# 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

*Inception Report*

Energy Institute Hrvoje Požar | Zagreb | 20 March 2024

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# Abbreviations and acronyms

| | |
|---|---|
| CAPEX | Capital Expenditures |
| CBA | Cost Benefit Analysis |
| CP | Contracting Party |
| DE | Distributed Energy |
| DSO | Distribution System Operator |
| EC | Energy Community |
| ENTSO-E | European Network of Transmission System Operators for Electricity |
| ENTSOG | European Network of Transmission System Operators for Gas |
| EU | European Union |
| GA | Global Ambition |
| JRC | Joint Research Centre |
| MCA | Multi criteria analysis |
| MS | Member State |
| NPV | Net Present Value |
| NT | National Trends |
| OPEX | Operating Expenditures |
| PECD | Pan European Climate Database |
| PECI | Projects of Energy Community Interest |
| PINT | Put In one at the Time |
| PMI | Projects of Mutual Interest |
| RES | Renewable Energy Sources |
| SEW | Socio-economic Welfare |
| TEN-E | Trans-European Networks for Energy |
| TOOT | Take Out One at a Time |
| TSO | Transmission System Operator |
| TYNDP | Ten Year Network Development Plan |

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# 1 Project objectives

In order to create conditions for an integrated energy market of the European Union (EU) and neighbouring countries, it is necessary to create good regulatory and market framework that would attract investments in energy infrastructure and enhance stability and sustainability of energy supply. Integrated energy market is one of the basic conditions for increasing security of supply.

In 2013 **Trans-European Networks for Energy (TEN-E)** was adopted through Regulation (EU) No 347/2013 of the European Parliament and of the Council on guidelines for trans-European energy infrastructure. The TEN-E policy focuses on linking the energy infrastructure of EU countries and defines eleven priority corridors and three priority thematic areas. Regulation 347/2013 was also adopted by the Ministerial Council Decision in the Energy Community in 2015.

The new **Regulation (EU) No 2022/869** (further in text: the Regulation), i.e. the revised TEN-E was adopted in the EU in June 2022, because of the need to ensure consistency with climate neutrality objectives. The Regulation contributes to EU emissions reduction objectives by promoting integration of renewable energy sources and new clean energy technologies into the energy system. It identifies eligible categories for energy infrastructure development projects and promotes better cooperation between countries, with the main objective **to ensure market and system integration** that benefits EU Member States. The same is valid for the Energy Community Contracting Parties (CPs), since revised TEN-E was adopted in the EnC by the Ministerial Council Decision 2023/02/MC-EnC of 14 December 2023.

Eligible energy infrastructure categories, with respect to the EnC adaptation of the original regulation, may be divided into two broader categories, **electricity-related and gas-related projects**, with the following specific eligible sub-categories:

- **Electricity-related energy infrastructure**
  - high and extra-high voltage overhead transmission lines, crossing a border or within a Member State territory including the exclusive economic zone, if they have been designed for a voltage of 220 kV or more, and underground and submarine transmission cables, if they have been designed for a voltage of 150 kV or more;
  - energy infrastructure for offshore renewable electricity;
  - energy storage facilities, provided they are directly connected to high-voltage transmission lines and distribution lines designed for a voltage of 110 kV or more;
  - any equipment or installation essential for the previous categories to operate safely, securely and efficiently, including protection, monitoring and control systems at all voltage levels and substations;
  - smart electricity grids involving at least two Member States;
  - any equipment or installation essential for the high and extra-high voltage

overhead transmission lines having dual functionality: interconnection and offshore grid connection system from the offshore renewable generation sites to two or more Member States;

- **Gas(es)-related energy infrastructure**
  - smart gas grids aiming to enable and facilitate the integration of a plurality of low-carbon and particularly renewable gases, including biomethane or hydrogen, into the gas network;
  - hydrogen systems, including pipelines for the transport of hydrogen, including repurposed natural gas infrastructure, reception/storage/regasification/ decompression facilities for liquefied hydrogen or hydrogen embedded in other chemical substances with the objective of injecting the hydrogen into the grid, any equipment or installation essential for the hydrogen system to operate safely, securely and efficiently or to enable bi-directional capacity, including compressor stations, any equipment or installation allowing for hydrogen or hydrogen-derived fuels use in the transport sector within the TEN-T core network;
  - electrolysers of at least 50 MW capacity;
  - carbon dioxide pipelines, fixed facilities for liquefaction, buffer storage and converters of carbon dioxide, surface and injection facilities for the permanent geological storage of carbon dioxide, any equipment or installation essential for the $CO_2$ system to operate properly, securely and efficiently, including protection, monitoring and control systems;

Based on the old TEN-E Regulation, three processes of the **Projects of Energy Community Interest (PECI)** and Projects of Mutual Interest (PMI)[1] were conducted in 2016, 2018 and 2020. These processes resulted in recommendations on the establishment of the list of PECI and list of PMI between Contracting Parties, within themselves and with the Member States of the European Union.

In line with the revised TEN-E, the new selection process for PECI projects started in February 2024. Potential eligible projects must involve **at least two Energy Community Contracting Parties** by directly or indirectly crossing the border thereof or be located on the territory of one Energy Community Contracting Party having a significant cross-border impact on at least another.

*The overall objective of the project is to enhance market integration, security of supply, sustainability and competition of the electricity and hydrogen/gas markets of the Energy Community Contracting Parties.*

The Consultant's task is **to assist Energy Community Secretariat (ECS) and the two Groups (related to electricity and gas(es)) in compiling the preliminary list of PECI projects to be approved by the Ministerial Council**. The main output of the entire process is the list of PECI

[1] *PMI projects are under EU process now, according to the revised TEN-E.*

projects to be submitted to the Ministerial Council for adoption in December 2024.

To this end, the Consultant will develop **a project-assessment methodology** which will be used to evaluate the impact of proposed projects on the Contracting Parties and the Energy Community as a whole. The methodology consists of **cost benefit analysis (CBA)** to assess socio-economic dimensions of the projects (monetization) in line with methodologies published by the European Network of Transmission System Operators (ENTSO) for Electricity and the ENTSO for Gas or developed by the European Commission, and of a **multi criteria analysis (MCA)** to evaluate other important contributions of the projects (non-monetary component) in line with the indicators defined in the Regulation. Both analyses and project impacts evaluation will cover time horizon until 2050 and shall be done in a manner that enables result comparison between individual projects and **relative ranking of the projects** in the different project categories.

## 1.1 Main project activities

In order to reach the final goal of the project, namely to draft the list of PECI, the Consultant will carry out the following **tasks/activities**:

1. **Create candidate project questionnaires** – preparation of the project-specific questionnaires for collection of the relevant input data (technical, economic, status and progress) for candidate projects;
2. **Create country-specific questionnaires** – preparation of the country-specific data questionnaires for collection of the relevant country input data for CPs;
3. **Validate collected data** – validation of the collected input data in terms of techno-economic consistency;
4. **Carry-out a project eligibility verification** - project eligibility verification based on the criteria defined in the Regulation, prior to modelling activities;
5. **Apply ENTSO-E and ENTSOG scenarios using modelling tool/s** – development of electricity and gas sector models and scenarios using appropriate modelling tools that enable project assessment considering regional market conditions and existing energy infrastructure of the CPs;
6. **Perform socio-economic cost-benefit analysis** – assessment of socio-economic monetary and non-monetary project benefits and costs, based on the methodologies defined in the Regulation;
7. Assess the **individual project candidates and compose relative rankings** - individual project assessment for each of the eligible project categories based on the results under previous activity and creation of relative rankings of all eligible projects.

