TYNDP 2017 - identification of problems

Contribution to the 3rd PCI process

Preliminary results

BEMIP Regional Group - 26 October 2016

ENTSOG System Development Team
Infrastructure gap under TYNDP 2017
BEMIP Region

1. TYNDP 2017 - overview

2. The TYNDP Scenario framework

3. The TYNDP assessment frame

4. Identification of problems
Infrastructure gap under TYNDP 2017
BEMIP Region

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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 BEMIP Region

1. TYNDP 2017 - overview
2. The TYNDP Scenario framework
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## 4 Demand Scenarios

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

**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 substituting 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 should be kept in mind that targets are set globally across 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 - 2030

<table>
<thead>
<tr>
<th>1990</th>
<th>Slow Progression</th>
<th>Blue Transition</th>
<th>Green Evolution</th>
<th>EU Green Revolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>21%</td>
<td>41%</td>
<td>43%</td>
<td>46%</td>
</tr>
</tbody>
</table>

**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

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

The gas grid is to be assessed for the different paths

When looking at targets’ achievement in the gas and power sectors it should be kept in mind that targets are set globally across 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
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The TYNDP 2017 assessment frame

4 infrastructure levels
*Dynamic over time based on projects commissioning date*

<table>
<thead>
<tr>
<th>FID projects</th>
<th>Non-FID advanced projects</th>
<th>2nd PCI list</th>
<th>Non-FID less advanced projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing infra</td>
<td>Existing infra</td>
<td>Existing infra</td>
<td>Existing infra</td>
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</table>

<table>
<thead>
<tr>
<th>Low infra level analysis:</th>
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<td>Focus of today presentation</td>
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<th>Multi-criteria analysis</th>
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<table>
<thead>
<tr>
<th>EU Green Rev</th>
<th>2nd PCI list</th>
<th>Advanced</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue Transition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green Evolution</td>
<td></td>
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</tbody>
</table>

3 scenarios assessed

- Low infra level analysis:
A multi-criteria analysis

Security of supply

- Risk of demand curtailment
- N-1

Competition

- EU-level supply needs
  - Supply mixes
  - Dependence to supply sources

- Import Route Div.
  - Supply diversification and access to supply sources
  - Prices effects under contrasted supply mixes

Market Integration

- Price spreads

- Bilateral indicator

Not covered in the preliminary results
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Identification of problems

**TYNDP identifies the infrastructure gap**

> TYNDP assessment is performed under an assumption of perfect market functioning

  - To avoid identifying needs where better market functioning would solve the issue
  - To focus 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*
Security of supply
Exposure to demand disruption

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)

The BEMIP Region is able to cover its demand even under peak situation

Blue Transition

<table>
<thead>
<tr>
<th>Remaining Flexibility</th>
<th>Share of curtailed demand</th>
<th>BEMIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>20% - 50%</td>
<td>50% - 100%</td>
<td></td>
</tr>
<tr>
<td>0% - 20%</td>
<td>20% - 50%</td>
<td></td>
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<tr>
<td></td>
<td>0% - 20%</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Low Rem Flex: SE, DK, PL Green Rev: only SE</td>
</tr>
</tbody>
</table>

High demand situation (peak day)
Security of supply
Exposure to demand disruption – under Belarus route disruption

Blue Transition

<table>
<thead>
<tr>
<th>Remaining Flexibility</th>
<th>2017-LOW</th>
<th>2020-LOW</th>
<th>2030-LOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>20% - 50%</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>0% - 20%</td>
<td></td>
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</table>

HR unchanged from normal situation

BEMIP

| Exposure to demand disruption under Belarus route disruption | Disruption: PL GRev: PL low Rem Flex |
Decline of indigenous production leads to increased supply needs over time for 2 out of the 3 scenarios.
Security of supply / Competition
EU supply mixes – Retained supply potentials

Minimum Supply Potentials

Maximum Supply Potentials
Security of supply / Competition
EU supply mixes

Blue Transition

The low infrastructure level enables a wide range of supply mixes.
Security of supply / Competition
EU supply mixes

