Selection of Projects of Energy Community Interest (PECIs)

2nd Meeting of Electricity and Gas Groups

Presentation REKK / DNV GL

Vienna 08.04.2016

Agenda

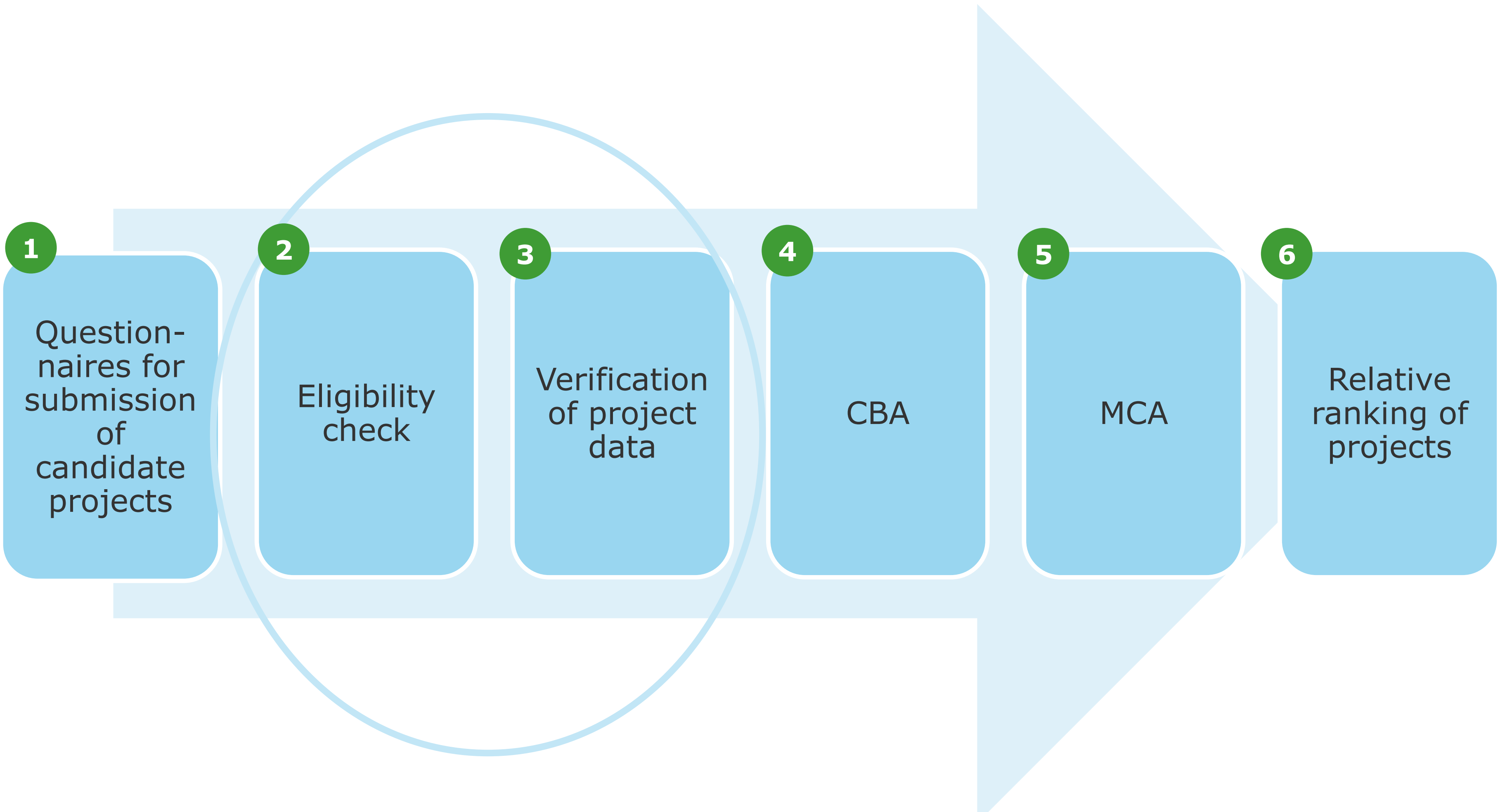
1. Project Timeline
2. Screening of Submitted Project Proposals
   a) Eligibility
   b) Verification
3. Overview on Final Assessment Methodology
4. Overview of Electricity Network Model
5. Cost Benefit Analysis for Electricity

   Specification of reference scenarios and presentation of example project evaluation
6. Cost Benefit Analysis for Natural Gas

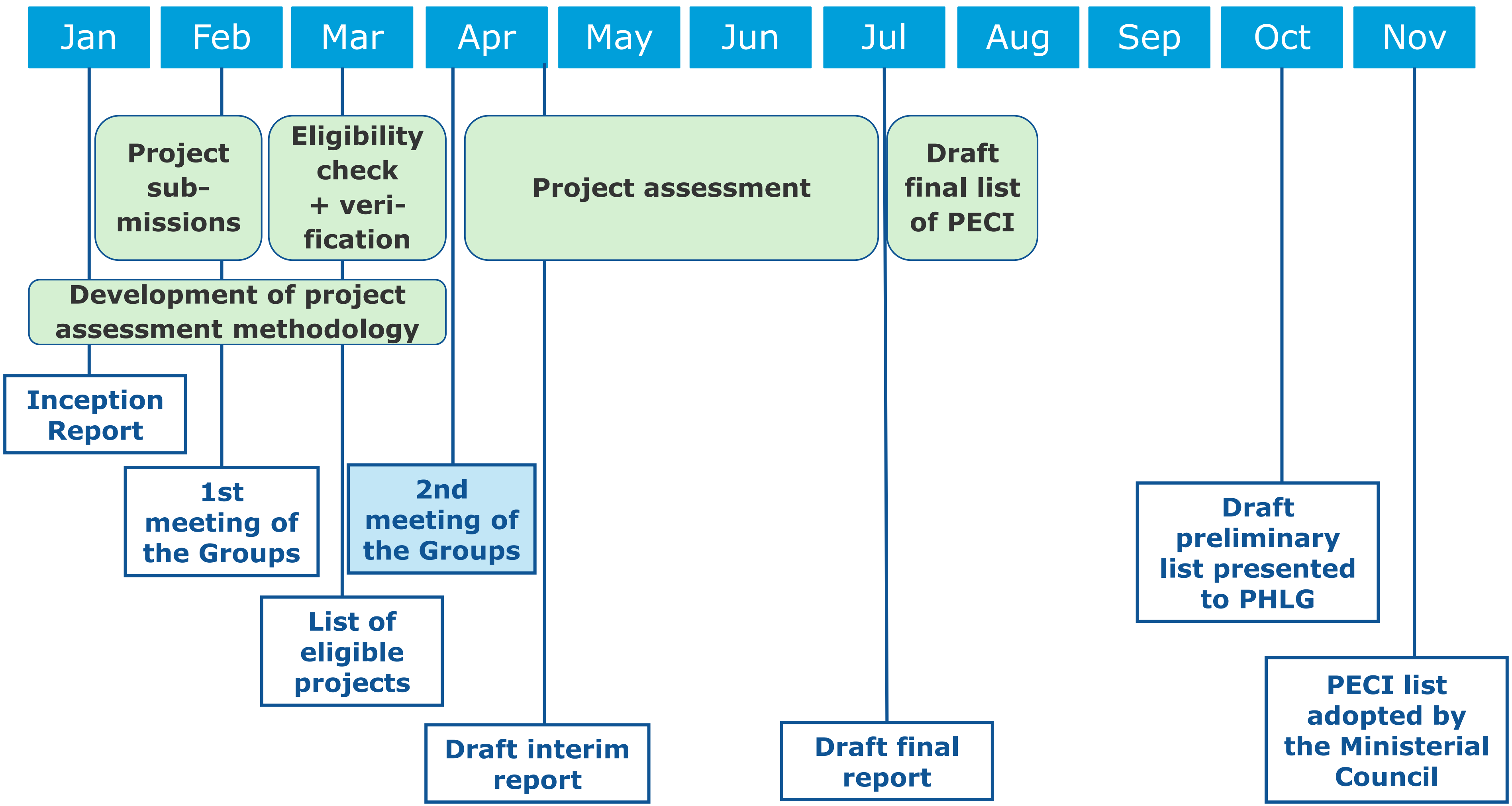
   Specification of reference scenarios and presentation of example project evaluation
7. Multi-criteria Assessment Methodology

   Presentation of example project evaluation

Project Workflow



Project Timetable



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Projects submitted by categories

	Electricity trans-mission	Electricity storage	Gas trans-mission	Gas Storage	LNG	Smart Grid	Oil	Total
Submitted projects	13	0	16	0	1	2	1	33
Eligible projects	10-12?	-	16	-	1	0	1	29
Project data verified by 1 April 2016	9	-	5	-	0	-	1	tbc
Submitted investment cost	Ca.1200 million €		Ca. 2350 million €				490 million €	Ca.4040 million €

- Out of the 33 submitted projects two electricity and two smart grid projects did not meet the criteria of the adopted Regulation
- All gas projects and the only oil project submitted qualified for further evaluation and data verification.
- Submitted investment CAPEX for all projects: 4000 million €, more than half of it goes to gas infrastructure. (For comparison: in 2013 there were 85 projects with a total CAPEX of ca 25.000 million €. Note: electricity generation is not eligible this time, and from Croatia there was only IAP submitted)

Location of Submitted Electricity Projects

Map source: ENTSO-E

Eligibility Check Based on Adopted Regulation (1)

Project code	Project name	Infrastructure	Crossing border of two CPs or MSs	Capacity over 500 MW	Candidate for (PECI/PMI/NO)
el_01	Transbalkan corridor phase 1	☑	☑	☑	PECI
el_02	Transbalkan corridor phase 2, 400 kV OHL Bajina Basta Kraljevo 3	☑	?	?	PECI
el_03	TransBalkan Electricity Corridor, Grid Section in Montenegro	☑	☑	☑	PECI
el_04	Interconnection between Banja Luka (BA) and Lika (HR) with Internal lines between Brinje, Lika, Velebit and Konjsko (HR) including substations	☑	☑	☑	PMI
el_05	Power Interconnection project between Balti (Moldova) and Suceava (Romania)	☑	☑	☑	PMI
el_06	B2B station on OHL 400 kV Vulcanesti (MD) Issacea (RO) and new OHL Vulcanesti (MD) Chisinau (MD)	☑	☑	☑	PMI

Eligibility Check Based on Adopted Regulation (2)

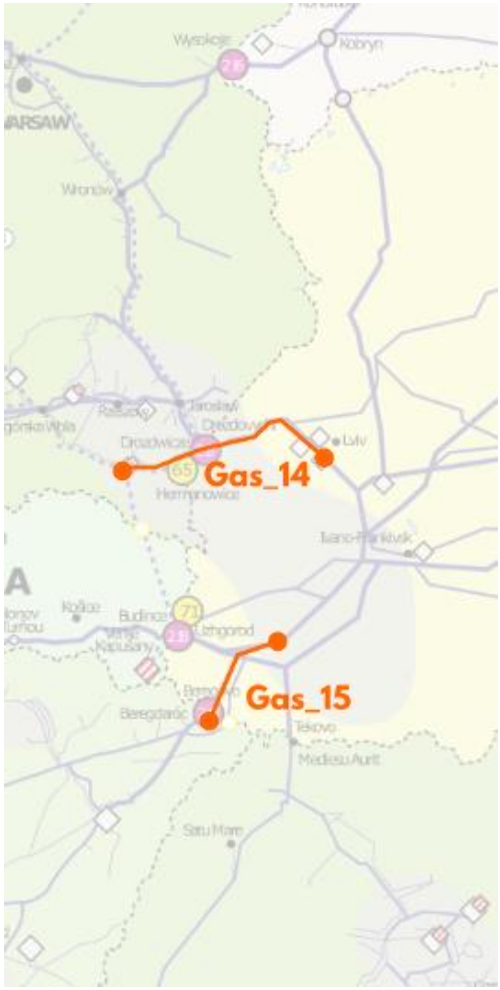
Project code	Project name	Infrastruc-ture	Crossing border of two CPs or MSs	Capacity over 500 MW	Candidate for (PECI/PMI/NO)
el_07	Power Interconnection project between Straseni (Moldova) and Iasi (Romania) with B2B in Straseni (MD)	☑	☑	☑	PMI
el_08	Asynchronous Interconnection of ENTSOE and Ukrainian el. network via 750 kV Khmelnytska NPP (Ukraine) – Rzeszow (Poland) overhead line connection, with HVDC link construction	☑	☑	☑	PMI
el_09	400 kV Mukacheve (Ukraine) – V.Kapusany (Slovakia) OHL rehabilitation	☑	☑	☑	PMI
el_10	750 kV Pivdennoukrainska NPP (Ukraine) – Isaccea (Romania) OHL rehabilitation and modernisation, with 400 kV Primorska – Isaccea OHL construction.	☑	☑	☑	PMI
el_11	400/110 kV Substation Kumanovo	☑	✗	✗	This project is part of a larger cluster of the current TYNDP – not assessed in PECI
el_12	400 kV interconnection Skopje 5 - New Kosovo	☑	☑	?	PECI
el_13	400 kV Interconnection Bitola(MK)-Elbasan(AL)	☑	☑	200-300 MW?	?

Proposal for Merging Projects

- Project el_01: Transbalkan corridor (Serbian Section) phase one should be clustered with el_03 (Transbalkan corridor grid section in Montenegro)
- Project el_02: Transbalkan corridor (Serbian Section) phase two should be analysed as a dependent project on the Transbalkan corridor (el_01) phase one Serbia + Montenegro section (el_03)
- We need confirmation of the project promoters for this approach

Natural Gas

Location of Submitted Gas Projects



Map source: ENTSO-G

Eligibility Check Based on Adopted Regulation (1)

Project code	Project name	From country – to country	Infrastruc-ture type	Crossing border of two CPs + MSs	Reverse flow or capacity increase over 10%	Candidate for (PECI/PMI/NO)
GAS_01	Interconnection pipeline BiH-HR (Slobodnica-Brod-Zenica)	BA-HR	☑	☑	☑	PMI
GAS_02	Interconnection Pipeline BiH HR (Licka JesenicaTrzac-Bosanska Krupa)	BA-HR	☑	☑	☑	PMI
GAS_03	Interconnection Pipeline BiH HR (PloceMostarSarajevo / ZagvozdPosusje Travnik)	BA-HR	☑	☑	☑	PMI
GAS_04	Interconnector of Republic of Macedonia with Bulgaria and Greece	BG-MK	☑	☑	☑	PMI
		GR-MK			☑	PMI
GAS_05	Interconnector of Republic of Macedonia with Kosovo, Albania and Serbia	MK-KO*	☑	☑	☑	PECI
		MK-RS	☑	☑	☑	PECI
		MK-AL	☑	☑	☑	PECI
GAS_06	Infrastructure gas pipeline Skopje Tetovo Gostivar Albanian border	AL-MK	☑	☑	☑	PECI

Eligibility Check Based on Adopted Regulation (2)

Project code	Project name	From country – to country	Infrastruc-ture type	Crossing border of two CPs + MSs	Reverse flow or capacity increase over 10%	Candidate for (PECI/PMI/ NO)
GAS_07	Macedonian part of TESLA project	GR-MK	☑	☑	☑	PECI
		MK-RS	☑	☑	☑	
GAS_08	Interconnector Serbia-Romania	SB-RO	☑	☑	☑	PMI
GAS_09	Gas Interconnector RS-BG - Section on the Serbian territory	BG-RS	☑	☑	☑	PECI
GAS_10	Gas Interconnector Serbia Croatia	HR-RS	☑	☑	☑	PMI
GAS_11	Gas Interconnector RS-FYROM Section on the Serbian territory	RS-MK	☑	☑	☑	PECI
GAS_12	Gas Interconnector RS-FYROM Section Nis (Doljevac) Pristina	RS-KO	☑	☑	☑	PECI
GAS_13	AlbaniaKosovo Gas Pipeline (ALKOGAP)	AL-KO	☑	☑	☑	PECI
GAS_14	Gas Interconnection Poland Ukraine	PL-UA	☑	☑	☑	PMI
GAS_15	Development of the HU to UA firm capacity	HU-UA	☑	☑	☑	PMI
GAS_16	Ionian Adriatic Pipeline	AL-ME	☑	☑	☑	PMI
		ME-HR	☑	☑	☑	
GAS_LNG_17	EAGLE LNG and Pipeline	FSRU-IT	☑	☑	☑	PMI
		AL-IT	☑	☑	☑	

Proposal for Merging/Dividing Projects

- GAS05 should be divided up to three distinctive project for the sake of the analysis:
  - GAS05_KO*
  - GAS05_AL
  - GAS05_RS
- GAS11 includes the Serbian part of the GAS05_RS, these projects we would evaluate jointly
- We need confirmation of the project promoters for this approach

