

---

# **Draft Results of the PECI/PMI 2020 Assessment**

## **Electricity Infrastructure Projects**

---

3rd PECI/PMI Electricity Group meeting

26.05.2020

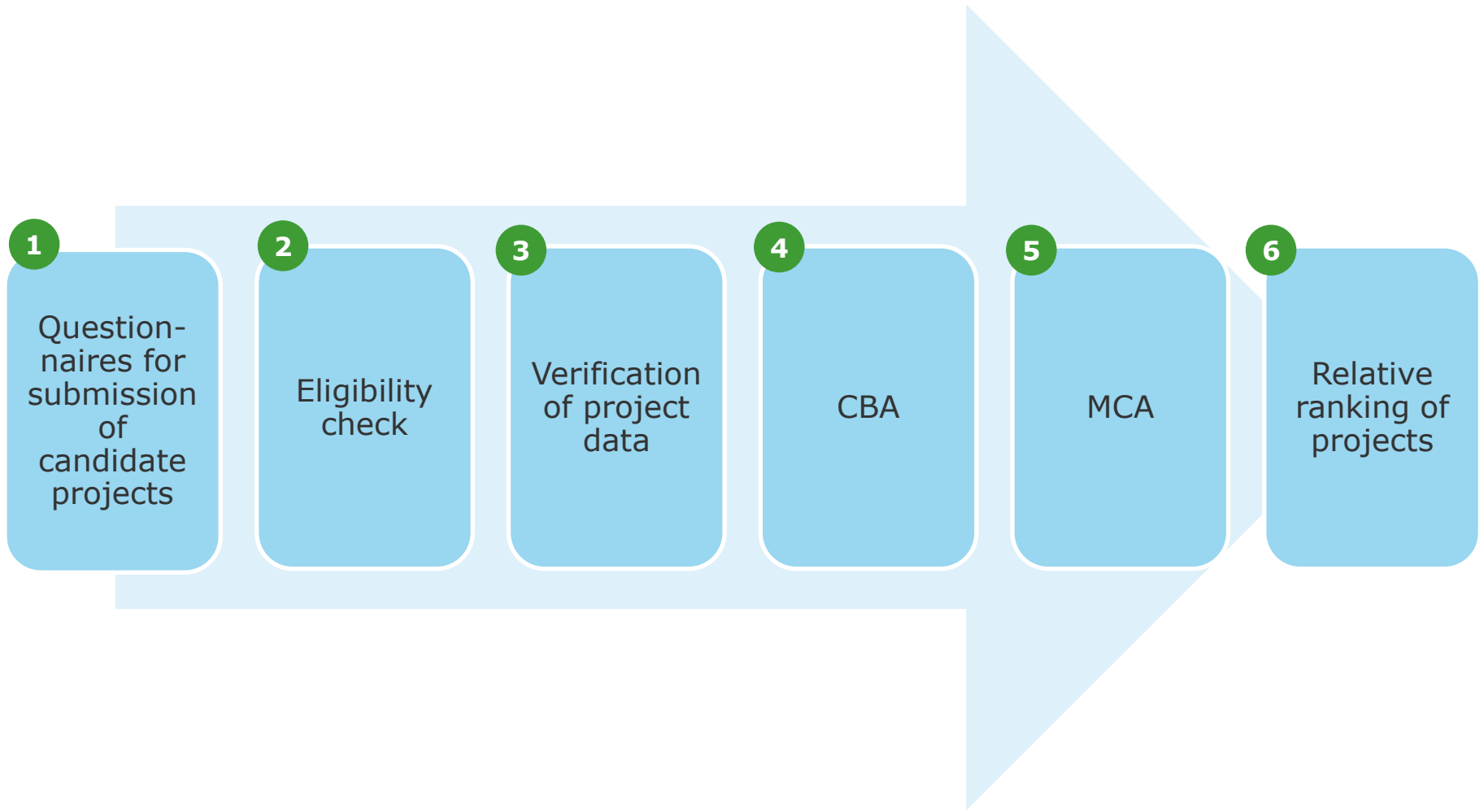
# Agenda

---

1. Overview of Assessment Methodology
2. Reference scenario for CBA modelling
3. Results of cost-benefit analysis and sensitivities
4. Results of multicriteria assessment and relative ranking

