# 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

***Data Validation and Scenario Report***

Energy Institute Hrvoje Požar | Zagreb | 6 May 2024

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## Version history

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# Contents

# Abbreviations and acronyms

| | |
|---|---|
| aFRR | Automatic Frequency Restoration Reserve |
| AL | Albania |
| ARM | Armenia |
| AZ | Azerbaijan |
| BA | Bosnia and Herzegovina |
| 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 |
| FCR | Frequency Control Reserve |
| GA | Global Ambition |
| GE | Georgia |
| GSE | Georgian State Electrosystem |
| HPP | Hydro Power Plant |
| JRC | Joint Research Centre |
| LNG | Liquified Natural Gas |
| MCA | Multi criteria analysis |
| MD | Moldova |
| ME | Montenegro |
| MK | North Macedonia |
| MS | Member State |
| NOSBiH | Independent System Operator in Bosnia and Herzegovina |
| NPP | Nuclear Power Plant |
| NPV | Net Present Value |

| | |
|---|---|
| NT | National Trends |
| OHL | Overhead Line |
| OPEX | Operating Expenditures |
| OT | Operational Technology |
| PECD | Pan European Climate Database |
| PECI | Projects of Energy Community Interest |
| PINT | Put In one at the Time |
| PMI | Projects of Mutual Interest |
| POD | Power Oscillation Damping |
| PSHPP | Pump Storage Hydro Power Plant |
| RES | Renewable Energy Sources |
| RO | Romania |
| RS | Serbia |
| RU | Russia |
| SE | State enterprise |
| SEW | Socio-economic Welfare |
| SK | Slovakia |
| SS | Substation |
| TEN-E | Trans-European Networks for Energy |
| TOOT | Take Out One at a Time |
| TR | Turkey |
| TSO | Transmission System Operator |
| TYNDP | Ten Year Network Development Plan |
| UA | Ukraine |
| XK | Kosovo* |

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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 with respect to the original regulation and EnC CPs with respect to the adopted version in the Energy Community. 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 projects to be submitted to the Ministerial Council for adoption in December 2024.

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

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 carried out (*italic*) or 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.

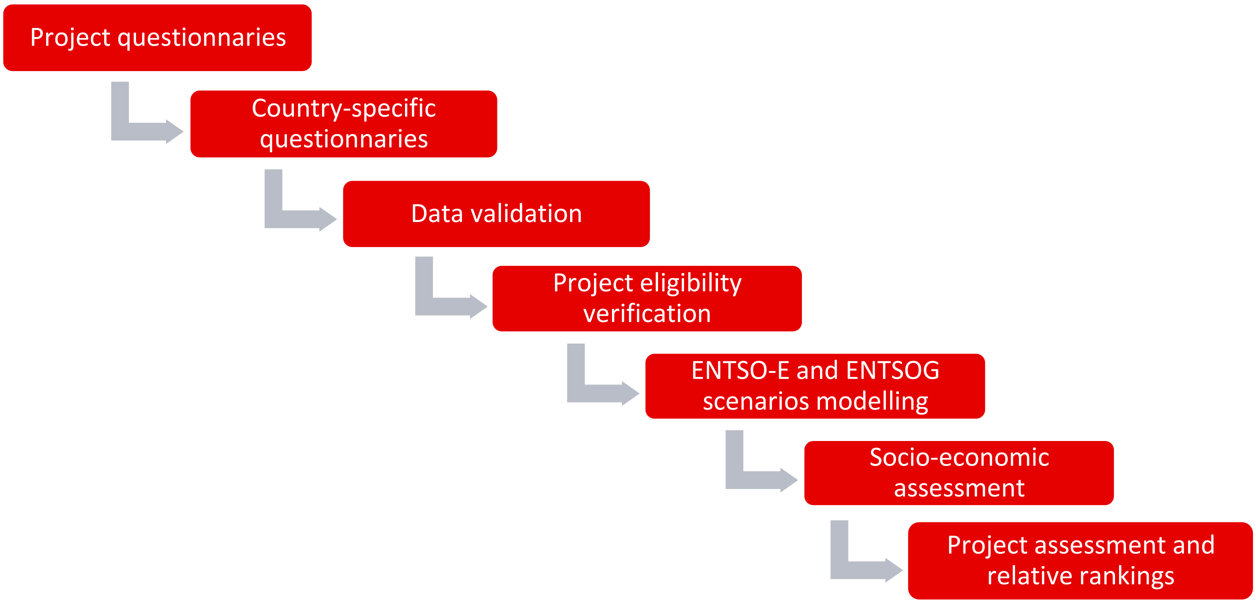


*Figure 1 Activities to be carried out during the project implementation*

## 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 the main project activities and deliverables is 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 was implemented during the inception phase of the project. More detailed explanations on the questionnaires are presented in section 2. The questionnaires were 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 was used for **data validation and project eligibility verification**. The results of these activities are presented in this report, originally submitted on 6 May but later updated due to data changes and comments received by the EU Commission at the end of May 2024.

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. 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 a 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 ***Data Validation and Scenario Report*** present a report on the collected data regarding projects and countries, data validation as well as projects' eligibility verification based on the general and specific eligibility criteria for each project category. A report on the proposed scenarios and sensitivity analyses is also part of the document (section 4).

# 2 Data collection process

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 are collected in line with the ENTSO-E and ENTSOG TYNDP 2022 joint development scenarios, which is in more detail addressed in section 4. At the time of collecting data, the newest set of data for TYNDP 2024 was not publicly available, which is the main reason for using TYNDP 2022 data as an initial set of data.

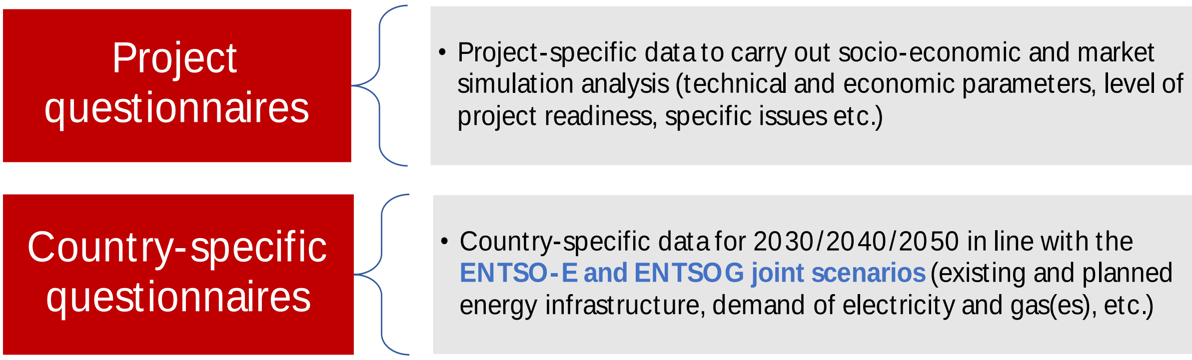


*Figure 3 Project and country-specific data collection*

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.

In the following figure a screenshot of the 'General Data' sheet in the project questionnaire related to electricity infrastructure is presented. The yellow-coloured cells represent **compulsory data which had to be filled-in by project promoters** in order to be further assessed in the data validation and eligibility verification process. Input data in the cells marked with green colour should have been filled-in wherever available, but not mandatory. The same principle with a minimum of compulsory data is applied in each sheet (related to technical, cost and status data).

| A | B | C | D |
|---|---|---|---|
| 1 | General Data on the Project | | |
| 1.1 | Project name: | | |
| 1.2 | Short description of the project (please include expected benefits from the project): | | |
| 1.3 | Full legal name of the project promoter(s): | | |
| 1.4 | Name of the sharehodler(s) in the implementation of the investment project: | Full name of the shareholder | Shareholding (%) |
| 1.5 | Is the project cross-border? | | |
| 1.6 | Is the project internal (national) with cross-border impact? | | |
| 1.6a | If yes, describe in brief cross-border impact: | | |
| 1.7 | Energy Community Contracting Parties in which the project is located: | | |
| 1.8 | Project ID in ENTSO-E TYNDP 2020: | | |
| 1.9 | Project ID in ENTSO-E TYNDP 2022: | | |
| 1.10 | Was the project included in any of the previous PECI processes? | | |
| 1.11 | Project in National Network Development Plan (NNDP) | | |
| | Project name in NNDP: | | |
| | Full name of the NNDP: | | |
| | HTML link to NNDP: | | |
| 1.12 | Are there any other internal or cross-border projects depending on the realisation of the project? | | |
| 1.12a | If yes, indicate the project(s) name(s) and location(s): | | |

Info | 1. General Data | 2. Technical Data | 3. Cost Data | 4. Status Data | 5. Contact Data

*Figure 4 'General Data' sheet in project questionnaire related to electricity infrastructure*

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

### 2.1.1 List of submitted projects

In this section general information about the collected project applications are presented. In Table 2 a list of all candidate projects is presented, including project promoters and project categories for each project, as declared by the project promoters. In total, there were **17 candidate projects**, 14 related to electricity sector and 3 related to gas(es) sector. In the electricity sector, 10 out of 14 projects are overhead transmission lines, 2 projects are related to smart electricity grids and 2 projects are energy storage (pump hydro power plant and batteries). With regard to the gas(es) sector, 2 submitted applications refer to hydrogen interconnections and one to smart gas grids.

*Table 2 List of candidate projects applied for PECI 2024 selection process*

| No | Project Title | Project Promoter(s) | Project Category |
|---|---|---|---|
| E01 | **Increasing the capacity of existing 220 kV interconnection between Bosnia and Herzegovina and Montenegro, 220 kV OHL Trebinje – Perućica** | • CGES (Montenegro)<br>• NOSBiH/Elektroprijenos BiH (Bosnia and Herzegovina) | Electricity/Overhead line |
| E02 | **New 400 kV interconnection between Bosnia and Herzegovina and Montenegro, 400kV OHL Gacko - Brezna** | • CGES (Montenegro)<br>• NOSBiH/Elektroprijenos BiH (Bosnia and Herzegovina) | Electricity/Overhead line |
| E03 | **New 400 kV interconnection between Montenegro and Bosnia and Herzegovina, 400kV overhead line Brezna-Sarajevo with construction 400/220 kV substation Piva's mountain** | • CGES (Montenegro)<br>• NOSBiH/Elektroprijenos BiH (Bosnia and Herzegovina) | Electricity/Overhead line |
| E04 | **Trans Balkan Corridor: Double OHL 400 kV Bajina Basta (RS) – Visegrad (BA)/Pljevlja (ME)** | • NOSBiH/Elektroprijenos BiH (Bosnia and Herzegovina)<br>• CGES (Montenegro) | Electricity/Overhead line |
| E05 | **Internal transmission line 400 kV Banja Luka 6 - Mostar 4** | • NOSBiH/Elektroprijenos BiH (Bosnia and Herzegovina) | Electricity/Overhead line |
| E06 | **Reconfiguration of 400 kV grid and new 400 kV interconnection Albania-Kosovo** | • OST (Albania)<br>• KOSTT (Kosovo*) | Electricity/Overhead line |
| E07 | **Closing the 400 kV Albanian internal Ring** | • OST (Albania) | Electricity/Overhead line |
| E08 | **330 kV OHL Balti (MD) - Dnestrovsk HPP-2 (UA)** | • SE Moldelectrica (Moldova)<br>• NPC Ukrenergo (Ukraine) | Electricity/Overhead line |

| No | Project Title | Project Promoter(s) | Project Category |
|---|---|---|---|
| E09 | **Rehabilitation of 400 kV OHL Mukacheve (UA) – Velké Kapušany (SK)** | • NPC Ukrenergo (Ukraine)<br>• SEPS (Slovakia) | Electricity/Overhead line |
| E10 | **The reconstruction of the 400 kV transmission line Pivdennoukrainska NPP (Ukraine) – Isaccea (RO)** | • NPC Ukrenergo (Ukraine)<br>• CNTEE Transelectrica SA (Romania) | Electricity/Overhead line |
| E11 | **Construction of smart 110 kV grid in "Ukraine Bessarabia" region** | • DTEK Odesa grids (Ukraine) | Smart electricity grids |
| E12 | **Cybersecurity management system for protection grids assets from cyber threats** | • DTEK Odesa grids (Ukraine) | Smart electricity grids |
| E13 | **DTEK STORAGE 225 MW** | • DTEK (Ukraine) | Energy storage |
| E14 | **Pump Storage Plant Koman and Fierza** | • KESH, Ministry of infrastructure and energy (Kosovo*) | Energy storage |
| G01 | **Internal hydrogen infrastructure in Federation of BiH in connection with H2T Southern Interconnection BiH/CRO** | • BH-Gas d.o.o. Sarajevo (Bosnia and Herzegovina) | Hydrogen |
| G02 | **Gas interconnection Serbia – North (100% H2 Ready)** | • NOMAGAS JSC Skopje (North Macedonia)<br>• PE Srbijagas (Serbia) | Hydrogen |
| G03 | **Increasing capacities on the Trans-Balkan route with the integration of the Hydrogen element** | • Vestmoldtransgaz LLC (Moldova) | Smart gas grid |

In the following section, general information about each of the candidate projects, including brief project descriptions, are presented. **Data validation for technical and financial consistency** for each project was made upon the delivery of the projects' data. Where necessary, several iterations with project promoters were made to clarify provided or to provide missing data. Thus, data validation conclusions are also provided in the following section for each of the candidate projects.

## 2.1.2 Project characteristics and data validation

**E01: Increasing the capacity of existing 220 kV interconnection between Bosnia and Herzegovina and Montenegro, 220 kV OHL Trebinje – Perućica**

***Project promoter(s):*** CGES (ME), NOSBiH/Elektroprijenos BiH (BA)

***Infrastructure category:*** High and extra high voltage overhead transmission lines

***Commissioning year:*** 2028

***Project description (as defined by the project promoters):*** 220 kV OHL Trebinje - Perućica corresponds to long-term exploitation and the fact that it passes through a region with demanding-difficult climatic parameters. Transmission power (720 A) has been exceeded through the increase in requirements for the construction of new capacities (from renewable sources, primarily solar, but also hydro potential). Taking into account the requirements for the connection of renewable sources in Montenegro and Bosnia and Herzegovina, the capacity of the existing conductor of the transmission line in question, as well as its age and operating condition, it is necessary to carry out its reconstruction. The reconstruction, primarily due to insufficient capacity, would have to include the complete replacement of conductors, protective rope, insulation, suspension and connecting equipment. Since it is not possible to install classic conductors of higher capacity on the existing poles, due to their construction characteristics, this implies the replacement of the existing ones and the installation of conductors of a special construction, which in terms of transmission power correspond to a conductor that can carry 1500 A, and in terms of mechanical characteristics will not increase the load on the poles in relation to the load for which the columns are designed.

