



European Network of Transmission System Operators for Electricity

DATA COLLECTION GUIDELINES FOR MARKET DATA FOR ERAA, EVA, TYNDP AND SCENARIO BUILDING

ENTSO-E System Development Committee

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Contents

1	Introduction	6
2	Overview of Data Collection	7
2.1	Data Collection Studies	7
2.2	Time Horizons of Studies	7
2.3	Conventions	7
2.4	Data Collection Process: When, Where, How?	9
2.5	Changes Since Latest PEMMDB Data Collection	10
3	Scenario Storyline: National Trends	11
4	Package “Main and Thermal”	12
4.1	“Drop-down values” sheet	12
4.2	“Info & General” sheet	12
4.3	“MarketNodeSummary” Sheet	12
4.4	“Thermal” sheet	12
4.4.1	Thermal Categories	12
4.4.2	Data collected on the Thermal sheet	13
4.5	Must-run sheets	14
4.5.1	“Group Must-run” sheet	14
4.5.2	“Must-run” sheet	15
4.6	Inelastic sheet	16
4.7	Derating sheets	17
4.7.1	“Group Derating” sheet	17
4.7.2	“Derating” sheet	18
4.8	“Max Unit Maint.” sheet	18
4.9	“Planned Outage” sheet	19
4.10	“Exchanges” sheet	19
4.11	Investment_Constraints Sheet	21
4.12	“Reserves Requirements” sheet	21
4.13	TrajectoriesSheets	23
4.14	“Redispatch information’ sheet – Not required for current data collection	23
4.15	“Redispatch – 3.0 Fuel Types’ sheet – Not required for current data collection	23
4.16	“Market Node Summary” sheet	25
5	Package “Demand”	26

5.1	Intro from TF Demand Forecasting	26
5.2	“Demand” sheet	26
5.2.1	Heating Heat-Pumps (sheet “Demand”, rows 10-16).....	28
5.2.2	Hybrid Heat-Pumps (sheet “Demand”, rows 18-22).....	32
5.2.3	Air-Conditioning Heat-Pumps (sheet “Demand”, rows 24-27).....	32
5.2.4	Sanitary Water Heat-Pumps (sheet “Demand”, rows 29-33).....	33
5.2.5	Additional load (sheet “Demand”, rows 61-62)	34
5.2.6	Energy demand evolution (sheet “Demand”, rows 64-66).....	35
5.2.7	Battery impact (sheet “Demand”, rows 70, 71)	36
5.2.8	Target Energy Demand (sheet “Demand”, rows 75B, 75).....	36
5.2.9	Zonal Splitting Ratio (sheet “Demand”, rows 80-96)	36
6	Package “Electrolysers Fuel Cells Batteries DSR”	37
6.1	“Market Node Summary” sheet	37
6.2	Must-run sheets	37
6.3	Inelastic sheet	38
6.4	Derating sheets	39
6.5	“H2_Storage” Sheet	39
6.6	“Electrolysers” Sheet.....	39
6.6.1	Data collected in the Electrolysers Sheet	39
6.7	“Batteries” Sheet	40
6.8	“DSR” sheet	40
6.8.1	DSR Profile	42
6.8.2	DSR Trajectories Sheet	42
6.8.3	DSR Pivot	42
6.9	Trajectory Technologies	42
7	Package “Renewables”	44
7.1	“Renewables” sheet	44
7.1.1	Onshore_Technology and Offshore_Technology Sheets	44
7.2	“Other-RES hourly’ sheet	45
7.3	“Zonal Wind”, “Zonal Solar” and “Zonal Other-RES” sheets	46
7.4	“Hydro” sheet	46
7.5	“Zonal hydro” sheet	46
7.6	“Planned outage” sheet.....	46
7.7	“Trajectories-RES” sheet.....	47
7.8	“Trajectories-Hydro” sheet.....	47

7.9	“Capacity Expansion (RES)” sheet.....	47
8	NTC	6
8.1	Process.....	6
8.1.1	Data collected in the Max limit sheets	6
8.2	Maintenance	6
8.3	Coordination.....	7
9	Hydro Inflow	8
10	PECD – Pan-European Climate Database.....	9
10.1	Overview of current PECD	9
10.2	Hydrological Database	12
11	Missing Data.....	13
12	Confidentiality of Data in MMD	14
13	Appendix – How to?.....	15
13.1	How do I fill in Data in the Accounting Model.....	15
13.2	Example Specification of Unit Groups	16
13.3	Example Specification of Must-Run or Derating Obligations.....	17
13.4	What if I need to change “Operational Status” of a unit at a future date? (or any other attribute which is static in the template)	19
13.5	How to define Min and Max units number of units for maintenance optimisation?	19
13.6	What if I want to provide my own maintenance profile for year 2025?	20
13.7	What if I want to provide exact outage dates for only some units in 2025 and generate/optimize the planned outages for the other units?	20
13.8	How do I fill the ‘Renewables’ file? What is extremely important and what not so much? ..	20

1 INTRODUCTION

This report provides a detailed description of the market modelling data to be collected to perform pan-European market studies for the different ENTSO-E deliverables such as market-based resource adequacy studies (ERAA and Seasonal Outlook), TYNDP and Scenario Building. This document has been prepared by WG Data & Models \ TF PEMMDB with the input (and support) of the WG Scenario Building. The intended audience is composed of the Adequacy Correspondents (both LACs and SACs).

The focus of the present data collection is the PEMMDB 3.5 Excel files. New files have been created, and pre-filled with latest PEMMDB data available from the latest data collection, ENTSO-E ShareFile space. The files are the following:

- ***Main_and_Thermal***: Contains all general information about the market node (e.g. reserve requirements, exchanges with non-ENTSO-E countries, redispatch) and Thermal generation (e.g. unit-by-unit, must-run requirements, deratings, other non- RES, unavailability)
- ***Renewables***: Contains mainly information about Renewable plants (plant-by-plant, similar parameter to Thermal) including Wind, Solar, Hydro and other RES. Aggregated capacities are also collected, and there are summary sheets to ease handling of the data.
- ***Electrolysers_FuelCell_Batteries_DSR_***: Contains information about batteries, electrolysers, fuel cells and DSR

On top of the updates made to the three main files the following files have been revised / created:

- ***Transfer Capacities***: Contains information about countries Net Transfer Capacities
- ***Hydro Inflow***: contains information about flows of water and associated power generated by hydro units
- ***Energy Mix Survey***: EU member states only, designed to collect data on energy use in multiple scenarios based on NECPs

2 OVERVIEW OF DATA COLLECTION

2.1 Data Collection Studies

This data collection is intended to serve the needs of the following studies and subsections of studies:

- European Resource Adequacy Assessment (ERAA)
 - Economic Viability Assessment (EVA)
 - Adequacy Study
- Ten-Year Network Development Plan (TYNDP)
 - Off-Shore Network Development Plan (ONDP)
- Scenarios Report

2.2 Time Horizons of Studies

- **European Resource Adequacy Assessment (ERAA)**
 - Time horizon: 2023 – 2033
 - Target years: 2025, 2028, 2030, 2033
- **Ten Year Network Development Plan (TYNDP)**
 - Time horizon: 2030 – 2050
 - Target Years: 2030, 2040, 2050
- **Scenarios Report**
 - Time horizon: 2030 – 2050
 - Target Years: 2030, 2040, 2050
- **Off-Shore Network Development Plan (ONDP)**
 - Time horizon: 2030 – 2050
 - Target Years: 2030, 2040, 2050

2.3 Conventions

The naming convention for market nodes has been defined for harmonization reasons. The following rules were applied: a) same number of symbols; b) only capital letters and digits. This data collection, following the previous one, focuses on increasing the granularity of data. The geographical zonal split of capacities is being extended to other RES, and, where possible, plant-by-plant data being collected for renewable plants. Also, there is a focus on closing the gap between Market and Network models, as well as with the Transparency Platform.

This will prove extremely useful for future IoSN processes within.

A reminder of changes that were applied already from the previous data collection: Some market nodes are split to few geographical zones inside their template file. The same harmonized naming convention has been used and the zones match the resolution of the PECD. New Offshore zones have been created, and they do not match 1-to-1 with Onshore zones, with few offshore zones being connected to a single onshore zone. Due to this fact, offshore zones are now named with 3 numbers, to ease the mapping from offshore to

onshore. In the templates, a new specific Offshore sheet has been created. The Excel templates are created still for market nodes. The sub-zones are listed in each file accordingly for the specific market node for the data types which require such sophistication.

The market nodes to collect most data, PECD zones and offshore zones can be found [here](#)

The following sets of data will be collected for each market node:

1. **Main and Thermal** file:

Supply Data

- a. Thermal Dispatchable Generation Data Set (THERMAL)
- b. Must-run and derating Data Set of Thermal Dispatchable Generation (MUST-RUN, GROUP MUST-RUN, DERATING, GROUP DERATING)
- c. Other Non-Renewables Generation Data Set (OTHER NON-RES)
- d. Maintenance information (MAX UNIT MAINTENANCE and PLANNED OUTAGE)

General data and requirements of Market Node

- a. Operational reserves Data Set (RESERVES)
- b. Power Exchange Data with non ENTSO-E countries (EXCHANGES)
- c. Lower and higher bound of capacity evolution per fuel type, representing uncertainty of development of generation fleet (TRAJECTORIES)

Overview of the provided data (MARKET NODE SUMMARY)

2. **Renewables file:**

Supply Data

- a. Plant-by-Plant renewable (wind, solar, small biomass, marine, waste, geothermal) generation dataset (RENEWABLES)
- b. Output timeseries for Renewable capacity (small biomass, marine, waste, geothermal, not-defined RES) – possibility to set individual timeseries (OTHER RES HOURLY)
- c. Hydro plant-by-plant generation dataset (HYDRO)
- d. Reservoir dataset for Hydro plants (HYDRO_RESERVOIRS)
- e. Maintenance information (PLANNED OUTAGE)

General data and requirements of Market Node

- a. **Summary Sheets** – aggregation of Plant-by-Plant data with Capacity Evolution – **FORMULAS NOT TO BE EDITED**, for ease

of checking total capacity per technology type (ZONAL WIND, ZONAL SOLAR, ZONAL OTHER-RES, ZONAL HYDRO, MARKET NODE SUMMARY)

- b. Lower and upper bound of capacity evolution for RES, representing uncertainty of development of generation fleet (TRAJECTORIES-RES, TRAJECTORIES-HYDRO)

3. **Electrolysers FuelCell Batteries DSR:**

Demand Side Response

- a. Demand Side Response capacity, availability timeseries and prices (DSR)

Batteries and P2G Data

- a. Capacity evolution of Batteries (market participating and nonmarket participating) and Power to Gas (Batteries)

General data and requirements of Market Node

- a. Lower and higher bound of demand and batteries data, representing uncertainty of their development (TRAJECTORIES)

For each market node, the aim is to gather data covering all voltage levels and per region inside the Market Node (at PECD level). However, if the lowest voltage levels are not considered, then both load and generation at these levels should be subtracted from the data provided.

2.4 **Data Collection Process: When, Where, How?**

WHEN:

TSOs are requested to complete their relevant country packages by **19th of October 2022**. After this date, the quality check & validation process will start. This may lead to further interactions between the WG D&M, PMOs and data correspondents.

WHERE:

This Data Collection will be performed by use of ShareFile. Data collection templates for each market node, including data transferred from the previous data collection. LACs will receive an email informing them of their ability to access the relevant ShareFile location. If no email is received, please inform

HOW:

The TSOs are asked to update the file directly working in ShareFile.

Always keep the exact same file name (automatic versioning in SharePoint means any previous version can be restored easily). **If you work offline, always download first the latest available file in SharePoint to avoid corrections centrally done by ENTSO-E being lost and then upload the latest version of the file to the same location with the**

file name kept (i.e. use *drag & drop*). Warning: if template is modified by deleting rows/columns functions won't work properly. So please **DO NOT DELETE ANY ROWS COLUMNS** inside the template. If you want to erase the data, do so by deleting the values, while keeping rows and columns unattached!

If you see the following message, click on “replace it”.

Never “save as” with another name. During *drag & drop*, the drop area should be the Country section of the PEMMDB page. If the initially prepared file was used, the uploaded file will be updated in the country-specific section of this area.



Each TSO is responsible to edit its own template file and has the edit rights for this. In case of unsolvable issues related to SharePoint, the TSOs may contact by mail Daniel Keogh or David Radu in the following addresses using the shared mailbox -

2.5 Changes Since Latest PEMMDB Data Collection

Changes from the previous data collection are listed in the “PEMMDB 35 Change Log.xlsx” in the “_Support” folder on ShareFile

3 SCENARIO STORYLINE: NATIONAL TRENDS

Guidelines by Scenario Building team were prepared by WG Scenario Building and are included in a separate document. The document should be accessible by clicking on the following link to the ShareFile folder here [Joint TYNDP 2024 Scenarios Data Collection Guidelines](#).

4 PACKAGE “MAIN AND THERMAL”

4.1 “Drop-down values” sheet

The purpose of the Drop-Down sheet is technical. Includes the necessary lists for the template to operate as expected. **Not to be modified**

4.2 “Info & General” sheet

Info & General sheet includes generic information collected by the template. Includes the necessary lists for the template to operate as expected. Section to provide feedback on big changes since previous data collection and references for the data assumptions provided.