The flowchart of the aforementioned tasks/activities is depicted in the following figure.

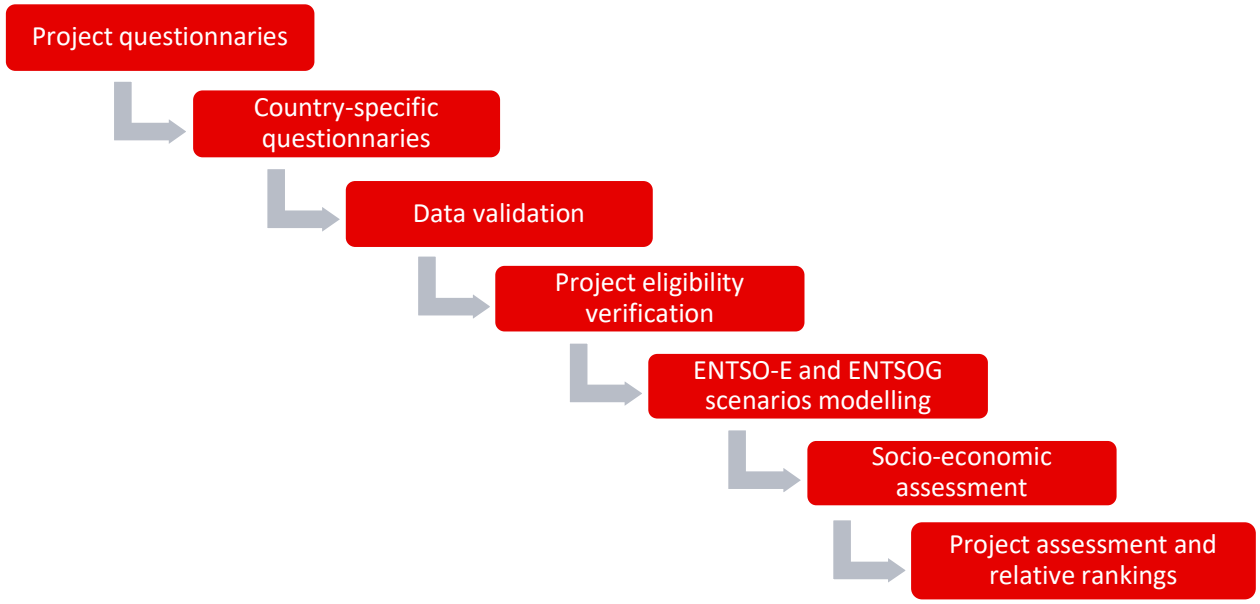


*Figure 1 Activities to be carried out during the project implementation*

## 1.2 Work plan and deliverables

The project started 15th of February 2024, and the planned finalization of all project activities is envisaged for 28th of June 2024. A detailed work plan with main project activities and deliverables is adjusted after the Kick-off meeting held on 16th of February 2024, in comparison to the work plan presented in the Technical Offer of the Consultant (presented in Figure 2).

| No | Activity | Begining | End | Duration (days) | February 2024 | | March 2024 | | | | April 2024 | | | | | May 2024 | | | | June 2024 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W10 | W11 | W12 | W13 | W14 | W15 | W16 | W17 | W18 | W19 |
| 1 | Kick-off meeting | 16/02/2024 | 16/02/2024 | 1 | ♦ | | | | | | | | | | | | | | | | | | |
| 2 | **Inception Report** preparation and submission | 16/02/2024 | 29/02/2024 | 10 | | ◆ | | | | | | | | | | | | | | | | | |
| 3 | 1st Groups' meetings | 07/03/2024 | 07/03/2024 | 1 | | | ♦ | | | | | | | | | | | | | | | | |
| 4 | Data Collection | 26/02/2024 | 08/04/2024 | 31 | | | | | | | | | | | | | | | | | | | |
| 5 | **Data Validation and Scenario Report** | 18/03/2024 | 15/04/2024 | 21 | | | | | | | | ◆ | | | | | | | | | | | |
| 6 | 2nd Groups' meetings | 18/04/2024 | 19/04/2024 | 2 | | | | | | | | | ♦ | | | | | | | | | | |
| 7 | Data and Scenario Finalization | 19/04/2024 | 03/05/2024 | 11 | | | | | | | | | | | | | | | | | | | |
| 8 | **Analysis Techniques' Guidance Document** | 19/04/2024 | 10/05/2024 | 16 | | | | | | | | | | | | ◆ | | | | | | | |
| 9 | 3rd Groups' meetings | 15/05/2024 | 16/05/2024 | 2 | | | | | | | | | | | | | ♦ | | | | | | |
| 10 | Project Assessment | 17/05/2024 | 14/06/2024 | 21 | | | | | | | | | | | | | | | | | | | |
| 11 | Assessment Results Consultation with the Secretariat | 12/06/2024 | 17/06/2024 | 4 | | | | | | | | | | | | | | | | | ♦ | | |
| 12 | 4th Groups' meetings | 19/06/2024 | 20/06/2024 | 2 | | | | | | | | | | | | | | | | | | ♦ | |
| 13 | **Final Report** preparation and submission | 22/04/2024 | 28/06/2024 | 50 | | | | | | | | | | | | | | | | | | | ◆ |

◆ Deliverables ♦ Meetings

*Figure 2 Work plan of project activities and deliverables*

Creation of project questionnaires and country-specific questionnaires will be implemented during the inception phase of the project. More detailed explanations on the questionnaires

are presented in section 2. The questionnaires will be used for the **data collection process**, which can be considered as the **first phase of the project**.

The **second phase of the project** will be implemented after the data collection process. Initial data set for candidate projects and countries will be used for **data validation and project eligibility verification**. Results of these activities will be presented in the *Data Validation and Scenario Report* (report on the collected project and country data, data validation process and compliance of the data with the proposed analysis, results of the project eligibility verification, description of defined scenarios). After data clarification/revision, collecting feedback on methodology, scenarios, data and assumptions, *Analysis Techniques' Guidance Document* will be finalized containing final description of the data, scenarios, applied methodologies and techniques, sensitivities to be carried out, and structure of results and indicators.

The **third phase of the project** will be **project assessment** process. Based on the defined methodology, data, assumptions, scenarios and sensitivities, a project specific socio-economic assessment will be made. In this phase, and for the purposes of projects' assessment, regional market and network models will be developed using appropriate modelling tools. A more detailed description of how the market and network models will be used to assess project benefits (such as using market models for assessing socio-economic welfare and using network models to assess the decrease in network losses) is described in 4.3.1. Project-specific, aggregated assessment results and sectoral relative rankings will be presented to the groups. This phase of the project will be finalized with the delivery of the *Final Report* containing summary of the applied methodology, scenarios, data and assumptions and detailed presentation and interpretation of the results for each analysed project in all scenarios and sensitivities.

