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Moldova Energy Independence and Resilience (MEIR)

Support in modelling and analysis of Moldova’s power system for the integration of renewables and energy storage solutions

Modelling and Analysis of Moldova’s Power System for the Integration of Renewables and Energy Storage Solutions

Prepared by: Tetra Tech
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Energy Community Secretariat

Energy Community Secretariat

Modelling and Analysis of Moldova’s Power System for the Integration of Renewables and Energy Storage Solutions

Task 2: Update of power system model in Moldova

Deliverable 2: Power system model report

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
BESS	Battery Energy Storage Systems
CCGT	Combined Cycle Gas Turbines
CHP	Combined Heat and Power
EnCS	Energy Community Secretariat
ENTSO-E	European Network of Transmission System Operators for Electricity
ERAA	Electricity Regional Adequacy Assessment
EU	European Union
ETS	European Emissions Trading System
HPP	Hydro Power Plant
HPS	Hydro Pump Storage
IPS	Integrated Power System
kW	Kilowatt
MESA	Moldova Energy Security Activity
MW	Megawatt
MWh	Megawatt Hour
MoE	Ministry of Energy
MGRES	Moldavskaya GRES
NECP	National Energy and Climate Plan
NTC	Net Transfer Capacity
RES	Renewable Energy Resources
RoR	Run of River
TYNDP	Ten Year Network Development Plan
TPP	Thermal Power Plant
PV	Photovoltaic
PEMMDB	Pan-European Market Modelling Data Base
RES	Renewable Energy Resource
TSO	Transmission System Operator
USAID	United States Agency for International Development
UPS	Unified Power System
WPP	Wind Power Plant
WAM	With Additional Measures

1.0 INTRODUCTION

This report comprises the second deliverable of the PN07-2025 service agreement for supporting the Moldovan government in fulfilling certain commitments, stemming from the Letter of Intent signed on 4 February 2025[1] between the Government of the Republic of Moldova and the European Commission. The agreement underscores Moldova's determination to fast-track renewable energy deployment and the integration of energy storage solutions. This initiative is supported by the Energy Community Secretariat, an international organization dedicated to harmonizing the European Union (EU) internal energy market with its neighboring regions, thereby extending European energy market rules and principles to the Energy Community Contracting Parties.

The Letter of Intent foresees the development of an action plan aimed at organizing a series of new renewable energy and energy storage auctions throughout 2025, specifying the allocated capacities for each auction, with a view to fast-track renewable energy deployment by the end of 2026. With the European Commission providing technical support, the Government of Moldova has been tasked with defining the capacity allocations for each auction. As part of this effort and in continuation of the work carried out under the U.S. Agency for International Development (USAID) Moldova Energy Security Activity (MESA), the current assignment will leverage an exhaustive review of existing studies and analyses, including the latest version of the Moldovan National Energy and Climate Plan (NECP) and the draft Ten-Year Network Development Plan (TYNDP), to thoroughly capture the current policy environment and strategic priorities for enhancing energy security and sustainability.

This report presents an overview of the PLEXOS model developed for the Modelling and Analysis of Moldova's Power System for the Integration of Renewables and Energy Storage Solutions project. Originally designed for the Moldovan TYNDP 2025-2034, the model has been updated as part of Task 2 to incorporate the latest input data from Task 1 and refine key operational constraints, ensuring it remains aligned with current system dynamics and planning objectives.

As Moldova's power system undergoes a transition, balancing the need for secure thermal generation with the increasing integration of renewable energy resources (RES) becomes a critical challenge. A key factor in this shift is the Moldavskaya GRES (MGRES) thermal power plant, whose operational status will play a decisive role in maintaining supply-demand equilibrium. At the same time, energy security remains a pressing concern, particularly in the context of geopolitical uncertainties and challenges related to natural gas supply. In this evolving landscape, updating the power system model with the latest operational data, stakeholder insights, and real-time renewable generation metrics is essential to support informed decision-making and strategic planning.