# Steps of the Project Assessment

---

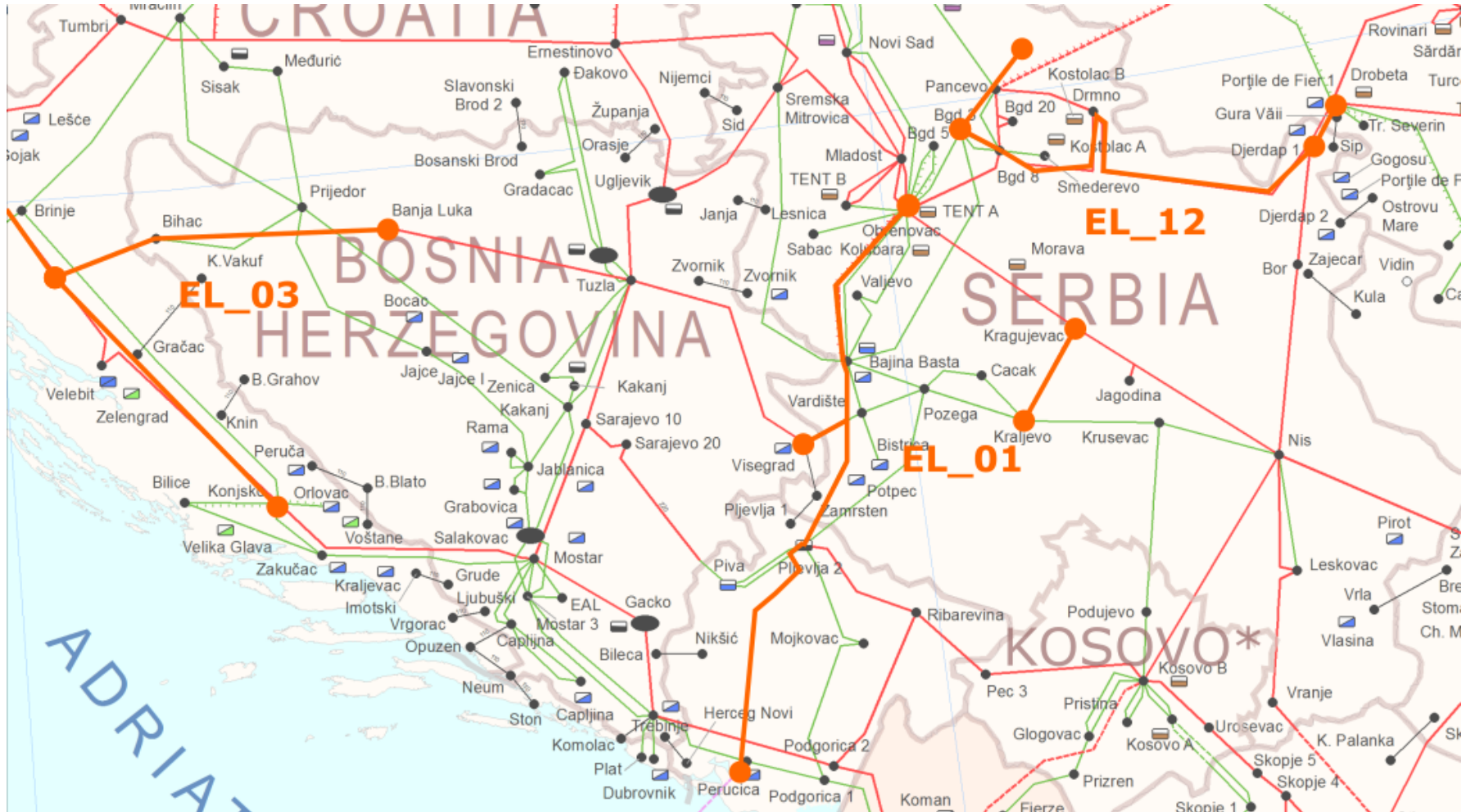


## Summary of project submissions

	<b>Elec- tricity trans- mission</b>	<b>Elec- tricity storage</b>	<b>Gas trans- mission</b>	<b>Gas storage</b>	<b>LNG</b>	<b>Smart grid</b>	<b>Oil</b>	<b>Total</b>
<b>Number of projects submitted</b>	6	0	19	1	0	0	3	29
<b>Number of assessed projects</b>	6	0	18	0	0	0	2	26
<b>Submitted investment cost (million €)</b>	2879	-	7908	75	-	-	416	11278

