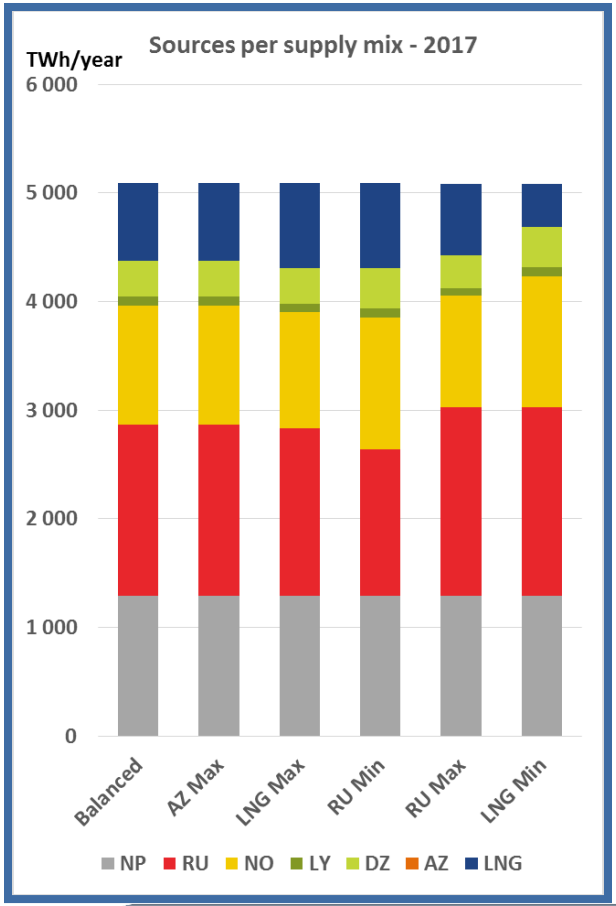


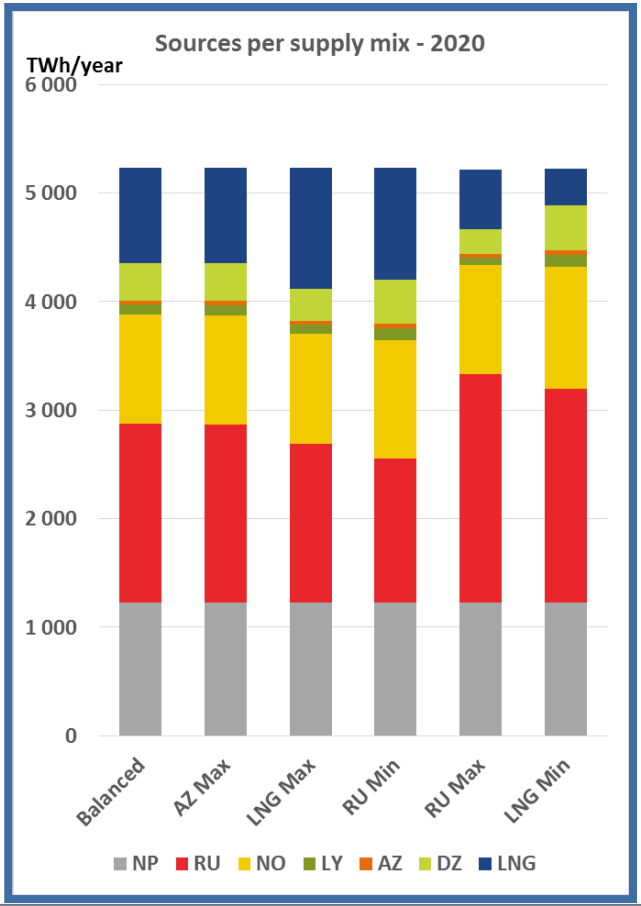


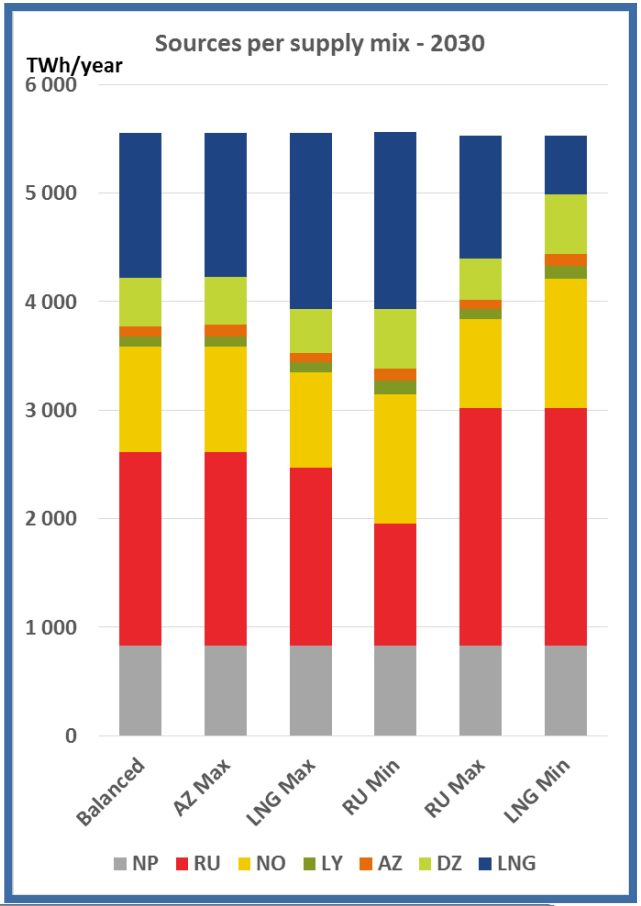
EU supply mixes

Whole year

Blue Transition







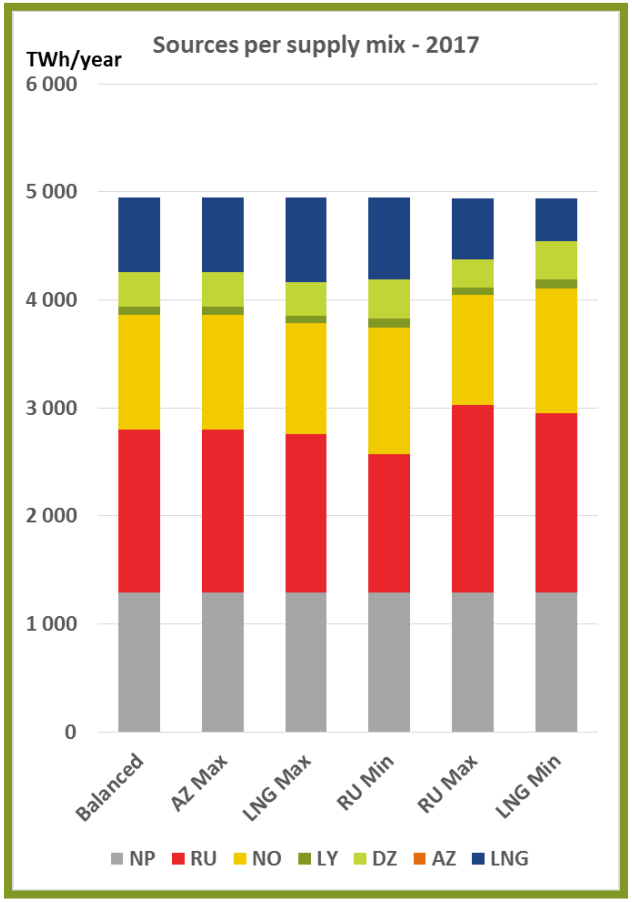
The low infrastructure level enables a wide range of supply mixes.