To address these complexities, the model update places a strong emphasis on providing the basis for the evaluation of RES penetration thresholds while refining the representation of must-run constraints for thermal power plants in Moldova. This ensures that seasonal requirements, such as heat supply in winter, are accurately reflected. Additionally, the model integrates cross-border transmission capacities with Ukraine and Romania

[1] Letter of Intent between the Government of the Republic of Moldova and the European Commission - European Commission

in line with the latest Moldovan TYNDP projections, allowing for a more comprehensive understanding of regional interdependencies and overall system dynamics.

2.0 THE MODEL SETUP

The techno-economic optimization and determination of the optimal size for RES and battery energy storage systems (BESS) in this assignment are based on analyses conducted using the PLEXOS software. Generation optimization studies have been carried out utilizing PLEXOS, a state-of-the-art power system simulation tool that utilizes mathematical programming techniques, including mixed-integer programming.

By incorporating comprehensive data on the existing system, future prospects, electricity demand evolution, and both current and planned power plants, the model simulates generation system operations to identify optimal solutions for each scenario. Scenario development is essential for assessing the future trajectory of Moldova's power system, considering demand forecast alternatives, the evolution of generation capacity, and key operational and market dynamics. As part of Task 2, our team developed the following three scenarios that we will simulate in Task 3: (1) the Moldovan power system model for year 2026; (2) that of year 2030 without the new gas-fired power plant (125 MW): (3) and that of year 2030 with the addition of the new gas-fired power plant. The uncertainty regarding the commissioning of the new gas-fired power plant has led to the need for two scenarios for year 2030. The impact of the new interconnection transmission line between Balti and Suceava will be accounted for in 2030 by adjusting the NTC value between Moldova and Romania.

The PLEXOS model of the Moldovan power system has been adjusted according to the rearranged input data agreed upon with stakeholders. Initially, we will conduct the following simulation phases in PLEXOS during the implementation of Tasks 3 and 4 of this assignment:

- Mid-term (MT) and short-term (ST) schedule for the years 2026 and 2030 – this simulation is used to run the yearly dispatch at an hourly level. Wind, solar and biomass/biogas power plant capacity would be added to power system of Moldova in iterative manner. The stop-condition of the simulation would be 5 per cent spillage of wind and solar technologies. Next step would be to estimate necessary frequency regulation reserve and dimension BESS to provide such a reserve. MT and ST schedules will be used to estimate the arbitrage influence of BESS on RES spilled energy.

2.1 POWER SYSTEM MODELING

The power system model developed for this study represents Moldova, Ukraine, Romania, and the broader European Network of Transmission System Operators for Electricity (ENTSO-E) region, employing a structured nodal approach to capture the key operational characteristics of the neighboring ENTSO-E countries connected to Ukraine and Romania. Figure 2-1 illustrates the model implemented in PLEXOS.

Moldova is modelled as two distinct nodes: left bank and right bank. The left bank, representing Transnistria, is connected solely to the right bank to reflect its "island mode of supply". To accurately simulate system behavior, power flows from the left to the right bank are permitted only during nighttime hours (50 MW allowed), reflecting excess energy from MGRES operating with one unit at its minimum stable power output and supplying the right bank during low-load periods.

The representation of power plants varies by region. In Moldova, generation assets are modelled on a unit-by-unit basis to capture individual plant characteristics. Conversely, in Ukraine and Romania, power plants are aggregated by fuel type and hydro plant classification to streamline the modelling process while maintaining the necessary level of detail for accurate market simulations.

The broader ENTSO-E region is modelled as a single node. Power flows between ENTSO-E, Ukraine, and Romania are driven by the wholesale electricity price time series for the target year (2030 Hungary wholesale electricity price time series (source: ENTSO-E TYNDP 2024)), updated for year 2026 by using the annual historical wholesale electricity price in 2024 in Hungary (source: Hungarian Power Exchange (HUPX) website). These flows are further constrained by adapted net transfer capacities (NTCs) to ensure realistic interconnection behavior aligned with regional transmission limits. With a view to appropriately represent the inter-area exchanges of the Romanian-Moldovan-Ukrainian markets with that of the broader are of European single electricity market, an adaptation has been imposed in the model through the analysis of wholesale electricity price in Hungary. Importing NTC to ENTSO-E was reduced proportionally in hours when hourly electricity price is lower that yearly average. Exporting NTC from ENTSO-E was reduced proportionally in hours when hourly electricity price is higher that yearly average.