All submitted electricity projects were analysed

# Summary of Electricity Projects – map I.



# Summary of Electricity Projects – map II.

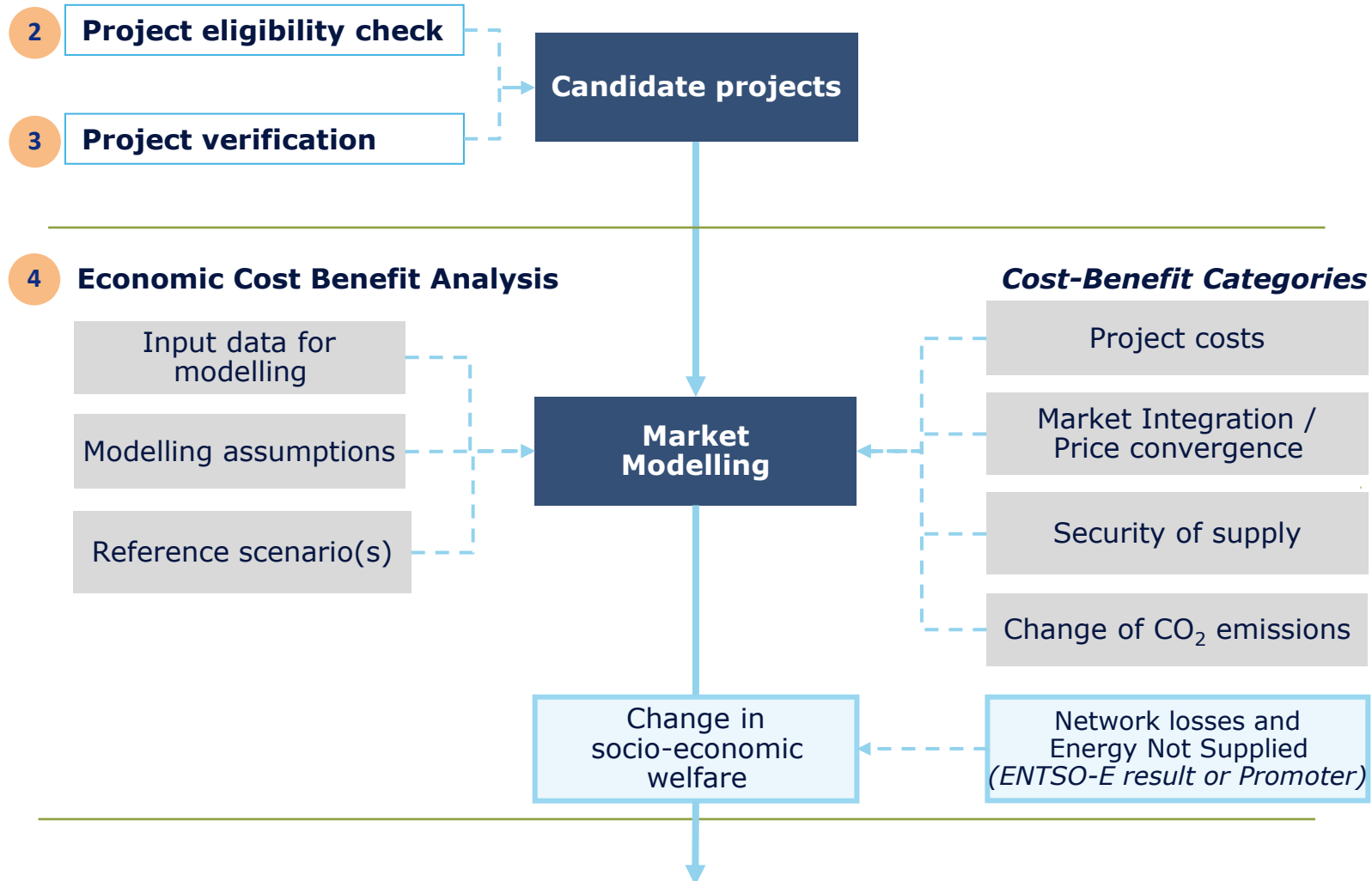


## Summary of all relevant technical data of the projects

Project code	Total cost (M€)	Commission date	NTC	NTC	NTC	NTC	NTC	NTC
			A-B	A-B	A-B	B-A	B-A	B-A
			2020 (MW)	2025 (MW)	2030 (MW)	2020 (MW)	2025 (MW)	2030 (MW)
EL_01* (Montenegro-Serbia)	165.49	2026	0	0	500	0	0	500
EL_01* (Serbia-Bosnia)			0	0	600	0	0	500
EL_01* (Montenegro-Italy)			0	0	600	0	0	600
EL_03 (Croatia-Bosnia)	160.14	2030	0	0	644	0	0	298
EL_07 (Ukraine-Slovakia)	18.5	2030	474	474	500	616	616	657
EL_09 (Ukraine-Romania)	388.37	2029	0	0	1000	0	0	1000
EL_12 (Serbia-Romania)	51.5	2030	0	0	347	0	0	622
EL_13 (Georgia-Romania)	2110	2029	0	0	1050	0	0	1050

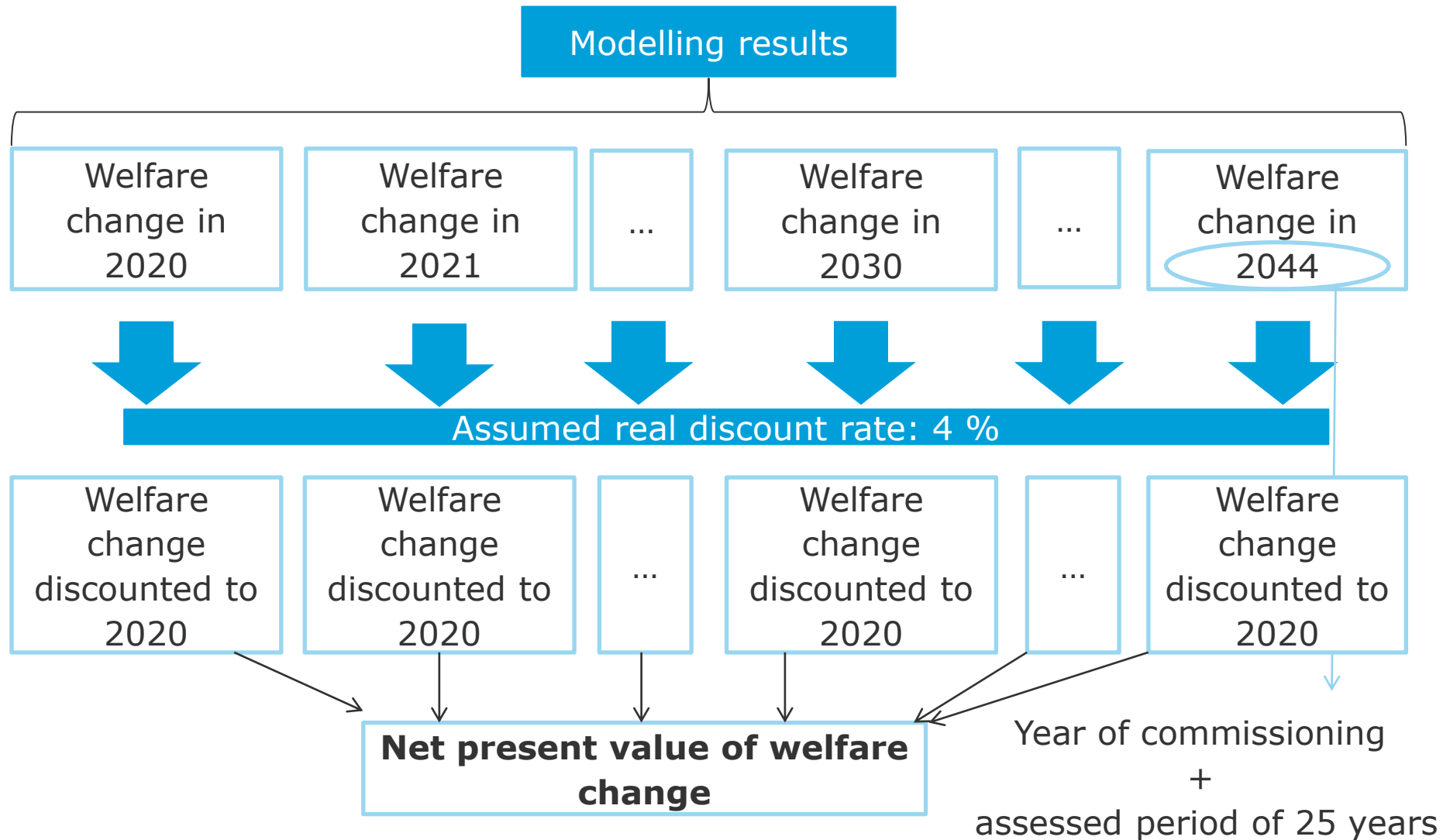
\*This project also includes two internal lines in Serbia (400 kV Kragujevac - Kraljevo 2 and 2x400 kV Obrenovac - Bajina Basta)

# Conceptual framework for the assessment (I)



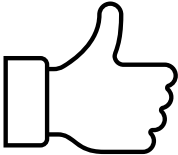


# Calculating the Net Present Value of Social Welfare Changes



## CBA measures the merit of the project + ELIGIBILITY

- Calculated socio-economic benefits shall outweigh the costs otherwise the project does not meet the GENERAL eligibility criteria of adopted Regulation 347/2013
- Shall be calculated for the Energy Community (= EU27+9 Contracting Parties)