Benefits include resolving existing congestions between Bosnia and Herzegovina and Montenegro, enabling and supporting integration of a large number of RES in Bosnia and Herzegovina (region of East Herzegovina) and Montenegro (southwest region), increasing net transfer capacity (NTC) of energy from Bosnia and Herzegovina to Montenegro and Montenegro to Bosnia and Herzegovina and further development and integration of the market, security of supply, elimination of perceived insecurities in the past period.


*Figure 5 Location of E01*

Data for E01 were validated for financial and technical consistency. Compulsory data were provided and there were no additional inputs necessary. However, delta NTC values should be clarified in more detail by the project promoters, which was done afterwards.

**E02: New 400 kV interconnection between Bosnia and Herzegovina and Montenegro, 400 kV OHL Gacko - Brezna**

***Project promoter(s):*** CGES (ME), NOSBiH/Elektroprijenos BiH (BA)

***Infrastructure category:*** High and extra high voltage overhead transmission lines

***Commissioning year:*** 2035

***Project description (by project promoters)***: New 400 kV interconnection between Bosnia and Herzegovina and Montenegro will connect SS Gacko (BA) with SS Brezna (ME), total length about 51 km. Benefits include enabling and supporting integration of a large number of RES in Bosnia and Herzegovina (region of East Herzegovina) and Montenegro (west region), enabling the transfer of energy from Bosnia and Herzegovina to Montenegro and avoiding existing congestions between Bosnia and Herzegovina and Montenegro, further development and integration of the market and security of supply. Reduction of losses about 5 GWh (-4%) in Montenegro and Bosnia and Herzegovina 6.4 GWh (-1.5%).


*Figure 6 Location of E02*

Data for E02 were validated for financial and technical consistency. Expected year of commissioning was not defined so additional request was sent to project promoters to which they responded with the commissioning date of 2035. Additionally, delta NTC values should be clarified in more detail by the project promoters, which was done afterwards.

**E03: New 400 kV interconnection between Montenegro and Bosnia and Herzegovina, 400 kV overhead line Brezna-Sarajevo with construction 400/220 kV substation Piva's mountain**

***Project promoter(s):*** CGES (ME), NOSBiH/Elektroprijenos BiH (BA)

***Infrastructure category:*** High and extra high voltage overhead transmission lines

***Commissioning year:*** 2033

***Project description (by project promoters):*** The new 400 kV interconnection between Montenegro and Bosnia and Herzegovina would connect 400/110/35 kV substation Brezna in Montenegro with 400/220/110/x substation Sarajevo 20 in Bosnia and Herzegovina with construction of substation 400/220 kV Piva's mountain. New 400 kV interconnection transmission overhead line with the construction of new 400/220 kV SS Piva's mountain and establishment of a connection between HPP Piva and new SS Piva's mountain is analysed within two phases of construction:

- Phase I - construction of 400/220 kV SS Piva's mountain with the construction of a new 400 kV OHL from SS Piva's mountain to the location of Buk Bijela (BA), from which the existing line 2x490/65 mm$^2$ continues to SS Sarajevo 20 and connecting HPP Piva with SS Piva's mountain transmission line of higher capacity (larger than the existing 220 kV OHL Piva – Sarajevo 20)
- Phase II - construction of 400 kV OHL Brezna - 400/220 kV SS Piva's mountain, for which it is estimated that the construction period will be significantly longer than Phase I (if a decision is made, preparation and construction can begin simultaneously with the construction of SS Piva's mountain).

Expected benefits from the project are: reduction of losses in the transmission system, security of supply, connection of renewable energy sources to the transmission system, the new connection between Montenegro and Bosnia and Herzegovina will eliminate the possibility of congestion with increase of the NTC at this border and electricity market integration.


*Figure 7 Location of E03*

Data for E03 were validated for financial and technical consistency. Compulsory data were provided and there were no additional inputs necessary.

**E04: Trans Balkan Corridor: Double OHL 400 kV Bajina Bašta (RS) – Višegrad (BA)/Pljevlja (ME) (BA section)**

***Project promoter(s):*** NOSBiH/Elektroprijenos BiH (BA), CGES (ME)

***Infrastructure category:*** High and extra high voltage overhead transmission lines

***Commissioning year:*** 2027

***Project description (by project promoters):*** Increasing NTC between Serbia and Bosnia and Herzegovina, enabling full capacity production of HPP Višegrad (N-1 criteria), and increasing and support to RES integration.


*Figure 8 Location of E04*

Data for E04 were validated for financial and technical consistency. Compulsory data were provided. The entire project includes three CPs, but only two CPs are promoters of the project so only the part of the project corresponding to those two CPs will be analysed, assuming that Serbian section is put in place in 2027.

**E05: Internal transmission line 400 kV Banja Luka 6 - Mostar 4**

***Project promoter(s):*** NOSBiH/Elektroprijenos BiH (BA)

***Infrastructure category:*** High and extra high voltage overhead transmission lines

***Commissioning year:*** 2034

***Project description (by project promoters):*** Enabling and supporting integration of a large number of RES, enabling the transfer of energy through Bosnia and Herzegovina power system and avoiding possible congestion in the transmission network, further development and integration of the market.


*Figure 9 Location of E05*

Data for E05 were validated for financial and technical consistency. A request for clarification was sent regarding the CAPEX costs since it was not clear whether the cost for additional substations was included in the Cost sheet. Also, the exact locations of new substations were requested. The promoters responded affirmatively to the CAPEX data and provided the locations of the new substations which are Šuica (West Herzegovina) and Bosanski Petrovac (West Bosnia). Investments in lines 110 kV are not included into CAPEX.

**E06: Reconfiguration of 400 kV grid and new 400 kV interconnection Albania-Kosovo***

***Project promoter(s):*** KOSTT (XK), OST(AL)

***Infrastructure category:*** High and extra high voltage overhead transmission lines

***Commissioning year:*** 2030

***Project description (by project promoters):***

**OST** - The project consists of the extension of SS Fierza to 400 kV level and construction of a new 400 kV interconnection between Albania and Kosovo. The Project will include the following measures:

- construction of a new 400/220/110 kV substation near the existing Fierza substation,
- installation of a 400/220 kV, 600 MVA phase shift transformer PST,
- reconfiguration of the 220 kV and 400 kV lines that will connect to this substation,

- connection to existing interconnections 400 kV Koman – Kosova B and 220 kV Fierza-Prizren2,
- connection to 110 kV transmission grid in the area,
- construction of a new 400 kV interconnection line between the new 400/220 kV SS Fierza and the new 400 kV SS Prizren4 in Kosovo,
- construction/upgrade of new 400 kV substation Prizren-4.

There are currently more than 1.3 GW of wind power plants applications in the northeastern region of Albania and there is a need to accommodate this increased level of additional generation and create further energy exchange opportunities. In this aspect, current 220 kV interconnection Fierza – Prizren 2 is often subject to congestion and represents a bottleneck element. This project will reduce the loading of 220 kV line Fierza-Prizren2, enhance the role of existing 400 kV interconnection Koman-Kosova B and together with the new 400 kV interconnection with Kosovo enable the grid integration of large amounts of wind power plant generating capacity.

Main benefits of this project include:

- improving the reliability of the regional network, the general security of supply and flexibility in the operation of the energy system,
- increasing the value of the Net Transfer Capacity (NTC) of the Albanian network, allowing the increase of energy exchange between neighbouring countries,
- a better distribution of the generation flows of Fierze and the Drin river cascade in the 400 kV network,
- increasing commercial exchanges with Kosovo and the potential to develop the regional energy market,
- improvement of quality indicators and further utilization of the 400 kV interconnection network through redirection of energy flows,
- helping in the gradual decrease of the role of internal 220 kV network of the country,
- supplying the increasing electricity demand of the Prizren area.

**KOSTT** - The project consists in the extension of SS Prizreni 2 (actual voltage 220/110 kV) to Prizreni-4, 400 kV level and the construction of a new 400 kV interconnection between Albania and Kosovo. The project will include the following measures:

- construction of SS Prizreni 4 (Nashec), 400/110 kV with one 300 MVA autotransformer, which contains two 400 kV line bays, one 400 kV bus Coupler bay, one 400 kV and one 110 kV transformer bay,
- expansion of the 110 kV busbar system,
- construction of the Switch Gear Station Gjakova, 400 kV with four 400 kV line bays and a 400 kV bus coupler bay,
- construction of the 400 kV single line, 31.5 km SG Gjakova-SS Prizren -4 (Nashec),
- construction of the single line SG Gjakova - SS Peja 3 with a length of 35.5 km,
- construction of the second interconnection line 400 kV SS Nashec-SS Fierza with a length of 70 km (45 km in Kosovo and 25 km in Albania).

Based on Energy Strategy 2022-2031 Kosovo transmission system should integrate more than 1.4 GW RES capacity mainly solar and wind. To achieve the objectives of the Energy Strategy and National Energy and Climate Plan toward electricity sector decarbonisation is needed reinforcement and reconfiguration of 400 kV network and new 400 kV interconnectors to accommodate this increased level of additional generation and create further energy exchange opportunities. In this aspect, the current 220 kV interconnection Fierza – Prizren 2 is often subject to congestion and represents a bottleneck element. This project will reduce the loading of 220 kV line Fierza-Prizren2, enhance the role of the existing 400 kV interconnection Koman-Kosova B, and together with the new 400 kV interconnection with Kosova enable the grid integration of large amounts of RES capacity in Kosovo power system. Same intense integration of new RES is foreseen also in the Albanian power system. Furthermore, the new submarine 400 kV cable between Albania and Italy which is in the OST plans will enable a new 400 kV corridor which will be used for power exchanges between the regions and will give a positive signal on new investments in RES, market integration, and exchange of power regulation reserves so much needed for RES successful integration.

Main benefits of this project include:

- enables the support of new generation capacities from RES,
- improving the reliability of the regional network, the general security of supply and flexibility in the operation of the power system,
- increasing the value of the Net Transfer Capacity (NTC) between OST and KOSTT, allowing the increase of energy exchange between neighbouring countries,
- increasing commercial exchanges with Albania and other regional countries and the potential to develop a competitive regional energy market, and integration in Pan European Electricity Market,
- helping in the gradual decrease of the role of the internal 220 kV network of the country,
- enables the reconfiguration of the 110 kV network with the aim of optimizing power flows as well as optimizing the operational conditions of the transmission system.


*Figure 10 Location of E06*

Data for E06 were validated for financial and technical consistency. The CAPEX seemed lower than expected considering the inclusion of a phase shift transformer so additional request was made to promoters to confirm that all the investment costs are included in the data, for which they responded affirmatively.

**E07: Closing the 400 kV Albanian internal ring**

***Project promoter(s):*** OST(AL)

***Infrastructure category:*** High and extra high voltage overhead transmission lines

***Commissioning year:*** 2030

***Project description (by project promoter):*** The project consists of closing the 400 kV internal transmission lines in a ring topology through the construction of new 400 kV transmission line between substations Fier-Rrashbull and further to Tirana-2. The project will include the following measures:

- construction of a new 400 kV single circuit OH transmission line between Fier substation and Rrashbull substation – about 78 km long with ACSR 2x490/65 $mm^2$ conductor,
- extension of 400 kV Fier substation,
- extension and reinforcement of Rrashbull substation,
- conversion works at 400 kV Tirana-2 substation in order to be able to operate one circuit of the new 220 kV double circuit line Tirana 2 – Rashbull at 400 kV.

It should be noted that the project of a double circuit 220 kV transmission line between Tirana 2 – Rrashbull (in implementation phase) will have one circuit with 490/65 $mm^2$ cross-section conductor and the other with 2x490/65 $mm^2$ conductor (with a perspective to upgrade this second circuit to 400 kV once this project is implemented – therefore eliminating the need for a new 400 kV line Tirana 2-Rrashbull).

The main outcomes of this project regarding Albanian national objectives are:

- enforcement of the existing corridor of energy flows in the north-south direction,
- extension of the Fier substation, which will become a very important node for the connection of solar power plants,
- maintaining security of supply and responding to the expected increase of demand in the Durres area, where it is planned that a major new marine port will be built along with additional cargo port,
- closing the internal 400 kV network ring connecting the main 400 kV substations in the country such as those of Tirana - Elbasan – Durres – Fier, situated in important industrial areas,
- the closed 400 kV ring will avoid possible bottlenecks in the internal 400 kV network, providing the way for increased transmission capacity (NTC) between Albania and neighbouring countries,

- decreasing the dependence of Albanian power system from changing hydrological conditions by allowing more exchange opportunities and therefore mitigating some of the effects of climate change in Albania.


*Figure 11 Location of E07*

Data for E07 were validated for financial and technical consistency. Compulsory data were provided and there were no additional inputs necessary. However, delta NTC values should be clarified in more detail by the project promoter, which was done afterwards.

**E08:330 kV OHL Balti (MD) - Dnestrovsk HPP-2 (UA)**

***Project promoter(s):*** Moldelectrica (MD), Ukrenergo (UA)

***Infrastructure category:*** High and extra high voltage overhead transmission lines

***Commissioning year:*** 2032

***Project description (by project promoter):*** Strengthening the electricity interconnection between Republic of Moldova and Ukraine. Increasing the security of supply.

