Energy Institute Hrvoje Požar
Croatia

Technical support to the Energy Community and its Secretariat to assess the candidate Projects of Energy Community Interest in electricity, smart gas grids, hydrogen, electrolysers, and carbon dioxide transport and storage, in line with the EU Regulation 2022/869

- Cost-benefit analysis (CBA 4.0) and Multi-criteria analysis (MCA) -

TEN-E (PECI) Groups meeting – 4th meeting of the “Electricity” Group

19 June 2024

Contents

1. Cost-benefit analysis (CBA 4.0)
2. Multi-criteria analysis (MCA)

TEN-E Regulation specific criteria for project assessment

According to the **TEN-E Regulation**, the PECI eligible candidates falling under **electricity transmission**, distribution and **energy storage** infrastructure categories shall contribute:

- **significantly to sustainability** through the integration of renewable energy into the grid, the transmission or distribution of renewable generation to major consumption centers and storage sites, and to reducing energy curtailment, where applicable,

and to at least one of the specific criteria:

- **market integration**, including through lifting the isolation of at least one CPs and reducing energy infrastructure bottlenecks, competition, interoperability and system flexibility,
- **security of supply**, including through interoperability, system flexibility, cybersecurity, appropriate connections and secure and reliable system operation.

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Methodologies for project assessment

- Relevant methodologies for assessment of **overhead high-voltage transmission lines and energy storage projects** (according to Article 11(1) and Article 11(8) of the TEN-E Regulation as adopted in the Energy Community)
  - **CBA Methodology of the ENTSO-E (applied for the OH transmission lines projects)**
    - ✓ **4th ENTSO-E Guideline for Cost-Benefit Analysis of Grid Development Projects, April 2024**
  - **Methodology developed by the European Commission (applied to the energy storage project)**
    - ✓ **Harmonised system-wide cost-benefit analysis for candidate energy storage projects, May 2023**
- The methodology which is also considered in the PECI selection process is the one developed by the EU Commission and agreed/used by the respective groups in the 2023 PCI/PMI process at the EU level:
  - Methodology for assessing the electricity and offshore infrastructure candidate PCI and PMI 1st Union PCI-PMI list 2023, June 2023

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4th ENTSO-E Guideline for CBA of Grid Development Projects

- The **4th ENTSO-E Guideline for the CBA of Grid Development Projects** was prepared by ENTSO-E in compliance with the requirements of the TEN-E Regulation
- The Guideline is the 4th version of the document produced by ENTSO-E and is built upon the 3rd CBA Guideline, which was the result of an extensive consultation process
- It describes the common principles and procedures for performing the analysis of costs and benefits for projects using network and market simulation methodologies
- A **multi-criteria approach** is used to describe the indicators associated with each project
- To ensure a full assessment of all transmission benefits, some of the indicators are monetised, whereas others are quantified in their typical physical units (i. e. tons or GWh)

