Selection of Projects of Energy Community Interest (PECIs)
1st Meeting of the Gas Group – Proposed Assessment Methodology

Presentation REKK / DNV GL

Vienna 12.12.2017
Agenda

1. Overview of general project assessment methodology
2. Cost-benefit analysis (CBA) and Gas market modelling (EGMM)
3. Multi-criteria assessment methodology
4. Country specific data and modelling assumptions
Project Objectives and Deliverables

- **Objectives**
  - To assess the candidate projects for electricity, gas and oil infrastructure, as well as for smart grids, in order to be able to identify those which bring the largest benefits for the EnC.
  - To develop the electricity and gas market models for the Energy Community Contracting Parties needs and use these in the assessment of PECI AND PMI candidates;
  - To develop a multi criteria assessment methodology, using also the ENTSOE and ENTSOG methodology for cost benefit analysis where applicable;

- **Deliverables**
  - Interim report (by 02. January 2018) containing:
    - the list of submitted projects, the result of the eligibility checks and data verification process, the description of the CBA methodology, indicators and weights used for the multi-criteria assessment
  - Draft final report (by 07. May 2018) containing:
    - description of the CBA methodology, indicators and weights used for the multi-criteria assessment, results of the CBA and multi-criteria assessment
  - Final report (by 11.07.2018), which incorporates the contents of the draft final report and reflects to the comments and feedback received by EnC Secretariat and project promoters.
Project Workflow

1. Questionnaires for submission of candidate projects
2. Eligibility check
3. Verification of project data
4. CBA
5. MCA
6. Relative ranking of projects
Project Team

**Project Manager**
Borbála Takácsné Tóth (REKK)

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- Martin Paletar

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- Nenad Sijakovic

**European Commission DG Energy**
- Catharina Sikow
- Magny
- Adam Szolyak
- Adam Cwetsch

**Working Group for Gas and Oil**

**Working Group for Electricity and Smart Grid**
Step 1 – Questionnaires for Submissions of Candidate Projects

1. Questionnaires for submission of candidate projects
2. Eligibility check
3. Verification of project data
4. CBA
5. MCA
6. Ranking

Type of projects

- Electricity
- Transmission lines
- Electricity storage
- Gas
- Interconnectors
- Gas storage
- LNG
- Oil
- Pipeline
- Storage
- Smart grid

- Interconnector projects on the two side of the borders can only be modelled together
- Project promoters are hence requested to submit proposals jointly for the same project
- Oil and smart grid project evaluation follows a slightly different approach: no modelling
All eligible projects will be evaluated according to the same approach. The PCI status will be decided on in the final step of the decision making: selected projects will qualify as a PECI or as a Project of Mutual interest. (Art 4 para 5 and 6.)
Step 3 – Verification of Project Data

1. Questionnaires for submission of candidate projects
2. Eligibility check
3. Verification of project data
4. CBA
5. MCA
6. Ranking

Verification of project data

- Check with PCI, PECI and TYNDP: In case of projects that were submitted to previous evaluations the data consistency will be checked.
- Check for project groups: In case projects are dependent on each other and has not been submitted jointly by promoters the project promoters are requested to join the project.
- Check of CAPEX and OPEX: Benchmarking of submitted costs based on ACER guidelines and other relevant literature.
- Check basic data requirement: In case of missing data project promoters will be asked to submit missing data / to accept assumed data suggested by consultant / to withdraw application.

Key data needed for project assessment: capacity (at the border), cost, commissioning date.
Step 4 – Cost-Benefit Analysis

An investment project would be beneficial to the investigated stakeholder group if the cost-benefit analysis provides a positive net benefit (i.e. a positive NPV)

- Costs and benefits of a project are assessed in the economic analysis by the Net Present Value (NPV) OR Benefit/Cost (B/C) ratio
- Calculation of the Net Present Value (NPV) and Benefit/Cost ratio of economic costs and benefits includes
  - the monetary costs and benefits of the investor
  - the costs and benefits to other stakeholders and the society as a whole affected by an investment project
- (Economic) NPV is the difference between the discounted total social benefits and costs
- Economic assessment of a project is positive if the NPV is positive (NPV > 0) OR if the B/C > 1
Step 4 – Cost-Benefit Analysis

1. Questionnaires for submission of candidate projects
2. Eligibility check
3. Verification of project data
4. CBA
5. MCA
6. Ranking

NPV calculations based on two modelling approaches

- Gas market model
- REKK EGMM: welfare change will be modelled, monetized benefits calculated (NPV)

- PINT: Change in NPV (or B/C) when adding individual projects to the reference
- TOOT: Change in NPV (or B/C) when removing individual projects from reference with all candidates

Cost-benefit analysis of the project: social NPV of the project calculated for the region
- PINT: put-in-one-at-a-time modelling
- TOOT: take-out-one-at-a-time modelling

Basic input for MCA
For sensitivity only
Step 5 – Multi Criteria Assessment

1. Questionnaires for submission of candidate projects
2. Eligibility check
3. Verification of project data
4. CBA
5. MCA
6. Ranking

