PS-CBA 2017: Guidance for users

Contents

1. General considerations on the PS-CBAs

Following the requirements of the TEN-E Regulation, ENTSOG has developed an Energy System Wide Cost-Benefit Analysis (CBA) methodology supporting the selection of Projects of Common Interest (PCI). This methodology is composed of a TYNDP-Step, and a Project Specific (PS)-Step. The CBA methodology was approved by the European Commission on 4 February 2015. Under invitation from the European Commission ENTSOG applies the PS-CBA step on behalf of promoters of projects which are candidates for PCI status in the third PCI list. The PS-CBAs were requested by the projects promoters during the submission of the projects during the call for PCI candidates.

The purpose of this document is to increase the understanding of the PS-CBA results which were created following the CBA methodology[1] and in consistency with the TYNDP 2017. This document is drafted for the stakeholders of the PS-CBA results:

- Project promoters of PCI applicants for the third PCI list
- Members of the Regional Groups (EC, MS representatives, NRAs, ACER, others)

This document does neither replace the approved CBA methodology nor information from the TYNDP 2017, in particular the methodology description provided as annex F. It is an additional contribution with a descriptive character. Partial redundancy with the before mentioned documents might exist.

In addition to this document ENTSOG also organises two webinars and invites project promoters to participate and raise possibly remaining questions.
After this exhaustive support ENTSOG wishes project promoters good luck and success for each PCI application!

2. PS-CBA results

2.1. Overview: What ENTSOG provided to promoters

The results of the PS-CBAs are divided in three categories of the analysis results (project fiche, main results, and overall results) plus the economic view. The categories follow an aggregation from the last level to the first:

- Project fiche (*): Overview of project profile with a selection of main results. The project fiche is one Excel file. Promoters can make use of this file for presenting a brief overview of the results.

[1] http://www.entsog.eu/public/uploads/files/publications/CBA/2015/INV0175-150213_Adapted_ESW-CBA_Methodology.pdf

- Main results: The main results focus on the infrastructure needs identified by the Regional Groups[2] for all years. The main results are in one Excel file. Promoters can make use of this file for evaluating the project benefits towards the needs of the regions.
- Overall results: There are 9 Excel files making available all CBA results. These results comprise of the direct outcome for all capacity, modelling and other indicators specified in the CBA methodology plus the voluntary contributions.

In addition to this the following file is part of the PS-CBAs:

- Economic template (*): This file is showing the economic results for the project group comprising of a summary of the costs and benefits with the different cash flows and net present values as well as their calculations. The economic template is one Excel file. Promoters can use this template for demonstrating the economic benefits of their projects.

The Financial template (*) from the PS-CBA process 2015 for the selection of the second PCI list is still available on the ENTSOG homepage[3]. An update of this template has not been requested. Promoters are advised to follow the agreements in the Regional Groups and their own interests in how to proceed with the financial project information.

(*): In these files project promoters have to fill out information.

The assessment of project groups in the frame of the CBA methodology follows the incremental approach. For each infrastructure level two assessments are done, one with (+) and one without (-) the projects in the assessed group. The difference between these two assessments is the incremental project impact. Depending on the status of projects (FID / Non-FID, Advanced / Non-FID, Non-Advanced) they form part of the respective infrastructure level or not. If a project is part of an infrastructure level, the incremental approach investigates the effect of removing this project. If a project is not part of an infrastructure level the incremental approach investigates the effect of adding this project. The projects within an assessed project groups might have different project statuses resulting in an assessment in which some of the projects are removed from an infrastructure level for the assessment without the project group (-) and the other projects are added to this infrastructure level for the assessment with the project group (+). The incremental approach is explained more in detail in the Energy System-Wide Cost Benefit Analysis methodology chapter 7.9.1, page 51.

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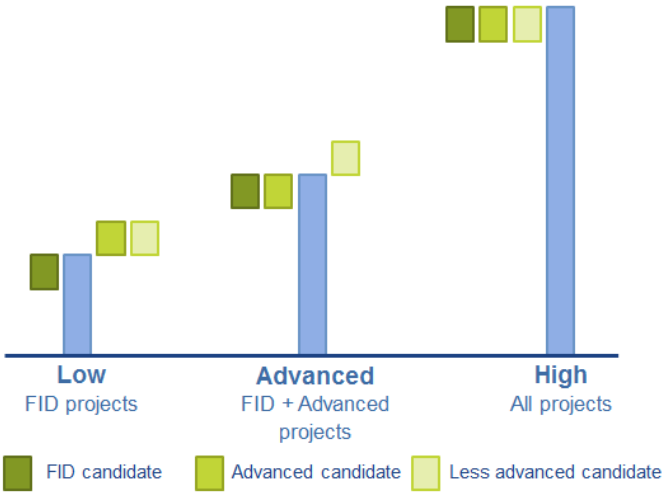
[2] https://circabc.europa.eu/sd/a/03470959-bb70-468d-832b-d2bc892b8154/2016%2012%2008%20Gas%20Problem%20Needs%20Countries%20-%20overview%20table.pdf

[3] http://entsog.eu/public/uploads/files/publications/CBA/2015/PS_CBA_Financial_Template_FINAL_150415_ver1_2.xlsx



In the next section of this document it will be explained for each file

- what information needs to be filled in, and
- how the file is to be understood.

2.2. Detailed file description (prioritised files)

The presentation of the files follows the order of relevance of the files.
For a given project group the file name of the respective Excel file will start with the group number, as defined by the Regional Groups, continue with an ENTSOG internal code and then show the table name.

2.2.1. Project Fiche

File structure
The Project Fiche presents in a condensed format of 2 pages, an overview of the groups of projects being PCI candidates.
The fiche is divided in 3 categories:

1. The description of the projects and the group.
2. An overview of the main indicators and benefits resulting from ENTSOG's simulations or calculations.
3. An overview of the main economic benefits of the group resulting from ENTSOG's analysis.

Some fields of the Project Fiche are Pre-filled by ENTSOG based on the data submitted by the promoters or based on the results of ENTSOG's simulations and analysis, these fields are highlighted **in blue** and **green**. Other fields to be filled out by the promoters are highlighted in **Orange**.

Group Fiche

NSIEASTWEST 01	Group name - To be filled in by promoters

CAPEX [Million EUR 2017] | To be filled in by promoters

Description - To be filled in by promoters

<please provide the necessary description>
<Should you have any change in the schedule compared to project submission in TYNDP please report it here>

Projects Constituting the Group

Project Code	Project Name	Promoter	Applied for 3rd PCI list	2nd PCI List No.
TRA-E-001	ENTSOG 1	ENTSOG	Yes	1.1
UGS-E-001	ENTSOG 2	ENTSOG	Yes	2.1
LNG-E-001	ENTSOG 3	ENTSOG	Yes	3.1
TRA-E-003	ENTSOG 4	ENTSOG	Yes	4.1

Complementarity - based on PCI call information

Project Code	Project Name	Promoter	Complementarity	Comments
TRA-E-002	ENTSOG 4	ENTSOG	Yes	

Project Overview - based on TYNDP project data

Transmission Projects

Project Code	Country	Operator	Interconnection Point	Entry Capacity Increment	Exit Capacity Increment	Commissioning Year	Diameter (weighted average) [mm]	Length [km]	Compressor Power [MW]	Last Completed Stage	Enabler	Commissioning Year in TYNDP 2015
TRA-E-001	Belgium	ENTSOG	Bru	100	150	2020	500	100	10	FEED	Yes	2019
TRA-E-003	Belgium	ENTSOG	Bru	100	150	2020	500	100	10	FEED	Yes	2020

LNG Projects

Project Code	Country	Operator	Interconnection Point	Increment Capacity [GWh/d]	Commissioning Year	Expected Yearly Volume	Storage Increment	Last Completed Stage	Enabler	Commissioning Year in TYNDP 2015
LNG-E-001	Belgium	ENTSOG	Bru	100	2020	100	50	FEED	No	2019

Underground Storage Projects

Project Code	Country	Operator	Interconnection Point	Injection Capacity Increment [mcm]	Withdrawal Capacity Increment [mcm]	Commissioning Year	WGV Increment [mcm]	Last Completed Stage	Enabler	Commissioning Year in TYNDP 2015
UGS-E-001	Belgium	ENTSOG	Bru	50	100	2020	500	Feasability	No	2018

Group Benefits - Pre-filled by ENTSOG based on selected needs by promoters as part of PCI call

Infrastructure needed to ensure compliance with the N-1 requirement. Relevant for RO, BG, IE, SE, FI, EE, LU, SI, HR, GR, PT, DK
Infrastructure to enable reverse flow or to increase diversification of entry points. Relevant for FI, DK, HR, CZ, AT, SV, BG, RO, HU, SI, IE

Comments on benefits - To be filled in by promoters

<please provide the necessary information>

Impacted Countries - Pre-filled by ENTSOG based on Simulation results (below)

Sweden
Portugal
Ireland
Bulgaria

Economic Results in Million EUR/year [2017] - Pre-filled by ENTSOG based on monetised benefits from Economic template

	LOW			ADVANCED		
	Blue Transition	Green Evolution	EU Green Revolution	Blue Transition	Green Evolution	EU Green Revolution
EU Bill improvement	1,000	1,500	2,000	1,000	1,500	2,000
Mitigation in Disrupted Demand	43	45	48	43	45	48
Mitigation in N-1	0	0	0	0	0	0

Simulation Results - *based on PS-CBA results*

Delta values are the incremental impact of the group up to (resp. down to) the threshold defined by Regional Groups