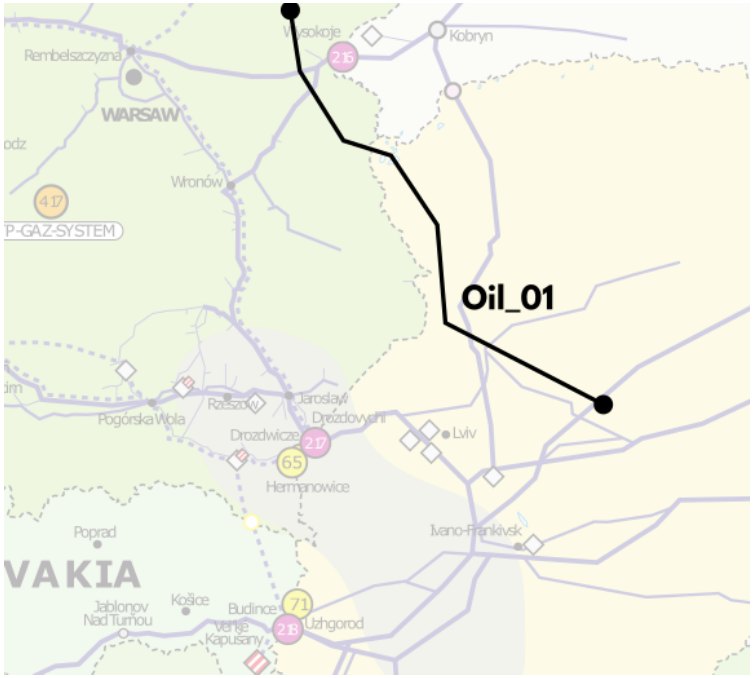
Smart Grid Projects – Eligibility

- Overall two Smart Grid projects submitted for PECI 2016
- Both of them have been found non-eligible with a number of criteria set in Regulation (EU) No 347/2013 (Ministerial Council Decision 2015/09/MC-EnC of 16 October 2015)

Eligibility Criteria	SM_01 (Reduction of Grid Losses EVN MK)	SM_02 (Kosovo Smart Meter Project)
Voltage level(s) (kV) above 10kV	*Mostly 10kV*	35kV and 10(20)kV ✓
Number of users involved more than 50,000	*100,000*	400,000 ✓
Consumption level in the project area equals at least 300 GWh/year	*666 GWh/year*	4,676 GWh/Year ✓
In terms of capacity, share (%) of energy supplied by non-dispatchable resources levels above 20%	N/A ✗	N/A ✗
Involvement of TSOs / DSOs from at least two Contracting Parties	N/A ✗	N/A ✗

Submitted Oil Project – Eligibility (1)

Project code	Project name	Crossing border of two CPs + MSs	Reducing single source dependency (SOS)	Environmen-tal risk mitigation	Interopera-bility	Lifetime (Years)	Letter of intent?
Oil_01	Construction of the Brody Adamowo oil pipeline	☑	☑	☑	☑	20	Joint submission



A pipeline of 396,3 km length (270,6 km in Poland + 125,7 km in Ukraine) connecting the JSC Uktransnafta's Handling Site in Brody (UA) and Adamowo Tank Farm (PL) and with a maximum technical capacity of 10, 20 and 30 million tonnes per year respectively, depending on the three consecutive stages of project implementation.

Submitted Oil Project – Eligibility (2)

- **(a) security of supply reducing single source dependency**. The delivery of Caspian and Central Asian crude oil through the Brody Adamowo pipeline will increase security of oil transportation to the countries along the route (Az-Georgia, UA, PL). It will enhance the diversification of supply routes to the EU and Poland by not relying heavily on receiving crude from a single source in the world.
- **(b) efficient and sustainable use of resources through mitigation of environmental risks** The project contributes to protecting and improving the condition of the natural environment and health by avoiding shipping risks and emissions arising from tanker traffic which would be the transport alternative in case the Brody-Plock pipeline was not realized.
- **(c) interoperability** Brody Adamowo oil pipeline would ensure continuous oil flows to the depending refineries in case of a supply disruption in the conventional supply route. The Project will provide for integration of Ukrainian oil transportation system with Polish and European ones. The Brody Adamowo oil pipeline creates the possibility to transport the crude oil in reverse mode from Baltic Sea to the consumers in Ukraine, Slovakia and Czech Republic.

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Overview on Elements of Verification

PCI 2015

ENTSO-E,/G TYNDP

PECI 2013

Project questionnaire

Submitted by Promoters

National TYNDPs

ACER cost bench-mark

Expert assessm ent

General Steps to Verify Project Data

Verification of technical data

- Length of project, diameter, capacity
- Geographical match

Verification of mutual interest

- Letter of intent of the other hosting country in the project
- Commissioning date

Verification of cost data

- Check if all parts of the projects are included
- Benchmarking of total cost – in a range

Results of Verification – ELECTRICITY Projects

Technical data verification: all projects ☑

Disclaimer: Two project have a commissioning date beyond 2026. There is no problem to evaluate them, however consideration should be given, that the PECI/PMI list will be updated every 2 year, and projects beyond 10 years time could be submitted at a later phase.

Verification of mutual interest:

- Projects El_01,02,03,04 and El_11,12,13 are included into ENTSO-E TYNDP. ☑
- Projects El_05,06,07 are included in the Romanian TYNDP; El_09 is included in the Slovakian TYNDP ☑
- On El_08: the Polish side does not indicate the planned commissioning year „?”
- On El_10 project there is no decision in Romania and in Moldova about the project „?”

Verification of cost data: all projects (except for one) are in range ☑

Verification of Project Data – as of 01.04.2016 (1)

Project code	Project name	Technical data	From-to	Letter of intent	Cost
el_01	Transbalkan corridor phase 1	☑	RO-RS-BA-ME	☑	☑
el_02	Transbalkan corridor phase 2, 400 kV OHL Bajina Basta Kraljevo 3	?	RS	☑	☑
el_03	TransBalkan Electricity Corridor, Grid Section in Montenegro	☑	RS-ME	☑	☑
el_04	Interconnection between Banja Luka (BA) and Lika (HR) with Internal lines between Brinje, Lika, Velebit and Konjsko (HR) including substations	☑	BA-HR	☑	☑
el_05	Power Interconnection project between Balti (Moldova) and Suceava (Romania)	☑	MD-RO	☑	Above range
el_06	B2B station on OHL 400 kV Vulcanesti (MD) Issacea (RO) and new OHL Vulcanesti (MD) Chisinau (MD)	☑	MD-RO	☑	?
el_07	Power Interconnection project between Straseni (Moldova) and Iasi (Romania) with B2B in Straseni (MD)	☑	MD-RO	☑	?

Verification of Project Data – as of 01.04.2016 (2)

Project code	Project name	Technical data	From-to	Letter of intent	Cost
el_08	Asynchronous Interconnection of ENTSOE and Ukrainian electricity network via 750 kV Khmelnytska NPP (Ukraine) – Rzeszow (Poland) overhead line connection, with HVDC link construction	☑	UA-PL	?	☑
el_09	400 kV Mukacheve (Ukraine) – V.Kapusany (Slovakia) OHL rehabilitation	☑	UA-SK	☑	☑
el_10	750 kV Pivdennoukrainska NPP (Ukraine) – Isaccea (Romania) OHL rehabilitation and modernisation, with 400 kV Primorska – Isaccea OHL construction.	☑	UA-RO	?	☑
✗ el_11	✗ 400/110 kV Substation Kumanovo	✗ ☑	✗ M[illegible]	✗ ☑	✗ ☑
✗ el_12	400 kV interconnection Skopje 5 - New Kosovo	?	MK-KO	✗	☑
el_13	400 kV Interconnection Bitola(MK)Elbasan(AL)	☑	MK-AL	☑	☑

Results of Verification – GAS projects

- Joint submissions are rare, but there are a few good examples: e.g. Bosnian projects, IAP, Polish-Ukrainian reverse flow.
- Lots of basic data missing (e.g. on capacity): data request was sent to promoters
- Majority of the interconnector projects were submitted only up to the border: there is a risk of building pipelines that are never commissioned/or only very much delayed
  - Letter of intent from the other hosting party is needed
  - PCI status of the project can be accepted (RS-BG, Macedonian part of the TESLA project) To correctly model Tesla, we will assess the entire project based on PCI 2015.
  - Or if the project is included in the TYNDP of the other hosting country
- Data on planned commissioning date and cost of the other part of the project can come:
  - From the TYNDP of the other hosting party
  - From the other TSO or Ministry (letter of intent)
  - In case there is no cost data, an estimated benchmark cost will be assigned to the other part of the project based on length and diameter of the pipeline

Verification of Project Data – as of 01.04.2016

Project code	Project name	Technical data	From-to	Letter of intent	Cost
GAS_01	Interconnection pipeline BiH-HR (Slobodnica-Brod-Zenica)	☑	BA-HR	☑	☑
GAS_02	Interconnection Pipeline BiH HR (Licka Jesenica-TrzacBosanska Krupa)	☑	BA-HR	☑	☑
GAS_03	Interconnection Pipeline BiH HR (PloceMostar-Sarajevo / ZagvozdPosusje Travnik)	☑	BA-HR	☑	☑
GAS_04	Interconnector of Republic of Macedonia with Bulgaria and Greece	Basic data missing	BG-MK	tbc BG	no cost
			GR-MK	tbc GR	no cost
GAS_05	Interconnector of Republic of Macedonia with Kosovo, Albania and Serbia	Basic data missing	MK-KO*	✗ Not supported*	no cost
			MK-RS	☑	no cost
			MK-AL	tbc AL	no cost
GAS_06	Infrastructure gas pipeline Skopje Tetovo Gostivar Albanian border	☑	AL-MK	tcb AL	Only MK cost submitted
GAS_07	Macedonian part of TESLA project	☑	GR-MK MK-RS	☑	☑
GAS_08	Interconnector Serbia-Romania	☑	RS-RO	Tbc RO	Only RS cost submitted

Project code	Project name	Technical data	From-to	Letter of intent	Cost
GAS_09	Gas Interconnector Serbia Bulgaria - Section on the Serbian territory	☑	BG-RS	☑	Only RS cost submitted
GAS_10	Gas Interconnector Serbia Croatia - Section on the Serbian territory	☑	HR-RS	☑	Only RS cost submitted
GAS_11	Gas Interconnector Serbia FYROM Section on the Serbian territory	☑	RS-MK	Tbc MK	Only RS cost submitted
GAS_12	Gas Interconnector Serbia Montenegro (incl. Kosovo) Section Nis (Doljevac) Pristina	Capacity data missing	RS-KO	✗ Not supported	Only RS cost submitted
GAS_13	AlbaniaKosovo Gas Pipeline (ALKOGAP)	Capacity data missing	AL-KO	☑	☑
GAS_14	Gas Interconnection Poland Ukraine	☑	PL-UA	☑	☑
GAS_15	Development of the HU to UA firm capacity	☑	HU-UA	☑	☑
GAS_16	Ionian Adriatic Pipeline	☑	AL-ME ME-HR	☑	Above range
GAS_LNG_17	EAGLE LNG and Pipeline	☑	LNG_AL AL-IT	☑	only the FSRU part was included into the cost

Verification of Cost Data

2015 indexed unit investment cost of transmission pipelines commissioned in 2014 (average values)

Pipeline diameter	<16"	16-27"	28-35"	36-47"	48-57"
Average unit cost, real 2015 €/km	643 936	746 801	847 966	1 427 041	2 098 567

Source: ACER

- CAPEX cost for gas projects was cross-checked with ACER's *Report On Unit Investment Cost Indicators And Corresponding Reference Values For Electricity And Gas Infrastructure - Gas Infrastructure Annex* 2015 real € investment cost (€/km)
- Some projects failed to provide CAPEX figures. If no CAPEX is provided by (date is to be agreed on), ACER report average cost figures will be used for project evaluation.
- Projects that have submitted CAPEX seems generally to be in line with ACER's cost data, some clarifications are needed
- Project promoters have been contacted for clarification and CAPEX data the answers are handled individually due to the sensitivity of the issue

Verification OIL Project Data

- Project is on the 2015 PCI list
- Planned commissioning: 2020 (2019 on the PCI list, end of 2015 on the 2013 PECI list)
- Length of the project: 396.3 km (371 km on the PCI list)
- Cost of the project: increase of cost submitted now (about 10% compared to PECI 2013)
- Implementation status:
  - updating Feasibility Study (Design and permitting on the PCI list),
  - the project was delayed do to change of external factors
  - Financing gap and land acquisition are the mayor risks

Missing Data – Inconsistency of Submitted Project Data

Missing Data

- Capacity data is missing – the project can not be assessed
- Cost data is missing or is only party submitted – modelling of benefits is possible, however the NPV can not be calculated
  - Submission of data is essential latest by: ……..
  - In case of missing data we could estimate a CAPEX figure, however this could jeopardize the seriousness of the PECI/PMI label
- Proof of the mutual intent should be provided before …..(end of April)

Inconsistent Data

- Capacity: „ENTSO-G: To enable the modelling tool to assess a project, both legal entities on both sides of a border should submit a project with a matching capacity" In the PECI case we are fine with one capacity submitted and will assume that this matches with the other part. Although in case we find inconsistency with national TYNDP, the lesser rule will apply.
- Commissioning date: the later date will apply

Input Data Verification for EEMM Modelling

Electricity demand (in GWh/year)				
	2015	2020	2025	2030
AL	7 842	9 163	10 704	12 399
BA	12 606	13 000	14 000	15 000
KO*	5 570	6 318	9 216	10 484
ME	3 395	3 419	3 870	4 366
MD	5 861	6 567	7 357	8 243
MK	7 491	9 262	10 226	11 290
RS	37 735	36 648	38 600	40 845
UA_E	143 915	160 937	166 292	176 679
UA_W	4 429			

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	1 765	0	0	0	0	2 162	0
KO*	1171	0	0	1,35	0	52,7	0,1
ME	218,5	0	0	0	0	668,27	0
MD	1000	1727	0	1,1	0	64	2,9
MK	736	260	0	37	198	671	20
RS	4 075	416,66	0	10,4	0	3 018	13,35
UA_E	20 069	11 721	13 835	420	0	5 771	395
UA_W	2 334	217	0	7	0	38	19

Planned Fossil-Based and RES Generation Capacities

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	1100	390		300					
KO*	0	0	0	500	0	0	500	0	0
ME	225	0	0	0	0	0	0	0	0
MD	0	0	0	0	0	0	0	0	0
MK	120/-120	30	0	0	150	0	200/-200	420	-198
RS	0	478	0	700	0	0	350	0	0
UA_E	1300	550	0	1000	200	0	0	0	0
UA_W	0	0	0	0	0	0	0	0	0

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	285	65,4	0	10	0	0	232	0	0	0	0	0
KO*	212	0	0	10	0	0	148,65	0	0	10	0	0
ME	54	451,3	0	10	13,5	8	151,2	17,1	21,4	31	10	8
MD	0	0	0	0	0	0	149	124	124	8	8	8
MK	114	26	45	7	8	30	13	50	50	3	5	10
RS	458	100	780	5	90	100	500	0	100	144	69	72
UA_E	1330	2400	0	1 170	0	0	1 600	265	0	165	2000	0
UA_W	0	0	0	0	0	0	0	0	0	0	0	0

Input Data Verification for EGMM

Gas demand TWh/year					source	Note
	2015	2020	2025	2030		
Albania	0	4,9	8,82	11,76	ECA	conditional on new infra
Bosnia	1,66	1,66	8,37	8,92	TYNDP	conditional on new infra
Kosovo*	0	0	3,92	5,88	MED,ERO, KSOTT	conditional on new infra
Montenegro	0	0	0,26	0,4	ECA	conditional on new infra
Moldova	10	11	12	13	REKK	
FYR of Macedonia	1,96	6,61	6,85	6,88	TYNDP	conditional on new infra
Serbia	22	27	30	35	Energy balance 2015	
Ukraine	369	368	371	375	Naftogas	

Gas production TWh/year					source
	2015	2020	2025	2030	
Albania	0	0	0	0	ECA
Bosnia	0	0	0	0	TYNDP
Kosovo*	0	0	0	0	ECA
Montenegro	0	0	0	0	ECA
Moldova	0	0	0	0	REKK
FYR of Macedonia	0	0	0	0	TYNDP
Serbia	5,43	3,72	2,78	1,9	Energy balance 2015
Ukraine	170	170	170	170	Naftogas

No response from: AL

Natural Gas

Gas input data for EGMM

Pipeline	From market	To market	Maximum flow	Transmission fee Entry	Transmission fee Exit
			GWh/d	€/MWh	€/MWh
HU-RS	HU	RS	141	1,06	2,00
RS-BA	RS	BA	16	1,56	2,85
BG-MK	BG	MK	27	1,96	0,90
UA-HU	UA	HU	600	1,25	2,55
HU-UA	HU	UA	0	0,00	0,00
UA-MD	UA	MD	73	2,22	1,95
UA-PL	UA	PL	0	1,28	1,46
PL-UA	PL	UA	45	0,00	0,94
UA-SK	UA	SK	2 288	0,80	2,67
SK-UA	SK	UA	265	0,00	0,63
UA-RO	UA	RO	855	1,45	2,17
RO-MD	RO	MD	67	1,00	1,00
MD-RO	MD	RO	67	1,00	1,00

Storage	Market	Injection	Withdrawal	Working gas capacity
		GWh/d	GWh/d	TWh
Storage_RS	RS	36,3	41,5	4,7

Long term contract with Russia			
	ACQ	Price in 2016 \Q1*	contract expiry
	TWh/year	€/MWh	
Albania	0	0,0	n.a
Bosnia	1,66	28,5	yearly
Kosovo*	0	0,0	n.a
Montenegro	0	0,0	n.a
Moldova	10	17,6	yearly
FYR of Macedonia	1	20,8	yearly
Serbia	up to 50	18,6	2021
Ukraine	60	13,4	yearly

Source for capacity: ENTSO-G,

Source for transmission fee: NRA, REKK calculation

* LTC price for each country is forecased by REKK: calculation is based on national statistical data and World Bank oil price forecast