- **Monetized benefits**
  - CBA – input from the modelling
- **Other non-monetized benefits**
  - Indicators for benefit categories outside of the CBA
- **Scoring**
  - Scores from 1-10 will be assigned to the CBA and to the calculated indicators
- **Weights**
  - Weights are assigned to each benefit category to arrive to a final score of each project

- MCA allows integration of monetized benefits (result of CBA) with non-monetized benefits (assessment of additional quantitative and qualitative criteria)
- Outcome will be a relative ranking of all eligible projects (separate for electricity and gas projects)
Step 6 – Relative Ranking

1. Questionnaires for submission of candidate projects
2. Eligibility check
3. Verification of project data
4. CBA
5. MCA
6. Ranking

Relative ranking of projects

- Ranking
- Modelling based on PINT
- Indicators calculated
- MCA
- Sensitivity analysis
- Supporting high level decision making
## Assessment of Oil Projects – eligibility check

### Evaluation
- The proposed methodology is based on our previous PECI project assessment and on the ministerial decision 2015/09/MC-EnC adopting 347/2013 Regulation
- We suggest to follow this approach and evaluate smart grid projects talking into account eligibility **and specific criteria**

### Eligible project categories

#### ANNEX I. (3)
1. Pipelines used to transport crude oil
2. Pumping stations and storage facilities necessary for the operation of crude oil pipelines;
3. Any equipment or installation essential for the system in question to operate properly, securely and efficiently, including protection, monitoring and control systems and reverse flow devices

### Geographical eligibility criteria

#### Art. 4. 1(c )
1. Directly crossing the border: involves at least two CPs; or a CP and an MS or more
2. Located in one CP only, but has a significant cross-border impact
Assessment of Oil Projects

Art. 4.2. (d) and ANNEX III (5) of Ministerial Decision 2015/09/MC-EnC adopting 347/2013 Regulation

Specific Criteria

Security of supply
- reducing single supply source or route dependency

Efficient and sustainable use of resources
- To what extent the project makes use of existing infrastructure
- Contribution of minimising environmental risks

Interoperability
- Possibility of reverse flow Yes/No
- Improves the operation of the oil network (additional capacity, reliability)
Agenda

1. Overview of general project assessment methodology
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4. Country specific data and modelling assumptions
General Approach for Cost-Benefit Analysis

- Taking the ENTSO-G CBA methodology as a basis, and monetize the benefit categories where data availability allows it

- Use of the European Gas Market Modell to monetize welfare change due to the analysed project (project added to reference) under normal and security of supply (SOS) circumstances

**Monetized benefits (+)**

- Market integration effect = the total welfare change under normal circumstances
- SOS effect = the welfare change under a monthly cut of the largest import route of the region (through Ukraine) (one in 20)
- CO2 emission reduction effect = Accounted for as if gas would substitute a mix in of the primary energy of the respective countries

**Verified CAPEX and OPEX costs (-)**

\[
\text{NPV} = 0.95 \times \text{Total welfare change(normal)} + 0.05 \times \text{Total welfare change (SOS)} - \text{Investment cost} + \text{(CO2)}
\]

\[
\text{B/C} = \frac{(0.95 \times \text{Total welfare change(normal)} + 0.05 \times \text{Total welfare change(SOS)} + \text{CO}_2 \text{ effect})}{\text{Investment cost}}
\]
Parameters of the Cost-Benefit Analysis

- **Market Integration**
- **CO2 Savings**
- **Security of Supply**

= **Net Social Benefits**

- **Welfare Change Market Integration & Competition**
- **Welfare Change Security of Supply**
- **CO2 Savings**

= **CAPEX**

= **Net Benefits**
Components of Net Present Value Calculation

- Modelled welfare components: Total welfare change = CS + PS + TSO + LTC holder + SSO + LSO
  - CS: Consumer surplus change in the countries of the area of analysis compared to reference
  - PS: Producer surplus change in the countries of the area of analysis
  - TSO, SSO, LSO: Change in profit
  - Change in LTC contract holder’s profit
  - Investment cost: verified investment cost
  - CO2: Calculated according to the selected option

- When calculation the NPV or B/C ratio 25 years of lifetime and a residual value of zero are applied → ACER recommendation

- Values between 2018-2050 are modelled by EGMM yearly → harmonized with ENTSOG methodology

- Real social discount rate: 4 % → ENTSOG methodology
- Reference scenario built up till 2045:
  - Infrastructure development according to ENTSO-G TYNDP
  - Production and demand in the Region as agreed with the Group
  - All proposed and verified infrastructure elements are assessed individually – using the PINT (Put-IN one at the Time) approach
Whole Europe (35 countries) is modelled

Competitive prices by countries; price modelled for each 12 months

Trade is based on long term contracts and spot trade within the EU and with exogenous countries and global LNG market (NO, RU, TR, LNG)

Natural gas flows and congestions on interconnectors

Physical constraints are interconnection capacities (transmission tariffs are also included)

