Selection of Projects of Energy Community Interest (PECIs)

1st Meeting of Electricity and Gas Groups

Presentation REKK / DNV GL

Vienna 26.2.2016

Agenda

1. Overview of general project assessment methodology
2. Electricity Market Model and Electricity Network Model
3. Gas Market Model
4. Multi-criteria assessment methodology

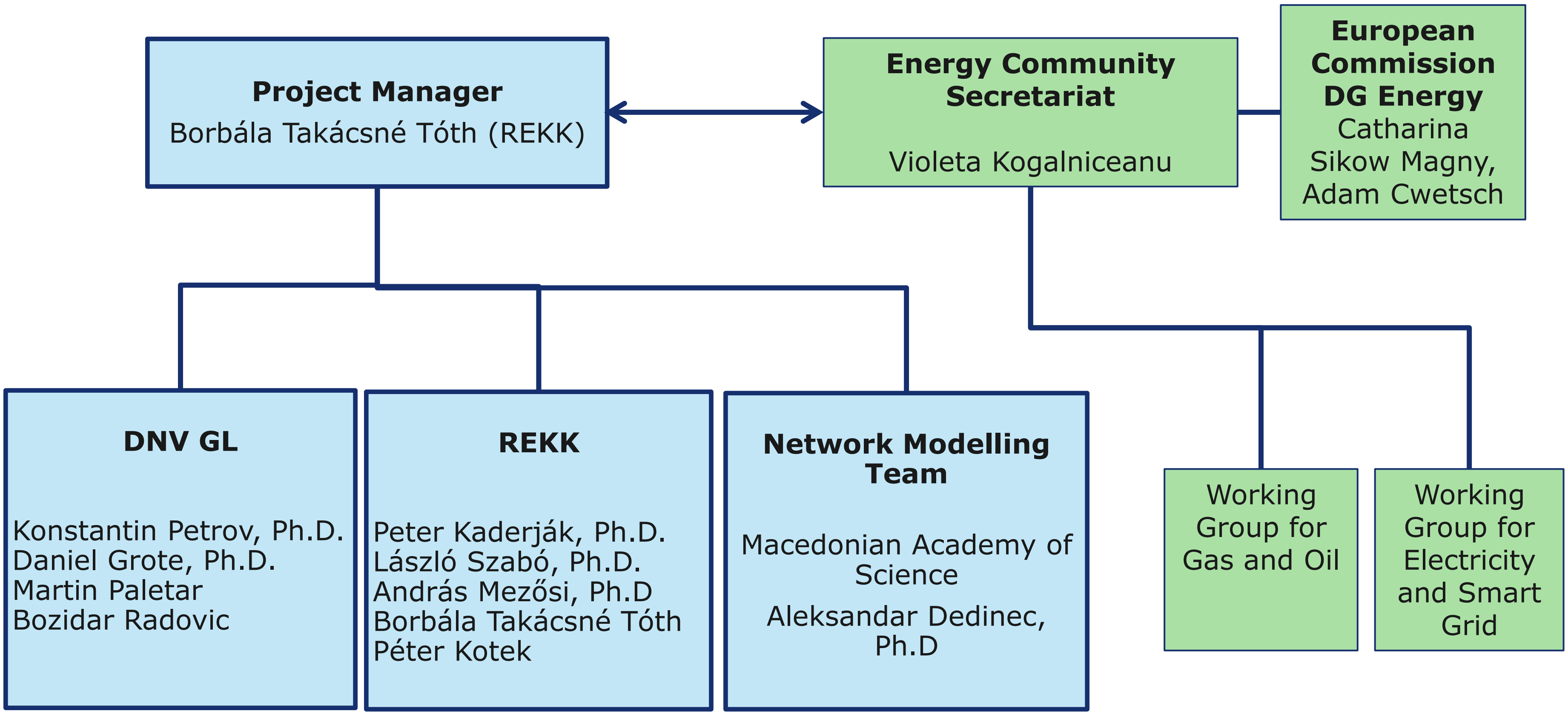
Project Objectives and Deliverables

- **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 larges 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 April 2016) 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 mid July 2016) 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 18.09.2016), which incorporates the contents of the draft final report and reflects to the comments and feedback received by EnC Secretariat and project promoters.

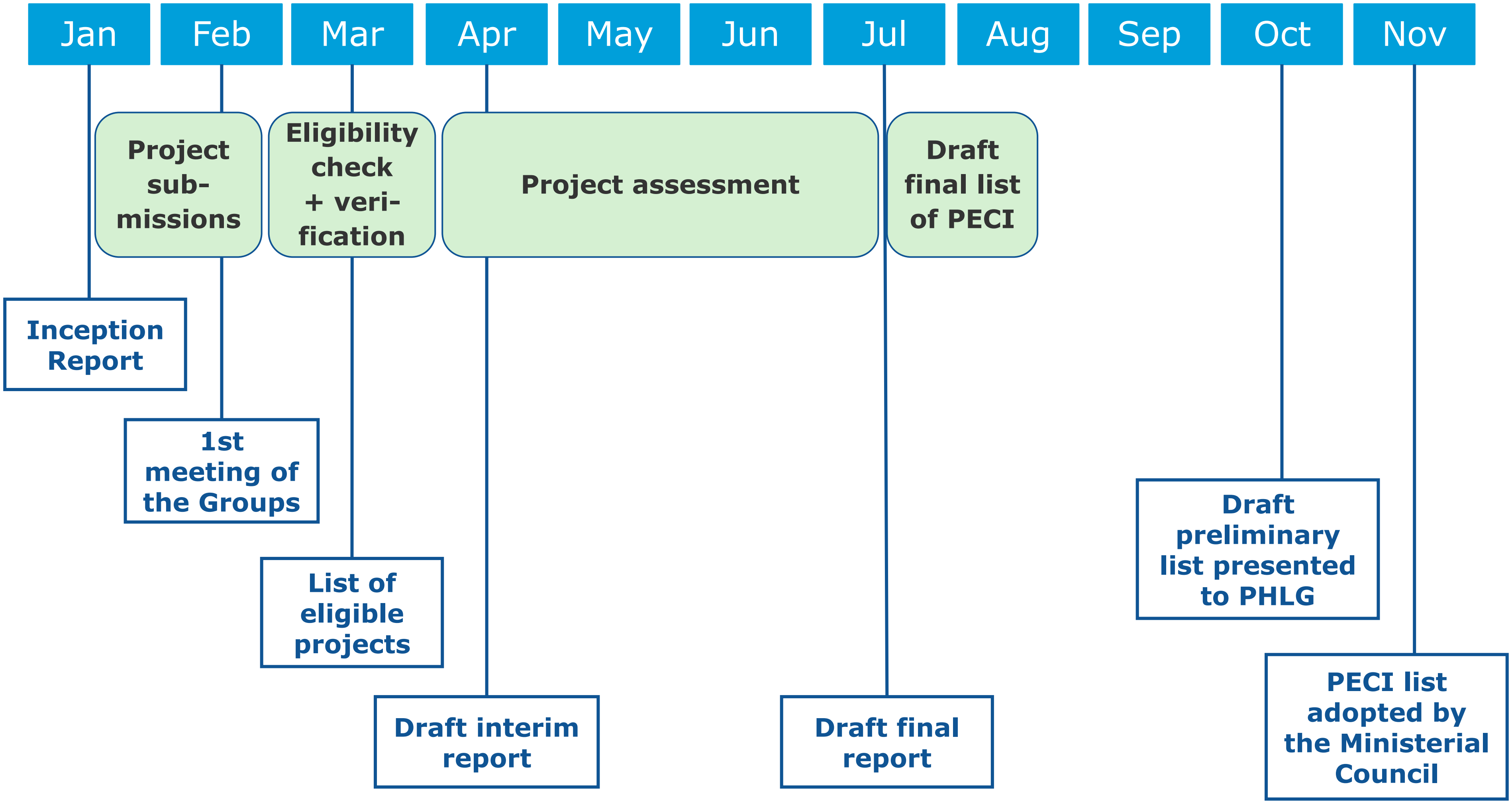
Project Workflow

1. Question-naires for submission of candidate projects
2. Eligibility check
3. Verification of project data
4. CBA
5. MCA
6. Relative ranking of projects