$B/C > 1.1$  

$B/C < 0.9$  

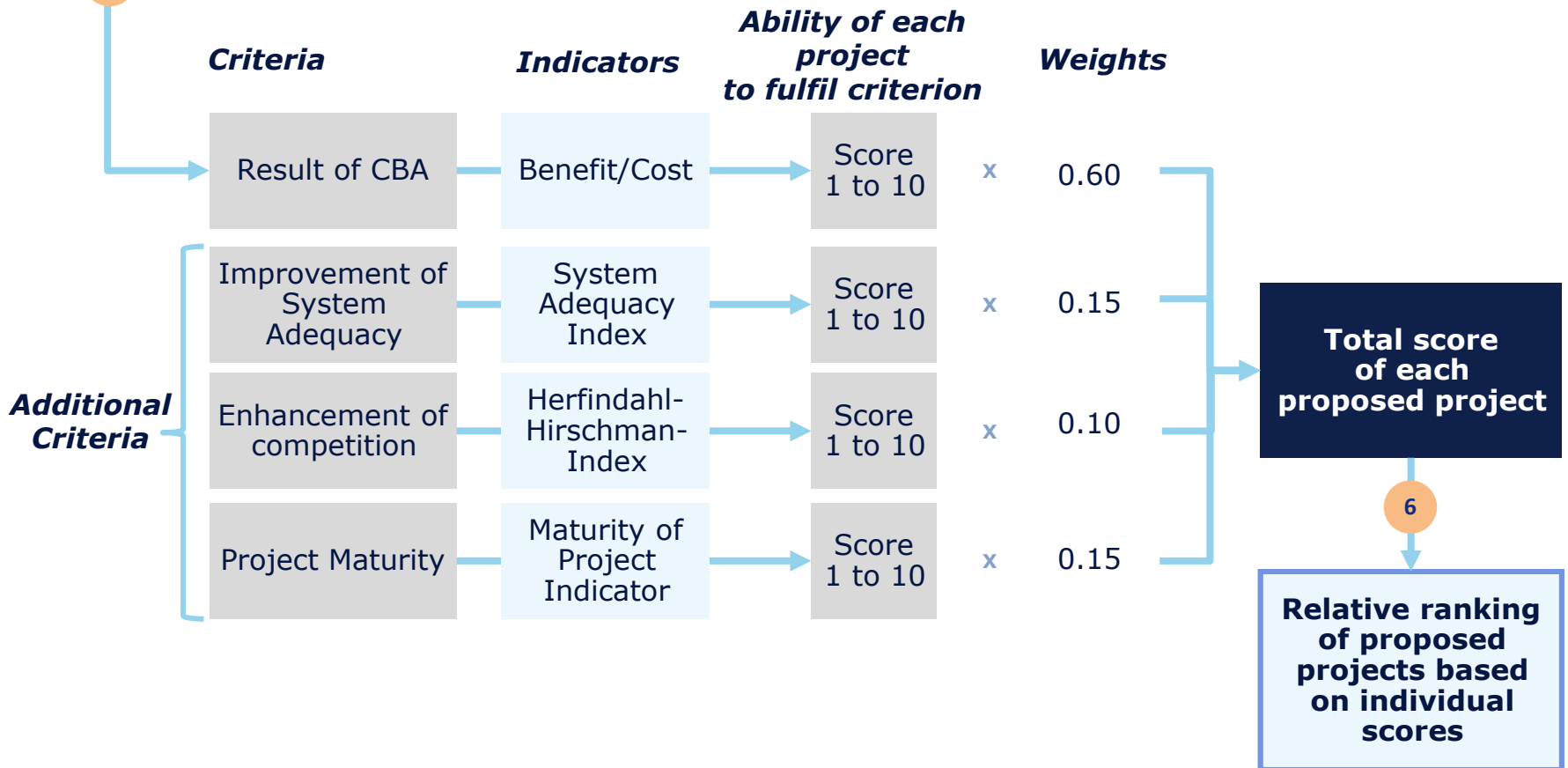
- if  $0.9 \leq B/C \leq 1.1$  **sensitivity results** and **other indicators** shall guide the decision)

Ranking is based on the Benefit/Cost ratio (B/C) of the projects.

The region applied is the **Energy Community**, but other regions are calculated to orient the decision making.

# Conceptual framework for the assessment (II)

## 5 Multi-Criteria Assessment



# Agenda

---

1. Overview of Assessment Methodology
2. Reference scenario for CBA modelling
3. Results of cost-benefit analysis and sensitivities
4. Results of multicriteria assessment and relative ranking

# Scenario assessment

---

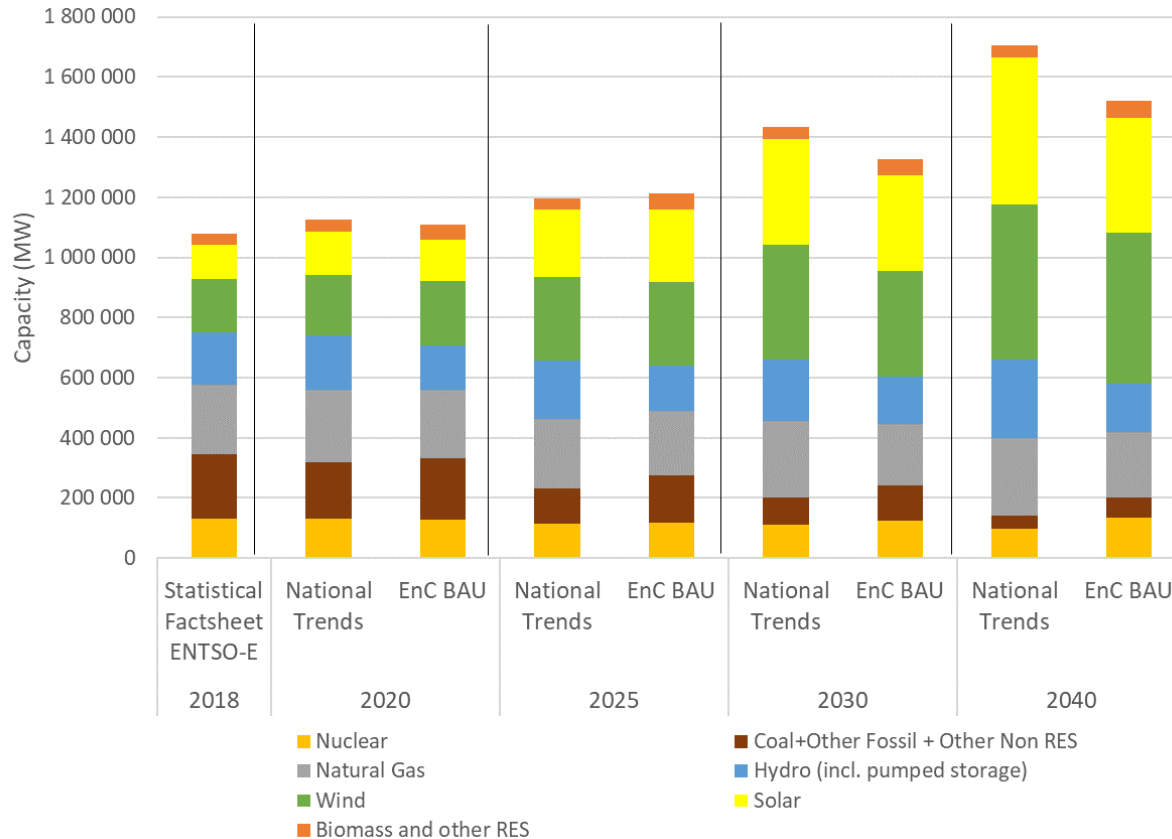
- Two main scenarios:
  - 1) ENTSOs National Trend scenario
  - 2) Energy Community Business as Usual scenario  
(based on country data and EUCO3232.5 input data)
  