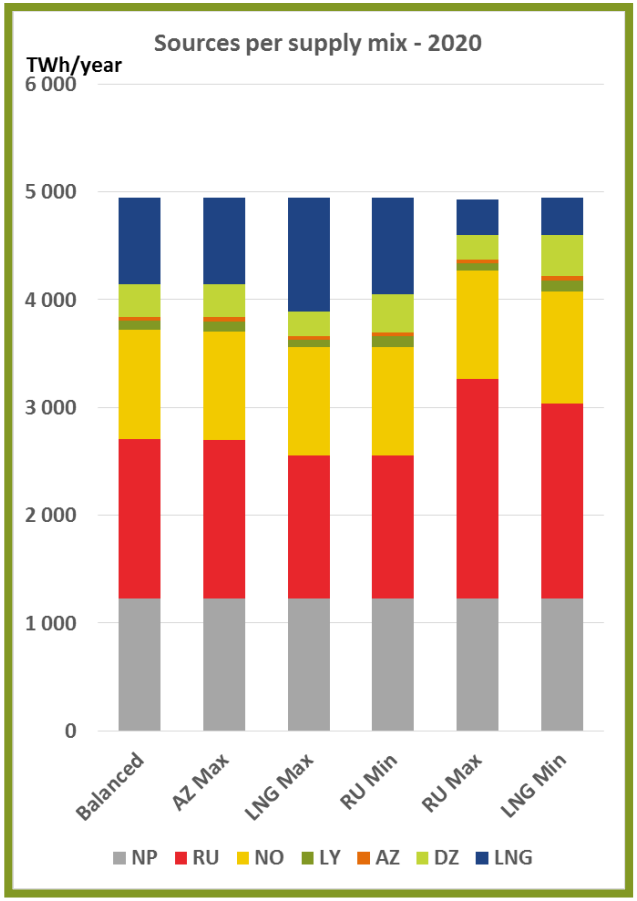
Azeri supply and local additional indigenous production enter the supply mix over time.

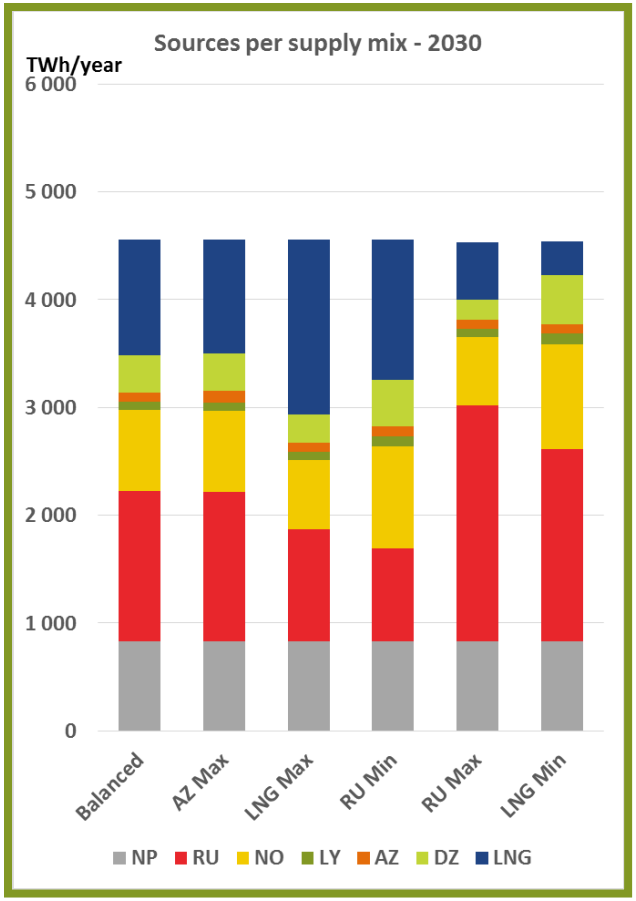
EU supply mixes

Whole year

Green Revolution







The low infrastructure level enables a wide range of supply mixes.

Azeri supply and local additional indigenous production enter the supply mix over time.

Security of supply

Exposure to demand disruption

High demand situation

Disrupted rate and Remaining Flexibility

> The **disrupted rate** indicates the share of a country's demand that cannot be covered. It is calculated under **cooperative behaviour** between countries
  - Countries will align their disruption rate if infrastructures allows for it
  - Non-alignement between countries indicate an **infrastructure bottleneck**

> When a country does not face disruption, the **remaining flexibility** indicates the additional share of demand that the infrastructure would allow to cover. It is calculated non-simultaneously for each country.

Cases investigated

> Normal situation

> Specific route disruption cases: in this case we are interested in the **additional impact compared to the normal situation case**

> Cases leading to demand disruption are presented

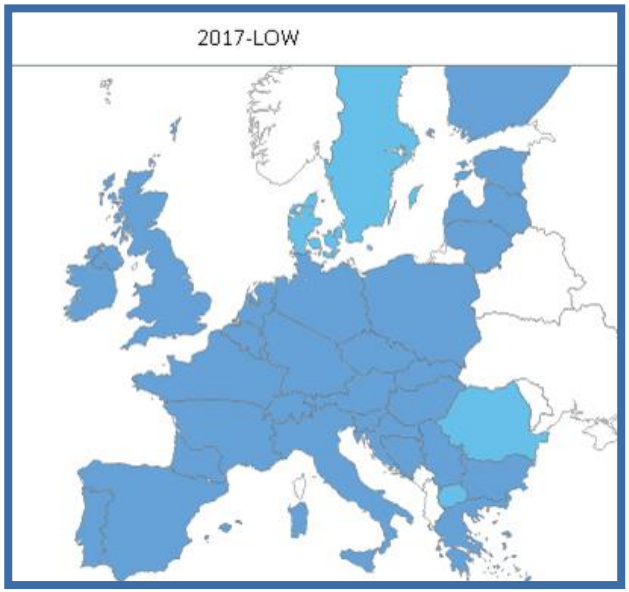
Security of supply

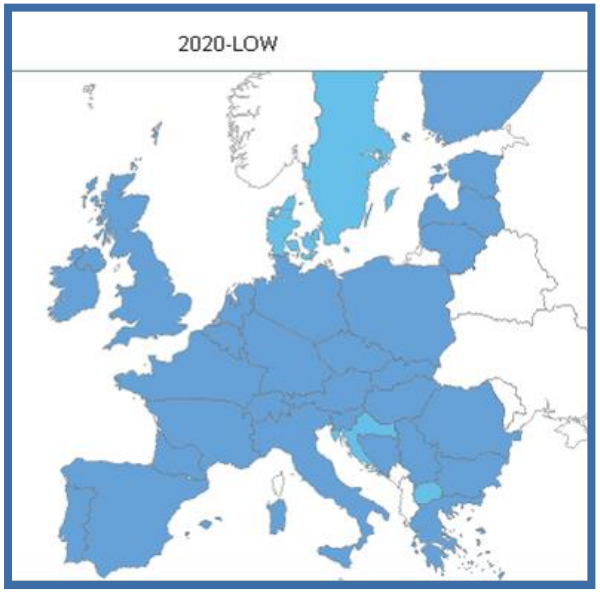
Exposure to demand disruption (normal situation)

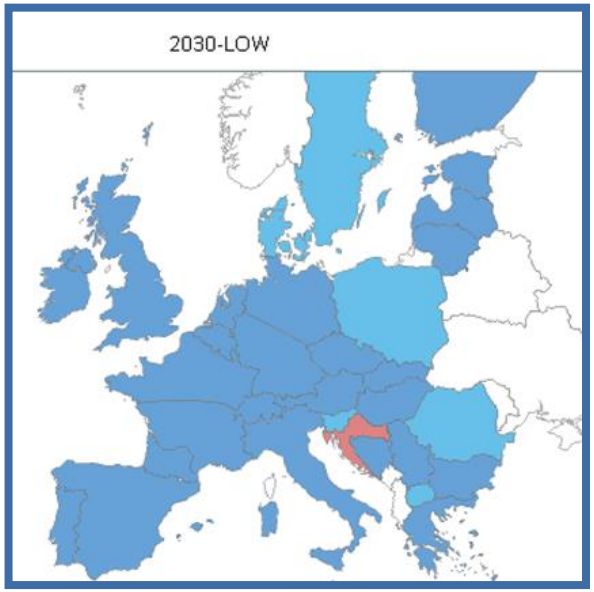
High demand situation (peak day)

The Region is generally able to cover its demand even under peak situation. Croatia is exposed to demand disruption in 2030.