	LOW 2020 Green Evolution		2025 Blue Transition		Green Evolution		EU Green Revolution		2030 Blue Transition		Green Evolution		EU Green Revolution	
	Value	Delta	Value	Delta	Value	Delta	Value	Delta	Value	Delta	Value	Delta	Value	Delta
Access to supply sources (nb of sources)														
-														
Dependence to LNG (%)														
-														
Dependence to Russia (%)														
ES			18	-1	18	-1								
Disruption Rate (%) - Ukraine route disruption														
BG			10	-1	11	-1	10	-1						
IE			10	-1	11	-1			20	-1	20	-2		
PT			10	-1	11	-1								
Disruption Rate (%) - Belarus route disruption														
-														
Disruption Rate (%) - Without any supply disruption														
-														
IRD														
-														
N-1 for ESW CBA (%)														
ES			99	3					99	3	99	3	99	3

	ADVANCED 2020 Green Evolution		2025 Blue Transition		Green Evolution		EU Green Revolution		2030 Blue Transition		Green Evolution		EU Green Revolution	
	Value	Delta	Value	Delta	Value	Delta	Value	Delta	Value	Delta	Value	Delta	Value	Delta
Access to supply sources (nb of sources)														
-														
Dependence to LNG (%)														
-														
Dependence to Russia (%)														
ES			18	-1	18	-1								
Disruption Rate (%) - Ukraine route disruption														
BG			10	-1	11	-1	10	-1						
IE			10	-1	11	-1			20	-1	20	-2		
PT			10	-1	11	-1								
Disruption Rate (%) - Belarus route disruption														
-														
Disruption Rate (%) - Without any supply disruption														
-														
IRD														
-														
N-1 for ESW CBA (%)														
ES			99	3					99	3	99	3	99	3

Description

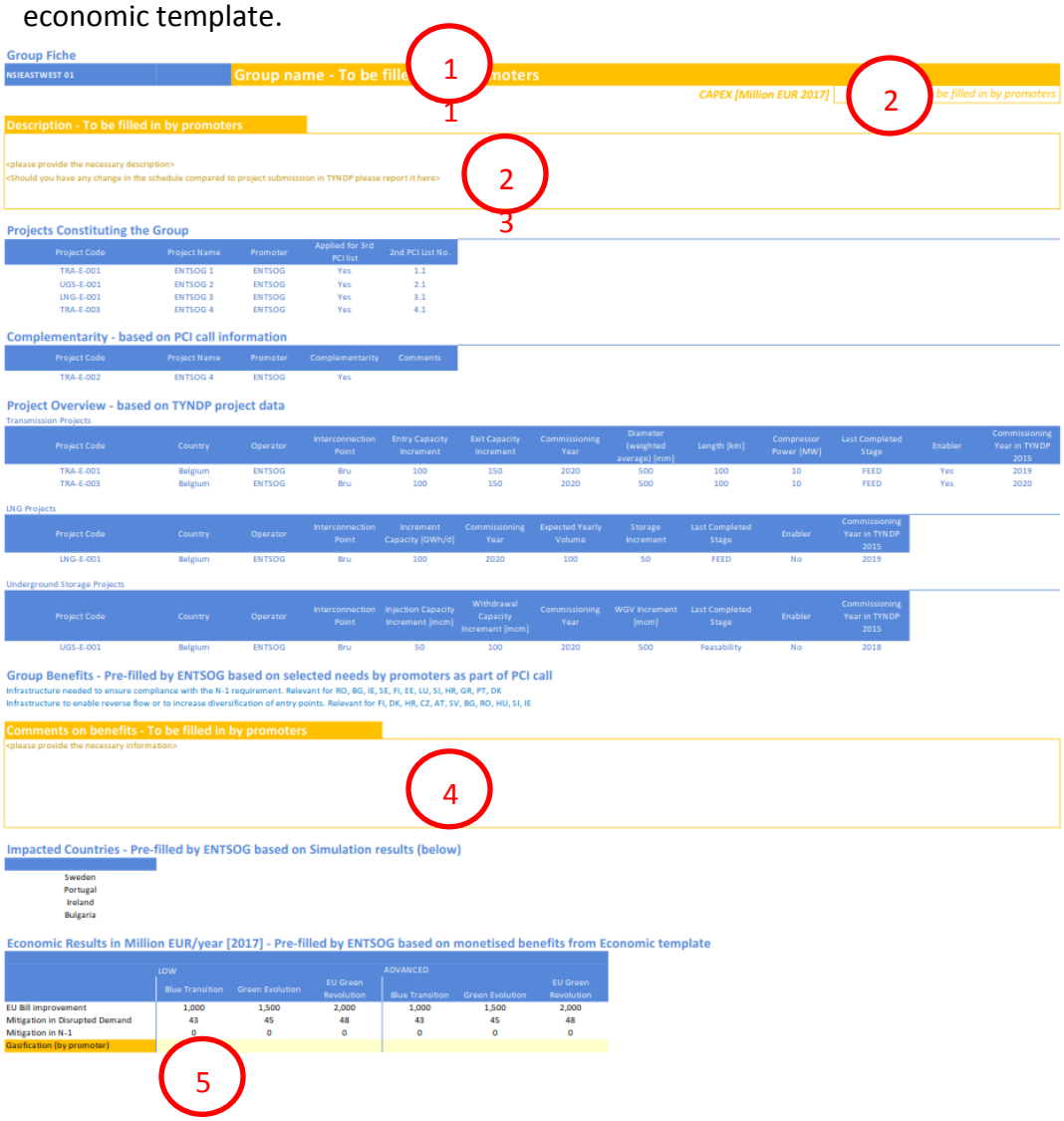
Main economic benefits

Main indicators

What to fill in

The following fields have to be filled in by the promoters:

1. Group Name: promoters can fill in the name of the group. By default, the Fiche only indicates the reference code of the Group.
2. CAPEX: the CAPEX of the Group in Million Euro **at constant real price and discounted at 2017, using a Social Discount Rate of 4% (the value is generated in the Economic Template once the promoter has filled all the required information)** .
3. Group description: promoters can provide a descriptions of the group of projects and some important information like change of schedule. This field is limited to 1,500 characters.
4. Comments on benefits: just below the table of the simulation results, promoters have the possibility to comment the results and provide further qualitative information. This field is limited to 1,500 characters.
5. Gasification benefits (for concerned projects only): promoters can fill in the monetised benefits resulting from the gasification in Million Euro (2017) per year as calculated in the economic template.



How to find information and interpret the results

The fields to be filled out by the promoters are explicitly indicated in the Project Fiche.

Project description fields are automatically filled in with the information provided by the promoters when submitting their projects to TYNDP 17. They cannot be changed.

Economic results presented in the fiche are an overview of the results presented in the Economic Template.

Simulation results presented in the fiche are an overview of the main results and the economic results.

The incremental impact of the group is reported in the "Delta" columns whereas the other columns show the absolute values of the indicators with project implementation.

For each indicator, the incremental impact of the projects is shown up (or down) to a pre-defined value. For example, an N-1 indicator changing from 90% to 150%, has an incremental impact of 10% (the threshold being set at 100% for this indicator).

The thresholds are set accordingly to the list of identified needs, available here:

Criterion	**Threshold**
Access to supply source	Up to 3
Dependence to LNG	Down to 25%
Dependence to Russia	Down to 25%
Disruption rate	Down to 0%
IRD	Down to 5000
N-1	Up to 100%

Disruption Rates in the "Simulation results" are given for the Peak-Day (Design Case).

More results can be found in the *Main results* and *Economic Template* files.

2.2.2. Economic Template

File structure

The Economic Template provides a view of the economic performance of a project (or of a group of projects[4]). Through the Economic Template promoters can evaluate the impact of their projects on the European social economic welfare. This impact is measured through the monetisation of the benefits (based on the results of the project-specific CBA) and the financial information provided by promoters (CAPEX and OPEX), for the 20 years after the commissioning of the project.

[4] The group of projects on which to assess the project-specific CBA have been defined by the European Commission in the context for the Regional Groups and can be found here.

The Economic Template has 8 sheets, “Navigation”, “PROMOTER input”, “GASIFICATION input”, “BENEFIT Overview”, “EPI Overview”, “LOW infrastructure”, “ADVANCED infrastructure” and “HIGH infrastructure”.

How to find information

List of the sheets included in the Economic Template:

- “Navigation”: promoters can use it to move through all the different sheets in the Template
- “PROMOTER input”: based on both input provided by promoters and information prefilled by ENTSOG, it shows the main information of the project (or project group)
- “GASIFICATION input”: **available only for projects impacting on countries where info on gasification by switching from a different fuel to gas** have been provided for TYNDP 2017[5], it allows those promoters to complement the PS-CBA analysis performed by ENTSOG, indicating the benefits of their projects enabling gasification in terms of fuel switch (gas replacing more expensive fuels), CO2 reductions (gas replacing more polluting fuels) and other benefits
- “BENEFIT Overview”: it provides an overview of the benefits (in Million EUR) from the assessed project-specific CBA of the project. Per each demand scenarios it shows the present value (actualised at year 2017) of the EU Bill, disrupted demand, N-1 and gasification[6]. It show only the benefits while the cost are taken into account in a second step (in the sheet “EPI Overview”
- “EPI Overview”: compares the monetised benefits with the costs provided by promoters and calculates the Economic Performance Indicators, such as economic NPV (economic net present value) and economic Benefit/Cost ratio)
- “LOW infrastructure”, “ADVANCED infrastructure” and “HIGH infrastructure”: those three sheets show in detail all the steps followed in the computation per each infrastructure level, demand scenario, configuration and demand case

For more description on input please refer to sub-chapter “What to fill in” while for more description on the benefits and EPI please refer to sub-chapter “How to read the results”

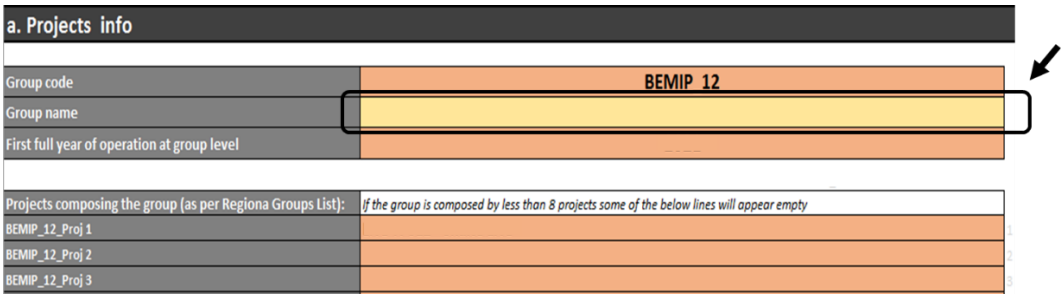
What to fill in

[5] This sheet is available only for few countries where the “gasification” of the area relies on the implementation of a specific enabling projects. For more details on gasification demand and gasification projects please refer directly to TYNDP 2017 Report and Annexes (link).