Trade constraints: TOP obligations with flexibility

Domestic production and storage facilities are included

Arrows: modelled gas flows

LNG market representation is linked to Asian LNG prices
One Gas Year – 12 Months

**INPUT**
- Demand by countries (annual quantity, monthly distribution)
- Domestic production (annual quantity, minimum and maximum production)
- LTC contract (ACQ/DCQ), flexibility
- Infrastructure: Interconnectors, storage, LNG
- Tariffs: transmission, storage and regasification

**MODEL**

**OUTPUT**
- Wholesale gas price by country
- Consumption by countries
- Gas flows on interconnectors
- Storage stock change
- Import through long term contracts and spot trade

**Social welfare:**
- Consumer surplus
- Producer surplus
- Storage operation profit
- Storage arbitrage profit
- Net profit from long-term contracts
- TSO auction revenue
- TSO operation profit
A Simple Model of Spot LNG Pricing for Europe (in€/MWh)

\[ P_{ex>im} = P_{JP} - (C_{ex>JP} - C_{ex>im}) \]

- **US**: \( C_{US>JP} = 3.8 \text{ €/MWh} \)
- **JP**: \( P_{JP} = 15 \text{ €/MWh} \)
- **UK**: \( P_{US>UK} = 12.9 \text{ €/MWh} \), \( P_{QA>UK} = 15.5 \text{ €/MWh} \)
- **TR**: \( P_{US>TR} = 13.5 \text{ €/MWh} \), \( P_{QA>TR} = 14.8 \text{ €/MWh} \)
- **QA**: \( C_{QA>JP} = 2.2 \text{ €/MWh} \)
- **QA**: \( C_{QA>UK} = 2.7 \text{ €/MWh} \), \( C_{QA>TR} = 2.0 \text{ €/MWh} \)

Graphical representation of LNG supply to UK and TR with price ranges and capacity limits.
## Input Data Sources

<table>
<thead>
<tr>
<th>Input data</th>
<th>Unit</th>
<th>Source</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearly gas demand</td>
<td>TWh/year</td>
<td>Primes ref 2016</td>
<td>For those modelled countries not included in primes: TYNDP 2016 Green evolution</td>
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<tr>
<td>Monthly demand</td>
<td>In % of yearly</td>
<td>Eurostat</td>
<td>Based on fact data from 2013-15</td>
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<tr>
<td>Production</td>
<td>TWh/year</td>
<td>Primes ref 2016</td>
<td>For those modelled countries not included in primes: TYNDP Green evolution</td>
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<tr>
<td>Pipeline Capacity</td>
<td>GWh/day</td>
<td>ENTSOG capacity map 16</td>
<td>For future projects ENTSOG TYNDP 2017</td>
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<tr>
<td>Pipeline Tariff on IP</td>
<td>€/MWh</td>
<td>REKK calculation; regulators websites as of 2017</td>
<td>Except for UA, where 2020 tariffs are used based on Naftogas data</td>
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<tr>
<td>Storage capacity</td>
<td>Working gas: TWh, Inj.. withdr: GWh/day</td>
<td>GSE</td>
<td>Data on each storage site – than aggregated on a country level</td>
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<td>Storage tariff</td>
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<td>Storage operators websites 2017 Jan</td>
<td>1 €/MWh cap is used</td>
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<tr>
<td>LNG regas capacity</td>
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<td>GIE</td>
<td>Aggregated on a country level</td>
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<td>LNG regas tariff</td>
<td>GWh/day</td>
<td>Operators websites</td>
<td>Entry into pipeline network is taken into account</td>
</tr>
<tr>
<td>LNG liquefaction</td>
<td>GWh/day</td>
<td>GIIGNL 2016</td>
<td>Source is constrained by liquefaction capacity</td>
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<tr>
<td>LNG transport cost</td>
<td>€/MWh</td>
<td>REKK calculation</td>
<td>Distance based. takes into account ship rates and boil off cost</td>
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<tr>
<td>Long term contracts</td>
<td>ACQ: TWh/year. DCQ: GWh/day</td>
<td>REKK collection from press + Cedigaz</td>
<td>TOP. flexibility. except for gas islands</td>
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<td>Delivery point on borders. Pricing based on foreign trade statistics.</td>
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<tr>
<td></td>
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<td></td>
<td>Delivery routes predefined</td>
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</table>
**EGMM and EEMM interlinkages**

1. **step:** Gas market modelling
   -> PRIMES/Reference gas demand corrected by the EnC

2. **step:** Electricity market modelling with gas price based on the result of EGMM

3. **step:** Modified gas demand data
   -> Reference gas demand +/- gas consumption changes in the power sector

4. **step:** New gas market modelling with updated gas demand
   -> this will be the reference gas scenario

5. **step:** New electricity market modelling with updated gas prices
   -> this will be the reference gas scenario
Dummy project: a new transmission pipeline between Greece and Bulgaria

- Bidirectional pipeline:
  - capacity of 90 GWh/day from Greece to Bulgaria and
  - 90 GWh/day capacity from Bulgaria to Greece.

- Commissioning year of the project is 2020.