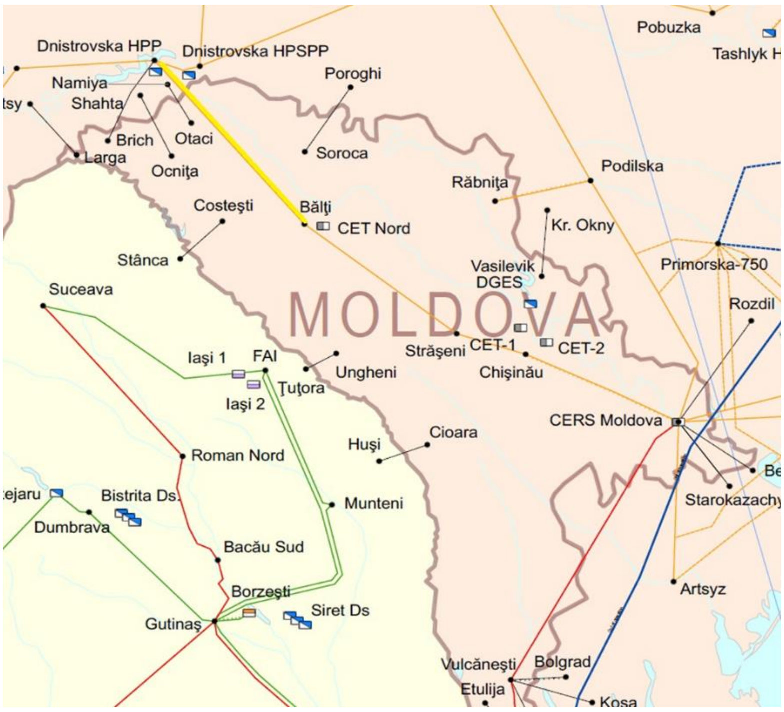


*Figure 12 Location of E08*

Data for E08 were validated for financial and technical consistency. Compulsory data were provided and there were no additional inputs necessary.

**E09: Rehabilitation of 400 kV OHL Mukacheve (UA) – Veľké Kapušany (SK)**

***Project promoter(s):*** Ukrenergo (UA)

***Infrastructure category:*** High and extra high voltage overhead transmission lines

***Commissioning year:*** 2026

***Project description (by project promoter):*** The project envisages an increase in the capacity of the Ukraine-Slovakia interconnector up to 1000 MW.


*Figure 13 Location of E09*

Data for E09 were validated for financial and technical consistency. Compulsory data were provided and there were no additional inputs necessary.

**E10: The reconstruction of the 400 kV transmission line Pivdennoukrainska NPP (UA)-Isaccea (RO)**

***Project promoter(s):*** Ukrenergo (UA)

***Infrastructure category:*** High and extra high voltage overhead transmission lines

***Commissioning year:*** 2028

***Project description (by project promoter):*** Increasing the capacity of the interconnector with Romania to 1000-1200 MW after 2028. Improving the reliability of power supply to consumers in the southern regions of Ukraine and Romania. Removing restrictions on renewable energy production capacity in southern Ukraine and eastern Romania.


*Figure 14 Location of E10*

Data for E10 were validated for financial and technical consistency. Compulsory data were provided and there were no additional inputs necessary.

**E11: Construction of smart 110 kV grid in "Ukraine Bessarabia" region**

***Project promoter(s):*** DTEK Odesa Grids (UA)

***Infrastructure category:*** Smart electricity grids

***Commissioning year:*** Section I 2025, Section II 2026-2027, Section III 2026

***Project description (by project promoter):*** The "Ukrainian Bessarabia" region is connected to the energy system of Ukraine by one 110 kV power line. The reduced reliability of electricity supply in the region also affects the interstate connection between Ukraine and Moldova (Bolgrad - Vulcanesti). The project envisages the construction of two new 110 kV power lines (overhead or cable) to connect the region with the power system of Ukraine and to relieve interstate connections between Ukraine and Moldova. Also, the project envisages creation of the smart grid infrastructure which will increase the security of supply, interoperability of the grid and increase the capacity for new RES connections.


*Figure 15  Location of E11*

Data for E11 were validated for financial and technical consistency. Compulsory data were provided and there were no additional inputs necessary.

**E12: Cybersecurity management system for protection grids assets from cyber threats**

***Project promoter(s):*** DTEK Odesa Grids (UA), Premier Energy Distribution (MD)

***Infrastructure category:*** Smart electricity grids

***Commissioning year:*** Section I 2026, Section II 2027-2034

***Project description (by project promoter):*** The project involves the development of measures and implementation of software and hardware equipment for protection of the grid infrastructure from cyber threats and attacks.

The following aspects are envisaged:

1. Protection of the OT grid from an unauthorized interference.
2. Implementing tools for prompt detection of devices that were connected to the OT infrastructure without proper authorization.
3. Implementing the following systems: grid monitoring, grid protection, OT resources access management, traffic management, advanced attacks protection.
4. Complete isolation of the OT network from other networks and division of the OT network into separate control and management segments.
5. Increasing the resilience and reliability of smart grids for both countries while increasing the level of protection of technological grid management systems from cyber threats.

Benefits:

Ensuring grid reliability, interoperability, and security under the conditions of war and constant cyber threats.

By employing above mentioned measures, the project will positively affect the stable and reliable energy supply to customers. Therefore at least 1 million customers from Ukraine and Moldova will benefit from the outcomes of the project.

Implementation of the project will have significant positive impact on the Energy Community 2030 targets and the 2050 climate neutrality objective. Namely, the resilience of the distribution system from cyber threats will foster the efficiency and pace of renewable energy resources integration into the grid. Also, the protection of the new automated grid infrastructure from the cyber threats/attacks will increase energy efficiency of the system therefore contributing to the above-mentioned targets.

The implementation of the project will contribute to the security of supply, incl. through efficiency and interoperability of electricity distribution in day-to-day network operation, avoidance of congestion.


*Figure 16 Location of E12*

Data for E12 were validated for financial and technical consistency. Compulsory data were provided and there were no additional inputs necessary.

### E13: DTEK STORAGE 225 MW

***Project promoter(s):*** JSC DTEK WESTENERGY (UA)

***Infrastructure category:*** Electricity storage

***Commissioning year:*** 2025-2028

***Project description (by project promoter):*** DTEK intends to develop, build and operate 225 MW / 450 MWh battery sites located in several locations in Western and Central Ukraine with a single control centre to ensure the power oscillation damping (POD) control and to provide ancillary services (FCR, aFRR) to the power grids of Ukraine and Moldova (UA/MD).


*Figure 17 Location of E13*

Data for E13 were validated for financial and technical consistency. Compulsory data were provided. A question on the annual production of the BESS was raised and the project promoter provided data of approximately 315 GWh/yearly*.

** In terms of net annual electricity generation, the 225 MW/2h system is able to provide 2 charging/discharging cycles per day to cover the morning and evening peak consumption. Considering 350 working days per year (the rest for maintenance), we can calculate the system annual output - 225 MW * 2h * 2 (number of cycles) * 350 (working days per year) = 315 GWh per year.*

### E14: Pump Storage Plant Koman and Fierza

***Project promoter(s):*** KESH (AL)

***Infrastructure category:*** Electricity storage

***Commissioning year:*** 2028

***Project description (by project promoter):*** The proposed Fierza-Koman PSHPP makes an optimal use of the existing reservoirs, and the investment includes the construction of the power waterway, the power house and the installation of the electro-mechanical equipment (incl. switchyard).

Due to the large reservoirs the proposed PSHPP has the capability to be operated in a very flexible way, which is especially relevant in providing balancing services – in the absence of baseload capacity KESH's role in balancing is essential. The PSHPP operation could create significant additional revenues, especially in dry years, thereby also reducing Albania's dependence on polluted imports and improving the overall climate resilience of KESH´s operations. The PSHPP would also contribute to mitigating the risk of floods.


*Figure 18 Location of E14*

Data for E14 were validated for financial and technical consistency. Upon the primary inspection of the questionnaire, it was noticed that a significant part of the compulsory data were not clear such as expected lifetime (set at 6 years), installed capacity (given in a range of 400-600 MW), storage capacity, while crucial compulsory modelling and calculation data were missing, such as average monthly inflows into the reservoir, pumping capacity and CAPEX and OPEX data. A request was sent to project promoter to clarify and provide the missing data but their response was incomplete and therefore it was concluded that the data cannot be further validated.

**G01: Internal hydrogen infrastructure in Federation of BiH in connection with H2T Southern Interconnection BiH/CRO**

***Project promoter(s):*** BH-Gas d.o.o. Sarajevo (BA)

***Infrastructure category:*** Hydrogen pipeline

***Commissioning year:*** 2029

***Project description (by project promoter):*** Bosnia and Herzegovina, in addition to being a signatory to the Energy Community Treaty, is also a signatory to a number of international agreements and documents in the energy and climate fields, including the Green Agenda for the Western Balkans (Sofia Declaration), by which BA has an obligation to reduce all greenhouse gases, including $CO_2$, all in order to achieve carbon neutrality by 2050. In this connection, Bosnia and Herzegovina should take the necessary steps to introduce new technologies, such as the introduction of hydrogen as a fuel with zero carbon footprint, including the development of new and repurposing of existing gas infrastructure for hydrogen transmission. The Project Internal hydrogen infrastructure implies the researching of possible options for repurposing, as well as the repurposing of the existing gas transmission infrastructure within the Federation of Bosnia and Herzegovina for the hydrogen transmission. The first phase of the project is repurposing of the section Novi Travnik - Sarajevo that would be connected to Southern H2T interconnection, and second phase will be repurposing the other part of existing gas pipeline infrastructure i.e. pipeline Sarajevo - Kladanj. Southern Interconnection Project of BiH/CRO, as a project of strategic interest for BiH / Federation of BiH, is planned to be designed and built as $H_2$ ready and will be connected to the existing gas transmission system of the Federation of BiH in Novi Travnik. The Project will enable meeting the set goals of decarbonization, in particular the reducing greenhouse gas emissions, but also the competition of multiple supply sources.


*Figure 19 Location of G01*

Data for G01 were validated for financial and technical consistency. Compulsory data was provided, but additional clarification was requested on the project cross-border impact which was not sufficiently described in the questionnaire. The received answer on potential cross-border impact on CPs proved that the cross-border that might occur on neighbouring CPs is not sufficient for further analysis of the project.

**G02: Gas interconnection Serbia – North Macedonia**

***Project promoter(s):*** NOMAGAS JSC Skopje (MK), Public Enterprise Srbijagas (RS)

***Infrastructure category:*** Hydrogen pipeline

***Commissioning year:*** 2027

***Project description (by project promoter):*** The project is in line with the EU directives for gasification of the country and it enables gas transit to and from the neighbouring countries. The project is 100% hydrogen ready.


*Figure 20 Location of G02*

Data for G02 were validated for financial and technical consistency. Compulsory data was provided, but additional clarification was requested on the project compliance with the TEN-E Regulation regarding the hydrogen readiness of the project – whether it will be hydrogen ready from the commission or, as it is stated in the application, will firstly be used for natural gas transport. A response was received that the project will be hydrogen ready in further stages.

**G03: Increasing capacities on the Trans-Balkan route with the integration of the Hydrogen element**

***Project promoter(s):*** "Vestmoldtransgaz" LLC (MD)

***Infrastructure category:*** Smart gas grids

***Commissioning year:*** Section I 2026, Section II 2030, Section III 2050

***Project description (by project promoter):*** Increasing the capacity on the Trans-Balkan route is one of the objectives of the vertical Corridor that will allow the transport of gas from the south to the north and vice versa, through the European natural gas and LNG transport systems.

The increase of the transport capacities in physical reverse mode on the trans-Balkan gas pipeline requires the realization of the following improvements at the level of the natural gas transport infrastructure of the Republic of Moldova:

The project involves the injection of hydrogen into natural gas pipelines as an efficient mean of using the existing infrastructure for distribution of green hydrogen. Consideration of hydrogen blending opportunities must take into account necessary modifications to equipment and changes to network operating procedures to ensure safety, reliability, and economic viability. The studies carried out so far demonstrate that the injection of hydrogen in low concentrations, from less than 5% to 20%, does not require major changes to the final consumer equipment. However, considering that the hydrogen blending into natural gas also affects some gas properties associated with end-use appliances, such as flame speed, density, calorific value, Wobbe index, air excess ratio and methane number - consequently, the compatibility of a system with a hydrogen blend must be assessed on a case-by-case basis with extensive study, testing and verifications. The project's advantages are the ensuring of the energy security of The Republic of Moldova and Ukraine, possibility of storing larger amount of natural gas in underground gas storages of Ukraine but, another advantage that is equally important is as gradually increasing the proportion of hydrogen in the natural gas blend, the overall carbon intensity of the fuel can be reduced, leading to a decrease in greenhouse gas emissions. Overall, the addition of hydrogen to natural gas presents a promising pathway for reducing greenhouse gas emissions in the near term while leveraging existing infrastructure, but it is an important part of a broader strategy for transitioning to a more sustainable energy future.

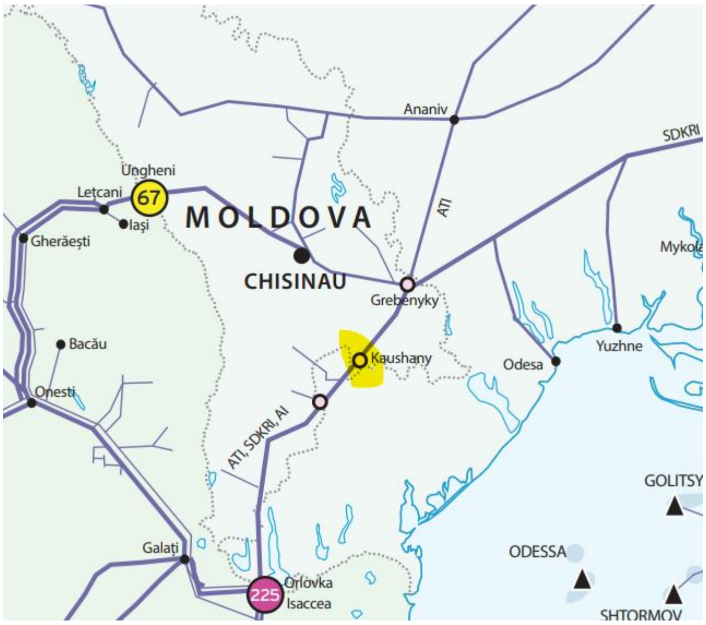


*Figure 21 Location of G03*

> Data for G03 were validated for financial and technical consistency. Compulsory data was provided and there were no additional inputs necessary.

## 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 should be located. Collected input data will be used to develop market and network models of all CPs using appropriate software tools 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 the electricity and gas sectors.