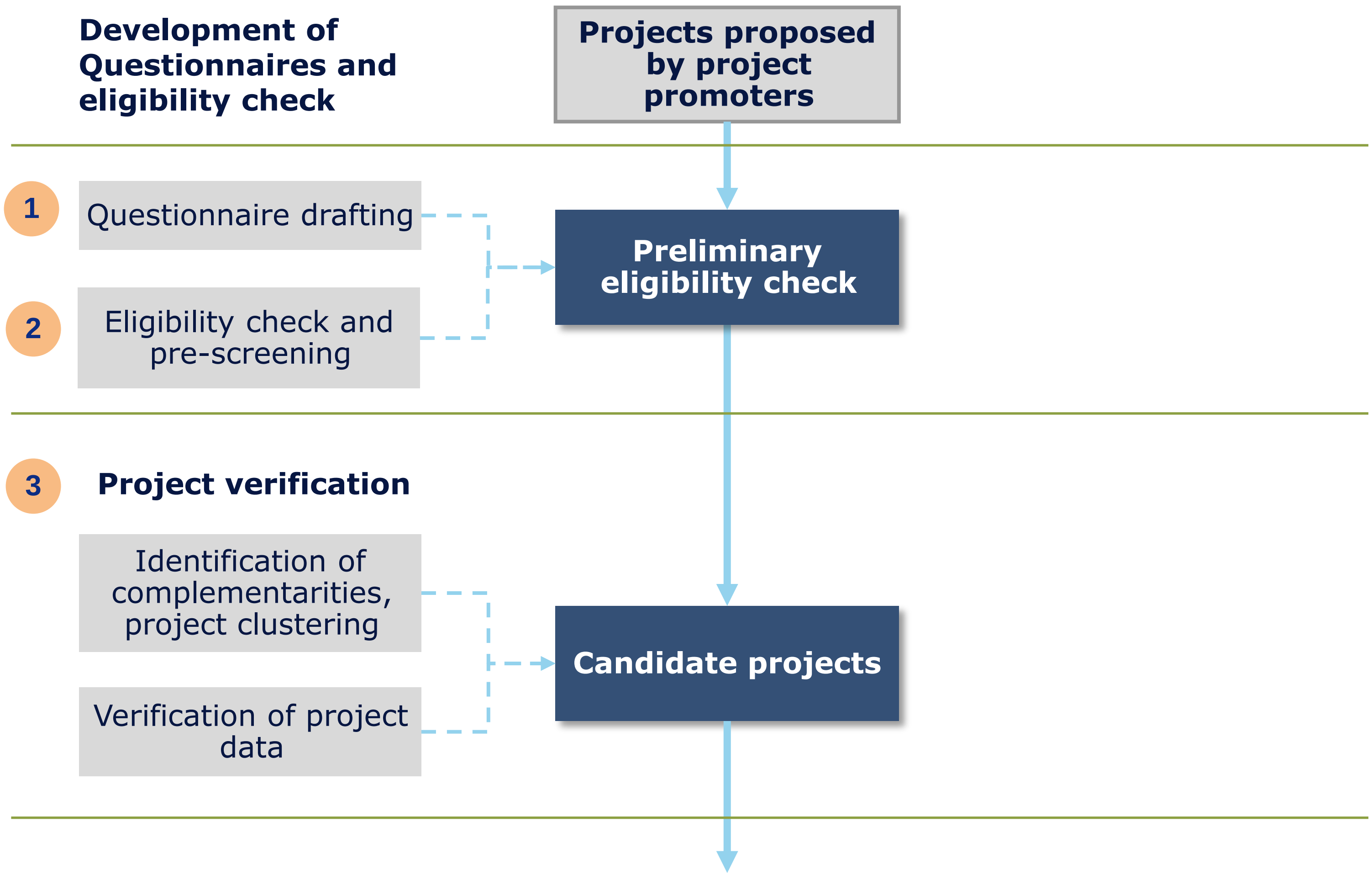
Project Team



Project Timetable



Overview of the Project Assessment Methodology



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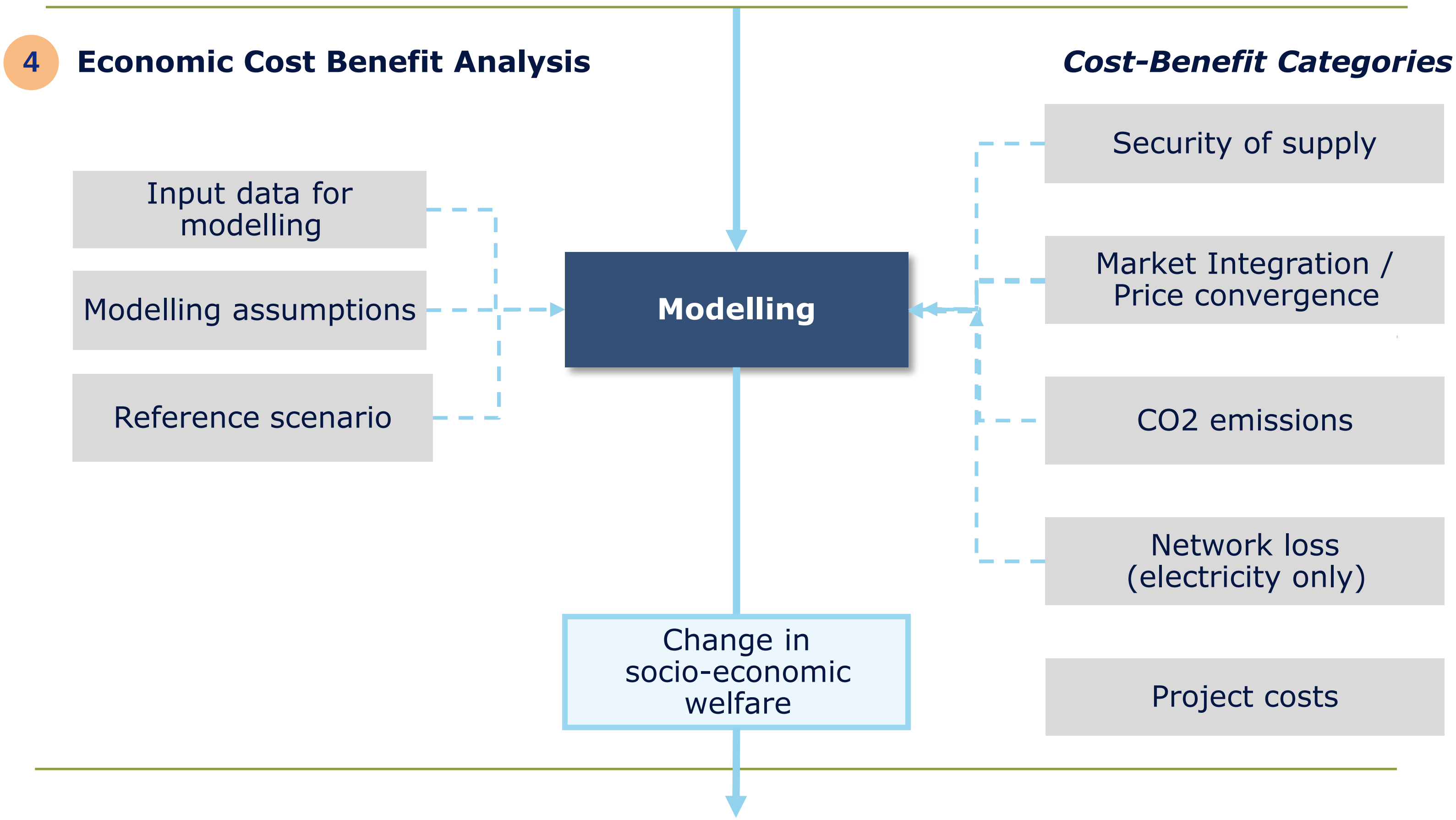
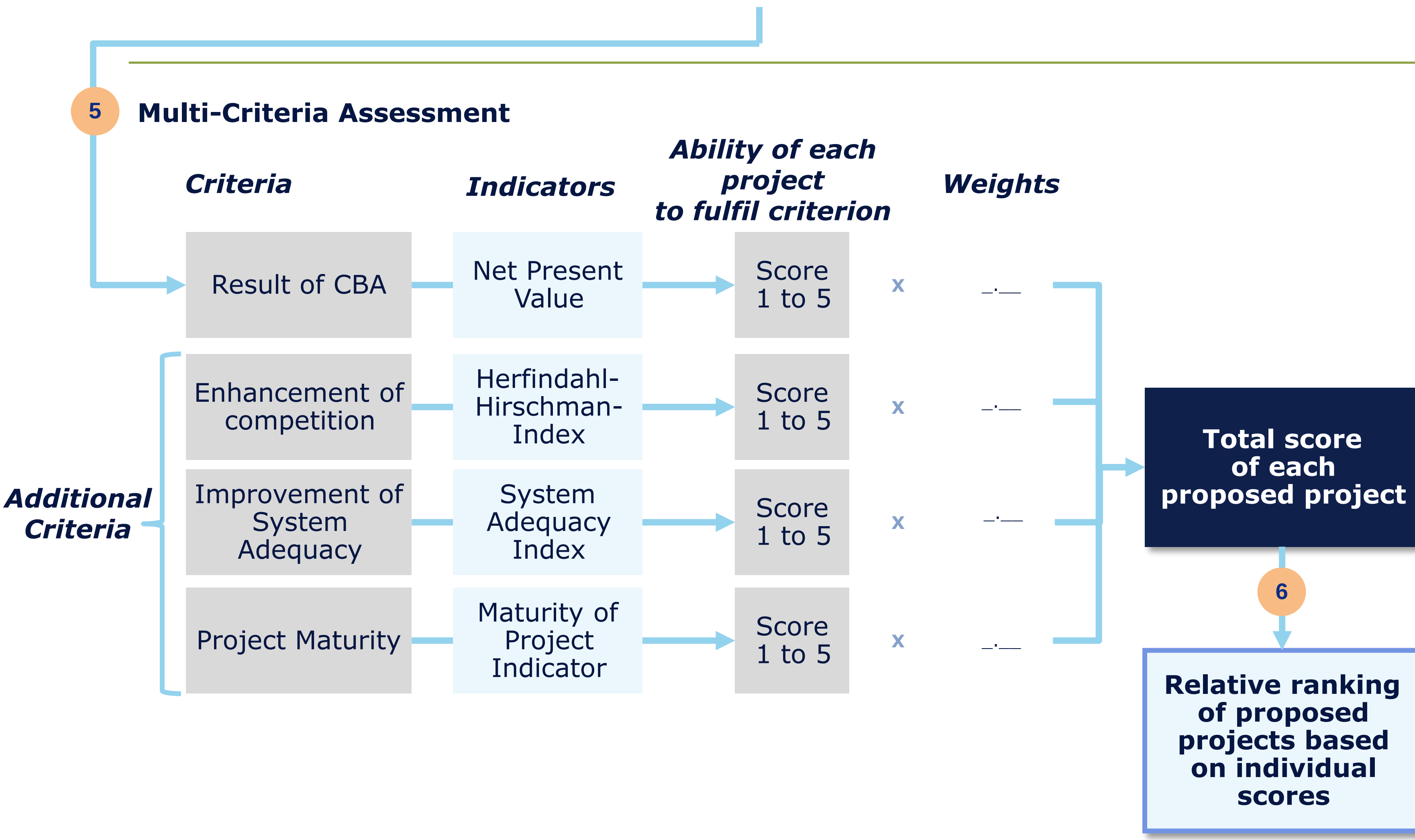
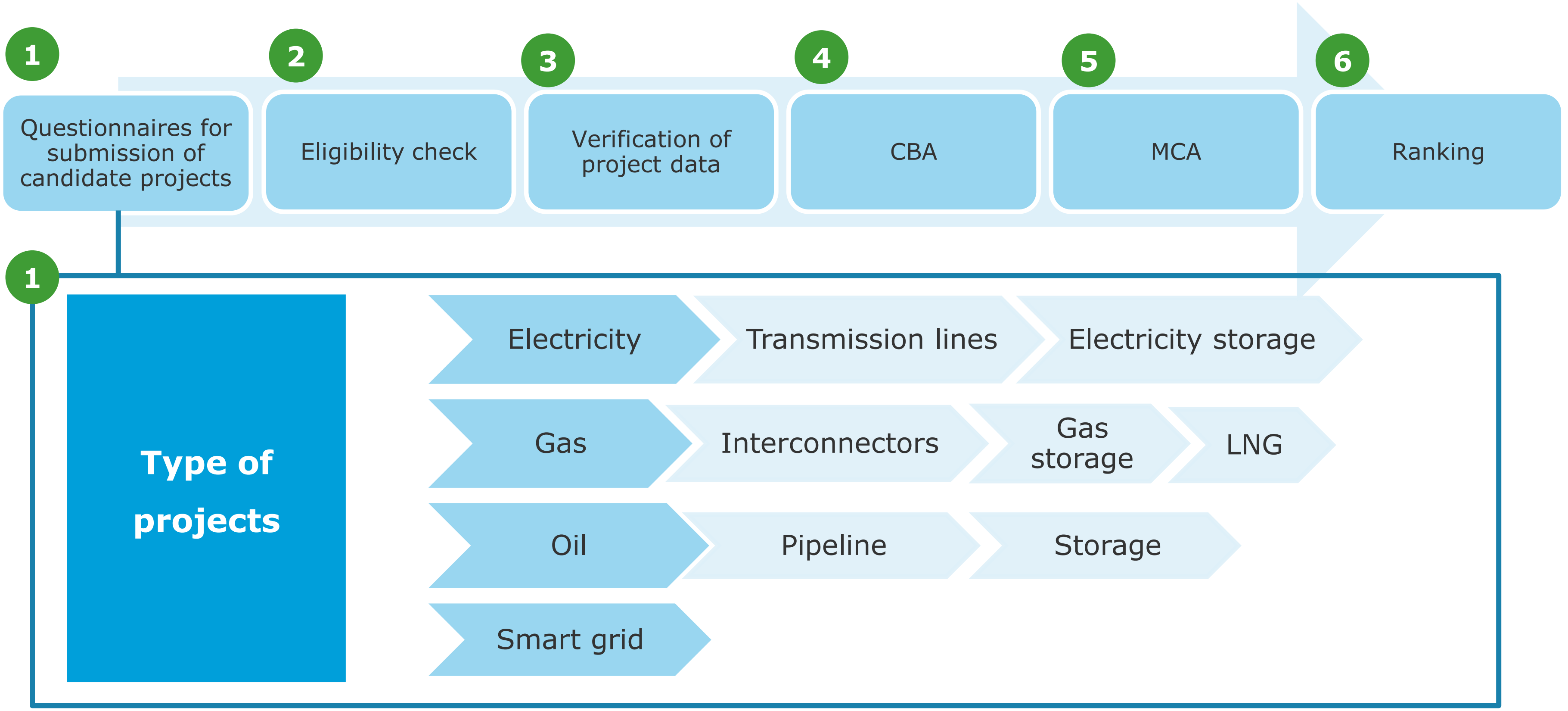