No respond from: AL

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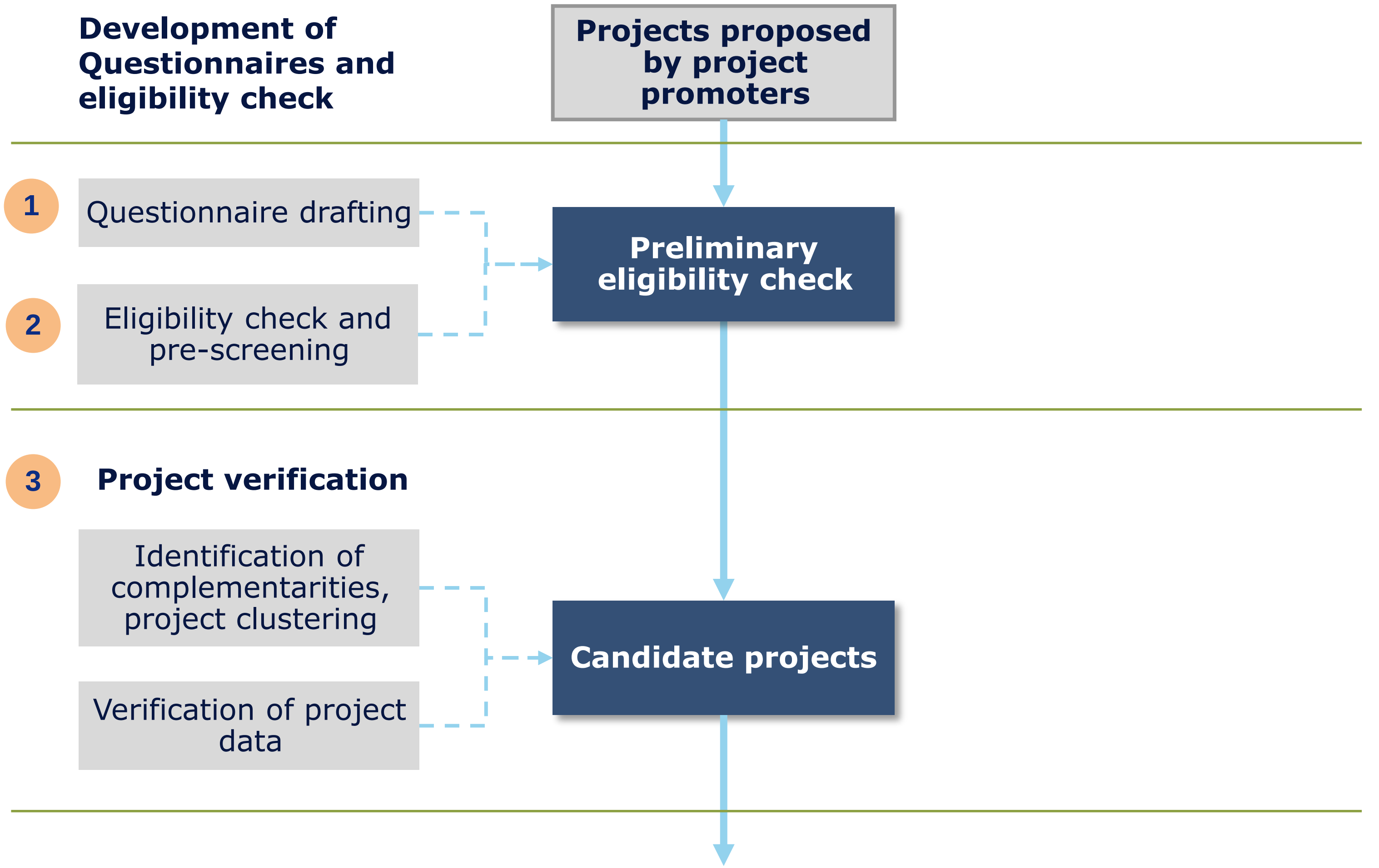
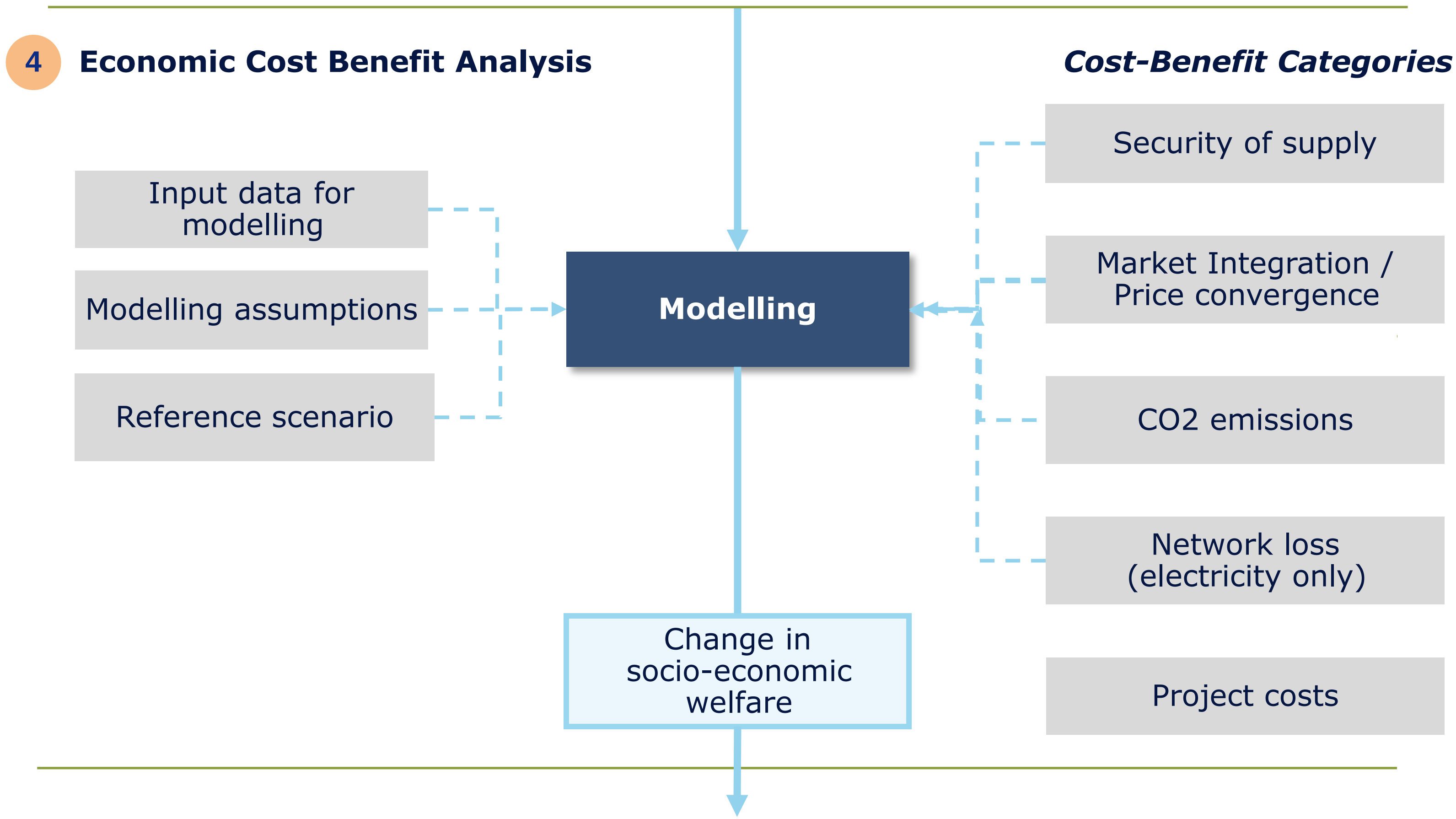
7. Multi-criteria Assessment Methodology
   Presentation of example project evaluation

Overview of the Project Assessment Methodology



Overview of the Project Assessment Methodology



Overview of the Project Assessment Methodology

5 Multi-Criteria Assessment

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

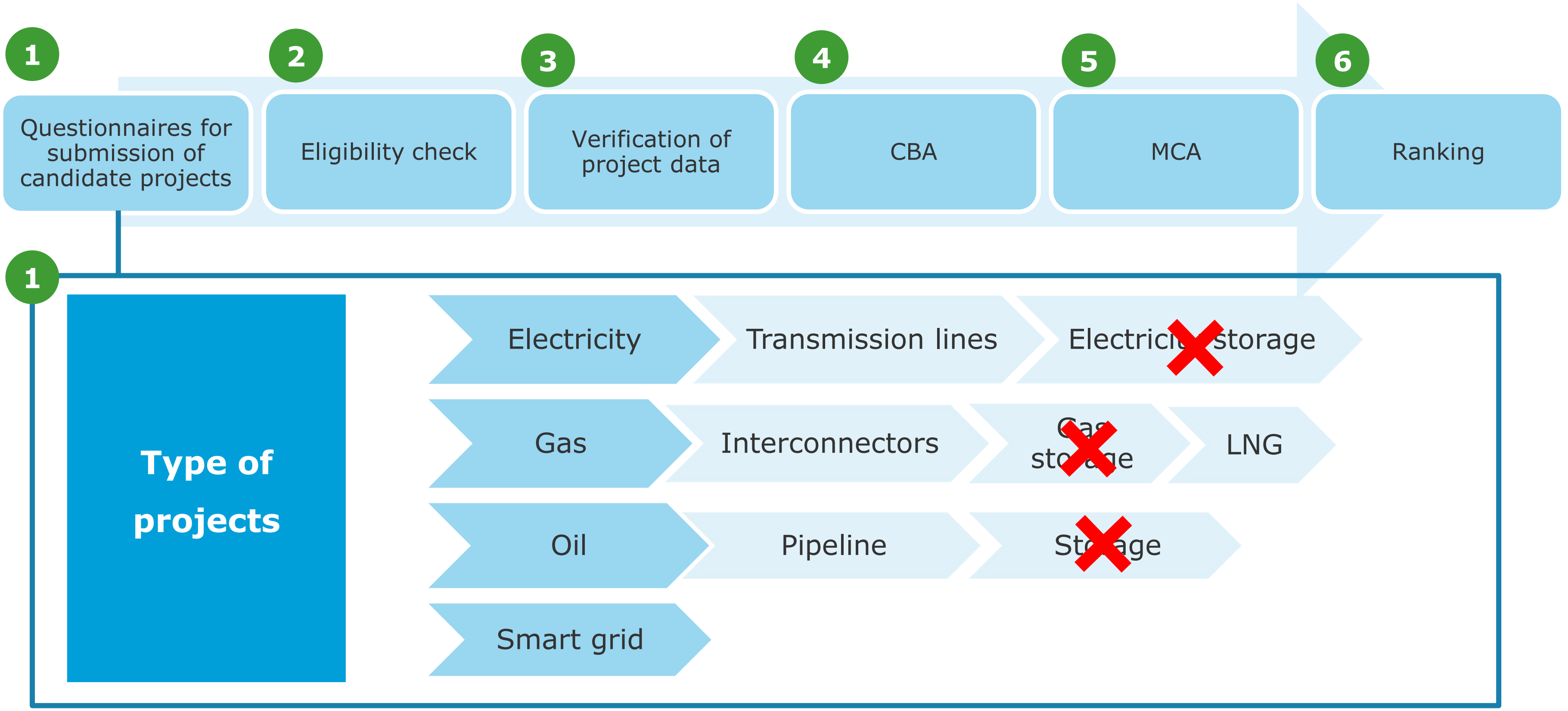
	Criteria	Indicators	Ability of each project to fulfil criterion		Weights
	Result of CBA	Net Present Value	Score 1 to 5	x	0.60
Additional Criteria	Enhancement of competition	Herfindahl-Hirschman-Index	Score 1 to 5	x	0.15
Additional Criteria	Improvement of System Adequacy	System Adequacy Index	Score 1 to 5	x	0.15
Additional Criteria	Project Maturity	Maturity of Project Indicator	Score 1 to 5	x	0.10

Total score of each proposed project

6

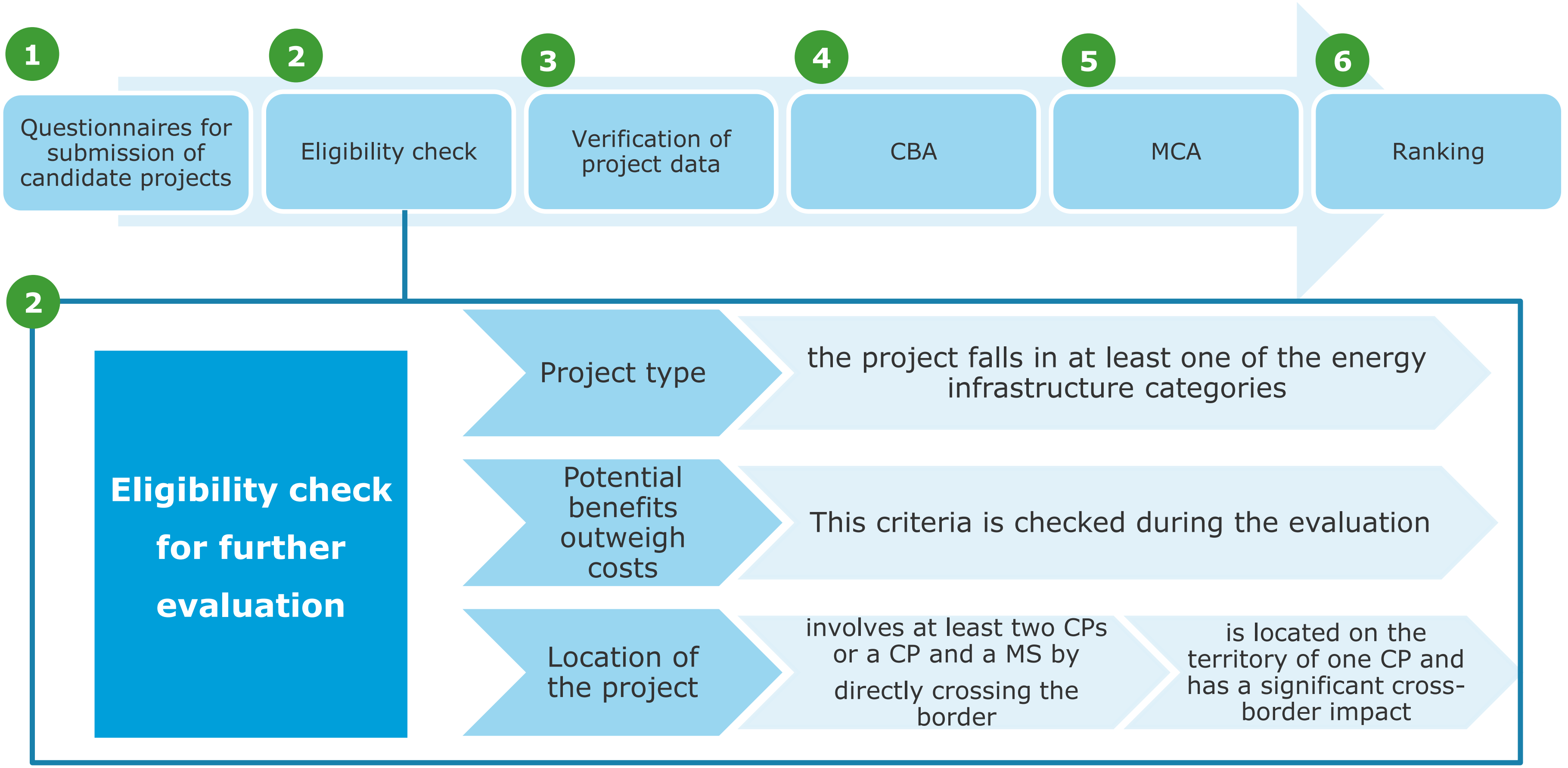
Relative ranking of proposed projects based on individual scores

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

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

3 – Verification of project data

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

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

Step 4 – Cost-Benefit Analysis

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

- Costs and benefits of a project are assessed in the economic analysis by the Net Present Value (NPV)
- 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)