- The total investment cost is 220 m€, distributed evenly between the two countries and spent evenly:
  - BG: 110 m€ real 2016
  - GR: 110 m€ real 2016
Price effect of the Dummy project (BG-GR) in a sample year, 2030

- A new bi-directional interconnector is commissioned connecting BG and GR (capacity 151 GWh/day)
- Effect: spot LNG gas flows may reach Serbia
GR-BG Interconnector Welfare Change Effects for 2030 - normal

Change in welfare (m€), „normal”

- **BG:**
  - Consumer surplus surges due to lower prices.
  - Producer surplus and LTC holder profit drops, since the domestic production can be marketed at a lower price.

- **GR:**
  - TSO profits and LNG terminal operator profits increase, due to higher utilisation of infrastructure.
  - Consumer surplus decrease is outweighted by TSO and LSO profit increase.
GR-BG Interconnector Welfare Change Effects for 2030 - SOS

Change in welfare (m€), „SOS”

- **BG:**
  - Consumer surplus surges due to lower prices is much higher – the pipeline offers an alternative route to a previously isolated country
  - TSO operating profits increase due to higher flows on the newly commissioned pipeline

- **GR**
  - TSO profits and LNG terminal operator profits increase, due to higher utilisation of infrastructure
Summary table of the CBA results (2020-2045)

<table>
<thead>
<tr>
<th>Region</th>
<th>Normal welfare</th>
<th>SoS welfare</th>
<th>Welfare 95% normal +5% SoS</th>
<th>CO2</th>
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<td>1807</td>
<td>1577</td>
<td>14</td>
<td>220</td>
<td>1371</td>
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</tbody>
</table>
Graphic representation of the results on the main criteria

Regional welfare change due to the project in SOS case 25 years (5% weight)

Regional welfare change due to the project in 25 years under normal conditions (95% weight)
Agenda

1. Overview of general project assessment methodology
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### Overview on Multi-Criteria Assessment Methodology

| Rationale for MCA | ▪ Not all dimensions of impacts may be monetised (which is necessary for inclusion within economic CBA)  
▪ MCA allows to integrate qualitative criteria with results of the CBA |
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Step-wise methodology of Multi-Criteria Assessment</td>
<td></td>
</tr>
</tbody>
</table>
1. ▪ Identification and definition of criteria  
2. ▪ Specification of indicators to measure criteria  
3. ▪ Weighting of criteria (using the AHP approach)  
4. ▪ Assessment of the fulfilment of each criterion by each investment project  
5. ▪ Calculation of a final score for each project  
   \[ \sum \text{score of each criterion} \times \text{weight of each criterion} \]  
6. ▪ Relative ranking of projects based on the project scores |
Overview of Project Assessment Criteria

**Source of criteria**
- EU Regulation 347/2013 as adopted by the Ministerial Council Decision
- Assessment approach for EU Projects of Common Interest (PCI)
- ENTSO-E and ENTSO-G methodologies with feedback provided from ACER
- Consultant’s expertise from previous PECI 2016 selection

**Criterion**

<table>
<thead>
<tr>
<th>Change in socio-economic welfare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improvement of System Reliability</td>
</tr>
<tr>
<td>Enhancement of competition</td>
</tr>
<tr>
<td>Project Maturity</td>
</tr>
</tbody>
</table>

**Indicator**

1. Net Present Value (NPV) or Benefit/Cost ratio
2. System Reliability Index (SRI)
3. Import Route Diversification Index (IRD)
4. Implementation Progress Indicator (IPI)

**Result of CBA**

**Additional Criteria of MCA**
## Calculation and Scoring of Indicators

### Calculation of Indicators

<table>
<thead>
<tr>
<th>SRI, IRD</th>
<th>Indices calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>– with and without the individual project</td>
</tr>
<tr>
<td></td>
<td>– for the year of commissioning of the project</td>
</tr>
<tr>
<td></td>
<td>– as aggregate of the impacts in the countries on each end of the interconnector</td>
</tr>
</tbody>
</table>

| IPI | Index determined by project specific progress reported in questionnaire |

### Scoring of Indicators

<table>
<thead>
<tr>
<th>NPV, SRI, IRD</th>
<th>Score of 1 and 10 assigned to projects with the smallest and largest change in the indicator respectively</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Scores of projects with changes in-between calculated by linear interpolation between min and max values of the change of the indicator</td>
</tr>
</tbody>
</table>

| IPI | Score of 1 assigned for each step completed by individual project |
Project Assessment Criteria – Change in Socio-Economic Welfare

Within the economic CBA, *incremental changes in socio-economic welfare from project implementation* measures the project's impact on:

- **Market integration** via the impact on wholesale price changes (convergence) resulting from reduced congestion, access to sources with lower production costs and enhancement of competition
- **Security of supply** via change in economic welfare in case of a gas supply disturbance
- **CO₂ emissions** via impact of changes in gas consumption on the primary energy mix

The change in socio-economic welfare is measured by the net present value (NPV) or the Benefit/Cost (B/C) ratio.