[6] In line with the stakeholders feedback received in the preparation of the TYNDP considering the HIGH infrastructure level as not realistic, the “BENEFIT Overview” sheet shows only the results for LOW and ADVANCED infrastructure levels. The results of the simulation on the HIGH infrastructure level are instead available in the sheet “HIGH infrastructure”.

In "**PROMOTER input**" sheet:

- promoters together to define and indicate in the light yellow box a common name for the group of projects the Economic Template refers to.



Note: the group code and the list of the single projects composing the group are prefilled by ENTSOG (orange cells). Promoters will not be able to change the group code.

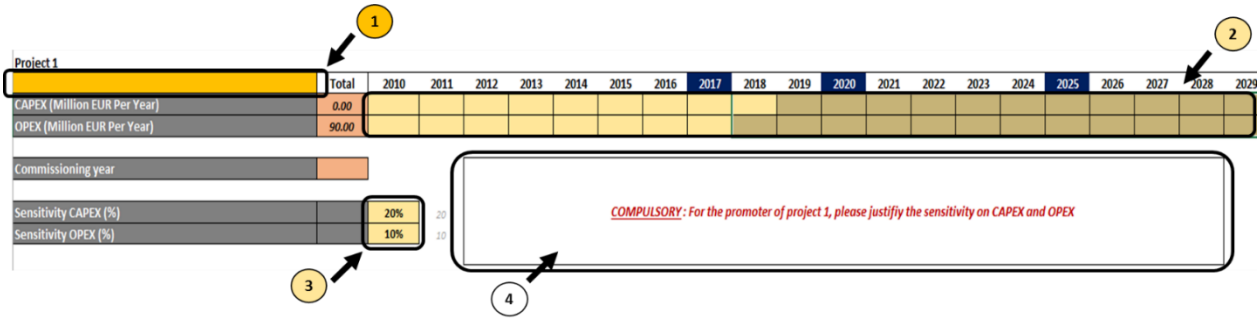
- each promoter to

(1) select its project from the list of available projects composing the group
Note: promoters are allowed to select only projects that are part of the prefilled group.

(2) to indicate, for each of the projects part of the group, CAPEX and OPEX information
- CAPEX and OPEX should be filled in the sheet **at constant real price of 2017**
- CAPEX should be reported only for the years for which they are expected while OPEX should be reported for all the 20 years and starting for the first year of commissioning of the project
- in case of **reinvestment** expected during the considered 20 years, promoters to indicate directly in the CAPEX row the **total reinvestment cost** and the **residual value** (this with negative sign in the last year of the 20 years considered). For a practical example please refer to the box below "Example of how to treat reinvestment costs"

(3) indicate the range in % to be used for the sensitivity on both CAPEX and OPEX (the Economic Template will automatically consider +/- the range filled by the promoter)

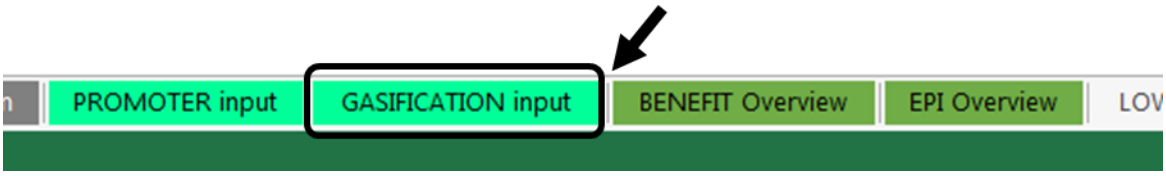
(4) provide in the comment box a justification for the ranges indicated in point (3). In case of a project enabling more than one project and whose cost may be shared by different enabled project groups in case of their commissioning, promoters should include a reasonable explanation in the comment box.



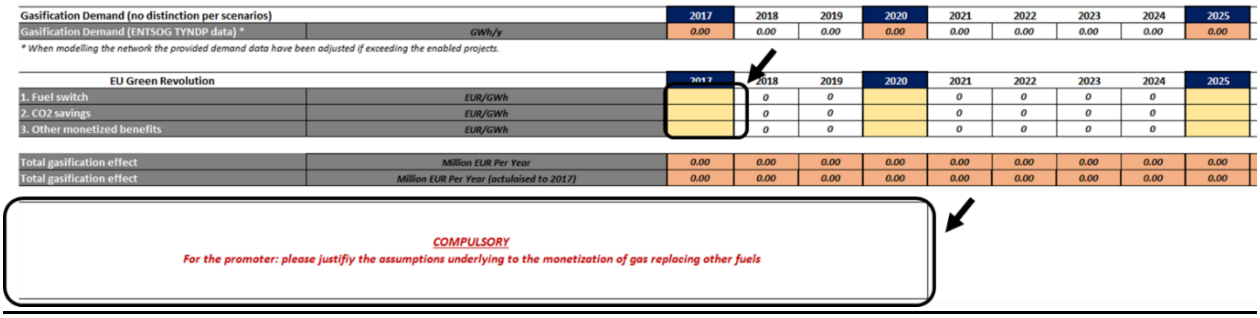
Example: how to treat reinvestment costs

A project to be commissioned in 2020 has total CAPEX of 300 Mln EUR in years 2017-2019 and total OPEX from 2020 to 2039 (20 years of operation) of 200 Mln EUR. However, in 2030 the project promoter has to support reinvestment costs of 100 Mln that will allow the project to run, let assume, for other 20 years. The promoter will therefore indicate in 2030 the CAPEX value for the expected reinvestment cost (with positive sign as done for the other CAPEX) and the OPEX for each year until 2039 (for simplicity let assume that the yearly OPEX will be 10 Mln EUR per year for a total of 100 Mln EUR in 2030-2039). The total cost of the project, including also the reinvestment costs, would be then 300 + 200 + 100 + 100 = 700 Mln EUR.
However, since the analysis stops in 2039 (i.e. after 20 years of operation) the promoter will indicate also the residual value in form of CAPEX and with a negative sign to be deducted to the total CAPEX. With a residual value of 50 (in the example we assume a linear interpolation over the 20 years the projects could afford thanks to the reinvestment), the overall final cost of the project for the period 2020-2039 will be therefore 700 – 50 = 650 Mln EUR.

In the "**GASIFICATION input**" sheet:



The total benefit in Million EUR from gasification is calculated multiplying the net savings value indicated (in EUR/GWh) by promoters with the "gasification demand" (prefilled by ENTSOG according to TYNDP 2017 collected data).



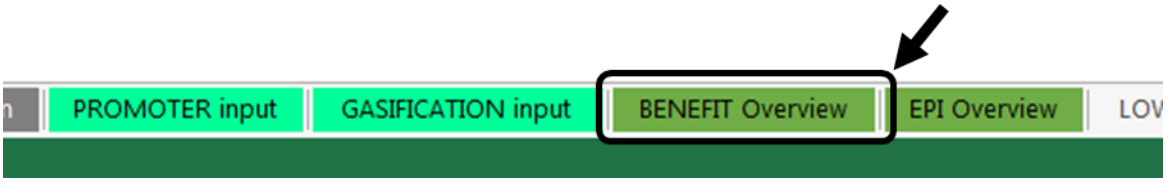
- promoters together to indicate in the light yellow cells, for each of the simulated years, the unit value in EUR/GWh for the net savings linked to:
  - switch to gas from more expensive fuels (i.e. $\text{EUR/Gwh}_{\text{cost other fuels}} - \text{EUR/GWh}_{\text{cost gas}}$). This will be then automatically multiplied by the demand.
  - reduction of CO2 emissions due to the switch to gas as less polluting than other fuels (i.e. $\text{EUR/Gwh}_{\text{saved CO2}}$).
  - "other benefits" related to the increase of gas demand in the area and not covered in the category above

As already mentioned above, those figures will be then automatically multiplied by the "gasification demand".

- promoters together to provide, in the specific comment box, justification for the net saving input as per previous point

How to read the results

The **monetized benefits** are included in the sheet "BENEFIT Overview"



and cover, for each demand scenarios and LOW and ADVANCED infrastructure levels, the following:

- **EU Bill**,
  - For the 13 standardised supply configurations, intended at maximising or respectively minimising specific supply
  - For the import spread configuration, intended to reflect the ability of projects to challenge the market power of a single supplier

Benefits at EU level from the standard supply configurations can be observed in case of projects connecting EU to a new supply source or to national production.

- **Demand curtailment mitigation**, for the cases identified in the TYNDP "identification of infra gap" assessment as leading to demand curtailment. This also corresponds to the needs identified by Regional Groups:
  - Demand curtailment mitigation under no route disruption ("None"), that is solving cases were countries are not able to cover their peak demand, for Design Case (1-in-20 years peak day) and 2-Week Case (1-in -20 years 2-week peak period)7
  - Demand curtailment mitigation under Ukraine route disruption ("Ukraine"), for Design Case and 2-Week Case
  - Demand curtailment mitigation under Belarus route disruption ("Belarus") – for Design Case and 2-Week Case
  - N-1 situation

The infrastructure gaps and needs assessment (as presented also to Regional Groups during the 3rd PCI selection process) indicate that the gas infrastructure is resilient to most of the route disruptions cases investigated, even in case of high demand situation. Only Ukraine (UA) and Belarus (BY) transit disruptions lead to potential demand disruption in some countries during a high demand situation. Furthermore in the long term the demand increase in Croatia, may require additional infrastructure reinforcement to cope with its high demand situations, even without any route disruption.
For this reason the Economic Template displays only monetisation of avoided disrupted demand in case of no route disruption and in case of transit disruption from UA and BY, in high demand situation.