Overview of the Project Assessment Methodology

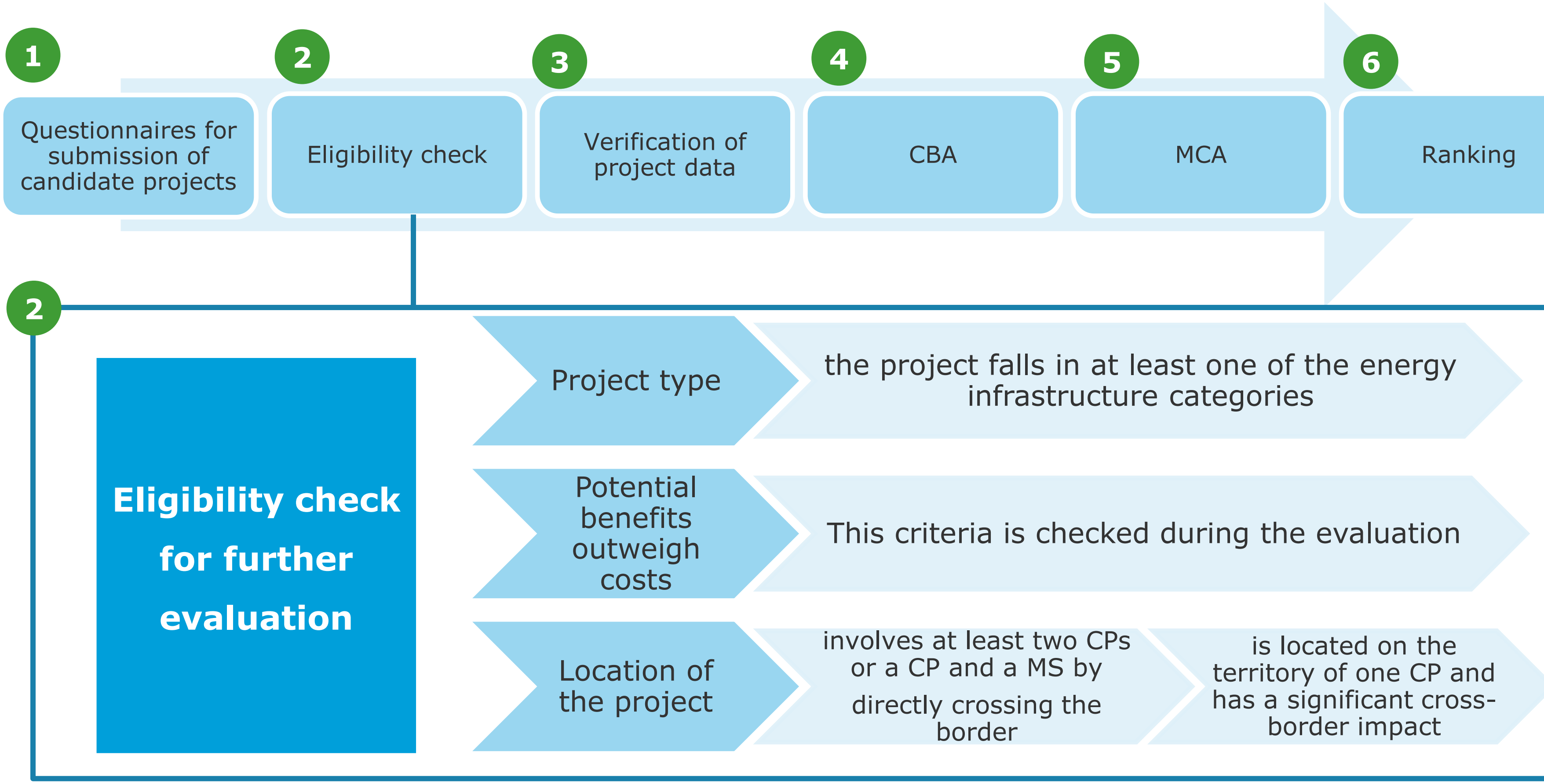


Step 1 – Questionnaires for Submissions of Candidate Projects



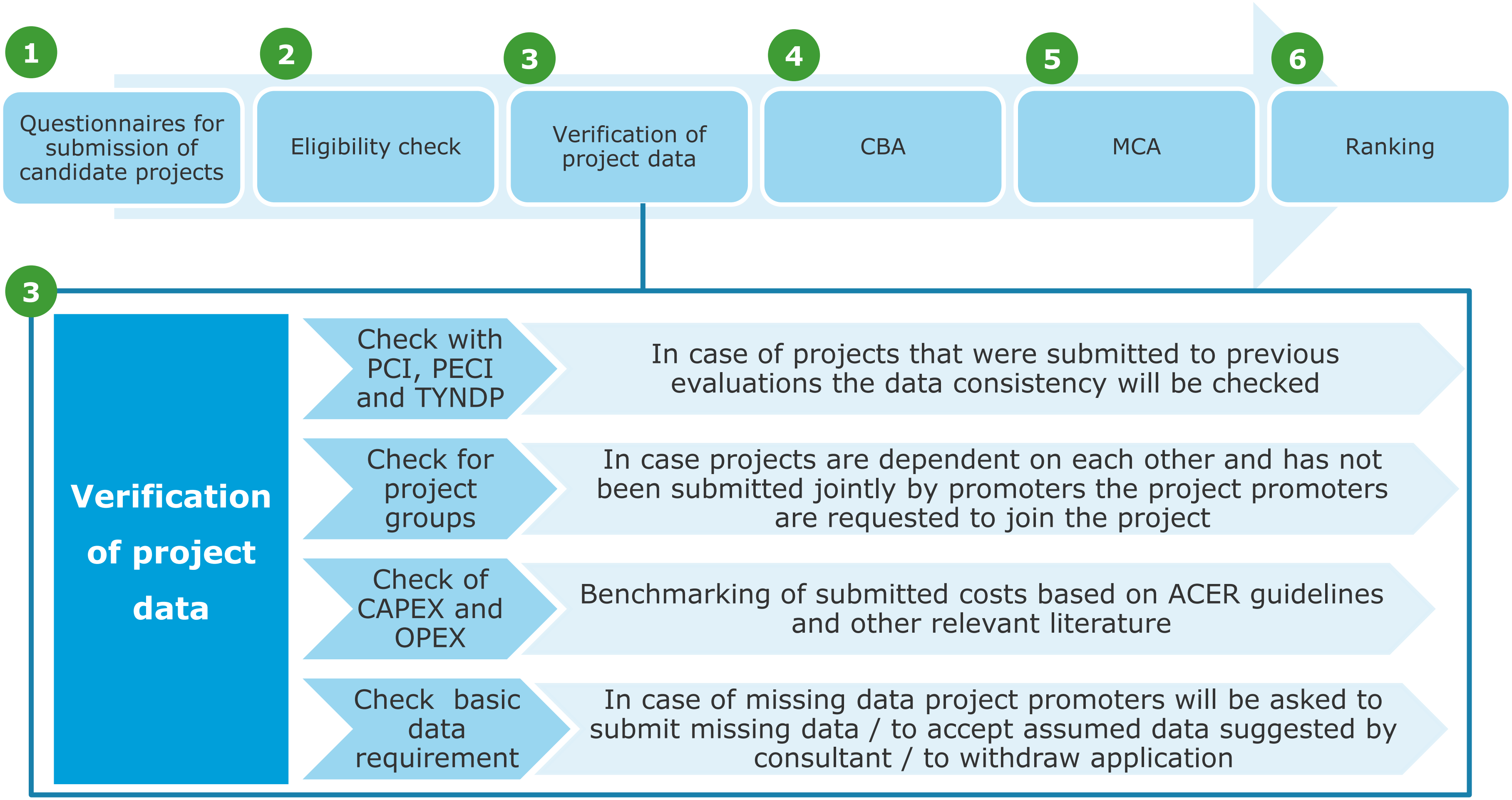
- Interconnector projects on the two side of the borders can only be modelled together
- Project promoters are hence requested to submit proposals jointly for the same project
- Oil and smart grid project evaluation follows a different approach: no modelling

Step 2 – Eligibility Check



- Evaluation of projects with and without having a PCI status follows the same approach. The PCI status will be taken into account 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

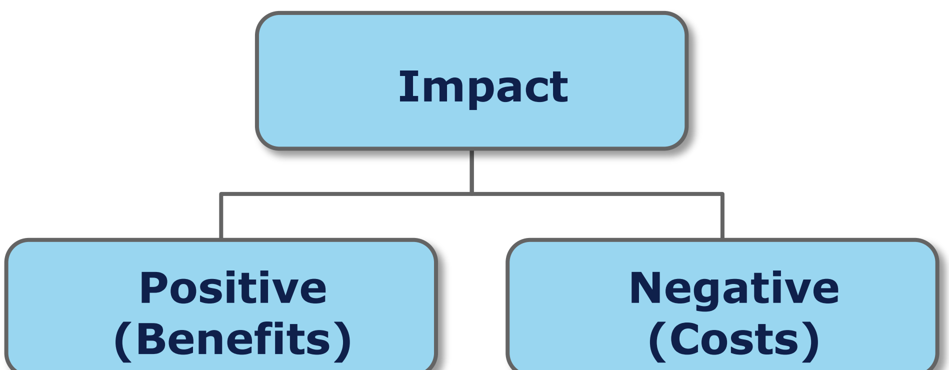


- Minimal data need for project assessment: capacity (at the border), cost, commissioning date

Step 4 – Cost-Benefit Analysis - introduction

A cost-benefit analysis (CBA) is a technique to systematically compare the benefits and revenues with the costs over the life span of an investment project.

- Project evaluation from the view point of different stakeholders is called Cost Benefit Analysis
- The cost-benefit analysis should (ideally) assess all possible costs and benefits of a project
- Costs and benefits to be included in the CBA need to be quantified and monetised
- Additional qualitative criteria can be considered outside a CBA (second stage analysis)



Step 4 – Cost-Benefit Analysis

Steps of a cost-benefit analysis:

- Selection and definition of input data and model parameters
- Definition of costs and benefits
- Assumptions on future development of input data and definition of expected values
- Calculation of the total net economic benefit for different scenarios:
  - NPV: discounting future costs and benefits at a given discount rate (see also next slide)
- Sensitivity analysis of the results in order to determine critical input variables

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)
- Calculation of the Net Present Value (NPV) 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)

Step 4 – Cost-Benefit Analysis (Market and Network Modelling)

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

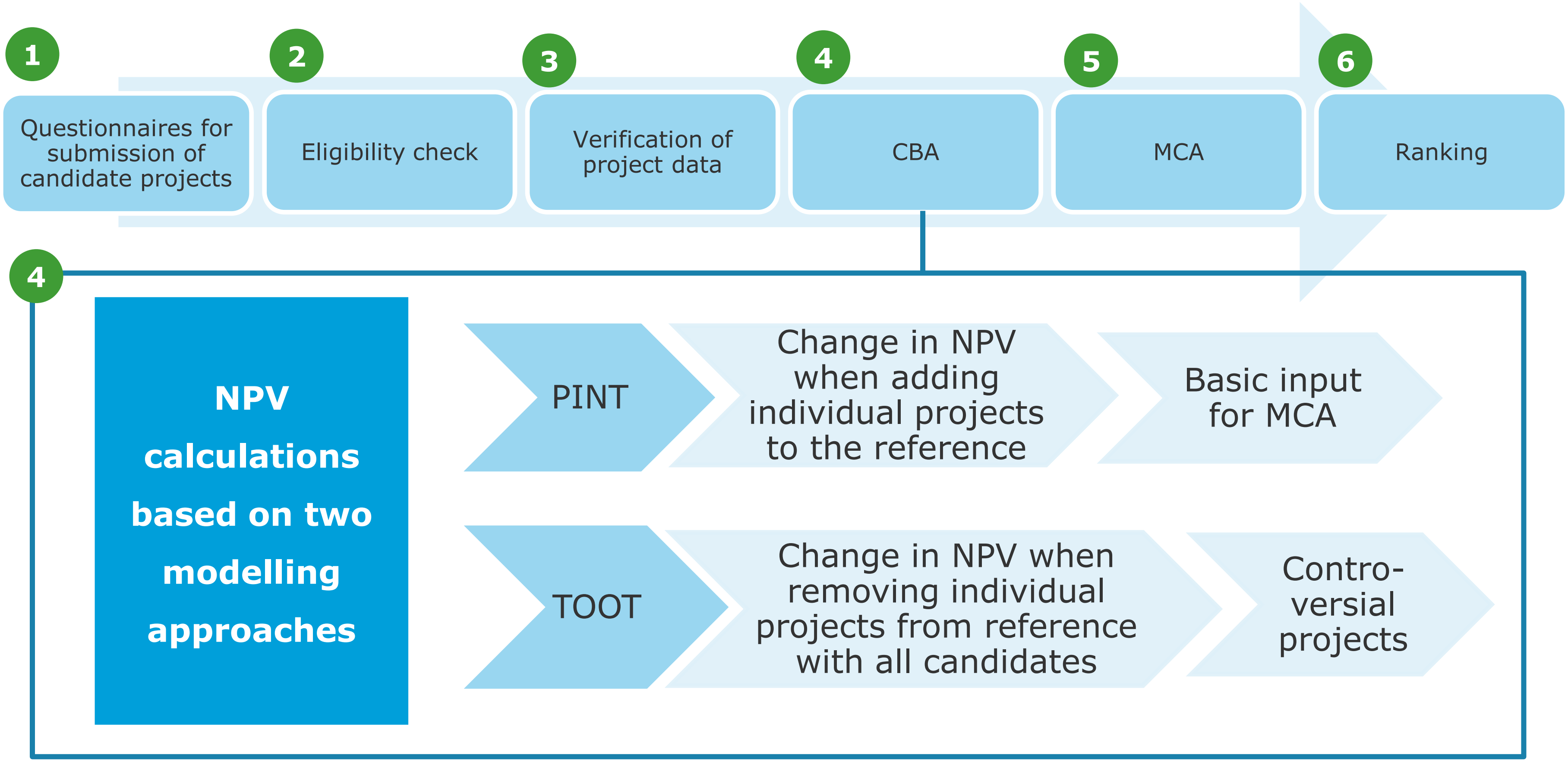
4

Modelling background for Cost-Benefit Analysis

Electricity network model	RSCED-MASA network model: estimates loss and EENS variation
Electricity market model	REKK EEMM: welfare change will be modelled, monetized benefits calculated (NPV)
Gas market model	REKK EGMM: welfare change will be modelled, monetized benefits calculated (NPV)

- Cost benefit analysis of the project: social NPV of the project calculated for the region

Step 4 – Cost-Benefit Analysis (Market and Network Modelling)



- PINT: put-in-one-at-a-time modelling
- TOOT: take-out-one-at-a-time modelling

Step 5 – Multi Criteria Assessment

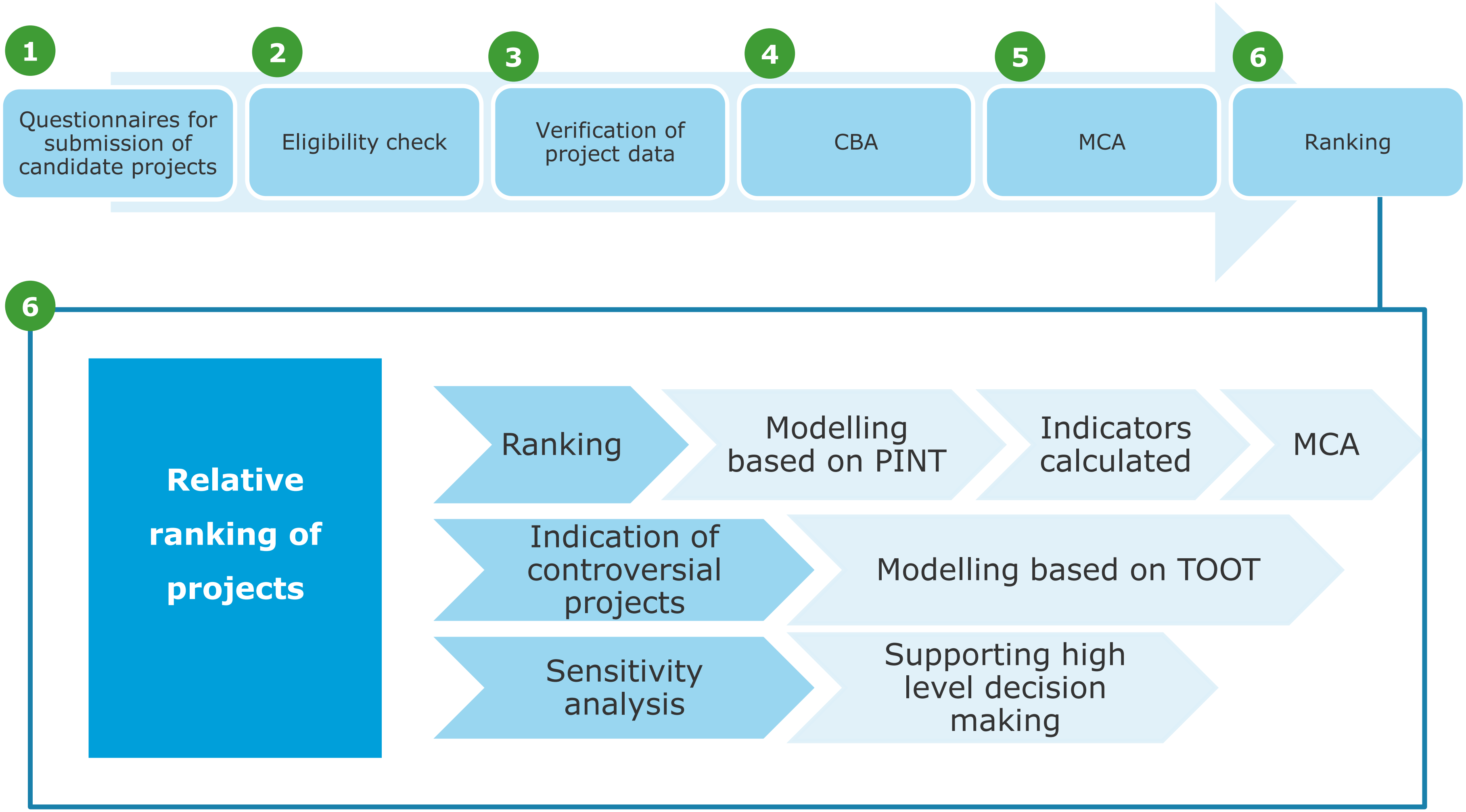
1. Questionnaires for submission of candidate projects
2. Eligibility check
3. Verification of project data
4. CBA
5. MCA
6. Ranking

5 Multi criteria assessment

Monetized benefits	CBA – input from the modelling
Other non-monetized benefits	Indicators for benefit categories outside of the CBA
Scoring	Scores from 1-5 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 – Ranking



Agenda

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General Approach to Cost-Benefit Analysis

- Takes the ENTSO-E CBA (February 2015) methodology as a basis, and monetizes the benefit categories where data availability allows it
- Monetised benefit values, together with the verified CAPEX and OPEX costs serve as input to the NPV calculation
- Reference scenario built up till 2030:
  - Network development according to ENTSO-E
  - Generation and demand in the Region as shown on slide 32-34
- All proposed and verified infrastructure elements are assessed individually – using the PINT (**P**ut-**IN** one at the **T**ime) approach
- All proposed and verified projects are also assessed using the TOOT (**T**ake-**O**ut **O**ne at the **T**ime) approach

Parameters of the Cost-Benefit Analysis

- Components of Net Present Value (NPV) calculation
  - NPV = CS + PS+ Rent + Value of losses – OPEX - Investment cost + (CO_2)
    - CS: Consumer surplus change in the countries of the area of analysis
    - PS: Producer surplus change in the countries of the area of analysis
    - Rent: Rent change in the countries of the area of analysis
    - Value of losses: Value of loss change in the countries of the area of analysis
    - OPEX: Operation and Maintenance cost change due to the project
    - Investment cost: verified investment cost
    - CO_2: Calculated according to the selected option (in slide 25)
- When calculating the NPV 25 years of lifetime and a residual value of zero are applied → ENTSO-E methodology
- Values between 2016-2030 are modelled by EEMM; after 2030 values are kept constant → harmonized with ENTSO-E methodology
- Real social discount rate: 4 % → ENTSO-E methodology

