Climate Change

Introduction to the requirements for the ENTSO-E's Pan-European Climate Database

Energy Seminar

C3S Enhanced Operational European Service in Support to ENTSO-E

PROGRAMME OF THE EUROPEAN UNION

Copernicus Europe's eyes on Earth

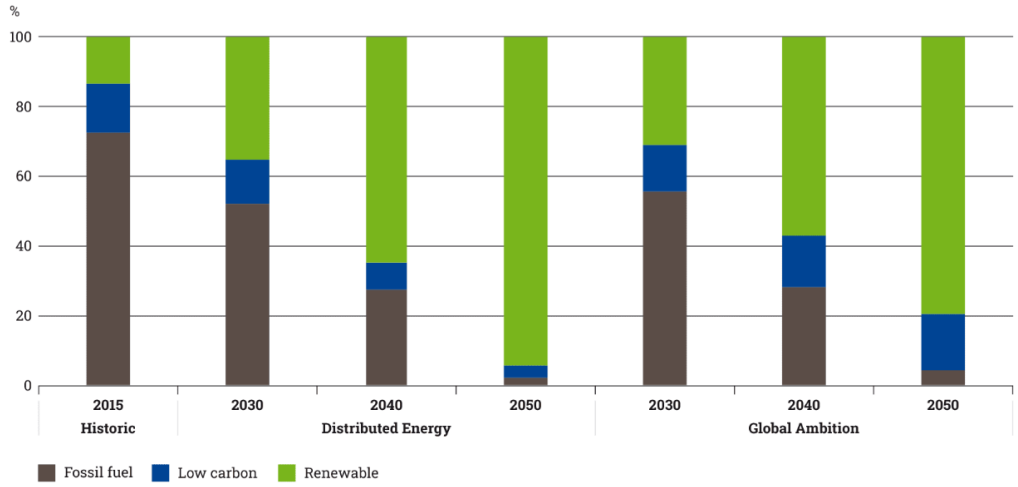
IMPLEMENTED BY ECMWF

ICS Inside Climate Service

Climate Change

ENTSO-E Mission

Ensuring the security of the interconnected power system in all time frames at pan-European level and the optimal functioning and development of the European interconnected electricity markets, while enabling the integration of electricity generated from ***renewable energy sources*** *and of emerging technologies* *(Source: ENTSO-E)*



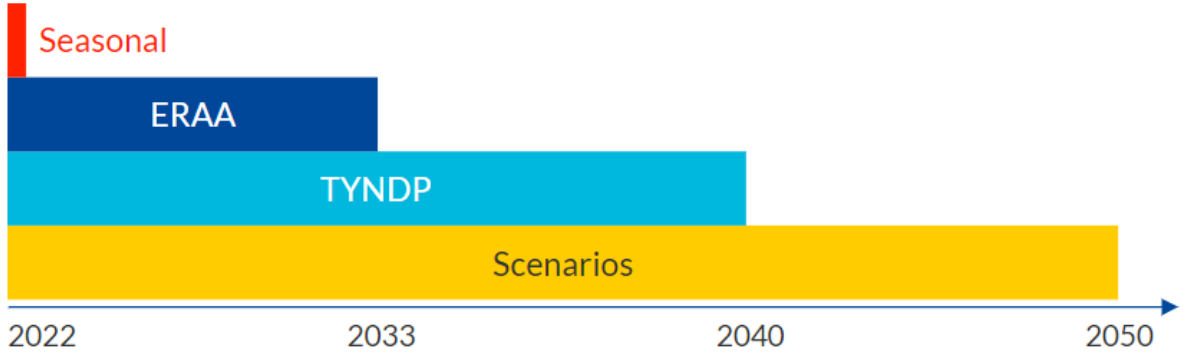
Share of fossil, low carbon and renewable energy in the primary energy supply mix per technology, scenario and target year (Fig. 20, TYNDP 2022)

PROGRAMME OF THE EUROPEAN UNION
Copernicus Europe's eyes on Earth
IMPLEMENTED BY ECMWF
ICS Inside Climate Service

Climate Change

ENTSO-E Legally Mandated Outlooks

To ensure the optimal functioning and development of the European interconnected electricity markets, ENTSO-E is legally mandated to periodically deliver pan-European outlooks of the power system in the short-, mid-, and long-term