Blue Transition







Remaining Flexibility
20% - 50%
0% - 20%

Share of curtailed demand
50% - 100%
20% - 50%
0% - 20%

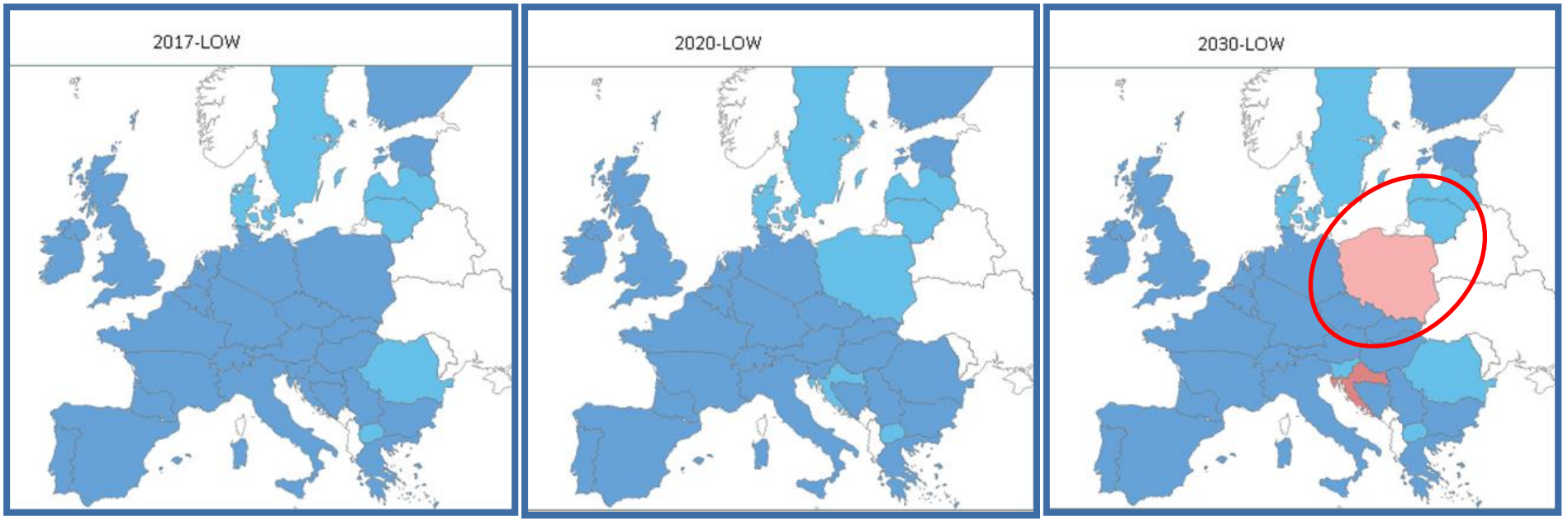
	NSI East + South. Corridor
Exposure to demand disruption under normal situation	**Disruption: HR** ***Green Rev: HR less disrupted*** Low Rem Flex: PL, SI, RO *Green Rev: only RO*

Security of supply

Exposure to demand disruption – under Belarus route disruption

High demand situation (peak day)

Blue Transition



Remaining Flexibility
20% - 50%
0% - 20%

Share of curtailed demand
50% - 100%
20% - 50%
0% - 20%

HR unchanged from normal situation

	NSI East + South. Corridor
Exposure to demand disruption under Belarus route disruption	Disruption: PL in 2030 *Green Rev: PL low Rem Flex*

Security of supply

Exposure to demand disruption - under Ukraine route disruption

High demand situation (peak day)

Blue Transition

Remaining Flexibility
20% - 50%
0% - 20%

Share of curtailed demand
50% - 100%
20% - 50%
0% - 20%

HR unchanged from normal situation

	NSI East + South. Corridor
Exposure to demand disruption under Ukraine route disruption	**Disruption: BG, HR, HU, RO,** GR in 2017 ***Green Rev: same***

Improvement of the situation after 2017 is linked to the foreseen commissioning of projects in the region by 2020

Security of supply / Competition

Dependence to supply sources

Whole year

> Dependence **to a given supply source** (CSSD) should be understood as the **minimum share of this source** necessary for a country to cover its demand on a yearly basis

> Dependence is presented under **cooperative behaviour** between countries
- Countries will align their mimimum source share (CSSD) if infrastructures allow for it
- Non-alignement between countries indicate an **infrastructure bottleneck**

> High CSSD level can inform both on **security of supply** and **competition**
- In the case of LNG, being a multi-source supply, security of supply is not at stake

Results show:
- no EU-level and no country-level dependence to Norwegian*, Algerian, Libyan or Azeri supply
- EU-level but no country-level dependence in the NSI East and Southern Corridor Regions to LNG supply

***In 2017: limited EU-level dependence on Norwegian gas due to restricted supply flexibilities for this time horizon, no infrastructure bottleneck**

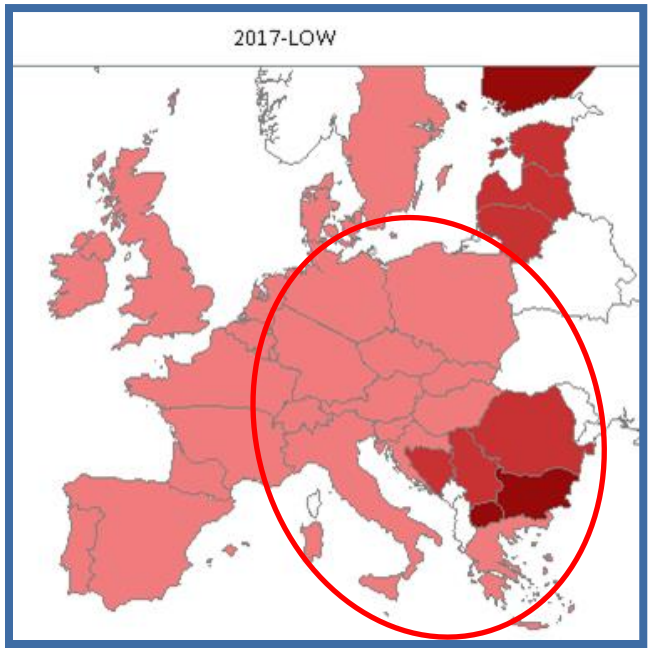
Security of supply / Competition

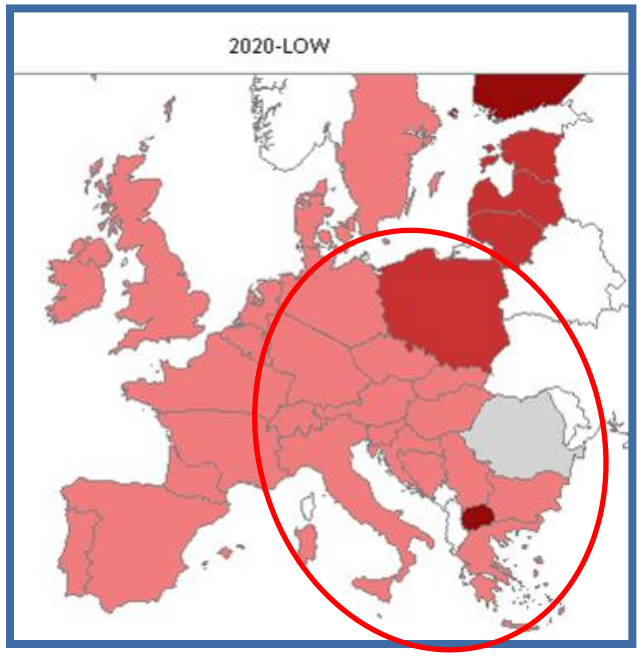
Dependence to Russian supply

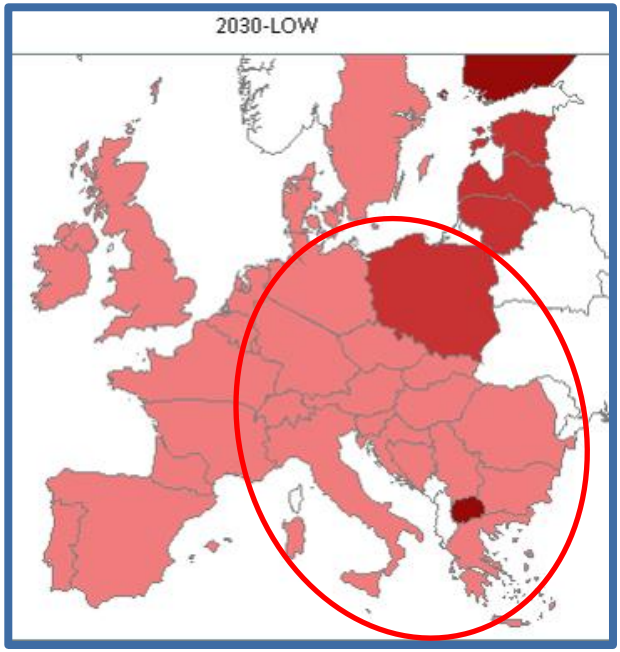
Whole year

Blue Transition

- **At EU level**, no infrastructure limitation preventing full access to the other supply sources*
- **At country-level**, some highly dependent countries indicating infrastructure bottleneck







	NSI East + South. Corridor
Dependence to Russian supply above 25%	BG, RO, PL *GE and GRev.: same but PL below 25%*

*the EU-level dependency derive from the maximum supply potential from the other sources