4.3 “MarketNodeSummary” Sheet

An information sheet that summaries all data that has been added to the “Thermal” by year and technology type. **Do not edit this sheet**

4.4 “Thermal” sheet

4.4.1 *Thermal Categories*

The reworked Thermal sheet aims to collect more granular thermal capacities in 4 directions:

- The resolution of the thermal power plants representation is increased to generating unit level, with the ability to create the hierarchy of “generating units” under “groups”.
- The time horizon of the thermal data collected is not tied to a single year with this format. Instead, we collect the expected commissioning and decommissioning dates available for the plants/units available now and expected to be available in the future. This means that a scenario (e.g. in TYNDP) with different time horizons will only have one Thermal data sheet that covers all study years for that scenario.
- Geographic location of plants, at least defining the PECD region, is now needed. This will be extremely important for any zonal modelling approach
- Information regarding connectivity of plants in the Network Model, closing the gap between market and network models. As for the geographic location of plants, this will be extremely useful for any zonal modelling approach.
- Other Non-RES technologies are now collected in the Thermal sheet

To ensure consistent treatment of thermal units in Europe, and to avoid deviations in simulations, the same 22 thermal categories are pre-defined, with fixed technical and economic characteristics (see the set of common pan-European values in the PEMMDB template Common Data sheet), which were used in former TYNDPs. All thermal units should be assigned by TSOs to one of the listed types in the table 2, depending on:

- The fuel (e.g. gas, hard coal, lignite...)
- The type (e.g. OCGT, CCGT...)
- The age categories (e.g. old 1, old 2, new...), which correspond to standard efficiencies. The age category is used to ensure a realistic efficiency is applied, collected commissioning dates are not used to determine efficiency.

CCS (Carbon Capture & Storage) is a sub-category which assumes the CO₂ emission factor is reduced by 90% and the standard efficiency reduced by 10% compared to the parent category.

Gas CCGT present 1 and present 2 categories were included in the last data collections to tackle the high number of units in the CCGT new category. Present 2 category has the same common data values as the former CCGT new (with standard efficiency value of 58%). The updated CCGT new category has its standard efficiency increased to 60%. The present 1 category retained all the former CCGT new attributes but with a standard efficiency changed to 56%.

The list below explains how to deal with some other specific units:

- Biofuels: Biofuel units can be defined with the usage of the “Secondary fuel” attribute by selecting biofuel option and the “Secondary fuel usage ratio” attribute. The marginal price calculation for these units remained the same as for TYNDP2018. The option to provide custom biofuel price for these units is handled now in the Thermal sheet and can be defined for each unit separately.
- Mixed Fuels (except biofuels): If a unit burns several fuels (one after the other or simultaneously), two of them can be defined, the mostly used as primary through the “PEMMDB Fuel & Type” attribute and a second one through the “Secondary fuel” attribute. In this case the “Secondary fuel usage ratio” attribute is mandatory. With a secondary fuel defined, it will be assumed that the two fuels are used simultaneously.
- Dispatchable CHPs should be assigned to the most commonly used fuel, bearing in mind the consequence on the merit-order.
- CCGT units: Steam and gas turbines of one CCGT block should be merged and represented in one row of the Thermal sheet. If the network representation contains more synchronous machines, the additional rdf:ID fields have to be provided also.
- Fully non-dispatchable units (should it result from a contract or technical constraints) should be included in the “Other non-RES” (if not renewable) data set or reported in Thermal sheet with attribute “Operational Status” set to “Inelastic Supply/Fixed Profile”. If reported in Thermal sheet as “Inelastic Supply/Fixed Profile”, a separate file will be required to report the timeseries for each specific unit with this status. For the moment, such sophistication is not strictly needed hence it is fine if such capacities are only reported in “Other non-RES” sheet.
- Units that are not mentioned in the list should be assigned to the closest fitting category, taking into account standard values, especially fuel costs and efficiencies.

4.4.2 Data collected on the Thermal sheet

The Common Data Sheet contains common thermal characteristics applied to each thermal generation unit. Other data must be collected in addition to this and can be split into mandatory and optional data. Mandatory attributes are marked with yellow, while optional data, for which Common Data is available is marked by blue in the template.

4.5 Must-run sheets

For thermal generation it is important to indicate so called must-run obligations, which can have many causes (heat requirements, technical, economic/subsidies/taxes, environmental, etc.) and should not be confused with minimum stable generation.

Climatic years associated with must-runs can now be selected in these sheets

Reasons that could induce must-run obligation include:

- Network constraints (overload management, voltage control...)
- Specific policies (subsidies of lignite mines...)
- Minimum number of units needed to provide system services
- Heat constraints

Reasons that, in most cases, should not induce must-run obligation include:

- Fully non-dispatchable units such as biomass, waste... (if unit is fully nondispatchable, it should be specified in either the sheet "Other Non-RES")
- Low flexibility. This can be represented by other parameters such as "minimum stable generation" and "Ramp up/down rate"

4.5.1 "Group Must-run" sheet

This worksheet contains the hourly ratios of possible Group-based must-run criteria to be modelled in the market simulations as well as the number of units to allocate the group must-run obligation. The data provider should fill two separate columns for each different hourly curve (cells between rows 11 to 8770) of must run ration and units to allocate must run as they go in pairs. To reference the defined curve, the data provider should use matching curve IDs in row 5 of this sheet and the Group based must-run curve ID column in the new Thermal sheet.

To check whether the referencing is done right, the Cell in row 6 of the Group must-run sheet will change to "Referenced" if at least one matching ID can be found on the Thermal sheet.

The sheet also includes validity start and end year cells, to specify an interval of years, where the hourly curve should be considered. The defined starting and end year is included in the validity interval. The same curve ID can be used more than once if the validity intervals are not overlapping, thus defining different hourly curves for different years. The sheet enables the definition of the "Number of units to be used to allocate Group mustrun" attribute. If provided, only this amount of units need to run to provide the calculated must-run commitment from the group must-run criteria. The attributes enables to provide must-run with only a sub-set of the generators in the group regardless of any planned or forced outage event.

The defined curves can be referenced by more unit groups. In this case these groups will still be modelled independently, but the must-run ratio values will be the same for all of them.

The generating units defined under the same group, must have the same group based must-run curve ID and the must-run criteria will be met (if possible) with the available units (which are not on planned/unplanned outage).

The provided ratios will be multiplied by the sum of net generating capacities of the generating units defined under the group to get the generation that has to be committed on the units of the group. The net generating capacities used for determining the amount of must-run shouldn't include any derating effect.

The allocation of this MW value has the following rules:

If "Number of units to be used to allocate Group must-run" is empty: the sum of the generation of the units in the group should be higher or equal than Must-run value in MW and there isn't any criteria on how many units should satisfy this. But in reality this will be met with the minimum amount of units necessary if start-up costs are implemented.

If "*Number of units to be used to allocate Group must-run*" is defined (and has to be lower than the number of units in the group): then (as an additional constraint) this value act as a minimum number units that have to be committed to at least their technical minimum generation (PMin).

4.5.2 "Must-run" sheet

This worksheet contains the hourly ratios of possible generating unit based must-run criteria to be modelled in the market simulations. The data provider should fill a separate column for each different hourly curve (cells between rows 11 to 8770). To reference the defined curve, the data provider should use a matching curve IDs in row 5 of this sheet and the Generation Unit based must-run curve ID column in the new Thermal sheet.

To check whether the referencing is done right, the Cell in row 6 of the Must-run sheet will change to "Referenced" if at least one matching ID can be found on the Thermal sheet.

The sheet also includes validity start and end year cells, to specify an interval of years, where the hourly curve should be considered. The defined starting and end year is included in the validity interval. The same curve ID can be used more than once if the validity intervals are not overlapping, thus defining different hourly curves for different years.

The defined curves can be referenced by more generation units. In this case these units will still be modelled independently.

The provided ratios will be multiplied by the net generating capacity of the generating unit that is referencing the curve to get the generation that must be committed on this unit. The net generating capacities used for determining the amount of must-run shouldn't include any derating effect.

4.6 Inelastic sheet

This worksheet contains the hourly ratios of possible generating unit based inelastic profile criteria to be modelled in the market simulations. The data provider should fill a separate column for each different hourly curve (cells between rows 11 to 8770). To reference the defined curve, the data provider should use a matching curve IDs in row 5 of this sheet and the Generation Unit based Inelastic profile curve ID column in the new Thermal sheet.

To check whether the referencing is done right, the Cell in row 6 of the Inelastic sheet will change to "Referenced" if at least one matching ID can be found on the Thermal sheet.

The sheet also includes validity start and end year cells, to specify an interval of years, where the hourly curve should be considered. The defined starting and end year is included in the validity interval. The same curve ID can be used more than once if the validity intervals are not overlapping, thus defining different hourly curves for different years.

The defined curves can be referenced by more generation units. In this case these units will still be modelled independently.

The provided ratios will be multiplied by the net generating capacity of the generating unit that is referencing the curve to get the generation inelasticity on this unit. The net generating capacities used for determining the amount of inelastic profile shouldn't include any derating effect.

	A	B	C	D	E	F	G
1	ENTSO-E Market Modelling Database: Generating Unit obligations						
2	N.B. use convention first January always Monday (2007 (or 2018) calendar year) --> see guidelines for further details						
3	Generating unit Inelastic criteria will be defined by multiplying the net generating capacity of the unit with the ratio value for the given hour.						
4	Please use matching curve name in the Thermal sheet in column "Generating Unit based Inelastic curve ID".						
5				Curve ID			
6				Curve ID check	Not referenced	Not referenced	Not referenced
7				Validity starting year (including this year)			
8				Validity ending year (including this year)			
9				Climate Year Validity start			
10				Climate Year Validity end			
11	Week	Month	Date	Hour	Inelastic Ratio profile	Inelastic profile	Inelastic profile
12	1	1	01 01	1			

4.7 Derating sheets

Derating data reflects that the total installed capacity of a unit is not always available for market optimization. Potential causes include:

- Generators providing system service reserve. If you specify a value here, do not include this in the Reserve Requirements sheet.
- Generators whose output power is limited by e.g., transmission constraints, cooling constraints, others.
- Generators using inferior quality fuel.

The default derating value is 100%, which is equal to a reduction value of 0%. TSOs should provide hourly values possibly for the entire year. Hourly value cells left empty for a defined curve ID will be considered as 1.0.

The modelling of derating introduced here is independent of the forced outage modelling method also called derating. The reduction of NGC introduced with this parameter is independent of the forced outage and maintenance modelling in the studies: units can still be considered unavailable in the model because of maintenance and forced outage regardless of any defined derating.

Providing data sets related to derating follows the same logic as for must-run. The two specific sheets collect the derating curves related to unit groups and individual generating units.

4.7.1 “Group Derating” sheet

To model generation constraining effects, like fuel availability and quality, inner transmission constraints, heat/cold waves etc. time-dependent derating factors can be provided for each unit group that was defined on the Thermal sheet.

The Group Derating worksheet contains the hourly ratio curves, which can be assigned to unit groups. The data provider should fill a separate column for each different hourly curve (cells between rows 11 to 8770). To reference the defined curve, the data provider should use a matching curve IDs in row 5 of this sheet and the Group Derating curve ID column in the new Thermal sheet for each unit linked together with the Group name column.

To check whether the referencing is done right, the Cell in row 6 of the Group Derating sheet will change to “Referenced” if at least one matching ID can be found on the Thermal sheet.

The defined curves can be referenced by more unit groups. In this case these groups will still be modelled independently, but the derating ratio values will be the same for all of them.

The sheet also includes validity start and end year cells, to specify an interval of years, where the hourly curve should be considered. The defined starting and end year is included

in the validity interval. The same curve ID can be used more than once if the validity intervals are not overlapping, thus defining different hourly curves for different years.

The effective net generating capacity of a group of units with defined group derating curve is the sum of the original net generating capacity of the units in the group multiplied by the derating ratio value of the given hour in the simulation. If some of the units in the group are unavailable (maintenance or forced outage), the remaining units only suffer the reduction that would remain if the original reduction would have been allocated to the outaged unit(s).

[Example: If one of two units (each 1'000 MW) in a derating group is on forced outage in the hour where summed max. output is 0.8, the outage comes on top and the output in the derated group is only 0.5, equaling 1'000 MW]

4.7.2 "Derating" sheet

To model generation constraining effects, like fuel availability and quality, inner transmission constraints, heat/cold waves etc. time-dependent derating factors can be provided for each unit that was defined on the Thermal sheet.

The Derating worksheet contains the hourly ratio curves, which can be assigned to units. The data provider should fill a separate column for each different hourly curve (cells between rows 11 to 8770). To reference the defined curve, the data provider should use a matching curve IDs in row 5 of this sheet and the Derating curve ID column in the new Thermal sheet.

To check whether the referencing is done right, the Cell in row 6 of the Derating sheet will change to "Referenced" if at least one matching ID can be found on the Thermal sheet.

The defined curves can be referenced by more generating units. In this case these units will still be modelled independently, but the derating ratio values will be the same for all of them.

The sheet also includes validity start and end year cells, to specify an interval of years, where the hourly curve should be considered. The defined starting and end year is included in the validity interval. The same curve ID can be used more than once if the validity intervals are not overlapping, thus defining different hourly curves for different years.

The effective net generating capacity of a unit with defined derating curve is its original net generating capacity multiplied by the derating ratio value of the given hour in the simulation.

4.8 "Max Unit Maint." sheet

This worksheet contains the weekly maximum and minimum number of units on maintenance for each defined group (defined with a group name in the "thermal" sheet"). The group name should be specified in row 6.

The sheet also includes validity start and end year cells, to specify an interval of years, where the weekly curve should be considered. The defined starting and end year is included in the validity interval. The same group name can be associated with different columns in case the validity years are not overlapping. It can be used to reflect an evolution of the weekly curve.

Maximum and minimum curves go in pairs for each group.

4.9 “Planned Outage” sheet

This worksheet contains the exact dates of planned outages – it can serve both short term and more long-term studies. For each generating unit to be considered, represented by the unit ID and the generating unit name from the “thermal” sheet, several planned outage windows can be specified. The format of the date should be dd/mm/yyyy in a TEXT cell format.