Questionnaires regarding **electricity sector** contain the 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 have been filled in considering joint ENTSO-E and ENTSOG TYNDP 2022 development scenarios (more details in section 4). A minimum set of data was 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.

The relevant authorities had a chance to verify and fill in the country-specific data until the 17th of April 2024.

In Figure 22 a screenshot of the 'Thermal' sheet in the country questionnaire related to electricity sector is presented, with required data for existing and planned thermal power plants in a certain country.

Figure 23 presents a screenshot of the 'Interconnections' sheet in the country questionnaire related to gas sector.

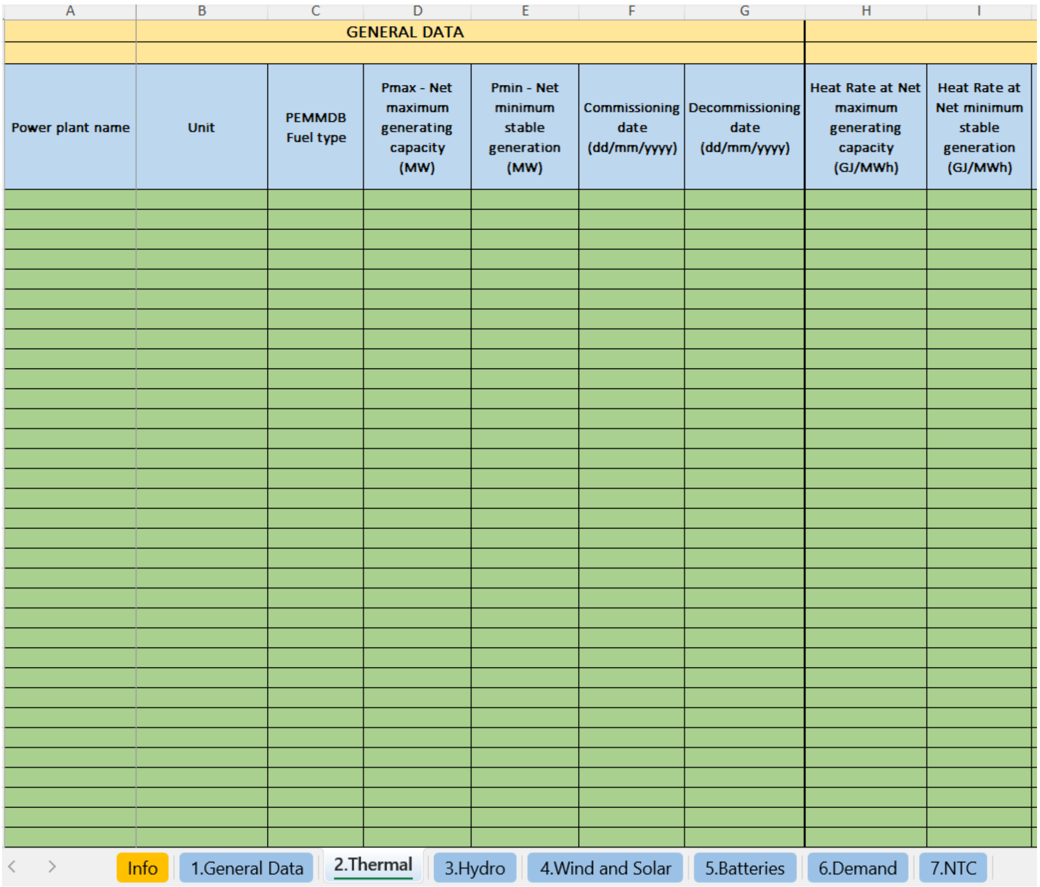


*Figure 22 'Thermal' sheet in country-specific questionnaire related to electricity sector*

| A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|
| Interconnections | | | | | | | | | | |
| Name of interconnector | Type of interconnector | Year of commissioning | From Country 1 | To Country 2 | Maximum daily flow 1-2 (GWh) | Maximum daily flow 1-2 (GWh) | Transmission fee (entry) 1-2 (EUR/MWh) | Transmission fee (exit) 1-2 (EUR/MWh) | Transmission fee (entry) 1-2 (EUR/MWh) | Transmission fee (exit) 1-2 (EUR/MWh) |



*Figure 23 'Interconnections' sheet in country-specific questionnaire related to gas(es) sector*

Country data for the countries that are not CPs were not 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.

## 2.2.1 Collected data and data validation

The following table shows the status of the collected country-specific data related to the electricity and gas(es) sectors during the data collection process.

*Table 3 Status of the country-specific data collection*

| Sector | AL | BA | GE | MD | ME | MK | RS | UA | XK |
|---|---|---|---|---|---|---|---|---|---|
| Electricity | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Gas(es) | | ✓ | ✓ | ✓ | | | ✓ | | |

One out of nine CPs has not delivered country-specific electricity data or verified the data proposed by the Consultant based on the publicly available TYNDP 2022 data and EIHP modelling database.

With regard to gas(es), four CPs have delivered country-specific data for the gas(es) sector. Country data regarding the gas(es) sector are presented in this report but will not be used in further analyses due to the fact that there are no eligible projects in the gas(es) sector for further assessment that would require modelling of the gas(es) systems (more details on eligibility available in section 3).

In the following subsections collected **country-specific data** are presented for each of the Contracting Parties that have delivered the data. The delivered data are **validated and compared** to the values available in the TYNDP 2022 for electricity sector (where available).

#### 2.2.1.1 Albania

**Country-specific data for Albania were delivered** by the transmission system operator OST on 10 May 2024, after the finalisation of this report.

Based on the delivered data, available generation capacities in the horizon up to 2050 are presented in Table 7.

*Table 4 Generation capacities (MW) per fuel/technology type in Albania in 2030, 2040 and 2050 based on the delivered data*

| Fuel/technology type | 2030 | 2040 | 2050 |
|---|---|---|---|
| **Thermal - Lignite** | 0 | 0 | 0 |
| **Thermal – Natural gas** | 300 | 300 | 300 |
| **Hydro** | 2533 | 2633 | 2633 |
| **Wind** | 300 | 700 | 1650 |
| **Solar** | 700 | 1300 | 1650 |
| **Batteries** | 0 | 0 | 0 |

The total projected electricity demand based on the delivered data is presented below.

*Table 5 Electricity demand in 2030, 2040 and 2050 in Albania based on the delivered data*

| | | 2030 | 2040 | 2050 |
|---|---|---|---|---|
| **Total ELECTRICITY demand** | **GWh** | 8 900 | 9 400 | 12 116 |

NTC values for the borders between Albania and the neighbouring countries are presented in Table 9.

*Table 6 NTC values for borders between Albania and neighbouring countries*

| Interconnection | From | To | Year | NTC (MW) |
|---|---|---|---|---|
| **AL00-GR00** | AL00 | GR00 | 2030 | 600 |
| | | | 2040 | 600 |
| | | | 2050 | 600 |

| Interconnection | From | To | Year | NTC (MW) |
|---|---|---|---|---|
| | GR00 | AL00 | 2030 | 600 |
| | | | 2040 | 600 |
| | | | 2050 | 600 |
| **AL00-ME00** | AL00 | ME00 | 2030 | 400 |
| | | | 2040 | 400 |
| | | | 2050 | 400 |
| | ME00 | AL00 | 2030 | 400 |
| | | | 2040 | 400 |
| | | | 2050 | 400 |
| **AL00-MK00** | AL00 | MK00 | 2030 | 500 |
| | | | 2040 | 500 |
| | | | 2050 | 500 |
| | MK00 | AL00 | 2030 | 500 |
| | | | 2040 | 500 |
| | | | 2050 | 500 |
| **AL00-XK00** | AL00 | XK00 | 2030 | 500 |
| | | | 2040 | 500 |
| | | | 2050 | 500 |
| | XK00 | AL00 | 2030 | 500 |
| | | | 2040 | 500 |
| | | | 2050 | 500 |

For the modelling purposes, the Consultant intends to use provided Albanian data by OST. NTC values were additionally checked and described in the Analysis Techniques' Guidance Document that followed after this report.

### 2.2.1.2 Bosnia and Herzegovina

**Electricity**

Country-specific data for the electricity sector in Bosnia and Herzegovina in 2030, 2040 and 2050 were provided by the Independent System Operator in Bosnia and Herzegovina (NOSBiH).

Based on the delivered data, available generation capacities in the horizon up to 2050 are presented in Table 7.

*Table 7 Generation capacities (MW) per fuel/technology type in Bosnia and Herzegovina in 2030, 2040 and 2050 based on the delivered data*

| Fuel/technology type | 2030 | 2040 | 2050 |
|---|---|---|---|
| **Thermal - Lignite** | 1418 | 1418 | - |
| **Hydro** | 2323.8 | 2480.3 | 2480.3 |
| **Wind** | 798 | 1500 | 2500 |
| **Solar** | 1514 | 3000 | 5000 |
| **Batteries** | 50 | 381 | 500 |

In comparison to the TYNDP 2022 data, there are some meaningful differences in the delivered data, primarily regarding wind and solar capacities. For example, expected capacities of wind power plants in DE scenario in 2050 are significantly higher in the TYNDP 2022 (around 13 GW) compared to the delivered data presented in table (2.5 GW). Total solar capacity according to the TYNDP 2022 NT scenario in 2030 amounts to 350 MW, and according to the delivered data total installed capacity of solar power plants in 2030 will be more than 1.5 GW.

With regard to hydro power plants, the difference between the TYNDP 2022 and provided data is not significant. For thermal power plants, according to the delivered data, there are 500 MW of lignite power plants less than in the TYNDP 2022 data.

Additionally, DE scenario assumes lower capacity for batteries in 2050 (158 MW) in comparison to the delivered data, i.e. 500 MW.

In table below total projected electricity demand based on the delivered data is presented.

*Table 8 Electricity demand in 2030, 2040 and 2050 in Bosnia and Herzegovina based on the delivered data*

| | | 2030 | 2040 | 2050 |
|---|---|---|---|---|
| **Total ELECTRICITY demand** | **GWh** | 11 158 | 12 681 | 13 457 |

In comparison to the TYNDP 2022 data, total annual demand for 2030 and 2050 are lower.

NTC values for the borders between Bosnia and Herzegovina and the neighbouring countries are presented in Table 9. The provided values are in line with the TYNDP 2022 values.

*Table 9 NTC values for borders between Bosnia and Herzegovina and neighbouring countries*

| Interconnection | From | To | Year | NTC (MW) |
|---|---|---|---|---|
| **BA00-HR00** | BA00 | HR00 | 2030 | 750 |
| | | | 2040 | 750 |

| Interconnection | From | To | Year | NTC (MW) |
|---|---|---|---|---|
| | | | 2050 | 750 |
| | HR00 | BA00 | 2030 | 700 |
| | | | 2040 | 700 |
| | | | 2050 | 700 |
| **BA00-ME00** | BA00 | ME00 | 2030 | 800 |
| | | | 2040 | 800 |
| | | | 2050 | 800 |
| | ME00 | BA00 | 2030 | 750 |
| | | | 2040 | 750 |
| | | | 2050 | 750 |
| **BA00-RS00** | BA00 | RS00 | 2030 | 530 |
| | | | 2040 | 530 |
| | | | 2050 | 530 |
| | RS00 | BA00 | 2030 | 510 |
| | | | 2040 | 510 |
| | | | 2050 | 510 |

There are noticeable differences between the provided data and TYNDP 2022 data in relevant scenarios for generation capacities. In further modelling activities, the Consultant proposes to use the data provided by NOSBiH, which is considered as the updated TYNDP 2022 data.

## Gas(es)

Country-specific data for the gas(es) sector in Bosnia and Herzegovina in 2030, 2040 and 2050 were provided for interconnections and storages.

Based on the delivered data, hydrogen projects are presented in Table 10.

*Table 10 Gas(es) interconnectors in Bosnia and Herzegovina*

| Name of interconnector | Type | Year of commissioning | From | To | Max Flow 1-2 (GWh) | Max Flow 2-1 (GWh) |
|---|---|---|---|---|---|---|
| **Southern Interconnection BiH/CRO** | Hydrogen | 2027 | HR | BA | 40 | 40 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Northern Interconnection BiH/CRO** | Hydrogen | 2028 | HR | BA | 139 | 40 |
| **Western Interconnection BiH/CRO** | Hydrogen | 2029 | HR | BA | 35 | 35 |

The data given in the table above are taken from the project applications for ENTSOG TYNDP 2024, for which the listed projects are applied as hydrogen transport. However, until hydrogen sources become available, the project will be used for natural gas transmission.

Transmission fees were only given for the Southern Interconnector since Bosnia and Herzegovina has not yet adopted the Gas Law at the state level, which would, among other, regulate transmission activities, and create conditions for adoption of methodology for determining the amount of transmission fees. The approximate amount of the transmission fees for the Southern Interconnection project was taken from the feasibility study for the project and amounts to 3 EUR/MWh in both directions.

In Bosnia and Herzegovina there is one underground gas storage project according to the ENTSOG TYNDP 2024 in salt cavern Tetima-Tuzla, presented in Table 11.

*Table 11 Gas(es) storage in Bosnia and Herzegovina*

| Name of storage | Type | Year of commissioning | Max volume (GWh) | Daily injecting capacity (GWh) | Daily withdrawal capacity (GWh) |
|---|---|---|---|---|---|
| **Underground natural gas storage (UGS) in salt mine Tetima – Tuzla** | Natural gas | 2035 | 634 | 5.12 | 7.61 |

Other requested data in the questionnaire were not provided.

### 2.2.1.3 Georgia

#### Electricity

Country-specific data for the electricity sector in Georgia in 2030, 2040 and 2050 were provided by the Georgian State Electrosystem (GSE).

Based on the delivered data, available generation capacities in the horizon up to 2050 are presented in Table 12.

*Table 12 Generation capacities (MW) per fuel/technology type in Georgia in 2030, 2040 and 2050 based on the delivered data*

| Fuel/technology type | 2030 | 2040 | 2050 |
|---|---|---|---|
| **Thermal – Natural gas** | 1598.2 | 1598.2 | 1598.2 |
| **Thermal – Hard coal** | 22.3 | 22.3 | 22.3 |
| **Hydro** | 4065 | 5805 | 8350 |
| **Wind** | 750 | 1700 | 2900 |
| **Solar** | 700 | 1650 | 2600 |
| **Batteries** | 200 | 200 | 200 |

For thermal power plants, there are no changes in the total installed capacity of gas-fired power plants and coal-fired power plants during the observed horizon. Hydro capacities will increase from 4 GW in 2030 to 8.35 GW in 2050. In 2050 wind and solar capacities will amount to 2.9 GW and 2.6 GW, respectively.