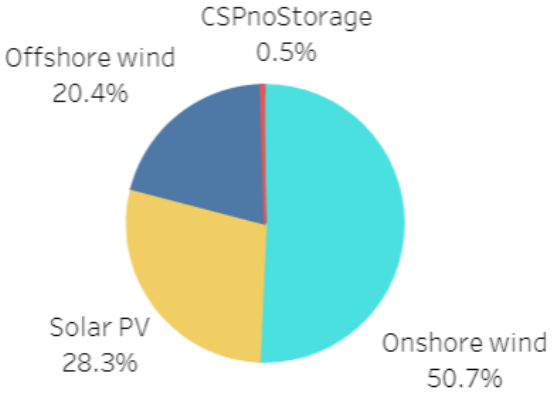
Source: ENTSO-E

PROGRAMME OF THE EUROPEAN UNION
Copernicus Europe's eyes on Earth
IMPLEMENTED BY ECMWF
ICS Inside Climate Service

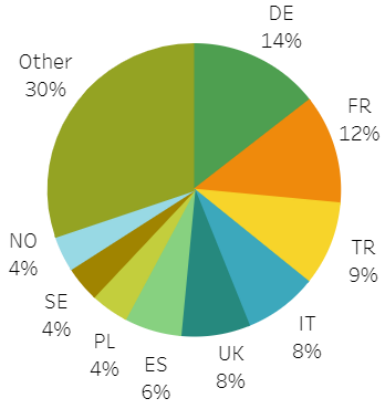
Climate Change

Climate data relevance for ENTSO-E outlooks

Accurate estimations of the system adequacy and of the benefits in social welfare deriving from investments need to account for **uncertain climate conditions** and their impact on **RES power generation** and **demand**



PECD available RES energy averaged per CY and TY (Inputs, ERAA 2022)

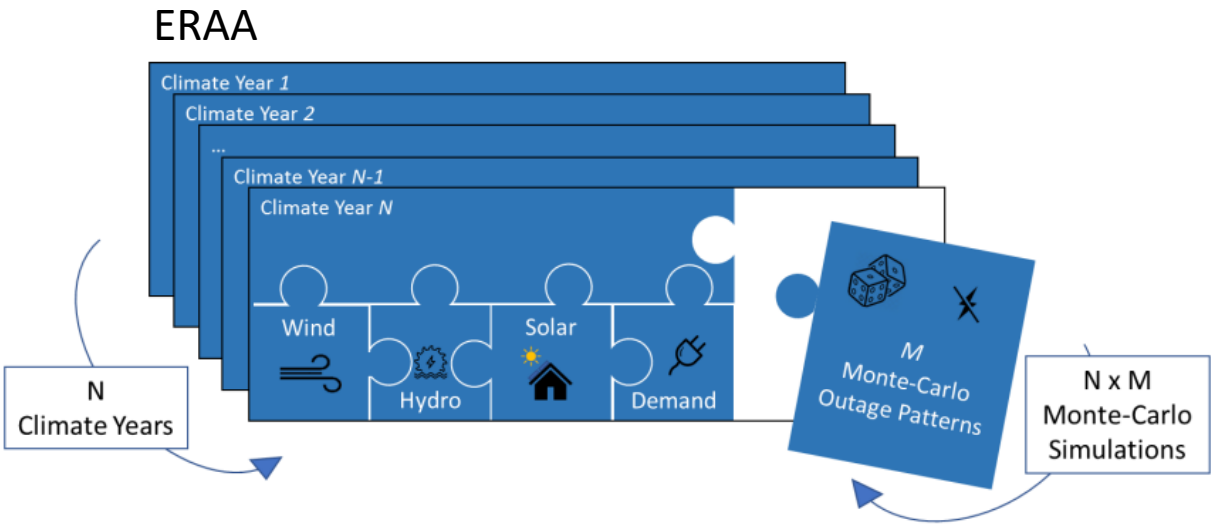


Yearly Demand share per country averaged per CY and TY (Inputs, ERAA 2022)

PROGRAMME OF THE EUROPEAN UNION
Copernicus Europe's eyes on Earth
IMPLEMENTED BY ECMWF
ICS Inside Climate Service

Climate Change

Climate data infeed into ENTSO-E outlooks



Monte Carlo simulation principles for a given target year. Source: ENTSO-E (2022 ERAA Methodology Report, Fig. 18)

PROGRAMME OF THE EUROPEAN UNION
Copernicus Europe's eyes on Earth
IMPLEMENTED BY ECMWF
ICS Inside Climate Service