For each planned outage, the ration of capacity on outage can be provided. A ratio of 1 mean that all that the capacity is on maintenance. If the cell is left empty, it will be a ratio of 1 will assumed.

Reason of the outage can be selected in column E for further explanation.

It is possible to set entire maintenance profiles by reporting each individual outage using as many rows as necessary. It is also possible to report outages of some units only, meaning a partial maintenance profile of the generation fleet.

In column J, it shall be defined if the maintenances provided should be taken into account for the maintenance profile of the market node for each target year in its entirety, partially, or not at all.

In case TRUE is selected for a target year (e.g. 2025) it means market modelling will read all outages set for 2025 from this table and will consider this as the maintenance profile for the market node. Optimisation of outages based data provided in Thermal sheet WILL NOT BE DONE.

In case FALSE is selected for a target year, the maintenance profile will be generated in the maintenance optimisation process using the data provided in Thermal sheet. In this case, it is not necessary to report any outage for that specific year in this sheet.

In case PARTIAL is selected, the outages provided in this sheet will be considered and optimisation will be done only for units that don't have outages defined here.

4.10 “Exchanges” sheet

This sheet requests information for every market node with connections to non ENTSO-E countries. The following data are collected:

- Node name of the non-ENTSO-E country (selectable)
- Yearly evolution multipliers
- Hourly exchanges with the specified non-ENTSO-E country

The PEMMDB database does not contain data regarding the generation portfolio, demand and other parameters necessary to model the countries of the non-ENTSO-E region, hence it is not possible to model the exchanges with these countries in the standard way (e.g. explicitly). For this reason, the exchanges are not an output of the simulation driven by the market, but are input to the model in the form of annual hourly data series.

Therefore, hourly time-series of the estimated overall power (MW) that would be exchanged with all the countries outside the ENTSO-E region under regular market conditions from an economic standpoint (market competition) must be provided. The value is **positive if the flow is a net import** (i.e. the ENTSO-E member country imports from the non-ENTSO-E neighbour) and negative if it is a net export. The sum of the 8760 values represents the expected overall net amount of energy annually exchanged with countries outside the ENTSO-E region.

To account for expected changes of the volume of the exchange with the non-ENTSO-E country, multipliers can be defined for each year in the mid-term horizon. The final hourly curve used for a specific study year will be calculated by multiplying the factor for the specific year with the hourly curve provided. Therefore, the cells for 2018, 2020, 2021, 2023, 2025 and 2030 multipliers have a default value of 1.0 and for the years in between if the cells are left empty, a linear interpolation will be applied between the given values.

How to build the hourly data series

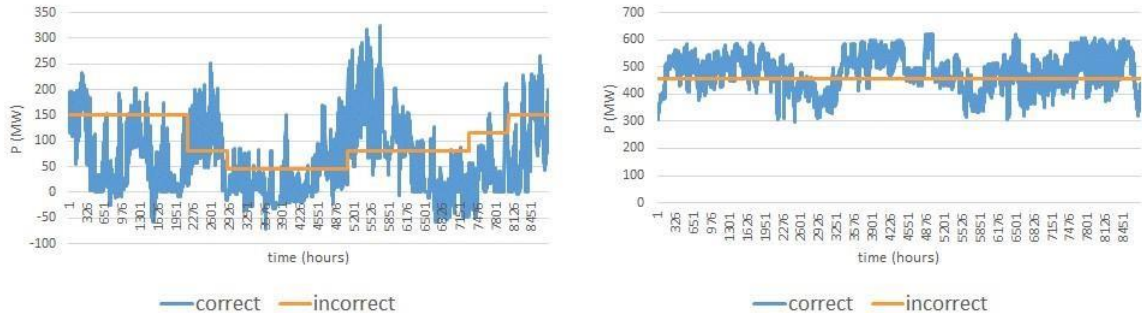
If the required exchanges are related to the border, which **is in operation** at present, the hourly data series should be built based on the real operation, using information about the real commercial flows on that border as a base. It is important to account, to the possible extent, for the dependency of commercial exchanges/flows on fluctuation caused by the alternation of seasons (winter/summer), changing of the load within a day (peak/off-peak), and switching-off of related systems/equipment for the reasons of outages/regular annual maintenance or others.

For simplicity, the typical behaviour of the real exchanges should be kept even if future interconnection development project which might influence on these exchanges, is expected to be realised within the time frame considered.

Some countries interconnected via non ENTSO-E countries (e.g., Slovakia-Hungary-Romania via Ukraine; Estonia-Latvia via Russia) may affect each other's exchanges. If they do, TSOs of these countries should cooperate during the process of building these hourly data series to **keep the correlation** between these exchanges (e.g., build the exchanges on the base of the real exchanges from the same commonly agreed year).

If the required exchanges are related to a border which **does not exist** on the present, it is not possible to build the exchanges based on the real operation, and it is up to the TSO to build the exchanges profile based on his/her best estimate. However, it is important to keep in mind that the profile should not gain the shape of a line with the constant power in all year long, unless such exchanges are really expected. This may be the case for DC

connections, but not for AC connections connecting two meshed systems, where constant exchanges are not likely to occur. TSOs having their own market simulation tool may build the exchanges by their internal market simulation. In this case, similar data sets should be used for both market assessments and adequacy modelling.



Simulated exchanges should be similar to real exchanges

Non ENTSO-E country as a market node

Where generators are operating in a non-ENTSO-E country to purely provide power for a market node, with no other contribution from the rest of the non-ENTSO-E country grid, TSOs should include this generation in the Thermal sheet, either as part of their own portfolio or as a new market node. This power plant will be modelled in the standard way according the fuel type and the border connection will be defined by the NTC value.

4.11 Investment_Constraints Sheet

This table represents the maximum quantity of capacity that could be built in each future year for each fuel/technology type, given the unique set of constraints associated with each region and with the development of each fuel/technology type.

For example, regions with no indigenous gas reserves, no gas pipeline and no LNG port are unlikely to develop gas capacity in the coming years, meaning that future investments in capacity in this type of region will likely be in other technologies/fuel types.

Similarly, regions that are not actively developing new gas capacity right now will not have additional gas capacity next year, or in 2 years, given the lead times associated with developing gas units.

4.12 “Reserves Requirements” sheet

Reserve data will be gathered for each market zone. In this worksheet, the operational reserves requirements should be provided while avoiding risk of double-counting

In the sheet RESERVES REQUIREMENTS you are asked to provide information related to reserve requirements and information useful to decide how to model it.

Note: the aggregated FCR and FRR thermal requirement submitted by TSO LACs as additional to the unit-by-unit derating (already provided in sheet 'Thermal' column 'AA'), will be accounted in ERAA through a central approach defined by the ERAA MST team. This proposal will be based on derating the capacity of the units of each fuel type proportionally to the fuel type share of the total installed thermal capacity. The derating will not affect any must run requirements.

In particular we refer to:

- **Frequency Containment Reserves (FCR)** comprises of operational reserves which are activated to contain system frequency after an incident inside a pre-defined band. FCR are based on the automated, decentralised response of the governor controls on individual generators with a full activation time of 10-30 seconds. Please divide FCR's requirements in:
 - FCR that need to be made available by thermal. From a modelling perspective, this information would allow to constrain unit commitment to ensure (together with information provided in sheet 'Thermal' column 'AA') that these requirements will be respected. Please provide as 'free text' if some thermal units cannot provide FCR
 - FCR that will be procured by Hydro
 - FCR available from Demand (reduction of demand possible thanks to specific contract to cope with system imbalances; while DSR would work on the DA & ID, here only interruptible contract activated to contain system frequency should be considered). In case of systems imbalance this part of demand will be curtailed.

- **Frequency Restoration Reserves (FRR)** are operational reserves used to restore system frequency to its nominal value and, where applicable, the power balance to the scheduled value. FRR consists of manually-instructed services (manual FRR) as well as automatically instructed services (automatic FRR). The latter are based on the centralised control of specific generating units or loads. To model FRR requirements in adequacy assessment, or in future balancing market, you are asked to specify:
 - FRR that will be procured by thermal (unit commitment of thermal units able to provide FRR considers this requirements); This will be modelled in using different methods: either as 'additional load' by imposing in the unit commitment the respect of this constraints for the units able to provide FRR. Please indicate in "Thermal" sheet if some unit cannot provide FRR
 - FRR that will be procured by Hydro

To reduce the risk of further iteration linked to the need of clarification on how to model reserve requirements, we also ask a recommendation of how reserves requirements should be modelled in case of simulation of Day Ahead market. This clarification is particularly important for hydro dominated country:

- Additional load – this option could be preferred in case there are concern related to the availability of Reserves due to energy constraints (e.g. if reserve is provided mainly by hydro and you want to be sure to 'keep enough water in the reservoir').
- Reduction of turbinning capacity – if the constraint is more represented more accurately by generating capacity than by water availability (also in order to reduce

the impact on marginal price of DA) it is better you impose a constraint to hydro generating output.

ATTENTION: DO NOT provide a “maximum turbinning capacity” in Hydro Inflow files that already reflect the Reserve Requirements.

Since we came across various issues during the previous data collection, for a simplified approach, we have added Thermal FCR and explicitly listed Hydro categories. Finally, please provide any ‘free text’ comments about reserves requirements and suggestions about modelling assumptions in the dedicated section.

4.13 TrajectoriesSheets

This sheet has the main objective of reflecting uncertainties in the development of the generation fleet in the market node. For each technology type, lower and higher bounds of capacity for each fuel type can be defined. Detailed description how those sheets should be found by the WG Scenario Building guidelines. (link provided in ch.2)

4.14 “Redispatch information’ sheet – Not required for current data collection

This sheet aims to collect general information on the way redispatch is performed in each market node.

The primary goal function of redispatch optimization should specify the main principle behind the optimization: minimizing the cost, the amount of electricity or the number of units involved in it.

The geographical scope of this optimization can be selected between Pan-European, National, TSO operating area (which corresponds to national in certain cases) or interregional (in case the optimization is coordinated with other TSOs). The time horizon should also be selected.

The comment section provides TSOs with the opportunity to elaborate on their redispatch process.

4.15 “Redispatch – 3.0 Fuel Types’ sheet – Not required for current data collection

This sheet aims to collect information on if and how different plants, separated by fuel types, participate in redispatch for each market node.

It contains the similar information as in Thermal sheet, but in this case it is generalized for fuel type rather than unit-by-unit information. It also contains further details regarding how the mark-ups have been calculated.

It is the intention of the BZR study to use the more general (per fuel type) data regarding redispatch. Supplying individual markups on unit level may carry undesirable existing market biases and bidding strategies into the BZ study, so TSOs should provide aggregated /weighted values using the best data they have available.

Unit-by-unit data can supersede the fuel type redispatch data provided, so LACs should only provide data on unit level when it is relevant and any difference in data stems from technical reasons and not market bias.

It is important that TSO/LACs provide redispatch data making their best estimate for the BZ timeframe (2023-2025) and not simply reflect the current status, as it can be expected some redispatch markets will mature and evolve.

'Markup' refers to **additional costs** incurred in the redispatch timeframe compared to the estimated variable costs incurred in the day-ahead timeframe. Included in this definition are higher costs due to opportunity costs, potential market power and – in some cases – startup costs (see next slide).

Markups are to be estimated by comparing historical redispatch bids received by TSOs with **estimated generator variable costs**.

For generation units, the formula for calculating redispatch markups **depends on generator type and redispatch direction**, as given in the following table.

	Thermal units		Variable renewable energy sources & hydropower	
Redispatch direction	Upward	Downward	Upward	Downward
Markup (%) =	$\frac{P_{redispatch}^{\uparrow} - SRMC}{SRMC}$	$\frac{SRMC + P_{redispatch}^{\downarrow}}{SRMC}$	$\frac{P_{redispatch}^{\uparrow} - P_{DA}}{P_{DA}}$	$\frac{P_{DA} + P_{redispatch}^{\downarrow}}{P_{DA}}$

= Upward redispatch price (€/MWh)

= Short-run marginal cost (€/MWh)

= Downward redispatch price (€/MWh)

Day-ahead price (€/MWh)

Note: All formulas assume the same sign convention below. When estimating their markups, TSOs should ensure their upward and downward redispatch prices matches this convention.

If payment for redispatch is from TSO -> market party,	must be positive number
If payment for redispatch is from market party -> TSO	must be negative number

The variable costs to be included in the 'SRMC' term for thermal units are **fuel costs**, **carbon costs**, and **variable operating & maintenance (VOM)** costs. TSOs should use historical fuel and CO₂ prices corresponding to the same year(s) as their redispatch offer data, and standard efficiency values per generator type from PEMMDB where appropriate.

TSOs are free to calculate markups either on **all the bids received** for redispatch, or just on those bids which are **called**, depending on the data available, their best judgement, and

expectation of future developments over the timeframe of the BZR (i.e. three years). *For example, TSOs could estimate markups based on a weighted average of the called bids, or a weighted average of the received offers.*

Note that if TSOs receive only lumped bids for redispatch energy (€/MWh), their redispatch offers from market parties will implicitly include unit startup costs (where relevant), and thus their calculated markups may be higher than for TSOs who receive separate bids for redispatch startups and redispatch energy. To avoid double-counting of start-up costs, generators in countries which receive lumped redispatch bids will be considered to have zero startup costs in the redispatch timeframe optimisation, as these will be already included in the markup values.

4.16 “Market Node Summary” sheet

A new sheet was introduced to get an overview of the provided data for the specific market node and provide results of simple consistency checks to support the TSOs during the data collection process. The simple checks cover data sets which have to be linked to each other:

- capacity values on the Other non-RES sheet and hourly curves
- Market node 4-digit code, multiplier factors and hourly curves of fixed exchanges

The feedback of these checks is located in column O and is updated as the data is provided. These checks only support (but not replace) the data consistency checks planned after the data collection.