In table below total projected electricity demand in Georgia based on the delivered data is presented.

*Table 13 Electricity demand in 2030, 2040 and 2050 in Georgia based on the delivered data*

| | | 2030 | 2040 | 2050 |
|---|---|---|---|---|
| **Total ELECTRICITY demand** | **GWh** | 19 111 | 23 907 | 29 071 |

NTC values for the borders between Georgia and the neighbouring countries are presented in Table 14.

*Table 14 NTC values for borders between Georgia and neighbouring countries*

| Interconnection | From | To | Year | NTC (MW) |
|---|---|---|---|---|
| **GE00-AZ00** | GE00 | AZ00 | 2030 | 2000 |
| | | | 2040 | 2000 |
| | | | 2050 | 2000 |
| | AZ00 | GE00 | 2030 | 2000 |
| | | | 2040 | 2000 |
| | | | 2050 | 2000 |
| **GE00-TR00** | GE00 | TR00 | 2030 | 1050 |
| | | | 2040 | 1050 |
| | | | 2050 | 1050 |
| | TR00 | GE00 | 2030 | 1050 |
| | | | 2040 | 1050 |
| | | | 2050 | 1050 |

| Interconnection | From | To | Year | NTC (MW) |
|---|---|---|---|---|
| GE00-ARM00 | GE00 | ARM00 | 2030 | 700 |
| | | | 2040 | 700 |
| | | | 2050 | 700 |
| | ARM00 | GE00 | 2030 | 700 |
| | | | 2040 | 700 |
| | | | 2050 | 700 |
| GE00-RU00 | GE00 | RU00 | 2030 | 1600 |
| | | | 2040 | 1600 |
| | | | 2050 | 1600 |
| | RU00 | GE00 | 2030 | 1600 |
| | | | 2040 | 1600 |
| | | | 2050 | 1600 |
| GE00-RO00 | GE00 | RO00 | 2030 | 1300 |
| | | | 2040 | 1300 |
| | | | 2050 | 1300 |
| | RO00 | GE00 | 2030 | 1300 |
| | | | 2040 | 1300 |
| | | | 2050 | 1300 |

For Georgia, there are no available data related to the electricity sector in the TYNDP 2022 scenario data and modelling results, so the data provided by the GSE would be used for modelling purposes under the PECI project assessment process, although ENTSO-E DE scenario assumes carbon neutrality by 2050. Because of that, it will be assumed that there are no coal-fired capacities in Georgia operational in 2050.

### Gas(es)

Country-specific data for the gas(es) sector in Georgia in 2030, 2040 and 2050 were provided by Georgian Gas Transportation Company LLC.

In the table below total projected gas(es) demand based on the delivered data is presented.

*Table 15 Natural gas demand in 2030, 2040 and 2050 in Georgia based on the delivered data*

| | | 2030 | 2040 | 2050 |
|---|---|---|---|---|
| **Total NATURAL GAS demand** | **GWh** | 34 939 | 36 143 | 37 330 |

Based on the delivered data, existing gas(es) interconnectors are presented in Table 16.

*Table 16 Gas(es) interconnectors in Georgia*

| Name of interconnector | Type | Year of commissioning | From | To | Max Flow 1-2 (GWh) | Max Flow 2-1 (GWh) |
|---|---|---|---|---|---|---|
| **North-Caucaus-Transcaucasus main gas pipeline** | Natural gas | 1994-95 | RU | GE | 216.52 | N.a. |
| **Tsiteli khidi -Berdi main gas pipeline** | Natural gas | 1992 | GE | AR | 127.95 | N.a. |
| **Kazakhi-Saguramo main pipeline** | Natural gas | 1980 | AZ | GE | 108.26 | N.a. |
| **South-Caucasus pipeline (domestic entry point)** | Natural gas | 2007 | AZ | GE | 54.13 | N.a. |

In Georgian gas(es) questionnaire data about gas(es) fields was also provided and is presented in the table below.

*Table 17 Gas(es) fields in Georgia*

| Name of field | Year of commissioning | Max daily production (GWh) |
|---|---|---|
| **Ninotsminda** | 1979 | 0.337 |
| **West Rustavi** | 2019 | 0.235 |
| **Krtsanisi** | 1992 | 0.109 |

### 2.2.1.4 Kosovo*

Country-specific data for the electricity sector in Kosovo* in 2030, 2040 and 2050 were provided by the Ministry of Economy of Kosovo.

Based on the delivered data, available generation capacities in the horizon up to 2050 are presented in Table 18.

*Table 18 Generation capacities (MW) per fuel/technology type in Kosovo* in 2030, 2040 and 2050 based on the delivered data*

| Fuel/technology type | 2030 | 2040 | 2050 |
|---|---|---|---|
| **Thermal - Lignite** | 904 | 904 | 904 |
| **Hydro** | 100.7 | 100.7 | 100.7 |
| **Wind** | 677 | 1275 | 1873 |
| **Solar** | 550 | 1340 | 1938 |
| **Batteries** | 170 | 170 | 170 |

According to the delivered data, there will be lignite-fired power plants in 2050, which is not in line with ENTSO-E DE scenario storyline on carbon neutrality in 2050.

In table below total projected electricity demand based on the delivered data is presented.

*Table 19 Electricity demand in 2030, 2040 and 2050 in Kosovo* based on the delivered data*

| | | 2030 | 2040 | 2050 |
|---|---|---|---|---|
| **Total ELECTRICITY demand** | **GWh** | 6802 | 7998 | 10 180 |

NTC values for the borders between Kosovo* and neighbouring countries are presented Table 20.

*Table 20 NTC values for borders between Kosovo* and neighbouring countries*

| Interconnection | From | To | Year | NTC (MW) |
|---|---|---|---|---|
| **XK00-AL00** | XK00 | AL00 | 2030 | 500 |
| | | | 2040 | 1000 |
| | | | 2050 | 1000 |
| | AL00 | XK00 | 2030 | 500 |
| | | | 2040 | 1000 |
| | | | 2050 | 1000 |
| **XK00-ME00** | XK00 | ME00 | 2030 | 300 |
| | | | 2040 | 300 |
| | | | 2050 | 300 |
| | ME00 | XK00 | 2030 | 300 |
| | | | 2040 | 300 |
| | | | 2050 | 300 |
| **XK00-MK00** | XK00 | MK00 | 2030 | 300 |
| | | | 2040 | 300 |
| | | | 2050 | 300 |

| Interconnection | From | To | Year | NTC (MW) |
|---|---|---|---|---|
| | MK00 | XK00 | 2030 | 270 |
| | | | 2040 | 270 |
| | | | 2050 | 270 |
| **XK00-RS00** | XK00 | RS00 | 2030 | 400 |
| | | | 2040 | 400 |
| | | | 2050 | 400 |
| | RS00 | XK00 | 2030 | 400 |
| | | | 2040 | 400 |
| | | | 2050 | 400 |

For Kosovo, there are no available data related to the electricity sector in the TYNDP 2022 scenario data and modelling results (the data is presented jointly for RS and XK), so the data provided by the Ministry of Economy of Kosovo will be used for modelling purposes under the PECI project assessment process. However, the Consultant emphasizes that the lignite-fired power plants in 2050 are not in line with the TYNDP 2022 DE scenario storyline on carbon neutrality and thus should be considered as decommissioned by 2050.

### 2.2.1.5 Moldova

#### Electricity

Country-specific data for the electricity sector in Moldova in 2030, 2040 and 2050 were provided by SE Moldelectrica.

Based on the delivered data, available generation capacities in the horizon up to 2050 are presented in Table 21.

*Table 21 Generation capacities (MW) per fuel/technology type in Moldova in 2030, 2040 and 2050 based on the delivered data*

| Fuel/technology type | 2030 | 2040 | 2050 |
|---|---|---|---|
| **Thermal – Natural gas** | 1720 | 1720 | 1720 |
| **Thermal - Others non renewable** | 47.2 | 47.2 | 47.2 |
| **Hydro** | 64.5 | 64.5 | 64.5 |
| **Wind** | 442 | 960 | 1120 |

| Fuel/technology type | 2030 | 2040 | 2050 |
|---|---|---|---|
| **Solar** | 470 | 750 | 880 |
| **Batteries** | 10 | 10 | 10 |

In table below total projected electricity demand based on the delivered data is presented.

*Table 22 Electricity demand in 2030, 2040 and 2050 in Moldova based on the delivered data*

| | | 2030 | 2040 | 2050 |
|---|---|---|---|---|
| **Total ELECTRICITY demand** | **GWh** | 7002 | 8417 | 9993 |

NTC values for the borders between Moldova and neighbouring countries are presented in Table 23.

*Table 23 NTC values for borders between Moldova and neighbouring countries*

| Interconnection | From | To | Year | NTC (MW) |
|---|---|---|---|---|
| **MD00-RO00** | MD00 | RO00 | 2030 | 300 |
| | | | 2040 | 750 |
| | | | 2050 | 1600 |
| | RO00 | MD00 | 2030 | 450 |
| | | | 2040 | 750 |
| | | | 2050 | 1600 |
| **MD00-UA00** | MD00 | UA00 | 2030 | 600 |
| | | | 2040 | 1100 |
| | | | 2050 | 1600 |
| | UA00 | MD00 | 2030 | 600 |
| | | | 2040 | 1100 |
| | | | 2050 | 1600 |

For Moldova, there are no available data related to electricity sector in the TYNDP 2022 scenario data and modelling results, so the data provided by the SE Moldelectrica will be used for modelling purposes under the PECI project assessment process. However, there is some missing input data, such as average monthly generation of hydro power plants, that is necessary for further modelling activities.

**Gas(es)**

Country-specific data for the gas(es) sector in Moldova in 2030, 2040 and 2050 were provided by Vestmoldtransgaz.

In the table below total projected gas(es) demand based on the delivered data is presented.

*Table 24 Gas(es) demand in 2030, 2040 and 2050 in Moldova based on the delivered data*

| | | 2030 | 2040 | 2050 |
|---|---|---|---|---|
| **Total NATURAL GAS demand** | **GWh** | 172.82 | 172.82 | 172.82 |
| **Total annual HYDROGEN demand** | **%** | 5 | 10 | 20 |

Based on the delivered data, gas(es) interconnectors projects are presented in Table 25.

*Table 25 Gas(es) interconnectors in Moldova*

| Name of interco-nnector | Type | Year of commissi-oning | From | To | Max Flow 1-2 (GWh) | Max Flow 2-1 (GWh) | Transmission fee (entry) 1-2 (EUR/MWh) | Transmission fee (exit) 1-2 (EUR/MWh) |
|---|---|---|---|---|---|---|---|---|
| **IP Kaushany** | Natural gas | 2026 | MD | UA | 172.82 | 126.6 | 1.09 | 1.16 |
| **IP Grebenyky** | Natural gas | 2026 | MD | UA | 158.82 | 379.8 | 1.09 | 1.16 |

## 2.2.1.6 Montenegro

Country-specific data for the electricity sector in Montenegro in 2030, 2040 and 2050 were provided by the Ministry of Energy and Mining of Montenegro.

Based on the delivered data, available generation capacities in the horizon up to 2050 are presented in Table 26.

*Table 26 Generation capacities (MW) per fuel/technology type in Montenegro in 2030, 2040 and 2050 based on the delivered data*

| Fuel/technology type | 2030 | 2040 | 2050 |
|---|---|---|---|
| **Thermal - Lignite** | 225 | 225 | 225 |
| **Thermal – Others renewable** | 49 | 49 | 49 |
| **Hydro** | 961.4 | 961.4 | 961.4 |
| **Wind** | 250 | 600 | 700 |
| **Solar** | 750 | 2400 | 4300 |
| **Batteries** | 28 | 28 | 28 |

In comparison to the TYNDP 2022 data, there are some differences in the delivered data. For example, there are lignite-fired capacities in 2050, which should not be the case based on the DE scenario. Total hydro capacities are somewhat lower compared to the TYNDP 2022 data (961 MW compared to 1137 MW). Total wind and solar capacities in 2050 are also lower compared to the TYNDP 2022 data. For example, according to the Table 16, total installed capacity of wind power plants in 2050 amounts to 700 MW, and in TYNDP 2022 DE scenario there are around 1.2 GW of wind power plants in 2050 in Montenegro. With regard to solar power plants, total installed capacity in 2030 and 2040 in TYNDP 2022 is only 32 MW and according to the provided data 750 MW and 2400 MW, respectively.

In table below total projected electricity demand based on the delivered data is presented.

*Table 27 Electricity demand in 2030, 2040 and 2050 in Montenegro based on the delivered data*

| | | 2030 | 2040 | 2050 |
|---|---|---|---|---|
| **Total ELECTRICITY demand** | **GWh** | 4539 | 5534 | 6281 |

In comparison to the TYNDP 2022 data, total annual demand is the same for all years.

NTC values for the borders between Montenegro and the neighbouring countries are presented in Table 28. The provided values are not in line with the TYNDP 2022 values, i.e. corrections were made in comparison to the TYNDP 2022 data.