Climate Change

Climate data infeed into ENTSO-E outlooks

EVA (ERAA)

- Computation time constraints
- Representativeness of the climatic variability

↓

Calculation of a ‘distance’ value (in terms of system cost) between each CY, clustering of the closest CYs

↓

Selection the CYs with the **most mutually acceptable expansion plans**

TYNDP

- Computation time constraints
- Representativeness of the climatic variability

↓

Definition of residual load to capture the temporal and spatial variability of the system due to climatic conditions

↓

Selection of the **most representative combination** of three years

PROGRAMME OF THE EUROPEAN UNION

Copernicus Europe's eyes on Earth

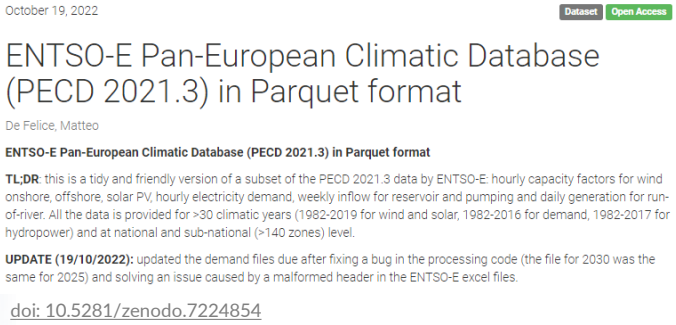
IMPLEMENTED BY ECMWF

ICS Inside Climate Service

Climate Change

PECDv3.1 – Historic climate conditions limitation

The Pan-European Climate Database (PECD) fulfils the needs of ENTSO-E study teams for climate data. However, this dataset relies solely on data representing **KNOWN** climate conditions



October 19, 2022

Dataset | Open Access

ENTSO-E Pan-European Climatic Database (PECD 2021.3) in Parquet format

De Felice, Matteo

ENTSO-E Pan-European Climatic Database (PECD 2021.3) in Parquet format

TL;DR: this is a tidy and friendly version of a subset of the PECD 2021.3 data by ENTSO-E: hourly capacity factors for wind onshore, offshore, solar PV, hourly electricity demand, weekly inflow for reservoir and pumping and daily generation for run-of-river. All the data is provided for >30 climatic years (1982-2019 for wind and solar, 1982-2016 for demand, 1982-2017 for hydropower) and at national and sub-national (>140 zones) level.

UPDATE (19/10/2022): updated the demand files due after fixing a bug in the processing code (the file for 2030 was the same for 2025) and solving an issue caused by a malformed header in the ENTSO-E excel files.

doi: 10.5281/zenodo.7224854

The current version (v3.1) of this database consists of climate timeseries

- at a spatial resolution defined by PECD zones
- covering a temporal horizon between 1982 and 2019
- originating from **historical (reanalysis) data** (i.e., wind speed, solar irradiance, temperature, etc.)
- including 1 solar PV, 2 CSP, 3 offshore wind and 10 onshore wind technologies

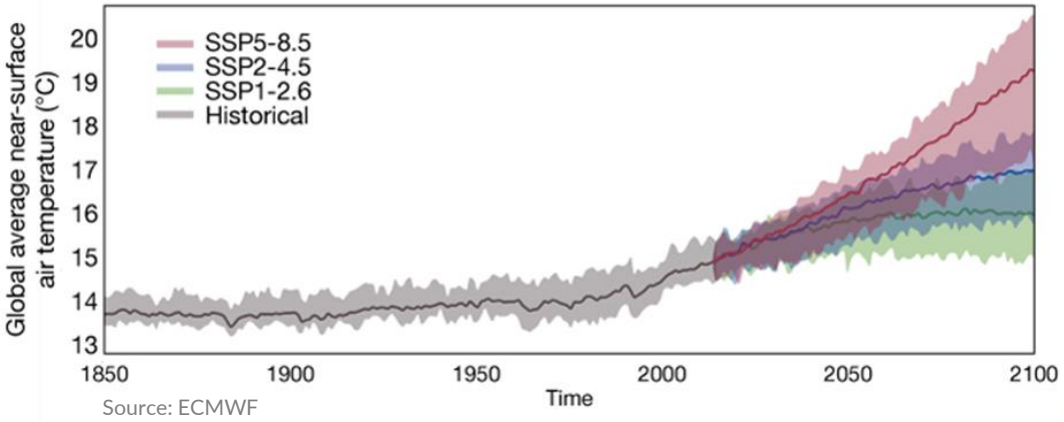
PROGRAMME OF THE EUROPEAN UNION | Copernicus Europe's eyes on Earth | IMPLEMENTED BY ECMWF | ICS Inside Climate Service