The following sections of the *Inception Report,* present the Consultant's approach for implementation of the three specified project phases, namely data collection, data validation and eligibility verification, and project assessment.

# 2 Data collection

Under the first two activities of the project, the template questionnaires for eligible project categories and template questionnaires for country-specific data collection were created. Data collection process for candidate projects is necessary to collect input data for project validation and assessment. Data collection process for countries is necessary to collect techno-economic data on energy infrastructure in the CPs in which the projects should be located, as well as on the future energy infrastructure and market conditions. Such data enables development of regional market model and analysis of costs and benefits for each candidate project with regard to future regional market development of the CPs. Future market conditions in the CPs will be collected in line with the ENTSO-E and ENTSOG TYNDP 2022 joint development scenarios, which is in more detail addressed in section 4.2.3.

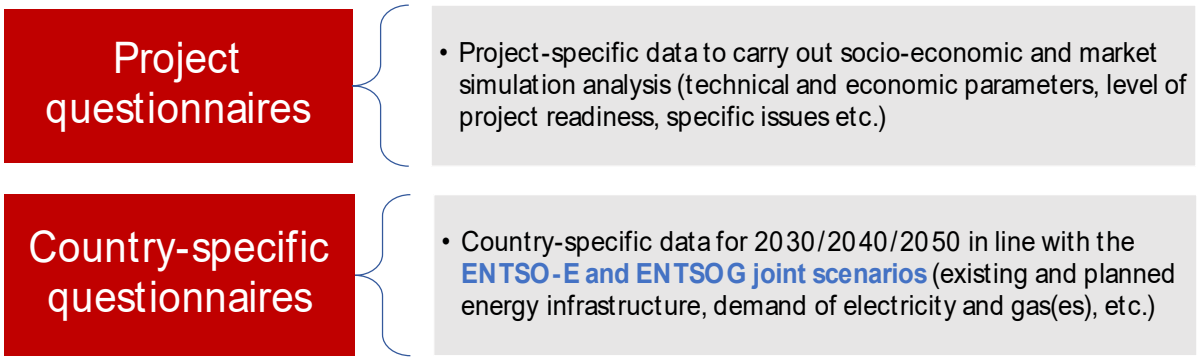


*Figure 3 Project and country-specific data collection*

The Consultant's previous experience in numerous regional assignments that implied questionnaires design and data collection, highlights the importance of up-to-date and good quality input data. Timely retrieved and complete data sets are critical in keeping planned dynamic of the project activities. In case there are some missing data the Consultant intends to use data from various sources, including publicly available data, upon agreement with the Secretariat and the two Groups established under the TEN-E Regulation.

## 2.1 Project-specific data

**Project questionnaires** are used to collect project-specific data from the project promoters for each of the eligible project categories defined in the Regulation. Eligible categories are listed in Table 1[2].

[2] *Under PECI 2024, energy infrastructure for offshore renewable electricity will not be considered.*

*Table 1 Eligible energy infrastructure project categories for PECI 2024 nomination*

| Electricity Infrastructure | Gas Infrastructure |
|---|---|
| a) high and extra-high voltage overhead transmission lines and underground and submarine transmission cables | a) smart gas grids |
| b) any equipment or installation falling under the energy infrastructure category referred to in point a) enabling transmission of offshore renewable electricity from the offshore generation sites | b) hydrogen-based technologies |
| c) energy storage facilities | c) electrolyser facilities |
| d) any equipment or installation essential for the systems referred to in points (a), (b) and (c) to operate safely, securely and efficiently, including protection, monitoring and control systems at all voltage levels and substations | d) carbon dioxide projects |
| e) smart electricity grids | |
| f) any equipment or installation falling under the energy infrastructure category referred to in point (a) having dual functionality: interconnection and offshore grid connection system from the offshore renewable generation sites | |

The project questionnaires include all the necessary project data to carry out socio-economic and market simulation analysis, in line with available assessment methodologies, divided into several categories that need to be filled-in by project promoters:

- **General data** – general information about the project, such as name, location, description of project benefits, data on project promoters, etc.
- **Technical data** – data on infrastructure type, investment type (new or upgrades), commissioning year, techno-economic parameters necessary for project assessment and (if applicable) project modelling, etc.
- **Cost data** – data on capital and operating expenditures expressed in real 2022 Euros (CAPEX and OPEX), and
- **Status data** – data on the current project status and progress, completed phases of the project, indicative implementation schedule, environmental impact, etc.

In total, the following seven template questionnaires were created based on the eligible project categories listed in Table 1:

1. Electricity Infrastructure,
2. Energy Storage Facilities,
3. Smart Electricity Grids,

4. Smart Gas Grids,
5. Hydrogen,
6. Electrolyser,
7. Carbon Dioxide.

Public invitation for project promoters together with the above listed project questionnaires were published by the Energy Community Secretariat on 26th of February 2024. Promoters had chance to submit their applications until 18th of March 2024.

## 2.2 Country-specific data

**Questionnaires for collection of country-specific data** are created to collect input data for Energy Community Contracting Parties, i.e. in the countries in which candidate projects have to be located. Collected input data will be used to develop market and network models of all CPs using appropriate software tools (more details in section 4.2) in order to assess candidate projects taking into account relevant market and infrastructural conditions in each country for the period until 2050.

Two separate country-specific template questionnaires are created for electricity and gas sectors.

Questionnaires regarding **electricity sector** contain following input data sections:

- **Thermal** – general information and techno-economic parameters about thermal power plants,
- **Hydro** – general information and techno-economic parameters about hydro power plants,
- **Wind and Solar** – information about total wind and solar capacities in 2030, 2040 and 2050,
- **Batteries** – general information and technical parameters about batteries,
- **Demand** – information about total electricity demand in 2030, 2040 and 2050,
- **NTC** - values of net transfer capacity on each border and each direction for 2030, 2040 and 2050.

Input data should be filled in considering joint ENTSO-E and ENTSOG TYNDP 2022 development scenarios (more details in section 4.2.3). A minimum set of data will be filled in the questionnaires in advance by the Consultant using the publicly available data and Consultant's in-house data and sent to CPs' representatives for their verification and update.

Questionnaires regarding **gas(es) sector** contain following input data sections:

- **Demand** – data on annual and hourly demand of gas and hydrogen,
- **Interconnections** – general information and techno-economic parameters about gas interconnections,
- **Storages** - general information and technical parameters about gas storages,
- **Fields** - general information and technical parameters about gas fields.

Country data for the countries that are not CPs will not be collected. For those countries, that are relevant to the assignment as the neighbouring markets to CPs, publicly available data sources (ENTSO-E and ENTSOG TYNDP 2022) and Consultant in-house data sets will be used.

# 3 Data validation and eligibility verification

## 3.1 Data validation

Under this activity, and in close cooperation with the Secretariat, the Consultant shall carry out **validation and if necessary, correction of the collected data for projects and countries**.

In terms of the candidate projects, project data validation consists of **technical and financial consistency checks** of the collected project data.