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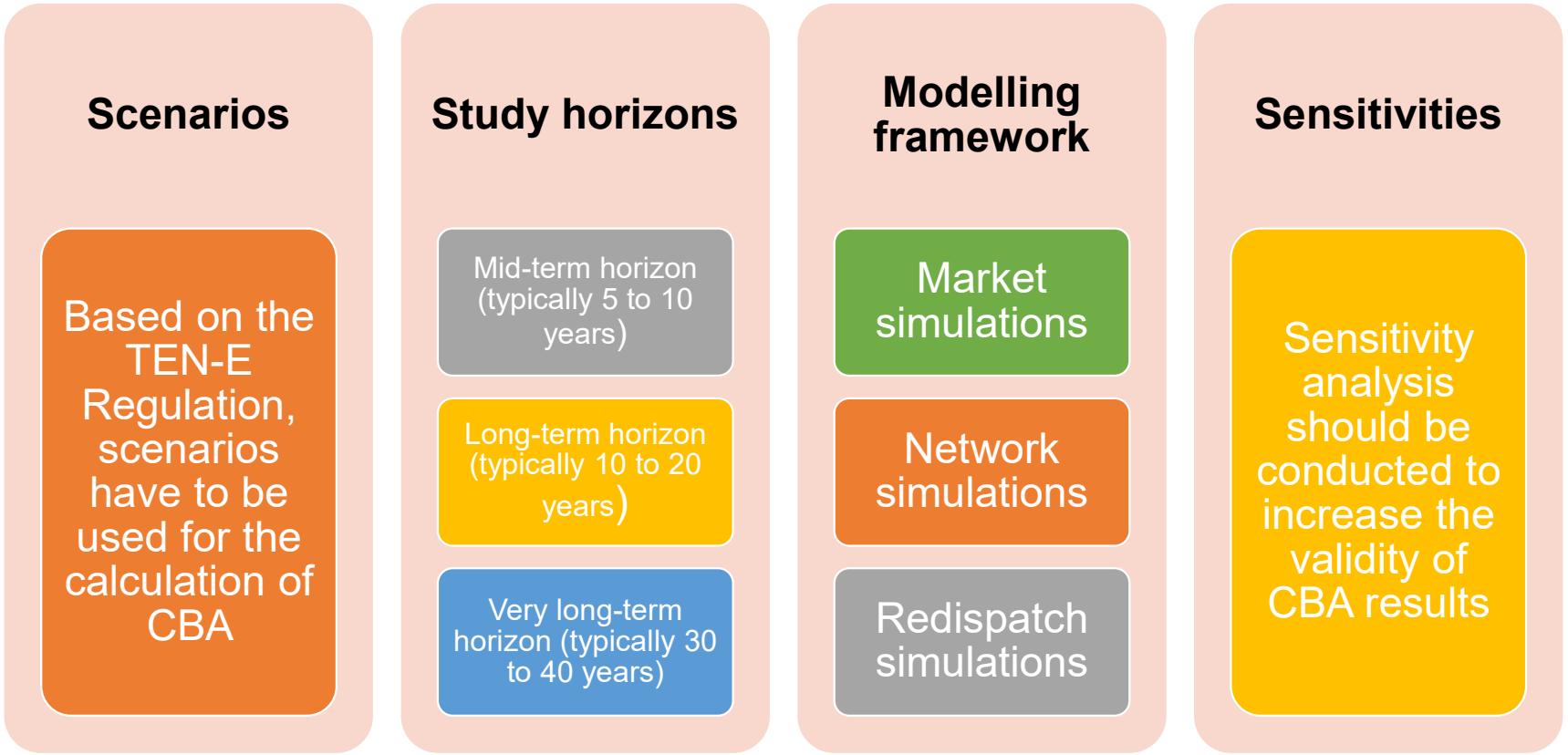
4th ENTSO-E Guideline for CBA of Grid Development Projects

General approach



4th ENTSO-E Guideline for CBA of Grid Development Projects

General assumptions for project assessment

- **Net Present Value (NPV) or Benefit-to-Cost Ratio (BCR)** are used to determine the viability of an investment
- Assessment period: **25 years**
- A common discount rate: **4%**
- The benefits are accounted from the first year after commissioning
- To evaluate projects on a common basis, benefits should be aggregated across the years, as follows:
  - For years from the first year after commissioning (i. e. the start of benefits) to the first mid-term: to extend the first mid-term benefits backwards;
  - For years between different mid-term, long-term and very long-term (if any): to linearly interpolate benefits between the time horizons; and
  - For years beyond the farthest time horizon: to maintain benefits of this farthest time horizon