- **Gasification**, concerning only a limited number of countries (mainly MT and CY).

In case of benefits the cells in excel will be displayed with a green colour.

In the "BENEFIT Overview" spreadsheet only the benefits are showed while the costs are taken into consideration in the "EPI Overview" spreadsheet (explained in the next page).

[7] Please refer to TYNDP 2017 publication (link) for more detail on the considered demand cases (Design Case and 2-week period).

Green Revolution

EU Bill	LOW	Advanced
EU Green Revolution_Balanced	0.0	0.0
EU Green Revolution_AZ Max	0.0	0.0
EU Green Revolution_DZ Max	0.0	0.0
EU Green Revolution_LNG Max	0.0	0.0
EU Green Revolution_LY Max	0.0	0.0
EU Green Revolution_NO Max	0.0	0.0
EU Green Revolution_RU Max	0.0	0.0
EU Green Revolution_AZ Min	0.0	0.0
EU Green Revolution_DZ Min	0.0	0.0
EU Green Revolution_LNG Min	0.0	0.0
EU Green Revolution_LY Min	0.0	0.0
EU Green Revolution_NO Min	0.0	0.0
EU Green Revolution_RU Min	0.0	0.0
EU Green Revolution_Import Price Spread	1,396.9	635.2

Disrupted Demand - Peak day (1-20)	LOW	Advanced
Design case - None	0.0	0.0
Design case - Belarus	2.6	0.0
Design case - Ukraine	0.0	0.0
Disrupted Demand - 2-Weeks (1-20)	**LOW**	**Advanced**
2-Weeks case - None	0.0	0.0
2-Weeks case - Belarus	45.9	0.0
2-Weeks case - Ukraine	0.0	0.0

N-1 for ESW-CBA (1-20)	LOW	Advanced
EU Green Revolution_N-1	0.0	0.0

Gasification	LOW	Advanced
EU Green Revolution_Gasification	0.0	0.0

Green Evolution

EU Bill	LOW	Advanced
Green Evolution_Balanced	0.0	0.0
Green Evolution_AZ Max	0.0	0.0
Green Evolution_DZ Max	0.0	0.0
Green Evolution_LNG Max	0.0	0.0
Green Evolution_LY Max	0.0	0.0
Green Evolution_NO Max	0.0	0.0
Green Evolution_RU Max	0.0	0.0
Green Evolution_AZ Min	0.0	0.0
Green Evolution_DZ Min	0.0	0.0
Green Evolution_LNG Min	0.0	0.0
Green Evolution_LY Min	0.0	0.0
Green Evolution_NO Min	0.0	0.0
Green Evolution_RU Min	0.0	0.0
Green Evolution_Import Price Spread	1,434.6	858.3

Disrupted Demand - Peak day (1-20)	LOW	Advanced
Design case - None	0.0	0.0
Design case - Belarus	2.6	0.0
Design case - Ukraine	0.0	0.0
Disrupted Demand - 2-Weeks (1-20)	**LOW**	**Advanced**
2-Weeks case - None	0.0	0.0
2-Weeks case - Belarus	42.2	0.0
2-Weeks case - Ukraine	0.0	0.0

N-1 for ESW-CBA (1-20)	LOW	Advanced
Green Evolution_N-1	0.0	0.0

Gasification	LOW	Advanced
Green Evolution_Gasification	0.0	0.0

Blue Transition

EU Bill	LOW	Advanced
Blue Transition_Balanced	0.0	0.0
Blue Transition_AZ Max	0.0	0.0
Blue Transition_DZ Max	0.0	0.0
Blue Transition_LNG Max	0.0	0.0
Blue Transition_LY Max	0.0	0.0
Blue Transition_NO Max	0.0	0.0
Blue Transition_RU Max	0.0	0.0
Blue Transition_AZ Min	0.0	0.0
Blue Transition_DZ Min	0.0	0.0
Blue Transition_LNG Min	0.0	0.0
Blue Transition_LY Min	0.0	0.0
Blue Transition_NO Min	0.0	0.0
Blue Transition_RU Min	0.0	0.0
Blue Transition_Import Price Spread	1,200.5	1,016.9

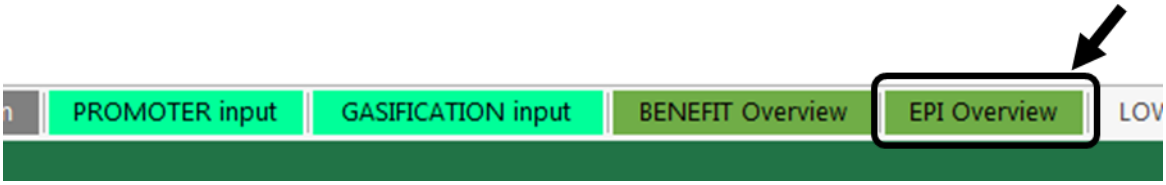
Disrupted Demand - Peak day (1-20)	LOW	Advanced
Design case - None	0.0	0.0
Design case - Belarus	4.1	0.0
Design case - Ukraine	0.0	0.0
Disrupted Demand - 2-Weeks (1-20)	**LOW**	**Advanced**
2-Weeks case - None	0.0	0.0
2-Weeks case - Belarus	38.8	0.0
2-Weeks case - Ukraine	0.0	0.0

N-1 for ESW-CBA (1-20)	LOW	Advanced
Blue Transition_N-1	0.0	0.0

Gasification	LOW	Advanced
Blue Transition_Gasification	0.0	0.0

From the sheet BENEFIT Overview (with fake figures only for example).

The **Economic Performance indicators**[8] are calculated in the "EPI Overview" sheet



where the benefits are aggregated and compared to the costs provided by promoters

- The Economic Net Present Value (ENPV) represents the discounted economic benefits for Europe minus the discounted costs of the project. If the ENPV is positive the projects generates net benefits.
- The (Economic) B/C is the ratio between the discounted benefits and the discounted costs.

To compute the EPI indicators, the monetised benefits are aggregated as follow:

- EU Bill: Max (Import spread configuration; Average of 2 best standardized configurations)
- Demand curtailment:
  - the climatic conditions considered are supposed to happen once in 20 years: therefore each monetized impact is affected a weight of 5% over the 20 years period
  - the considered events could all happen in the course of the 20 considered years (they are non-exclusive): the monetized impact for the different cases are summed

[8] For further explanation on the Economic Performance Indicators refer to the CBA methodology (link)

The elements described above are independent and therefore summed together when calculating the EPIs.

2.2.3. Main results

File structure

The main results file has the eight sheets N-1, IRD, Impact on Supply Source Access, CSSD-RU, CSSD-LNG, UA Disruption, BY Disruption, and Demand curtailment.
Each of these sheets shows a brief explanation of the shown data on the top left. On the top right the relevant screenshot from the Regional Groups' identification of needs is displayed. This is followed by a table.

What to fill in

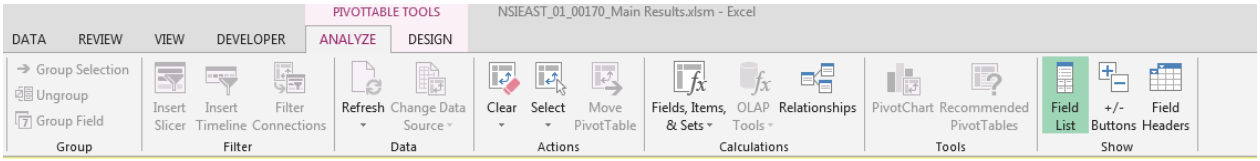
Nothing

How to find information

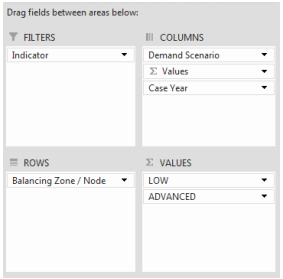
The main results show the incremental project group impact for the low and advanced infrastructure level.

After enabling editing the layout of the different pivot tables can be adjusted to personal preferences by following these steps:

- Click into a table
- In the ANALYSE toolbar enable that the Field List is shown, this list will appear on the right



- Drag and drop items between the areas FILTERS, COLUMNS, ROWS



- The order of items in the columns and rows can also be changed by selecting the cell with the concerned column or row value and moving this cell.

The sheet “N-1” shows the results for the incremental projects impact on the N-1 for ESW-CBA indicator. A definition of this indicator can be found in TYNDP 2017 Annex F, chapter 4.1.2, page 16. The displayed incremental project impact is measured up to a maximum final level of 100% level.

The sheet “IRD” shows the results for the incremental projects impact on the Import Route Diversification indicator. A definition of this indicator can be found in TYNDP 2017 Annex F, chapter 4.1.1, page 15. The displayed incremental project impact is measured down to a minimum final level of 5,000.

The sheet “Impact on Supply Sources Access” shows the incremental project impact on the access to supply sources for each balancing zone. The left table shows the number, the right one the additional sources. The access to supply sources is measured based on the SSPDi indicator for each supply source with a threshold of 20%. More information about the indicator calculation can is available in TYNDP 2017 Annex F, chapter 4.2.5, page 19. More information about measuring the supply source access is described in TYNDP 2017, chapter 6.3.3.1, starting on page 168.

The sheet “CSSD-RU” shows the results for the incremental projects impact on the Cooperative Supply Source Dependence indicator for Russian gas. A definition of this indicator can be found in TYNDP 2017 Annex F, chapter 4.2.4, page 18. The modelling precision for the calculation of this indicator is 2%; lower differences are not considered when both positive and negative figures are observed.