The higher the NPV (or the B/C ratio) the larger the net benefit.
- Score of 1 assigned to project with smallest NPV (or B/C ratio) above zero
- Project with NPV negative but close to zero, will be assigned a score of 0

### Dummy project example Bulgaria – Greece interconnector

<table>
<thead>
<tr>
<th></th>
<th>NPV Value (m€)</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project 1</td>
<td>18.25</td>
<td>1.00</td>
</tr>
<tr>
<td>Project 2</td>
<td>350</td>
<td>3.02</td>
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<tr>
<td>Project 3</td>
<td>1500</td>
<td>10.00</td>
</tr>
<tr>
<td>IP GR-BG</td>
<td>1371</td>
<td>9.22</td>
</tr>
</tbody>
</table>

NPV values of dummy project and three other gas infrastructure projects calculated within CBA.
Project Assessment Criteria – Import Route Diversification Index

Enhancement of Competition

- **Incremental enhancement of competition** is calculated as change in the simplified **Import Route Diversification (IRD)** index with and without the individual project as aggregate of the impacts in the countries on each end of interconnector.

- The higher the value of the index the higher the market concentration.

\[
IRD = \sum \left( \frac{\text{tech. interconnection capacity at each border}}{\text{total system entry capacities}} \right)^2 
+ \sum \left( \frac{\text{tech. send-out capacity at each LNG terminal}}{\text{total system entry capacities}} \right)^2
\]

Reasoning

- Interconnection / LNG projects may enhance wholesale competition by providing access to alternative import capacities.

- Transfer of monopoly rents (i.e. price-mark-ups over production costs) gained by producers / importers / traders to consumers.

- Market model (used in CBA) assumes competitive market equilibrium.
MCA Example of Dummy Project – Import Route Diversification

**IRD for Bulgaria without project**

\[
\left(100 \times \frac{1214}{1323}\right)^2 + \left(100 \times \frac{109}{1323}\right)^2 = 8488
\]

**IRD for Bulgaria with project**

\[
\left(100 \times \frac{1214}{1413}\right)^2 + \left(100 \times \frac{199}{1413}\right)^2 = 7580
\]

- Applying same approach for Greece results in increase of IRD by 195 (indicating a deterioration of competition).
- Adding up both numbers results in an overall IRD impact of the dummy project of -713

<table>
<thead>
<tr>
<th>Project</th>
<th>Change in IRD</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project 1</td>
<td>-312</td>
<td>1.00</td>
</tr>
<tr>
<td>Project 2</td>
<td>-520</td>
<td>4.16</td>
</tr>
<tr>
<td>Project 3</td>
<td>-905</td>
<td>10.00</td>
</tr>
<tr>
<td><strong>IP GR-BG</strong></td>
<td><strong>-713</strong></td>
<td><strong>7.09</strong></td>
</tr>
</tbody>
</table>
The incremental *improvement of overall system reliability* with regards to the daily operational flexibility and ability of the system to withstand extreme conditions is calculated as the change of the **System Reliability Index (SRI)** with and without the individual project.

The higher the value of the index the higher the level of system reliability:

\[
SRI = \frac{(\text{import cap.} + \text{production} + \text{storage} + \text{LNG}) - \text{single largest infr.}}{\text{daily peak demand}}
\]

**Reasoning**

- CBA incorporates only some aspects of security of supply measured on monthly basis
- Additional indicator to account for daily operational flexibility and ability of the system to withstand extreme conditions
MCA Example of Dummy Project – System Reliability Index

1st Working Group Meeting

SRI for Bulgaria without project

\[
\frac{(1323 + 11 + 34 - 1214)}{168} = 0.917
\]

SRI for Bulgaria with project

\[
\frac{(1323 + 90 + 11 + 34 - 1214)}{168} = 1.452
\]

Increase of SRI by 0.535 indicates improvement in reliability due to implantation of dummy project.

Applying same approach for Greece results in increase of SRI by 0.257 (indicating an improvement of reliability).

Adding up both numbers results in an overall SRI impact of the dummy project of 0.792.

<table>
<thead>
<tr>
<th>Project</th>
<th>Change in SRI</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project 1</td>
<td>0.655</td>
<td>1.00</td>
</tr>
<tr>
<td>Project 2</td>
<td>0.982</td>
<td>10.00</td>
</tr>
<tr>
<td>Project 3</td>
<td>0.85</td>
<td>6.37</td>
</tr>
<tr>
<td>IP GR-BG</td>
<td><strong>0.792</strong></td>
<td><strong>4.77</strong></td>
</tr>
</tbody>
</table>
Project Assessment Criteria – Implementation Progress Indicator

- The **Implementation Progress Index (IPI)** assesses the preliminary implementation potential of each individual project based on information provided in questionnaires.
- A score of 1 is assigned for each project implementation step already undertaken.
- Evaluation is conducted separately for each proposed investment project.
- Where project maturity is significantly different on each side of a border, progress of least developed part will be applied for calculation.
- Favours projects which have a clear implementation plan and/or have already commenced their preparatory activities.