Criteria Evaluated within CBA

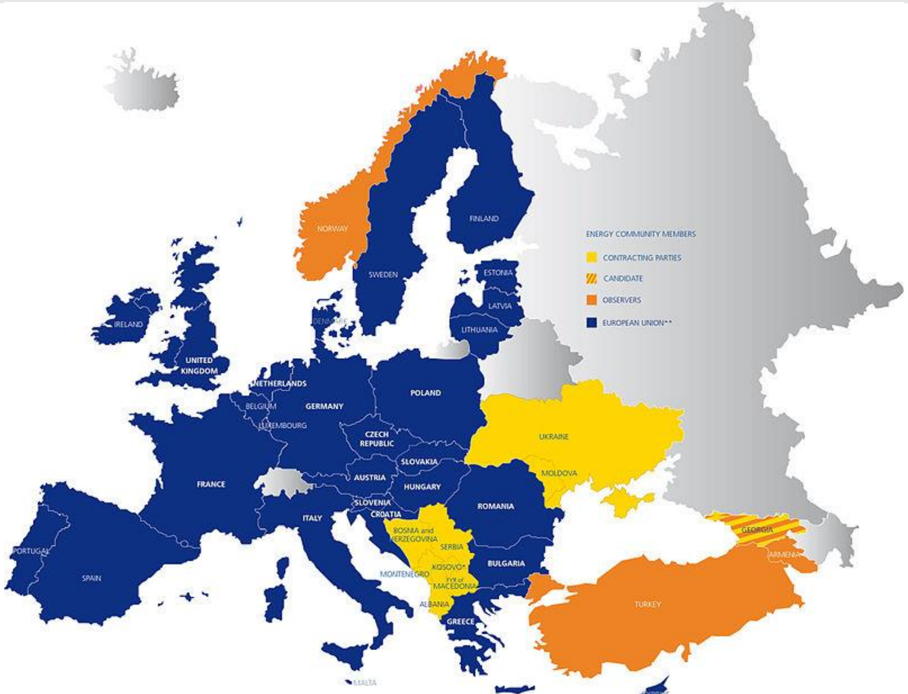
	SoS	Socio-economic welfare	Variation of losses	Variation of CO2 emission
Measure	Expected Energy Not Supplied	Producer surplus change Consumer surplus change Cross-border rent change	Change of transmission losses	Change in the marginal cost of production
Method	Multi-criteria assessment	EEMM modelling	Network and EEMM modelling	To be Decided
Evaluation	Network modelling; Questionnaire TYNDP	NTC Change: Questionnaire Welfare changes: EEMM	Quantity: network model; Questionnaire , TYNDP Value: EEMM	EEMM

Evaluation of the Variation of CO2 Emissions

- There are two options to evaluate CO_2 emissions
- CO2 emissions change based on the result of market model (EEMM)
  - Option A: Within the optimization of the market model -> this assumes a credible carbon taxation scheme, which is introduced in the modelling timeframe
    - ETS price in 2030: 22 €/tCO2
    - Linear growth path from 0 €/tCO2 (2020) to 22 €/tCO2 in 2030
  - Option B: Based on the emission changes of EEMM, ex-post calculation of CO2 emission impact

Transmission Network Model (EC-ET) – Regional Scope

- Update of the EC-ET model:
  - Albania
  - Bosnia and Herzegovina
  - Bulgaria
  - Croatia
  - Greece
  - Hungary
  - Kosovo*
  - Montenegro
  - Macedonia
  - Romania
  - Serbia
  - Slovenia
- Ukraine and Moldova will be added to the model
- The model is implemented in MATLAB



* This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo declaration of independence.

Transmission Network Model (EC-ET) – General Structure

- Planning horizon:
  - 2020
  - 2025
  - 2030
- Two methods are discussed at the moment:
  - Take Out One at the Time (TOOT)
  - Put In one at the Time (PINT)
- The EC-ET model represents the actual network flows
- Output: Additionally, the following assessments will be obtained:
  - Changes in non served energy
  - Changes in transmission losses

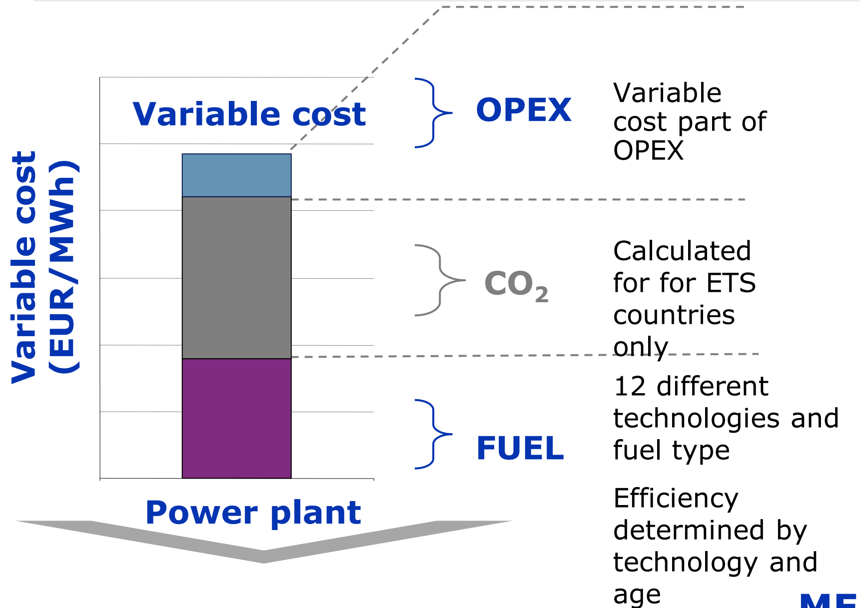
Transmission Network Model (EC-ET) – Input Data

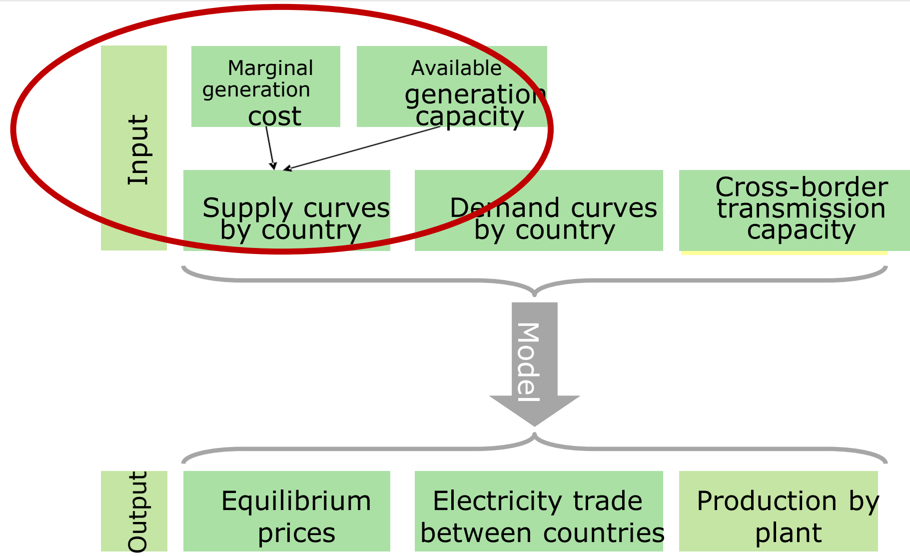
- Input data needed for the model:
  - Generation capacity (electricity production)
  - Demand
  - Characteristics of the transmission network (voltage level: 110 and up)
- At the moment - detailed network transmission data for 2007
  - The model will be updated with data from ENTSO-E
  - For Ukraine and Moldova the data will be provided by EC, from the Ukraine and Moldova TSO

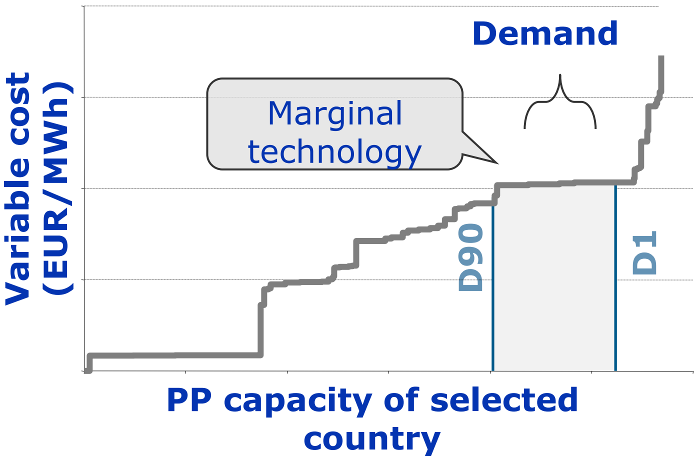
European Electricity Market Model – Functionality

- The map shows the geographical coverage of the model in the South East European region:
  - 25 European Union countries handled by model (whole Energy Community region is covered)
- EEMM:
  - Competitive market equilibrium prices by countries
  - Electricity flows and congestions on cross-border capacities
- The exogenous power prices are reflecting the changes in fuel prices.
- Non ENTSO-E part of Ukraine and Moldova are also covered
- The model calculates the marginal cost of more than 3500 power plant blocks and sets up the merit order country by country.
- Taking into consideration the merit order and exports/import, the model calculates equilibrium prices.
- Regional power flow is ensured by 90 interconnectors between countries.

Supply Side: Calculation of Variable Costs and Merit Order







MERIT ORDER

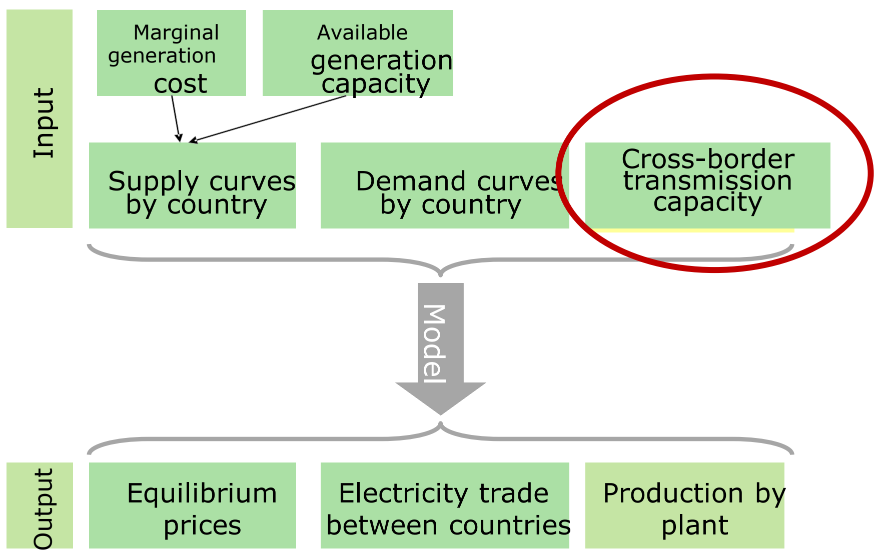
- Power plants with increasing marginal costs are ordered next to each
- The merit order as supply curve shows the competitiveness of different technologies/power plants in a given country
- Marginal power plant set by the actual demand determines the power price
- Due to the cross-border capacities and import/export between the countries, foreign power plants could set the domestic power prices in a given moment

Cross Border Trade and Demand Side

Cross border trade

- Based on Net Transfer Capacity (NTC) values
- Non-satisfied demand for capacity results in price differences amongst regions

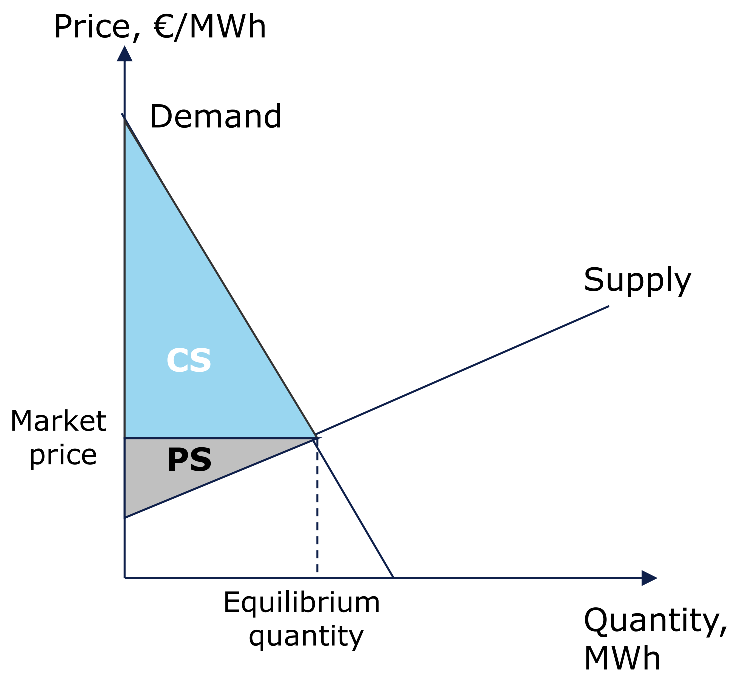
	Country A	Country B
Generation capacity	1000	500
MC	50	100
Consumption	400	400
Price	**50**	**100**
1.Case: 0 MW NTC	**50**	**100**
2.Case: 100 MW NTC	**50**	**100**
3.Case: 1000 MW NTC	**50**	**50**



Demand side

- Based on hourly modelling
- 90 representative hours, weighted to cover the year:
  - calculates baseload and peakload prices,
  - welfare effects

Welfare Components



Consumer surplus (CS):

Consumer surplus is the difference between the maximum price a consumer is willing to pay and the actual price they do pay.