- Sensitivity analyses for the main factors:
  - High/low CO<sub>2</sub> price -> Reference CO<sub>2</sub> price path +/- 10 €/t
  - High/low demand -> Reference electricity consumption +/- 0.5%/year change for all modelled countries not only for EnC
  
- PINT and TOOT assessments are also modelled
  
- Region definition:
  - In the Reference case Contracting Parties and EU27 (EnC) countries are taken into account
  - The welfare effects are also demonstrated separately for: i) Contracting Parties, ii) Contracting Parties + Neighbouring EU countries, iii) Hosting countries iv) All modelled countries

## Main input price assumptions

CO <sub>2</sub> quota price (€/t <sub>CO2</sub> )	2018	2020	2025	2030	2040
ENTSOs National Trends		19.7	23.0	27.0*	75.0
EnC (based on EU EUCO3232.5)		19.2	23.0	27.0*	75.0
Fact (European Environmental Agency)	15.5				
Natural gas price (€/MWh)	2018	2020	2025	2030	2040
ENTSOs National Trends		Result of the iteration, differentiated by country			
EnC		Result of the iteration, differentiated by country			
Fact (TTF, EU Quarterly Report)	23.3				
Coal price €/GJ	2018	2020	2025	2030	2040
ENTSOs National Trends		3.0	3.8	4.3	6.9
EnC (based on Worldbank)		2.6	2.4	2.2	2.2
Fact (ARA, marketwatch)	3.4				

\*at the stage of input data finalisation the printed version of ENTSOs TYNDP 2020 Scenario Report featured 27 €/t; by the time it was corrected to 28 €/t, the modelling exercise was already finished

# Installed capacity and electricity consumption (EU27+CP)



- Similar trends are visible, but National Trends is „greener“:
  - Includes higher RES capacities
  - And more ambitious coal-phase-out
- EnC BAU also reaches very high RES penetration levels by 2040, and most of the coal + oil capacities exit the system
- Overall demand pathways are very similar but with significant regional difference

Demand	EnC BAU		National Trends	
	CAGR 2020-2030	CAGR 2030-2040	CAGR 2020-2030	CAGR 2030-2040
ENC	0.5%	1.1%	0.6%	1.0%
EU27	0.3%	1.0%	0.5%	1.0%
EnC CPs	2.2%	1.8%	2.4%	1.7%

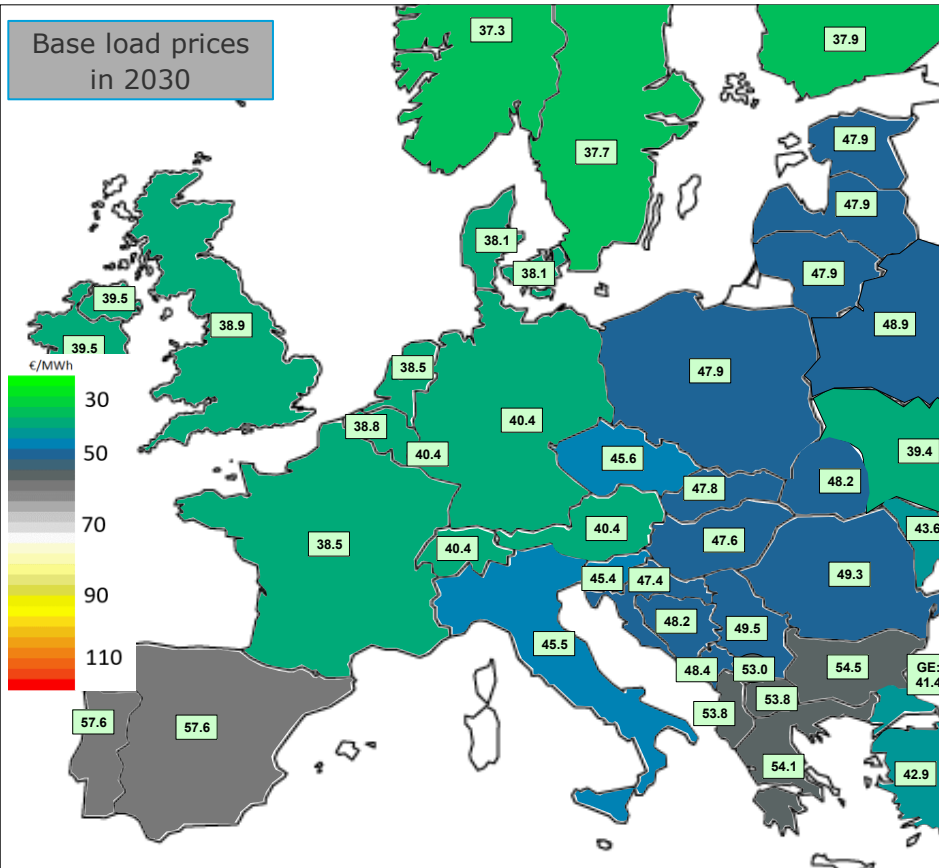
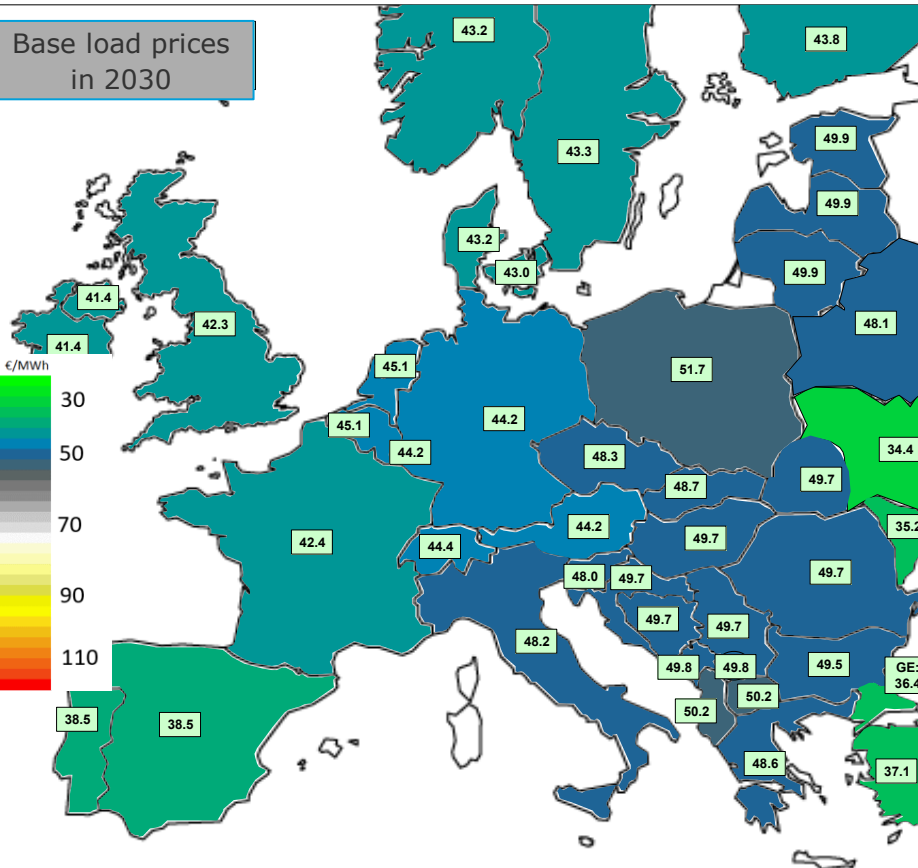
# Wholesale price developments, 2030, REF scenarios, €/MWh