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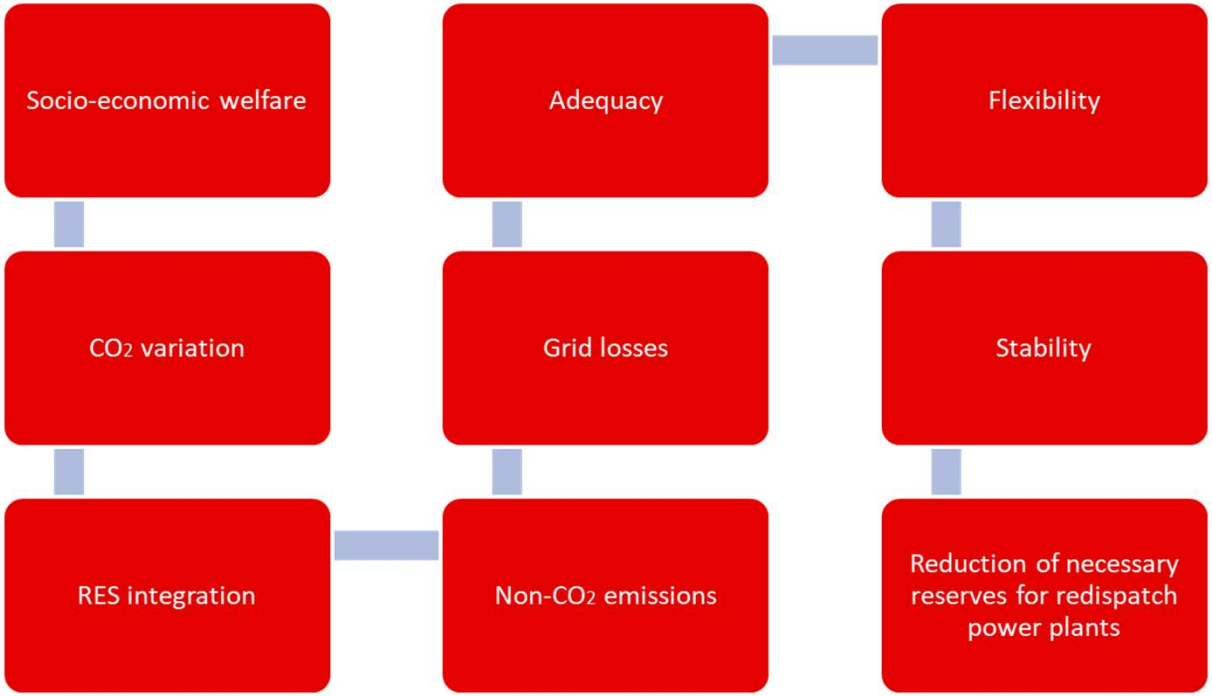
4th ENTSO-E Guideline for CBA of Grid Development Projects

Nine categories of possible benefits/indicators (B1-B9) for OHLs



- *Some indicators are developed to meet specific requirements of the TEN-E Regulation concerning market integration, security of supply (SoS) and sustainability*
- *Some indicators can be quantified and monetised, while others can only be qualitatively described*

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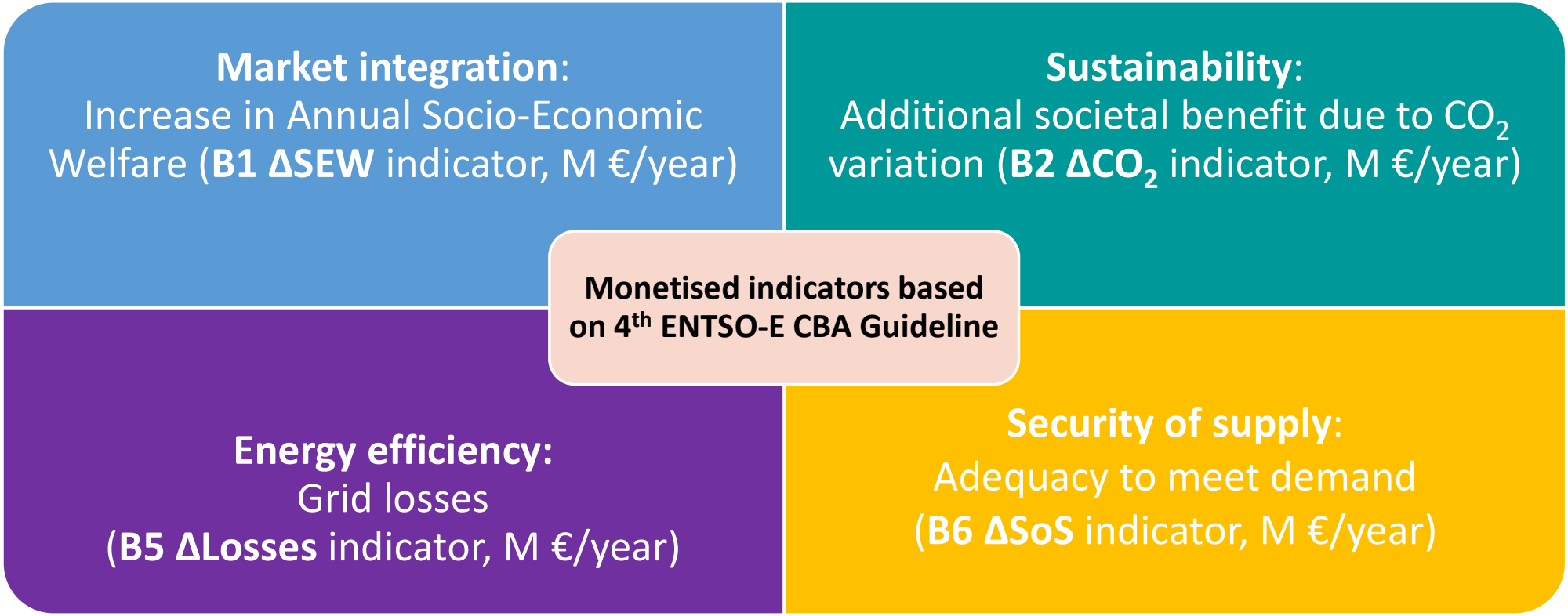
Benefits based on 4th CBA Guidelines