Producer surplus (PS)

Market price multiply by the equilibrium quantity decreased by the total variable cost of production

Cross-border rent (RENT)

Price differentiate between two markets multiplied by the traded quantity

Total welfare

CS+PS+RENT

Main Market Model Assumptions – Supply Side I

- Net installed capacity in the region in 2015 (in MW)

	Coal and lignite	Natural gas	Nuclear	Wind	HFO/LFO	Hydro	Other RES
AL	0	0	0	0	0	1 801	1
BA	1 965	0	0	0	0	2 252	0
KO*	1171	0	0	1,35	0	48,71	0,1
ME	210	0	0	0	0	685	10
MD	0	2 858	0	0	0	80	2
MK	822	337	0	37	210	692	1
RS	3 501	0	0	9	0	2 270	3
UA_E	19 783	8 202	13 835	514	0	5 439	691
UA_W	5 000	0	0	0	0	27	0

- New fossil-based power generation capacities (in MW)

	2016-2020			2021-2025			2026-2030		
	Coal and lignite	Natural gas	HFO/LFO	Coal and lignite	Natural gas	HFO/LFO	Coal and lignite	Natural gas	HFO/LFO
AL	0	200	0	0	160	0	0	0	0
BA	1650	390	0	0	0	0	0	0	0
KO*	0	0	0	500	0	0	0	0	0
ME	225	0	0	0	0	0	0	0	0
MD	0	0	0	0	0	0	0	0	0
MK	120	440	0	200	0	0	1400	0	0
RS	1305	630	0	320	0	0	0	0	0
UA_E	0	12000	0	0	0	0	0	0	0
UA_W	0	0	0	0	0	0	0	0	0

Electricity

Main Market Model Assumptions – Supply Side II

- New RES-E power generation capacities (in MW)

	Hydro			PV			Wind			Other		
	2016-2020	2021-2025	2026-2030	2016-2020	2021-2025	2026-2030	2016-2020	2021-2025	2026-2030	2016-2020	2021-2025	2026-2030
AL	523	457	457	30	26	26	30	25	25	0	0	0
BA	0	0	0	0	0	0	0	0	0	0	0	0
KO*	212	0	0	6	5	5	148	100	100	10	0	0
ME	166	158	158	7	8	8	151	126	126	22	24	24
MD	0	0	0	0	0	0	149	124	124	8	8	8
MK	16	27	27	0	0	0	13	11	11	6	6	6
RS	391	644	644	8	9	9	500	400	400	141	123	123
UA_E	452	468	468	1 300	1 880	1 200	1 280	5 437	1 317	712	770	770
UA_W	0	0	0	0	0	0	0	0	0	0	0	0

Main Market Model Assumptions – Demand Side

- Electricity demand (in GWh/year)

	2015	2020	2025	2030
AL	7 842	9 163	10 704	12 399
BA	11 780	12 709	13 726	14 825
KO*	2 663	6 316	9 216	10 484
ME	4 569	5 335	6 036	6 829
MD	5 861	6 567	7 357	8 243
MK	8 067	9 155	10 242	12 246
RS	36 004	37 237	41 107	47 662
UA_E	208 206	228 542	252 329	278 592
UA_W	4 559	4 767	4 974	5 182

- Present net transfer capacity (NTC) values are based on ENTSO-E; future cross-border capacity investments are based on Ten-Year Network Development Plan according to the Ministerial Council Decision 2015/09/MC-EnC

Main Market Model Assumptions – Fuel Prices

Oil price	▪ Based on US Energy Information Administration (EIA), Brent Europe forecasts
Natural gas price	▪ Result of the EGMM Reference case
Coal price	▪ Hard coal price equal ARA price ▪ Coal price forecasts are based on Economist Intelligence Unit ▪ Lignite price = hard coal * 0.55
Nuclear	▪ Taken from literature, but irrelevant (never marginal)
HFO, LFO	▪ Indexed to crude oil price

Assessed Geographical Area – Same for All Project Types

- *Ministerial Council Decision 2015/09/MC-EnC Annex IV./(6)*
  - „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)

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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
- SOS simulation: a monthly cut of Russian supplies through Ukraine for January
  - Weights: 95% for normal and 5% for SOS case
- Monetised benefit values, together with the verified CAPEX and OPEX costs serve as input to the NPV calculation
- Reference scenario built up till 2030:
  - Infrastructure development according to ENTSO-G TYNDP
  - Production and demand in the Region as shown on slide 52-53
- All proposed and verified infrastructure elements are assessed individually – using the PINT (**P**ut-**IN** one at the **T**ime) approach
- All proposed and verified infrastructure elements are also assessed using the TOOT (**T**ake-**O**ut **O**ne at the **T**ime) approach

Parameters of the Cost-Benefit Analysis

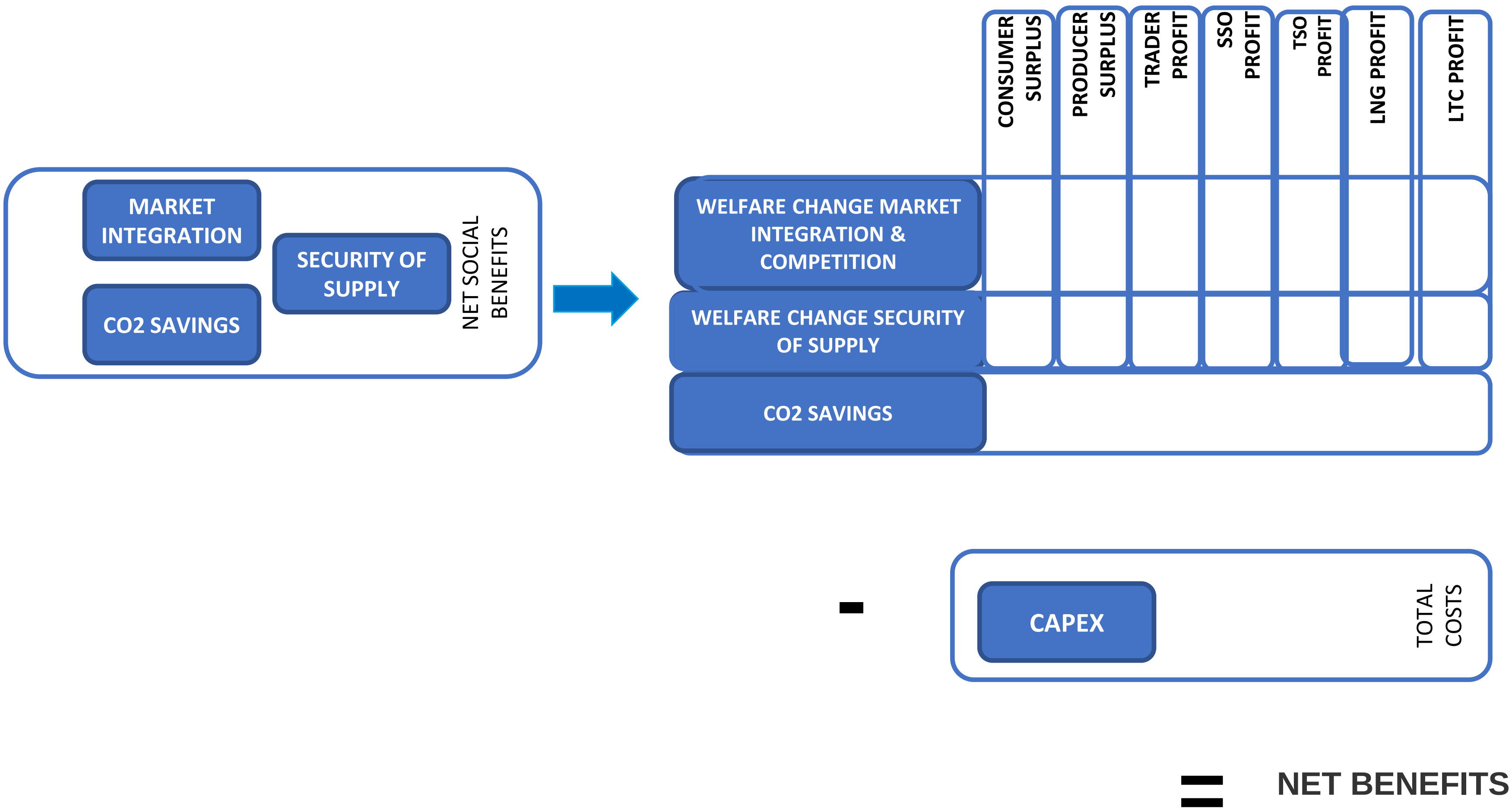
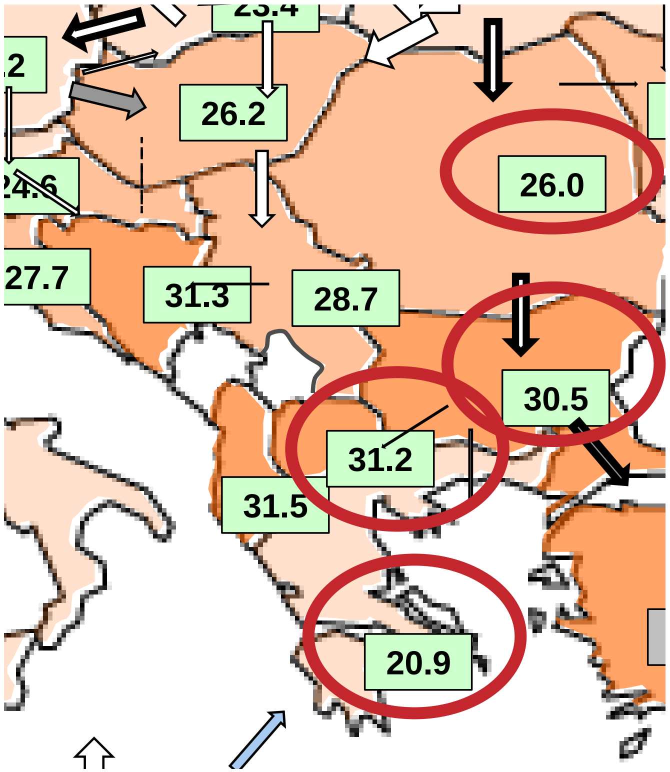


Illustration only example: New Interconnector BG-GR in 2020

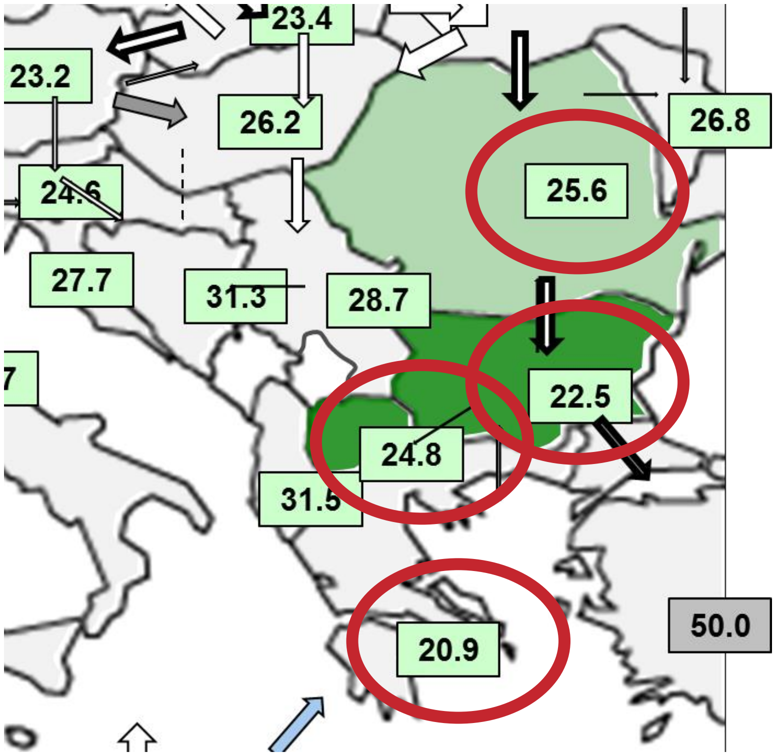
Gas wholesale price (€/MWh)

Without the project



Gas wholesale price (€/MWh)

With the project



- A new bi-directional interconnector is commissioned connecting BG and GR (capacity 134 GWh/day)
- Effect: spot LNG gas flows may reach Bulgaria and Macedonia

GR-BG Interconnector Welfare Change Effects

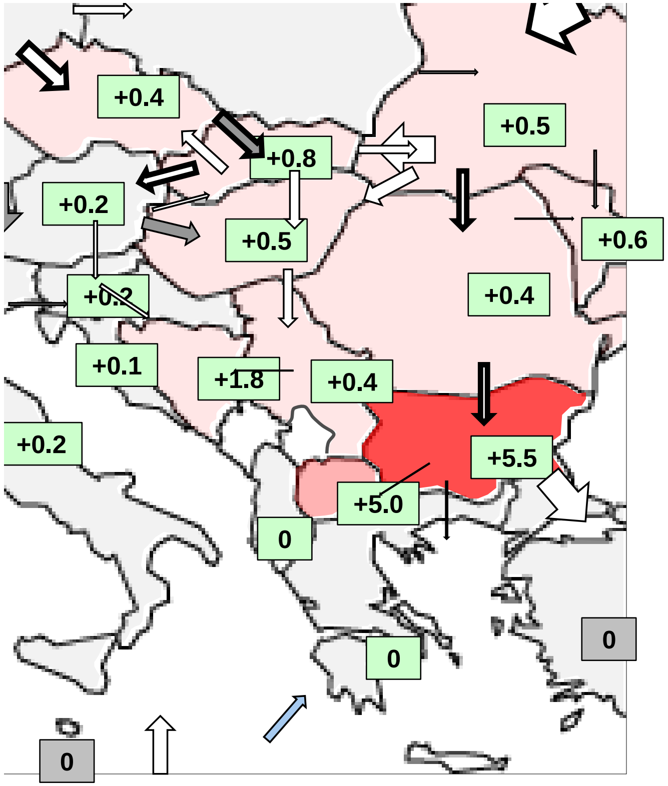
	Consumers	Producers	LTC trader profit	SSO	TSO	LNG	Total welfare
GR	-0,4	0	0,1	0	7,6	9,4	16,7
BG	347,1	-102,8	-219	1,2	12	0	38

- **BG:**
  - Consumer surplus surges due to lower prices (price drop from 30.5€/MWh to 22.5€/MWh)
  - Producer surplus and LTC holder profit drops, since the domestic production can be marketed at a lower price
  - 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