Green Revolution

The low infrastructure level enables a wide range of supply mixes.
Security of supply / Competition
Dependence to supply sources

> 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 minimum source share (CSSD) if infrastructures allows 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 noticeable dependence in the BEMIP Region to Norwegian* gas or LNG

*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

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

<table>
<thead>
<tr>
<th>CSSD</th>
<th>BEMIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% - 100%</td>
<td>EE, FI, LV, LT, PL G.Rev: PL below 25%</td>
</tr>
</tbody>
</table>

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

Results for the other scenarios are provided in Annex
**Competition - Access to Supply Sources**

*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**

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*
Competition - Access to Supply Sources

Indigenous production fades out as a diversification option

Blue Transition – Access to sources

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

BEMIP focus

Access to less than 3 supply sources (* including LNG)

EE*, FI, LV*, LT*

> Most of the countries accessing a limited number of supply sources also show high dependence to Russian gas
Price effects - LNG

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

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

<table>
<thead>
<tr>
<th>Price effect: barriers to low price propagation</th>
<th>BEMIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNG Maximisation (low LNG price)</td>
<td>FI vs Baltic states PL vs Baltic states</td>
</tr>
</tbody>
</table>

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

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

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

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

<table>
<thead>
<tr>
<th>2020-LOW</th>
<th>Barriers to low price propagation</th>
<th>BEMIP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Russian gas Max. (low RU price)</td>
<td>West vs East</td>
</tr>
<tr>
<td>0.0</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>5.0</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>2020-LOW</th>
<th>Barriers to high price mitigation</th>
<th>BEMIP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Russian gas Min. (high RU price)</td>
<td>Same as CSSD to RU supply</td>
</tr>
<tr>
<td>0.0</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>2.0</td>
<td></td>
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<tr>
<td>3.0</td>
<td>5.0</td>
<td></td>
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*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

<table>
<thead>
<tr>
<th>BEMIP</th>
<th>Price spreads</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>EE, FI, LV, LT, PL</td>
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</table>
## Conclusions

<table>
<thead>
<tr>
<th></th>
<th>BEMIP</th>
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<tbody>
<tr>
<td>Isolation</td>
<td>FI</td>
</tr>
<tr>
<td>Exposure to demand disruption</td>
<td>PL</td>
</tr>
<tr>
<td>Increased supply needs</td>
<td>All countries</td>
</tr>
<tr>
<td>due to decreasing indigenous production</td>
<td></td>
</tr>
<tr>
<td>Dependence or access to limited number of supply sources</td>
<td>EE*, FI, LV*, LT*, PL</td>
</tr>
<tr>
<td>(* including LNG)</td>
<td></td>
</tr>
<tr>
<td>Price effects</td>
<td></td>
</tr>
<tr>
<td>- Barriers to low price propagation</td>
<td>FI vs Baltic states</td>
</tr>
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> 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

Céline Heidrecheid  
System Development Business Area Manager  
ENTSOG -- European Network of Transmission System Operators for Gas  
Avenue de Cortenbergh 100, B-1000 Brussels  

EML:  Celine.heidrecheid@entsog.com  
WWW:  www.entsog.eu
Infrastructure gap under TYNDP 2017
BEMIP Region

Annex
Demand – BEMIP focus

**Demand TYNDP 2017**

- **EU Demand**
  - Blue Transition
  - Green Evolution
  - EU Green Revolution

- **BEMIP Demand**

**Blue Transition Demand**

- DEg
- DEn
- DK
- EE
- FI
- LT
- LV
- PL
- SE

**Green Evolution Demand**

- DEg
- DEn
- DK
- EE
- FI
- LT
- LV
- PL
- SE

**EU Green Revolution Demand**

- DEg
- DEn
- DK
- EE
- FI
- LT
- LV
- PL
- SE
Country-level demand evolution

Slow Progression

Blue Transition

Green Evolution

EU Green Revolution

Total annual gas demand evolution – 2017 to 2035
Dependence to Russian gas

CSSD Russia 2020

CSSD Russia 2030