With regard to the technical consistency, the Consultant will assess if the compulsory technical project inputs were delivered, as well as their values, considering at minimum following parameters listed per eligible technologies:

- **Electricity Infrastructure:** infrastructure type, expected year of commissioning, expected lifetime, voltage, capacity, length of overhead lines, capacity of substations, expected increase of NTC values, etc.
- **Energy Storage Facilities**: infrastructure type, expected year of commissioning, expected lifetime, connection point, installed electric capacity, storage capacity, minimum and maximum reactive power, minimum and maximum charge/discharge capacities, etc.
- **Smart Electricity Grids:** expected year of commissioning, expected lifetime, contribution to the specific criteria listed in the Regulation, contribution to the specific criteria listed in *Harmonised system-wide cost-benefit analysis for candidate smart electricity grid projects* issued by the EU Commission, etc.
- **Smart Gas Grids:** expected year of commissioning, expected lifetime, contribution to the specific criteria listed in the Regulation, contribution to the specific criteria listed in *Harmonised system-wide cost-benefit analysis for candidate smart gas grid projects* issued by the EU Commission, etc.
- **Hydrogen:** infrastructure type, expected year of commissioning, expected lifetime, number of compressor stations and their power, connection point, etc.
- **Electrolyser:** infrastructure type, expected year of commissioning, expected lifetime, market status demand, nominal voltage, nominal capacity, etc.
- **Carbon Dioxide:** infrastructure type, expected year of commissioning, expected lifetime, pipeline length and diameter, number of compressor stations and their power, connection point, etc.

In addition to technical data, **general project data** for each candidate project shall be delivered, otherwise the project cannot be assessed. Mandatory project data refers to: project name, names of all project promoters, description of project and its potential benefits, and Contracting Parties in which the project is located. The Consultant will check and validate the quality of delivered data.

Furthermore, it will be assessed if the project promoters have delivered data regarding possible complementarity with other projects, to determine if there is any project clustering. Identification of project complementarities, competition among projects and project clustering will contribute to more sound economic modelling of proposed projects (e.g. two projects which are complementary might have greater economic value when assessed together as opposed to when each project is evaluated individually).

With regard to **financial consistency of the project data**, the Consultant will assess the proposed cost data (i.e. CAPEX and OPEX). The project costs are site specific, nevertheless, cost benchmarking is necessary and can give immediate insight into data inconsistency. To this end, the Consultant will benchmark provided costs data to verify that values fall within an expected range. Based on its experience in the region in evaluating projects in gas and electricity infrastructures, the Consultant has built a considerable database of project related costs which will be used to benchmark proposed project costs. The Consultant will also use publicly available costs data such as ACER Report[3] and Projected Costs of Generating Electricity (IEA/NEA)[4]. Values outside of the expected range will be assessed in detail and where necessary additional information required (e.g. which categories of costs were taken into account under investment).

Data validation for country-specific data will be also assessed based on the Consultants extensive experience in data collection and modelling of energy sector in the CPs for existing and future period. Thus, where inconsistencies appear, the additional information will be required and data correction proposed.

The correction of missing/not validated project data shall be organized by the Consultant in cooperation with the Secretariat outside the Groups' meetings, on bilateral basis with the entities that provided the data (project promoters/national authorities).

## 3.2 Project eligibility verification

In this phase of the Project, The Consultant shall carry out **project eligibility verification** based on the criteria defined in the Regulation, and prior to the modelling activities. The data delivered by the project promoters will be assessed to determine if each candidate project satisfies following **general eligibility criteria**:

- it involves at least two Contracting Parties by directly or indirectly, via interconnection with a third country, crossing the border of two or more Contracting Parties;
- it is located on the territory of one Contracting Parties, either inland or offshore, including islands, and has a significant cross-border impact.

The projects that satisfy general eligibility criteria will be further assessed for additional specific criteria per different energy infrastructure categories based on the TEN-E Regulation

[3] *Unit Investment Cost Indicators - Project Support to ACER, 14 June 2023*

[4] *Projected costs of generating electricity, IEA/NEA, 2020 Edition*

and relevant methodologies to determine if the project is eligible for further analyses (CBA, MCA).

Eligibility criteria that shall be assessed are listed hereinafter, per different project categories type:

- for **electricity transmission**: the project increases the grid transfer capacity, or the capacity available for commercial flows, at the border of that CP with one or several other CPs, or at any other relevant cross-section of the same transmission corridor having the effect of increasing this cross-border grid transfer capacity, by at least 500 MW compared to the situation without commissioning of the project;
- for **electricity storage**: the project provides at least 225 MW installed capacity and has a storage capacity that allows a net annual electricity generation of 250 GWh/year;
- for **smart electricity grids**: the project is designed for equipment and installations at high-voltage and medium voltage level, and involves TSOs, TSOs and DSOs, or DSOs from at least two CPs; the project should satisfy at least two of the following criteria: it involves 50 000 users, generators, consumers or prosumers of electricity, it captures a consumption area of at least 300 GW hours/year, at least 20% of the electricity consumption linked to the project originates from variable renewable resources, or it decreases energy isolation of non-interconnected systems in one or more CPs;
- for **smart gas grids**: the project involves TSOs, TSOs and DSOs, or DSOs from at least two CPs. DSOs may be involved, but only with the support of the TSOs of at least two CPs that are closely associated to the project and ensure interoperability;
- for **hydrogen**: hydrogen transmission - the project enables the transmission of hydrogen across the borders of the CPs concerned, or increases existing cross-border hydrogen transport capacity at a border between two CPs by at least 10% compared to the situation prior to the commissioning of the project, and the project sufficiently demonstrates that it is an essential part of a planned cross-border hydrogen network and provides sufficient proof of existing plans and cooperation with neighbouring countries and network operators or, for projects decreasing energy isolation of non-interconnected systems in one or more CPs, the project aims to supply, directly or indirectly, at least two CPs; hydrogen storage or hydrogen reception facilities - the project aims to supply, directly or indirectly, at least two CPs;
- for **electrolysers**: the project provides at least 50 MW installed capacity provided by a single electrolyser or by a set of electrolysers that form a single, coordinated project and brings benefits directly or indirectly to at least two CPs,
- for **carbon dioxide** projects: the project is used to transport and, where applicable, store anthropogenic carbon dioxide originating from at least two CPs.

In case of unclear or missing information in submitted project questionnaires that enable project eligibility verification according to the listed criteria, the Consultant shall contact project promoters to deliver complete data set.

# 4 Project assessment

After the data collection process, data validation and verification, a final (validated) data sets regarding candidate projects and countries will be used in the project assessment phase. In this section, approach and methodology for assessing project is presented in brief, referring primarily to market model assumptions, modelling scenarios, approach for multi-criteria analysis and relative rankings for each infrastructure category.