The sheet collects most values for 2021, 2023, 2025 and 2030, but for the Thermal generation capacity report the specific year can be written in C10 and the values will be collected by the formula instantly.

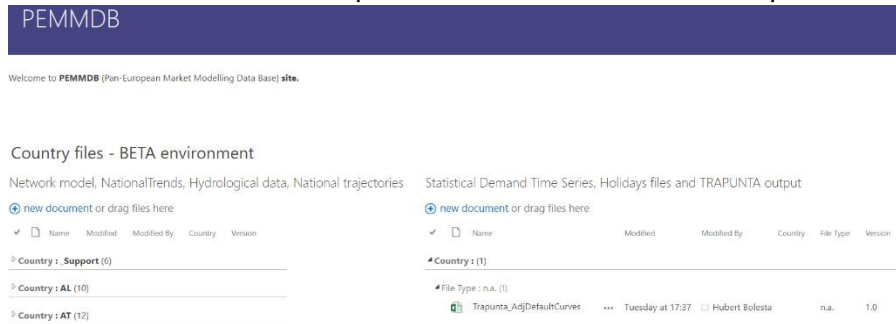
For some generation types the Equivalent Full Load Hours value is also reported, which is calculated from the hourly curve. The indicator is the sum of the hourly ratios for the specific generation type/price band showing how much hours it would need to run at maximum capacity to provide the same energy value as it was provided with the hourly curve. (The values have to be between 0 and 8760.)

5 PACKAGE “DEMAND”

5.1 Intro from TF Demand Forecasting

Due to procurement of new PECD climatic years (2017-2019) as well as Trapunta models revision, correspondents are kindly asked to:

- Provide the updated historical load profiles to SharePoint PEMMDB area of the years **(UTC time convention) (2012-2020)**; whereas the definition of the load is: Load on a power system is referred to as the hourly average active power absorbed by all installations connected to the transmission network or to the distribution network. The load is the value at a given moment of the electrical power supplied or absorbed at any point of a system as determined by an instantaneous measurement or by the integration of power during a given period of time. Load can refer to a consumer, an appliance, a group of consumers or appliances or a network. Load is the power consumed by the network including (+) the network losses but excluding (-) the consumption for pumped storage and excluding (-) the consumption of generating auxiliaries and excluding (-) energy consumed by batteries.
- Provide the updated information on the Electric Vehicle profiles;
- If available, please deliver or revise the country corresponding curves to be used in Trapunta:
- The default curves used in Trapunta are available in the Sharepoint PEMMDB area:



- Sanitary Water Hourly Profile
- Sanitary Water COP curve
- Air to air Air conditioning COP curve
- Air to water Air conditioning COP curve
- Air to air Heat Pump COP curve
- Air to water Heat Pump COP curve
- Air to air hybrid heat pump COP curve
- Air to water Hybrid heat pump COP curve
- Battery Impact: fixed load and discharge
- Battery Impact: photovoltaic load and discharge
- Additional base loads: hourly profile

5.2 “Demand” sheet

The new ERAA and Scenario Building processes require the development of a variety of load profiles for each market node, based on different climatic conditions, storylines etc. One of the specific objectives of TRAPUNTA was to avoid the “black box” effect - for the interested users

MATLAB code will also be available. To reduce the amount of work for TSOs, there will still be an option to have the **load profiles been prepared centrally for the different studies**. For this purpose, TRAPUNTA tool comes with a set of default options that reduce the need for user input. A description of the various data needed for this assessment is provided hereafter, which is in line with the excel sheet “Demand” of the PEMMDB file.

Main definitions

Thermal Load	Refers to overall demand for heat energy
“Electric” thermal load	Refers to any thermal load supplied by electrical devices (for example, electric heater)
Electric heating	Refers to any device that generate thermal load by using electrical energy
Non-electric heating	Refers to any device that generate thermal load by using fossil fuels (for example: gas heater, coal heater)
Additional Heat Pumps	Refer to the number of heat pumps that <u>do not</u> replace electric or non-electric heating, thus creating additional load in the system
COP	Coefficient of Performance

- The PEMMDB template for the Demand has two new rows in the beginning (**row 7-8**):
 - o Target Energy Demand [TWh] and Average Annual Peak [MW]
 - o Please provide these values for a specific year in the PEMMDB (for example, for the year 2025 the expected Target Average Annual Energy is 8 TWh and the expected average maximum peak is 1900MW). Similarly, for all the years available.

	A	B	C	D	E	F	G	H	I	J	K	
1	ENTSO-E Market Modelling Database: Demand											
2												
3	<i>Linear interpolation will be assumed for years, where capacity is not provided</i>											
4	<i>Hourly curves have to be defined on the specific sheet for...</i>											
5												
6	Rescaling KPI's											
7	Average Annual Maximum Peak		[MW]	2017	2018	2019	2020	2021	2022	2023	2024	2025
8	Target Energy Demand - National Trends only		[TWh]									
9												

- The PEMMDB template for the Demand has two new rows at the end (**row 118-121**):
 - o Ratio of price-sensitive consumer

- Ratio of EVs, Heat Pumps and Non-Market Participating Batteries from the Demand sheet, which are responding to electricity prices seen in the wholesale market. The ratio represents the share of price-sensitive consumers in its category for the respective target year. In ERAA, the price-sensitive consumers can provide flexibility to the system to a certain extent (taking into account constraints such as a minimum SoC level of EVs).

	Ratio of price-sensitive consumer	Default: 0%	2017	2018	2019	2020	2021	2022	2023	2024	2025
118	EVs	(%)									
119	Heat Pumps	(%)									
120	Non-Market Participating Batteries	(%)									
121											
122											

5.2.1 Heating Heat-Pumps (sheet "Demand", rows 10-16)

5.2.1.1 Fraction of existing "electric" thermal load shifting from electric heating to:

Row	Description
11	<u>air-to-air</u> Heat Pumps : it is the percentage fraction of "electric" thermal load, of the previous year which represents electric heating replaced by <u>air-to-air</u> heat pumps in the considered year.
12	<u>air-to-water</u> Heat Pumps : it is the percentage fraction of "electric" thermal load, of the previous year which represents electric heating replaced by <u>air-to-water</u> heat pumps in the considered year.
13	<u>geothermal</u> Heat Pumps : it is percentage fraction of "electric" thermal load, of the previous year which represents electric heating replaced by <u>geothermal</u> heat pumps in the considered year.

5.2.1.2 Fraction of existing "electric" thermal load shifting from non-electric heating to:

Row	Description
14	<u>air-to-air</u> Heat Pumps + increase due to additional <u>air-to-air</u> Heat Pumps (variation with respect to the previous year) : It is non electric thermal load, expressed as a percentage of electric thermal load of the previous year, which represents non electric heating replaced by <u>air-to-air</u> heat pumps in the considered year and Additional <u>air-to-air</u> heat pumps, expressed as a percentage of electric thermal load of the previous year.
15	<u>air-to-water</u> Heat Pumps + increase due to additional <u>air-to-water</u> Heat Pumps (variation with respect to the previous year) : It is non electric thermal load, expressed as a percentage of electric thermal load of the previous year, which represents non electric heating replaced by <u>air-to-water</u> heat pumps in the considered year and Additional <u>air-to-water</u> heat pumps, expressed as a percentage of electric thermal load of the previous year.
16	<u>geothermal</u> Heat Pumps + increase due to additional <u>geothermal</u> Heat Pumps (variation with respect to the previous year) : It is non

electric thermal load, expressed as a percentage of electric thermal load of the previous year, which represents non electric heating replaced by geothermal heat pumps in the considered year **and** Additional geothermal heat pumps, expressed as a percentage of electric thermal load of the previous year.

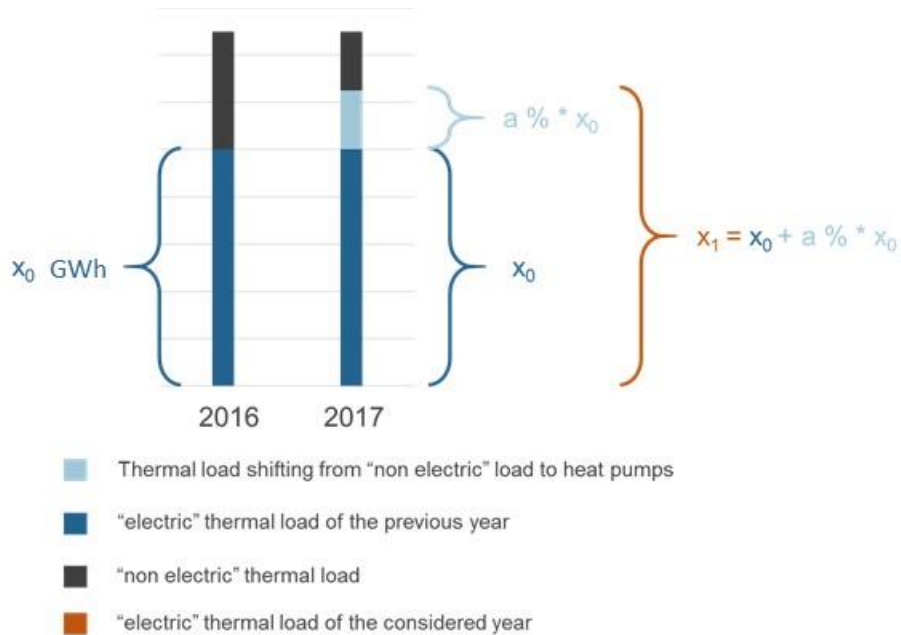


Illustration of “electric” thermal load shifting from non-electric heating to heat pumps (the „a” percentage being the one to be provided in the PEMMDB table)

Example:

Consider the following case that we want to fill in data for **target year 2018**:

- The electric heating systems’ portion (e.g., resistive) which corresponds to 0,4% of the total thermal demand supplied by electric devices – „electric” thermal load - **at year 2017**, is replaced by air-to-air heat pumps.
- The non-electric heating systems’ portion (e.g., gas heaters) which is equivalent of 0,1% of the total thermal demand supplied by electric devices – „electric thermal load” - **at year 2017** is replaced in the target year by air-to-air heat pumps. This 0,1% might also correspond to new installations of air-to-air heat pumps, e.g., additional thermal load due to increase of population.

According to the above, the values are reported as follows:

Heating Heat-Pumps		2017	2018
Fraction of existing “electric” thermal load shifting from electric heating to airto-air Heat Pumps (variation with respect to the previous year)	[%]	...	0,4 %
...

Fraction of existing "electric" thermal load shifting from non-electric heating to air-to-air Heat Pumps + Increase due to additional air-to-air Heat Pumps (variation with respect to the previous year)	[%]	...	0,1%
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How to calculate the required fraction?

Consider the following data for 2017 and 2018:

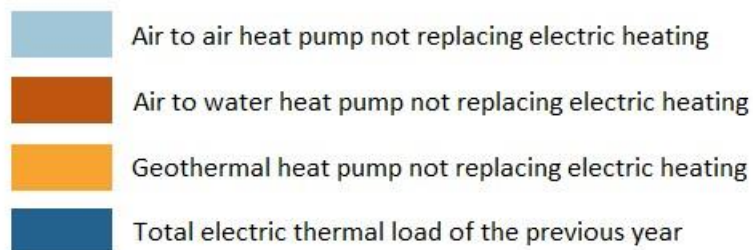
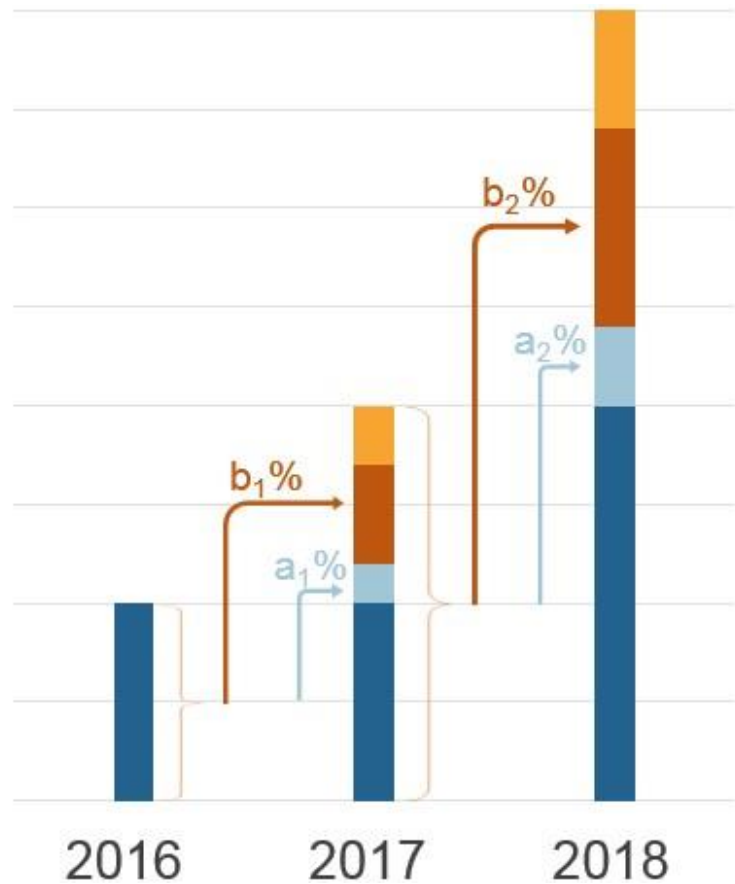
Heating Thermal Load (MWh)	Energy	2017	2018
Gas Heaters	Gas	500	499
Direct Electric Heaters	Electricity	800	796
Air-to-air Heat Pumps	Electricity	200	205

The required input for PEMMDB based can be calculated based on the following assumptions:

- The total thermal load does not evolve from 2017 to 2018.
- The 1MWh loss of thermal load provided by gas heaters is entirely provided in 2018 by air-to-air heat pumps.
- The 4 MWh loss of thermal load by direct electric heaters, is provided in 2018 by air-to-air heat pumps.