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Benefits based on 4th CBA Guidelines

B1. Socio – economic welfare (SEW)

- The indicator reflects the contribution of the project in increasing transmission capacity(ies) over the borders of the EnC CPs (excluding the EU Member States), making an increase in commercial exchanges possible so that electricity markets can trade power in a more economically efficient manner
- The monetisation of SEW is done in EUR/yr
- **Generation cost method** is used to monetize the increase in SEW, by determining a difference between the total generation costs in the power systems of EnC countries with and without the project, based on the PLEXOS market simulation results

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Benefits based on 4th CBA Guidelines

B2. Additional Societal benefit due to CO_2 variation

- The indicator is used to properly reflect the objectives of CO_2 emissions reduction
- To avoid double counting with the CO_2 variation already monetised into the SEW (B1) and the losses (B5), changes in CO_2 emission (without and with a project) are multiplied by the difference between the CO_2 societal cost and the ETS price used in the scenario
- CO_2 societal cost is assumed according to the high levels in the TYNDP 2024: **189 EUR/t in 2030 and 498 EUR/t in 2040**

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Benefits based on 4th CBA Guidelines

B5. Grid losses

- The indicator is used to reflect the changes in transmission system losses that can be attributed to a project
- The energy efficiency benefit of a project is measured through the change of thermal losses in the grid
- For the grid losses calculation, both market and network models are used
- In the network model the amount of losses (GWh) is calculated and then multiplied by marginal prices acquired from the market model in order to fully monetize this benefit

B6. SoS: Adequacy

- this indicator is calculated in case there is an occurrence of unserved energy in the modelling results and is then monetised by multiplying that unserved energy with the value of lost load (VoLL)

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Harmonised system-wide CBA for candidate energy storage projects

- **Harmonised system-wide cost-benefit analysis for candidate energy storage projects** was published by the European Commission in compliance with the requirements of the TEN-E Regulation
- The current methodology is used for candidate PCI energy storage projects and provides for a societal CBA with the use of monetised, quantified and qualitative indicators
- Taking account of the Guidelines for CBA of Grid Development Projects, the methodology is designed to be compatible in terms of benefits and costs with the CBA methodologies developed by the ENTSO-E

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Harmonised system-wide CBA for candidate energy storage projects

- CBA methodology for energy storage projects is similar to the ENTSO-E CBA methodology and recognises the following main benefits that must be calculated:
  - **Market integration:** increase in Annual Socio-Economic Welfare (**B1 ΔSEW** indicator, M €/year)
  - **Sustainability:** additional societal benefit due to CO_2 variation (**B2 ΔCO_2** indicator, monetised by using societal costs of CO_2 (M €/year))
  - **Security of supply:** adequacy to meet demand (**B8 ΔSoS** indicator, M €/year)
  - **Grid losses:** (**B5 ΔLosses** indicator, M €/year)