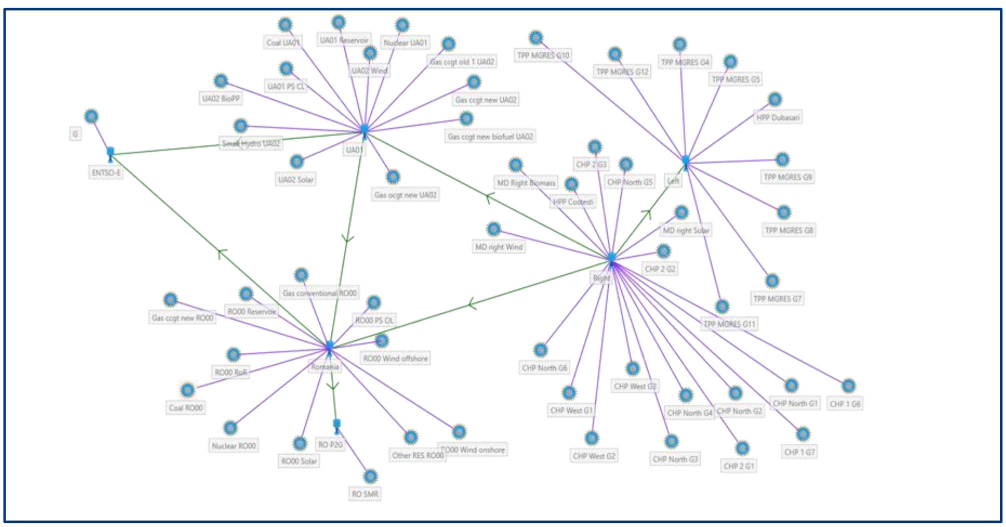

Figure 2-1 Power system model in PLEXOS

2.1.1 GENERATION CAPACITY

2.1.1.1 Current Generation Mix in Moldova

The existing generation mix in Moldova is primarily composed of gas-fired thermal power plants, which have been individually modelled within the generation dispatch and unit commitment framework. The modeling approach provides detailed insights into each generator's operation, ensuring an accurate evaluation of system performance. The available generation capacity in the Moldovan electricity system amounted to 2,583.31 MW in the end of February 2025, mainly in thermal plants. However, excluding the capacities on the left bank of the Nistru River, which will be used solely for supplying consumption in the Transnistria region, leads to the conclusion that the available capacity of generation units is only 1,015.31 MW. This includes the currently connected renewable energy capacities in both the transmission and distribution network. In terms of its electricity sector energy balance, Moldova generally maintains limited domestic generation and relies on imports during periods of high demand. Increasing gradually the integration of renewable energy is expected to reduce this reliance with due consideration to maintaining the frequency quality of the system.