Fraction of existing "electric" thermal load shifting from electric heating to air-to-air Heat Pumps (variation with respect to the previous year) $\frac{4}{800+200} 0,004 0,4\%$

Fraction of existing "electric" thermal load shifting from non-electric heating to air-to-air Heat Pumps + Increase due to additional air-to-air Heat Pumps (variation with respect to the previous year) $\frac{1}{800+200} 0,001 0,1\%$



Note: As shown in the example above, the evolution is always calculated on the total basis of the “electric” thermal load of the previous year. In the example above, in 2018 the “electric” thermal load corresponds to the “electric” thermal load of 2017 plus the percentage change of air-to-air, air-to-water and geo Heat Pumps that are not replacing existing electric devices (which correspond respectively to light blue, orange and yellow color).

5.2.2 Hybrid Heat-Pumps (sheet "Demand", rows 18-22)

5.2.2.1 Fraction of existing "electric" thermal load shifting from electric heating to Hybrid Heat Pumps (variation with respect to the previous year)

Row	Description
19	It is the percentage fraction of " <u>electric thermal load</u> " replaced by <u>hybrid heat pumps</u> in the considered year.

5.2.2.2 Fraction of existing "electric" thermal load shifting from non-electric heating to Hybrid Heat Pumps + increase due to additional Hybrid Heat Pumps (variation with respect to the previous year)

Row	Description
20	It is non-electric thermal load, expressed as a percentage of electric thermal load of the previous year, which represents <u>non-electric heating</u> replaced by <u>hybrid heat pumps</u> in the considered year.

5.2.2.3 Switch Temperature (HP to gas switch):

Row	Description
21	Threshold temperature (°C) under which the <u>hybrid heat-pump</u> starts using gas instead of electricity.

5.2.2.4 COP threshold for switching (HP to gas switch):

Row	Description
22	Threshold COP (of the Heat Pump) under which the <u>hybrid heat-pump</u> uses gas instead of electricity.

5.2.3 Air-Conditioning Heat-Pumps (sheet "Demand", rows 24-27)

5.2.3.1 "Electric" thermal load increase due to new air-to-air / air-to-water / geothermal AirConditioning Heat Pumps (variation with respect to the previous year):

Row	Description
25	Data regarding air-conditioning heat pumps are to be provided the same way as the corresponding data for heating heat pumps of the previous
26	sub-section. The only difference is that data of this category refer only to heat pumps <u>not</u> replacing electric air-conditioning systems. 27

5.2.4 Sanitary Water Heat-Pumps (sheet "Demand", rows 29-33)

5.2.4.1 Daily thermal load increase due to new Sanitary air-to-water / geothermal Heat Pumps replacing electric water heaters

Row	Description
30	
31	Thermal load increase (in MWh/day) due to the installation of new heat pumps for sanitary water. The data are divided in air-to-air and geothermal heat pumps and in thermal load replacing or not replacing electric water heaters.
32	
33	

5.2.4.2 Electric Vehicles (sheet "Demand", rows 35-59)

Four types of electric vehicles could be specified to represent different use of EVs (e.g. user of EV type A is commuting and doing 100 km/day from Monday to Friday while type B is just using the car in the weekend to do groceries assumptions of 10 km/EV/day, etc.). Also, the fraction of types A/B/C/D with fast or slow charging need to be specified. Therefore, the same data are required for each category (i.e., type A, type B, type C and type D):

Row	Description
36	Number of additional EV (-) [type A] (with respect to the previous year)
37	Average effective usage (km/EV/day) for week days [type A]
38	Average effective usage (km/EV/day) for weekend days [type A]
39	Average efficiency (kWh/100km) [type A]
48	Number of additional EV (-) [type D] (with respect to the previous year)
49	Average effective usage (km/EV/day) for week days [type D]
50	Average effective usage (km/EV/day) for weekend days [type D]
51	Average efficiency (kWh/100km) [type D]

Additional baseload [MW]	100	100	100	100	100	100	100
-----------------------------	-----	-----	-----	-----	-----	-----	-----

The values in the Table above represent an additional load that was added to the system in comparison with previous year. For example, the additional load in 2023 compared in 2016 is 700 MW whilst when compared to 2022 it is 100 MW.

5.2.6 Energy demand evolution (sheet "Demand", rows 64-66)

Row	Description
65	Temperature-dependent demand evolution, either growth (+) or reduction(-) due to e.g. population/residential/tertiary: This value corresponds to the growth or reduction in <i>temperature-dependent</i> demand expected for the target year as a fraction of the demand in the previous year.
66	Temperature-independent demand evolution, either growth (+) or reduction(-) due to e.g. industrial production: This value corresponds to the growth or reduction in <i>temperature-independent</i> demand expected for the target year as a fraction of the <i>temperature-independent</i> demand in the previous year.

Warning: this temperature-independent demand evolution should not be related (in order to avoid a double counting) to the categories defined before, however if the data was not provided because the previous categories were too specific, it can be provided here instead:

- 4.2.4 Sanitary Water Heat-Pumps (sheet "Demand", rows 29-33)
- 4.2.5 Electric Vehicles (sheet "Demand", rows 35-59)
- 4.2.5 Additional load (sheet "Demand", rows 61-62)

Warning: this temperature-dependent demand evolution should not be related (in order to avoid a double counting) to the categories defined before, however if the data was not provided because the previous categories were too specific, it can be provided here instead:

- 4.2.1 Heating Heat-Pumps (sheet "Demand", rows 10-16)
- 4.2.1 Heating Heat-Pumps (sheet "Demand", rows 10-16)

5.2.6.1 Total energy consumption (industrial, residential and services, transport) (rows 93 – 96)

This is the total energy consumption for each of these sectors comprising not only electricity, but the entire consumption.

5.2.6.2 Sectoral Breakdown - Electricity in energy mix consumption (industrial, residential and services, transport) (rows 99 – 102)

For each of the sectors, what is the share of electricity in the energy mix. From all the consumption of the sector, how much comes from electricity. As this is the ratio of electricity

in each sector, the sum of ratios (industrial, residential and services, transport) is extremely unlikely to be 1.0!

5.2.7 Battery impact (sheet "Demand", rows 70, 71)

Row	Description
70	ADDITIONAL Installed non-market participating Battery storage capacities (output, MW). Is the maximum total power, in MW.
71	ADDITIONAL Installed non-market participating Battery storage capacities (storage, MWh). Is the total capacity, in MWh.

5.2.8 Target Energy Demand (sheet "Demand", rows 75B, 75)

The user can rescale the adjusted profile in order to meet an annual target demand. The value of the energy demand (in TWh) is user-inputted.

Row	Description
75B	Scaling Method selection. Please refer to the TRAPUNTA Theory Manual for detailed methodologies explanation. fill with 0 at all times (the functionality is not working correctly)
75	Target energy Demand in TWh to be rescaled

5.2.9 Zonal Splitting Ratio (sheet "Demand", rows 80-96)

In this area, it is expected an approximation of the split of the demand (not of each demand driver, the split of the entire market node demand) between the regions inside the market node (PECD level). This can be useful to support zonal modelling activities. This is now a yearly attribute, and values have been copied to all years based on single value previously provided by TSO. The sum of the ratios must be equal to 1.0 for each year!

6 PACKAGE “ELECTROLYSERS FUEL CELLS BATTERIES DSR”

6.1 “Market Node Summary” sheet

This sheet summarizes the data provided in the different sheets of this file.

6.2 Must-run sheets

For Electrolyser and Fuel Cells it is important to indicate so called must-run obligations, which can have many causes (heat requirements, technical, economic/subsidies/taxes, environmental, etc.) and should not be confused with minimum stable generation.

Climatic years associated with must-runs can now be selected in these sheets

Reasons that could induce must-run obligation include:

- Network constraints (overload management, voltage control...)
- Minimum number of units needed to provide system services

Reasons that, in most cases, should not induce must-run obligation include:

- Fully non-dispatchable units
- Low flexibility. This can be represented by other parameters such as “minimum stable generation” and “Ramp up/down rate”

These worksheets contain the hourly ratios of possible generating unit based must-run criteria to be modelled in the market simulations. The data provider should fill a separate column for each different hourly curve (cells between rows 11 to 8770). To reference the defined curve, the data provider should use a matching curve IDs in row 5 of this sheet and the Generation Unit based must-run curve ID column in the Electrolyser and Fuel Cell sheets.

To check whether the referencing is done right, the Cell in row 6 of the Must-run sheet will change to “Referenced” if at least one matching ID can be found in the Electrolyser and Fuel Cell sheets.

The sheet also includes validity start and end year cells, to specify an interval of years, where the hourly curve should be considered. The defined starting and end year is included in the validity interval. The same curve ID can be used more than once if the validity intervals are not overlapping, thus defining different hourly curves for different years.

The defined curves can be referenced by more generation units. In this case these units will still be modelled independently.

The provided ratios will be multiplied by the net generating capacity of the generating unit that is referencing the curve to get the generation that must be committed on this unit. The net generating capacities used for determining the amount of must-run shouldn't include any derating effect.

6.3 Inelastic sheet

This worksheet contains the hourly ratios of possible generating unit based inelastic profile criteria to be modelled in the market simulations for Electrolysers and Fuel cells. The data provider should fill a separate column for each different hourly curve (cells between rows 11 to 8770). To reference the defined curve, the data provider should use a matching curve IDs in row 5 of this sheet and the Generation Unit based Inelastic profile curve ID column in the new Electrolyser and Fuel Cell sheets.

To check whether the referencing is done right, the Cell in row 6 of the Inelastic sheet will change to "Referenced" if at least one matching ID can be found on the Thermal sheet.

The sheet also includes validity start and end year cells, to specify an interval of years, where the hourly curve should be considered. The defined starting and end year is included in the validity interval. The same curve ID can be used more than once if the validity intervals are not overlapping, thus defining different hourly curves for different years.

The defined curves can be referenced by more generation units. In this case these units will still be modelled independently.

The provided ratios will be multiplied by the net generating capacity of the generating unit that is referencing the curve to get the generation inelasticity on this unit. The net generating capacities used for determining the amount of inelastic profile shouldn't include any derating effect.

	A	B	C	D	E	F	G
1	ENTSO-E Market Modelling Database: Generating Unit obligations						
2	N.B. use convention first January always Monday (2007 (or 2018) calendar year) --> see guidelines for further details						
3	Generating unit Inelastic criteria will be defined by multiplying the net generating capacity of the unit with the ratio value for the given hour.						
4	Please use matching curve name in the Thermal sheet in column "Generating Unit based Inelastic curve ID".						
5				Curve ID			
6				Curve ID check	Not referenced	Not referenced	Not referenced
7				Validity starting year (including this year)			
8				Validity ending year (including this year)			
9				Climate Year Validity start			
10				Climate Year Validity end			
11	Week	Month	Date	Hour	Inelastic Ratio profile	Inelastic profile	Inelastic profile
12	1	1	01 01	1			

6.4 Derating sheets

Derating sheets are provided for Electrolysers, Fuel Cells and Demand Side Response (DSR). Derating data reflects that the total installed capacity of a unit is not always available for market optimization. Potential causes include:

- Generators providing system service reserve. If you specify a value here, do not include this in the Reserve Requirements sheet.
- Generators whose output power is limited by e.g., transmission constraints, cooling constraints, others.
- Generators using inferior quality fuel.

The default derating value is 100%, which is equal to a reduction value of 0%. TSOs should provide hourly values possibly for the entire year. Hourly value cells left empty for a defined curve ID will be considered as 1.0.

The modelling of derating introduced here is independent of the forced outage modelling method also called derating. The reduction of NGC introduced with this parameter is independent of the forced outage and maintenance modelling in the studies: units can still be considered unavailable in the model because of maintenance and forced outage regardless of any defined derating.

Providing data sets related to derating follows the same logic as for must-run. The two specific sheets collect the derating curves related to unit groups and individual generating units.

6.5 “H2_Storage” Sheet

Quantity of stored hydrogen connected to fuel cell. Fuel cells can be supplied by either stored hydrogen or directly by an electrolyser.

6.6 “Electrolysers” Sheet

The modelling approach that has been chosen for ERAA 2022 does not require any additional data beyond the data already available in the current PEMMDB.

Demand for hydrogen is assumed to be equal to the installed capacity of electrolysers, i.e. it is a flat demand band. The hydrogen demand can be fulfilled either by operating electrolysers, or by steam-methane reforming. If the electricity price is below a certain threshold, electrolysers are covering the hydrogen demand. If the electricity price exceeds the threshold, steam-methane reforming processes are covering the hydrogen demand, implying no additional electricity demand. The threshold price is defined based on the price of hydrogen in the respective target year, which will be obtained from scenario building team, and the efficiency of electrolysers.

6.6.1 *Data collected in the Electrolysers Sheet*

6.7 “Batteries” Sheet

Battery storage capacities are given for both Market participating and non-market participating batteries. Market participating batteries will be explicitly modelled while nonmarket participating are taken as input for TRAPUNTA for demand profile calculation.

For the zonal splitting, it is expected an approximation of the split of the capacities reported for all technologies. As it doesn't differentiate between technologies, an approximation is enough. This is now a yearly attribute, and values have been copied to all years based on single value previously provided by TSO. The sum of the ratios must be equal to 1.0 for each year!