## 4.1 General approach

General approach for candidate project assessment consists of the following steps:

- **Development of reference scenario**, against which all projects will be assessed,
    - Each project will be added to the reference scenario to determine its benefits (*PINT modelling approach*[5]) until 2050,
- **Determination of socio-economic monetary and non-monetary benefits and costs** for each project (project-specific CBA and MCA),
- **Comparison of individual project** assessment results between projects in the same project category and proposition of **relative project rankings.**

In order to apply methodology for project assessment it is necessary to develop electricity and gas sector models using appropriate modelling tools that enable project assessment considering **regional market conditions** and energy infrastructure of the Contracting Parties. Thus, the Consultant shall develop regional energy model of the electricity and gas systems of CPs using **PLEXOS Energy Modelling software**[6] (further in text: PLEXOS). PLEXOS enables modelling of many different parts of the energy sector, including electricity, gas, storages, hydrogen and other. The model simulates the behaviour of the system and market by trying to meet the demand at least cost over the planning horizon, respecting all the imposed constraints. In other words, **the objective of the optimization function is to minimize the total system cost** by taking into account various characteristics and constraints of the system and market.

To determine costs and benefits of the project, a **reference case, i.e. reference scenario** has

[5] *Put IN one at the Time (PINT) is a methodology that considers each new investment/project on the given network structure one-by-one and evaluates the results with and without the examined network investment/project reinforcement.*

[6] *Detailed characteristics of all production units and fundamentals in the market can be modelled. The model accounts for both the technical and economic operation of the system characteristics. In addition to the techno-economic input data, energy demand forecasts, RE production profiles, fuel prices, etc. can also be provided as inputs to the model.*

to be established (against which all projects will be assessed). Reference case assumes energy system without any of the project candidates, and simulation results for this case will be used for comparison with scenario with the project, to calculate the benefits of adding a certain project into the system.

In addition to the PLEXOS model, for electricity sector candidates, **PSS/E model** that enables detailed electricity network modelling, will be used to determine benefits such as impact of the project to network losses.

While some benefits of the projects will be determined based on the modelling results, there will also be benefits that will be assessed based on the data sent by the project promoters, depending on specific assessment criteria set out in the respective methodologies. The methodologies that will serve as the basis for project assessment are:

- **CBA Methodologies of the ENTSO-E and ENTSOG**
    - *4th ENTSO-E Guideline for Cost-Benefit Analysis of Grid Development Projects, April 2023,*
    - *2nd ENTSOG Methodology for Cost-Benefit Analysis of Gas Infrastructure Projects, February 2019,*
- Methodologies developed and published by the **European Commission**
    - *Harmonised System Wide Cost-Benefit Analysis for Candidate Electrolyser Projects, May 2023,*
    - *Harmonised System Wide Cost-Benefit Analysis for Candidate Hydrogen Projects, May 2023,*
    - *Harmonised System Wide Cost-Benefit Analysis for Candidate Smart Gas Grid Projects, May 2023,*
    - *Harmonised System Wide Cost-Benefit Analysis for Candidate Smart Electricity Grid Projects, May 2023,*
    - *Harmonised System Wide Cost-Benefit Analysis for Candidate Cross-Border Carbon Dioxide Network Projects, May 2023,*
- Other methodologies developed by the EU Commission (like Methodology for assessing the electricity and offshore infrastructure candidate PCI and PMI 1st Union PCI-PMI list 2023) and previously developed methodologies at the EnC level used for the selection of former PECI/PMI projects in the Energy Community.

Based on the results of quantitative as well as qualitative analysis, individual project assessment will be made for each of the eligible project categories. Each of the criteria evaluated in a specific project category will have a certain weight in the total possible score. 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 Consultant, in cooperation with the Energy Community Secretariat, will also consider whether the energy efficiency first principle is applied as regards the establishment of the

regional infrastructure needs and as regards each of the candidate projects, and share its opinion with the PECI Groups. Possible solutions such as demand-side management, market arrangement solutions, implementation of digital solutions, and renovation of buildings will be particularly assessed, in order to estimate are such solutions more cost-efficient on a system wide perspective than the construction of new supply side infrastructure.

## 4.2 Market model framework and assumptions

This section explains main market modelling assumptions that are proposed in the *Service Specifications* or by the Consultant in the inception phase of the project. All assumptions have to be approved by the Groups, so the final set of modelling inputs (data and assumptions) will be determined after the inception phase and presented in the *Analysis Techniques' Guidance Document*.

Main input data for market models refer to: techno-economic parameters on all generators (existing and planned), both for conventional and renewable technologies, network constraints, demand profiles, fuel and $CO_2$ prices, specific scenario assumptions, data on external markets.

### 4.2.1 Geographical scope

The developed market model will include systems of Contracting Parties: Albania, Bosnia and Herzegovina, Kosovo*, Moldova, Montenegro, North Macedonia, Serbia, Ukraine and Georgia.


*Figure 4 Geographical scope of regional market model in PLEXOS*

These countries will be modelled on a detailed **unit-by-unit level** based on the collected input data through country-specific questionnaires, and based on the previous experience of the

Consultant in modelling these countries. In case of missing data for unit-by-unit level approach, the Consultant will model generation technologies clustered on a technology level.

In addition to the Contracting Parties, their neighbouring countries/markets (as presented in Figure 4) shall also be considered based on the best available data (primarily ENTSO-E and ENTSOG) and extensive experience of the Consultant in modelling these countries. Depending on the data availability, some countries will be presented on a unit-by-unit level (e.g. Croatia, Bulgaria, Romania, Greece), while others will be modelled on a technology level (e.g. Hungary, Italy, Slovakia and Poland).

Power systems of other countries, that have borders with neighbouring countries of CPs, such as Austria, shall be considered in regional PLEXOS model as spot markets. Hourly market prices are supposed to be insensitive to price fluctuations in the CPs region and its neighbouring countries. Electricity exchange between external spot markets and the CPs region and their neighbouring market areas will be modelled to be constrained with actual transmission capacities.

### 4.2.2 Time horizon

The time horizon will cover period until 2050, analysing in particular three time-frames: 2030, 2040 and 2050. For the periods between selected years, linear interpolation will be used for CBA.

### 4.2.3 Modelling scenarios

According to the *Service Specifications* scenarios that will be modelled have to be in line with the latest joint ENTSO-E and ENTSOG scenarios developed under Ten Year Network Development Plan 2024 or 2022 (depending on the data availability of TYNDP 2024). Given that final report and datasets for the TYNDP 2024 have not been published yet, the data from the **TYNDP 2022 will be used**. This primarily refers to the scenarios that will be modelled as the reference cases for the period until 2050.

Under the TYNDP 2022 the **National Trends (NT)** scenario reflects national energy and climate policies (NECPs, national long-term strategies, hydrogen strategies…) based on the joint European targets. NT scenario should be used for modelling 2030 and 2040 horizon, while for the later periods in the horizon, i.e. 2050, **Distributed Energy (DE)** scenario should be used.

Once the **reference case** is implemented based on the TYNDP 2022 scenarios, the PINT modelling approach will be used to assess the impacts of each project to the system costs and benefits.

### 4.2.4 Fuel and $CO_2$ prices

Fuel and $CO_2$ prices are important input parameters in market models. These parameters have

impact on marginal generation costs of thermal units, and thus affect the optimal dispatch of all units in the system. They have impact on total generation costs, as well as on the level of $CO_2$ emissions, which are the parameters directly related to determination of socio-economic welfare in the project assessment process (more details in section 4.3).

For the reference case, it is proposed to use the TYNDP 2022 values for fuel and $CO_2$ prices, as presented in Table 2 and Table 3, i.e. values for NT scenario in 2030 and 2040, and for DE scenario in 2050.