The sheet “CSSD-LNG” shows the results for the incremental projects impact on the Cooperative Supply Source Dependence indicator for LNG. A definition of this indicator can be found in TYNDP 2017 Annex F, chapter 4.2.4, page 18. The modelling precision for the calculation of this indicator is 2%; lower differences are not considered when both positive and negative figures are observed.

The sheet “Demand curtailment UA” shows the results for the incremental projects impact on the Disrupted Rate indicator for the Ukrainian transit disruption case. A definition of this indicator can be found in TYNDP 2017 Annex F, chapter 4.2.2, page 17. The modelling precision for the calculation of this indicator is 2%; lower differences are not considered when both positive and negative figures are observed.

The sheet “Demand curtailment BY” shows the results for the incremental projects impact on the Disrupted Rate indicator for the Belarusian transit disruption case. A definition of this indicator can be found in TYNDP 2017 Annex F, chapter 4.2.2, page 17. The modelling precision for the calculation of this indicator is 2%; lower differences are not considered when both positive and negative figures are observed.

The sheet “Demand curtailment” shows the results for the incremental projects impact on the Disrupted Rate indicator without any route disruption case. A definition of this indicator can be found in TYNDP 2017 Annex F, chapter 4.2.2, page 17. The modelling precision for the calculation of this indicator is 2%; lower differences are not considered when both positive and negative figures are observed.

2.3. Detailed file description: Overall results

Some comments for identifying results in the different templates for the overall results:

- Wherever route disruption cases can be selected, apart from the normal case without route disruption the route disruptions for Ukraine and Belarus could show results.
- Supply source dependence (CSSD and USSD) is mostly interesting for Russian supply and LNG.
- The flows from the supply sources can help understanding the effects in the EU Bill
- The Marginal Prices are usually well aligned across all countries except for Romania with its National production.
- The SSPDi indicator shows some impact.
- The IRD and N-1 for ESW-CBA indicators produce some meaningful results.
- Pivot tables within the files for the main results can be rearranged as explained for the main results above.
- In instances where no incremental project group impact could be identified some tables can appear to be empty. This can be interpreted as zero result values. For technical reasons some countries might appear in the sheets with zero results while others are not shown and can be interpreted similarly.
- Whenever the selection of a certain parameter is required, avoiding a selection can be technically feasible by selecting “(All)” but is not necessarily result in meaningful information since the table would show the aggregation of the available results for all parameters.

2.3.1. CapacityBasedIndicators

File structure

The capacity based indicators file has the eight sheets N-1, N-1 Difference, IRD, IRD Difference, BDPz, BDPz Difference, BDPi, and BDPi difference. So for each of the four capacity based indicators there are two sheets, one showing the indicator result with and without the project and the other one showing the incremental project impact.

What to fill in

Nothing

How to find information

The sheet “N-1” shows the results for the N-1 for ESW-CBA indicator for the assessment of the TYNDP 2017 infrastructure levels with and without the assessed project group for all scenarios. Row 3 shows the scenario for the columns below until the next scenario name. The assessed year is shown in row 4. Row 5 shows whether the respective column lists the assessment of the infrastructure level without [N-1(-)] or with [N-1(+)] the assessed project group. The countries for the indicator results in the table are shown in column A. The infrastructure levels to which the indicator results refer are shown in column B. A definition of this indicator can be found in TYNDP 2017 Annex F, chapter 4.1.2, page 16.

The sheet “N-1 Difference” shows the incremental project group impact on the N-1 for ESW-CBA indicator. This equals the difference of the assessment results with and without the project in the previous sheet.

The sheet “IRD” shows the results for the Import Route Diversification indicator for the assessment of the TYNDP 2017 infrastructure levels with and without the assessed project group for all scenarios. The assessed year is shown in row 3. Row 4 shows whether the respective column lists the assessment of the infrastructure level without [IRD(-)] or with [IRD(+)] the assessed project group. The countries / balancing zones for the indicator results in the table are shown in columns A and B. The infrastructure levels to which the indicator results refer are shown in column C. A definition of this indicator can be found in TYNDP 2017 Annex F, chapter 4.1.1, page 15.

The sheet “Difference” shows the incremental project group impact on the IRD indicator. This equals the difference of the assessment results with and without the project in the previous sheet.

The sheet “BDPz” shows the results for the Bi-Directional Project indicator at cross-zone level for the assessment of the TYNDP 2017 infrastructure levels with and without the assessed project group for all scenarios. The assessed year is shown in row 3. Row 4 shows whether the respective column lists the assessment of the infrastructure level without [BPDz (-)] or with [BPDz (+)] the assessed project group. The countries / balancing zones that are connected through the cross-zone capacity are shown in column A/C and B/D. The infrastructure levels to which the indicator results refer are shown in column E. The definition of this indicator can be found in the adapted ESW-CBA Methodology, chapter 5.1.3, page 35.

The sheet “BDPz Diff” shows the incremental project group impact on the Bi-Directional Project indicator at cross-zone level. This equals the difference of the assessment results with and without the project in the previous sheet.

The sheet “BDPi” shows the results for the Bi-Directional Project indicator at Interconnection Point level for the assessment of the TYNDP 2017 infrastructure levels with and without the assessed project group for all scenarios. The assessed year is shown in row 3. Row 4 shows whether the respective column lists the assessment of the infrastructure level without [BPDi (-)] or with [BPDi (+)] the assessed project group. The investigated interconnection points are shown in column B with column A showing its category. The infrastructure levels to which the indicator results refer are shown in column C. The definition of this indicator can be found in the adapted ESW-CBA Methodology, chapter 5.1.3, page 3.

The sheet “BDPi Diff” shows the incremental project group impact on the Bi-Directional Project indicator at cross-zone level. This equals the difference of the assessment results with and without the project in the previous sheet.

2.3.2. Disrupted demand

File structure

The Disrupted Demand file has the two sheets Disrupted Demand and Disrupted Demand Diff.

What to fill in

Nothing

How to find information

The sheet “Disrupted Demand” shows the results for the Disrupted Demand for the assessment of the TYNDP 2017 infrastructure levels with and without the assessed project group. The scenario can be selected in cell B1. The route disruption case can be selected in cell B2. In cell B3 the user can select the high demand situation for which the results should be displayed – the choice is between the Design Case and the two weeks of the 2-weeks high demand case. The assessed year is shown in row 6. Row 7 shows whether the respective column lists the assessment of the infrastructure level without (-) or with (+) the assessed project group. The countries / balancing zones for the indicator results in the table are shown in columns A and B. More information about this indicator can be found in TYNDP 2017 Annex F, chapter 4.2.2, page 17. For countries that are not listed in the sheet the results for the disrupted demand are zero. For technical reasons some countries can also be listed in instances where the result is zero.

The sheet “Disrupted Demand Diff” shows the incremental project group impact on the Disrupted Demand. This equals the difference of the assessment results with and without the project in the previous sheet. Users can select the demand scenario in cell B1, the route disruption in cell B2, and the high demand case in cell B3.

2.3.3. Disrupted rate

File structure
The Disrupted Rate file has the two sheets Disrupted Rate and Disrupted Rate Diff.

What to fill in
Nothing

How to find information
The sheet "Disrupted Rate" shows the results for the Disrupted Rate for the assessment of the TYNDP 2017 infrastructure levels with and without the assessed project group. The scenario can be selected in cell B1. The route disruption case can be selected in cell B2. In cell B3 the user can select the high demand situation for which the results should be displayed – the choice is between the Design Case and the two weeks of the 2-weeks high demand case. The assessed year is shown in row 6. Row 7 shows whether the respective column lists the assessment of the infrastructure level without (-) or with (+) the assessed project group. The countries / balancing zones for the indicator results in the table are shown in columns A and B. More information about this indicator can be found in TYNDP 2017 Annex F, chapter 4.2.2, page 17. For countries that are not listed in the sheet the results for the disrupted demand are zero. For technical reasons some countries can also be listed in instances where the result is zero.

The sheet "Disrupted Rate Diff" shows the incremental project group impact on the Disrupted Rate. This equals the difference of the assessment results with and without the project in the previous sheet. Users can select the demand scenario in cell B1, the route disruption in cell B2, and the high demand case in cell B3.

2.3.4. Flows

File structure
The Flows file has the ten sheets Supply, Supply Diff, LNG Tank, LNG Tank Diff, Storage Injection, Storage Injection Diff, Storage Withdrawal, Storage Withdrawal Diff, NP Send-Out, and NP Send-Out Diff. So for each of the sources of supply for the model there are two sheet, one showing the actual supply use in the assessment and the other one showing the incremental project group impact. The intention of the provision of the information is this file is to support the understanding of the other modelling results. A project impact can be expected in particular when a project group allows for access to new or additional supply.

What to fill in
Nothing

How to find information

The sheet “Supply” shows the use of each supply source in GWh/d. The user can select the demand scenario in cell B1, the route disruption case in cell B2, and the extra-EU supply source in cell B3. Row 6 shows whether the respective column lists the assessment of the infrastructure level without (-) or with (+) the assessed project group. The year for the assessment is shown in row 7. The information can be found for the whole year, consisting of an average summer (AS) and an average winter (AW), the Peak Day (DC) and the two weeks of the 2-weeks high demand case (2W). For the whole year the supply use for the different supply configurations is shown (Balanced plus max and min for each source).

The sheet “Supply Diff” shows the change in the use of the extra-EU supply source in GWh/d from the assessment without to the assessment with the project group in the previous sheet as an incremental project impact for each infrastructure level (row 6). The rest of the sheet structure is identical with the previous sheet.

The sheet “LNG Tank” shows the use of the flexibility from the LNG tanks during the high demand situations in GWh/d. The user can select the demand scenario in cell B1, and the route disruption case in cell B2. Row 6 shows whether the respective column lists the assessment of the infrastructure level without (-) or with (+) the assessed project group. The year for the assessment is shown in row 7. The information can be found for the Peak Day (DC) and the two weeks of the 2-weeks high demand case (2W).