Results for the other scenarios are provided in Annex

CSSD

50% - 100%

25% - 50%

15% - 25%

5% - 15%

0%-5%

Improvement of the situation after 2017 is linked to the foreseen commissioning of projects in the region by 2020;
RO face infrastructure limitations in exporting its indigenous production

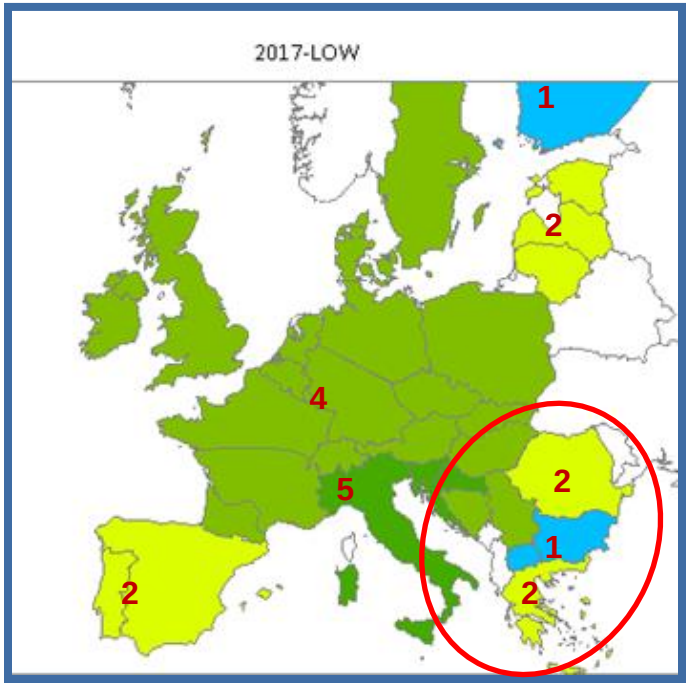
Competion - Access to Supply Sources

Whole year

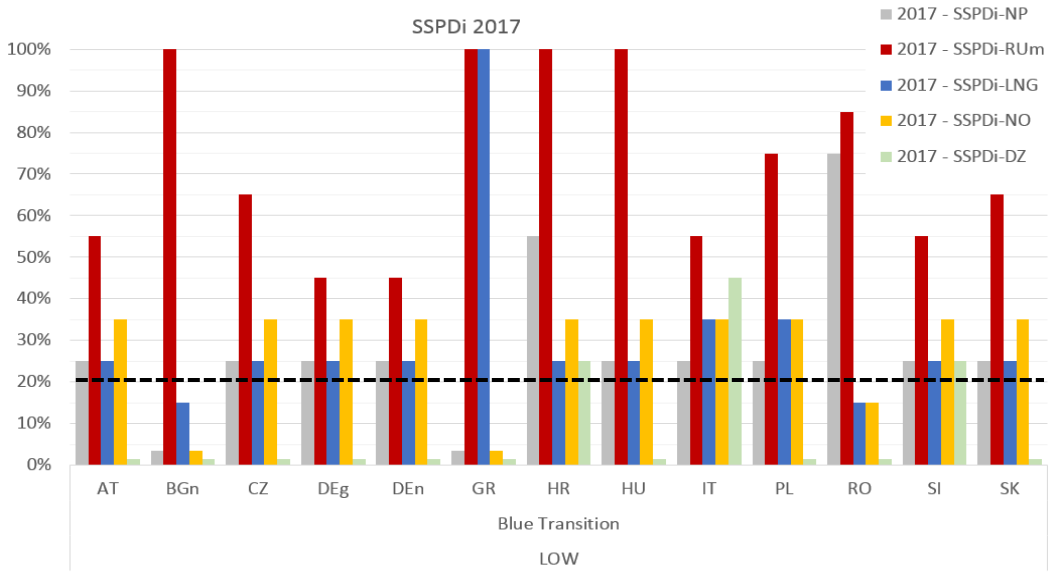
Access to Supply Sources is based on the **SSPDi** indicator

- **SSPDi**: capacity of a country to reflect a given source low price in its supply bill (SSPDi: supply bill share impacted)
- **Access to Supply Sources** indicates the **number of sources** for which SSPDi exceeds a 20% threshold

Blue Transition – Access to sources



NSI East + Southern Corridor Regions focus



LNG is a multi-source supply: results should be interpreted accordingly

***At EU-level, Libyan and Azeri volumes are too low to have any significant impact on prices**

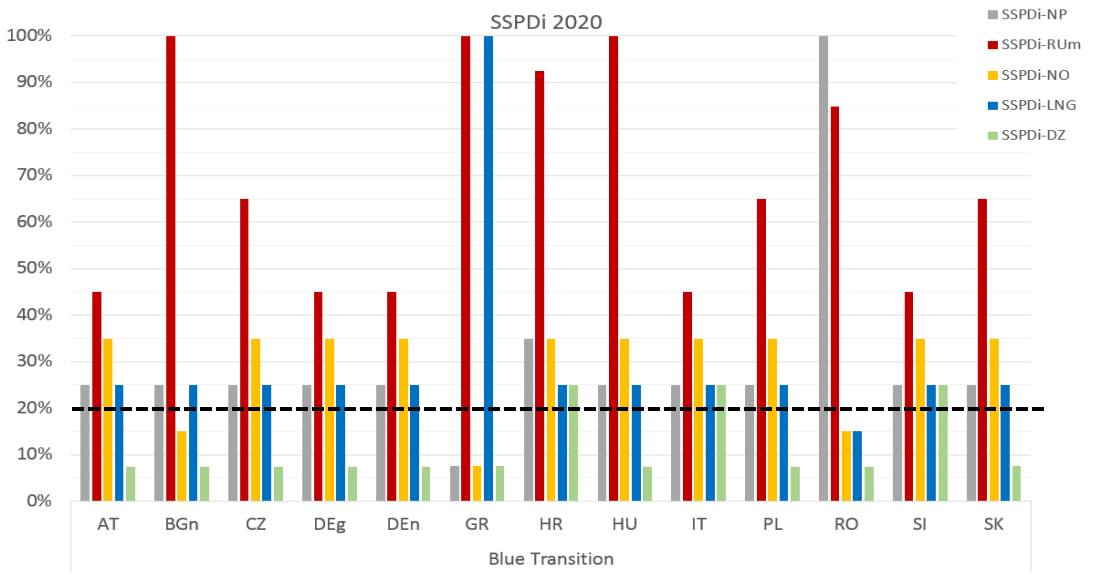
Competion - Access to Supply Sources

Whole year

Blue Transition – Access to sources

LNG is a multi-source supply: results should be interpreted accordingly

NSI East + Southern Corridor Regions focus



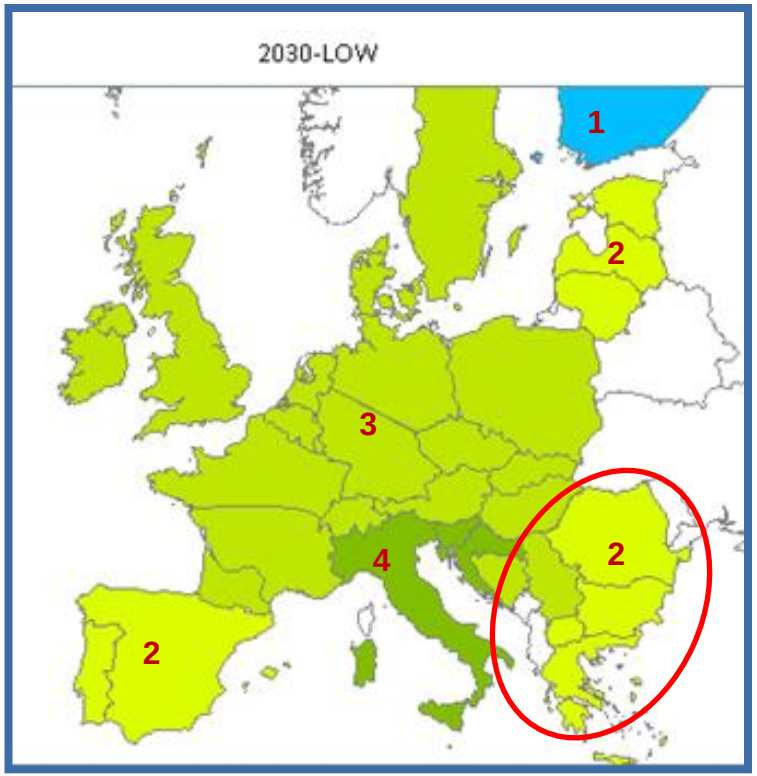
Improvement of the situation after 2017 is linked to the foreseen commissioning of projects in the region by 2020.