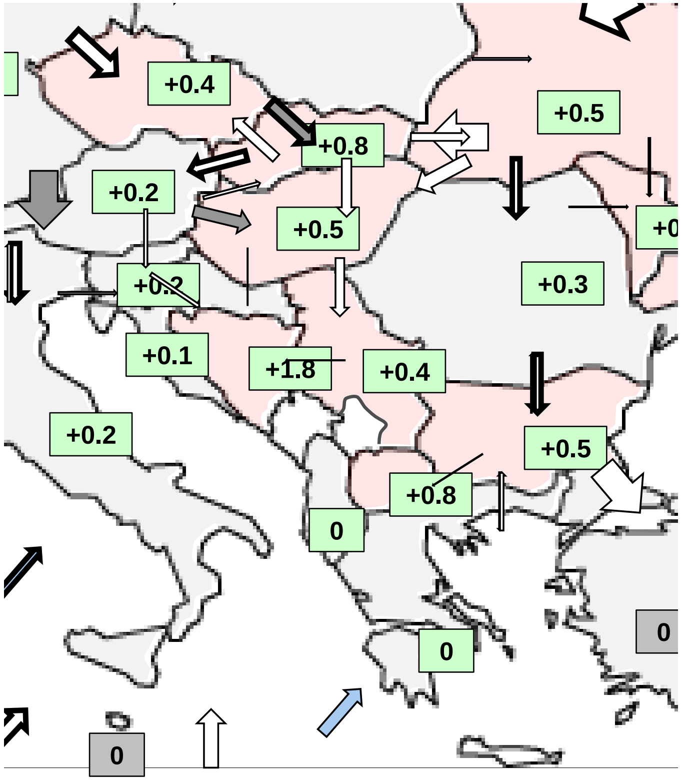
Natural Gas

Impacts on SoS

SOS without project



SOS with project



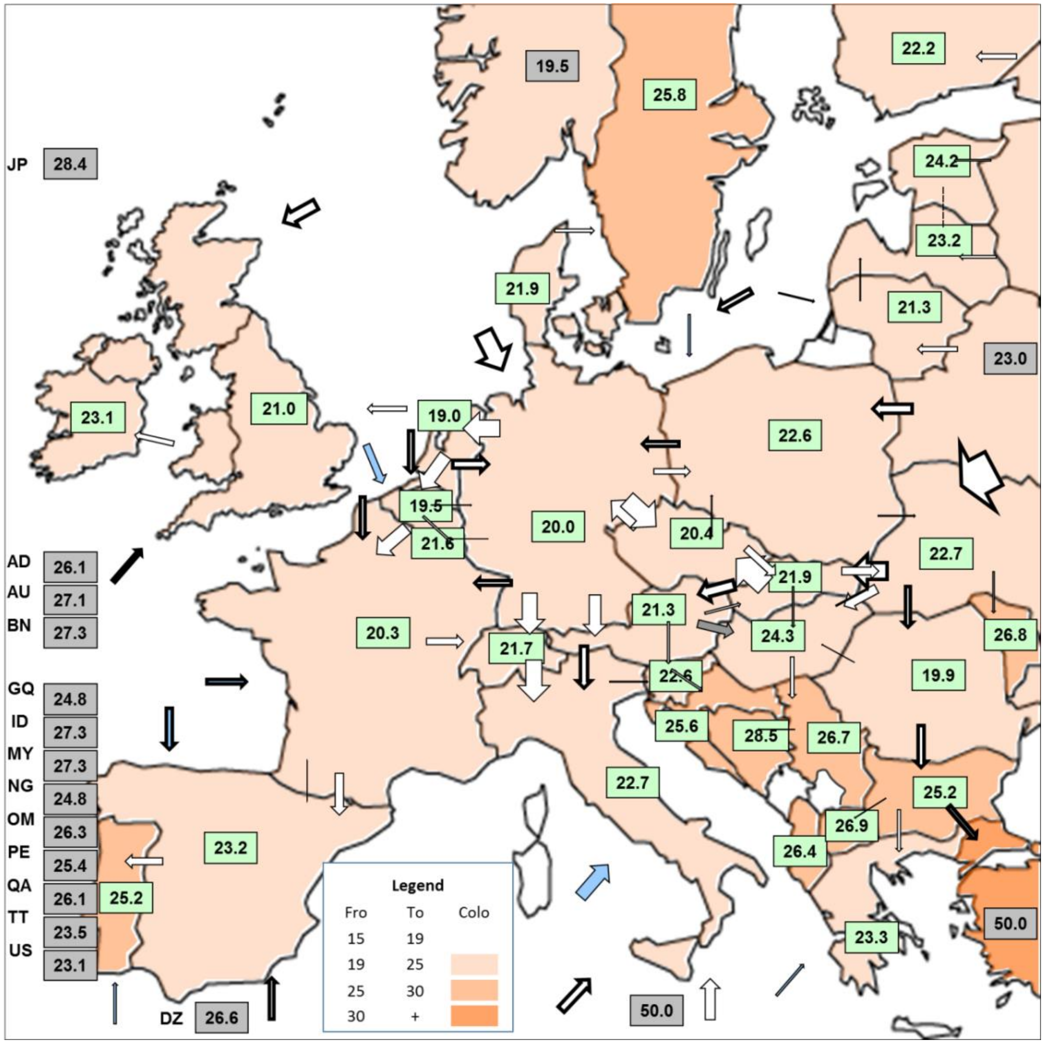
- The project alleviates the SOS situation in BG and MK

Sample Project Evaluation

	Welfare change in normal scenario (mill €) Weight: 95%			Welfare change in SOS scenario (mill €) Weight:5%			total Investment cost (mill€)	change in CO2 emissions	NPV
	2016…2020	2021…2025	2025…2030	2016…2020	2021…2025	2025…2030			
AL									
BA									
BG									
GR									
HR									
HU									
IT									
KO*									
ME									
MK									
MV									
PL									
RO									
SB									
SK									
UA									
REGION									

Natural Gas

European Gas Market Model – Major Characteristics



- 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

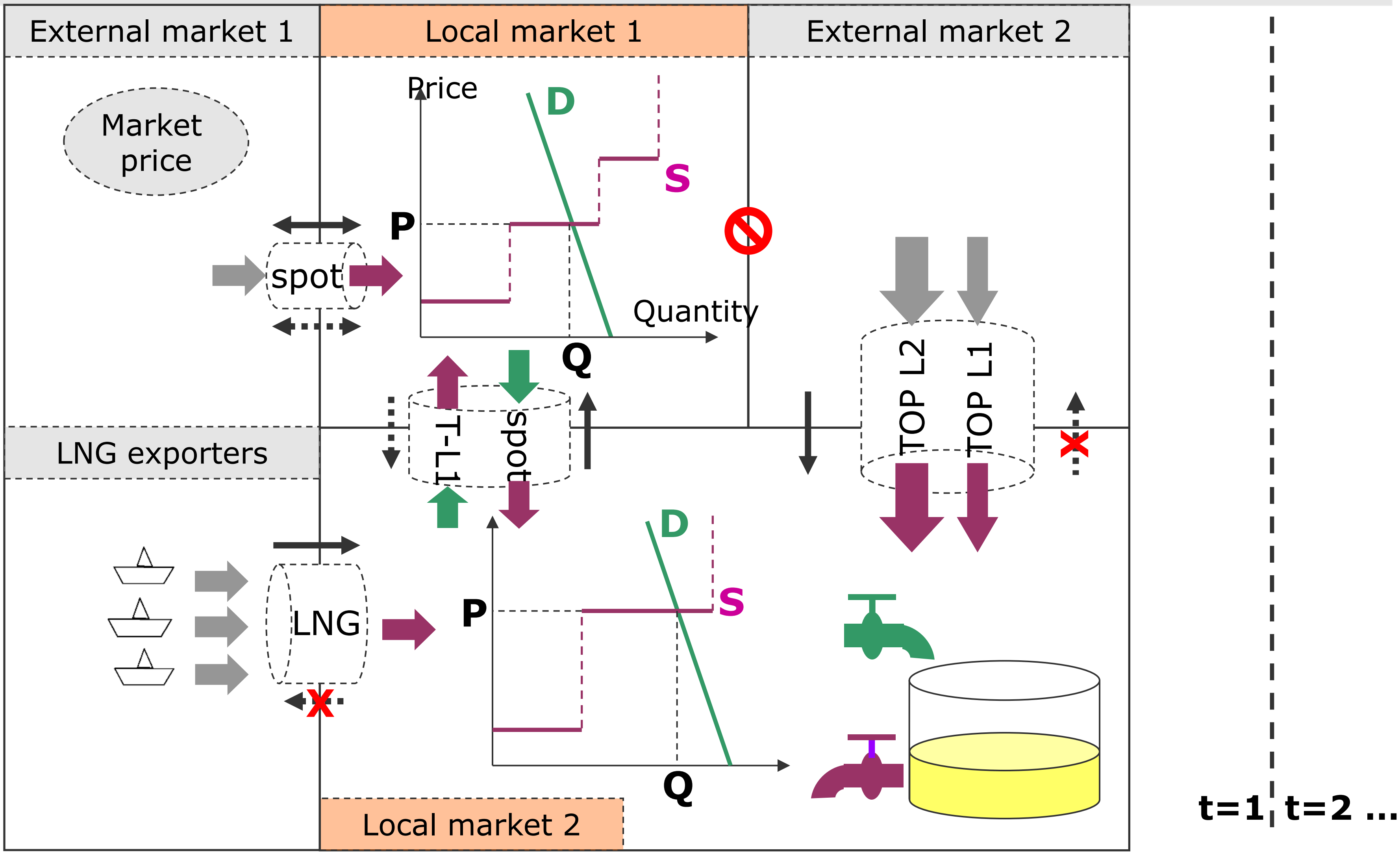
Storage stock change

Import through long term contracts and spot trade

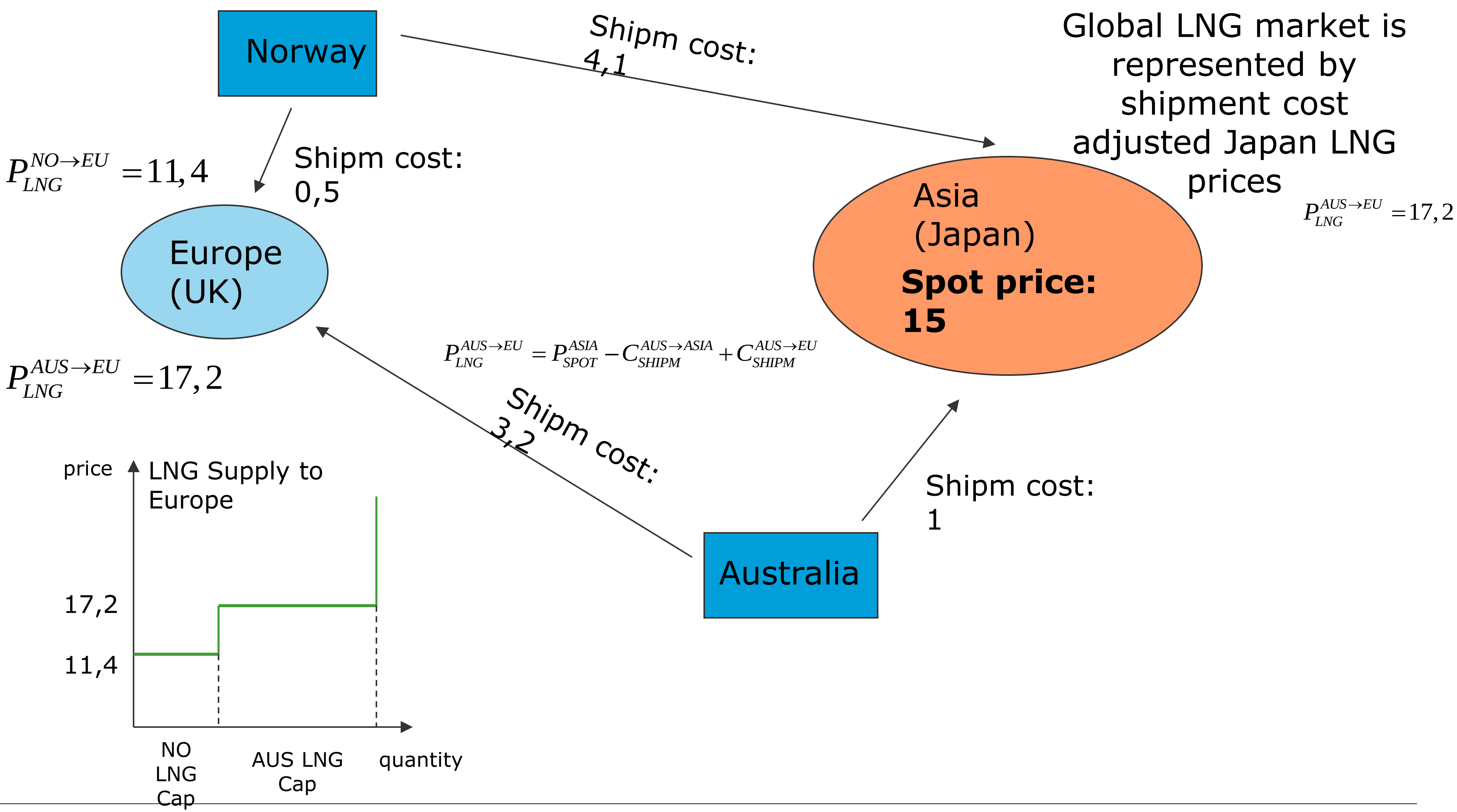
Social welfare:

- Consumer surplus
- Producer surplus
- Storage operation profit
- Storage arbitrage profit
- Net profit from long-term contracts
- TSO auction revenue
- TSO operation profit

Model Scheme



A Simple Model of Spot LNG Pricing for Europe (in $/MMBtu)



Key Modelling Assumptions and Data Sources

	2016-2020	2021-2025	2026-2030	Source
Demand, production	TYNDP 2015	TYNDP 2015 (revised) forecast	TYNDP 2015 (revised) forecast	ENTSO-G TYNDP 2015
Infrastructure (LNG, pipeline, storage)	Existing infrastructure + new projects under construction (PL_LNG)	FID projects based on ENTSO-G TYNDP 2016-2020	No new infrastructure added	ENTSO-G GIE, GSE, GLE ENTSO-G TYNDP 2015
LTC-s	Current prices, Current routes Current ACQs Flexibility of LTCs is uniform (30%), except for energy island countries	LTC prices are adjusted to oil forecase price (according to assumed formula), after their expiry they are extended by half quantity	LTC prices are adjusted to oil forecase price (according to assumed formula)	Publicly available sources (press, Cedigas, Quarterly report) double checked with Commission LTC data
LNG	USA LNG enters: 7.7 bcm/year	USA LNG max 31.8 bcm/year Panama-canal extension		