*Table 28 NTC values for borders between Montenegro and neighbouring countries*

| Interconnection | From | To | Year | NTC (MW) |
|---|---|---|---|---|
| **ME00-AL00** | ME00 | AL00 | **2030** | 450 |
| | | | **2040** | 450 |
| | | | **2050** | 500 |
| | AL00 | ME00 | **2030** | 450 |
| | | | **2040** | 450 |
| | | | **2050** | 500 |
| **ME00-BA00** | ME00 | BA00 | **2030** | 1000 |
| | | | **2040** | 1000 |
| | | | **2050** | 1000 |
| | BA00 | ME00 | **2030** | 1000 |
| | | | **2040** | 1000 |
| | | | **2050** | 1000 |
| **ME00-IT00** | ME00 | IT00 | **2030** | 600 |
| | | | **2040** | 1200 |
| | | | **2050** | 1200 |

| Interconnection | From | To | Year | NTC (MW) |
|---|---|---|---|---|
| | IT00 | ME00 | **2030** | 600 |
| | | | **2040** | 1200 |
| | | | **2050** | 1200 |
| **ME00-RS00** | ME00 | RS00 | **2030** | 700 |
| | | | **2040** | 800 |
| | | | **2050** | 800 |
| | RS00 | ME00 | **2030** | 1140 |
| | | | **2040** | 1140 |
| | | | **2050** | 1140 |
| **ME00-XK00** | ME00 | XK00 | **2030** | 300 |
| | | | **2040** | 300 |
| | | | **2050** | 300 |
| | XK00 | ME00 | **2030** | 300 |
| | | | **2040** | 300 |
| | | | **2050** | 300 |

There are noticeable differences between the provided data and TYNDP 2022 data in relevant scenarios. Provided data on generation capacities will be used but assuming carbon neutrality for DE scenario in 2050. However, NTC values for same borders (e.g. BA-ME) differ in data provided by different national authorities due to the corrections made in comparison to the TYNDP 2022 data. Thus, the Consultant proposes to use TYNDP 2022 data for NTC values in further modelling activities.

### 2.2.1.7 North Macedonia

Country-specific data for the electricity sector in North Macedonia in 2030, 2040 and 2050 were provided by MEPSO.

Based on the delivered data, available generation capacities in the horizon up to 2050 are presented in Table 29.

*Table 29 Generation capacities (MW) per fuel/technology type in North Macedonia in 2030, 2040 and 2050 based on the delivered data*

| Fuel/technology type | 2030 | 2040 | 2050 |
|---|---|---|---|
| **Thermal – Natural gas** | 760 | - | - |
| **Thermal – Others renewable** | 31 | 31 | 31 |
| **Hydro** | 938.1 | 1480.5 | 1480.5 |
| **Wind** | 443 | 723 | - |
| **Solar** | 580 | 998 | - |
| **Batteries** | - | - | - |

According to the provided data, there will be no conventional thermal power plants in operation after 2030. However, TYNDP 2022 NT scenario assumes that there will be lignite-fired units in operation both in 2030 and 2040. Provided data for hydro capacities are in line with the TYNDP 2022 data. The data for solar and wind power plants are provided for 2030 and 2040 in line with the TYNDP 2022 data. With regard to batteries, TYNDP 2022 DE scenario assumes 105 MW in 2050, and according to data in Table 29 there are no batteries in the observed horizon.

In table below total projected electricity demand based on the delivered data is presented.

*Table 30 Electricity demand in 2030, 2040 and 2050 in North Macedonia based on the delivered data*

| | | 2030 | 2040 | 2050 |
|---|---|---|---|---|
| **Total ELECTRICITY demand** | **GWh** | 8879 | 10 147 | - |

In comparison to the TYNDP 2022 data, total annual demand is different in 2030 and 2040, while for 2050 data was not provided.

NTC values for the borders between North Macedonia and the neighbouring countries are presented in Table 31.

*Table 31 NTC values for borders between North Macedonia and neighbouring countries*

| Interconnection | From | To | Year | NTC (MW) |
|---|---|---|---|---|
| **MK00-AL00** | MK00 | AL00 | **2030** | 500 |
| | | | **2040** | 500 |
| | | | **2050** | 500 |
| | AL00 | MK00 | **2030** | 500 |
| | | | **2040** | 500 |
| | | | **2050** | 500 |

| Interconnection | From | To | Year | NTC (MW) |
|---|---|---|---|---|
| **MK00-BG00** | MK00 | BG00 | **2030** | 400 |
| | | | **2040** | 400 |
| | | | **2050** | 400 |
| | BG00 | MK00 | **2030** | 500 |
| | | | **2040** | 500 |
| | | | **2050** | 500 |
| **MK00-GR00** | MK00 | GR00 | **2030** | 850 |
| | | | **2040** | 850 |
| | | | **2050** | 850 |
| | GR00 | MK00 | **2030** | 1100 |
| | | | **2040** | 1100 |
| | | | **2050** | 1100 |
| **MK00-RS00** | MK00 | RS00 | **2030** | 270 |
| | | | **2040** | 270 |
| | | | **2050** | 270 |
| | RS00 | MK00 | **2030** | 300 |
| | | | **2040** | 300 |
| | | | **2050** | 300 |
| **MK00-XK00** | MK00 | XK00 | **2030** | 330 |
| | | | **2040** | 330 |
| | | | **2050** | 330 |
| | XK00 | MK00 | **2030** | 350 |
| | | | **2040** | 350 |
| | | | **2050** | 350 |

There are some differences between the provided data and TYNDP 2022 data in relevant scenarios. Provided data on generation capacities which is considered as the updated TYNDP 2022 data will be used in the further assessment for 2030 and 2040. With regard to 2050, the data based on TYNDP 2022 DE modelling results will be used for generation capacities and electricity demand.

### 2.2.1.8 Serbia

**Electricity**

**Country-specific data for Serbia were not delivered in the requested format** by the relevant national authorities during the data collection process.

For the modelling purposes, the Consultant intends to use the available TYNDP 2022 data for the respective scenarios, in combination with the EIHP in house modelling database.

**Gas(es)**

Country-specific data for the gas(es) sector in Serbia in 2030, 2040 and 2050 were provided by Ministry of Mining and Energy.

Based on the delivered data, gas(es) interconnectors that are constructed are presented in Table 32.

*Table 32 Gas(es) interconnectors in Serbia*

| Name of interco-nnector | Type | Year of commi-ssioning | From | To | Max Flow 1-2 (GWh) | Max Flow 2-1 (GWh) | Transmission fee (entry) 1-2 (EUR/MWh) | Transmission fee (exit) 1-2 (EUR/MWh) |
|---|---|---|---|---|---|---|---|---|
| **Kireevo-Zaychar** | Natural gas | 2021 | BG | RS | 367 | | 6330 | |
| **Kiskundorszma 2** | Natural gas | 2021 | RS | HU | 246 | | | 7330 |
| **HU-RS** | Natural gas | 1979 | HU | RS | 142 | | 113.55 | |
| **IP Point Balkan Stream-Serbia** | Natural gas | 2021 | BG | RS | 117.27 | | 113.55 | |
| **BG-RS-IBS** | Natural gas | 2023 | BG | RS | 47.01 | 3 | 113.55 | 246.28 |
| **RS-BA** | Natural gas | 1982 | RS | BA | 20.52 | | | |
| **RS-MK** | Natural gas | 2027 | RS | MK | 10.4 | 42.35 | | |
| **RS-RO** | Natural gas | 2026 | RS | RO | 35.04 | 46.51 | | |
| **RS-HR** | Natural gas | 2029 | RS | HR | 32.8 | 42.11 | | |

In Serbian gas(es) questionnaire data about gas(es) storages was also provided and is presented in the table below.

*Table 33 Gas(es) storages in Serbia*

| Name of storage | Type | Year of commis sioning | Max volume (GWh) | Daily injecting capacity (GWh) | Daily withdrawal capacity (GWh) |
|---|---|---|---|---|---|
| **PSG Banatski dvor** | Natural gas | 2011 | 4617 | 27.7 | 51.3 |
| **Planned capacity II phase** | | | 8208 | | |

In the table below gas(es) fields are presented according to the provided data from the questionnaire.

*Table 34 Gas(es) fields in Serbia*

| Name of field | Year of commissioning | Max daily production (GWh) |
|---|---|---|
| **RGE Elemir** | 1963 | 4 |
| **SGS Međa** | 1972 | 0.15 |
| **SGS Ban dvor** | 1978 | 0.45 |
| **SGS Ban dvor zapad** | 1986 | 0.08 |
| **SGS Itebej** | 1983 | 0.15 |
| **SGS Miloševo** | 1967 | 0.18 |
| **SGS Martonoš** | 2001 | 0.15 |
| **SS-1 Velebit** | 1969 | 0.22 |
| **SGS Palić** | 1976 | 0.10 |

### 2.2.1.9 Ukraine

**Country-specific data for Ukraine were not delivered** by the relevant national authorities during the data collection process.

**After the finalisation of this report, Ukrenergo delivered necessary electricity-related data for the modelling purposes, but the data is considered confidential and will not be described in this report.**

# 3 Project eligibility verification

In order for project to be found eligible, it must comply with the eligibility criteria described in the TEN-E Regulation. There are several categories of criteria that are mentioned in the TEN-E Regulation. The first category that projects must comply with in order to be further assessed is the following **general eligibility criteria**:

- the project falls in at least one of the energy infrastructure priority interconnection corridors and areas set out in Annex I of the TEN-E Regulation;
- the potential overall benefits of the project outweigh its costs, including in the longer term (will be calculated later through the CBA);
- the project meets any of the following 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 following specific criteria shall apply to PECI falling within specific energy infrastructure categories:

(a) **for electricity transmission**, distribution and storage projects the project contributes significantly to sustainability through the integration of renewable energy into the grid, the transmission or distribution of renewable generation to major consumption centres and storage sites, and to reducing energy curtailment, where applicable, and contributes to at least one of the following specific criteria:

(i) market integration, including through lifting the energy isolation of at least one Contracting Party and reducing energy infrastructure bottlenecks, competition, interoperability and system flexibility;

(ii) security of supply, including through interoperability, system flexibility, cybersecurity, appropriate connections and secure and reliable system operation;

(b) **for smart electricity grid projects**, the project contributes significantly to sustainability through the integration of renewable energy into the grid, and contributes to at least two of the following specific criteria:

(i) security of supply, including through efficiency and interoperability of electricity transmission and distribution in day-to-day network operation, avoidance of congestion, and integration and involvement of network users;

(ii) market integration, including through efficient system operation and use of interconnectors;

(iii) network security, flexibility and quality of supply, including through higher uptake of innovation in balancing, flexibility markets, cybersecurity, monitoring, system control and error correction;

(iv) smart sector integration, either in the energy system through linking various energy carriers and sectors, or in a wider way, favouring synergies and coordination between the energy, transport and telecommunication sectors;

(c) **for carbon dioxide transport and storage projects** the project contributes significantly to sustainability through the reduction of carbon dioxide emissions in the connected industrial installations and contributes to all of the following specific criteria:

(i) avoiding carbon dioxide emissions while maintaining security of supply;

(ii) increasing the resilience and security of transport and storage of carbon dioxide;

(iii) the efficient use of resources, by enabling the connection of multiple carbon dioxide sources and storage sites via common infrastructure and minimising environmental burden and risks;

(d) **for hydrogen**, the project contributes significantly to sustainability, including by reducing greenhouse gas emissions, by enhancing the deployment of renewable or low carbon hydrogen, with an emphasis on hydrogen from renewable sources in particular in end-use applications, such as hard-to-abate sectors, in which more energy efficient solutions are not feasible, and supporting variable renewable power generation by offering flexibility, storage solutions, or both, and the project contributes significantly to at least one of the following specific criteria:

(i) market integration, including by connecting existing or emerging hydrogen networks of Contracting Parties, or otherwise contributing to the emergence of an Energy Community-wide network for the transport and storage of hydrogen, and ensuring interoperability of connected systems;

(ii) security of supply and flexibility, including through appropriate connections and facilitating secure and reliable system operation;

(iii) competition, including by allowing access to multiple supply sources and network users on a transparent and non-discriminatory basis;

(e) **for electrolysers**, the project contributes significantly to all of the following specific criteria:

(i) sustainability, including by reducing greenhouse gas emissions and enhancing the deployment of renewable or low-carbon hydrogen in particular from renewable sources, as well as synthetic fuels of those origins;

(ii) security of supply, including by contributing to secure, efficient and reliable system operation, or by offering storage, flexibility solutions, or both, such as demand side response and balancing services;

(iii) enabling flexibility services such as demand response and storage by facilitating smart energy sector integration through the creation of links to other energy carriers and sectors;

(f) **for smart gas grid projects**, the project contributes significantly to sustainability by ensuring the integration of a plurality of low-carbon and particularly renewable gases, including where they are locally sourced, such as biomethane or renewable hydrogen, into the gas transmission, distribution or storage systems in order to reduce greenhouse gas emissions, and that project contributes significantly to at least one of the following specific criteria:

(i) network security and quality of supply by improving the efficiency and interoperability of gas transmission, distribution or storage systems in day-to-day network operation by, inter alia, addressing challenges arising from the injection of gases of various qualities;

(ii) market functioning and customer services;

(iii) facilitating smart energy sector integration through the creation of links to other energy carriers and sectors and enabling demand response.

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

- 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.

The results of the general (except CBA which will be performed later) and specific project eligibility verification for each project are given below. If the general criterion was not satisfied, the specific criteria were not assessed since compliance with the general criteria is the first mandatory condition of project's eligibility:

**E01: Increasing the capacity of existing 220 kV interconnection between Bosnia and Herzegovina and Montenegro, 220 kV OHL Trebinje – Perućica**

- General criteria: E01 **complies with the general criteria (except economic criterion[3] which will be evaluated in a later stage)**, since it is a cross-border project connecting two CPs.
- Specific criteria: E01 **complies with the specific criteria,** with GTC[4] increase ME-BA 500 MW, BA-ME 500 MW, as declared and verified by the project promoters[5].

**E02: New 400 kV interconnection between Bosnia and Herzegovina and Montenegro, 400 kV OHL Gacko – Brezna**

- General criteria: E02 **complies with the general criteria (except economic criterion)**, since it is a cross-border project connecting two CPs.
- Specific criteria: E02 **complies with the specific criteria,** with GTC increase larger than 500 MW at the ME-BA border, as declared and verified by the project promoters[6].

**E03: New 400 kV interconnection between Montenegro and Bosnia and Herzegovina, 400 kV overhead line Brezna-Sarajevo with construction 400/220 kV substation Piva's mountain**

- General criteria: E03 **complies with the general criteria (except economic criterion)**, since it is a cross-border project connecting two CPs.
- Specific criteria: E03 **complies with the specific criteria,** with GTC increase larger than 500 MW at the ME-BA border, as declared and verified by the project promoters[7].

**E04: Trans Balkan Corridor: Double OHL 400 kV Bajina Basta (RS) – Visegrad (BA)/Pljevlja (ME) (BA section)**

- General criteria: E04 **complies with the general criteria (except economic criterion)**, since it is a cross-border project connecting three CPs.