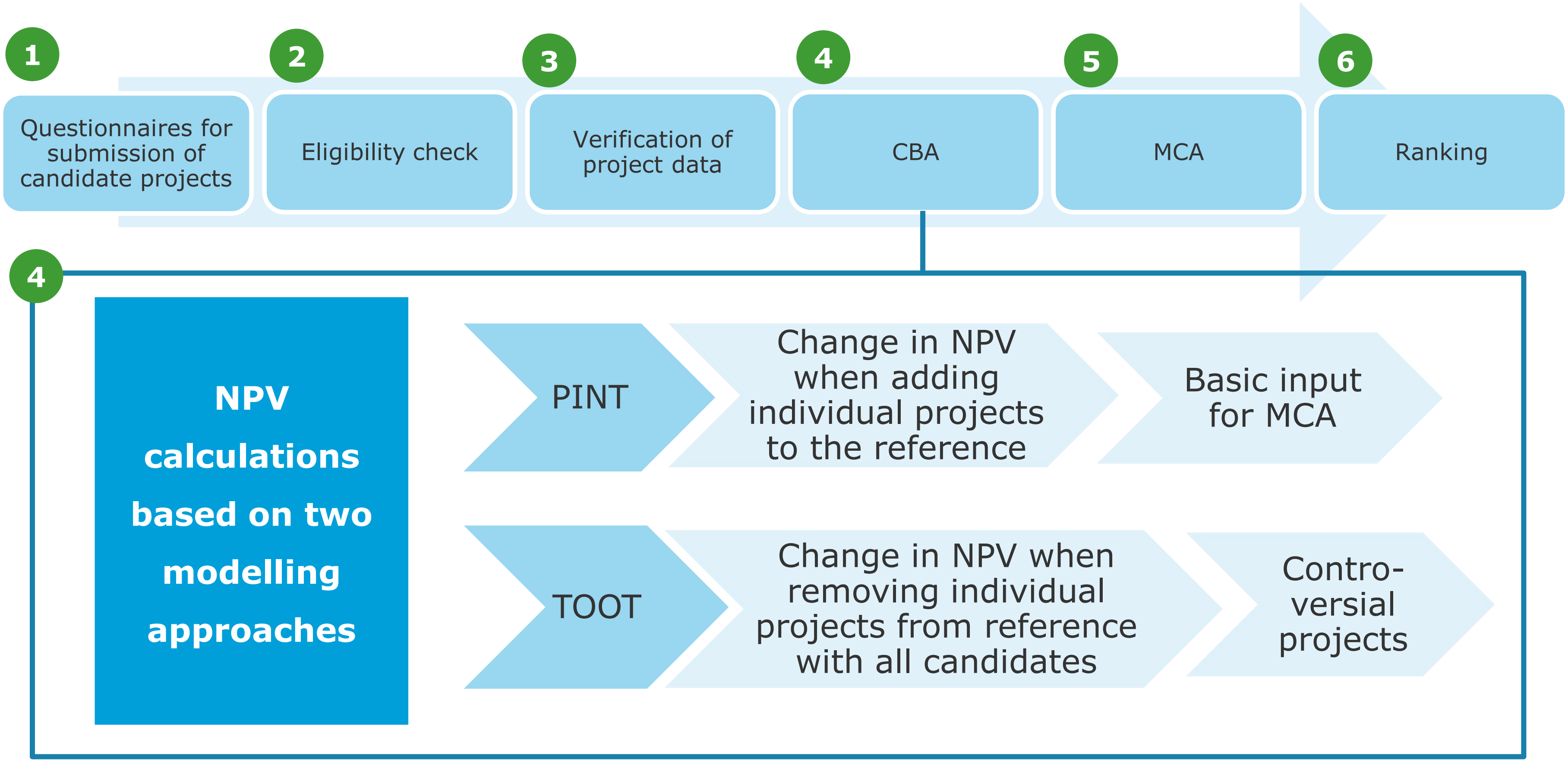
1. Questionnaires for submission of candidate projects
2. Eligibility check
3. Verification of project data
4. CBA
5. MCA
6. Ranking

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

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

6

Relative ranking of projects

- Ranking → Modelling based on PINT → Indicators calculated → MCA
- Indication of controversial projects → Modelling based on TOOT
- Sensitivity analysis → Supporting high level decision making

Open Questions on Methodology from 1st Meeting

- Geographical coverage for the assessment – EnC CPs + neighboring EU MSs
- Application of PINT vs TOOT approach: Which method should be used when evaluating the impacts of the infrastructure elements?
  - TOOT would give results reflecting the ‚marginal' contribution of the given line, as it would be evaluated in an environment, where possible other network elements are already operated in the system and ‚take their market share'.
  - PINT, in opposite would tend to result in higher utilisation of the lines, as other network elements are missing from the network.
  - Our recommendation: use the PINT approach first, as the order and timing of the construction of lines are quite uncertain. But calculate TOOT as well, to check if it changes the ‚order' of the projects. Also, application of both would help to detect competing projects (where TOOT would negatively score them)
- Modell input data:
  - for market modelling – thank you for all your inputs
  - for network modelling – still discussed

Open Questions on Methodology for Electricity

- CO_2 impact evaluation: Shall we include CO_2 taxation for the modelling of EnC region from 2020 on? If yes, the model will endogenize decision on fuel switching, so CO_2 impacts will be included in welfare estimations of the EEMM model. If not, change in CO_2 emissions need to be monetized in an ‚outside of the modelling' ad-hoc calculation (e.g. What carbon price level should be applied?).
  - Our recommendation: Assume a carbon taxation regime after 2020 for the EnC region, so CO_2 impacts are endogenized in the economic modelling.
- Value of Loss Load (VOLL) in monetizing EENS (Expected Energy Not Supplied): What should be the basis for the VOLL calculations – VOLL values from the literature (re-calibrated from other countries, as it is not available for EnC countries) or use the GDP/Electricity consumption value as a proxy for VOLL?
  - Our recommendation: Use the GDP/Electricity consumption value as a proxy for VOLL, as it is region specific and based on more reliable data (e.g. on Eurostat data)

Open Questions on Methodology for Natural Gas

How can we ensure that Russian gas is still possible to reach the region even when Russian LTCs partially expire?

- The problem of Russian gas supplies reaching the region can be addressed by **keeping regional LTCs on their current ACQ** – the strategies of the CPs forecast a huge demand increase parallel to the commissioning of the proposed new infrastructure. This means that the dominance of Russian gas in the region can be challenged in the future by new competing gas sources being available serving new demand.
- Modell allows that further amount of gas can be delivered by Russia either by the flexibility of the contracts (uniform +30%) oil indexed or through Russian deliveries on a TTF price + transportation cost. Other sources will compete with the Russian gas above the current LTC level. This approach allows for an increasing proportion of market priced gas (Russian or other source) in the region when more infrastructure and more demand is present.

Reflections on Comments Received After 1st Meeting

- Input data shall be as good as possible – agree
- Same data should be used as by ENTSO-E modelling: do not necessarily agree, e.g. the demand forecasts and fuel prices might be outdated, the latest forecasts of the respective countries will be used.
- There should be no ranking based on the CBA – in line with the Regulation 347 in the Energy Community the final list will not include any ranking
- The NPV should indicate weather a project is positive or negative for the Energy Community – there are more possible solutions for this:
  - We publish for the Group the NPV results for each project, but we do not publish it in the Final Report
  - We publish to the Group and in the Final Report whether a projects' NPV is clearly negative/ positive/close to zero. This can be reflected in the multi-criteria assessment as well: projects with a negative NPV can score 0 for the CBA…
- We believe that besides the CBA there might be non monetized benefits of the project, and this is why the multi-criteria assessment is a good approach.

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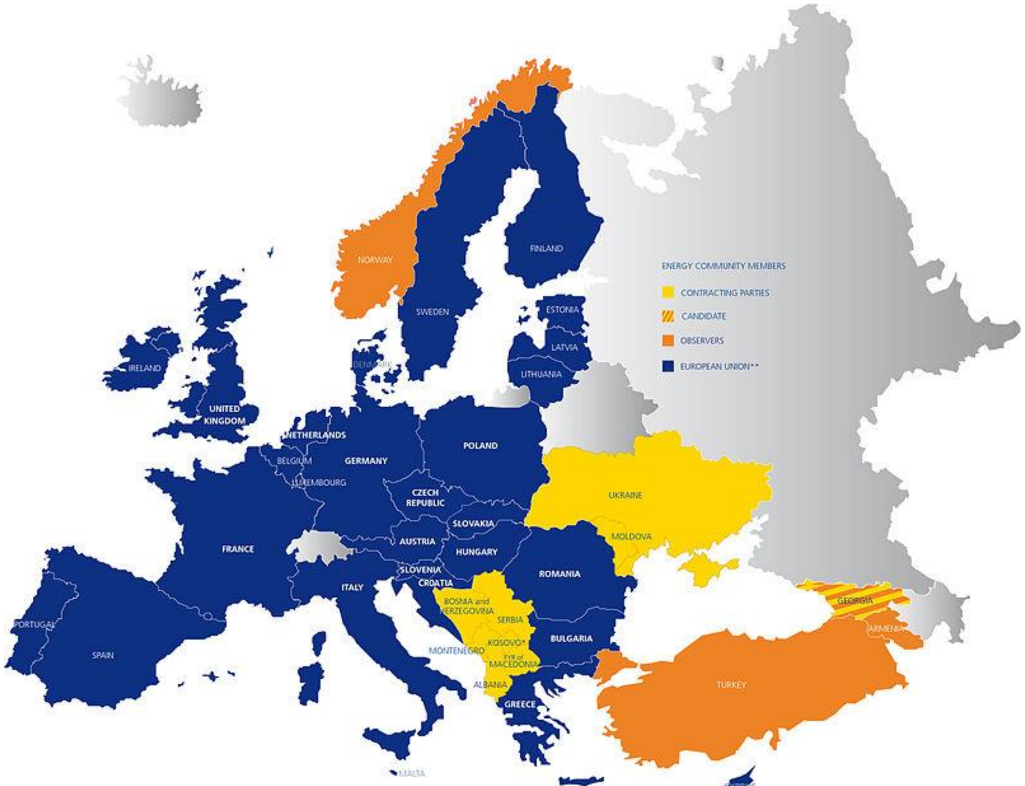
Introduction

- Network Modelling (MANU) team:
  - Two professors
  - Three lecturers
  - Three teaching and research assistants

- Research center for energy and sustainable development – Macedonian academy of sciences and arts (RCESD-MASA)
- Faculty of electrical engineering and information technology – Skopje, Macedonia
- Faculty of computer science and engineering – Skopje, Macedonia

Energy Community Electricity Transmission (EC-ET) model

- Update of the EC-ET model:
  - Albania
  - Bosnia and Herzegovina
  - Bulgaria
  - Croatia
  - Greece
  - Hungary
  - Kosovo*
  - Montenegro
  - Macedonia
  - Romania
  - Serbia
  - Slovenia



* 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.

- Ukraine and Moldova will be added to the model

Input Data

- Input data needed for the model:
  - Generation capacity (electricity production)
  - Demand
  - Characteristics of the transmission network (voltage level: 110kV and up)
- At the moment – detailed network transmission data for 2007, 2008 and 2011 (used only to test the possibilities of the model)

- STILL waiting for updated data
  - official letter sent by the Secretariat asking for the data
  - SECI and Ukraine and Moldova regional projects use PSS/E software
  - .raw format is suitable for us

Characterisation of the Electricity Network Model

- Planning horizon:
  - 2020
  - 2025
  - 2030
- Two methodology will be applied (ENTSO-E uses TOOT in TYNDP):
  - Take Out One at the Time (TOOT)
  - Put In one at the Time (PINT)
- The EC-TC model represents the actual network power flows
- Model Output:
  - Additionally, the following assessments will be obtained:
  - Changes in net transfer capacity (NTC)
  - Changes in non served energy
  - Changes in transmission losses

Criteria – Changes in Transmission Losses

- AC – directly calculated
- DC – approximately calculated:

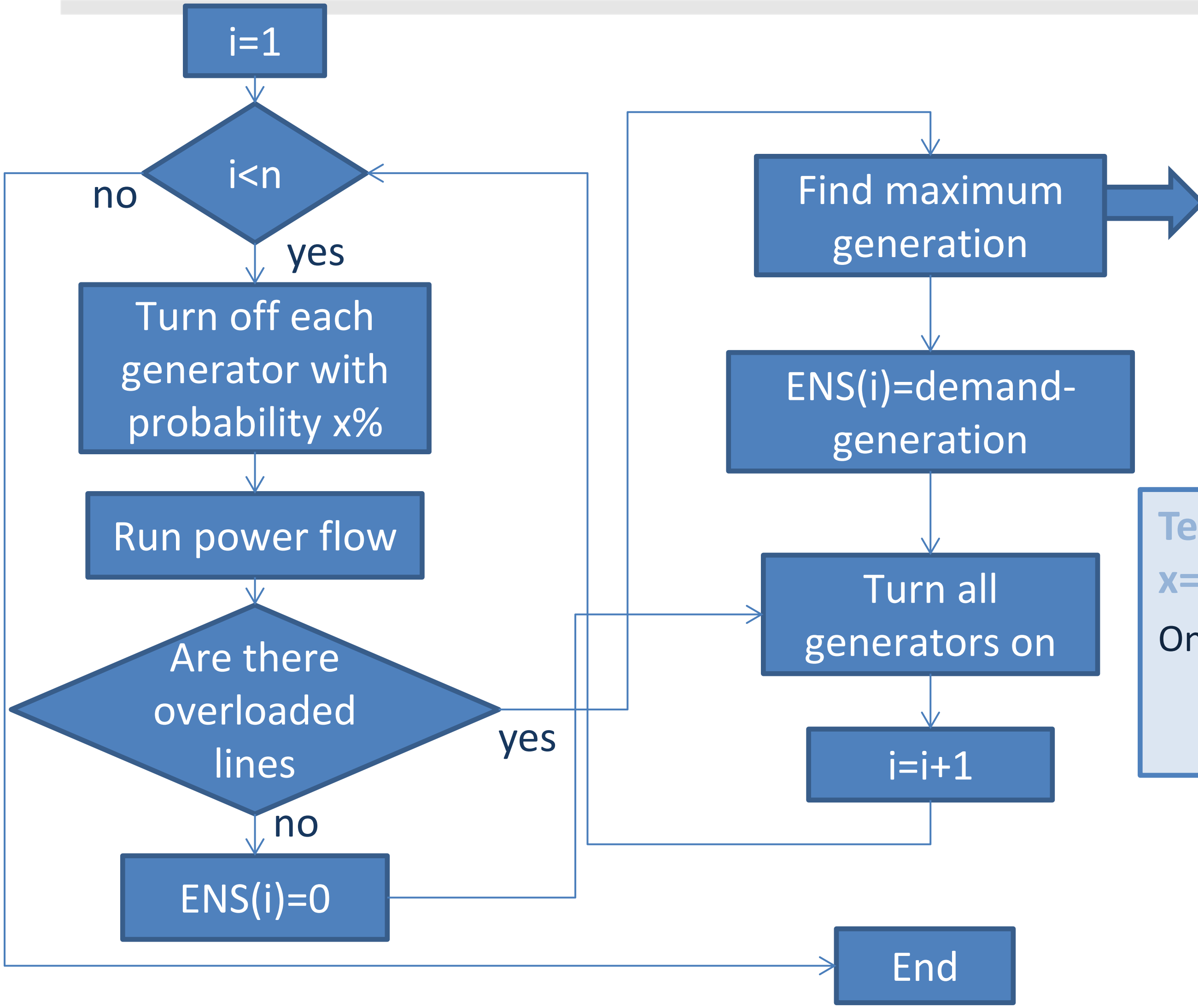
$$Losses = R_{br} * \frac{P_{br}^2}{cos^2\varphi * U^2} \quad where\ U = 1\ p.u. \quad cos\varphi = [0.95 - 0.99]$$

- Example for calculation of transmission losses in SEE network:

  AC model: $losses$ =662.5 MW

  DC model: for $cos\varphi$ [0.95−0.99], $losses$=[690.4MW −662.5MW]

Criteria – Changes in Non Served Energy



LP problem

max generation

subject to

1. network constraints
2. generation capacities limit

Tested for n=2000 cases and x=[1% - 2%]

Only one ENS case = 1660 MW

Criteria – Changes in Net Transfer Capacity (NTC)

- Calculation of NTC between two counties:
  - increase generation in country 1
  - decrease generation in country 2

LP problem

max generation in country 1

subject to

1. Generation from the reference scenario = generation from increasing/decreasing (NTC) scenario
2. network constraints
3. generation capacities limit

- Example for calculation of non served energy
  - Macedonia – Greece 342 MW
  - Greece – Macedonia 420 MW

Conclusion

- Electricity network model suitable for the calculation of
  - Transmission losses
  - Energy not served
  - Net Transfer Capacity

- Model input data to be updated with current data from TSOs

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Description of Electricity Dummy Project (BG-RO new OHL line)

The dummy project: a new 400kV OHL between Romania and Bulgaria

- Capacity: the new OHL increases the NTC by 1000 MW in both directions
- Commissioning year: 2020
- Investment costs:
  - BG: 25 m€ in 2018; 25 m€ in 2019
  - RO: 25 m€ in 2018; 25 m€ in 2019
- Operation cost: 0.5 m€/year in both countries from 2020
- Transmission loss and EENS changes are assumed to be the followings (in the assessment these values will come from the network modelling):
  - Loss change: +100 GWh/year in BG, -50 GWh/year in RO
  - EENS change: 0.3 GWh/year in BG; 0.6 GWh/year in RO
- We assume that ETS will be fully introduced in EnC Countries from 2020 → CO_2 costs are taken into account within the optimization of the market model

Parameters of the Cost-Benefit Analysis

- Components of Net Present Value (NPV) calculation
  - NPV = CS + PS+ Rent + Value of losses +EENS – OPEX - Investment cost
    - 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
    - EENS: Value of Expected Energy Not Supplied change
    - OPEX: Operation and Maintenance cost change due to the project
    - Investment cost: verified investment cost
- When calculating the NPV, we apply the 25 years of assessment period and a residual value of zero are applied → ENTSO-E methodology (assuming the same period length allows comparability)
- 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