Further Modelling Assumptions

- Infrastructure tariffs: TSO/SSO publications
  - We assume tariffs at their actual (2015 December) level
- New infrastructure is modelled with a uniform 2 €/MWh tariff
  - In the absence of flow we also examine lower values (1€/MWh on each interconnection point: 0.5/0.5 €/MWh on exit and on entry in both directions)
- Outside market prices are set exogenously
  - Japanese LNG Price is 28.4 €/MWh on average – 2015 (seasonal fluctuation is assumed) LNG suppliers use Japanese price levels for their netback price. For 2020, 2025 and 2030 we use a fixed low Asian market price (21 €/MWh), to allow increased flow of LNG supply to Europe
  - Turkish and Algerian markets trade only through long term contracts the 50€/MWh price on the border is the spot trade price (we assume that there is no spot trade)
  - Russian spot gas is allowed in a low quantity (TTF price + 2 €/MWh)
  - Norwegian spot price is set based on TTF price (seasonal fluctuation is also assumed)

Assumptions on Production and Consumption

	2016-2020		2021-2025		2026-2030	
Country	Yearly quantity (TWh)		Yearly quantity (TWh)		Yearly quantity (TWh)	
	Demand	Production	Demand	Production	Demand	Production
AL	0	0	0	0	0	0
AT	86	16	79	13	74	12
BA	2	0	2	0	2	0
BE	173	0	170	0	191	0
BG	36	8	46	14	48	16
CH	31	0	31	0	35	1
CZ	99	3	99	1	106	0
DE	702	100	671	80	625	67
DK	34	53	28	47	24	28
EE	8	0	9	0	9	0
ES	323	0	369	0	405	0
FI	28	0	32	2	26	4
FR	427	1	416	38	444	60
GR	34	0	38	0	52	0
HR	26	14	26	9	26	6
HU	98	16	119	11	111	5
IE	38	10	43	30	44	13
IT	751	88	769	79	783	68

	2016-2020		2021-2025		2026-2030	
Country	Yearly quantity (TWh)		Yearly quantity (TWh)		Yearly quantity (TWh)	
	Demand	Production	Demand	Production	Demand	Production
KO	0	0	0	0	0 (	0
LT	26	0	26	0	25	0
LU	12	0	14	0	14	0
LV	20	0	22	0	24	0
ME	0	0	0	0	0	0
MK	2	0	7	0	7	0
MV	10	0	11	0	12	0
NL	406	686	456	366	460	366
PL	171	25	184	25	190	25
PT	53	0	62	0	80	0
RO	102	112	109	95	130	75
SB	32	2	38	1	52	1
SE	17	0	16	1	16	1
SI	8	0	9	1	10	1
SK	53	0	59	0	61	0
UA	331	170	331	170	331	170
UK	797	380	746	384	820	355
TOTAL	**4945**	**1684**	**5046**	**1367**	**5246**	**1274**

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)

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

TWH/year	2015	2020	2025	2030
Albania	0	4,9	8,82	11,76
Bosnia	3,92	8,82	11,76	15,68
Kosovo*	0	0	3,92	5,88
Montenegro	0	0	0,98	0,98
FYR of Macedonia	1,96	6,86	10,78	13,72

Source: ECA Gas to Power Study 2015

New Infrastructures Expected to be Built Between 2016 and 2020

New interconnector		Capacity (GWh/day)
Biriatou	FR-ES	60
	ES-FR	55
Alveringem-Maldegem	FR-BE	270
Griespass-Passo Gries	IT-CH	421
Ellund	DE-DK	40.56
Ruse-Giurgiu	BG-RO	14.38
	RO-BG	14.38
LNG	**Country**	**Capacity (GWh/day)**
Revythoussa extension	GR	+80.38
Dunkerque	FR	348
Klaipeda extension	LT	+27.1

Source: TYNDP 2015

We consider TAP to be a crucial infrastructure in the region

- Many gas projects in the region are dependent on Trans-Atlantic Pipeline. This is why we propose to analyse the projects with having TAP in the reference (2020)
- We will check the robustness of the results without TAP as well.

New interconnector		Capacity (GWh/day)
Trans Adriatic pipeline (TAP)	TR-GR GR-AL AL-IT	350
Interconnector Greece Bulgaria (IGB)	GR-BG BG-GR	90

New LTCs	to	ACQ (bcm/year)
SOCAR	Italy	8
	Greece	1
	Bulgaria	1

Assessed Geographical Area – Same for All Project Types

- *Ministerial Council Decision 2015/09/MC-EnC Annex IV./(6)*
  - „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)

Components of Net Present Value Calculation

- NPV = 0.95*Total welfare change(normal)+ 0.05*Total welfare change (SOS) - Investment cost + (CO2)
- 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 (in slide 49)
- When calculation the NPV 25 years of lifetime and a residual value of zero are applied → ACER recommendation
- Values between 2016-2030 are modelled by EGMM yearly; after 2030 values are kept constant → harmonized with ENTSOG methodology
- Real social discount rate: 4 % → ENTSOG methodology

Agenda

1. Overview of general project assessment methodology
2. Electricity Market Model and Electricity Network Model
3. Gas Market Model
4. Multi-criteria assessment methodology

Overview on Multi-Criteria Assessment Methodology

1 Pre-assesment

- Eligibility check
- Data verification

2 Application of CBA

- Economic Cost-Benefit Analysis
- Application of market models for electricity and gas
- Supported by network model for electricity

3 Multi-Criteria Assesment

- Assessment of additional qualitative and quantitative criteria
- Integration of additional criteria with results of CBA

4 Relative Ranking

- Ranking of all eligible projects according to the calculated scores

Rationale for MCA

- When a decision-making problem has more than one goal to reach, there is always a trade-off between the different goals
- It may not be possible to sufficiently monetise all dimensions of impacts, which is necessary for inclusion within economic CBA
- MCA is a tool that allows to take into account several criteria and opinions by scoring, ranking and weighting a wide range of qualitative impact categories and criteria and to integrate them with the results of the CBA

Overview on Multi-Criteria Assessment Methodology

Step-wise methodology of Multi-Criteria Assessment

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
   → Σ score of each criterion * weight of each criterion
6. Relative ranking of projects based on the project scores

Overview on Multi-Criteria Assessment Methodology

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 ENTSOG methodologies with feedback provided from ACER
- Consultant's expertise from previous PECI 2013 selection

Dimensions of criteria

Electricity transmission and storage projects				
Market integration	Security of supply	Sustainability	Competition	Maturity

Natural gas projects				
Market integration	Security of supply	Sustainability	Competition	Maturity

Overview on Multi-Criteria Assessment Methodology

How to evaluate criteria?	

How to evaluate criteria?

- Evaluation of criteria will be based on indices that either
  - quantify impacts based on changes in different structural variables
  - score impacts based project specific characteristics provided by the answers to the questionnaire

Principles for selection and specification of indices

- Avoid duplications resulting from a correlation or an overlapping of indicators of the multi-criteria analysis and criteria evaluated in CBA
- Avoid a discrimination of projects because of differences in quality and quantity of information submitted by project promoters
- Account for the fact that analysis is conducted in economic terms and irrespective of any financing arrangements
- Avoid a subjective and potentially discriminatory assessment based on a lack of detailed information that can only be provided by a detailed feasibility study or environmental impact assessment
- Ensure compatibility of criteria with proposed assessment framework

Overview on Multi-Criteria Assessment Methodology

How are weights determined?

- **Analytic hierarchy process (AHP)** is a structured technique for organizing and analysing complex decisions
- Methodology is considered to be particularly efficient whenever investment projects have to be assessed based on different quantifiable and qualitative criteria taking into account various aspects of decision making
- In the context discussed here AHP approach is used to determine weights of identified project assessment criteria by measuring their relative importance
- Basis of the AHP approach is a pairwise comparison of relative importance of a criterion over any other criterion expressed by a numerical rating scale (separately for each technology), which allows comparing the diverse criteria to one another in a rational and consistent way
- By using the eigenvectors, the weights (i.e. the percentages) of each criterion are then calculated.
- Draft weights based on separate application of AHP approach by DNV GL and REKK experts

Scale	Relative Importance
1	Both criteria are equally important
3	Criterion A is slightly more important than criterion B
5	Criterion A is more important than criterion B
7	Criterion A is much more important than criterion B
9	Criterion A is absolutely more important than criterion B

Indicators Assessed Within Multi-Criteria Analysis – Electricity

Net Present Value (NPV) – Result of economic CBA

- Within the economic CBA the change in socio-economic welfare is assessed by the following criteria:
  - **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** related benefits measured by reductions of outages and non-supplied electricity
  - variation of **CO_2 emissions** related to changes in regional electricity production patterns
  - variation of **network losses** related to changing load flow patterns

Indicators Assessed Within Multi-Criteria Analysis – Electricity

Herfindahl-Hirschman-Index (HHI)

- Price reductions caused by an interconnection project may be driven not only by decrease of congestion and introducing sources with lower production costs, but can also occur due to the additional enhancement of competition
- The latter does not affect the production costs, but just transfers monopoly rents (the price-mark-ups over production costs), gained by producers / importers / traders (due to insufficient competition) to consumers
- As the market model used in the CBA assume a competitive market equilibrium, we suggest incorporating an **explicit criterion on enhancement of competition**
- The competition enhancement is approximated with the change of market concentration measured with the **Herfindahl-Hirschman Index (HHI)**
- **Calculation** on country level with and without the project:
  - Defined as the sum of the squares of the market shares in power generation (accounting for interconnection capacities)
  - The higher the value of the index the higher the market power

Indicators Assessed Within Multi-Criteria Analysis – Electricity

System Adequacy Index (SAI)

- Although CBA incorporates some aspects of security of supply, we suggest incorporating an **explicit structural criterion to account for the system adequacy impact** of each proposed electricity infrastructure project, reflecting on flexibility and ability of the system to withstand extreme conditions.
- **Indicator reflects** that overall a new transmission facility can:
  - provide more options for the maintenance of outages
  - increase reserve sharing and firm capacity purchases;
  - provide additional flexibilities for switching and protection arrangements;
  - provide load relief for parallel facilities, especially under outage conditions;
  - decrease the amount of power plants that have to be constructed in the importing region to meet reserve adequacy requirements.
- **Calculation** on country level with and without the project:
  - SAI = (generation capacity + interconnection capacity – system peak demand) / system peak demand
  - The higher the value of the index the higher system security
- Addresses Flexibility, Safety and Security of Supply of Regulation 347/2013

Indicators Assessed Within Multi-Criteria Analysis – Electricity

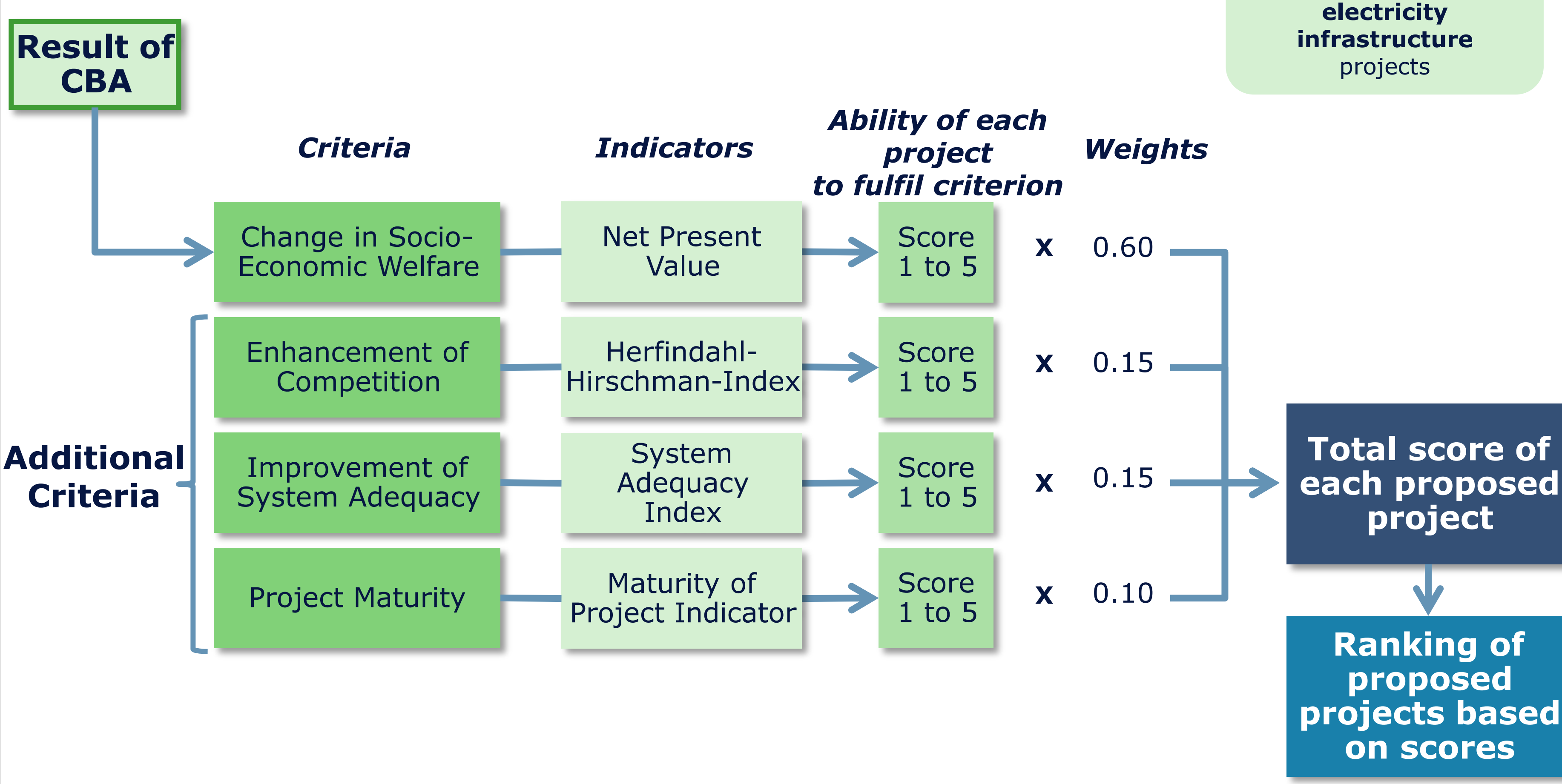
Maturity of Project Indicator (MPI)