Table 2-1 Generation mix in Moldova, February 2025

POWER PLANT (NAME)	START OF COMMERCIAL OPERATION (YEAR)	EXPECTED DECOMMISSIONING (YEAR)	RESOURCE (TYPE)	RESOURCE TECHNOLOGY (TYPE)	PRIMARY FUEL (TYPE)	NUMBER OF UNITS	INSTALLED CAPACITY (MW)	AVAILABLE CAPACITY (MW)
TPP MGRES (G1-G8)	1964–1982		Thermal	Steam	Coal	8	1,600	600
TPP MGRES (G9-G12)			Thermal	Steam	Natural gas	4	920	920
CHP-1 Chisinau	1951–1961	End of 2028	Thermal	Steam	Natural gas	5	66	56
CHP-2 Chisinau	1976–1980	After 2030	Thermal	Steam	Natural gas	3	276	276
CHP North	1956–1970		Thermal	Steam (2) Gas motor (4)	Natural gas	6	37.2	37.2
Costesti HPP	1978		Hydro	Run of river	Water	1	16	16
Small HPP			Hydro	Run of river	Water	1	0.75	0.75
Dubasari HPP	1954–1966		Hydro	Run of river	Water	4	48	48
Solar power plants			Solar	PV	Sun		282.81	282.81
Distributed PV (net metering)			Solar	PV	Sun		150.56	150.56
Wind power plants			Wind	Wind	Wind		188.98	188.98
Biogas power plants			Thermal	Steam	Biogas		7.01	7.01

2.1.1.2 Generation Mix Development

The development of the generation mix in Moldova, Romania, and Ukraine is influenced by evolving energy and climate policy, market conditions, and the transition toward renewable energy. Each country is actively working to enhance energy security, integrate cleaner energy sources, and modernize its power system.

Moldova

The following forecasts address the generation capacities on which the Moldovan TYNDP 2025-2034 is based:

1. Total installed capacity of the combined cycle gas turbines (CCGTs) on the right bank of the Nistru River (CHP 1, CHP 2, and CHP North) is currently 361.2 MW, and available capacity is 351.2 MW. CHP 1 will be replaced with a new 22 MW ICE power plant on the same site and by the ICE CHP West (33 MW) in 2029.
2. For gas units in Moldova, the market gas prices from the 2024 ENTSO-E European Resource Adequacy Assessment (ERAA)[2] projections (7.32 €/GJ in 2026 and 6.22 €/GJ in 2030) are used.
3. Available installed capacity of the existing hydropower plants (HPPs) is 64 MW. These capacities are available until 2030.
4. The Moldovan government has decided to accept a donation from Norway for a 125 MW gas turbine. The assumption is that this unit will be in operation in 2028 and should be considered in the analysis in separate scenario for 2030.
5. The existing installed RES capacity has been considered, while the determination of additional capacity will result from this study in Task 3.

All assumptions are based on the Moldovan TYNDP and the NECP, with a few modifications confirmed by the Ministry of Energy (MoE). The With Additional Measures (WAM) scenario of the NECP serves as the basis for the development of the generation mix in Moldova. The refurbishment of the old CHP aligns with the NECP to some extent, as the decommissioning of CHP 1 has been moved from 2024 to 2029, and the decommissioning of CHP 2 has been postponed from 2027 to after 2030.

RES production was based on time series data for solar and wind power plants collected from the RES forecasting service, accurately capturing the operational performance of existing renewable installations and serving as a critical historical benchmark. This dataset utilizes hourly renewable energy generation capacity factors and covers actual metered data for the largest solar and wind power installations in Moldova. The hourly solar and wind capacity factors are derived from measured data in 2024.

Each thermal power plant has been characterized based on its key technical and economic attributes, including:

- **Available capacity**: The maximum generation capacity available for dispatch;
- **Minimum stable generation:** The lowest feasible generation level at which a unit can operate stably without incurring shutdown or ramping inefficiencies;
- **Minimum up and down times:** Constraints governing the minimum duration a unit must remain online after startup or offline after shutdown;

- **Outage characteristics**: Representation of both forced outages and scheduled maintenance to reflect realistic availability patterns;
- **Marginal, fixed, and startup costs**: Economic parameters influencing dispatch decisions and system cost dynamics.

A comprehensive overview of Moldova's thermal power plants, including key operational characteristics, is presented in Table 2-2.

The modelling exercise included forced outages and scheduled maintenance to incorporate thermal power plants' reliability into PLEXOS models. For both types of outages, outage rate and outage duration were defined. For forced outages, a forced outage rate and an average outage duration for the thermal units were provided from the ENTSO-E ERAA report[2] and used in the model, as presented in Table 2-3.