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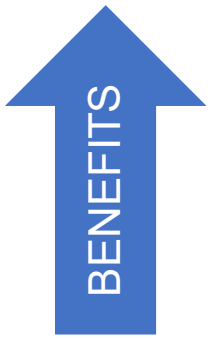
Methodologies for project assessment

Costs and benefits for electricity storage and overhead lines based on the relevant methodologies



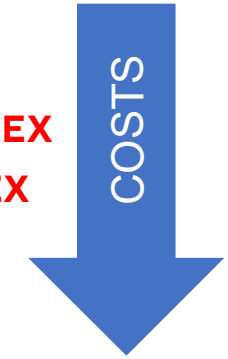
Market integration – socio-economic welfare (SEW)

Sustainability – CO_2 emissions variation

Security of supply – adequacy

Security of Supply – system stability

Savings due to the reduction of **grid losses**

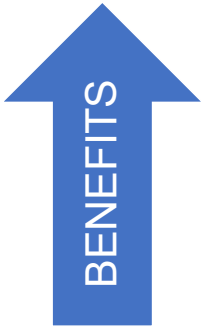


CAPEX

OPEX

High and extra-high voltage overhead transmission lines

Energy storage



Market integration – socio-economic welfare (SEW)

Sustainability – CO_2 emissions variation

Security of supply – adequacy

Security of Supply – balancing market services

Savings due to the reduction of **grid losses**

CAPEX

OPEX

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Multi-criteria analysis

- Along with monetised indicators, some indicators are given in the methodology as **non-monetized** that can be described qualitatively or quantified
- A combined **multi-criteria and CBA assessment** allows for a project evaluation based both qualitative assessments and quantified and monetised assessments to ensure that all the costs and benefits of a project are represented

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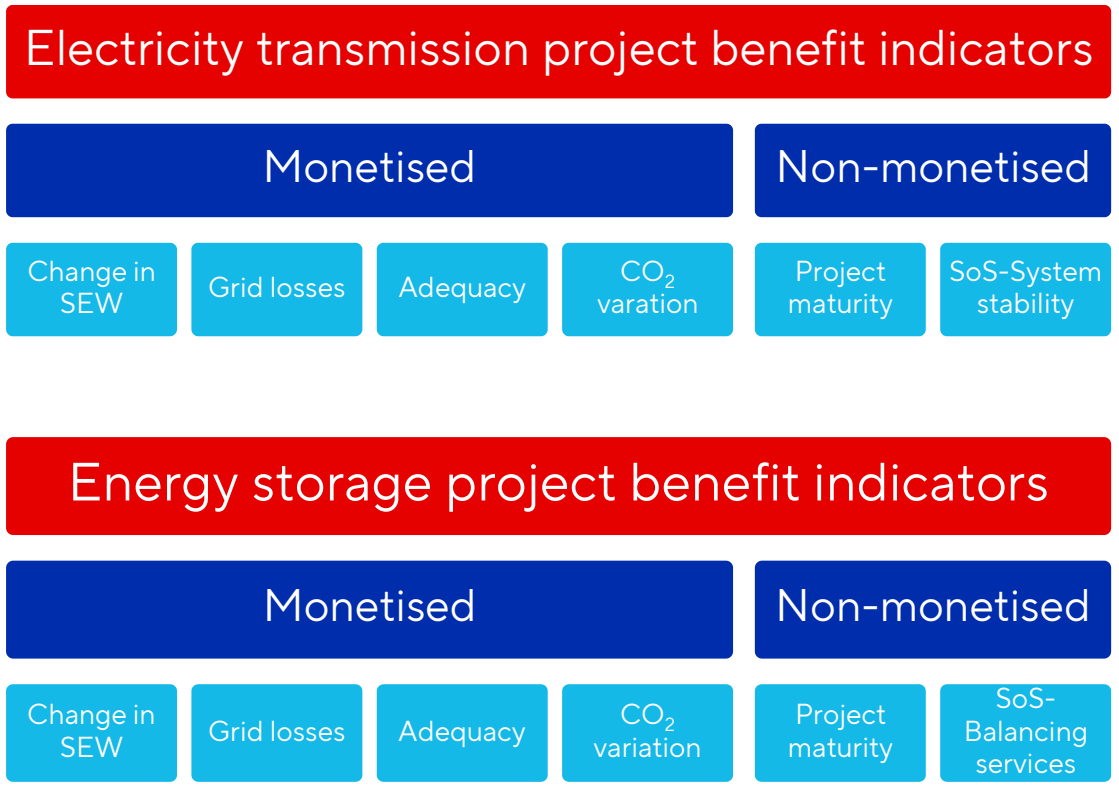
Multi-criteria analysis