Competion - Access to Supply Sources

Whole year

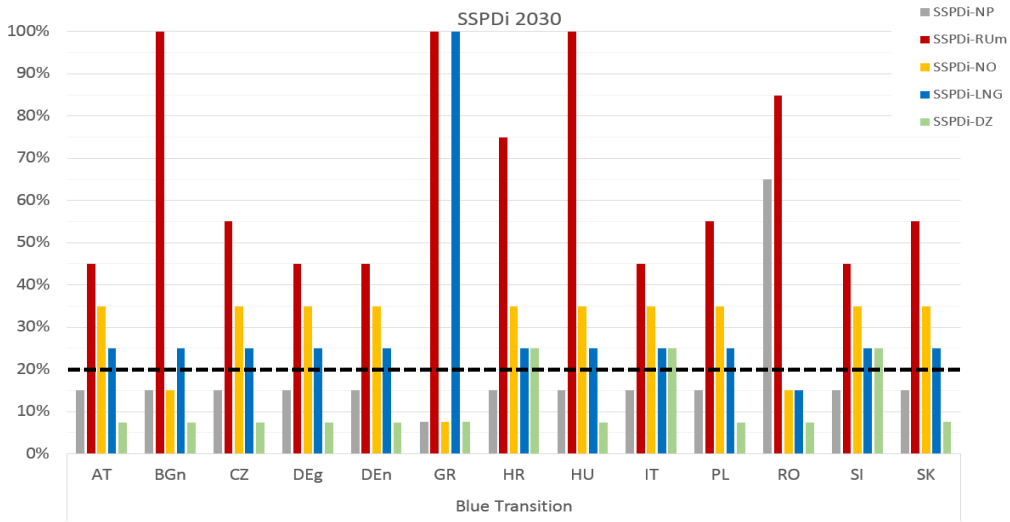
Indigenous production fades out as a diversification option

Blue Transition – Access to sources



LNG is a multi-source supply: results should be interpreted accordingly

NSI East + Southern Corridor Regions focus



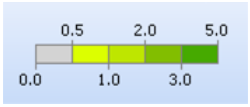
	NSI East + South. Corridor
Access to less than 3 supply sources (* including LNG)	BG, GR*, RO Barriers from GR to BG, RO to neighbours, West to East

> Countries accessing a limited number of supply sources also show high dependence to Russian gas

Price effects – LNG supply

Whole year

LNG supply maximisation* (low LNG price) - Green Evolution



Legend: price decrease compared to the balanced supply configuration (EUR/MWh)

LNG is a multi-source supply: results should be interpreted accordingly

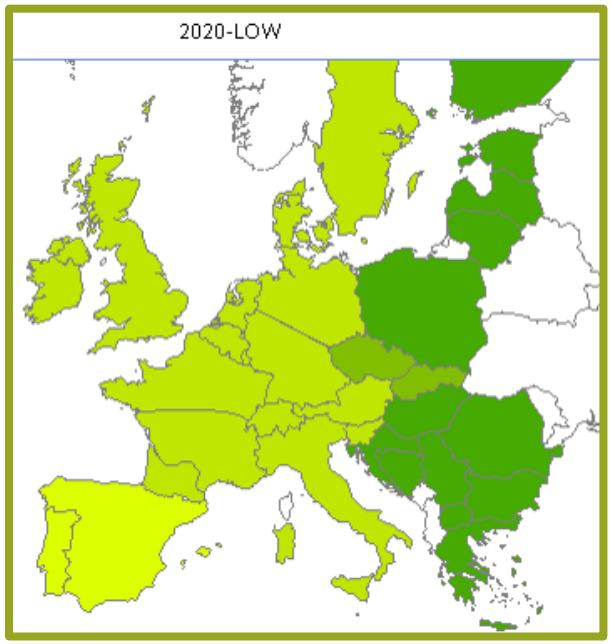
Price effect: barriers to low price propagation	NSI East + South. Corridor
LNG Maximisation (low LNG price)	BG *vs GR* East *vs West*

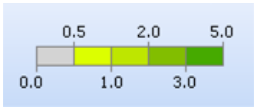
***Price effects under supply maximisation configuration based on SSPDi – Consider SSPDi when interpreting**

Price effects – Russian supply

Whole year

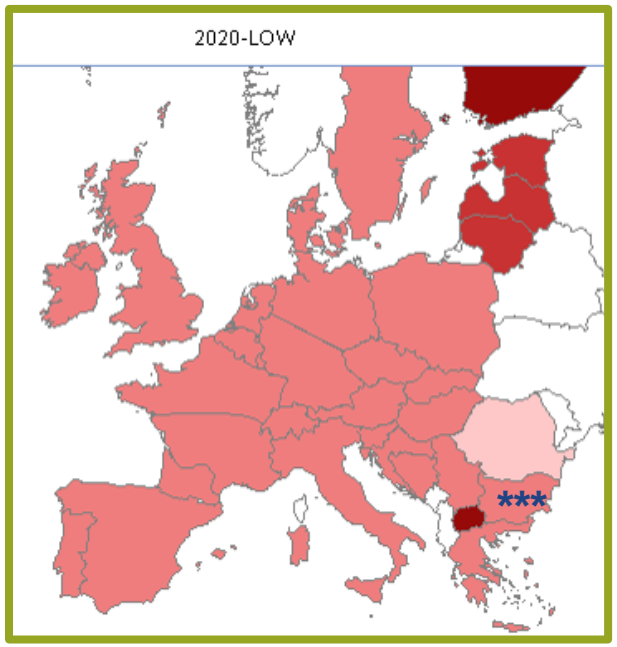
Russian supply maximisation* (low RU price) - Green Evolution

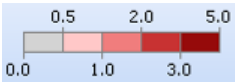




Legend: price decrease compared to the balanced supply configuration (EUR/MWh)

Russian supply minimisation (high RU price) - Green Evolution**





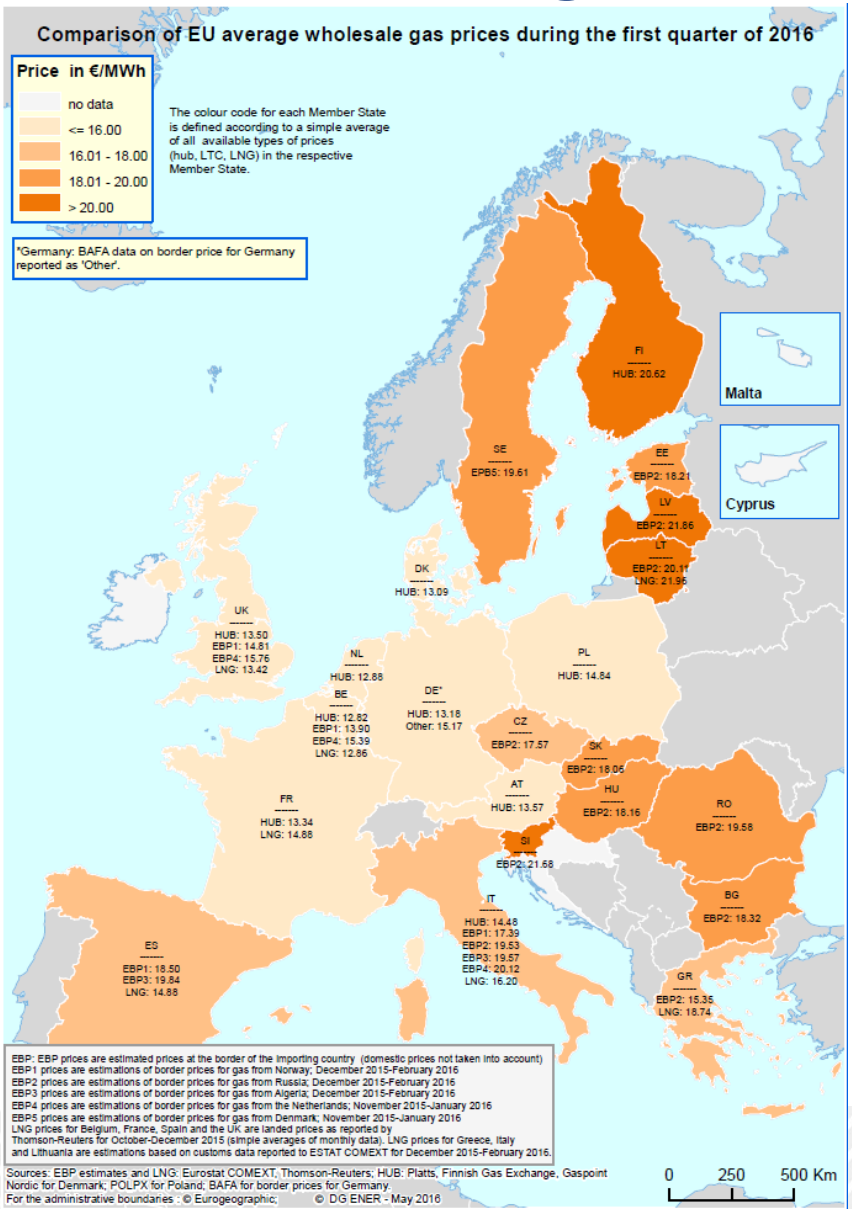
Legend: price increase compared to the balanced supply configuration (EUR/MWh)

Barriers to low price propagation	NSI East + Southern Corridor
Russian Max. (low RU price)	East to West barrier: Eastern part can benefit from a decrease, then CZ and SK AT, DE and SI are less sensitive.