No additional conventional generation capacity expansion has been assumed in the 2026–2030 planning horizon, reflecting current investment plans and regulatory outlooks. The assessment has been structured to account for the prevailing fleet of thermal power plants, with detailed technical and economic parameters incorporated into the modelling framework.

Start-up costs have been computed based on fuel price forecasts, start-up fuel offtake and fixed start-up costs, varying for both 2026 and 2030, and the specific efficiencies of each plant. Similarly, marginal costs for thermal generation units have been derived using projected natural gas prices for the respective planning years, ensuring a cost-reflective dispatch order aligned with the merit-order principle.

For some missing parameters, ENTSO-E ERAA data were used.[2]

[2] ENTSO-E ERAA 2024

Table 2-2: Technical characteristics of thermal power plants

POWER PLANT NAME	TYPE REFERENCE ENTSO-E DATA	NOMINAL CAPACITY (MW)	MUST-RUN CONSTRAINTS	MINIMUM STABLE POWER (MW)	MINIMUM UP TIME (H)	MINIMUM DOWN TIME (H)	CO2 EMISSION TAX (€/TONS CO_2)	FUEL COST (€/GJ)	VARIABLE OPERATION AND MAINTENANCE CHARGE (€/MWH)	CONSIDERED YEAR IN PLEXOS YEAR (2026/2030)
TPP MGRES G4	Coal, gas conventional old 1 (gas currently used)	100 (Installed capacity 200 MW, but 100 MW available)	Used just to supply load of the left bank	100	48	5	2026: 72.68 2030: 136.36	2026: 7.32 2030: 6.22	1.1	2026 2030
TPP MGRES G5	Coal, gas conventional old 1(gas currently used)	100 (Installed capacity 200 MW, but 100 MW available)		100						
TPP MGRES G7	Gas conventional old 1	200		120						
TPP MGRES G8	Gas conventional old 1	200		120						
TPP MGRES G9	Gas conventional old 1	210		120						
TPP MGRES G10	Gas conventional old 1	210		120						
TPP MGRES G11	Gas conventional old 1	250		120						
TPP MGRES G12	Gas conventional old 1	250		120						
CHP 1 (G1)	Gas CCGT old 2	12	Not operational during whole year	2	3	3	72.68	7.32	1.6	2026
CHP 1 (G2)	Gas CCGT old 2	12		2						
CHP 1 (G4)	Gas CCGT old 2	5		5						
CHP 1 (G5)	Gas CCGT old 2	27		0.2						
CHP 1 (G6)	Gas CCGT present 1 (ICE)	11	Must run for the whole year	4.4	2	2	136.36	6.22	1.6	2030
CHP 1 (G7)	Gas CCGT present 1 (ICE)	11								
CHP West G1	Gas CCGT present 1 (ICE)	11	Must run for the whole year	4.4	2	2	136.36	6.22	1.6	2030
CHP West G2	Gas CCGT present 1 (ICE)	11								

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POWER PLANT NAME	TYPE REFERENCE ENTSO-E DATA	NOMINAL CAPACITY (MW)	MUST-RUN CONSTRAINTS	MINIMUM STABLE POWER (MW)	MINIMUM UP TIME (H)	MINIMUM DOWN TIME (H)	CO2 EMISSION TAX (€/TONS CO_2)	FUEL COST (€/GJ)	VARIABLE OPERATION AND MAINTENANCE CHARGE (€/MWH)	CONSIDERED YEAR IN PLEXOS YEAR (2026/2030)
CHP West G3	Gas CCGT present 1 (ICE)	11	Must run during winter hours. Available according to market condition in period April-September							
CHP 2 (G1)	Gas CCGT old 2	98	Must run during winter hours (80.24 MW). Not operational in period April-September	40	3	3	2026: 72.68 2030: 136.36	2026: 7.32 2030: 6.22	1.6	2026 2030
CHP 2 (G2)	Gas CCGT present 1	80	Must run during winter hours (65.2 MW). Not operational in period April-September	40	2	2				
CHP 2 (G3)	Gas CCGT old 2	80	Must run during Jan and Feb (50 MW) Not operational in period March-December.	40	3	3				
CHP North G1	Gas CCGT old 2	12	Must run from December till February (90 %), in March and November 40 %. Not operational in period April-October	2.5	3	3	2026: 72.68 2030: 136.36	2026: 7.32 2030: 6.22	1.6	2026 2030
CHP North G2	Gas CCGT old 2	12	Must run from December till February (90 %), in March and November 40 %. Not operational in period April-October	2.5	3	3				
CHP North G3	Gas CCGT present 1	3.354	Must run during winter hours. Not operational in period April-September	1.6	2	2				
CHP North G4	Gas CCGT present 1	3.354		1.6	2	2				
CHP North G5	Gas CCGT present 1	3.354		1.6	2	2				
CHP North G6	Gas CCGT present 1	3.354		1.6	2	2				
New Gas PP	Gas CCGT present 1 (ICE)	125	Available throughout the year based on market conditions	50	2	2	136.36	6.22	1.6	2030