6.8 “DSR” sheet

Demand Side Response should now be provided through this unique worksheet, containing both the capacity evolution and the hourly curve, the activation price (EUR/MWh), the maximum number of hours to be used per day (if there are some constraints) and if there are any availability constraints (you can provide a ratio between 0 and 1.0)

Please note that we refer here to the capacity of demand reduction available on the market (user NOT willing to pay more than activation price). **For ‘interruptible’ contracts stipulated by TSOs for extreme situations/operational measures, row 25 “Out of Market – strategic reserves” can be used, and those will not be considered initially in market simulations. It can serve as sensitivity, especially for Seasonal Outlook studies.**

This demand reduction should be price-responsive, and will be used in the market models when price rises above the value denoted for each price band. TSOs can give information for up to 4 price bands. The price bands should be defined based on a forecast of future prices, rather than current prices.

TSOs have the option to give an hourly profile of availability, since for example some demand might not be available for reduction at night time. Profiles should assume that 1 January is a Monday. If the value does not change, and the same amount of DSR is expected to be available, TSOs could leave the default value of 1.0.

TSOs should note that the available demand response is additive across each band. Also, since the demand side response represents negative demand bidding into the market, it represents demand already included in the forecasted demand profile.

The DSR Sheet now accommodates information regarding DSR in Redispatch phase!

If a band is only available either in Redispatch or Day-Ahead phase, TSO should indicate a price of -1 for the unavailable phase.

If information would be conflicting (e.g. in different phases the profile or the capacity would be different) it is advised to make use of different bands, making the best use of the 10 available bands in the template.

Example: A group of industrial demand customers have pooled together to form a demandside unit which bids a negative demand into the electricity market. They bid 50 MW at €120/MWh, which represents the opportunity cost for one of the customers, and 100 MW at €200/MWh, which represents the opportunity cost for the remaining members of the group.

Demand Side Response				
Price Band 1 capacity (MW)	Provided	50.00	50.00	50.00
Price Band 2 capacity (MW)	Provided	100.00	100.00	100.00
Price Band 3 capacity (MW)	Provided			
Price Band 4 capacity (MW)	Provided			

Due to production requirements, they can only reduce load for 4 hours at most within a 24hour period.

Demand Side Response	Out of Market - strategic reserves	Price Band 1	Price Band 2	Price Band 3	Price Band 4
REDISPATCH - Activation price for demand reduction (EUR/MWh)	N/A	175.00	-1.00		
DAY AHEAD - Activation price for demand reduction (EUR/MWh)	N/A	100.00	120.00		
Max hours to be used per day (zero or empty value: no constraint, available at all hours)		4	4		

In the market models at Day-Ahead phase, if the price exceeds €100, demand will be reduced by 50 MW or until the price drops below €100, for up to 4 hours. If the price exceeds €120, demand will reduce by up to 150 MW, depending on how reducing demand impacts prices. The interplay between demand reduction and pricing is handled through the dispatch optimising algorithms within the market modelling tools.

For the Redispatch phase, only the first band is available (band 2 has a price of -1 for the redispatch phase) – and at a higher price, indicating the extra costs of responding at a shorter notice.



6.8.1 DSR Profile

Derating profiles of DSRs

6.8.2 DSR Trajectories Sheet

Data for DSR Trajectories is to be added in the form of an accounting model. The data can be prepared either by using the drop-down menus in columns A-D and adding values to column E, or by preparing the data in another file and copying and pasting the data into this sheet.

IDs in column A can be selected from a drop-down menu that is made up of all DSR units that are listed in the DSR tab. The PECD Zone associated with the DSR unit can be selected in column B. The Attribute that is to be added can be selected in column C. The Year that is to be added can be selected in column D. Finally, the value associated with the specific unit, Attribute and Year can be added in column E.

Trajectory data **will not be linearly interpolated**. Values that are provided for a specific year will be held constant for all future years, unless data related to a future year is added.

6.8.3 DSR Pivot

Summary of DSR Trajectories Sheet

6.9 Trajectory Technologies

This sheet has the main objective of reflecting uncertainties in developments in the market node. For each attribute, lower and higher bounds of capacity can be reported. Detailed description how those sheets should be found by the WG Scenario Building guidelines. (link provided in ch.2)

7 PACKAGE “RENEWABLES”

7.1 “Renewables” sheet

7.1.1 Onshore_Technology and Offshore_Technology Sheets

These sheets show the evolution of different onshore and offshore technologies over the coming years for each PECD zone. The values are ratios and the sum of values for each year should be 1.

These sheets are pre-filled with assumed values. These can be retained or updated.

Ratios refer to the mix of capacity increment over that year. Actually it is a mix over the previous year (i.e. 2021 capacity mix is valid for all wind additions from 1 January 2020 until 31 December 2020).

Example Ratio (provided by TSOs)

TECH\YEAR	2020	2021	2022
EXISTING	1	0	0
A	0	1	0
B	0	0	1

Example capacities:

TECH\YEAR	2020	2021	2022
TOTAL CAPACITY (PROVIDED BY TSOS)	10	11	11
EXISTING (COMPUTED BY US)	10	10	10
A (COMPUTED BY US)	0	1	1
B (COMPUTED BY US)	0	0	0

Using these capacities of individual technologies we create PECD files – a single file for onshore wind and a single file for offshore.

The following [link](#) give more information the technologies used in the these sheets. A list of technologies and explanations can be found in the file, and the screenshot from the linked document below

Energy variable	CSPs with thermal storage capacity factor time series – dispatched • 2025 • 2030	ERAA 2021, TYNDP 2022, SB 2022, Winter Outlook 2021/2022	zones to Study zones (according to capacities in PEMMDBs) This data assumes dispatch of CSPs as soon as possible.
	Offshore wind time series – raw technology data ² • Existing technology • SP316-HH155 • SP370-HH155	SB 2022 (top down scenarios)	Each technology is considered as a candidate for investment. Existing technology – considers all available wind farms in a given PECD zone.
	Onshore wind time series – raw technology data • Existing technology • SP199 x (HH100; HH150; HH200) • SP277 x (HH100; HH150; HH200) • SP335 x (HH100; HH150; HH200)	SB 2022 (top down scenarios)	In total time series for 10 technologies are available. Target year indicated in file name shows from which year technology distribution was taken from PEMMDB files to aggregate data on Study Zone level.
	Offshore wind time series – bottom up aggregation • 2025 • 2030	ERAA 2021; TYNDP 2022 Winter Outlook 2021/2022	Aggregation of technology specific time series. • SP316-HH155 is considered for new installations • HH increase does not improve generation
	Onshore wind time series – bottom up aggregation • 2025 • 2030	ERAA 2021; TYNDP 2022 Winter Outlook 2021/2022	Aggregation of technology specific time series. Strong

² SP is specific power (w/m²); HH is Hub-height (m).

7.2 “Other-RES hourly’ sheet

The Other-RES hourly worksheet contains the hourly ratio curves, which can be assigned to individual units and/or to aggregated capacity provided in the “... Evolution” sheets. The data provider should fill a separate column for each different hourly curve (cells between rows 11 to 8770). To reference the defined curve, the data provider should use a matching curve IDs in row 6 of this sheet and the Curve ID column in the Renewable Evolution sheet and/or in column ‘R’ of Renewables sheet.

To check whether the referencing is done right, the Cell in row 7 of the “Other RES hourly” sheet will change to “Referenced” if at least one matching ID can be found on the ‘Renewable’ or ‘Renewable Evolution’ sheet.

The defined curves can be referenced by more generating units.

The sheet also includes validity start and end year cells, to specify an interval of years, where the hourly curve should be considered.

The defined starting and end year is included in the validity interval. The same curve ID can be used more than once if the validity intervals are not overlapping, thus defining different hourly curves for different years.

The effective net output of a unit with defined hourly curve is its original net generating capacity multiplied by the ratio value of the given hour in the simulation.

7.3 “Zonal Wind”, “Zonal Solar” and “Zonal Other-RES” sheets

These three worksheets are meant as a summary and a help for TSOs while filling the “Renewables”, “Renewables Evolution” and “Wind Offshore Evolution” sheets. They will be filled in automatically from the data provided in these three sheets.

For each technology, the total capacity installed at market node level is specified. It corresponds to the sum of all plant-by-plant specified capacity and of the aggregated capacities recorded in “Renewables Evolution’ and ‘Wind Offshore Evolution’ sheets.

In “Zonal wind’ sheet, TSO are invited to indicated the ratio of the total amount of onshore and offshore wind capacity connected at DSO and TSO level (under 132kV or above 220kV)

7.4 “Hydro” sheet

7.5 “Zonal hydro” sheet

This worksheet is meant as a summary and an help for TSO while filling the “Hydro” and “Hydro Evolution” sheets. It will be filled in automatically from the data provided in these two sheets.

For each technology, the total capacity installed per PECD zone and Market node level is specified. It corresponds to the sum of all plant-by-plant specified capacity and of the aggregated capacity recorded in “Hydro Evolution’ sheet.

7.6 “Planned outage” sheet

For Renewables, this sheet may work mainly as reporting table and not necessarily directly implemented in Market Models – explicitly modelling such outages can lead to double counting as load factors, hourly output curves and hydro capacity constraints might already include outages.

In any case, below there is a description in case this sheet will be filled.

This worksheet contains the exact dates of planned outages – it can serve both short term and more long term studies. For each generating unit to be considered, represented by the unit ID and the generating unit name from the “thermal” sheet, several planned outage windows can be specified. The format of the date should be dd/mm/yyyy in a TEXT cell format.

For each planned outage, the ration of capacity on outage can be provided. A ratio of 1 mean that all that the capacity is on maintenance. If the cell is left empty, it will be a ratio of 1 will assumed.

Reason of the outage can be selected in column E for further explanation.

It is possible to set entire maintenance profiles by reporting each individual outage using as many rows as necessary. It is also possible to report outages of some units only, meaning a partial maintenance profile of the generation fleet.

In column J, it shall be defined if the maintenances provided should be taken into account for the maintenance profile of the market node for each target year in its entirety, partially, or not at all.

In case TRUE is selected for a target year (e.g. 2025) it means market modelling will read all outages set for 2025 from this table and will consider this as the maintenance profile for the market node. Optimisation of outages based data provided in Thermal sheet WILL NOT BE DONE.

In case FALSE is selected for a target year, the maintenance profile will be generated in the maintenance optimisation process using the data provided in Thermal sheet. In this case, it is not necessary to report any outage in this sheet for that particular year.

In case PARTIAL is selected, the outages provided in this sheet will be considered and optimisation will be done only for units that don't have outages defined here.

7.7 “Trajectories-RES” sheet

This sheet has the main objective of reflecting uncertainties in the development of the generation fleet in the market node. For each technology type, lower and higher bounds of capacity for each renewable type can be defined. Detailed description how those sheets should be found by the WG Scenario Building guidelines. (link provided in ch.2)

7.8 “Trajectories-Hydro” sheet

This sheet has the main objective of reflecting uncertainties in the development of the generation fleet in the market node. For each technology type, lower and higher bounds of capacity for each renewable type can be defined. Detailed description how those sheets should be found by the WG Scenario Building guidelines. (link provided in ch.2)

7.9 “Capacity Expansion (RES)” sheet

For the development of the top-down scenarios restrictions must be put in place so that too much RES does not get built at any market node (e.g. installing 1000 GW of Solar PV in a small island). The following information is therefore collected for Onshore/ Offshore Wind, Solar PV/Thermal per sub-zone:

1. Total National Technical Potential (MW)
2. Public reference/study used (if any)

Total National Technical Potential (MW)

The *Total National Technical Potential* represents the upper limit of what could be produced from a certain energy resource from a theoretical point of-view, based on current scientific and system knowledge. The estimation may consider such factors as efficiencies of conversion, expected wind speeds, and overall technical limitations e.g. topographic limitations, environmental, and land-use constraints as well as the availability of

raw materials. Some suggested sources of data for European countries are as follows:

- [RE-SHAPING project](#)
- [GreenNet-Europe](#)
- [E-Highway 2050](#)
- [MED-CSP report](#) on CSP and other RES
- [EEA technical report](#) on wind energy

8 NTC

For HVAC and HVDC sheets, forced outage rates, number of weeks in maintenance and number of poles are included in this data collection. Please fill in these values, otherwise they will be automatically filled with default values.

8.1 Process

- TSOs will be asked to fill in the template with their best estimate/ best forecast (neither conservative nor optimistic) consulting the list of projects above as well as the NTC values that were used in ERAA 2020
- An additional constraint will possibly be imposed by TSOs referring to the max imports, exports, and net balance (optional).

8.1.1 Data collected in the Max limit sheets

For the “Max limitation” sheet we expect to provide data related to the limitations on country level.

An example on limitations can be found below:

Let's suppose we have country A connected to B and C via NTC connections eg A-B =1000MW and A-C = 1000MW

The theoretical MAX total simultaneous export/import can be 1000MW + 1000MW = 2000MW. However, it might not be possible to have the two NTC links at full export simultaneously so the 'Gross Export limitation' $B \rightarrow A + C \rightarrow A$ can be less, let's say 1800MW. This is the maximum simultaneous Export that B/C are able to provide simultaneously and together to A. Furthermore there might be a second limitation on how much A can actually import $B + C \rightarrow A$ which could still be less than the 'Gross Import limitation' since country A cannot manage import levels higher than 'Country position net Imp. Limit'. The latter is typically related to the minimum amount of inertia that country A needs to maintain i.e., minimum number of units running (spinning) in their system for the system to be operationally stable & running within operational safe levels.

8.2 Maintenance

- Planned maintenance is difficult to optimize and does not only depend on demand.
- TSOs are asked to anticipate planned maintenance in the provided data and explain how these periods were determined. The assumptions used to forecast planned maintenance should also be noted.