Project assessment indicators

- Positive impact of the proposed project will be analysed within the **benefits defined by the relevant methodologies**
- The benefits, i.e. indicators that will be calculated in the project assessment process refer to **monetised, and non-monetised**
- **CBA and MCA analyses will address** both monetised and non-monetised indicators



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Structure of results

B/C ratio

- The **Benefit/Cost (B/C) ratio** – the present value of all monetised benefits divided by the present value of all project costs (CAPEX and OPEX)
- **Discount rate of 4%** is used
- If the B/C ratio is lower than one, then the project **does not comply with the general eligibility criterion** set out by the TEN-E Regulation
- For projects with B/C ratio higher than one, **points are allocated to enable project ranking** under the same infrastructure category
- **Maximum points** that a project can receive is **20**

Range of B/C ratio value	Points
1	10
1-2	11
2-3	12
3-4	13
4-5	14
5-6	15
6-7	16
7-8	17
8-9	18
9-10	19
>10	20

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Structure of results

SoS - System stability

- **System stability** – non-monetized indicator which shows quantitatively how much the project supports the voltage stability, transient stability and frequency stability
  - ✓ '0' - no change: the technology/project has no (or just marginal) impact on the respective indicator,
  - ✓ '+' - small to moderate improvement: the technology/project has only a small impact on the respective indicator,
  - ✓ '++' - significant improvement: the technology/project has a large impact on the respective indicator
- Data regarding this indicator requested **in the project questionnaire**
- According to the *4th ENTSO-E Guideline for Cost-Benefit Analysis of Grid Development Projects*, a project can attain a maximum of 5 '+'
- For small to moderate impact on system's stability ('+'), a **0.4 points** will be assigned, and for significant impact ('++'), **0.8 points** will be assigned
- A project that has a maximum impact of 5 '+' can be assigned with maximum of **2 points (5*0.4)**

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Structure of results

Project maturity

- **Project maturity** – determined based on the data about status/completion of project development phases delivered by the project promoters through project questionnaires
- For the completion of each project development phase a score of **0.5 point** is assigned
- A maximum of **5 points** can be received for completion of all project phases before the construction

Project development phase	Possible points for phase completion
Prefeasibility study	0.5
Technical feasibility study	0.5
Economic feasibility study (CBA)	0.5
Environmental impact assessment	0.5
Detailed design study	0.5
Resloved financing	0.5
Obtained approvals/permits	0.5
Approval by regulatory authority	0.5
Final investment decision	0.5
Tendering procedure	0.5

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Relative rankings of projects

- Based on the calculated total scores of each individual project a **relative ranking of all eligible projects** will be provided as the final output of the assessment
- The candidate project will be ranked if it proves **that its overall benefits outweigh its costs**
- For electricity transmission overhead lines and energy storage projects **a maximum of 27 points** can be assigned based on the indicator scoring
- The projects will be ranked from top to bottom in line with the total score, e.g. **from 27 points to 10 points** (which is a threshold for a project to be economically viable, e.g. to have B/C > 1)

Indicator	Maximum points
B/C ratio	20
SoS - System stability (OHL) or Balancing services (Storage)	2
Project maturity	5
TOTAL	**27**

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Thank you for your attention

Contacts:

Goran Majstrović, gmajstrovic@eihp.hr

Ivana Milinković Turalija, imilinkovic@eihp.hr

Lucija Išlić, lislic@eihp.hr

Dražen Balić, dbalic@eihp.hr

Energy Institute Hrvoje Požar

www.eihp.hr