Table 2-3 Other techno-economic data for thermal power plants

POWER PLANT NAME	START-UP FUEL CONSUMPTION – COLD START (NET GJ/MW START)	START-UP FIX COST-COLD START (€ /MW START)	HEAT RATE (GJ/MWH)	FORCED OUTAGE RATE (%)	AVERAGE DURATION (DAYS)
TPP MGRES G4	9.7	70	10	8	1
TPP MGRES G5	9.7	70	10	8	1
TPP MGRES G7	9.7	70	10	8	1
TPP MGRES G8	9.7	70	10	8	1
TPP MGRES G9	9.7	70	10	8	1
TPP MGRES G10	9.7	70	10	8	1
TPP MGRES G11	9.7	70	10	8	1
TPP MGRES G12	9.7	70	10	8	1
CHP 1 (G1)	9.7	62	7.5	8	1
CHP 1 (G2)	9.7	62	7.5	8	1
CHP 1 (G4)	9.7	62	7.5	8	1
CHP 1 (G5)	9.7	62	7.5	8	1
CHP 1 (G6)	9.7	36	6.429	5	1
CHP 1 (G7)	9.7	36	6.429	5	1
CHP West G1	9.7	36	6.429	5	1
CHP West G2	9.7	36	6.429	5	1
CHP West G3	9.7	36	6.429	5	1
CHP 2 (G1)	9.7	62	7.5	8	1
CHP 2 (G2)	9.7	36	6.429	5	1
CHP 2 (G3)	9.7	62	7.5	8	1
CHP North G1	9.7	62	7.5	8	1
CHP North G2	9.7	62	7.5	8	1
CHP North G3	9.7	36	6.429	5	1
CHP North G4	9.7	36	6.429	5	1
CHP North G5	9.7	36	6.429	5	1
CHP North G6	9.7	36	6.429	5	1
New Gas PP	9.7	36	6.429	5	1

Romania

Romania is leveraging its diverse generation mix, including nuclear, hydro, and growing renewable capacities, to meet decarbonization targets. The next table shows planned generation mix in Romania for 2026 and 2030 according to the preliminary dataset from ENTSO-E ERAA 2024.

Table 2-4 Generation mix until 2030 in Romania

Available Capacity per type in PLEXOS (MW)		
Country	**Romania**	
Year	**2026**	**2030**
Nuclear	1300	1739
Coal	130	130
Gas conventional	2631	2631
Gas CCGT new	2109	3421
Total Thermal Capacity	**6170**	**7921**
Run of river (RoR)	3305	3364
Reservoir	2391	2403
Pump storage open loop	810	810
Total Hydro Capacity	**6506**	**6577**
Wind onshore	5099	5999
Wind offshore	0	1000
Solar	5100	8300
Other RES	128	137
Total RES Capacity	**10327**	**15436**
Total Romania	**23003**	**29934**

Ukraine

Ukraine, amid ongoing challenges, is focusing on rebuilding its energy infrastructure and expanding renewables to reduce dependency on fossil fuels. The generation capacity projections for Ukraine incorporate data from the Recovery Plan, the NECP, the Green Deal policy framework and ENTSO-E's ERAA 2022. Given the ongoing geopolitical situation, adjustments were made to reflect the impact of occupied and damaged infrastructure on generation capacity. Our team has assessed the available capacities for 2026 and 2030, as shown in the following Table 2-5. A detailed description of the methodology used to recalculate the capacities is provided in the Task 1 report.