EnC

ENTSOs NT

Base load prices  
in 2030

Base load prices  
in 2030







# Agenda

---

1. Overview of Assessment Methodology
2. Reference scenario for CBA modelling
3. Results of cost-benefit analysis and sensitivities
4. Results of multicriteria assessment and relative ranking

# Electricity CBA Results for EnC (CP+EU27)

## EnC scenario, PINT, REF

Project code	Country	Welfare change, m€				Investment cost, m€	OM cost, m€	Transmission loss reduction	ENS benefit, m€	NPV, m€	B/C
		Consumer	Producer	Rent	Subtotal						
EI_01	BA-ME-RS	1674.3	-849.0	-518.7	306.5	-146.2	-21.6	15.5	0.7	154.9	1.92
EI_03	BA-HR	337.1	-228.6	-77.6	30.9	-121.3	-4.7	2.2	0.0	-92.8	0.26
EI_07	UA_W-SK	244.6	-15.6	-49.1	179.9	-15.3	-0.2	0.0	0.0	164.4	11.59
EI_09	UA_E-RO	1626.9	-914.9	1119.4	1831.5	-317.6	-4.1	0.0	0.0	1509.8	5.69
EI_12	RS-RO	27.8	18.5	-40.5	5.8	-37.7	-6.4	-2.0	0.6	-39.7	0.10
EI_13	GE-RO	2697.2	-2591.3	1818.2	1924.0	-1557.0	-426.1	-194.2	1.2	-252.1	0.87

## ENTSOs NT scenario, PINT, REF

Project code	Country	Welfare change, m€				Investment cost, m€	OM cost, m€	Transmission loss reduction	ENS benefit, m€	NPV, m€	B/C
		Consumer	Producer	Rent	Subtotal						
EI_01	BA-ME-RS	5413.4	-3947.4	-473.9	992.0	-146.2	-21.6	17.5	0.7	842.5	6.02
EI_03	BA-HR	-46.0	71.9	-14.0	11.9	-121.3	-4.7	2.5	0.0	-111.6	0.11
EI_07	UA_W-SK	364.1	-204.9	-119.3	39.9	-15.3	-0.2	0.0	0.0	24.4	2.57
EI_09	UA_E-RO	10297.1	-7793.2	-622.2	1881.7	-317.6	-4.1	0.0	0.0	1560.0	5.85
EI_12	RS-RO	34.6	-9.5	-22.2	2.9	-37.7	-6.4	-2.3	0.6	-43.0	0.02
EI_13	GE-RO	4209.0	-2770.1	-78.6	1360.3	-1557.0	-426.1	-172.5	1.2	-794.2	0.60

Discounted, aggregated values in 25 years period

B/C: Benefit/Cost ratio=(Welfare change+Trans. Loss+EnS)/(Investment Cost+OM cost)

# Notes on Electricity CBA Results (I)

---

- Project EL\_01 (Transbalkan Corridor)
  - High positive NPV project with high B/C value (1.9 and 6.0) in both scenarios, indicating that the project brings benefits to the region
  - The benefit is higher in the ENTSOs scenario -> higher price difference in the region
  - Consumer welfare is positive, while producers loose, and also the congestion rents decrease. The highest savings in Loss Reduction values amongst the assessed project.
- Project EL\_03 (BA-HR interconnector)
  - Low welfare gain in both scenarios with high investments cost -> negative NPV
  - Socio-economic benefits do not outweigh the costs of the project
- Project EI\_07 (SK-UA\_W interconnector)
  - This project is an OHL rehabilitation, therefore low investment and OM cost
  - Moderate welfare gain, higher in EnC scenario
  - Highest B/C in the EnC scenario (B/C>11)