These values can be subject to **sensitivity analysis** if necessary.

*Table 2 Fuel prices common to all scenarios (TYNDP 2022)*

| €/GJ | 2030 | 2040 | 2050 |
|---|---|---|---|
| Nuclear | 0.47 | | |
| Biomethane | 20.74 | 16.94 | 13.97 |
| Shale Oil | 1.86 | 2.71 | 3.93 |
| Lignite: | | | |
| - Group 1 (BG, MK and CZ) | 1.40 | | N.a |
| - Group 2 (SK, DE, RS, PL, ME, UK, IE and BA) | 1.80 | | N.a |
| - Group 3 (SI, RO and HU) | 2.37 | | N.a |
| - Group 4 (GR and TR) | 3.10 | | N.a |

*Source: TYNDP Scenario Building Guidelines, April 2022*

*Table 3 Fuel and $CO_2$ prices per scenarios and horizons (TYNDP 2022)*

| | Unit | Scenarios | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|
| $CO_2$ | €/tonne | NT | 70 | 90 | N.a |
| | | DE and GA[7] | 78 | 123 | 168 |
| Hard coal | €/GJ | NT | 2.48 | 2.41 | N.a |
| | | DE and GA | 1.97 | 1.92 | 1.87 |
| Light oil | | NT | 13.78 | 15.41 | N.a |
| | | DE and GA | 10.09 | 9.61 | 9.12 |
| Natural gas | | NT | 6.23 | 6.90 | N.a |
| | | DE and GA | 4.02 | 4.07 | 4.07 |
| Biomethane | | NT | 20.74 | 16.94 | N.a |
| | | DE and GA | 20.74 | 16.94 | 13.97 |
| | | NT | 28.09 | 23.35 | N.a |

[7] *Global Ambition – another ENTSO-E scenario in 2050 that will not be analysed.*

| | | | | | |
|---|---|---|---|---|---|
| Synthetic methane | | DE and GA | 28.96 | 23.35 | 18.09 |
| Renewable H2 imports | | NT | 20.25 | 16.08 | N.a |
| | | DE and GA | 20.63 | 16.08 | 12.52 |
| Decarbonised H2 imports | | NT | 20.25 | 16.08 | N.a |
| | | DE and GA | 17.11 | 17.55 | 17.91 |

*Source: TYNDP Scenario Building Guidelines, April 2022*

### 4.2.5 Selection of climatic year

Electricity demand is used as input data in the form of hourly load profiles for each country and each analysed year. In the TYNDP 2022, hourly demand profiles are available for 35 climatic years (from 1982 to 2016). Given that the **year 2009** is selected as the most representative year in TYNDP 2022, the Consultant proposes to use load profiles for this year.

The same year is proposed for the hourly profiles of the RES generation, available in PECD (Pan European Climate database) that are also used as input data to PLEXOS model for wind and solar power plants.

## 4.3 Cost – benefit and multi-criteria analysis

Projects that have been deemed eligible for further analysis have to be assessed for its socio-economic monetary and non-monetary project benefits and costs. Chapter 3.2 describes the conditions under which the projects submitted for the PECI process are considered eligible and in this Chapter the process of cost-benefit and multi-criteria analysis that will be performed on eligible projects is described. The result of the full CBA and multi-criteria analysis is to perform a socio-economic assessment of the project, while the goal of the socio-economic assessment is to determine the net benefits a project brings to the society. The general principle of the CBA is that the net benefits (difference between economic benefits and economic costs) are evaluated at the level of the society, hence transfers between various market participants should not be taken into account as they do not contribute to increasing the economic welfare of the society.

Cost-benefit and multi-criteria analysis are done in unison in order to ensure a full assessment of all benefits, both monetized and non-monetized. Non-monetized benefits are quantified in their typical physical units (i.e. tons or GWh). CBA generally focuses on a unique criterion (the maximisation of socio-economic welfare), while multi-criteria analysis is a tool for dealing with a set of different objectives that cannot be aggregated through shadow prices and welfare weight[8].

[8] *EC Guide to Cost-Benefit Analysis of Investment Projects, Economic appraisal tool for Cohesion Policy 2014-2020*

Multi-criteria approach is also aimed at recognizing the different goals of different projects, for example one project might be focused on increasing the integration of RES into the grid, while another project's goal might be an increase in the security of supply by means of connecting highly flexible generation units. This will all be taken into account while performing the CBA and multi-criteria analysis for eligible projects. While many indicators that can be used for the multi-criteria analysis are part of methodologies and will be described in following sub-chapters, one of the additional proposed multi-criteria indicators for project assessment is **project maturity** that indicates the level of completeness of each project. The purpose of including project maturity index is to acknowledge the fact that projects that have reached a high level of preparation, are very likely to be undertaken and therefore should be higher on the ranking list. Project maturity will be determined based on delivered data by project promoters about completed project phases.

In order to be able to rank the projects according to socio-economic assessment, project benefits will be calculated using market and network models where applicable, using the corresponding methodologies described below.

In addition to benefits, **costs (CAPEX and OPEX)** will be assessed based on the collected data through the questionnaires. The CAPEX of an investment includes: the expected costs for permits, the feasibility studies, the design and land acquisition, the expected cost for equipment, the materials and execution costs, the expected costs for temporary solutions which are necessary to realize a project, the expected environmental and consenting costs, the expected costs for devices that have to be replaced within the given period and the dismantling costs at the end of the equipment life-cycle.

The OPEX of an investment includes the expected annual maintenance costs and the expected annual operation costs. It does not include the losses which are considered in the benefits side of calculation regarding the methodology, but which can be appointed in both directions, bringing benefits but sometimes costs as well.

Total costs of the project will be compared to total calculated benefits to calculate **Net Present Value (NPV) of benefits and costs and Benefit/Cost** ratio of the eligible project, which can then be compared and ranked.

Also, according to the Regulation, each CBA has to include **sensitivity analysis** with regard to the input data set, such as cost of $CO_2$ emissions, expected development of demand and supply, the commissioning date of various projects in the same area of analysis, climate impacts and other relevant parameters. Final parameters for sensitivity analysis will be determined in cooperation with Secretariat and the Groups.

### 4.3.1 Electricity sector

In the electricity sector, several categories of projects can be found eligible for application. Those are:

- **high and extra-high voltage overhead transmission lines**, crossing a border or within a Contracting Party territory including the exclusive economic zone, if they have been

designed for a voltage of 220 kV or more, and underground and submarine transmission cables, if they have been designed for a voltage of 150 kV or more;

- **energy storage facilities**, provided they are directly connected to high-voltage transmission lines and distribution lines designed for a voltage of 110 kV or more;
- any **equipment or installation** essential for the previous categories to operate safely, securely and efficiently, including protection, monitoring and control systems at all voltage levels and substations;
- **smart electricity grids** involving at least two Contracting Parties.

To assess electricity projects, aside to the electricity market model developed in PLEXOS, the electricity **network model will be developed using PSS/E tool**. Electricity market and network models will be aligned and synchronized in order to provide comprehensive and harmonized assessment of electricity infrastructure projects. Simultaneous application of electricity market and network models will allow complete project assessment and more accurate calculation of various project benefits.