Table 2-5 Generation mix until 2030 in Ukraine

Available Capacity per type in PLEXOS (MW)		
Country	**Ukraine**	
Year	**2026**	**2030**
Nuclear	7800	7800
Coal	2376	0
Gas CCGT new	3230	6130
Gas OCGT new	600	1000
Gas CHP	2608	508
Gas new CHP biogas	290	340
Total Thermal Capacity	**16904**	**15778**
Reservoir	4288	4318
Pump storage	1990	1990
Small hydro	128	135
Total Hydro Capacity	**6406**	**6443**
Solar	6079	8317
Wind	1990	3290
Biogas	324	418
Biomass	609	1030
Geothermal	8	20
Total RES Capacity	**9010**	**13075**
Total Ukraine	**32320**	**35297**

For modelling thermal units in Romania and Ukraine, we used the Standard Thermal Characteristics from the ENTSO-E PEMMDB[3] database.

2.1.2 MUST-RUN CONSTRAINTS SETUP

In PLEXOS, must-run constraints define conditions under which specific generating units must operate, irrespective of economic dispatch results. These constraints are essential for maintaining compliance with operational requirements.

In this model, must-run constraints are implemented to secure heat supply, especially during winter months. While some units are required to operate throughout the year, others are designated to run only during specific months or winter hours, depending on system needs.

[3] PEMMBD

For a detailed overview of the must-run constraints applied to individual generating units, please refer to the corresponding Table 2-2.

2.1.3 DEMAND

An integral component of power system modelling is the representation of electrical load, commonly referred to as demand. Electrical load time series were developed at an hourly granularity to provide high-resolution insights into system behavior. The creation of these time series followed a structured two-step approach:

1. **Historical hourly profile:** Hourly load profiles were established for each modelled country—Moldova, Ukraine, and Romania. For Moldova, the TYNDP 2025-2034 hourly timeseries for target year 2028 was used, with the 2022 historical climate year hourly load profile selected as the reference year. For Ukraine and Romania, load profiles were sourced from the ENTSO-E demand database, with 2010 historical climate year data serving as the baseline.
2. **Scaling for Future Time Horizons:** The second step involved scaling the normalized historical profiles to align with forecasted annual loads for the target years of 2026 and 2030. This scaling process ensured consistency with projections outlined in relevant national and regional planning documents.

Moldova

For the purposes of this study, the forecasted annual electricity demand for 2026 and 2030 was sourced from Moldova's TYNDP. Specifically, the projected annual net demand for the base scenario was considered for both the right and left bank. This forecasted value served as the basis for estimating annual electricity demand for 2026 and 2030.

The next step involved developing hourly load profiles for these years, ensuring consistency with the forecasted annual demand. The hourly load profile from climate year 2022 was used as a reference, with its values rescaled to align with the projected annual demand for 2026 and 2030.

Ukraine

For Ukraine, the forecasted annual electricity demand for 2026 and 2030 was sourced from the Recovery Plan document. This value was then adjusted by a 35 per cent reduction, in accordance with the NECP, which was also the estimate of the consultant's team, to account for the impact of occupied or destroyed territories.

To develop the hourly load profiles for 2026 and 2030, hourly demand data from the ENTSO-E database for the climate year 2010 were used as a reference. The values from this profile were rescaled to align with the projected annual demand for 2026 and 2030.