**Reasoning**
- Criterion aims to test preliminary implementation potential.
- Project (cost) data and implementation timeline of projects at a very early consideration phase is by nature more uncertain.
MCA Example of Dummy Project – Implementation Progress Indic.

Dummy project example Bulgaria – Greece interconnector

<table>
<thead>
<tr>
<th>Project implementation steps</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consideration phase</td>
<td>✔ 1</td>
</tr>
<tr>
<td>Preparatory studies / pre-feasibility studies</td>
<td>1</td>
</tr>
<tr>
<td>Technical feasibility study / Environmental impact assessment</td>
<td>1</td>
</tr>
<tr>
<td>Economic feasibility study / cost-benefit analysis</td>
<td>1</td>
</tr>
<tr>
<td>Detailed design study (FEED/Main Design)</td>
<td>1</td>
</tr>
<tr>
<td>Financing secured</td>
<td>1</td>
</tr>
<tr>
<td>Planning approval / permitting</td>
<td>1</td>
</tr>
<tr>
<td>Approval by regulatory authority</td>
<td>1</td>
</tr>
<tr>
<td>Final investment decision</td>
<td>1</td>
</tr>
<tr>
<td>Tendering</td>
<td>1</td>
</tr>
</tbody>
</table>

Assumption only “consideration phase” has been completed and recorded in questionnaire for the whole interconnection project (i.e. sections located in both countries)

<table>
<thead>
<tr>
<th>IPI</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project 1</td>
<td>1.00</td>
</tr>
<tr>
<td>Project 2</td>
<td>1.00</td>
</tr>
<tr>
<td>Project 3</td>
<td>2.00</td>
</tr>
<tr>
<td>IP GR-BG</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Overview on Multi-Criteria Assessment Methodology

Multi-Criteria Assessment

Result of CBA

Criteria

- Change in Socio-Economic Welfare
- Enhancement of Competition
- Improvement of System Reliability
- Project Maturity

Indicators

- Net Present Value
- Import Route Diversification Index
- System Reliability Index
- Implementation Progress Indicator

Ability of each project to fulfil criterion

- Score 1 to 10

Weights

- Change in Socio-Economic Welfare: 0.60
- Enhancement of Competition: 0.12
- Improvement of System Reliability: 0.18
- Project Maturity: 0.10

Total score of each proposed project

Ranking of proposed projects based on scores

Economic assessment of costs and benefits within CBA key element of the net benefit of an investment project, reflected by large weight of NPV (60%)
Relative Ranking of Projects

- Ranking is done by multiplying the score for each criterion, with the weight of each criterion a total score will then calculated for each project or project cluster (previous slide)
- Based on the calculated total scores of each individual project or project cluster a relative ranking of all eligible projects (i.e. a comparison of each individual project with the other submitted projects) will be provided in the final step

### Dummy project example Bulgaria – Greece interconnector

<table>
<thead>
<tr>
<th>Project</th>
<th>Indicators (Scores)</th>
<th>Weights</th>
<th>Indicators (Weighted Scores)</th>
<th>Total Score</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Result of the CBA</td>
<td>Enhancememt of Competition</td>
<td>Improvememt of System Adequacy</td>
<td>Project Maturity</td>
<td>Result of the CBA</td>
</tr>
<tr>
<td>P 1</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>60%</td>
</tr>
<tr>
<td>P 2</td>
<td>3.02</td>
<td>4.16</td>
<td>10.00</td>
<td>1.00</td>
<td>60%</td>
</tr>
<tr>
<td>P 3</td>
<td>10.00</td>
<td>10.00</td>
<td>6.37</td>
<td>2.00</td>
<td>60%</td>
</tr>
<tr>
<td>IP GR-BG</td>
<td>9.22</td>
<td>7.09</td>
<td>4.77</td>
<td>1.00</td>
<td>60%</td>
</tr>
</tbody>
</table>
Agenda

1. Overview of general project assessment methodology
2. Cost-benefit analysis (CBA) and Gas market modelling (EGMM)
3. Multi-criteria assessment methodology
4. Country specific data and modelling assumptions
Georgian projects

- Three possible ways to assess them:
  - extending the EGMM with Georgia
  - Use the world model WGMM
  - Use different assessment of benefits for these projects

- The main problem is with eligibility: effect on two EUMS or two CPs

- Geographical region?
Assessed Geographical Area – Same for All Project Types

  - “The area for the analysis of an individual project shall cover all Contracting Parties and Member States, on whose territory the project shall be built, all directly neighbouring Contracting Parties and Member States and all other Contracting Parties and Member States significantly impacted by the project.”
  - Our proposal for the definition of area for the analysis:
    - All Contracting Parties
    - Neighbouring EU Member States (Bulgaria; Croatia; Greece; Hungary; Italy; Poland; Romania, Slovakia)
## New pipeline and LNG infrastructure assumed in the reference