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*[3] Cost-benefit analysis will show eligibility according to the criterion that the potential overall benefits of the project outweigh its costs, including in the longer term (Article 4(b) of the revised TEN-E regulation). This is valid for all projects listed in this chapter.*

*[4] GTC values provided by the project promoters are equal to the NTC values at the specific border (valid for all nominated projects).*

*[5] The project promoters initially submitted data on the GTC increase ME-BA 600 MW, BA-ME 800 MW but after verification these values were decreased to 500 MW in both directions.*

*[6] The project promoters initially submitted data on the GTC increase ME-BA 550 MW, BA-ME 1650 MW but after verification these values were changed to 876 MW for ME-BA and 567 MW for BA-ME direction.*

*[7] The project promoters initially submitted data on the GTC increase ME-BA 600 MW, BA-ME 1475 MW but after verification these values were changed to 725 MW for ME-BA and 584 MW for BA-ME direction.*

- *Specific criteria:* E04 **complies with the specific criteria,** with GTC increase ME-RS 600 MW, ME-RS 600 MW, and BA-RS 300 MW and RS-BA 500 MW as declared by the project promoters.

**E05: Internal transmission line 400 kV Banja Luka 6 - Mostar 4**

- *General criteria:* E05 **complies with the general criteria (except economic criterion)**, since there is a cross-border impact from this internal project on two neighbouring CPs.
- *Specific criteria:* E05 **complies with the specific criteria,** with GTC increase BA-ME 400 MW, ME-BA 350 MW, BA-RS 200 MW, RS-BA 200 MW, as declared by the project promoters.

**E06: Reconfiguration of 400 kV grid and new 400 kV interconnection Albania-Kosovo**

- *General criteria:* E06 **complies with the general criteria (except economic criterion)**, since it is a cross-border project connecting three CPs.
- *Specific criteria:* E06 **complies with the specific criteria,** with GTC increase AL-XK 500 MW, XK-AL 500 MW, as declared by the project promoters.

**E07: Closing the 400 kV Albanian internal ring**

- *General criteria:* E07 **complies with the general criteria (except economic criterion)**, since there is a cross-border impact from this internal project on three neighbouring CPs.
- *Specific criteria:* E07 **complies with the specific criteria,** with GTC increase AL-ME 100 MW, AL-XK 200 MW, AL-MK 200 MW, which equals to the total GTC increase of 500 MW, as declared and verified by the project promoters.

**E08: 330 kV OHL Balti (MD) - Dnestrovsk HPP-2 (UA)**

- *General criteria:* E08 **complies with the general criteria (except economic criterion)**, since it is a cross-border project connecting two CPs.
- *Specific criteria:* E08 **complies with the specific criteria,** with GTC increase UA-MD 500 MW, MD-UA 500 MW, as declared by the project promoters.

**E09: Rehabilitation of 400 kV OHL Mukacheve (UA) – Velké Kapušany (SK)**

- *General criteria:* E09 does **not comply with the general criteria** since it connects one CP to non-CP and does not have a cross-border impact on any other CP.

**E10: The reconstruction of the 400 kV transmission line Pivdennoukrainska NPP (Ukraine)-Isaccea (RO)**

- *General criteria:* E10 does **not comply with the general criteria** since it connects one CP to non-CP and does not have a cross-border impact on any other CP.

**E11: Construction of smart 110 kV grid in "Ukraine Bessarabia" region**

- *General criteria:* E11 **complies with the general criteria (except economic criterion)**, since it has a cross-border impact on a neighbouring CP (Moldova) by affecting the electricity supply of the border region and loading of the Ukraine-Moldova interstate connection.

- *Specific criteria:* E11 does **not comply with the specific criteria** since it does not include two TSOs, DSOs or TSO and DSO from two CPs.

**E12: Cybersecurity management system for protection grids assets from cyber threats**

- *General criteria:* E12 **complies with the general criteria (except economic criterion)**, since it is a cross-border project influencing two CPs.
- *Specific criteria:* With regard to specific criteria defined in Article 4(b) of the revised TEN-E Regulation[8] **additional input has been required** from the project promoters. Afterwards, it was concluded E12 does **not comply with the specific criteria** since it does not have any positive impact on sustainability via enabling an increase of RES connections and does not fulfil at least two out of four specific criteria for smart electricity grid projects.
- *Additional specific criteria:* E12 **complies with the additional specific criteria,** since it includes two DSOs from two CPs and also complies with two technical requirements set by the TEN-E Regulation: it involves over 50 000 users (100 000) and has a consumption level in of over 300 GWh/year (6800 GWh/year).

**E13: DTEK STORAGE 225 MW**

- *General criteria:* E13 **complies with the general criteria (except economic criterion)**, since it has a cross-border effect on a neighbouring CP (Moldova) by improving frequency control in UA/MD control block.
- *Specific criteria:* E13 **complies with the specific criteria,** since it provides 225 MW installed capacity and has a storage capacity that allows a net annual electricity generation over 250 GWh/year.

**E14: Pump Storage Plant Koman and Fierza**

- *General criteria:* E14 **complies with the general criteria (except economic criterion)**, since it has a cross-border effect on a neighbouring CP (Kosovo) by decreasing the fossil fuel dependency of Kosovo by exporting the generated electricity from the PSHPP.
- *Specific criteria:* E14 **complies with the specific criteria,** since it provides over 225 MW installed capacity (250 MW) and has a storage capacity that allows a net annual electricity generation over 250 GWh/year

  However, since the project-specific questionnaire in the project submission did not provide sufficient data (the compulsory fields were not filled out) and additional data were not received after several requests to the project promoters, this project cannot

[8] *for smart electricity grid projects falling … the project contributes significantly to sustainability through the integration of renewable energy into the grid, and contributes to at least two of the following specific criteria:*

*(i) security of supply, including through efficiency and interoperability of electricity transmission and distribution in day-to-day network operation, avoidance of congestion, and integration and involvement of network users;*

*(ii) market integration, including through efficient system operation and use of interconnectors;*

*(iii) network security, flexibility and quality of supply, including through higher uptake of innovation in balancing, flexibility markets, cybersecurity, monitoring, system control and error correction;*

*(iv) smart sector integration, either in the energy system through linking various energy carriers and sectors, or in a wider way, favouring synergies and coordination between the energy, transport and telecommunication sectors;*

be further analysed due to insufficient data crucial for modelling and calculations of potential benefits in the CBA.

**G01: Internal hydrogen infrastructure in Federation of BiH in connection with H2T Southern Interconnection BiH/CRO**

- *General criteria:* G01 does **not comply with the general criteria** since it is an internal project that does not have a cross-border effect on any other CP.

**G02: Gas interconnection Serbia – North Macedonia**

- *General criteria:* G02 does **not comply with the general criteria** since it is not proven that the project is hydrogen ready infrastructure from its commissioning, by which it cannot enter into eligibility analysis.

**G03: Increasing capacities on the Trans-Balkan route with the integration of the hydrogen element**

- *General criteria:* G03 does **not comply with the general criteria** since this is in fact a natural gas project and therefore is not eligible under the revised TEN-E Regulation. It also only involves one project promoter.

After the project eligibility verification is completed, nine projects are concluded to be eligible and will go into further analysis, i.e. CBA and MCA analyses (Figure 24).

**E01: Increasing the capacity of existing 220 kV interconnection between Bosnia and Herzegovina and Montenegro, 220 kV OHL Trebinje – Perućica**

**E02: New 400 kV interconnection between Bosnia and Herzegovina and Montenegro, 400 kV OHL Gacko – Brezna**

**E03: New 400 kV interconnection between Montenegro and Bosnia and Herzegovina, 400kV overhead line Brezna-Sarajevo with construction 400/220 kV substation Piva's mountain**

**E04: Trans Balkan Corridor: Double OHL 400 kV Bajina Basta (RS) – Visegrad (BA)/Pljevlja (ME) (BA section)**

**E05: Internal transmission line 400 kV Banja Luka 6 - Mostar 4**

**E06: Reconfiguration of 400 kV grid and new 400 kV interconnection Albania-Kosovo**

**E07: Closing the 400 kV Albanian internal ring**

**E08: 330 kV OHL Balti (MD) - Dnestrovsk HPP-2 (UA)**

**E13: DTEK STORAGE 225 MW**

*Figure 24 Eligible projects for CBA and MCA analysis*

# 4 Scenarios and assumptions

In this section general approach for project assessment is presented, with the focus on the first step of the assessment process, i.e. **modelling the reference scenario** based on which the projects will be assessed for their benefits. The main modelling assumptions, including input data based on the TYNDP scenarios, and proposed sensitivity analyses, are described.

## 4.1 General approach for project assessment

After the data collection process, data validation and verification, final (validated) data sets regarding candidate projects and countries will be used in the project assessment phase.

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*[9]) 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.**

The main objective of the assessment is to determine **if the potential overall benefits of the project outweigh its costs**.

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. In the eligibility verification process (more details in section 3), all the gas(es) candidate projects were declared as not eligible. Thus, only modelling of the electricity sector will be considered in the modelling phase of the project. The Consultant shall develop regional model of the electricity systems of CPs using **PLEXOS Energy Modelling software**[10] (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

*[9] 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.*

*[10] 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.*

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 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 electricity project assessment are:

- **CBA Methodology of the ENTSO-E** (to be applied for the overhead transmission lines projects)
    - 4th ENTSO-E Guideline for Cost-Benefit Analysis of Grid Development Projects*, April 2024.*

- **Methodology developed by the European Commission** (to be 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[11] 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.*

The ***TYNDP-specific CBA Implementation Guidelines*** as an accompanying document of the *4th ENTSO-E CBA Guideline,* will also be used for project assessment calculations.

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

[11] *But not necessarily strictly followed.*

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 Modelling scenarios

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 during the first and the second phase of the project, the data from the **TYNDP 2022 is mostly used**. This primarily refers to the scenarios that will be modelled as the reference cases for the period until 2050. Exceptions are $CO_2$ prices and wholesale electricity prices on the distant spot markets in relation to the EnC CPs (modelled in a simplified way than EnC CPs and their neighbouring EU MS as described in Chapter 3.2.2) which were taken from the latest TYNDP 2024 Draft Scenarios Report that was published in May 2024[12].

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 will be used for modelling of 2030 and 2040 time horizons (agreed at the 1st joint meeting of the Electricity and Gases Groups on 7 March 2024), while for the later period, i.e. 2050, **Distributed Energy (DE)**[13] scenario will be used to properly reflect EnC Contracting Parties dedication to fully decarbonise until 2050, as is defined in the core of the revised TEN-E regulation. The decision to use National Trends scenarios for 2030 and 2040 is mainly based on the present conditions in the Energy Community CPs, especially by taking into account their distribution networks which are in general not ready to accept distributed energy sources on a large scale, which makes Distributed Energy scenarios for 2030 and 2040 practically not feasible for CPs due to their general lagging to the EU MSs in a technical, economic, regulatory and policy aspects. This assumption is also in line with the study made for the Energy Community Secretariat "Modernization, Decarbonization and Resilience - A Regional Transition Roadmap for the Western Balkans Study" (E3modelling, 2024), proposing gradual carbon pricing implementation with free allowances in the CPs to achieve carbon neutrality until 2050.

Country-specific data collected in the period from March 2024 until May 2024 are adjusted to the analysed scenarios, assumed to be in line with the Clean Energy Package targets, adopted in the Energy Community by the Ministerial Council Decision 2022/02/MC-EnC. This decision does not define specific electricity-related targets but just the sectorial ones (electricity, heating and cooling and transport) regarding greenhouse gas emissions, renewable energy and energy efficiency in relation to 1990 emissions, share of RES in gross

*[12] Since the PECI selection process is not fully synchronised with the ENTSO-E TYNDP process (the newest TYNDP data lag to PECI process), the Energy Community Secretariat expresses its request to synchronise better with the ENTSO-E and TYNDP process in the next rounds of PECI selection processes (2026, 2028…).*

*[13] DE is the top-down scenario under the TYNDP 2022, that pictures a pathway achieving EU-27 carbon neutrality by 2050 and at least 55 % emission reduction in 2030.*

final consumption of energy, and headline targets for energy efficiency. However, based on data delivered by the EnC CPs ministries and TSOs with respect to total installed capacities of hydro power plants, wind and solar power plants, and other RES, it was roughly estimated that delivered data is largely adjusted with the legally binding energy and climate targets[14].

The TYNDP scenarios and related data for modelled countries that shall be considered in the model refer to:

- total conventional (thermal and hydro) generation capacities per fuel/technology type,
- total wind and solar capacities and renewable energy time series (available in PECD) based on the selected climate year,
- batteries capacities,
- total electricity demand and demand time series,
- NTC values between CPs and between CPs and neighbouring EU member states,
- fuel and $CO_2$ prices.

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.