Romania

For Romania, the forecasted annual electricity demand for 2026 and 2030 was obtained from the ERAA 2024 dataset. To develop the corresponding hourly load profiles, hourly demand data from the ENTSO-E database for the climate year 2010 were used as a reference. The values from this historical profile were then rescaled to align with the projected annual demand for 2026 and 2030.

2.1.4 CROSS-BORDER CAPACITY (NTC)

As shown in Figure 2-1 Ukraine and Moldova are connected to the ENTSO-E region. The Ukraine-ENTSO-E connection is represented by an aggregated NTC value, calculated by summing the NTC values of all neighboring countries with Ukraine, specifically Slovakia, Poland, and Hungary, while excluding Moldova and Romania, which are explicitly modelled within the PLEXOS framework. Similarly, the Romania-ENTSO-E connection is represented by an aggregated NTC value, derived by summing the NTC values of Romania's neighboring countries, excluding Ukraine and Moldova, as these are explicitly modelled in the system.

Field Code Changed

2.1.5 FUEL PRICES AND EMISSION FORECASTS

Accurate fuel price and emission cost projections are essential for modelling generation dispatch and long-term system planning in PLEXOS. Fuel price forecasts influence the operational costs of thermal power plants, while emission price assumptions impact the competitiveness of fossil fuel-based generation and drive investment decisions in low-carbon technologies. These factors play a crucial role in evaluating the economic and environmental feasibility of different energy scenarios.

For this analysis, the ENTSO-E ERAA 2024 projections of CO_2 emission prices for 2030 have been adopted. While the Carbon Border Adjustment Mechanism (CBAM) will not be implemented in 2026, it is anticipated that Moldova will introduce a local CO_2 emission tax or integrate into the European Emissions Trading System (ETS). The assumption of a local CO_2 tax aligns with the ENTSO-E ERAA projections, ensuring consistency with regional market expectations. These factors shape the economic viability of fossil fuel-based generation and encourage the adoption of cleaner energy sources.

2.1.6 OTHER ENTSO-E COUNTRIES

As shown in Figure 2-1, the remaining ENTSO-E countries are modelled as one node, which has connections with Romania and Ukraine. The electricity exchange between the ENTSO-E and the explicitly modelled countries depends on the price assigned to the node. In this case, we used the 2030 hourly projected wholesale electricity price time series in Hungary from ENTSO-E TYNDP 2024 as a basis, rescaled for 2026 by using historical annual average wholesale electricity price in Hungary in 2024 recorded in HUPX annual report.

2.2 CONCLUSION

Task 2 crucially ensures that Moldova's power system model is robustly prepared to accommodate accelerated renewable energy deployment and energy storage integration, while maintaining operational stability and security of supply. By refining the PLEXOS model with data inputs, updated operational constraints, and granular regional interdependencies, this phase has established a critical foundation for evaluating Moldova's transition pathways under various future conditions.

The integration of must-run thermal generation constraints, aligned with seasonal heat and electricity demand, alongside updated cross-border transmission capacities with Ukraine and Romania, ensures the model accurately reflects both domestic priorities and regional market interactions. By incorporating the latest operational data and market insights, the study effectively simulates key system dynamics for 2026 and 2030, addressing both economic and reliability considerations. This is especially significant given Moldova's reliance on the MGRES plant and the evolving risks associated with gas supply.

The scenario-based analysis for 2026 and 2030, underpinned by high-resolution load profiles and market mechanisms aligned with ENTSO-E, provides actionable insights into capacity allocation strategies for upcoming renewable auctions. By harmonizing Moldova's NECP objectives with regional ENTSO-E market principles, the model supports evidence-based decisions to balance energy security, affordability, and decarbonization targets.

Building on these outcomes, the next step in the implementation of this assignment is Task 3: Analysis of Moldovan Power System Capability to Integrate Additional Renewable Energy Capacities. This task will quantify technical and economic limits for scaling variable renewable energy generation. This phase will evaluate the ability of Moldova's power system to remain resilient amid higher penetration of renewables, while advancing its alignment with the EU's internal energy market framework.