Barriers to high price mitigation	NSI East + Southern Corridor
Russian Min. (high RU price)	Countries are equally impacted except for RO due to its NP. ***In 2017, BG more impacted (higher price) than neighbours.

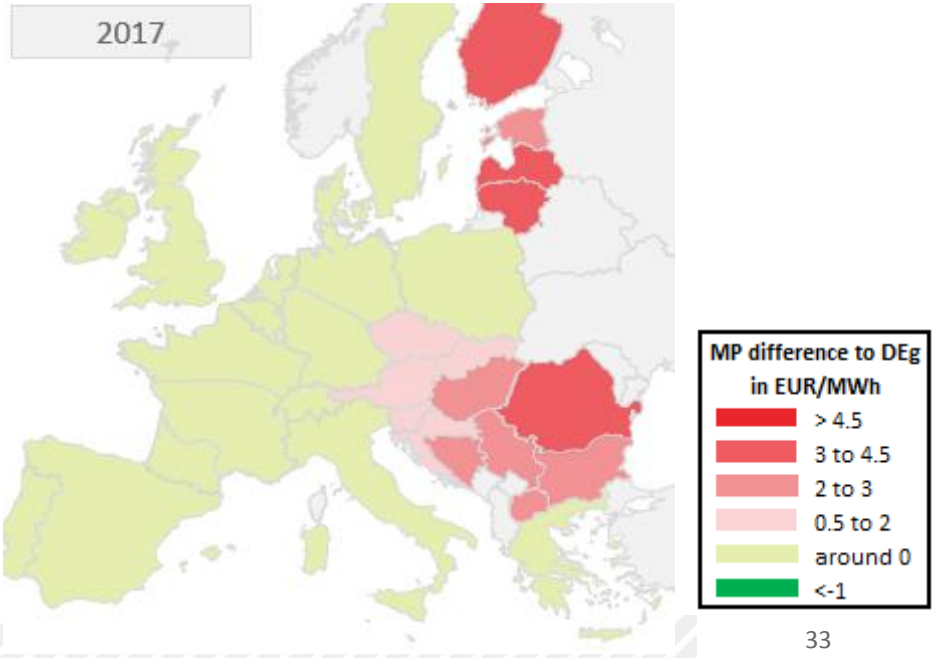
***Price effects under supply maximisation configuration based on SSPDi – Consider SSPDi when interpreting**
****Price effects under supply minimisation configuration based on CSSD**

Market integration - Price spreads



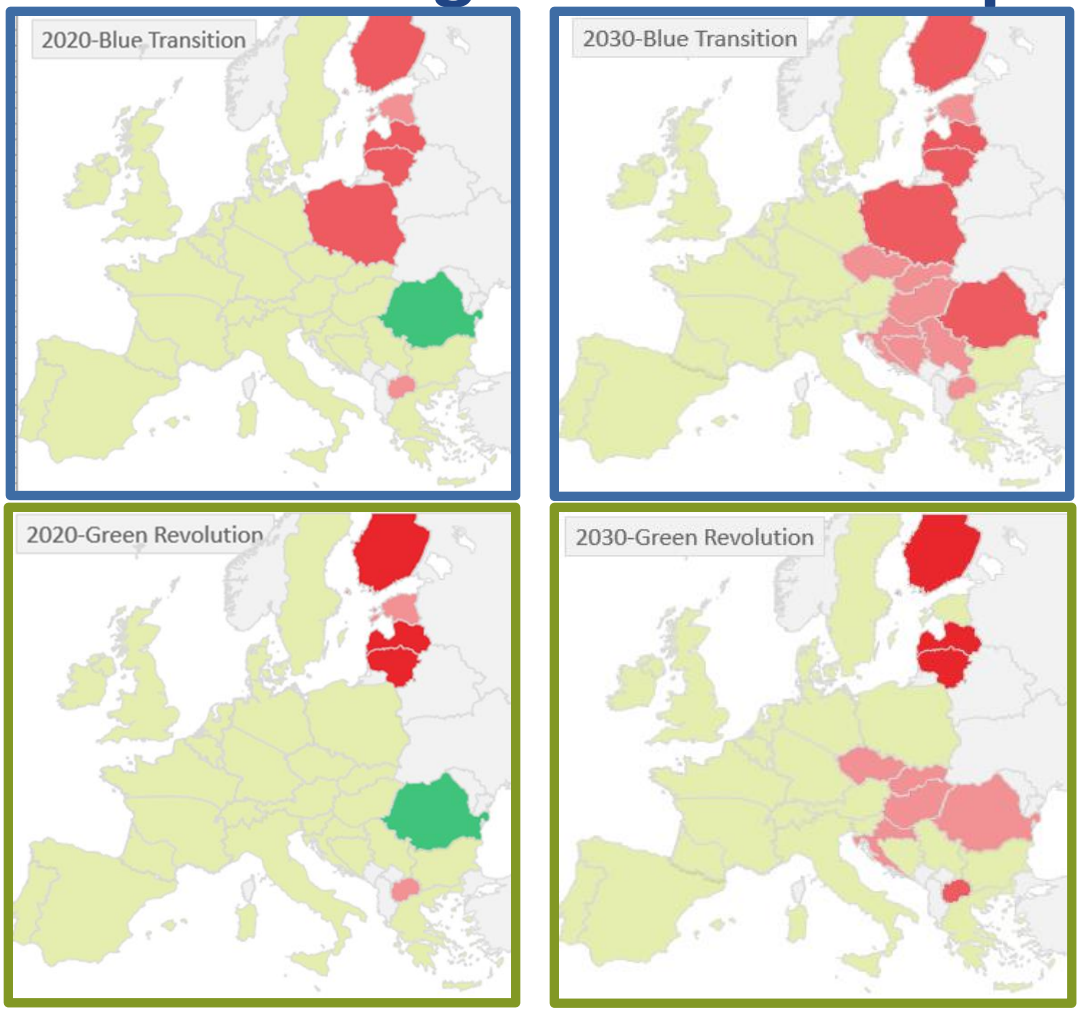
> Handled through a simulation focusing on Russian supply price information
  - Input: EC quarterly report Q1-16 EBP2 information* (European Border Price: Russia)
  - Price spreads measured to German border price

> Marginal prices simulated for 2017



*EBP2 not available for PL (use of LT) and FI (use of LT, LV, EE)

Market integration - Price spreads



Market integration

Whole year

MP difference to DEg in EUR/MWh
- > 4.5
- 3 to 4.5
- 2 to 3
- 0.5 to 2
- around 0
- <-1

	NSI East + Southern Corridor
Price spreads	BG (in 2017), CZ, HR, HU, PL, RO, SK

Results in Romania in 2020 related to increased national production

Conclusions – NSI East

	NSI East
Isolation	CY
Exposure to demand disruption	HR PL (2030 – Blue Transition) in case Belarus route disruption BG, GR (2017), HU, RO in case of Ukraine route disruption
Increased supply needs calling for diversified supply	EU wide
Dependence or access to limited number of supply sources (* including LNG)	BG, GR*, RO Barriers from GR to BG, RO to neighbours, West to East
Price effects - Barriers to LNG low price propagation - Barriers to RU low price propagation - Barriers to RU high price mitigation	 BG *vs GR* East *vs West* West *vs East* barrier: AT, DE , SI *vs East*; CZ, SK *vs East* BG *vs neighbours*; neighbours *vs RO*
Price spreads	BG, CZ, HR, HU, PL, RO, SK