<table>
<thead>
<tr>
<th>Name</th>
<th>Maximum flow GWh/d</th>
<th>Date of commissioning</th>
<th>Basis to include into reference for 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT-CH</td>
<td>368</td>
<td>2018</td>
<td>FID</td>
</tr>
<tr>
<td>BG-RS</td>
<td>51</td>
<td>2018</td>
<td>FID</td>
</tr>
<tr>
<td>RS-BG</td>
<td>51</td>
<td>2018</td>
<td>FID</td>
</tr>
<tr>
<td>CH-FR</td>
<td>100</td>
<td>2018</td>
<td>FID</td>
</tr>
<tr>
<td>CH-DE</td>
<td>240</td>
<td>2018</td>
<td>FID</td>
</tr>
<tr>
<td>TR-GR2_TAP</td>
<td>350</td>
<td>2019</td>
<td>FID</td>
</tr>
<tr>
<td>AZ-TR_TANAP</td>
<td>490</td>
<td>2018</td>
<td>FID</td>
</tr>
<tr>
<td>GR-BG</td>
<td>90</td>
<td>2018</td>
<td>FID</td>
</tr>
<tr>
<td>GR-BG</td>
<td>151</td>
<td>2021</td>
<td>FID</td>
</tr>
<tr>
<td>GR-IT_TAP</td>
<td>334</td>
<td>2019</td>
<td>FID</td>
</tr>
<tr>
<td>SI-HR2</td>
<td>165</td>
<td>2019</td>
<td>FID</td>
</tr>
<tr>
<td>HR-SI</td>
<td>165</td>
<td>2019</td>
<td>FID</td>
</tr>
<tr>
<td>BG-RO</td>
<td>14</td>
<td>2016</td>
<td>FID</td>
</tr>
<tr>
<td>RO-BG2</td>
<td>14</td>
<td>2016</td>
<td>FID</td>
</tr>
<tr>
<td>IT-AT2</td>
<td>189</td>
<td>2018</td>
<td>FID</td>
</tr>
<tr>
<td>AT-DE2</td>
<td>36</td>
<td>2017</td>
<td>FID</td>
</tr>
<tr>
<td>DE-AT2</td>
<td>143</td>
<td>2017</td>
<td>FID</td>
</tr>
<tr>
<td>GR-LNG expansion</td>
<td>81</td>
<td>2017</td>
<td>FID</td>
</tr>
</tbody>
</table>
Further Modelling Assumptions

- Outside market prices are set exogenously
  - Russia is assumed to trade on spot and LTC basis, using predominantly LTCs for marketing its production to Europe. Spot gas is priced at the TTF and delivered at the entry point of Nord Stream to Europe. Delivery points of the long-term contracts are at the border of the importing countries.
  - Norway is assumed to trade on spot and LTC basis similar to Russia.
  - North-African producers are considered inflexible and no option for spot trade is assumed

- Europe acts as a ‘last resort’ for LNG. Europe accounts for roughly 15% of global LNG imports, while the most volumes are traded at Asian markets of the Pacific basin. From modelling point of view this implies that European markets are rather following the Asia dominated market developments than forming the global market outcomes. Therefore, the price of natural gas in the Asian markets acts as an indicator for all LNG liquefaction terminals, which are able to trade to either Asian or European markets. The price of LNG sold to Europe is based on the opportunity cost of ‘not selling’ to Asia.
Assumptions related to Assessed projects

- Extension of capacity or a new pipeline parallel to an already existing one has the same tariff as the „old“ pipeline.

- New interconnector is modelled with a uniform 1.5 €/MWh tariff (average tariff on EU interconnection points), if no other tariff is indicated by the Promoters in the questionnaire.
Newly gasified countries – NOTE: benefits are overestimated

- Gas demand will be set to 0 in the reference scenario for all those countries that are currently not gasified. Demand increase will only be assumed when the project delivering gas to the respective market is assessed.

- When calculating the consumer surplus the assumption is that the gas demand has always been there, but could not met due to a lack of infrastructure; what will not be done, is to compare for each country, which fuel that has previously been used at which cost for the different purposes (i.e. heating, cooking,...) is now replaced by natural gas. In other words, for the calculation of the consumer surplus, gas is not replacing anything but comes as additional demand. This leads to a (substantial) overestimate of the consumer surplus change.

- In case the new project is gasifying a market that had no gas in the energy mix before, the cost of the distribution system will be taken into account. Additional data need will be asked from the Groups. (Applies to Albania, Montenegro, Kosovo*, and to certain projects in Bosnia and Herzegovina, and maybe to Macedonia)
## Assumptions on Consumption and Production