For each of these categories, there is a specified CBA methodology mentioned in previous sections. In the following subsections there is additional explanation of possible benefits for each electricity sector category.

#### 4.3.1.1 High and extra-high voltage overhead transmission lines and corresponding equipment

For overhead transmission lines project assessment categories are described in the *ENTSO-E Guideline for Cost Benefit Analysis of Grid Development Projects*. This guideline defines nine categories of possible benefits that a construction of overhead transmission line can obtain. They are shown in the Figure 5.

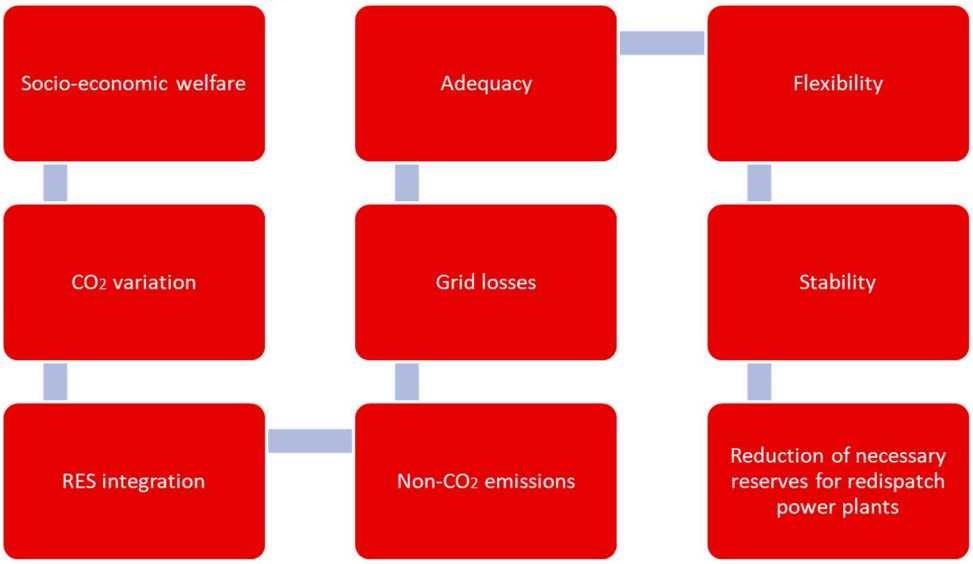


*Figure 5 Project benefits for grid development projects*

Out of these project benefits, some can be quantified and monetised, while others can only

be qualitatively described. Through the use of synchronized market and network models, the following indicators will be monetised:

- **Socio – economic welfare (SEW)** – this will be assessed through the contribution of the project or investment to increasing transmission capacity, making an increase in commercial exchanges possible so that electricity markets can trade power in a more economically efficient manner. Monetisation of SEW is done in EUR/yr. For this project, **generation cost method will be used to monetize the increase in SEW**. This method compares the generation costs with and without the project for the different bidding areas.
- **$CO_2$ variation** – shall be assessed through the change in $CO_2$ emissions produced by the power system due to the project.
- **Grid losses** – shall be assessed through the cost of compensating for thermal losses in the power system due to the project. For the grid losses calculation, both market and network models will be used – in the network model the amount of losses (GWh) will be calculated and then multiplied by marginal prices acquired from the market model in order to fully monetize this benefit.

Other benefits will not be monetized but can be qualitatively described. Some indicators, such as **RES integration**, which measures reduction of renewable generation curtailment in MWh (avoided spillage) and/or the additional amount of RES generation that is connected by the project in MW, can relatively easily be qualitatively described, and some indicators recognized by the ENTSO-E methodology are considered non-mature, i.e. the methodological description has not achieved a sufficient level of maturity and therefore those indicators will not be described in detail for eligible projects, unless project promotors present relevant data on these indicators. Those are Flexibility indicators (Balancing energy exchange and Balancing capacity exchange), and Stability indicators (Frequency Stability, Black start services, and Voltage/reactive power services).

#### 4.3.1.2 Energy storage facilities and corresponding equipment

The assessment methodology for the storage projects is based on the CBA methodology defined by the EU Commission. Indicators that will monetized using the same modelling approach as in the previous chapter are:

- **Socio-economic welfare (SEW)** – this benefit will also be calculated from the results of the market model using the generation cost approach.
- **$CO_2$ variation –** same as in previous section, this indicator will be calculated using the market model and comparing the change in $CO_2$ emissions produced by the power system due to the project.
- **Grid losses –** the same methodology as previously mentioned will be used for the calculation of grid losses, using the network model for the calculation of the amount of losses and the market model for the marginal prices.

Additionally, several additional indicators such as **reduction of non-CO2 emissions**, **security of supply – balancing market services** and **adequacy to meet demand** can be assessed and described to further qualify the project, which will be done if project promoters present

sufficient data for their qualification.

#### 4.3.1.3 Smart electricity grids

Smart electricity grids are another electricity-related category eligible for PECI submission. As established in the Regulation, smart electricity grid projects should always facilitate the integration of the behaviour and actions of all connected users and the uptake of large amounts of renewables, and should provide support in areas in line with the specific criteria, such as the integration of distributed energy resources, enabling demand response by conventional and new flexibilities including electric vehicles or energy storage; the facilitation of new business models including renewable energy communities and aggregators; the facilitation of new market structures such as market-based congestion management or V2G flexibility provision in balancing markets; the inclusion of innovative technologies that provide for a more efficient system operation and increase cross-zonal capacity; smart sector integration such as the interlink between smart electricity grids and heat systems based on heat pumps or district heating; the inclusion of cyber-security systems and technologies. Methodology for cost-benefit analysis for smart electricity grids, defined by the EU Commission, takes into account all of these characteristics of smart electricity grids, with 19 associated benefits that are recognized in the Methodology. Those benefits divided into four categories are:

1. **Sustainability**
   - Increase of electricity generated from new renewable sources
   - Reduction of greenhouse emissions
2. **Security of Supply**
   - Level of losses in transmission and distribution networks
   - Percentage utilisation (i.e. average loading) of electricity network components
   - Availability of network components (related to planned and unplanned maintenance) and its impact on network performances
   - Duration and frequency of interruptions, including climate-related disruptions
3. **Market integration**
   - Efficient and innovative system operation
   - Decrease of energy isolation and (increased) interconnection
   - Level of integrating other sectors and facilitating new business models and market structures
4. **Network security, flexibility and quality of supply**
   - Innovation
   - Flexibility, balancing, demand response and storage
   - Peak demand reduction
   - Cybersecurity
   - Efficient operability between TSO and DSO levels
   - Energy efficiency
   - Cost-efficient use of digital tools and ICT for monitoring and control purposes
   - Stability of the electricity system

- Voltage quality performance

5. **Smart sector integration**
   - Linking of energy carriers and sectors and favouring synergies and coordination between sectors.

Contribution of each eligible project to these benefits will be taken from project specific questionnaires, in which the instructions for determining each of these benefits are given in detail to project promoters. It is not expected that every eligible project will participate in all 19 benefits, but they all must always calculate the sustainability benefits (at least the **Increase of electricity generated from new renewable sources**) and benefits from at least two of the four remaining specific criteria.