## Notes on Electricity CBA Results (II)

---

- EL\_09 project (Ukraine-East - Romania)
  - Presents one of the highest social benefits for the region
  - B/C value is well over the threshold level of 1
  - Similar overall results in both scenarios, but the welfare components differ (revenue from congestion rents are positive in EnC scenario, while negative in ENTSOs NT scenario)
- EL\_12 project (North CSE Corridor – RS\_RO)
  - Welfare effects are compared to El\_01, not the reference (realisation is dependent on the Transbalkan Corridor)
  - Limited welfare effects in both scenarios
  - Negative NPV, and B/C ratio
- EL\_13 project (GE-RO)
  - Very high investment cost and OM cost
  - High welfare gains in both scenarios, but it can not outweigh the costs of this project

# Electricity CBA Sensitivity Results

NPV, m€	NT - REF	NT - Low_demand	NT - High_demand	NT - Low_CO2	NT - High_CO2	EnC - REF	EnC - Low_demand	EnC - High_demand	EnC - Low_CO2	EnC - High_CO2
EI_01	843	368	843	733	944	155	28	340	207	129
EI_03	-112	-104	-112	-119	-94	-93	-113	-47	-93	-94
EI_07	24	19	24	18	39	164	132	257	157	173
EI_09	1 560	847	1 560	1 339	1 795	1 510	1 071	2 079	1 216	1 780
EI_12	-43	-42	-43	-45	-40	-40	-39	-34	-40	-40
EI_13	-794	-745	-794	-1 092	-457	-252	-471	100	-555	65

B/C	NT - REF	NT - Low_demand	NT - High_demand	NT - Low_CO2	NT - High_CO2	EnC - REF	EnC - Low_demand	EnC - High_demand	EnC - Low_CO2	EnC - High_CO2
EI_01	6.02	3.19	6.02	5.37	6.63	1.92	1.17	3.02	2.23	1.77
EI_03	0.11	0.18	0.11	0.06	0.25	0.26	0.11	0.63	0.27	0.26
EI_07	2.57	2.23	2.57	2.14	3.53	11.59	9.50	17.59	11.09	12.12
EI_09	5.85	3.63	5.85	5.16	6.58	5.69	4.33	7.46	4.78	6.53
EI_12	0.02	0.05	0.02	-0.01	0.10	0.10	0.11	0.23	0.09	0.08
EI_13	0.60	0.62	0.60	0.45	0.77	0.87	0.76	1.05	0.72	1.03

# Notes on Electricity CBA Sensitivity Results

---

- The sensitivity results indicate that project assessment results are robust for all projects, with the exception of the GE-RO interconnector (EL\_13)
  - CBA results do not change sign in the sensitivity assessment (from positive to negative NPV or from negative to positive NPV)
  - Similarly confirmed for B/C ratios in the sensitivity assessment
  - Project assessment result are very robust for all these infrastructure projects
  
- In case the GE-RO interconnector small changes in the project environment can change project performance significantly:
  - Despite the negative NPV in the reference case, there are sensitivity runs, where the project gets close to or above the break-even point
  - In the EnC BAU scenario at higher CO<sub>2</sub> price values or higher demand the project NPV becomes positive
  - The project assessment does not take into account the possible additional benefits of the optical cable included in the project

# Agenda

---

1. Overview of Assessment Methodology
2. Reference scenario for CBA modelling
3. Results of cost-benefit analysis and sensitivities
4. Results of multicriteria assessment and relative ranking



# Electricity MCA Results – BAU Scenario

## PECI / PMI Projects

Project Code	Countries	Change in Indicator due to Project				Scores of Indicators [Scale 1 (min) to 10 (max)]				Weighted Scores of Indicators				Total Score
		Benefit / Cost Ratio (B/C)	System Adequacy Index (SAI)	Herfindahl-Hirschman-Index (HHI)	Implementation Progress Indicator (IPI)	B/C	SAI	HHI	IPI	B/C (60%)	SAI (15%)	HHI (10%)	IPI (15%)	
EL_01	ME-RS-BA	1.92	1.17	599.30	6	1.88	10.00	10.00	6	1.13	1.50	1.00	0.90	4.53
EL_03	BA-HR	0.26	0.42	175.91	5	0.00	3.49	2.53	5	0.00	0.52	0.25	0.75	1.53
EL_07	UA-SK	11.59	0.15	216.78	1	10.00	1.15	3.25	1	6.00	0.17	0.32	0.15	6.65
EL_09	UA-RO	5.69	0.15	89.43	-9	5.05	1.10	1.00	-9	3.03	0.16	0.10	-1.35	1.94
EL_12	RS-RO	0.10	0.13	317.66	1	0.00	1.00	5.03	1	0.00	0.15	0.50	0.15	0.80
EL_13	RO-GE	0.87	0.45	137.82	1	0.00	3.72	1.85	1	0.00	0.56	0.19	0.15	0.89