The sheet “LNG Tank Diff” shows the change in the use of the LNG tank flexibility in GWh/d from the assessment without to the assessment with the project group in the previous sheet as an incremental project impact for each infrastructure level (row 6). The rest of the sheet structure is identical with the previous sheet.

The sheet “Storage Injection” shows the storage injection in GWh/d aggregated over all storages. The user can select the demand scenario in cell B1, and the route disruption case in cell B2. In cell B3 it can be selected if the values should be displayed for the average summer (AS) or average winter (AW) from the whole year or a period for a high demand situation. A storage injection usually takes place in summer. Row 6 shows whether the respective column lists the assessment of the infrastructure level without (-) or with (+) the assessed project group. The year for the assessment is shown in row 7. The information in the table is shown for every supply configurations (Balanced plus max and min for each source) for which it is available for the given selection in cell B3.

The sheet “Storage Injection Diff” shows the change in the storage injection in GWh/d from the assessment without to the assessment with the project group in the previous sheet as an

incremental project impact for each infrastructure level (row 6). The rest of the sheet structure is identical with the previous sheet.

The sheet “Storage Withdrawal” shows the storage withdrawal in GWh/d aggregated over all storages. The user can select the demand scenario in cell B1, and the route disruption case in cell B2. Row 5 shows whether the respective column lists the assessment of the infrastructure level without (-) or with (+) the assessed project group. The year for the assessment is shown in row 6. The information can be found for the whole year, consisting of an average summer (AS) and an average winter (AW), the Peak Day (DC) and the two weeks of the 2-weeks high demand case (2W). For the whole year the supply use for the different supply configurations is shown (Balanced plus max and min for each source). A storage withdrawal usually takes place in winter and during the high demand situations.

The sheet “Storage Withdrawal Diff” shows the change in the storage withdrawal in GWh/d from the assessment without to the assessment with the project group in the previous sheet as an incremental project impact for each infrastructure level (row 6). The rest of the sheet structure is identical with the previous sheet.

The sheet “NP Send-Out” shows the indigenous production in GWh/d aggregated over all countries. The user can select the demand scenario in cell B2, and the route disruption case in cell B3. Row 6 shows whether the respective column lists the assessment of the infrastructure level without (-) or with (+) the assessed project group. The year for the assessment is shown in row 7. The information can be found for the whole year, consisting of an average summer (AS) and an average winter (AW), the Peak Day (DC) and the two weeks of the 2-weeks high demand case (2W). For the whole year the supply use for the different supply configurations is shown (Balanced plus max and min for each source). The national production typically does not depend on the different supply configurations for extra-EU supply.

The sheet “NP Send-Out Diff” shows the change in the national production in GWh/d from the assessment without to the assessment with the project group in the previous sheet as an incremental project impact for each infrastructure level (row 6). The rest of the sheet structure is identical with the previous sheet.

2.3.5. Marginal price

File structure

The Marginal Price file has the two sheets Marginal Price and Marginal Price Diff.

What to fill in

Nothing

How to find information

The sheet “Marginal Price” shows the results for the Marginal Price for the assessment of the TYNDP 2017 infrastructure levels with and without the assessed project group. As temporal period the two parts of the whole year, the average summer (AS) or the average winter (AW), can be selected in cell B2. The supply configuration can be selected in cell B3. The assessed year is shown in row 6. Row 7 shows whether the respective column lists the assessment of the infrastructure level without (-) or with (+) the assessed project group. The countries / balancing zones for the indicator results in the table are shown in columns A and B. More information about this indicator can be found in TYNDP 2017 Annex F, chapter 4.2.7, page 20. Usually the prices are aligned which is shown by the low differences between countries. This changes typically in instances where countries have additional access to national production.

The sheet “Marginal Price Diff” shows the incremental project group impact on the Marginal Price. This equals the difference of the assessment results with and without the project in the previous sheet. Users can select the demand scenario in cell B1, the average summer (AS) or average winter (AW) in cell B2, and the supply configuration in cell B3.

2.3.6. Modelling Indicators

File structure

The modelling indicators file has the two sheets Modelling indicators and Modelling Indicators Diff. It shows the indicator results for the cooperative supply source access (CSSD), Supply Source Price Dependence (SSPDe), Supply Source Price Diversification (SSPDi), and Uncooperative Supply Source Dependence (USSD).

What to fill in

Nothing

How to find information

The sheet “Modelling Indicators” shows the results for the different modelling indicators for the assessment of the TYNDP 2017 infrastructure levels with and without the assessed project group. The demand scenario can be selected in cell B1. As temporal period the whole year (AS-AW) can be selected completely or its two parts, the average summer (AS) or the average winter (AW), separately in cell B2. The indicator can be selected in cell B3. Available indicators are the CSSD, SSPDe, SSPDi, and USSD indicator for each extra-EU supply source (Russian, Norwegian, Algerian, Libyan, Azeri, and LNG) with the SSPDe and SSPDi indicators also existing for the national production. The assessed year is shown in row 6. Row 7 shows whether the respective column lists the assessment of the infrastructure level without (-) or with (+) the assessed project group. The countries / balancing zones for the indicator results in the table are shown in columns A and

B. More information about the CSSD indicator can be found in TYNDP 2017 Annex F, chapter 4.2.4, page 18. More information about the SSPDe indicator can be found in TYNDP 2017 Annex F, chapter 4.2.6, page 20. More information about the SSPDi indicator can be found in TYNDP 2017 Annex F, chapter 4.2.5, page 19. More information about the USSD indicator can be found in TYNDP 2017 Annex F, chapter 4.2.3, page 17. The dependence indicators are usually perceived more relevant for Russian supply and LNG.

The sheet "Modelling Indicators Diff" shows the incremental project group impact on the different modelling indicators. This equals the difference of the assessment results with and without the project in the previous sheet. Users can do the same selections as in the previous sheet.

2.3.7. Monetisation

File structure

The Monetisation file has the four sheets Monetisation, Monetisation per DemandUnit, Monetisation per country, and SUMMARYAllCountriesIMPACT. It shows the results for the EU Bill and its breakdown on a country level.

What to fill in

Nothing

How to find information

The sheet "Monetisation" shows the results for the EU Bill and how it is composed of the Import Supply Bill, the Notional production Bill and the Technical Modelling Costs. This information is shown in two tables with the one on the top showing the Import Supply Bill, the National production Bill and the Total EU Bill, and the table at the bottom showing the Technical Modelling Costs. Users can select the demand scenario in the cells B3 and C16. The supply configuration can be selected in the cells B4 and C17. The selection has to be done in both cells in order to change both tables. The terminology "Technical Modelling Costs" is identical with the "Weight of infrastructure used" as used in TYNDP 2017, Annex F, chapter 3, page 11 and ESW-CBA Methodology, chapter 4, page 27. The assessed year is shown in the rows 7 and 21. The rows 8 and 22 show whether the respective column lists the assessment of the infrastructure level without (-) or with (+) the assessed project group or the difference between the two. More information about the EU Bill can be found in TYNDP 2017 Annex F, chapter 6.1, page 22.

The sheet "Monetisation per DemandUnit" shows the monetisation results for the EU Bill per unit of gas demand in EUR/MWh. For this purpose the Total EU Bill as available on the previous sheet and the gas demand from the modelled perimeter are shown and the Total EU Bill (EUR/day)

divided by the Demand (GWh/day). The cells C2-C5 allow for the selection of the demand scenario, supply configuration, infrastructure level, and year.

The sheet “monetisation per country” shows the incremental project impact on the average price at country level. The incremental project impact is shown in column C as a difference of the average price and in column D as a relative change of the price for the countries or balancing zones in column B. The final average price in column E is the resulting price in the assessment with the project. The cells C3-C6 allow for the selection of the demand scenario, supply configuration, infrastructure level, and year. More information about the monetisation per zone can be found in TYNDP 2017 Annex F, chapter 6.3, page 23. The calculation could be followed in detail after unhiding the columns on the right.

The sheet “SUMMARYAllCountriesIMPACT” shows an overview about the differences of the average price as shown in the previous table. Users can select the supply configuration in cell B2. The infrastructure level serving as a basis for the incremental project impact is shown in row 5. The years are in row 6. The countries in column A appear per demand scenario, EU members appear first.

2.3.8. Remaining flexibility

File structure

The Remaining Flexibility file has the two sheets Remaining Flexibility and Remaining Flex Diff.

What to fill in

Nothing

How to find information

The sheet “Remaining Flexibility” shows the results for the Remaining Flexibility indicator for the assessment of the TYNDP 2017 infrastructure levels with and without the assessed project group. The scenario can be selected in cell B1. The route disruption case can be selected in cell B2. In cell B3 the user can select the high demand situation for which the results should be displayed – the choice is between the Design Case and the two weeks of the 2-weeks high demand case. The assessed year is shown in row 6. Row 7 shows whether the respective column lists the assessment of the infrastructure level without (-) or with (+) the assessed project group. The countries / balancing zones for the indicator results in the table are shown in columns A and B. More information about this indicator can be found in TYNDP 2017 Annex F, chapter 4.2.1, page 17.

The sheet “Remaining Flex Diff” shows the incremental project group impact on the Remaining Flexibility indicator. This equals the difference of the assessment results with and without the

project in the previous sheet. Users can select the demand scenario in cell B1, the route disruption in cell B2, and the high demand case in cell B3.

2.3.9. Import Price Spread

File structure

The ImportPriceSpread file has the three sheets PriceSpread MarginalPrice, PS MP Diff, and Price Spread Monetisation. The Import Price Spread configuration is described in draft TYNDP 2017, chapter 6.3.4.2, page 189.

What to fill in

Nothing

How to find information

The sheet "PriceSpread MarginalPrice" shows the marginal prices resulting of this configuration for the assessment of the TYNDP 2017 infrastructure levels with and without the assessed project group. The scenario can be selected in cell B1. The two seasons of the whole year can be selected in cell B2. The assessed year is shown in row 5. Row 6 shows whether the respective column lists the assessment of the infrastructure level without (-) or with (+) the assessed project group. The countries / balancing zones for the indicator results in the table are shown in columns A and B.