Climate Change

Need to account for climate change

*The standard climatology reference period of a 30-year period is deemed as sufficient to represent the mean climate, but is not sufficiently long to sample extreme events. It is therefore critical for adequacy purposes to aim for sufficiently long periods, which shall include sufficient **extreme events**.* (ERAA Methodology, 2022)

*The **frequency and intensity** of extreme events are **projected to increase** over the 21st century under all assessed emission scenarios.* (IPCC Report on Climate Change 2021)



Source: ECMWF

PROGRAMME OF THE EUROPEAN UNION
Copernicus Europe's eyes on Earth
IMPLEMENTED BY ECMWF
ICS Inside Climate Service

Climate Change

How to account for climate change?

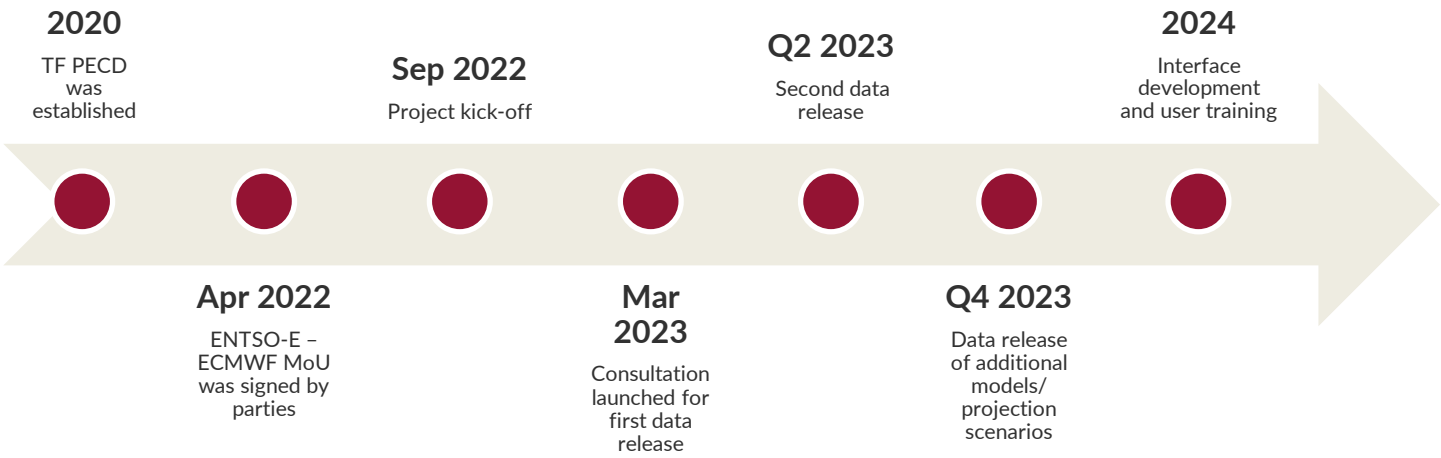
The development of PECDv4 was initiated following the requests – from NRAs and other stakeholders – to build a comprehensive meteorological database accounting for the **impacts of climate** to improve the quality and robustness of their studies

PECDv4 **scope**:

- to produce an open, extensive dataset of climate and energy variables replicating both historical and **projected climate conditions** (>10 different climate models & emission scenarios, based on EURO-CORDEX experiment and in line with IPCC's Assessment Report)
- to enhance the energy conversion models (e.g., more than one model for solar PV, improved hydro modelling)
- to improve the **flexibility** of the modelling solutions
- to provide data under **open-access** license, hosted on the Climate Data Store with a user interface that facilitates the use of the dataset

Climate Change

PECDv4 – Timeline



PROGRAMME OF THE EUROPEAN UNION
Copernicus Europe's eyes on Earth
IMPLEMENTED BY ECMWF
ICS Inside Climate Service

Climate Change

Thank you!

Questions? Reach out!

ilaria.federici@entsoe.eu

pecd@entsoe.eu

entsoe

PROGRAMME OF THE EUROPEAN UNION

Copernicus Europe's eyes on Earth

IMPLEMENTED BY ECMWF

ICS Inside Climate Service