> The results allow to identify the **most impacted countries** and **infrastructure limitations**

> Identified issues may be mitigated by **different types of gas infrastructure**

Conclusions – Southern Gas Corridor

	Southern Corridor
Isolation	*Relevant for NSI East*
Exposure to demand disruption	**BG, GR (2017), HU, RO in case of Ukraine route disruption**
Increased supply needs calling for diversified supply	**EU wide**
Dependence or access to limited number of supply sources (* including LNG)	**BG, GR*, RO Barriers from GR to BG, RO to neighbours, West to East**
Price effects	
- **Barriers to LNG low price propagation**	*Relevant for NSI East*
- **Barriers to RU low price propagation**	*Relevant for NSI East*
- **Barriers to RU high price mitigation**	**BG *vs neighbours*; neighbours *vs RO***
Price spreads	*Relevant for NSI East*

> The results allow to identify the **most impacted countries** and **infrastructure limitations**

> Identified issues may be mitigated by **different types of gas infrastructure**

Thank You for Your Attention

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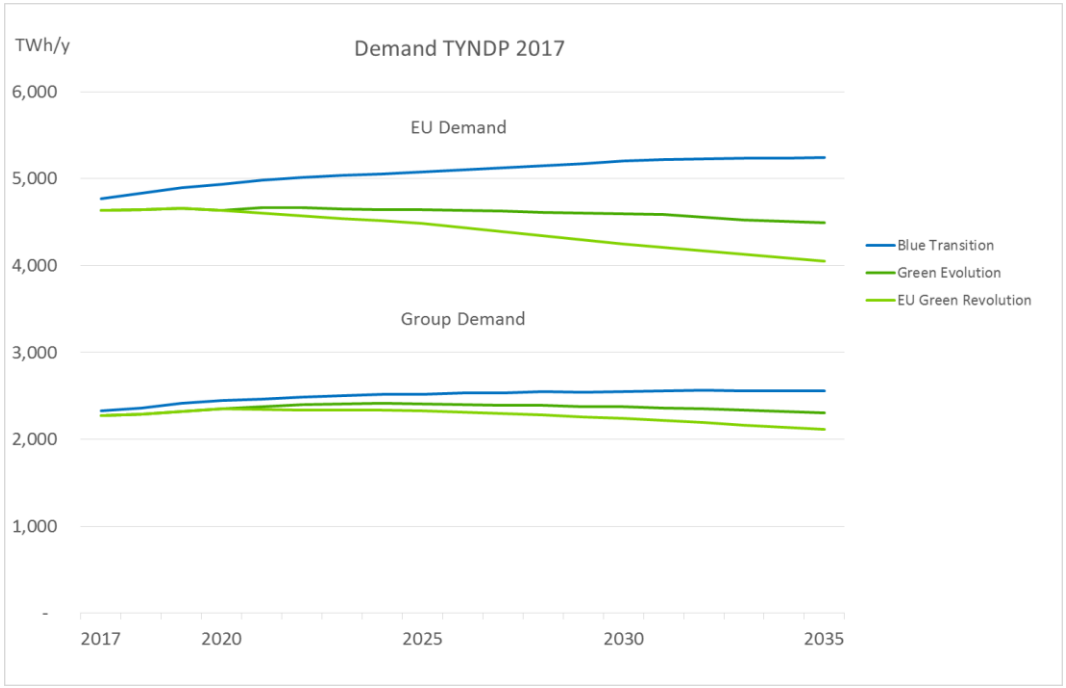
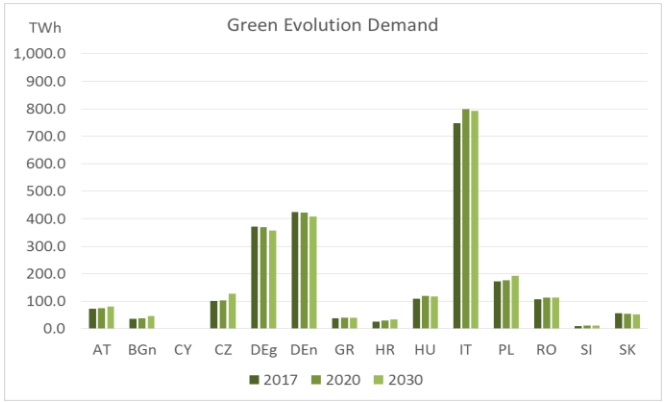
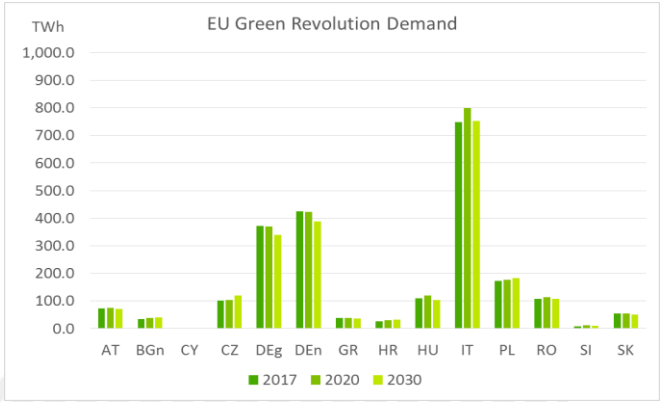
Infrastructure gap under TYNDP 2017

Annex

Demand – NSI East and SGC focus

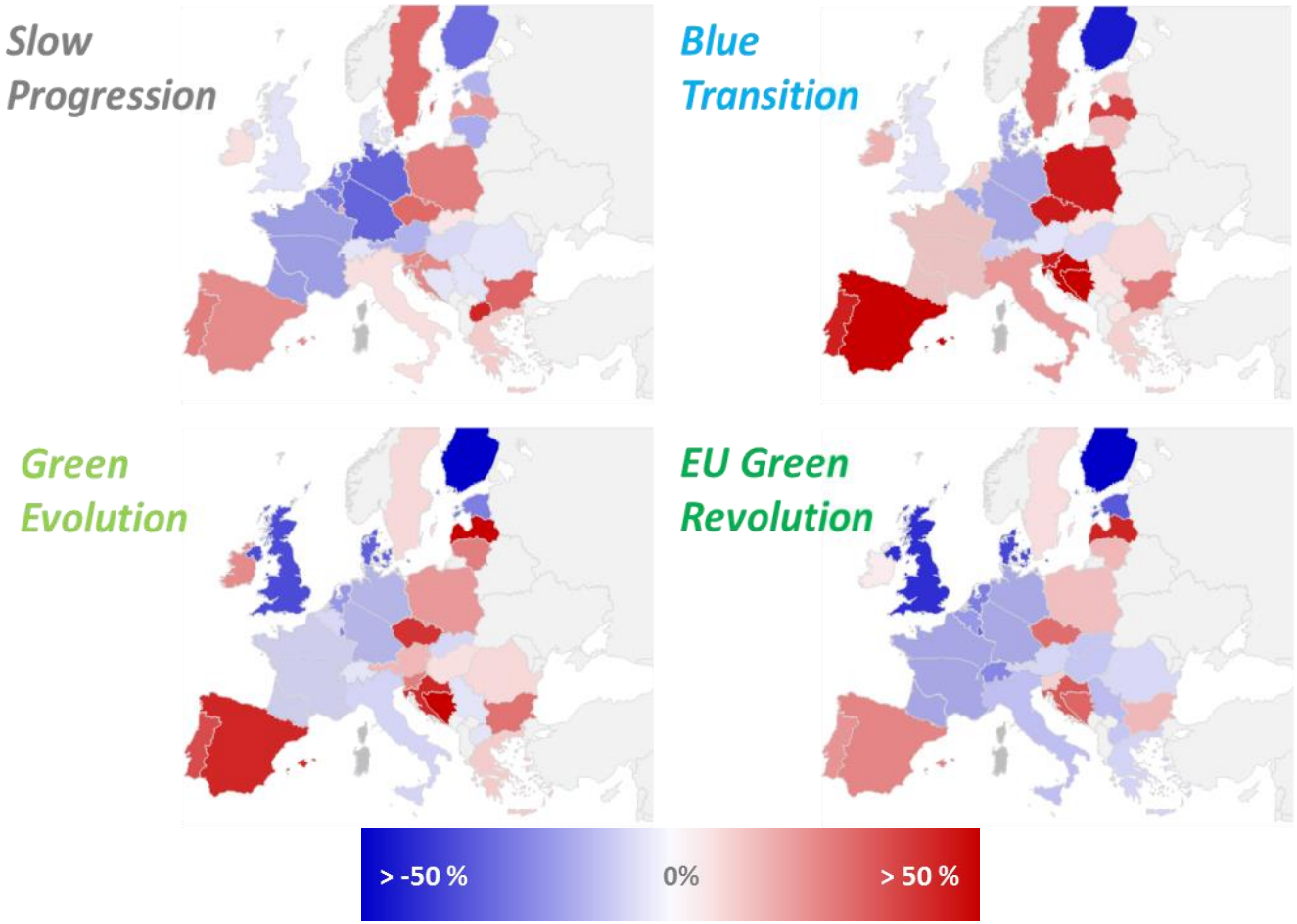






CY gasification demand cannot be covered under the Low infra level as necessary infrastructures are missing