TOOT vs. PINT

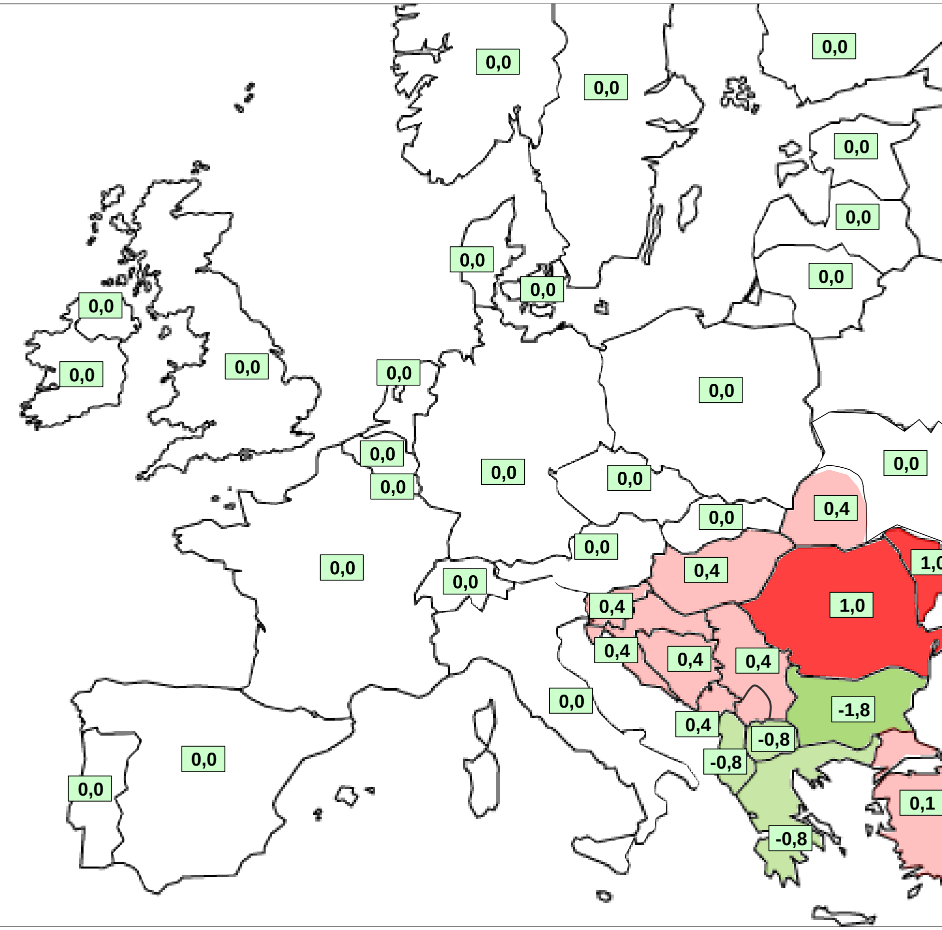
- REF(Pint) scenario includes all infrastructure elements listed in the ENTSO-E TYNDP 2014 except all PECI/PMI candidates
- REF(Toot) scenario includes all infrastructure elements listed in the TYNDP and all PECI/PMI candidates. From this pool PECI/PMI candidates are taken out one-by-one.
- Calculating the change in welfare/prices the following rules are followed:

	PINT	TOOT
Base scenario	REF(Pint)	REF(Toot)
Assessed scenario	REF(Pint) + assessed project	REF(Toot) – assessed project
Calculating the change of the assessed project	Assessed SC - REF(Pint)	REF(Toot) - Assessed SC

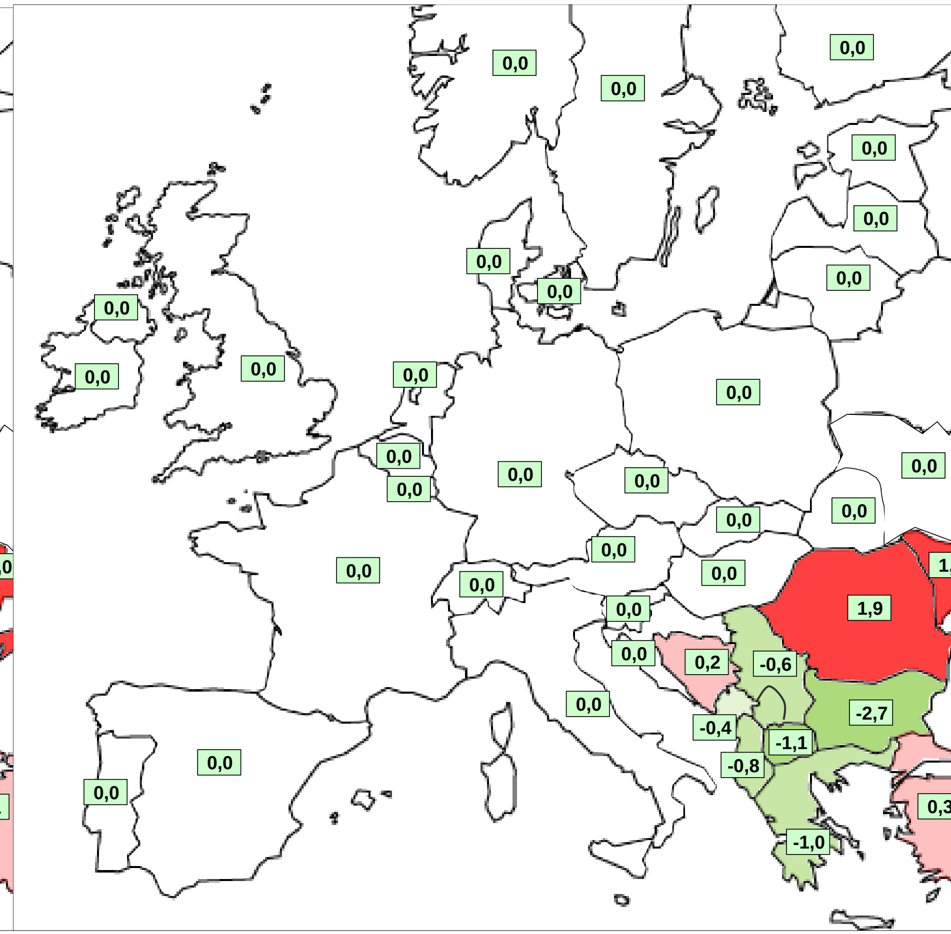
Electricity

EEMM Modelling Results: Price Changes Due to Dummy Project in 2030, €/MWh (TOOT vs PINT approach)

TOOT approach



PINT approach

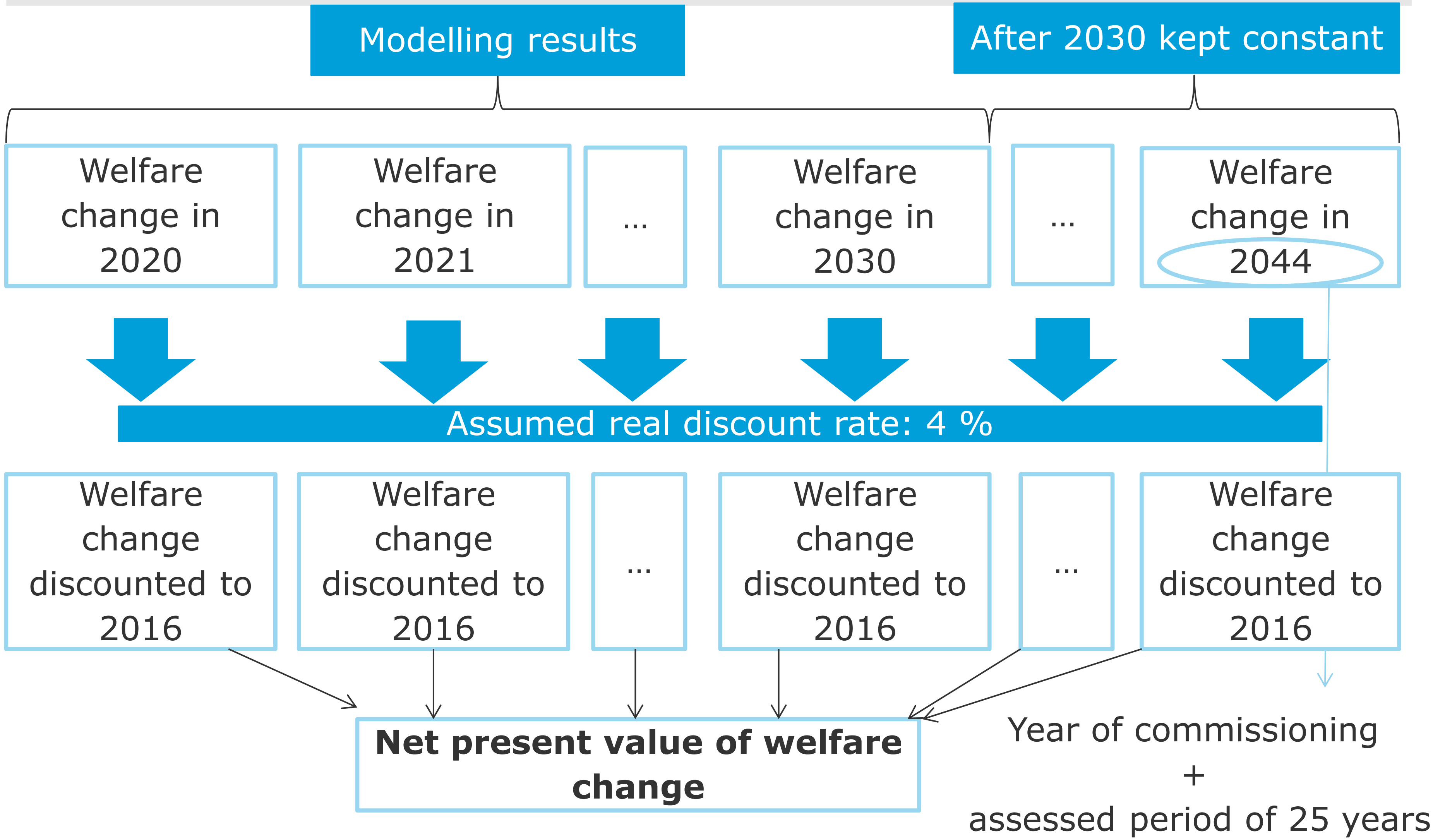


Social Welfare Effects in BG and in RO in TOOT Methodology

- Due to the new OHL, wholesale price increases in Romania and reduces in Bulgaria
- Price reduction in BG results in a consumer welfare gain, but producers loose
- Price increase in RO results in a producer welfare gain, but consumers loose

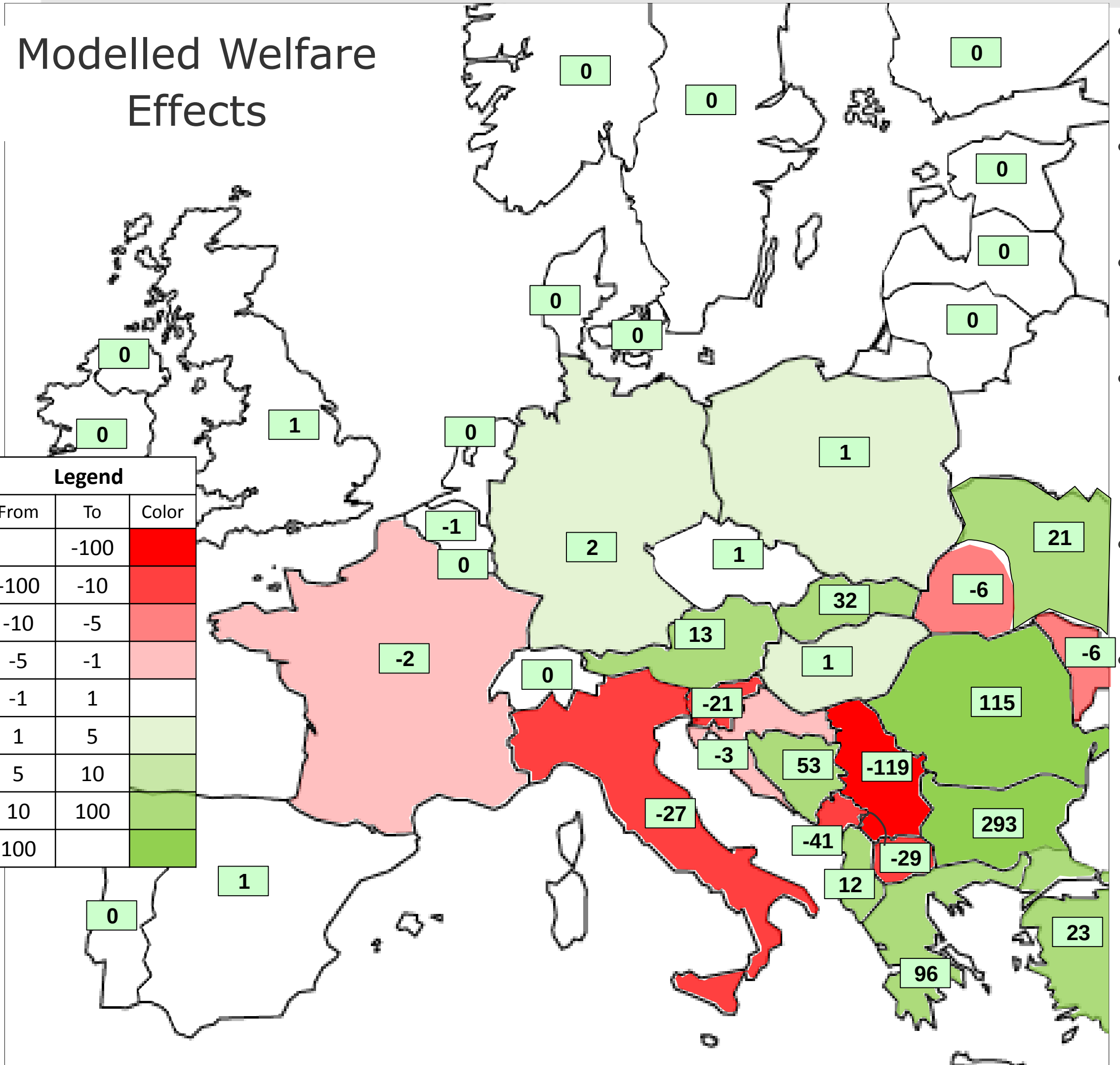
	Unit (M€)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
BG	Consumer welfare change	8.4	14.1	29.6	58.6	153.5	359.6	410.5	65.8	56.1	78.2	75.9
	Producer welfare change	-8.3	-13.8	-27.2	-53.9	-91.4	-187.2	-207.2	-57.3	-49.6	-65.7	-62.7
	Rent change	-0.1	-1.1	-2.8	-6.1	-25.6	-71.7	-84.5	-1.0	1.9	0.8	1.5
	Total social welfare change	**-0.1**	**-0.9**	**-0.3**	**-1.5**	**36.5**	**100.7**	**118.8**	**7.5**	**8.4**	**13.3**	**14.8**
RO	Consumer welfare change	-2.5	-4.4	-14.4	-19.9	-36.6	-46.8	-43.1	-33.5	-29.7	-36.8	-65.8
	Producer welfare change	2.8	5.1	18.7	26.6	50.4	60.6	55.7	42.2	38.1	50.5	85.8
	Rent change	-1.1	-1.9	-4.4	-8.1	-12.0	-30.8	-32.2	-3.4	-0.2	-2.9	-1.0
	Total social welfare change	**-0.7**	**-1.2**	**0.0**	**-1.4**	**1.8**	**-17.1**	**-19.6**	**5.2**	**8.2**	**10.8**	**19.0**

Calculating the Net Present Value of Social Welfare Changes



Net Present Value of Total Social Welfare Changes in TOOT method, M€

Electricity



Legend		
From	To	Color
	-100	
-100	-10	
-10	-5	
-5	-1	
-1	1	
1	5	
5	10	
10	100	
100		

- Total welfare change in modelled countries in **TOOT** method: **407 M€**
- Total welfare change in modelled countries in **PINT** method: **546 M€**
- Total welfare change in **BG+RO** in PINT method: **491 m€**
- Total welfare change in **EnC+Neighbouring** countries in PINT method: **562 M€**
- Total welfare change in **EnC countries** PINT method : **-84 M€**
- **Geographical coverage matters! Recommendation:**
  - **calculation to be based on EnC + neighbouring EU members or**
  - **whole ENTSO-E**

Monetization of Transmission Loss Changes

- Transmission loss change monetization steps:
  - 1. step: Determine the volume of transmission loss changes due to the project -> result of network model
  - 2. step: Calculate the yearly baseload price -> result of the market model, this price serves as a basis for valuing the loss changes
  - 3. step: Calculate the net present value of the yearly cost of transmission loss changes
- 1. step: Assumed transmission change is:
  - +100 GWh/year in BG; -50 GWh/year in RO
- 2. step: Baseload price between 2016-2030 -> result of the model; after 2030 the baseload price will be kept at the 2030 level
- 3. step: Same method as in social welfare change: **NPV=48.5M€**

		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	…	2044
Baseload price, €/MWh	BG	40.3	42.6	47.0	49.3	56.7	61.0	64.7	64.2	67.6	69.9	75.1	…	75.1
	RO	40.1	42.4	46.1	48.2	52.3	54.0	57.4	60.3	62.7	64.1	68.2	…	68.2
Monetization of transmission loss changes, M€	BG	4.0	4.3	4.7	4.9	5.7	6.1	6.5	6.4	6.8	7.0	7.5	…	7.5
	RO	-2.0	-2.1	-2.3	-2.4	-2.6	-2.7	-2.9	-3.0	-3.1	-3.2	-3.4	…	-3.4
	Total	**2.0**	**2.1**	**2.4**	**2.5**	**3.1**	**3.4**	**3.6**	**3.4**	**3.6**	**3.8**	**4.1**	**…**	**4.1**