### 4.3.2 Gas sector

For the calculation of benefits attributed to eligible projects from the gas sector, gas market model will be developed using PLEXOS, i.e. the same platform used for electricity projects.

Same as in the electricity sector, several categories of gas projects can be eligible for application. Those are:

- **smart gas grids** aiming to enable and facilitate the integration of a plurality of low-carbon and particularly renewable gases, including biomethane or hydrogen, into the gas network;
- **hydrogen systems**, including pipelines for the transport of hydrogen, including repurposed natural gas infrastructure, reception/storage/regasification/ decompression facilities for liquefied hydrogen or hydrogen embedded in other chemical substances with the objective of injecting the hydrogen into the grid, any equipment or installation essential for the hydrogen system to operate safely, securely and efficiently or to enable bi-directional capacity, including compressor stations, any equipment or installation allowing for hydrogen or hydrogen-derived fuels use in the transport sector within the TEN-T core network;
- **electrolysers** of at least 50 MW capacity;
- **carbon dioxide pipelines**, fixed facilities for liquefaction, buffer storage and converters of carbon dioxide, surface and injection facilities for the permanent geological storage of carbon dioxide, any equipment or installation essential for the $CO_2$ system to operate properly, securely and efficiently, including protection, monitoring and control systems.

For each of these categories, there is a specified CBA methodology mentioned in previous sections. In the following subsections there is additional explanation of possible benefits for each gas sector category.

#### 4.3.2.1 Smart gas grids

Smart gas grids are new to the PECI process, same as smart electricity grids. The methodology for estimation of smart gas grid projects has also been developed by JRC. This methodology

recognizes seven categories of benefits divided into four specific criteria. Those are:

1. **Sustainability**
   - Variation of GHG emissions
   - Variation of non-GHG emissions
   - Detection of methane leakage
2. **Network security and quality of supply**
   - Variation of the share of renewable and low-carbon gases integrated into the gas network
   - Reduction of curtailed gas demand
3. **Market functioning and customer services**
   - Increase of socio-economic welfare in the gas system
4. **Smart energy sector integration**
   - Cross sectoral cost savings.

Contribution of each eligible project to these benefits will be taken from project specific questionnaires, in which the instructions for determining each of these benefits are given in detail to project promotors. While not all benefits have to be present in the project application, the project must contribute to Sustainability and at least one of the remaining three specific criterions.

#### 4.3.2.2 Hydrogen systems

Methodology for CBA for hydrogen projects encompasses all relevant links in the supply chain of hydrogen, such as pipelines for transport of hydrogen, storage facilities, decompression facilities, and any equipment or installation necessary for the hydrogen system to operate safely, securely and efficiently. Methodology for evaluation of hydrogen projects was developed by JRC and it recognizes four specific criterions and seven benefits, which are:

1. **Sustainability**
   - Variation of GHG emissions
   - Variation of non-GHG emissions
   - Integration of renewable and low-carbon hydrogen potential into the system
   - Increase of cross-sectoral flexibility
2. **Competition**
   - Substitution effect – Fuel switching
3. **Security of supply and flexibility**
   - Reduction of curtailed hydrogen demand
4. **Market integration**
   - Improvement of market integration

The project in the PECI process must contribute significantly to Sustainability criterion and at least one of the other three specific criterions. Benefits for the hydrogen categories will be calculated using the gas market model where applicable, and also project assumptions and relative calculations using reputable methodologies.

#### 4.3.2.3 Electrolysers

Cost-benefit analysis for electrolysers was developed by JRC and contains all the relevant data on project benefits and validation of those. For electrolysers, there are three specific criterions, and the candidate projects must contribute significantly to all of them. Specific criterions and its corresponding benefits are:

1. **Sustainability**
   - Variation of GHG emissions
   - Variation of non-GHG emissions
   - Variation of renewable and/or hydrogen production – fuel cost savings
   - Variation of synthetic fuel production – fuel cost savings
2. **Security of supply**
   - Reduction of curtailed hydrogen demand
   - Variation of electricity RES curtailment
3. **Smart energy sector integration**
   - Variation of socio-economic welfare in electricity markets
   - Cross sectoral cost savings.

Out of these described benefits, under this project only are a few are considered: **Variation of $CO_2$ emissions** (not monetized, in tons), will be considered since electrolysers are key infrastructure projects for producing low carbon and particularly renewable hydrogen and therefore expected to decrease $CO_2$ emissions; **Variation of the amount of renewable and low-carbon hydrogen integrated into the system** (not monetized, in GWh), since a candidate electrolyser project can bring benefits stemming from the substitution of other fuels by low carbon and particularly renewable hydrogen; and **Reduction of RES curtailment** (not monetized, in GWh), since electrolysers can provide additional flexibility to the energy system as a whole, increasing their energy intake in renewable electricity surplus moments to produce renewable hydrogen**.**

Benefits for the electrolyser project that are found eligible will be calculated using the market model where applicable, and ENTSOG TYNDP 2022.

#### 4.3.2.4 Carbon dioxide pipelines and corresponding equipment and facilities

Methodology for carbon dioxide pipelines, as well as facilities used for liquefaction, and any equipment and installation necessary for the pipeline to operate safely, securely and efficiently, was developed by JRC. For carbon dioxide projects there are four specific criterions and four defined benefits:

1. **Sustainability**
   - Variation of GHG emissions
2. **Resilience and security of transport and storage**
   - Increase of the resilience and the security of the infrastructure
3. **Efficient use of resources**

- Multiple $CO_2$ sources and storage sites via common infrastructure

4. **Mitigation of environmental burden and risks**
   - Reduction of environmental burden and risks

Project must contribute significantly to all of the described criterions to be considered for the ranking. These benefits will be calculated using PLEXOS Gas market model, as well as project assumptions and relative calculations using reputable methodologies.

## 4.4 Project assessment and relative rankings

Under this Task and based on the results of quantitative as well as qualitative analysis in the previous Task, individual project assessment will be made for each of the eligible project categories.

Each of the criteria evaluated in a specific project category (monetised and non-monetised) will have a certain weight in the total possible score.

For the monetised criteria, calculated **Benefit/Cost ratio** will be a basis for the inclusion in the project ranking. Benefit is calculated as the sum of all calculated monetised indicators for each specific infrastructure category, while costs are a sum of CAPEX and OPEX delivered by the project promoters for all infrastructure categories. I. Further allocation of points for different levels of calculated Benefit/Cost ratio will be done in line with methodologies for assessing eligible projects[9].

Additionally, non-monetised indicators for each project category will be given a certain number of points. Finally, **project maturity** will also be given a certain weight and will participate in the final scoring of each eligible project. Project maturity will be determined based on data about status/completion of project phases (consideration phase, prefeasibility study, technical feasibility study, economic feasibility study (Cost-benefit analysis), environmental impact assessment, detailed design study, resolved financing, obtained approvals/permits, approval by regulatory authority, final investment decision, tendering procedure, construction).

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.

[9] *Methodology for assessing the electricity and offshore infrastructure candidate PCI and PMI 1st Union PCI-PMI list 2023*

*Methodology for assessing the hydrogen and electrolyser candidate PCI/PMI projects 2022-2023 exercise*


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