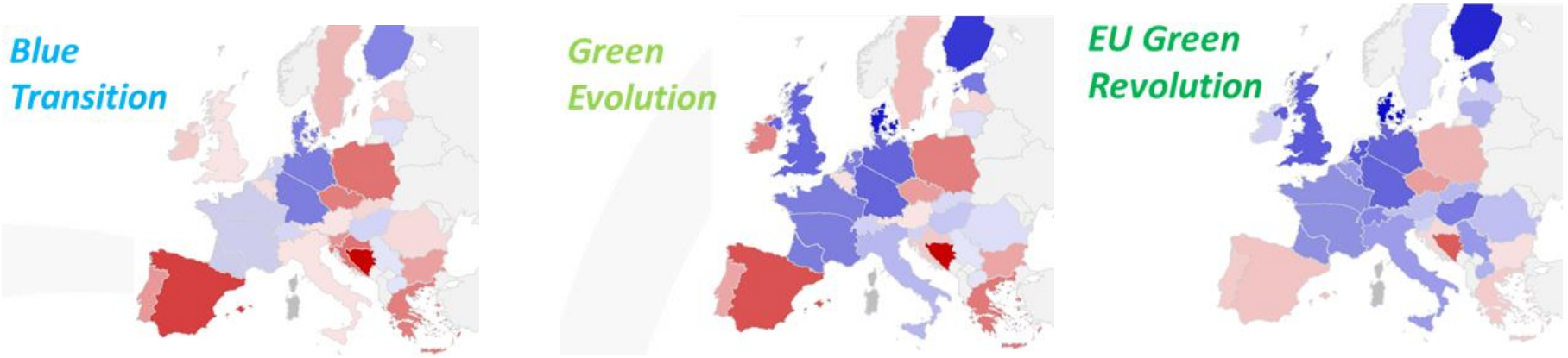
Overall demand evolution – country-level



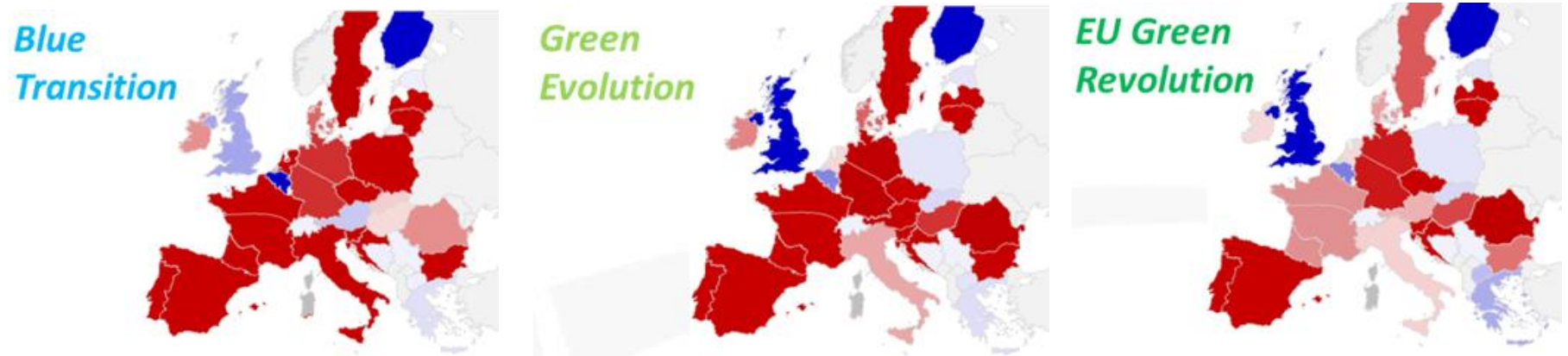
Total annual gas demand evolution – 2017 to 2035

Sectoral demand evolution – country-level

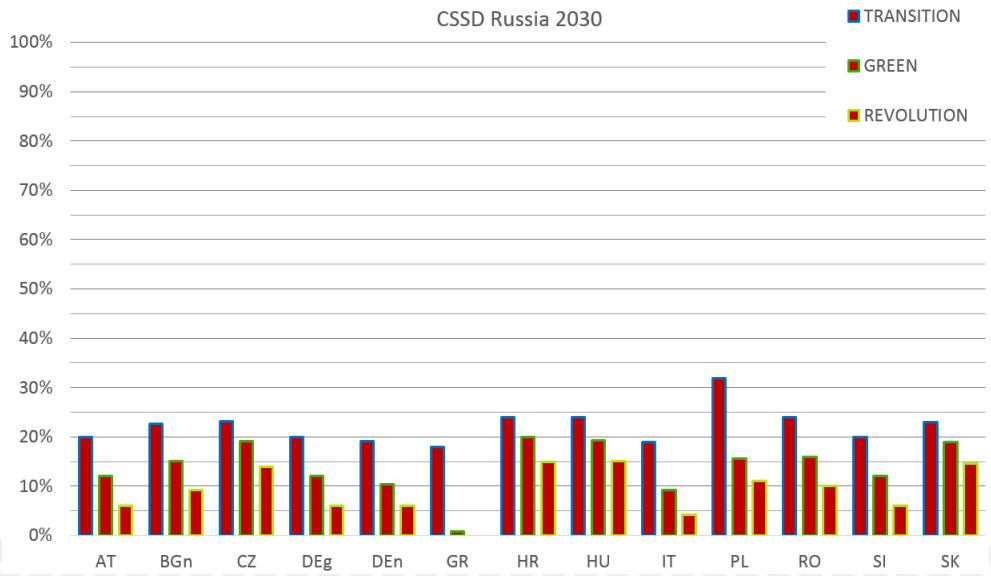
Evolution of annual end-user gas demand in the period 2017-2035



Evolution of annual gas demand for power generation in the period 2017-2035.



Dependence to Russian gas

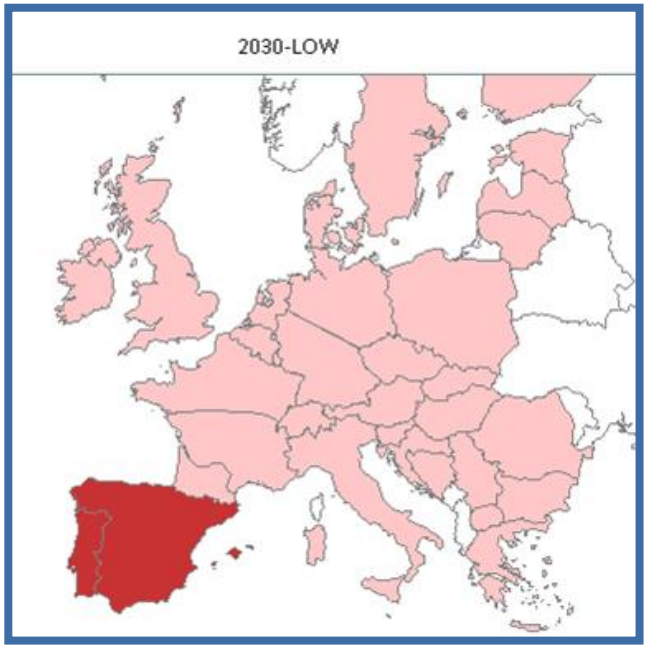


Security of supply / Competition

Dependence to LNG supply*

Whole year

- **At EU level**, no infrastructure limitation preventing full access to the other supply sources**
- **At country-level**, some highly dependent countries indicating infrastructure bottleneck



***LNG is a multi-source supply: results should be interpreted accordingly**

	NSI East + South. Corridor
Dependence to LNG supply (25% - 50%)	No dependency

CSSD

50% - 100%
25% - 50%
15% - 25%
5% - 15%
0%-5%

****the EU-level dependency derive from the maximum supply potential from the other sources**
*****The FR situation is remedied by 2020 thanks to the commissioning of a project**