Monetization of Changes in Energy not Supplied

- **EENS change monetization steps**:
  - 1. step: Determine the volume of EENS due to the project (in MWh) -> result of network model
  - 2. step: Monetize the EENS value by using the average yearly GDP figures of the EnC countries (GDP/electricity consumption, based on Eurostat Unit:€/kWh)
  - 3. step: Calculate the net present value of the yearly cost of EENS changes

Proposed values in calculations:

- 1. step: Assumed EENS change is (it will come from network modelling in the assessment):
  - 0.3 GWh/year in BG; 0.6 GWh/year in RO
- 2. step: ~1.04 € /KWh based on latest Eurostat figures
- 3. step: NPV calculation of benefits over 25 years: **NPV (BG)= 4.33 M€; NPV (RO)= 8.67 M€**

Net Present Value of Investment Cost and OM Cost

- Investment cost:
  - BG: 25 m€ in 2018; 25 m€ in 2019
  - RO: 25 m€ in 2018; 25 m€ in 2019
- The operation cost is 0.5 m€/year in both countries from 2020
- Net present value of investment cost:
  - Discounted each CAPEX value to 2016
  - **NPV** of investment cost is **-90.7 M€ (BG+RO)**
- Net present value of OM cost:
  - OM costs occur between 2020-2044 (assessment period of the project is 25 years)
  - Discounted OPEX costs value to 2016
  - **NPV** of OPEX cost is: **-13.8 M€ (BG+RO)**

Summary of Cost-Benefit Analysis of Dummy Project, M€

		Welfare change				Investment cost	OM cost	Trans. loss change	EENS change	**Total net present value**
		Consumer	Producer	Rent	Subtotal					
Modelled countries	TOOT	-40	850	-403	407	-91	-14	49	13	**364**
	PINT	-221	1305	-538	546	-91	-14	49	13	**503**
EnC + Neighbours	TOOT	746	56	-416	385	-91	-14	49	13	**342**
	PINT	1445	-383	-499	563	-91	-14	49	13	**520**

This NPV value goes into MCA

Main Market Model Assumptions – Fuel Prices

Oil price
- Based on World Bank

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

Year	ARA coal price, €/GJ
2016	1.52
2020	1.85
2025	1.85
2030	1.85

Nuclear
- Taken from literature, but irrelevant (never marginal)

HFO, LFO
- Indexed to crude oil price

CO_2 price
- By 2030 CO2 price will increase to 22 €/t according to Impact Assessment of Climate and Energy Package in 2014

Year	CO2 price, €/t
2016	4.10
2020	9.21
2025	15.61
2030	22.00

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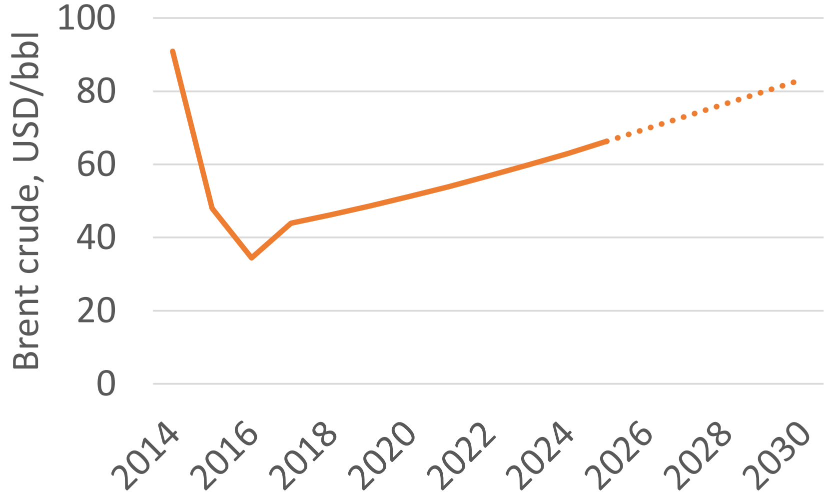
Detailed Assumptions of Reference Scenarios

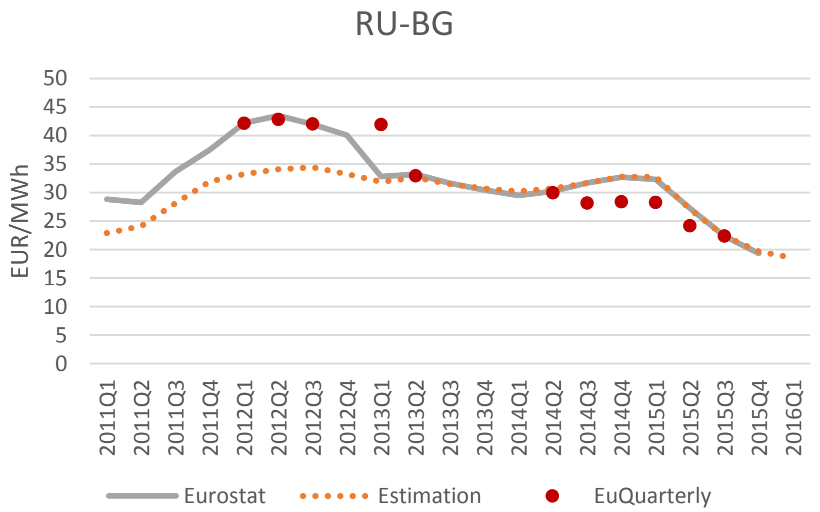
- A reference case is set up for each year in the 2016-2030 period
- 2016 reference is calibrated on the 2015 actual natural gas flows, gas consumption and production reported by ENTSOG, EUROSTAT and IEA
- Price levels were set to reflect 2015 and 2016 price developments of European gas market
- Forecasts of price are based on the Brent forecast of World Bank to 2025
- For the period 2025-2030, same growth rate is assumed as in 2020-2025 period
- Long term contracts and TTF is set to the oil price scenario

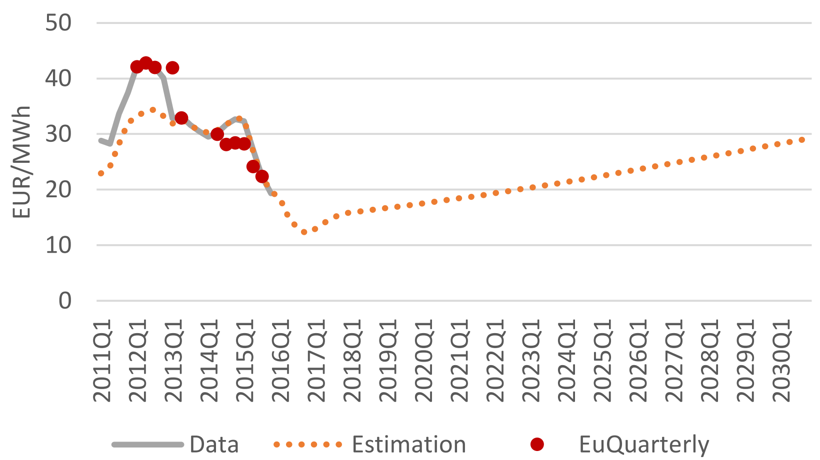


Source: World Bank Commodities price forecast, 01.20.2016. and for 2025-2030 REKK

Example: Long term Contract Estimation for Bulgaria

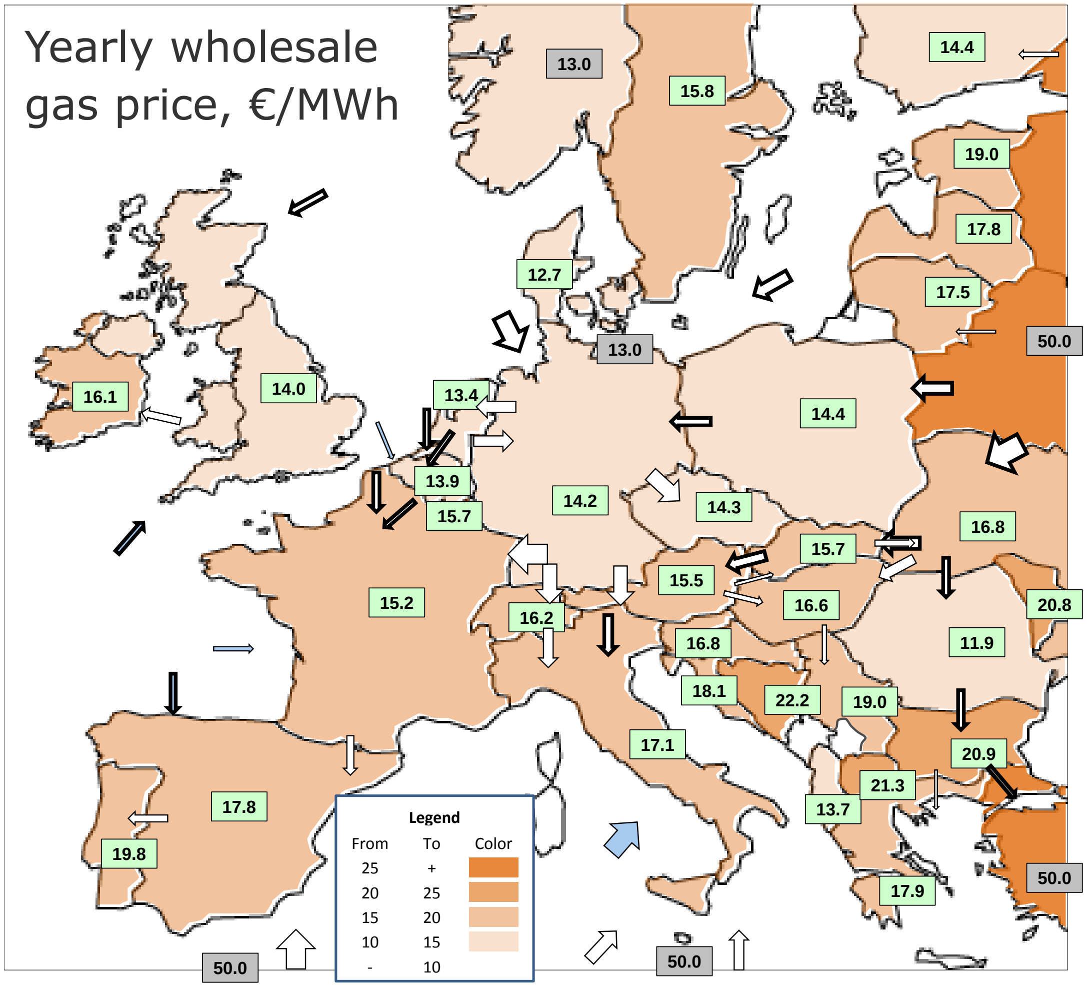
- Contracts in the region are assumed to be 100% oil indexed
- A simple OLS estimation establishes the connection of Brent crude and oil-indexed gas price at the border
- Data for estimation is collected from Eurostat or national statistical agencies foreign trade databases
  - Gaseous state natural gas import volumes form Russia
  - Gaseous state natural gas import value in € form Russia





Validation of the 2016 Reference

Yearly wholesale gas price, €/MWh



- Prices are in line with 2016Q1 price levels (as reported by Eurostat and national statistics)
- 90% of the modelled flows is in line with reported flows for 2015 (for those where data is available)
- Outside market supply reflects 2015 Eurostat data
- Flows, production and consumption levels cross-checked with Eurostat, ENTSO-G, IEA gas trade flows in Europe

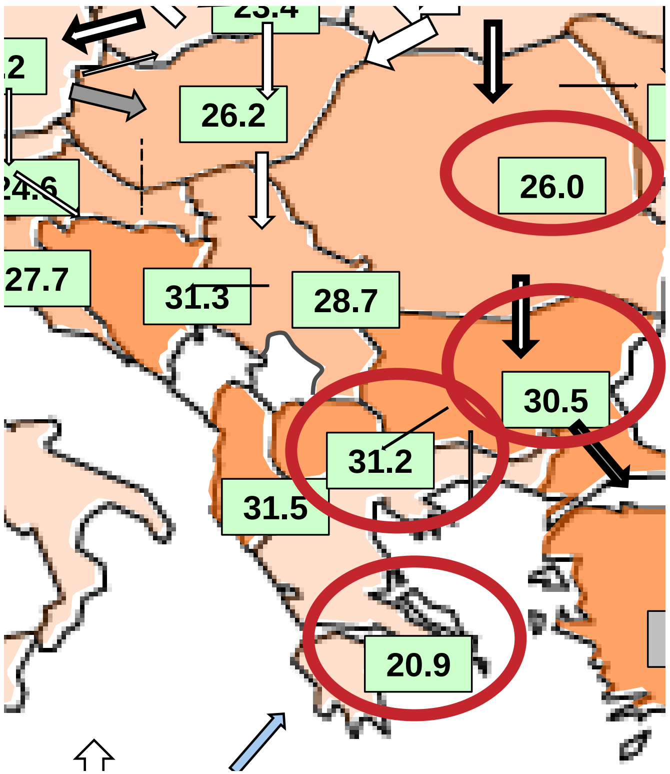
Main Assumptions for Modelling and Data Source

Input type	Data source 2016 reference	Forecast
Pipeline infrastructure	ENTSOG 2015	ENTSOG TYNDP
LNG infrastructure	ENTSOG 2015	ENTSOG TYNDP
UGS infrastructure	ENTSOG 2015	ENTSOG TYNDP
Long term contracts	REKK data collection, based on CEDIGAZ	LTCs re-contracted at the same ACQ
Production	Eurostat	ENTSOG TYNDP and Project Promoters
Consumption	Eurostat	ENTSOG TYNDP and Project Promoters

Illustration Only Example: New Interconnector BG-GR in 2020

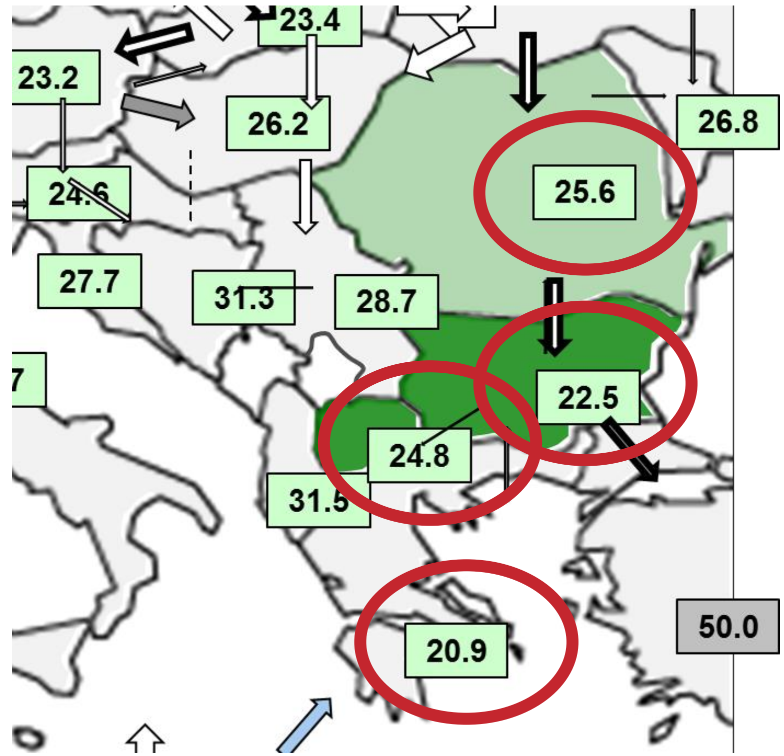
Gas wholesale price (€/MWh)

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

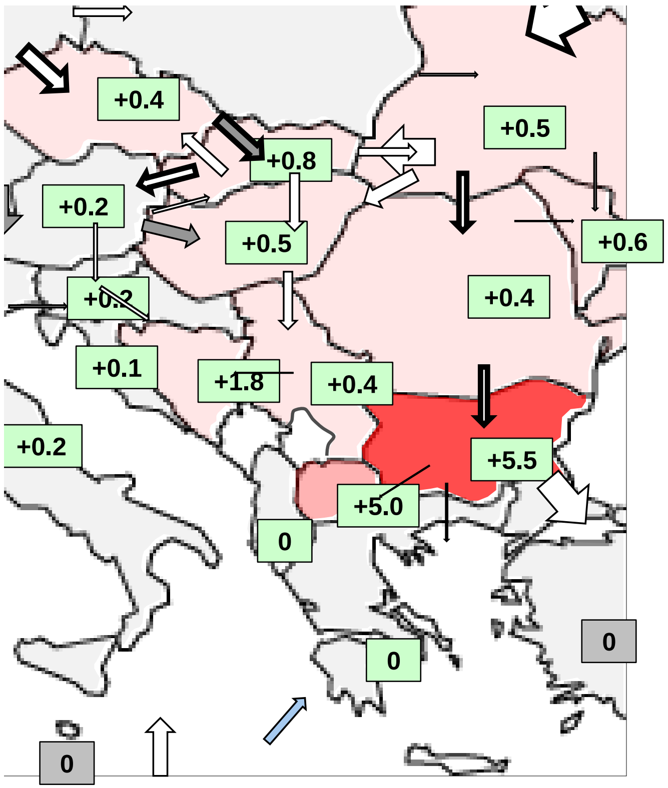
GR-BG Interconnector Welfare Change Effects