- Criterion aims to **test the preliminary implementation potential** and favours projects which have a clear implementation plan and/or have already commenced their preparatory activities
- Since the exact implementation potential related to every single project can only be established with detailed analysis of the project specifics and the legal and regulatory framework in the specific country, the suggested criterion can only provide an early indication based on the information provided in the questionnaires for each project
- Inter-alia the **indicator measures**:
    - progress in realisation (feasibility study, EIA, FID, permits and licences, etc.);
    - length of project realisation;
    - support from government and local authorities (i.e. exemption request decisions or cross-border cost allocation request / decision).
- Data to asses each project under this indicator will be gathered from **online questionnaires**

Overview on Multi-Criteria Assessment Methodology

Multi-Criteria Assessment

Criteria shown here applicable to **electricity infrastructure** projects



Example of Scoring and Ranking for Electricity Projects

Project Name	Indicators (Scores) [Scale 1 (min) to 5 (max)]				Weights				Indicators (Weigthted Scores)				Total Score	Ranking
	Result of the CBA (NPV)	System Adequacy Index	Competition Enhance-ment Index (HHI)	Maturity of Project Indicator	Result of the CBA (NPV)	System Adequacy Index	Competition Enhance-ment Index (HHI)	Maturity of Project Indicator	Result of the CBA (NPV)	System Adequacy Index	Competition Enhance-ment Index (HHI)	Maturity of Project Indicator		
A	5,00	5,00	5,00	2,60	48%	20%	18%	14%	2,40	1,00	0,90	0,36	4,66	**2**
B	3,07	4,51	5,00	1,80	48%	20%	18%	14%	1,47	0,90	0,90	0,25	3,53	**4**
C	2,52	5,00	3,65	1,80	48%	20%	18%	14%	1,21	1,00	0,66	0,25	3,12	**5**
D	3,10	1,11	1,90	1,00	48%	20%	18%	14%	1,49	0,22	0,34	0,14	2,19	**7**
E	3,12	4,51	5,00	2,60	48%	20%	18%	14%	1,50	0,90	0,90	0,36	3,66	**3**
F	3,18	1,96	3,28	1,80	48%	20%	18%	14%	1,53	0,39	0,59	0,25	2,76	**6**
G	5,00	5,00	5,00	3,40	48%	20%	18%	14%	2,40	1,00	0,90	0,48	4,78	**1**
...	...	...	...	...	...	...	...	...	...	...	...	...	...	**...**

Rank	Project Name
1	G
2	A
3	E
4	B
5	C
6	F
7	D
...	...

- The final list will show a relative ranking of all eligible projects (i.e. a comparison of each individual project with the other submitted projects) from an economic point of view (i.e. social welfare for the Energy Community)
- It will not specify whether the difference is large or small and not tell whether the project is commercially attractive for an investor or not

Indicators Assessed Within Multi-Criteria Analysis – Natural Gas

Net Present Value (NPV) – Result of economic CBA

- Within the economic CBA the change in socio-economic welfare is assessed by the following criteria:
  - **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** related benefits measured by the change in economic welfare in the case of a gas supply disturbance
  - variation of **CO_2 emissions** related to changes in gas demand patterns

Indicators Assessed Within Multi-Criteria Analysis – Natural Gas

Import Route Diversification Index (IDI)

- Price reductions caused by an interconnection project may be driven not only by decrease of congestion and introducing sources with lower production costs, but can also occur due to the additional enhancement of competition
- The latter does not affect the production costs, but just transfers monopoly rents (the price-mark-ups over production costs), gained by producers / importers / traders (due to insufficient competition) to consumers
- As the market model used in the CBA assume a competitive market equilibrium, we suggest incorporating an **explicit criterion on enhancement of competition**
- The competition enhancement is approximated with the **Import Route Diversification Index** (IDI), reflecting a simplified competition indicator based on system entry via interconnectors, offshore pipelines and LNG terminals
- **Calculation** on country level with and without the project:
  - Defined as the sum of the squares of the firm technical capacity at each interconnection point, each import point (offshore pipeline) and the firm technical send-out capacity at each LNG terminal
  - The higher the value of the index the higher the market power

Indicators Assessed Within Multi-Criteria Analysis – Natural Gas

System Reliability Index (SRI) – Daily N-1 Security

- Although CBA incorporates some aspects of security of supply measured on monthly basis, we suggest incorporating an **explicit structural criterion on system reliability**
- **Indicator accounts for** the impact of each proposed natural gas infrastructure project on daily operational flexibility and ability of the system to withstand extreme conditions.
- **Calculation** on country level with and without the project:
  - N-1 = (technical capacity + production capacity + max. storage deliverability + max. LNG send-out capacity) – single largest supply capacity / total daily gas demand
  - The higher the value of the index the higher is the contribution of the project to the overall network flexibility

Indicators Assessed Within Multi-Criteria Analysis – Natural Gas

Maturity of Project Indicator (MPI)

- Criterion aims to **test the preliminary implementation potential** and favours projects which have a clear implementation plan and/or have already commenced their preparatory activities
- Since the exact implementation potential related to every single project can only be established with detailed analysis of the project specifics and the legal and regulatory framework in the specific country, the suggested criterion can only provide an early indication based on the information provided in the questionnaires for each project
- Inter-alia the **indicator measures**:
  - progress in realisation (feasibility study, EIA, FID, permits and licences, etc.);
  - length of project realisation;
  - support from government and local authorities (i.e. exemption request decisions or cross-border cost allocation request / decision).
- Data to asses each project under this indicator will be gathered from **online questionnaires**

Overview on Multi-Criteria Assessment Methodology

Multi-Criteria Assessment

Criteria shown here applicable to **natural gas infrastructure** projects

Result of CBA

Additional Criteria

Criteria	*Indicators*	*Ability of each project to fulfil criterion*		*Weights*
Change in Socio-Economic Welfare	Net Present Value	Score 1 to 5	x	0.60
Enhancement of Competition	Import Route Diversification Index	Score 1 to 5	x	0.12
Improvement of System Reliability	System Reliability Index	Score 1 to 5	x	0.18
Project Maturity	Implementation Progress Indicator	Score 1 to 5	x	0.10

Total score of each proposed project

Ranking of proposed projects based on scores

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)

Assessment of Smart Grid Projects

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

Eligibility Criteria

1. Being implemented at a voltage level of 10kV or more
2. Involving at least two Contracting Parties
3. Involves transmission and distribution system operators
4. Covering at least 50,000 users (producers, consumers and prosumers)
5. Focusing on a consumption area of at least 300 GWh/year, of which at least 20% originate from non-dispatchable resources.

Assessment of Smart Grid Projects

Art. 4.2. (c) of Ministerial Decision 2015/09/MC-EnC adopting 347/2013 Regulation

Specific Criteria

1. Integration and involvement of network users with new technical requirements with regard to their electricity supply and demand
2. Efficiency and interoperability of electricity transmission and distribution in day-to-day network operation
3. Network security, system control and quality of supply
4. Optimized planning of future cost-efficient network investments
5. Market functioning and customer services
6. Involvement of users in the management of their energy usage

Next steps

- INPUT DATA CHECK: Please check input data on slides: 32-34 and 52-53 and in case you have objections, send your data for electricity and gas demand forecast and for electricity generation input dataset latest by 4 March 2016 – otherwise data presented here will be used.
- PROJECT DATA CHECK for eligibility and verification: Additional data request will be asked by Consultant from the Project promoters during March.
- Promoters please send additional data to the Consultant as soon as possible, latest in a week after the request.
- Letter of support should be sent for interconnector projects in case the submission occurred from one country only. Investment cost of the other part of the project should be sent to the Consultant at the same time.

Thank you!

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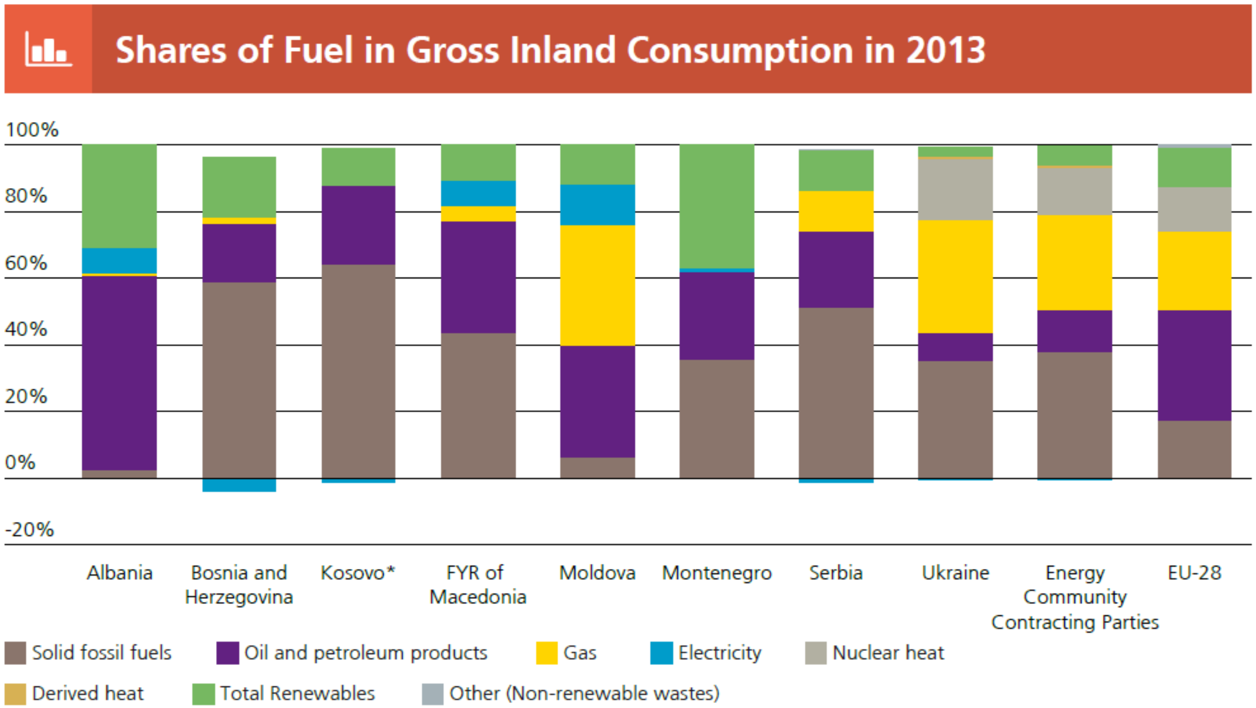
Background of gas in the EC

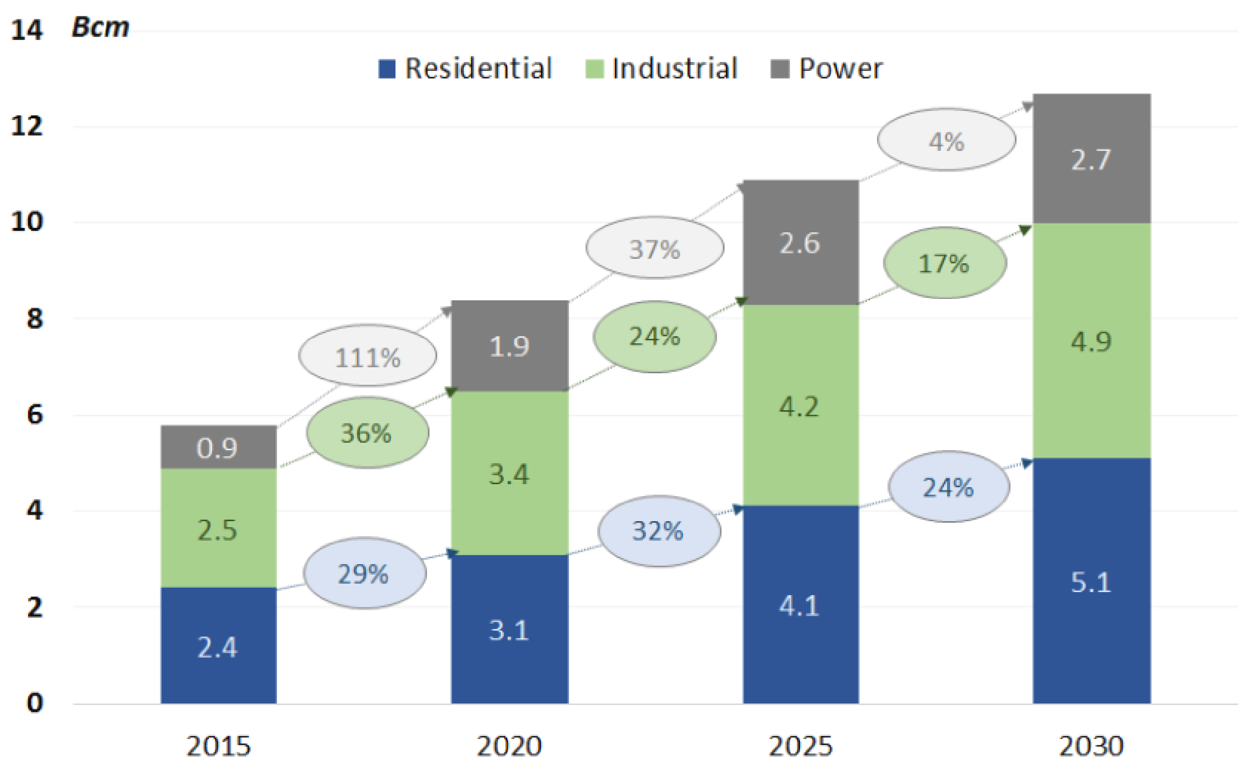


Source: EUROSTAT, Contracting Party national statistical institutes, compiled by the Energy Community Secretariat

- No gas market in 3 out of 8 Contracting Parties: Al, Kosovo*, Montenegro
- Energy island (gas): Serbia, Bosnia, Macedonia,
- Substantial gas consumption: in Moldova, Serbia and in the Ukraine (later declares reduction of gas consumption as a strategic goal)

Gas consumption for the West-Balkan : doubles in 15 years – under certain circumstances…

Figure 15 Total gas demand projection in West Balkan region – Low demand



Source: ECA analysis

Economic Consulting Associates: Gas to Power Study, 2015 downloaded from EnC website