- Every constraint that affects cross-border available capacity should be considered in the provided data
- 70% compliant values shall be provided – this applies to hours that there is no maintenance.

8.3 Coordination

TSOs are asked to coordinate NTC values with any other interconnected TSOs

Once the data collection has closed, the ENTSO-E Data and Models Team (D&M) will identify any time periods in which there are differences between the NTC data provided by two interconnected TSOs. D&M will ask the TSOs to validate data related to these time periods. In cases where the NTC profiles from two TSOs sharing an interconnection do not align, the profile with the lowest average NTC will be used.

9 Hydro Inflow

Hydro inflow files are practically the same as in the previous data collections. The main difference is that the inflows for the technology types Run of River (fuel type 30) and Pondage (fuel type 43) are to be provided in two separate sheets.

Additionally, the meaning of Minimum/Maximum Reservoir level has been clarified: The “historical” columns refer to historic constraints and can be entered CY by CY. The “technical columns refer to technical constraints and can only be entered as uniform constraints.

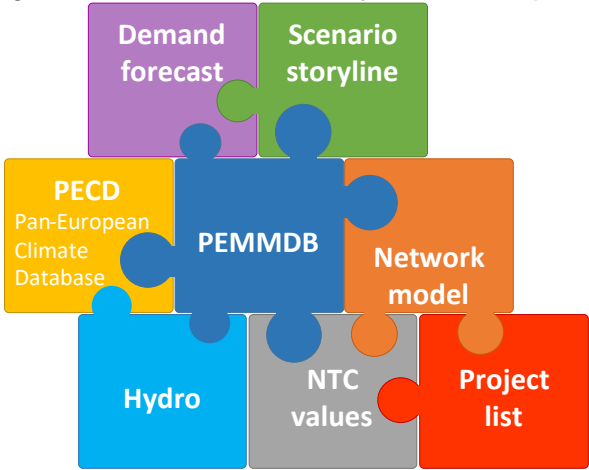
All data previously available has been kept in the file. TSO are advised to check, and make updates only if/where necessary.

As an enhancement to hydro modelling, once new capacities for Hydro are given at the end of the data collection, ENTSO-E will centrally propose (TSO can directly provide those as well) different Hydro_Inflow files for each target year to better account the energy contribution coming from new plants being added to the fleet. This will be done by simple rescaling of the existing dataset.

TSO will have the opportunity to check and amend whatever necessary.

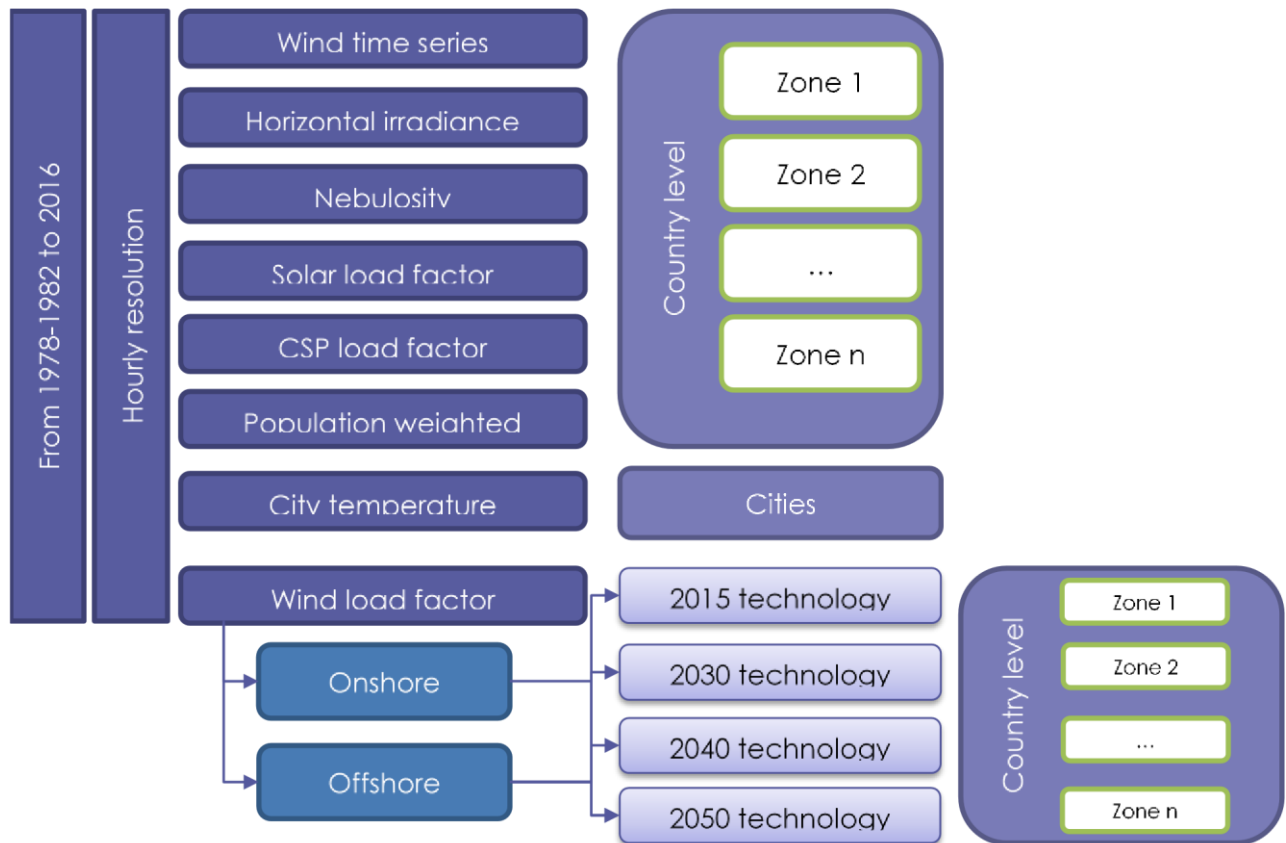
10 PECD – PAN-EUROPEAN CLIMATE DATABASE

PECD is centrally procured database which is not object of this data collections. However, this data has a strong link with PEMMDB and System development studies.



10.1 Overview of current PECD

PECD contains data packages with hourly time series from 1982 to 2016. Geographical scope covers all studied countries and contains more detailed information on zones in the countries. Furthermore, Wind Generation technology evolution is considered and 4 different times series are available representing unique wind technology states (today, 2030, 2040, 2050). This is summarized in following figure:

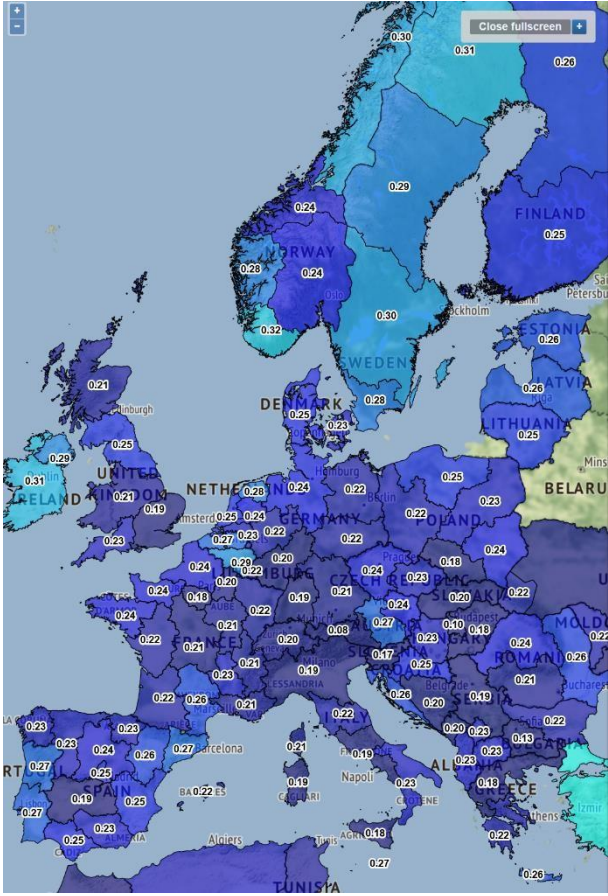


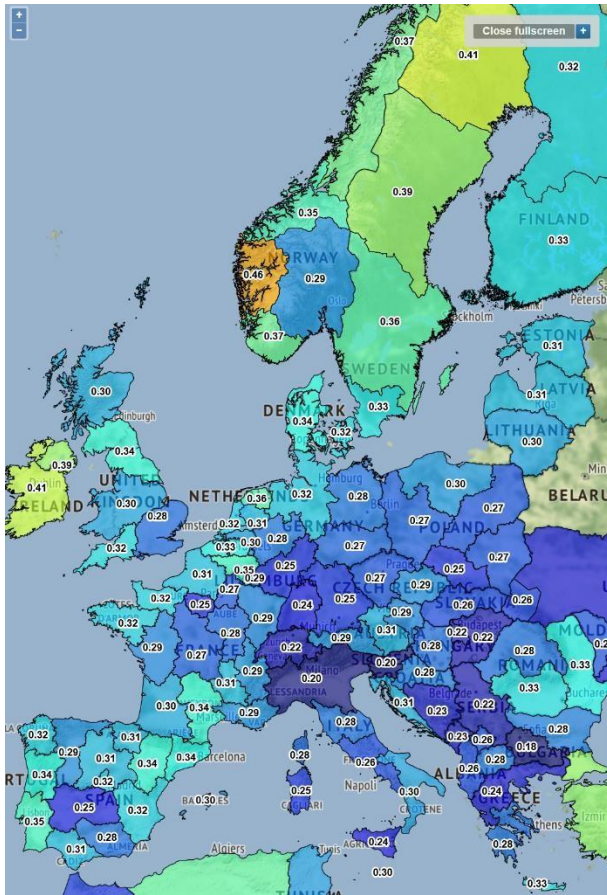
Recent achievements lead to major improvement of Wind package in PECD. Time series were adjusted because of updated assumptions as well as more detailed calibration data.

The update affected following:

- Wind time series with current technology
- Wind time series with 2030 technology •
- Wind time series with 2050 technology

Wind time series with 2040





Onshore Wind Capacity factors: present and 2030

10.2 Hydrological Database

11 MISSING DATA

If a TSO has difficulty in retrieving requested data, assistance can be requested from the secretariat. Delays or difficulties should be indicated to the secretariat as early as possible.

If there are missing data after the final database freeze, these data will be prepared by PEMMDB project team, based on generic assumptions and earlier available data.

12 CONFIDENTIALITY OF DATA IN MMD

The data in the PEMMDB are confidential, only for TSO use, and should not be disclosed to other parties, unless the data have already been made public through ENTSO-E reports and unless a legal framework (e.g. NDA) is in place. However, results of market studies using the PEMMDB data can be published.

There is ongoing work to set a simplified framework for possible publication of input datasets as well as disclosure to external parties under predefined and agreed conditions between all TSO and ENTSO-E. This work is being carried out under WG Data & Models framework, regularly reported to SDC, and will receive support from LRG (Legal Regulatory Group).

13 APPENDIX – HOW TO?

13.1 How do I fill in Data in the Accounting Model

Data for DSR Trajectories is to be added in the form of an accounting model. Accounting models allow for a simpler representation of complex, multi-dimensional data. New data fields, (which would typically be represented by new columns) and dimensions can be added by simply appending additional rows, rather than having to modify the structure of the table.

Below is an example of data added into the accounting model for DSR Trajectories:

ENTSO-E Market Modelling Database: Demand Side Response

Include here only Market Response (user not willing to pay more than 'Activation price')

ID	Zone	Attribute	Year	Value
DSR6	AL00	DAY AHEAD - Activation price for demand reduction (EUR/MWh)	2020	1
DSR6	AL00	DAY AHEAD - Activation price for demand reduction (EUR/MWh)	2021	5
DSR6	AL00	DAY AHEAD - Activation price for demand reduction (EUR/MWh)	2022	2
DSR6	AL00	DAY AHEAD - Activation price for demand reduction (EUR/MWh)	2023	5
DSR6	AL00	DAY AHEAD - Activation price for demand reduction (EUR/MWh)	2024	2
DSR6	AL00	DAY AHEAD - Activation price for demand reduction (EUR/MWh)	2025	5
DSR6	AL00	Max hours to be used per day	2020	11
DSR6	AL00	Max hours to be used per day	2021	12
DSR6	AL00	Max hours to be used per day	2022	13
DSR6	AL00	Max hours to be used per day	2023	14
DSR6	AL00	Max hours to be used per day	2024	15
DSR6	AL00	Max hours to be used per day	2025	16
DSR3	AL00	DAY AHEAD - Activation price for demand reduction (EUR/MWh)	2020	3
DSR3	AL00	DAY AHEAD - Activation price for demand reduction (EUR/MWh)	2021	4
DSR3	AL00	DAY AHEAD - Activation price for demand reduction (EUR/MWh)	2022	3
DSR3	AL00	DAY AHEAD - Activation price for demand reduction (EUR/MWh)	2023	3
DSR3	AL00	DAY AHEAD - Activation price for demand reduction (EUR/MWh)	2024	4
DSR3	AL00	DAY AHEAD - Activation price for demand reduction (EUR/MWh)	2025	45
DSR3	AL00	Max hours to be used per day	2020	56
DSR3	AL00	Max hours to be used per day	2021	4
DSR3	AL00	Max hours to be used per day	2022	45
DSR3	AL00	Max hours to be used per day	2023	5
DSR3	AL00	Max hours to be used per day	2024	4
DSR3	AL00	Max hours to be used per day	2025	4

In this example, the “Value” fields for the “Max hours to be used per day” and the “DAY AHEAD - Activation price for demand reduction (EUR/MWh)” attributes are populated for the years 2020-2025 for two DSR units, called DSR6 and DSR3.