	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

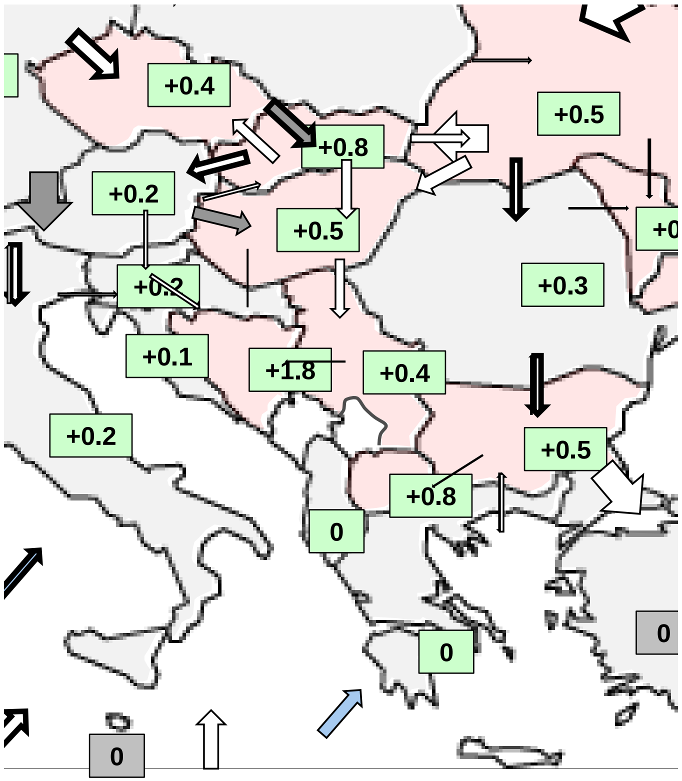
- **BG:**
  - Consumer surplus surges due to lower prices (price drop from 30.5€/MWh to 22.5€/MWh)
  - Producer surplus and LTC holder profit drops, since the domestic production can be marketed at a lower price
  - TSO operating profits increase due to higher flows on the newly commissioned pipeline
- **GR**
  - TSO profits and LNG terminal operator profits increase, due to higher utilisation of infrastructure

Impacts on Security of Supply

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									

TOOT vs. PINT

- REF(Pint) scenario includes all infrastructure elements of the current gas infrastructure + FID projects (investments into gas infrastructure is more uncertain/implementations are delayed)
- REF(Toot) scenario includes all infrastructure elements of Ref (Pint) and all PECI/PMI candidates. From this pool PECI/PMI candidates are taken out one-by-one.
- Calculating the change in welfare/prices the following rules are followed:

	PINT	TOOT
Base scenario	REF(Pint)	REF(Toot)
Assessed scenario	REF(Pint) + assessed project	REF(Toot) – assessed project
Calculating the change of the assessed project	Assessed SC - REF(Pint)	REF(Toot) - Assessed SC

Agenda

1. Project Timeline
2. Screening of Submitted Project Proposals
   a) Eligibility
   b) Verification
3. Overview on Final Assessment Methodology
4. Cost Benefit Analysis for Electricity

   Specification of reference scenarios and presentation of dummy project evaluation
5. Cost Benefit Analysis for Natural Gas

   Specification of reference scenarios and presentation of dummy project evaluation
6. Multi-criteria Assessment Methodology

   Presentation of dummy project evaluation

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 (transmission, storage, LNG)

Market integration	Security of supply	Sustainability	Competition	Maturity

Indicators Assessed Within Multi-Criteria Analysis

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

Herfindahl-Hirschman-Index (HHI)

Reasoning	▪ Interconnection projects may enhance wholesale competition by providing access to generation capacities from alternative power producers ▪ Transfer of monopoly rents (i.e. price-mark-ups over production costs) gained by producers / importers / traders to consumers ▪ Market model (used in CBA) assumes competitive market equilibrium
Indicator	▪ Enhancement of competition approximated by explicit criterion on change of market concentration ▪ Herfindahl-Hirschman-Index (HHI)
Calculation	▪ Defined as sum of the squared market shares in power generation (accounting for interconnection capacities) ▪ Calculated with and without the project as average for countries on each end of interconnector ▪ The higher the value of the index the higher the market concentration ▪ Score calculated by linear interpolation between min and max values of the change of the indicator of all eligible projects

Indicators Assessed Within Multi-Criteria Analysis

System Adequacy Index (SAI)

Reasoning	▪ CBA incorporates only some aspects of security of supply ▪ Additional indicator to account for system adequacy impact of each proposed electricity infrastructure project, reflecting on flexibility and ability of system to withstand extreme conditions
Indicator	▪ Enhancement of system flexibility approximated by simplified indicator for system adequacy based on generation and interconnection capacities and system peak demand ▪ System Adequacy Index (SAI)
Calculation	▪ SAI = (generation capacity + interconnection capacity – system peak demand) / system peak demand ▪ Calculated with and without the project as average for countries on each end of interconnector ▪ The higher the value of the index the higher system security ▪ Score calculated by linear interpolation between min and max values of the change of the indicator of all eligible projects

Indicators Assessed Within Multi-Criteria Analysis

Maturity of Project Indicator (MPI)

Reasoning	▪ Criterion aims to test preliminary implementation potential ▪ Favours projects which have a clear implementation plan and/or have already commenced their preparatory activities
Indicator	▪ Exact implementation potential of individual project would require detailed study of project specifics and legal and regulatory framework in the specific country ▪ Indicator based on information provided in questionnaires for each project relating to steps already undertaken at time of submission
Calculation	▪ Data to asses each project taken from online questionnaires ▪ Scores assigned to steps already undertaken ranging from consideration phase (1 point) to commissioning (5 points)

Indicators Assessed Within Multi-Criteria Analysis

Maturity of Project Indicator (MPI)

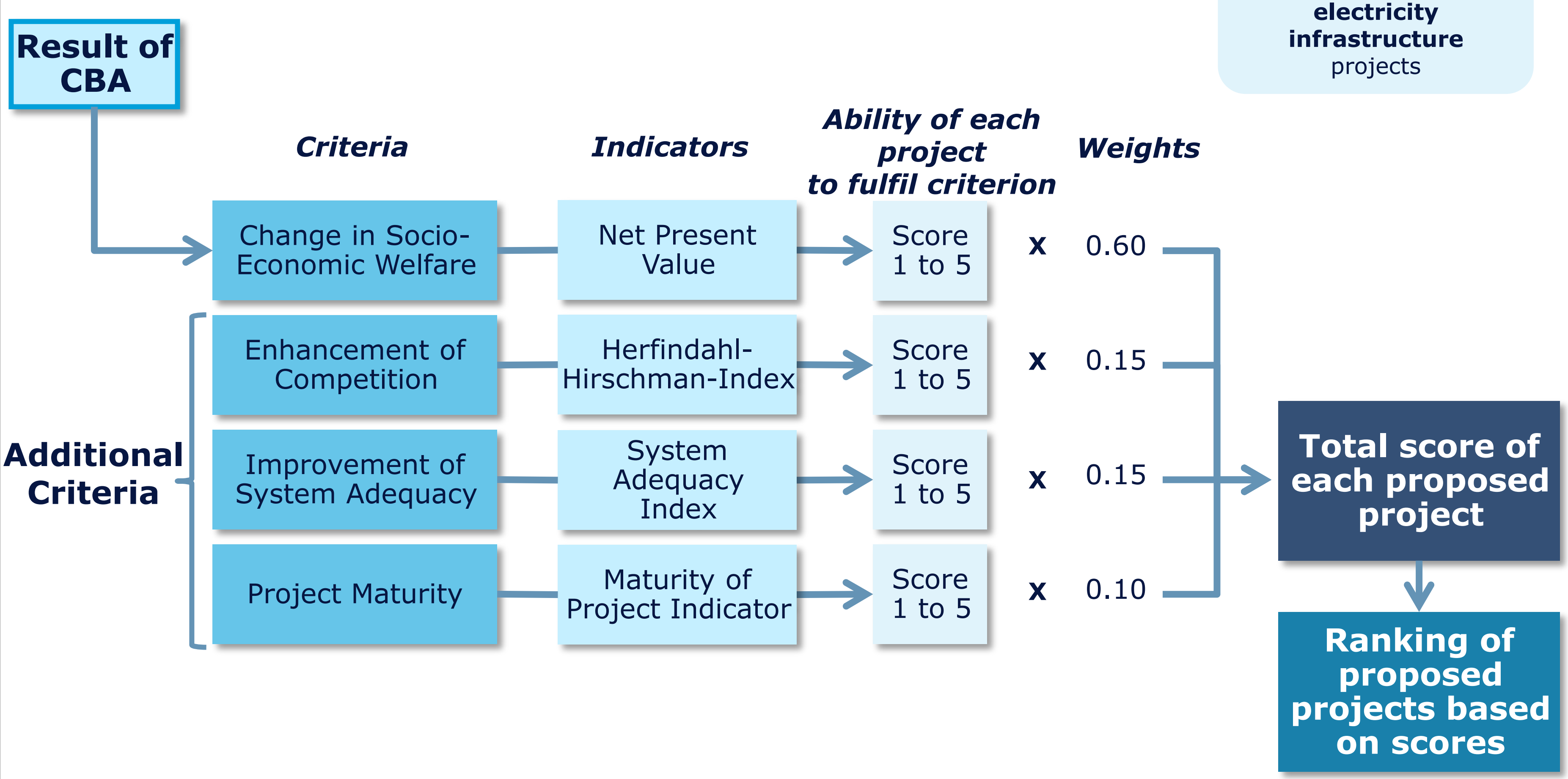
- Scores for each step already undertaken are equally distributed between all project phases
- Where project maturity is significantly different on each side of a border, progress of least developed part will be applied for calculation

Final ranking	Score
Consideration phase	1,00
Planning approval	1,36
Preliminary design studies	1,73
Market test	2,09
Preliminary investment decision	2,45
Public consultation of Art. 9	2,82
Permitting	3,18
Financing secured	3,55
Final investment decision	3,91
Tendering	4,27
Construction	4,64
Commissioning	5,00

Overview on Multi-Criteria Assessment Methodology

Multi-Criteria Assessment

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



Dummy Project Example – Interconnector OHL Bulgaria - Romania

HHI (Herfindahl-Hirschman-Index) – Bulgaria impact

- Generator A: 4398 (56%)
- Generator B: 216 (3%)
- Generator C: 151 (2%)
- Generator D: 344 (4%)
- Generator E: 2030 (26%)
- NTC RO – BG: 175 (2%)
- NTC MK – BG: 100 (1%)
- NTC RS – BG: 116 (1%)
- NTC GR – BG: 331 (4%)
- **HHI without project:** (56%²+3%²+2%²[…]+4%²)= 0.3854
- New Interconnection capacity: 722+**500** = 1222
- **HHI with the project**: (53%²+3%²+2%²[…]+4%²+6%²)= 0.3442
- **Project impact on Bulgaria**: 0.3854–0.3442=0.0412

Total Interconnection Capacity 1222

Above calculation only illustrates the methodology, it does not represent an actual assessment.

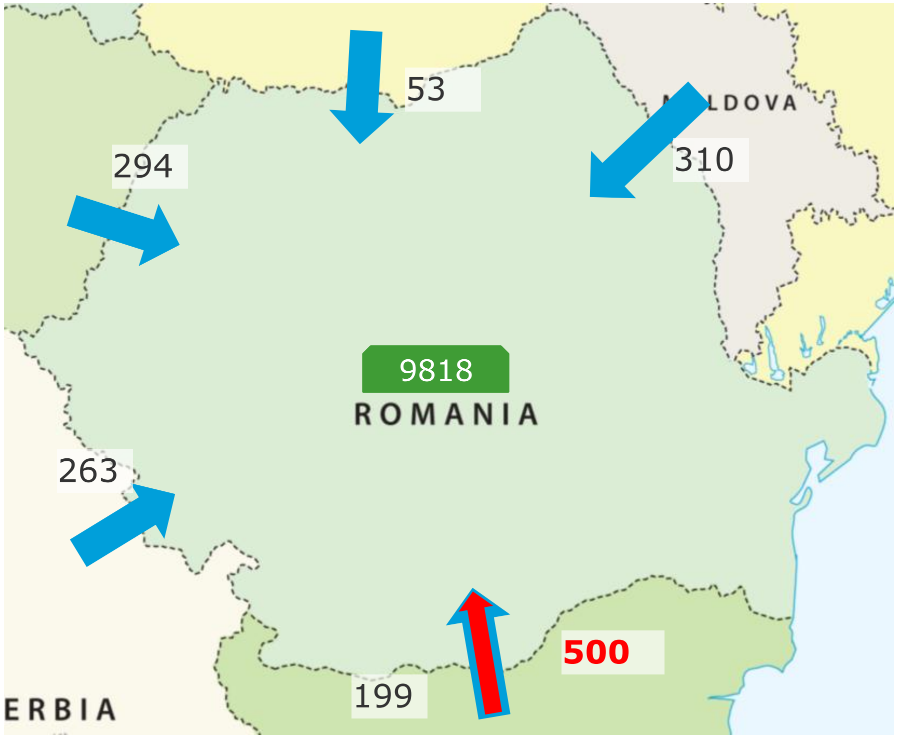
Electricity

Dummy Project Example – Interconnector OHL Bulgaria - Romania

HHI (Herfindahl-Hirschman-Index) – Romania impact

- Generator A: 1100 (10%)
- Generator B: 4022 (37%)
- Generator C: 723 (7%)
- Generator D: 1734 (16%)
- Generator E: 2214 (20%)
- NTC HU – RO: 294 (3%)
- NTC MD – RO: 310 (3%)
- NTC UA – RO: 53 (0%)
- NTC RS – RO: 263 (2%)
- NTC BG – RO: 199 (2%)
- **HHI without project:** (10%²+37%²+7%²[…]+2%²)= 0.2193
- New Interconnection capacity: 1094+**500** = 1594
- **HHI with the project**: (10%²+35%²+6%²[…]+2%²+4%²)= 0.2024
- **Project impact on Romania**: 0.2193–0.2024=0.0169

Total Interconnection Capacity 1594



Above calculation only illustrates the methodology, it does not represent an actual assessment.

Dummy Project Example – Interconnector OHL Bulgaria - Romania

HHI (Herfindahl-Hirschman-Index) – Overall impact

- Project Impact:
- Bulgaria: 0.0412
- Romania: 0.0169

- **Average result of both countries: (0.0412+0.0169)/2 = 0,02905**

- **Overall project impact 0,02905**

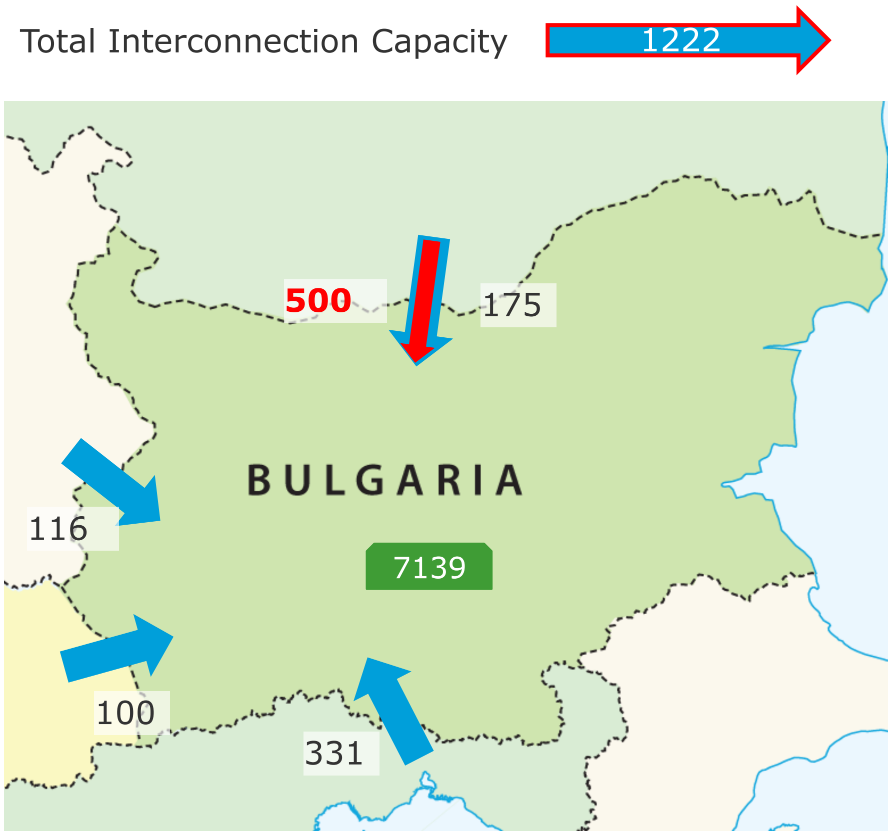
  will be transferred to a score 1-5

Above calculation only illustrates the methodology, it does not represent an actual assessment.

Dummy Project Example – Interconnector OHL Bulgaria - Romania

SAI (System Adequacy Index) – Bulgaria impact

- Generation Capacity: 7139
- Interconnection Capacity: 722
- System Peak Demand: 5192
- **SAI without project:** (7139+722-5192)/5192= 0.51
- New Interconnection capacity: 722+**500** = 1222
- **SAI with the project**: (7139+**1222**-5192)/5192= 0.61
- **Project impact on Bulgaria**: 0.61– 0.51=0.1



Above calculation only illustrates the methodology, it does not represent an actual assessment.