The sheet "PS MP Diff" shows the incremental project group impact on the Marginal Price in the Import Price Spread configuration. This equals the difference of the assessment results with and without the project in the previous sheet. Users can select the demand scenario in cell B1, and the two seasons of the whole year in cell B2.

The sheet "Price Spread Monetisation" shows the monetised results for the Import Price Spread configuration. In cells C2-C4 the demand scenario, year, and infrastructure level can be selected. The table in the cells B6:F9 shows the incremental project group impact on the EU Bill for the whole geographical perimeter of the assessment. The table in row 11 and below shows the impact per country. Column L shows the monetised incremental project group impact on the country or balancing zone in column B. The other columns represent the calculation steps as described in the following box.

Import Price Spread configuration - Methodology

The monetisation per Zone for price spread configuration is calculated for one infrastructure level relative to another.

As a basic principle a split of the difference in the EU bill is calculated between what can be directly allocated, and what cannot. The unallocated part will be split based on the difference of marginal prices between the two configurations, weighted by the demand.

In the following description, the term $\Delta(\text{quantity})$ is used to design the difference in the values of a given quantity between two configurations (for instance with and without a project).
First the difference of the adjusted EU Bill is computed:

$$\text{EU Bill Difference} = \Delta(\text{"Total EU BIll adjusted Price Spread"})$$

<u>Step 1</u>: Allocation based on "Price Spread Adjustment Gain"

In the modelling results, a quantity named "Price Spread Adjustment Gain" is available for each Zone. This quantity is computed ex-post. It is the amount by which the bill in the country would drop following an import price spread adjustment as a consequence of the import flow reaching the minimum flow threshold.
Any difference in the "Price Spread Adjustment Gain" can be allocated directly to the corresponding Zone.

- For each Zone, compute the directly allocated bill difference

  $$\text{Zone direct allocation} = -\Delta(\text{Price Spread Adjustment Gain})$$

- Compute the sum of the previous quantities (Labelled afterwards as "EU Bill Difference Allocated")

- Compute the unallocated part of the EU Bill (Labelled afterwards as "EU Bill Difference Unallocated")

  $$\text{EU Bill Difference Unallocated} = \text{EU Bill Difference} - \text{EU Bill Difference Allcoated}$$

<u>Step 2</u>: Allocation of the unallocated part based on the marginal prices

- For each Zone, compute the maximum potential change in consumer surplus

  $$\text{Zone Max Delta Consumer Surplus} = \text{demand} * \Delta(\text{Zone marginal price})$$

- For each Zone, compute the key to allocate the remaining part of the EU Bill difference

  $$\text{Zone Key Split} = \text{Min}(\text{Zone Max Delta Consumer Surplus}, 0)$$

- Compute the sum of the previous quantities (Labelled afterwards as "Total Key Split")

- For each Zone, compute the bill difference allocated indirectly

$$\text{Zone indirect allocation} = \text{EU Bill Difference Unallocated} * \frac{\text{Zone Key Split}}{\text{Total Key Split}}$$

Finally

For each Zone, compute the bill difference

$$\text{Zone bill difference} = \text{Zone direct allocation} + \text{Zone indirect allocation}$$

This allocation process works well when

- a big share of the EU Bill difference can be allocated directly,

AND/OR

- one or several Zones have a significant drop in their marginal price compared to the other ones.

In case none of the above conditions would be met, this allocation process would not be relevant as it would be based on noise (small marginal price changes, with a heavier weight on Zones with high demand).

3. Where to find the underlying data?

The input data for the TYNDP step of the ESW-CBA methodology is described in Annex F of the TYNDP 2017.

In addition to this project-specific data is an input for the incremental approach of the project assessment. This project data can be found for each project in the assessed group in the project fiche. The data has also been published the annexes A1 and A2 of TYNDP 2017.

The following table gives an overview about where the input data set for the methodology can be found:

Type	Data item	Information in
Total Gas demand	Yearly	TYNDP 2017 Annex C2, sheet "Demand_Yearly"; for gasification TYNDP 2017 Annex C1; exports in TYNDP 2017 page 151
	Average Summer Day	TYNDP 2017 Annex C2, sheets "Final_Yearly", "Final_Seasonal", and Power_Yearly; for gasification TYNDP 2017 Annex C1; exports in TYNDP 2017 page 151

	Average Winter Day	TYNDP 2017 Annex C2, sheets "Final_Yearly", "Final_Seasonal", and Power_Yearly; for gasification TYNDP 2017 Annex C1; exports in TYNDP 2017 page 151
	2-week high demand	TYNDP 2017 Annex C2, sheet "Demand_14d_Peak"; for gasification TYNDP 2017 Annex C1; exports in TYNDP 2017 page 151
	1-day Design Case	TYNDP 2017 Annex C2, sheet "Demand_Peak_Day"; for gasification TYNDP 2017 Annex C1; exports in TYNDP 2017 page 151
Supply price curve	Volumes at start of price curve	Built following the methodology in TYNDP Annex F, chapter 2.2.2 Supply Price Curve, page 7 The resulting price curves are shown below.
	Price at start of price curve	
	Volumes at end of price curve	
	Price at end of price curve	
Import Price	Import Price	TYNDP 2017, Table 6.5, page 190
Gas supply potential from import sources	Maximum for Design Case	TYNDP 2017 Annex C5 and TYNDP 2017 Annex F, chapter 2.2.4 Gas supply potential from import source, page 8 For LNG the non-network demand according to TYNDP 2017, Annex C2, sheet Non-network_Peak_Day, is subtracted from those figures
	Minimum for Design Case	TYNDP 2017 Annex C5 and TYNDP 2017 Annex F, chapter 2.2.4 Gas supply potential from import source, page 8 For LNG the non-network demand according to TYNDP 2017, Annex C2, sheet Non-network_Peak_Day, is subtracted from those figures
	Maximum for 2-Week Case	TYNDP 2017 Annex C5 and TYNDP 2017 Annex F, chapter 2.2.4 Gas supply potential from import source, page 8 For LNG the non-network demand according to TYNDP 2017, Annex C2, sheet Non-network_14d_Peak, is subtracted from those figures
	Minimum for 2-Week Case	TYNDP 2017 Annex C5 and TYNDP 2017 Annex F, chapter 2.2.4 Gas supply potential from import source, page 8 For LNG the non-network demand according to TYNDP 2017, Annex C2, sheet Non-network_14d_Peak, is subtracted from those figures
	Maximum for Summer	TYNDP 2017 Annex C5 and TYNDP 2017 Annex F, chapter 2.2.4 Gas supply potential from import source, page 8 For LNG the non-network demand according to TYNDP 2017, Annex C2, sheet Non-network_Yearly, is subtracted from those figures
	Minimum for Summer	TYNDP 2017 Annex C5 and TYNDP 2017 Annex F, chapter 2.2.4 Gas supply potential from import source, page 8 For LNG the non-network demand according to TYNDP 2017, Annex C2, sheet Non-network_Yearly, is subtracted from those figures
	Maximum for Winter	TYNDP 2017 Annex C5 and TYNDP 2017 Annex F, chapter 2.2.4 Gas supply potential from import source, page 8

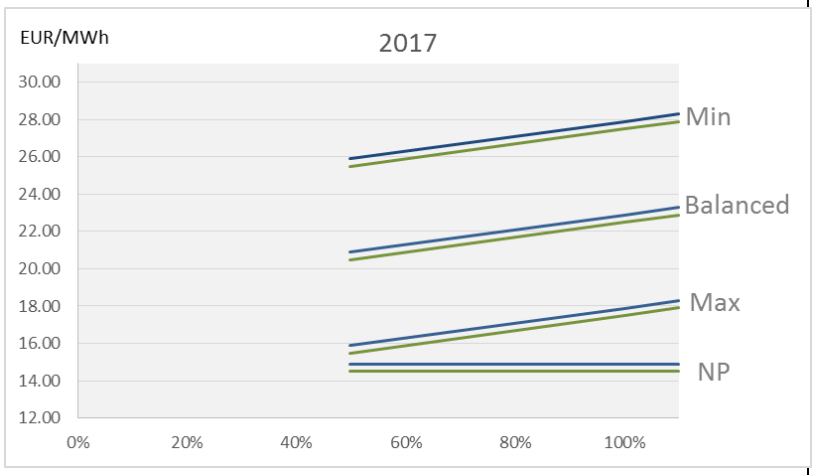
		For LNG the non-network demand according to TYNDP 2017, Annex C2, sheet Non-network_Yearly, is subtracted from those figures
	Minimum for Winter	TYNDP 2017 Annex C5 and TYNDP 2017 Annex F, chapter 2.2.4 Gas supply potential from import source, page 8 For LNG the non-network demand according to TYNDP 2017, Annex C2, sheet Non-network_Yearly, is subtracted from those figures
	Minimum yearly	TYNDP 2017 Annex C5 and TYNDP 2017 Annex F, chapter 2.2.4 Gas supply potential from import source, page 8 For LNG the non-network demand according to TYNDP 2017, Annex C2, sheet Non-network_Yearly, is subtracted from those figures
	Maximum yearly	TYNDP 2017 Annex C5 and TYNDP 2017 Annex F, chapter 2.2.4 Gas supply potential from import source, page 8 For LNG the non-network demand according to TYNDP 2017, Annex C2, sheet Non-network_Yearly, is subtracted from those figures
Existing Infrastructure (capacity, storage volumes)	Transmission (after Lesser-of-rule)	TYNDP 2017 Annex D, sheet "Transmission" (remark: data is shown per IP before aggregation per arc)
	UGS (Lesser-of-rule with transmission capacities, withdrawal and injection curves)	For capacities: TYNDP 2017 Annex D, sheet "Storage" (remark: data is shown per IP before aggregation per arc) The withdrawal and injection curves are based on data from GSE. Withdrawal curves can be found in the Winter Supply Outlook 2016/17, Annex A, page 22. Injection curves can be found in the Summer Supply Outlook 2016, Annex B, page 15.
	LNG Terminal (Lesser-of-rule with transmission capacities, tank flexibilities)	For capacities: TYNDP 2017 Annex D, sheet "LNG" (remark: data is shown per IP before aggregation per arc) The tank flexibilities stem from GLE. An example can be seen in the Winter Supply Outlook 2016/17, Annex B, page 26.
Flow constraints	Minimum and maximum flows	TYNDP 2017, Annex F, chapter 2.2.6, page 9
Route Disruption	Disruption Case definitions and applicability	Description in TYNDP 2017 Annex F, chapter 2.2.7 Route Disruption, page 9
General and technical	Gas and CO2 prices, Value of Lost Load	Gas and CO2 prices: TYNDP 2017, Table 2.5, page 46 links each scenario to the WEO 2015, in WEO: table 1.4 for CO2 prices, table 1.6 (real terms) for gas prices, currency conversion page 674 Value of Lost Load: TYNDP 2017 Annex F, chapter 2.2.8 General and technical, page 9
	Capacity increment	TYNDP 2017, Annex A1, sheet "Capacities", column P for each project TYNDP 2017 Annex D sheet "Capacity Changes", column N for others
	Expected commissioning date	TYNDP 2017, Annex A1, sheet "Capacities", column O for each project
	FID status	TYNDP 2017, Annex A1, sheet "Main information", column I
	Advanced Status	TYNDP 2017, Annex A1, sheet "Main information", column I