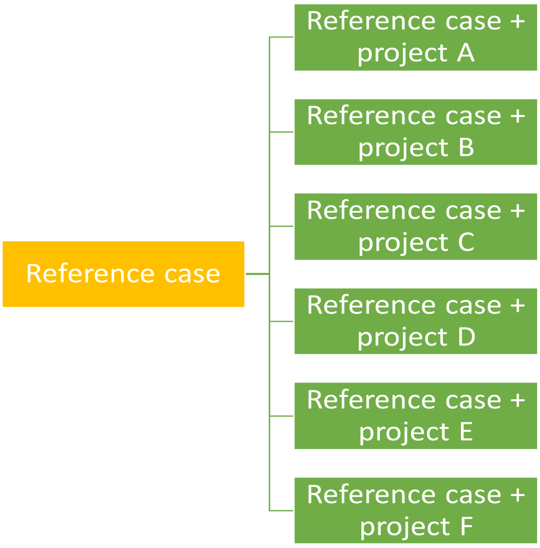


*Figure 25 Modelling approach - the reference case without and with the projects*

[14] *There were few countries which delivered data not fully in line with decarbonisation targets, regarding operation of coal-fired and gas-fired power plants in 2050 and this was adjusted by correcting the data by assuming phase-out of coal-fired power plants and possible operation of gas-fired ones but only equipped with Carbon Capture Storage (CCS), as described in section 3.2.4.*

## 4.3 Geographical scope

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

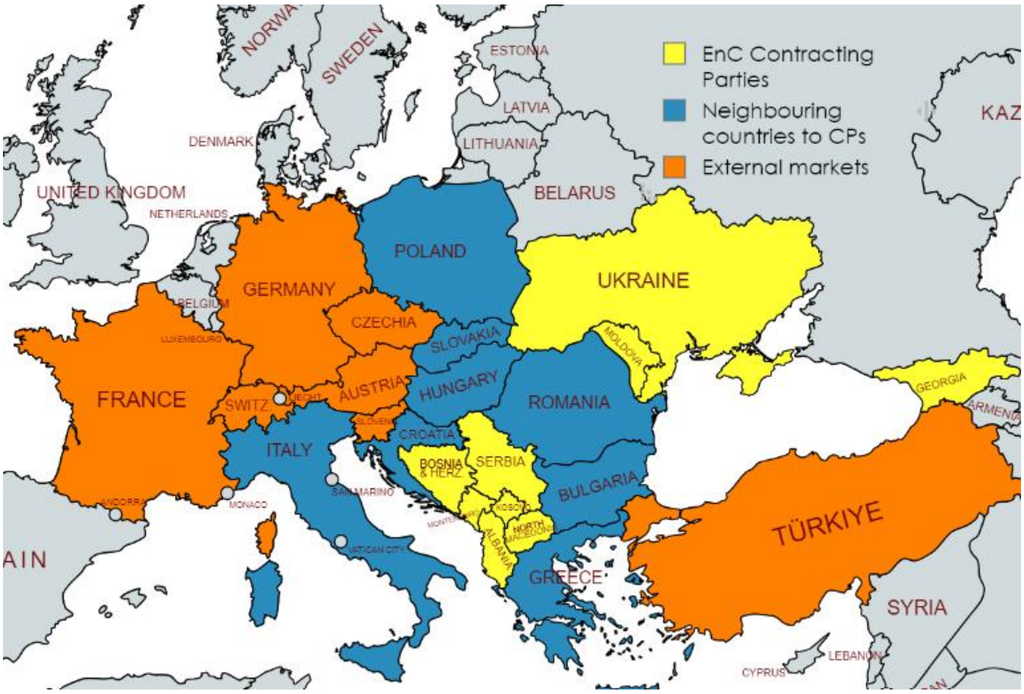


*Figure 26 Geographical scope of regional market model in PLEXOS*

These countries will be modelled based on the collected input data through country-specific questionnaires and based on the previous experience of the Consultant in modelling these countries. The approach for modelling of generation systems can be **unit-by-unit** meaning that each power plant will be modelled separately, or generation capacities can be clustered on a fuel/technology level. Based on the available data, all countries, except Ukraine, can be modelled on a unit-by unit level.

In addition to the Contracting Parties, their neighbouring countries/markets (as presented in Figure 26) shall also be considered based on the best available data (primarily ENTSO-E) 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.

## 4.4 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.

## 4.5 Generation capacities

Data on generation capacities for CPs are collected from relevant authorities (ministries and TSOs). Given that there are some differences in the collected data and the data based on the TYNDP 2022 scenarios, it has been agreed between the Secretariat and the Consultant[15], that the data provided by relevant national authorities will be used in market model development. The modifications of the provided input data are made where necessary to assume carbon neutrality in 2050 (DE scenario) by decommissioning all coal-fired thermal power plants without any exception, and by eventually assuming the application of carbon capture technology on gas-fired power plants or their usage of clean gases[16].

Table 35 - Table 37 contain data on generation capacities in CPs based on the collected data in the three years, 2030, 2040 and 2050. Cells marked in green signify the data that is taken from TYNDP 2022 since no other data has been provided/revised from the initial TYNDP 2022 data set, while the rest of the data is provided by the national authorities.

*Table 35 Generation capacities in 2030 in Contracting Parties (MW)*

| Country | Nuclear | Thermal-gas | Thermal-lignite/coal | Hydro | Wind | Solar | Batteries |
|---|---|---|---|---|---|---|---|
| **AL** | - | 300 | - | 2623 | 300 | 700 | - |
| **BA** | - | - | 1418 | 2323.8 | 798 | 1514 | 50 |
| **GE** | - | 1598.2 | 22.3 | 4065 | 750 | 700 | 200 |
| **XK** | - | - | 904 | 100.7 | 677 | 550 | 170 |
| **MD** | - | 1720 | 47.2[17] | 64.5 | 442 | 470 | 10 |
| **ME** | - | 49[18] | 225 | 961.4 | 250 | 750 | 28 |
| **MK** | - | 760 | 31[19] | 938.1 | 443 | 580 | - |
| **RS** | - | 400.9 | 4584 | 3244.2 | 3844 | 235 | - |
| **UA** | 13 940 | 4772.3 | 15855 | 2572.9 | 580 | 7350 | 258 |

[15] *Confirmed by the electricity group at the meeting on 16 May 2024.*

[16] *Gas-fired power plants in some EnC CPs (Ukraine, Serbia, Albania, Georgia and Moldova) are assumed to be operational in 2050 but operating in line with the carbon neutrality target.*

[17] *In Moldova thermal is not lignite/coal but other non-renewable thermal capacity*

[18] *In Montenegro thermal is not natural gas but other renewable thermal capacity*

[19] *In North Macedonia thermal is not natural gas but other renewable thermal capacity*

*Table 36 Generation capacities in 2040 in Contracting Parties (MW)*

| Country | Nuclear | Thermal-gas | Thermal-lignite/coal | Hydro | Wind | Solar | Batteries |
|---|---|---|---|---|---|---|---|
| AL | - | 300 | - | 2633 | 700 | 1300 | - |
| BA | - | - | 1418 | 2480.3 | 1500 | 3000 | 381 |
| GE | - | 1598.2 | 22.3 | 5805 | 1700 | 1650 | 200 |
| XK | - | - | 904 | 100.7 | 1275 | 1340 | 170 |
| MD | - | 1720 | 47.2 | 64.5 | 960 | 750 | 10 |
| ME | - | 49 | 225 | 961.4 | 600 | 2400 | 28 |
| MK | - | - | 31 | 1480.5 | 723 | 998 | - |
| RS | - | 400.9 | 3899 | 3848.3 | 3246 | 950 | - |
| UA | 13 940 | 4772.3 | 15 855 | 2572.9 | 2580 | 11 120 | 258 |

*Table 37 Generation capacities in 2050 in Contracting Parties (MW)*

| Country | Nuclear | Thermal-gas* | Thermal-lignite/coal | Hydro | Wind | Solar | Batteries |
|---|---|---|---|---|---|---|---|
| AL | - | 300 | - | 2633 | 1650 | 1650 | - |
| BA | - | - | - | 2480.3 | 2500 | 5000 | 500 |
| GE | - | 1598.2 | - | 8350 | 2900 | 2600 | 200 |
| XK | - | - | - | 100.7 | 1873 | 1938 | 170 |
| MD | - | 1720 | - | 64.5 | 1120 | 880 | 10 |
| ME | - | - | - | 961.4 | 700 | 4300 | 28 |
| MK | - | - | - | 1480.5 | 605 | 11553 | 105 |
| RS | - | 400.9 | - | 3848.3 | 2968 | 725 | - |
| UA | 13 940 | 4772.3 | - | 2572.9 | 6750 | 21220 | 258 |
| | | | | | | | |

* CCS applied

## 4.6 Electricity demand

Data on electricity demand for CPs are collected from relevant authorities. Given that there are some differences in the collected data and the data based on the TYNDP 2022 scenarios, it has been agreed between the Secretariat and the Consultant, that the data provided by relevant national authorities will be used in market model development. In cases where data were not provided, TYNDP 2022 data will be used. Cells marked green signify that the data is used from TYNDP since no other data has been provided by the authorities.

*Table 38 Electricity demand in Contracting Parties (GWh)*

| Country | 2030 | 2040 | 2050 |
|---|---|---|---|
| **AL** | 8900 | 9400 | 12 116 |
| **BA** | 11 158 | 12 681 | 13 457 |
| **GE** | 19 111 | 23 907 | 29 071 |
| **XK** | 6802 | 7998 | 10 180 |
| **MD** | 7002 | 8417 | 9993 |
| **ME** | 4539 | 5534 | 6281 |
| **MK** | 8879 | 10 147 | 10 759 |
| **RS** | 36 498 | 37 240 | 37 218 |
| **UA** | 151 840 | 208 500 | 296 600 |

## 4.7 Fuel and $CO_2$ prices

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

For the reference case, it is proposed to use the TYNDP 2022 values for fuel prices, as presented in **Error! Reference source not found.** and **Error! Reference source not found.**, i.e. values for NT scenario in 2030 and 2040, and values for DE scenario in 2050. During the project execution, TYNDP 2024 was published (mid May 2024) and it was agreed with the EnC Secretariat to use the $CO_2$ prices based on the new available data in the TYNDP 2024 report. This also includes wholesale electricity prices for the spot markets outside of EnC CPs and their neighbouring EU MS.

*Table 39 Fuel prices common to all scenarios in 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 40 Fuel prices in TYNDP 2022 and $CO_2$ prices in TYNDP 2024 per scenarios and horizons*

| | Unit | Scenarios | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|
| $CO_2$ | €/tonne | **-** | **113.4** | **147.0** | **168.0** |
| Hard coal | €/GJ | **NT** | **2.48** | **2.41** | N.a. |
| | | **DE** and **GA**[20] | 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** |
| Synthetic methane | | **NT** | 28.09 | 23.35 | N.a. |
| | | **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; TYNDP 2024 Scenarios Methodology Report, May 2024*

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

## 4.8 Selection of climatic year

Electricity demand will be 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.

## 4.9 NTC values

Data on NTC values between CPs and CPs and neighbouring countries are collected from relevant authorities and presented in section 2.2.1. Given that there are some differences in the collected data and the data based on the TYNDP 2022 scenarios, the final input data set regarding NTC values will be based on the data provided by relevant CPs authorities in cases where there are no differences between the provided data by the two national authorities for the same border. In cases where differences appear, NTC data from the TYNDP 2022 will be used. NTC data used are described in detail in the Analysis Techniques Guidance Document.

## 4.10 Sensitivity analysis

According to the TEN-E Regulation, each cost-benefit analysis shall include **sensitivity analyses concerning the input data set**, possibly related to the cost of generation and greenhouse gases as well as the expected development of demand and supply, expected development of renewable energy sources, and including the flexibility of both, and the availability of storage, the commissioning date of various projects in the same area of analysis, climate impacts and other relevant parameters.

**4$^{th}$ ENTSO-E Guideline for Cost-Benefit Analysis of Grid Development Projects** also points out the importance of conducting sensitivity analysis in the CBA, in order to increase the validity of the CBA results.

Sensitivity analysis can be performed to observe how the variation of parameters, either one parameter or a set of interlinked parameters, affects the model results, whereas aim is not to define complete new sets of scenarios but quick insights in the system behaviour with respect to single (few) changes in specific parameters.

In general, a sensitivity analysis **must be performed on a uniform level**, i.e. the sensitivity needs to be applied to all projects under assessment in the respective study. Some of the sensitivities conducted under the previous TYNDP processes are related to: fuel and $CO_2$ price, long-term societal cost of $CO_2$ emissions, climate year, load, technology phase-out/phase-in, must-run, installed generation capacity (including storage and RES), flexibility of demand and generation, availability of storage and the commissioning date of various projects.

Under the CBA of the ongoing PECI process, the Consultant proposes the following parameters to be variated in the sensitivity analysis:

- **Load** – it is expected that an increasing number of applications and different sectors like transport and heating will be electrified in the future (e.g. e-mobility, heat pumps, etc.), which would cause an increase in load and the necessary generation and therefore possibly affect several CBA indicators such as SEW. On the other hand, energy efficiency measures will lead to decreasing load.
- **RES** – amendments to the national RES goals, which could occur frequently in the observed horizon, could lead to dominant impacts on the results of the CBA assessment.

The Consultant proposes to **increase and decrease load for 20%, and increase solar capacity for 20%** in each of the analysed years in the horizon. The proposed variations have to be applied to reference scenario without and with each of the analysed projects, as graphically represented in the following figure.

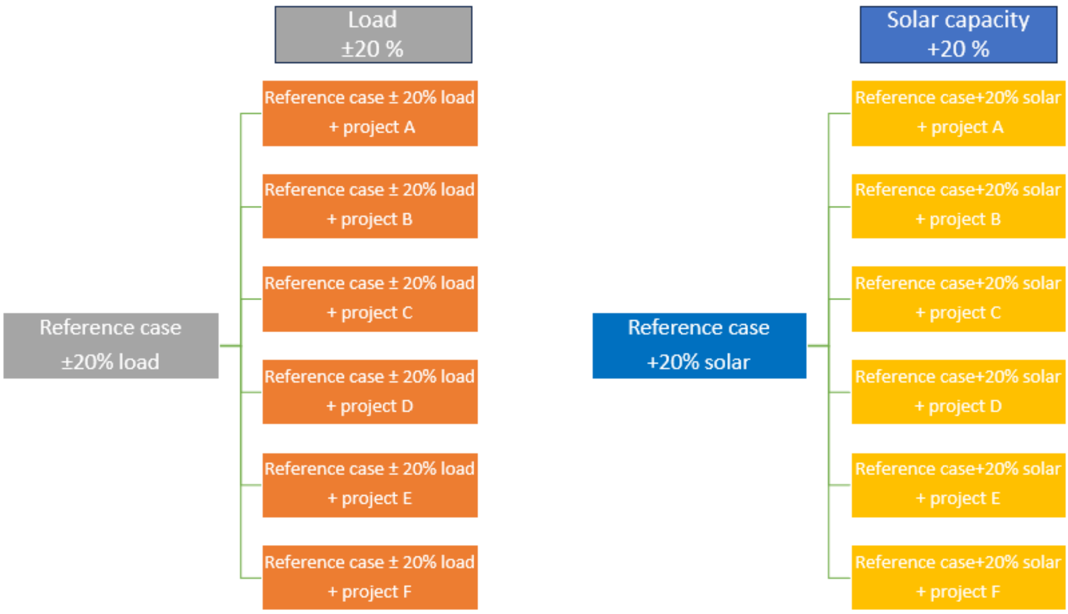


*Figure 27 Proposed sensitivities under the PECI project assessment process*

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