Dummy Project Example – Interconnector OHL Bulgaria - Romania

SAI (System Adequacy Index) – Romania impact

- Generation Capacity: 9818
- Interconnection Capacity: 1094
- System Peak Demand: 8228

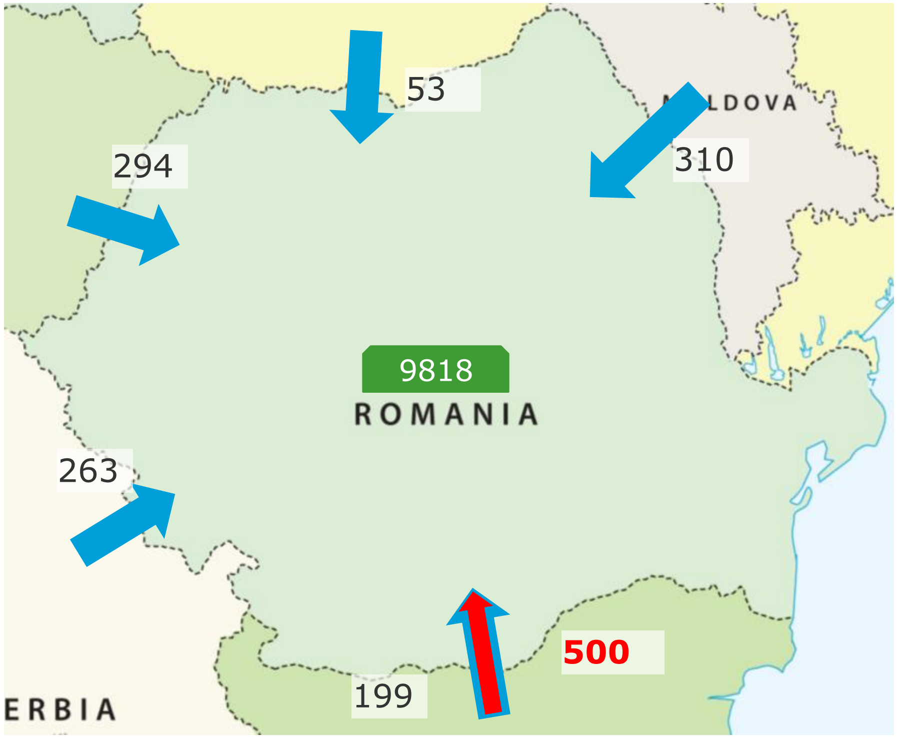
- **SAI without project:** (9818+1094-8228)/8228= 0.32

- New Interconnection capacity: 1094+**500** = 1594

- **SAI with the project:** (9818+1594-8228)/8228= 0.39

- **Project impact on Romania**: 0.39– 0.32=0.07

Total Interconnection Capacity 1594



Above calculation only illustrates the methodology, it does not represent an actual assessment.

Dummy Project Example – Interconnector OHL Bulgaria - Romania

SAI (System Adequacy Index) – Overall impact

- Project Impact:
- Bulgaria: 0.1
- Romania: 0.07

- **Average result of both countries: (0.1+0.07)/2 = 0.085**

- **Overall project impact 0.085 will be transferred to a score 1-5**

Above calculation only illustrates the methodology, it does not represent an actual assessment.

Dummy Project Example – Interconnector OHL Bulgaria - Romania

Calculation of Scores for System Adequacy Index (SAI)

- Score for SAI is calculated based on linear interpolation between minimal and maximal values of indicators among all submitted eligible electricity projects

Project	Value	Score
Project 1	0,067	2,00
Project 2	0,059	1,00
Project 3	0,091	5,00
IP BG-GR	**0,085**	**4,25**

Max Value	0,09
Min Value	0,06
Max Score	5
Min Score	1
Slope	125,00

Above calculation only illustrates the methodology, it does not represent an actual assessment.

Dummy Project Example – Interconnector OHL Bulgaria - Romania

Maturity of Project Indicator (MPI)

- Progress of Project "Interconnector Bulgaria-Romania" recorded throughout the questionnaire reached stage ***Tendering*** in Bulgaria, but only ***Permitting*** in Romania

- The progress of the project will be monitored as of **stage Permitting with score 3,18**

Final ranking	Score
Consideration phase	1,00
Planning approval	1,36
Preliminary design studies	1,73
Market test	2,09
Preliminary investment decision	2,45
Public consultation of Art. 9	2,82
Permitting	3,18
Financing secured	3,55
Final investment decision	3,91
Tendering	4,27
Construction	4,64
Commissioning	5,00

Electricity

Dummy Project Example – Interconnector OHL Bulgaria - Romania

Relative Ranking

	Indicators (Scores)				Weights				Indicators (Weighted Scores)				Total Score	Ranking
Project	CBA	HHI	SAI	MPI	CBA	HHI	SAI	MPI	CBA	HHI	SAI	MPI		
P 1	5,00	5,00	2,00	3,91	60%	15%	15%	10%	3,00	0,75	0,30	0,39	4,44	1
P 2	1,00	2,80	1,00	4,27	60%	15%	15%	10%	0,60	0,42	0,15	0,43	1,60	4
P 3	4,30	1,33	5,00	3,55	60%	15%	15%	10%	2,58	0,20	0,75	0,36	3,88	2
IP RO-BG	**4,58**	**1,00**	**3,63**	**3,18**	**60%**	**15%**	**15%**	**10%**	**2,75**	**0,15**	**0,54**	**0,32**	**3,76**	**3**

Indicators Assessed Within Multi-Criteria Analysis

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

Import Route Diversification Index (IDI)

Reasoning	▪ Interconnection / LNG projects may enhance wholesale competition by providing access to alternative import capacities ▪ Transfer of monopoly rents (i.e. price-mark-ups over production costs) gained by producers / importers / traders to consumers ▪ Market model (used in CBA) assumes competitive market equilibrium
Indicator	▪ Enhancement of competition approximated by simplified competition indicator based on system entry via interconnectors, offshore pipelines and LNG terminals ▪ Import Route Diversification Index (IDI)
Calculation	▪ Defined as sum of squared firm technical capacities at each interconnection point, each import point (offshore pipeline) and firm technical send-out capacity at each LNG terminal ▪ Calculated with and without the project as average for countries on each end of interconnector (or on national level for LNG projects) ▪ The higher the value of the index the higher the market concentration ▪ Score calculated by linear interpolation between min and max values of the change of the indicator of all eligible projects

Indicators Assessed Within Multi-Criteria Analysis

System Reliability Index (SRI) – Daily N-1 Security	
Reasoning	▪ CBA incorporates only some aspects of security of supply measured on monthly basis ▪ Additional indicator to account for daily operational flexibility and ability of the system to withstand extreme conditions
Indicator	▪ Enhancement of system flexibility approximated by simplified daily indicator for N-1 security ▪ System Reliability Index (SRI)
Calculation	▪ SRI (N-1) = (technical capacity + production capacity + max. storage deliverability + max. LNG send-out capacity) – single largest supply capacity / total daily gas demand ▪ Calculated with and without the project as average for countries on each end of interconnector (or on national level for LNG projects) ▪ The higher the value of the index the higher overall network flexibility ▪ Score calculated by linear interpolation between min and max values of the change of the indicator of all eligible projects

Indicators Assessed Within Multi-Criteria Analysis

Maturity of Project Indicator (MPI)

Reasoning	▪ Criterion aims to test preliminary implementation potential ▪ Favours projects which have a clear implementation plan and/or have already commenced their preparatory activities
Indicator	▪ Exact implementation potential of individual project would require detailed study of project specifics and legal and regulatory framework in the specific country ▪ Indicator based on information provided in questionnaires for each project relating to steps already undertaken at time of submission
Calculation	▪ Data to asses each project taken from online questionnaires ▪ Scores assigned to steps already undertaken ranging from consideration phase (1 point) to commissioning (5 points)

Indicators Assessed Within Multi-Criteria Analysis

Maturity of Project Indicator (MPI)

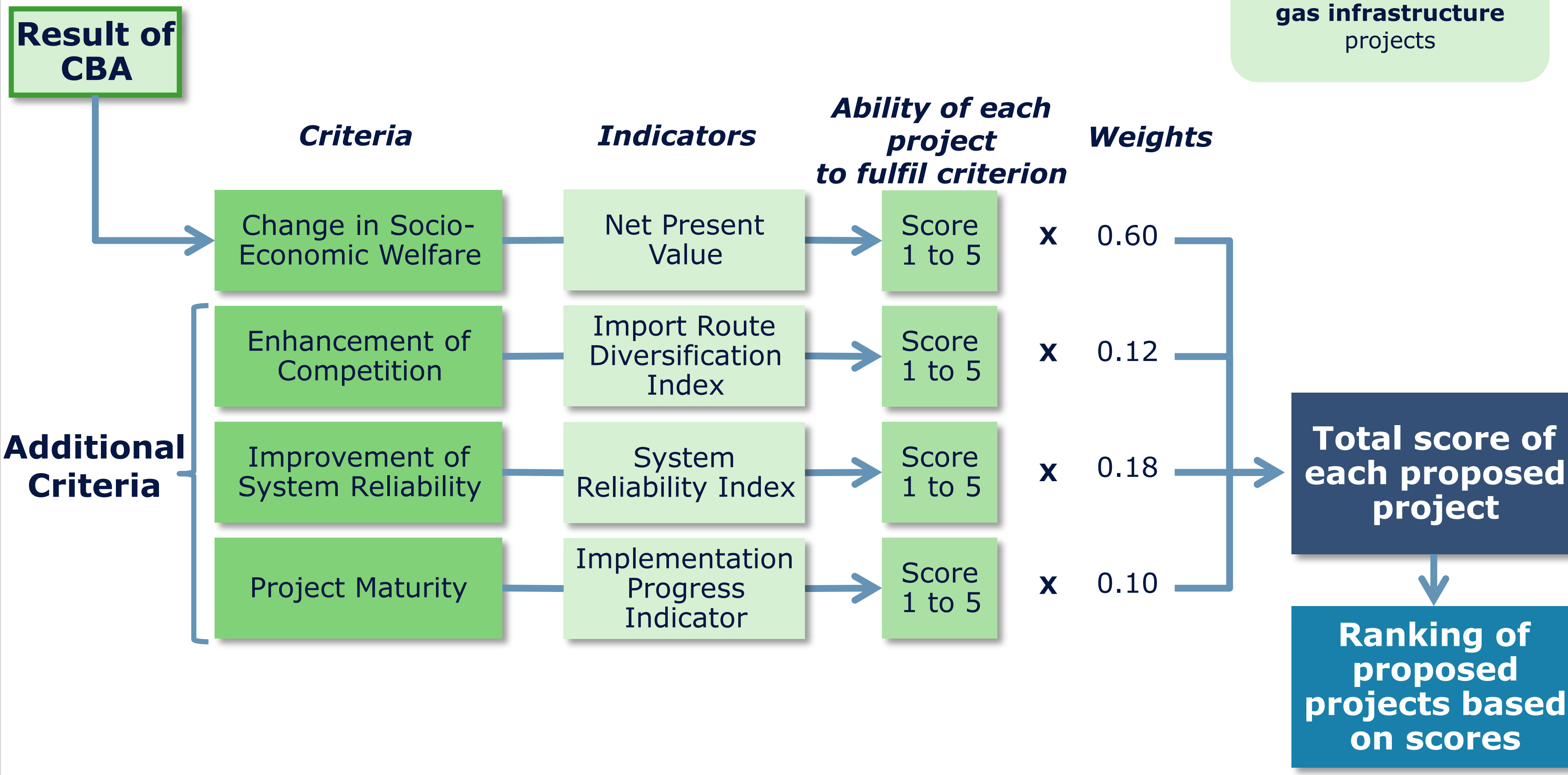
- Scores for each step already undertaken are equally distributed between all project phases
- Where project maturity is significantly different on each side of a border, progress of least developed part will be applied for calculation

Final ranking	Score
Consideration phase	1,00
Planning approval	1,36
Preliminary design studies	1,73
Market test	2,09
Preliminary investment decision	2,45
Public consultation of Art. 9	2,82
Permitting	3,18
Financing secured	3,55
Final investment decision	3,91
Tendering	4,27
Construction	4,64
Commissioning	5,00

Overview on Multi-Criteria Assessment Methodology

Multi-Criteria Assessment

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



Dummy Project Example – Interconnector Bulgaria - Greece

IRD (Import Route Diversification) – Bulgaria impact

- Total import capacity of Bulgaria: 1214 GWh/d
- **IRD without project:** $(100*1214/1321)^2 = 10000$
- New total import capacity: 1214+**134**= 1455 GWh/d
- **IRD with the project**: $(100*1214/1455)^2+(100*\mathbf{134}/1455)^2=$ 8209
- **Project impact on Bulgaria**: 10000 – 8209 = **1791**

Above calculation only illustrates the methodology, it does not represent an actual assessment.

Dummy Project Example – Interconnector Bulgaria - Greece

IRD (Import Route Diversification) – Greece impact

- Total import capacity of Greece: 107+208= 315 GWh/d
- **IRD without project:** $(100*107/315)^2+(100*208/315)^2= 5514$
- New total import capacity: 107+208+**134**= 449 GWh/d
- **IRD with the project**: $(100*107/449)^2+(100*208/449)^2 +(100*\mathbf{134}/449)^2= 3605$
- **Project impact on Greece**: 5514 – 3605= **1909**

Above calculation only illustrates the methodology, it does not represent an actual assessment.

Dummy Project Example – Interconnector Bulgaria - Greece

IRD (Import Route Diversification) – Overall impact

- Project Impact:
- Bulgaria: 1791
- Greece: 1909
- **Average result of both countries: (1791+1909)/2=1850**
- **Overall project impact 1660 will be transferred to a score 1-5**

Above calculation only illustrates the methodology, it does not represent an actual assessment.

Dummy Project Example – Interconnector Bulgaria - Greece

Calculation of Scores for Import Route Diversification Index (IRD)

- Score for IRD is calculated based on linear interpolation between minimal and maximal values of indicators among all submitted eligible electricity projects

Project	Value	Score
Project 1	1700	1,00
Project 2	1750	1,67
Project 3	2000	5,00
IP BG-GR	1849	2,99

Max Value	2000,00
Min Value	1700,00
Max Score	5
Min Score	1
Slope	0,01

Above calculation only illustrates the methodology, it does not represent an actual assessment.

Dummy Project Example – Interconnector Bulgaria - Greece

SRI (System Reliability Index) – Bulgaria impact

- IP: 1214 GWh
- NP: 11 GWh
- UGS: 34 GWh
- LNG: N/A
- I_m: 1214
- D_{max}: 168
- **SRI without**: (1214+11+34-1214)/168 = 29%
- **SRI with**: (1214+**134**+11+34-1214)/168= 108%
- **Project Impact**: 108% - 29% = 80%

then to be transferred to a score 1-5

Above calculation only illustrates the methodology, it does not represent an actual assessment.

Dummy Project Example – Interconnector Bulgaria - Greece

SRI (System Reliability Index) – Greece impact

- IP: 107 GWh
- NP: 6 GWh
- UGS: 10 GWh
- LNG: 208
- I_m: 208
- D_{max}: 350

- **SRI without**: (107+6+10+208-208)/350 = 35%
- **SRI with**: (107+**134**+6+10+208-208)/350 = 73%
- **Project Impact**: 73% - 35% = 38%

then to be transferred to a score 1-5

Above calculation only illustrates the methodology, it does not represent an actual assessment.

Dummy Project Example – Interconnector Bulgaria - Greece

SRI (System Reliability Index) – Overall impact

- Project Impact:
- Bulgaria: 80%
- Greece:38%
- **Average result of both countries: (80+38)/2=59 %**
- **Overall project impact 59% will be transferred to a score 1-5**

Above calculation only illustrates the methodology, it does not represent an actual assessment.

Dummy Project Example – Interconnector Bulgaria - Greece

Maturity of Project Indicator (MPI)

- Progress of Project "Interconnector Bulgaria-Greece" recorded throughout the questionnaire reached stage ***Tendering*** in Bulgaria, but only ***Permitting*** in Greece
- The progress of the project will be monitored as of **stage Permitting with score 3,18**

Final ranking	Score
Consideration phase	1,00
Planning approval	1,36
Preliminary design studies	1,73
Market test	2,09
Preliminary investment decision	2,45
Public consultation of Art. 9	2,82
Permitting	3,18
Financing secured	3,55
Final investment decision	3,91
Tendering	4,27
Construction	4,64
Commissioning	5,00

Above calculation only illustrates the methodology, it does not represent an actual assessment.

Natural Gas

Dummy Project Example – Interconnector Bulgaria - Greece

Relative Ranking

	Indicators (Scores)				Weights				Indicators (Weighted Scores)				Total Score	Ranking
Project	**CBA**	**IRD**	**SRI**	**MPI**	**CBA**	**IRD**	**SRI**	**MPI**	**CBA**	**IRD**	**SRI**	**MPI**		
P 1	1,00	1,00	1,00	3,91	60%	12%	18%	10%	0,60	0,12	0,18	0,39	1,29	4
P 2	5,00	1,67	3,56	4,27	60%	12%	18%	10%	3,00	0,20	0,64	0,43	4,27	1
P 3	1,76	5,00	2,95	3,55	60%	12%	18%	10%	1,06	0,60	0,53	0,36	2,54	3
IP BG-GR	**3,13**	**2,99**	**5,00**	**3,18**	**60%**	**12%**	**18%**	**10%**	**1,88**	**0,36**	**0,90**	**0,32**	**3,45**	**2**

Thank you!

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