# Electricity MCA Results – ENTSO-E NT Scenario

## PECI / PMI Projects

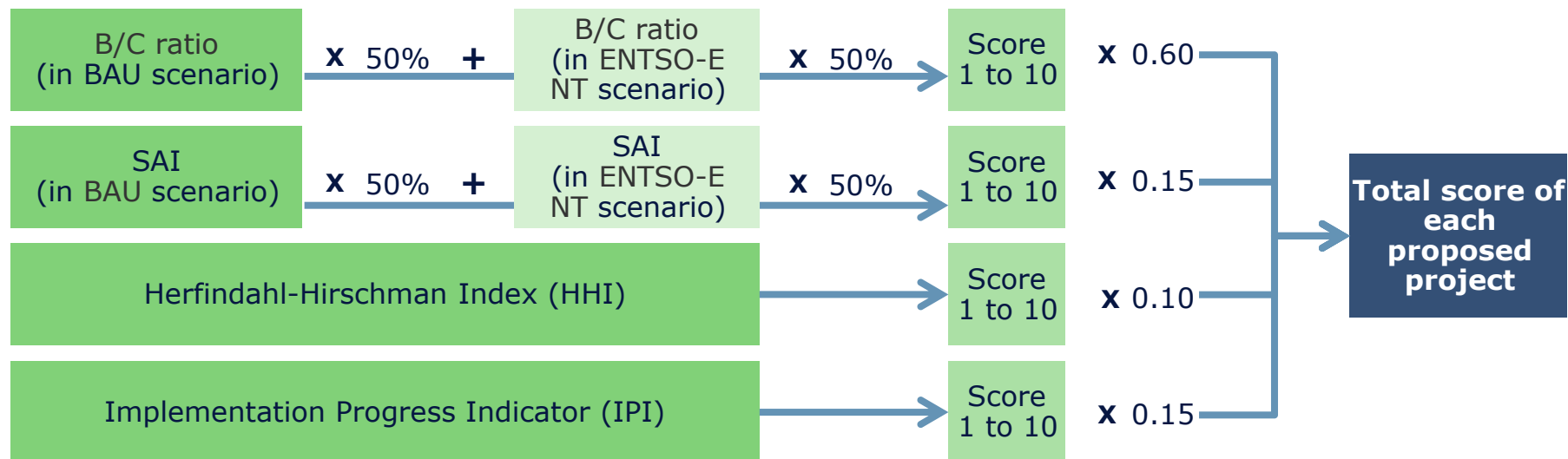
Project Code	Countries	Change in Indicator due to Project				Scores of Indicators [Scale 1 (min) to 10 (max)]				Weighted Scores of Indicators				Total Score
		Benefit / Cost Ratio (B/C)	System Adequacy Index (SAI)	Herfindahl-Hirschman-Index (HHI)	Implementation Progress Indicator (IPI)	B/C	SAI	HHI	IPI	B/C (60%)	SAI (15%)	HHI (10%)	IPI (15%)	
EL_01	ME-RS-BA	6.02	1.28	599.30	6	10.00	10.00	10.00	6	6.00	1.50	1.00	0.90	9.40
EL_03	BA-HR	0.11	0.45	175.91	5	0.00	3.54	2.53	5	0.00	0.53	0.25	0.75	1.53
EL_07	UA-SK	2.57	0.14	216.78	1	4.27	1.19	3.25	1	2.56	0.18	0.32	0.15	3.22
EL_09	UA-RO	5.85	0.15	89.43	-9	9.72	1.20	1.00	-9	5.83	0.18	0.10	-1.35	4.76
EL_12	RS-RO	0.02	0.12	317.66	1	0.00	1.00	5.03	1	0.00	0.15	0.50	0.15	0.80
EL_13	RO-GE	0.60	0.45	137.82	1	0.00	3.53	1.85	1	0.00	0.53	0.19	0.15	0.87

## Combined Scenario Results – Scoring and Ranking

Application of BAU and ENTSO-E NT scenario has an impact on CBA results (B/C ratio) and system reliability (System Adequacy Index)

- B/C ratio of a project in both scenarios is weighted 50%
- SAI is calculated for both scenarios for each country where the project is located, whereas change of indicator is weighted 50%
- Scoring is then done on the weighted values

Impact on competition (HHI) of alternative scenarios cannot be estimated without strong assumptions (therefore not done), project implementation is not assumed to change with scenarios



# Electricity MCA Results – Combined Scenario Results

## PECI / PMI Projects

Project Code	Countries	Change in Indicator due to Project				Scores of Indicators [Scale 1 (min) to 10 (max)]				Weighted Scores of Indicators				Total Score
		Benefit / Cost Ratio (B/C)	System Adequacy Index (SAI)	Herfindahl-Hirschman-Index (HHI)	Implementation Progress Indicator (IPI)	B/C	SAI	HHI	IPI	B/C (60%)	SAI (15%)	HHI (10%)	IPI (15%)	
EL_01	RS-BA	3.97	1.22	599.30	6	5.59	10.00	10.00	6	3.35	1.50	1.00	0.90	6.75
EL_03	BA-HR	0.19	0.43	175.91	5	0.00	3.52	2.53	5	0.00	0.53	0.25	0.75	1.53
EL_07	UA-SK	7.08	0.15	216.78	1	10.00	1.17	3.25	1	6.00	0.18	0.32	0.15	6.65
EL_09	UA-RO	5.77	0.15	89.43	-9	8.14	1.15	1.00	-9	4.89	0.17	0.10	-1.35	3.81
EL_12	RS-RO	0.06	0.13	317.66	1	0.00	1.00	5.03	1	0.00	0.15	0.50	0.15	0.80
EL_13	GE-RO	0.74	0.45	137.82	1	0.00	3.62	1.85	1	0.00	0.54	0.19	0.15	0.88

50% weight applied for the change of each indicator in each country for both BAU and ENTSO-E NT scenario results

## Projects with a negative NPV or B/C Ratio below 1 (based on both Scenarios)

---

Projects with a significantly negative NPV or B/C ratio below 1 – i.e. indicating that its benefits do not outweigh its cost – would not comply with the eligibility criterion of Regulation 347/2013 as adopted by the Ministerial Council for the Energy Community and are therefore not included in the relative ranking

Project Code	Project Name
EL_03	400 kV OHL Banja Luka (BA) – Lika (HR) (full)
EL_13	Black Sea Submarine Cable Georgia - Romania
EL_12	North CSE corridor (Serbia, Romania)

# Relative Ranking of Electricity Projects

## PECI / PMI Projects Combined Scenario

Rank	Project Code	Project Name
1	EL_01	Trans Balkan Corridor – Double OHL 400 kV Bajina Basta (RS) – Visegrad (BA); 400 kV Kragujevac - Kraljevo 2 and 2x400 kV Obrenovac - Bajina Basta
2	EL_07	400 kV Mukacheve (Ukraine) – V.Kapusany (Slovakia) OHL rehabilitation
3	EL_09	750 kV Yuzhnoukrainsk (Ukraine) – Isaccea (Romania) OHL rehabilitation and modernisation

Positive  
NPVs

B/C ratio  
above 1

# Thank you!

---

**REKK**  
www.rekk.hu

## András Mezősi

**Senior research associate**

REKK (REKK Kft.)  
Po. Box 1803  
1465 Budapest  
Hungary

**E-Mail:** andras.mezosi@rekk.hu

**Phone:** +36-1-482-5153

**DNV GL**  
www.dnvgl.com

## Dr. Daniel Grote

**Principal Consultant**

DNV GL Energy  
Zanderstr. 7  
53177 Bonn  
Germany

**E-Mail:** Daniel.Grote@dnvgl.com

**Phone:** +49-228-4469049