This data can also be represented as a pivot table in which values for all DSRs (in our example, there are only 2: DSR3 and DSR6) are summed and there is a column for each of the Attributes, as shown below:

Sum of Value		Attribute	
Year	Zone	DAY AHEAD - Activation price for demand reduction (EUR/MWh)	Max hours to be used per day
2020	AL00		4
2021	AL00		9
2022	AL00		5
2023	AL00		8
2024	AL00		6
2025	AL00		50

The data for the DSR Trajectories sheet can be prepared either by using the drop-down menus in columns A-D and adding values to column E, or by preparing the data in another file and copying and pasting the data into this sheet

IDs in column A can be selected from a drop-down menu that is made up of all DSR units that are listed in the DSR tab. The PECD Zone associated with the DSR unit can be selected in column B. The Attribute that is to be added can be selected in column C. The Year that is to be added can be selected in column D. Finally, the value associated with the specific unit, Attribute and Year can be added in column E.

Trajectory data **will not be linearly interpolated**. Values that are provided for a specific year will be held constant for all future years, unless data related to a future year is added.

13.2 Example Specification of Unit Groups

For defining constraints related to more than one generating unit a set of units can be grouped together by setting the Group Name attribute of generating units to the same value (i.e. Example Group 1) on the Thermal sheet.

7	Referencing (& li			
8	Unit ID	Group name	Generating unit name	G u
9	chosen ID not to be changed later for the same unit	can be Plant, owner, technology, or any other hierarchy level to act as a basis for Derating, Must-run and/or maintenance rules	(under power plant)	u ea
10				
11	string (35)	string (30)	string (30)	
12	generated, unique		unique per market node	st
13	BG00-Unit P1A	Example Group 1	Unit P1A	-6
14	BG00-Unit P1B	Example Group 1	Unit P1B	-c
15	BG00-Unit P1C	Example Group 1	Unit P1C	-0
16	BG00-Unit PP1		Unit PP1	-7
17	BG00-			

With the Group Names set, the following attributes will affect the modelling of these units:

- Group based derating curve ID
- Group based must-run curve ID
- Maximum number of units on maintenance in the group

These parameters have to be set to the same value for each unit in the group also, in order to be consistent and usable during the simulations.

13.3 Example Specification of Must-Run or Derating Obligations

The Thermal sheet includes attributes, which are only linking to data sets collected in separate sheets:

- Group based derating curve ID linking to Group Derating sheet
- Generating unit based derating curve ID linking to Derating sheet
- Group based must-run curve ID linking to Group Must-run sheet
- Generating unit based must-run curve ID linking to Must-run sheet

The linking must be done by the TSO by providing the same curve ID on the Thermal sheet and the specific sheet. For Group based curve IDs, all the rows in the same generating unit group have to be the same (i.e. "GDR Curve 1").

	Referencing (t)				Main techn		
	Unit ID	Group name	Generating unit name	Net maximum generating capacity (MW)	Net minimum stable generation (MW)	Group based derating curve ID	Generating unit based derating curve ID
	chosen ID not to be changed later for the same unit	can be Plant, owner, technology, or any other hierarchy level to act as a basis for Derating, Must-run and/or maintenance rules	(under power plant)	Available on the market		ID chosen on the Group Derating sheet (if provided)	ID chosen on the Derating sheet (if provided)
	string (35)	string (30)	string (30)	float	float	string (25)	string (25)
	generated, unique		unique per market node	0<=x	0<=x	reference	reference
	BG00-Unit P1A	Example Group 1	Unit P1A	440.0	125.0	GDR Curve 1	DR Curve 1
	BG00-Unit P1B	Example Group 1	Unit P1B	220.0	87.0	GDR Curve 1	
	BG00-Unit P1C	Example Group 1	Unit P1C	115.0	65.0	GDR Curve 1	
	BG00-Unit PP1		Unit PP1	380.0	120.0		
	BG00						

The same curve ID has to be set in at least one of the columns in the specific linked sheet. In the example: Group Derating sheet.

9				Curve ID	GDR Curve 1	GDR Curve 2	
10				Curve ID check	Referenced	Not referenced	Not r
11				Validity starting year (including this year)			
12				Validity ending year (including this year)			
13	Week	Month	Date	Hour	Derating ratio	Derating ratio	Dera
14	1	1	01.01.	1	0.98	0.97	
15	1	1	01.01.	2	0.98	0.97	
16	1	1	01.01.	3	0.98	0.97	
17	1	1	01.01.	4	0.98	0.97	

The Curve ID check Cell indicates that the curve ID is used in the Thermal sheet also. With no validity years provided, the curve will be used for all the simulations in the scenario regardless of the study year.

By providing the curve ID again in the other columns, different curves can be assumed for different study years. In this case the validity intervals shouldn't overlap.

9				Curve ID	GDR Curve 1	GDR Curve 1	
10				Curve ID check	Referenced	Referenced	Not r
11				Validity starting year (including this year)	2018	2021	
12				Validity ending year (including this year)	2020	2025	
13	Week	Month	Date	Hour	Derating ratio	Derating ratio	Dera
14	1	1	01.01.	1	0.98	0.97	
15	1	1	01.01.	2	0.98	0.97	
16	1	1	01.01.	3	0.98	0.97	
17	1	1	01.01.	4	0.98	0.97	

In the example the whole unit group linked to "GDR Curve 1" will be derated to 98% from 2018-2020, and to 97% from 2021 to 2025 (including the ending years also).

A defined curve on a specific sheet can be linked to several grouped or individual units on the Thermal sheet if it is intended to model them with the same curve. This will not create any links between these units, only the same values will be used to set the derating or must-run constraints in the market model.

The reason to apply this approach was to separate hourly data from the rows in the Thermal sheet and save on the template's size if more units (or unit groups) can be modelled with same hourly derating/must-run curve.

For Group Must-run definition, a small enhancement was made to the template. Now as well as defining the must run ratio, it can be defined in parallel the number of units to allocate this must-run obligation. The timeseries go in pairs, defining ratio and number of units for each group.

Please use matching curve name for all units under the same plant in the Thermal sheet in column "Group based must-run curve ID".

Curve ID				curve01	curve01	curve02	curve02
Curve ID check				Referenced	Referenced	Referenced	Referenced
Validity starting year (including this year)					0		0
Validity ending year (including this year)					0		0
Reason for must-run (free text)							
Week	Month	Date	Hour	Must run ratio	Number of Units to allocate Must-Run	Must run ratio	Number of Units to allocate Must-Run
1	1	01.01.	1	0,55	2,00	0,70	3,00
1	1	01.01.	2	0,55	2,00	0,70	3,00
1	1	01.01.	3	0,55	2,00	0,70	3,00
1	1	01.01.	4	0,55	2,00	0,70	3,00
1	1	01.01.	5	0,55	2,00	0,70	3,00
1	1	01.01.	6	0,55	2,00	0,70	3,00
1	1	01.01.	7	0,55	2,00	0,70	3,00
1	1	01.01.	8	0,55	2,00	0,70	3,00
1	1	01.01.	9	0,55	2,00	0,70	3,00

13.4 What if I need to change “Operational Status” of a unit at a future date? (or any other attribute which is static in the template)

In this case, the unit should be decommissioned and a new unit created in a different row with the new “Operational Status”.

Referencing (& link with network)		Dates and status					IE
Generating unit name	Commissioning date	Decommissioning date, official	Decommissioning date, expected	Decommissioning reason	Operational Status		
(under power plant)	Date format, empty cell: considered as available for all time horizons before decommissioning date(s)	Date format, empty cell: considered as available for all time horizons after commissioning date	Date format	Political reasons, phase-outs etc.	To distinguish between "available in the market" and "out of market - strategic reserve" default value: Available on the market	Indus LCP: BAT: LLD: Lit Defau	
string (30)	date (dd/mm/yyyy)	date (dd/mm/yyyy)	date (dd/mm/yyyy)	string (100)	string		
unique per market node	between 1900 and 2100	between 1900 and 2100	between 1900 and 2100	free text	selectable		
Unit A	01/01/1975	31/12/2024			Available on market		
Unit A - New op. status	01/01/2025	01/01/2100			Out of market/Contracted to provide o		

13.5 How to define Min and Max units number of units for maintenance optimisation?

You need to define a Group in Thermal sheet. The same name of this group needs to be put in “Max Unit Maint.” Sheet row 6 to correctly reference (checked and indicated automatically in row 7). Timeseries go in pairs, to define Maximum and Minimum number of units on maintenance per week.

same is provided in a column, empty cells for weekly values will mean no restriction

Referencing (& link with network)		Group name	Generating unit name	Su
Can be Plant, owner, technology, or any other hierarchy level to act as a basis for Derating, Must-run and/or maintenance rules		(under power plant)		Na
string (30)		string (30)		CG
unique per market node				
Group01	Unit A			
Group01	Unit B			
Group01	Unit C			
Group01	Unit D			
Group01	Unit E			
Group01	Unit F			
Group01	Unit G			

Group name	Group01	Group01	
Group check	Referenced	Referenced	Not refe
starting year (including this year)	2020	2020	
ending year (including this year)	2035	2035	
Week	Max. Number of units on maintenance	Minimum Number of units on Maintenance	Max. N of uni mainte
1	1	0	
2	1	0	
3	1	0	
4	1	1	
5	1	1	
6	2	1	
7	2	1	
8	2	1	
9	2	1	
10	3	2	
11	5	2	
12	5	2	

13.6 What if I want to provide my own maintenance profile for year 2025?

You have to fill the “Planned Outage” sheet with all the maintenances to be modelled and set column J as TRUE for year 2025. In this case, only the outages given in this sheet will be modelled for this Market Node – the data given in ‘Thermal’ sheet columns AP – AW will not be considered to generate/optimize planned outages.

All "ratio" type values (if provided) must be greater or equal to zero and lower or equal to 1.0

Generating unit name	Exact starting date of Planned Outage	Exact starting hour of Planned Outage	Exact end date of Planned Outage	Exact end hour of Planned Outage	Ratio of capacity on outage	Reason for Outage	Model maintenance profile from
(under power plant)	Transparency platform format/compliant		Transparency platform format/compliant	Transparency platform format/compliant	empty cell: 1 - all capacity out on maintenance		empty cell: FALSE
string (30)	date	hour	date	hour	float	string (40)	boolean
unique per market node	dd/mm/yyyy	hh:mm	dd/mm/yyyy	hh:mm	0<=x<=1.0	Selectable	Selectable
jnit A	01/02/2025	08:00	05/02/2025	22:00	1	Maintenance	2020 FALSE
jnit A	13/05/2025	07:00	03/07/2025	15:00	1	Maintenance	2021 FALSE
jnit C	07/03/2025	05:00	04/04/2025	21:00	1	Maintenance	2022 FALSE
jnit B	21/02/2025	08:00	06/03/2025	11:00	1	Maintenance	2023 FALSE
jnit E	02/09/2025	07:00	08/09/2025	22:00	1	Maintenance	2024 FALSE
jnit F	01/01/2025	05:00	05/09/2025	15:00	1	Mothballing	2025 TRUE
jnit G	27/07/2025	10:00	05/08/2025	21:00	1	Maintenance	2026
jnit D	03/10/2025	13:00	05/10/2025	11:00	1	Maintenance	2027
							2028

13.7 What if I want to provide exact outage dates for only some units in 2025 and generate/optimize the planned outages for the other units?

This is extremely similar to the full maintenance profile described above.

Set all individual outages for the units you wish to be considered, the difference is that column J should be set as **PARTIAL** instead of TRUE. Units that have outages reported in the sheet will not be considered when generating/optimizing maintenance. All other units will have their maintenances generated/optimized based on the data given in ‘Thermal’ sheet columns AP – AW.

13.8 How do I fill the ‘Renewables’ file? What is extremely important and what not so much?

The logic of this sheet is very similar to the well-known Thermal sheet, but for Renewables data should be provided **Plant-by-Plant** and not unit-by-unit.

The most important points are:

1. This data collection has ERAA as the first client to be served. It is not planned for the foreseeable future to model RES as individual plants in ERAA, so RES capacities could be provided only in aggregated form using the "...Evolution" sheets and the 'Renewables' sheet empty.
2. For all units (except Wind and Solar types) reported in "Renewables" sheet, a Curve ID (column 'R') must be defined and a timeseries provided in 'Other RES hourly' sheet. Many units can use the same timeseries, so there is no need for unique curves – this will limit the efforts needed by Correspondents to provide the output profile of renewable plants.
3. PECD Zone is also a must. The Summary sheets (Zonal Wind, Zonal Solar, Zonal Other RES) sum for each PECD zone all the capacity reported in 'Renewables' sheet, 'Renewables Evolution' and 'Wind Offshore Evolution'. If no PECD zone is selected, this capacity will be missing in the summary.
4. All capacity not reported individually in 'Renewables' sheet must be reported in the "... Evolution" sheet. Always check the summary sheets (Zonal Wind, Zonal Solar, Zonal Other RES) to be sure the capacities provided individually and in "... Evolution" add up to the expected value.
5. The way of reporting Hydro follows essentially the same logic explained for RES – Capacity being reported plant-by-plant (unit-by-unit in some cases) and in "Hydro_Evolution" sheet per PECD Zone (PECD attribute must be filled!!!). It is important to check the summary sheet (Zonal Hydro) to ensure capacities add-up to the expected value.
6. Hydro reservoirs are now worked on as separate objects, in "Hydro_Reservoirs" sheet. PECD and Technology data must be filled as it is needed for the summary sheet to work. The link between reservoir and plants is done by using the reservoir name in 'Hydro' sheet column 'V'.