	PCI status according to the 2015 selection	TYNDP 2017, Annex A1, sheet "Main information", column K

Table 1: List of input data items

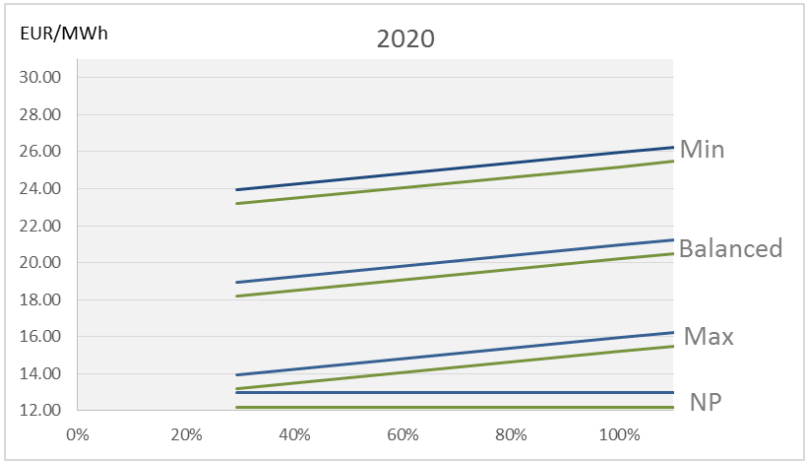
Price curves

The following charts and tables show the prices curves used as an input data for the modelling of the TYNDP 2017 and the PS-CBAs. The gas prices in EUR/MWh relate to a certain percentage of the annual maximum gas supply of the gas supply source and to the supply configuration. For the modelling the unit EUR/GWh is used which is achieved by a multiplication with the factor 1,000. While modelling the continuous price curves are approximated by discrete steps every 20 Euros.



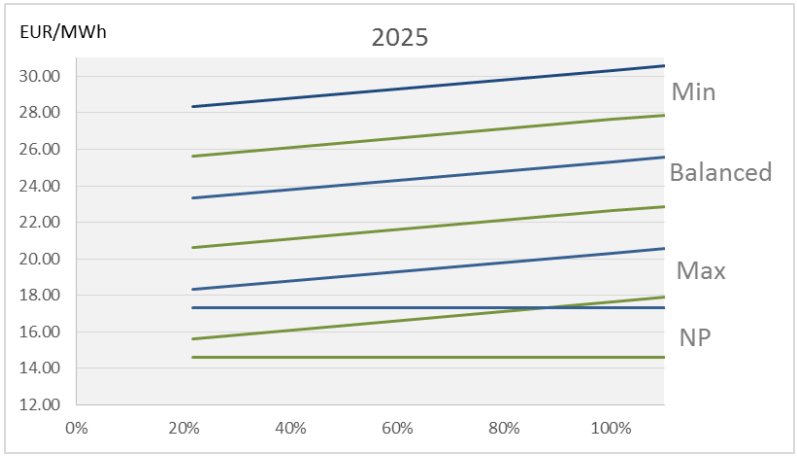
Balanced - Blue Transition	20.88	22.88	23.28
Balanced - Green Evolution, EU Green Evolution	20.50	22.50	22.89
Max - Blue Transition	15.88	17.88	18.28
Max - Green Evolution, EU Green Evolution	15.50	17.50	17.89
Min- Blue Transition	25.88	27.88	28.28
Min- Green Evolution, EU Green Evolution	25.50	27.50	27.89
NP- Blue Transition	14.88	14.88	14.88
NP- Green Evolution, EU Green Evolution	14.50	14.50	14.50
% of annual max supply	50%	100%	110%

[EUR/MWh]



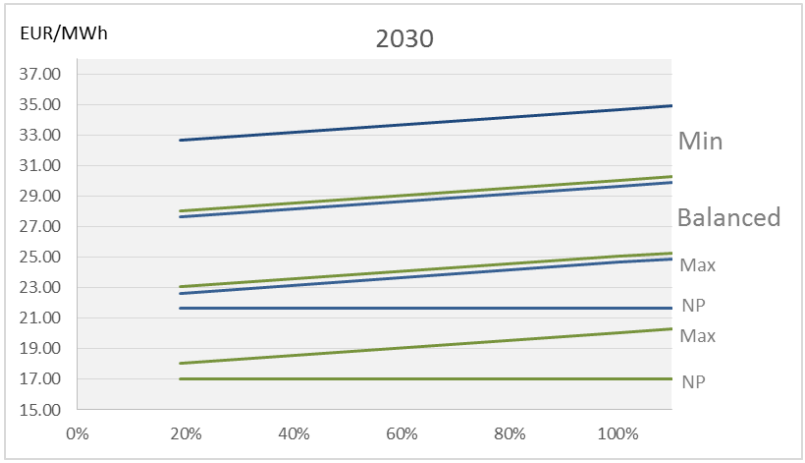
Balanced - Blue Transition	18.96	20.96	21.24
Balanced - Green Evolution, EU Green Evolution	18.19	20.19	20.48
Max - Blue Transition	13.96	15.96	16.24
Max - Green Evolution, EU Green Evolution	13.19	15.19	15.48
Min- Blue Transition	23.96	25.96	26.24
Min- Green Evolution, EU Green Evolution	23.19	25.19	25.48
NP- Blue Transition	12.96	12.96	12.96
NP- Green Evolution, EU Green Evolution	12.19	12.19	12.19
% of annual max supply	29%	100%	110%

[EUR/MWh]



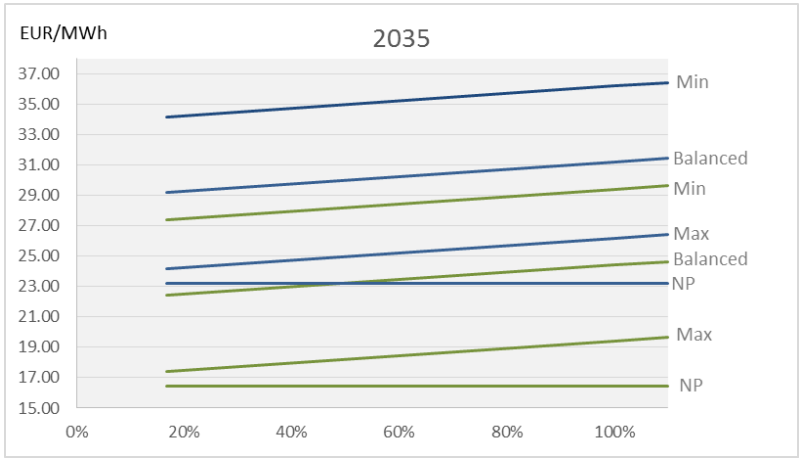
Balanced - Blue Transition	23.31	25.31	25.57
Balanced - Green Evolution, EU Green Evolution	20.62	22.62	22.88
Max - Blue Transition	18.31	20.31	20.57
Max - Green Evolution, EU Green Evolution	15.62	17.62	17.88
Min- Blue Transition	28.31	30.31	30.57
Min- Green Evolution, EU Green Evolution	25.62	27.62	27.88
NP- Blue Transition	17.31	17.31	17.31
NP- Green Evolution, EU Green Evolution	14.62	14.62	14.62
% of annual max supply	22%	100%	110%

[EUR/MWh]



Balanced - Blue Transition	27.66	29.66	29.91
Balanced - Green Evolution, EU Green Evolution	23.06	25.06	25.30
Max - Blue Transition	22.66	24.66	24.91
Max - Green Evolution, EU Green Evolution	18.06	20.06	20.30
Min- Blue Transition	32.66	34.66	34.91
Min- Green Evolution, EU Green Evolution	28.06	30.06	30.30
NP- Blue Transition	21.66	21.66	21.66
NP- Green Evolution, EU Green Evolution	17.06	17.06	17.06
% of annual max supply	19%	100%	110%

[EUR/MWh]



Balanced - Blue Transition	29.20	31.20	31.44
Balanced - Green Evolution, EU Green Evolution	22.42	24.42	24.66
Max - Blue Transition	24.20	26.20	26.44
Max - Green Evolution, EU Green Evolution	17.42	19.42	19.66
Min- Blue Transition	34.20	36.20	36.44
Min- Green Evolution, EU Green Evolution	27.42	29.42	29.66
NP- Blue Transition	23.20	23.20	23.20
NP- Green Evolution, EU Green Evolution	16.42	16.42	16.42
% of annual max supply	17%	100%	110%

[EUR/MWh]