### Gas demand TWh/year

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albania</td>
<td>0.0</td>
<td>4.9</td>
<td>8.8</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Bosnia and Herzegovina</td>
<td>1.7</td>
<td>2.0</td>
<td>2.2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Georgia</td>
<td>23.7</td>
<td>28.4</td>
<td>34.1</td>
<td>41</td>
<td>49</td>
<td>59</td>
<td>71</td>
<td>85</td>
</tr>
<tr>
<td>Kosovo*</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moldova</td>
<td>10.0</td>
<td>11.0</td>
<td>12.0</td>
<td>13</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Montenegro</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>FYR of Macedonia</td>
<td>1.8</td>
<td>4.0</td>
<td>3.8</td>
<td>3.6</td>
<td>3</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Serbia</td>
<td>21.7</td>
<td>17.0</td>
<td>15.3</td>
<td>16</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Ukraine</td>
<td>326.9</td>
<td>369</td>
<td>368</td>
<td>371</td>
<td>375</td>
<td>394</td>
<td>394</td>
<td>394</td>
</tr>
<tr>
<td>Total</td>
<td>385.8</td>
<td>436.3</td>
<td>444.2</td>
<td>458.6</td>
<td>469.9</td>
<td>502.2</td>
<td>513.9</td>
<td>528.1</td>
</tr>
</tbody>
</table>

### Gas production, TWh/year

<table>
<thead>
<tr>
<th></th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serbia</td>
<td>5.4</td>
<td>2.8</td>
<td>1.9</td>
<td>0.9</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Ukraine</td>
<td>208.1</td>
<td>237.0</td>
<td>251.4</td>
<td>265.8</td>
<td>280.2</td>
<td>294.6</td>
<td>309.0</td>
</tr>
</tbody>
</table>

Source: TYNDP 2015, incl.: BA, SB, FYR of MK. Currently non existent gas markets are set to 0: AL, ME, KO* national forecast UA, MV)
Assumptions on LTCs

- Current supply contracts in the EnC CPs are not expected to expire, but they will be recontracted.

- Supply contracts in the EU are assumed to be recontracted only to 30% of their ACQ, the rest will be offered on a spot trade basis by Russia, Norway and LNG. Russia trades spot only through Nord Stream 2.

<table>
<thead>
<tr>
<th>Supply from</th>
<th>ACQ (TWh/year)</th>
<th>Price in 2016 (€/MWh)</th>
<th>Contract expiry</th>
<th>Contract route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moldova</td>
<td>Russia</td>
<td>10</td>
<td>20.09</td>
<td>yearly</td>
</tr>
<tr>
<td>FYR of Macedonia</td>
<td>Russia</td>
<td>1</td>
<td>22.83</td>
<td>yearly</td>
</tr>
<tr>
<td>Serbia</td>
<td>Russia</td>
<td>up to 50</td>
<td>34.44</td>
<td>2021</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>UA-HU-RS</td>
</tr>
<tr>
<td>Ukraine</td>
<td></td>
<td>0</td>
<td>-</td>
<td>any short term?</td>
</tr>
</tbody>
</table>

New LTCs

SOCAR

- Italy: 8
- Greece: 1
- Bulgaria: 1
Consumption forecast for emerging gas markets

- Consumption change in some countries is subject to infrastructure not in place yet
- Will be used only when the projects on the territory of the respective country is modelled

<table>
<thead>
<tr>
<th>TWh/year</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albania</td>
<td>0</td>
<td>4.9</td>
<td>8.82</td>
<td>11.76</td>
</tr>
<tr>
<td>Bosnia and Herzegovina</td>
<td>3.92</td>
<td>8.82</td>
<td>11.76</td>
<td>15.68</td>
</tr>
<tr>
<td>Kosovo*</td>
<td>0</td>
<td>0</td>
<td>3.92</td>
<td>5.88</td>
</tr>
<tr>
<td>Montenegro</td>
<td>0</td>
<td>0</td>
<td>0.98</td>
<td>0.98</td>
</tr>
<tr>
<td>FYR of Macedonia</td>
<td>1.96</td>
<td>6.86</td>
<td>10.78</td>
<td>13.72</td>
</tr>
</tbody>
</table>

Source: ECA Gas to Power Study 2015
## New storage facilities assumed in the reference

<table>
<thead>
<tr>
<th>Storage facility</th>
<th>Market</th>
<th>Capacity</th>
<th>Commissioning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Working gas (TWh)</td>
<td>Injection (GWh/d)</td>
</tr>
<tr>
<td>Tuz Gölü</td>
<td>TR</td>
<td>5</td>
<td>159</td>
</tr>
<tr>
<td>Botas Tarsus</td>
<td>TR</td>
<td>11</td>
<td>319</td>
</tr>
<tr>
<td>Silivri (Marmara)</td>
<td>TR</td>
<td>46</td>
<td>638</td>
</tr>
<tr>
<td>Bordolano phase II</td>
<td>IT</td>
<td>7</td>
<td>109</td>
</tr>
</tbody>
</table>

Source: TYNDP 2017
Sensitivity

- The parameters to be assessed:
  - Natural gas demand: +/- 20% gas demand in EnC CPS
  - LNG inflow to Europe +/- 50%
  - Key infrastructure to the region (Krk LNG terminal, TAP-TANAP)

- Also applying the TOOT methodology is a special case of sensitivity assessment, where the reference network topology changes. The TOOT based assessment will help to identify which projects are competing in the proposed set of projects.

- Sensitivity assessment will be presented in the report in order to demonstrate the range of uncertainty in the modelling. Project NPVs will be calculated for all sensitivity cases in order to check the robustness of the ordering of projects.
Thank you!

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