



Climate Change

C3S Energy Seminar

Dr. Alberto Troccoli (ICS/WEMC)
Padova, 26 June 2023



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C3S Energy – Seminar - PART 1

Copernicus Climate Change Service (C3S) ENERGY SEMINAR 13:30 - 17:30 Monday 26 JUNE 2023

13:30 – 13:45	C3S Enhanced Operational Services for the Energy Sector <i>Introduction - Alberto Troccoli (ICS/WEMC)</i>
13:45 - 14:00	Copernicus Climate Change Service - Sam Almond (ECMWF) – remote
14:00 - 15:30	C3S Enhanced Operational Global Service for the Energy Sector – Global
14:00-14:15	Climate Data and Bias Adjustment - Letizia Lusito (ICS)
14:15-14:30	Global Energy Data - Elena Restivo (ICS)
14:30-14:45	Global Solar PV Indicator - Rodrigo Amaro e Silva (ARMINES)
14:45 – 15:00	Global Electricity Demand Indicator - Sylvie Parey (EDF)
15:00-15:30	Q&A and discussion
15:30 – 16:00	Coffee Break



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C3S Energy – Seminar – PART 2

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Copernicus Climate Change Service (C3S) ENERGY SEMINAR 13:30 - 17:30 Monday 26 JUNE 2023

16:00 - 17:30	C3S Enhanced Operational European Service in Support to ENTSO-E
16:00 - 16:15	Introduction to the requirements for the ENTSO-E's Pan-European Climate Database - <i>Ilaria Federici (ENTSO-E)</i>
16:15 - 16:30	European Hydropower Indicators for the PECD - <i>Giovanni Aldrigo (ICS)</i>
16:30 - 16:45	European Wind Power Indicators for the PECD - <i>Matti Juhani Koivisto (DTU) - remote</i>
16:45 - 17:00	European Solar Power Indicators for the PECD - <i>Rodrigo Amaro e Silva (ARMINES)</i>
17:00 - 17:25	Q&A and discussion
17:25 - 17:30	Summary, next steps and closing - <i>Alberto Troccoli (ICS/WEMC)</i>



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C3S Energy – Enhanced operational service for the Energy Sector

Lot 1 (Oct 2022—Sep 2025): Enhanced Energy Service, to produce operational high-quality global climate and energy indicators for the energy sector.

The **objectives** are:

- To deliver an enhanced operational energy service at the **global scale** extending the current operational service at the European scale and covering three streams: past climate, multi-model seasonal and projections
- To implement service fully based and running on the C3S Climate Data Store (CDS) infrastructure

Activities include:

- An increased temporal resolution of climate and/or energy indicator
- The development of enhanced toolbox applications, including for seasonal forecast
- The development of specific tools and continuous engagement with user communities through updated gap analysis and the development of case studies



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C3S Energy – Enhanced operational service for the Energy Sector

Lot 2 (Sep 2022—Aug 2025): Support to ENTSO-E in the preparation of the Pan-European Climate Database (PECD).

The **objectives** are:

- To provide support to ENTSO-E in the preparation of the PECD
- To engage with ENTSO-E to develop further service components, to provide specific consultation activities and support

Activities include:

- Delivering tailored climate and energy variables
- Building tools to aggregate the information over user relevant areas
- Delivering energy models through toolbox applications that run on CDS data
- Providing guidance through specific documentation and consultation activities, around C3S Energy products, to ENTSO-E and its members
- Further collecting of ENTSO-E requirements



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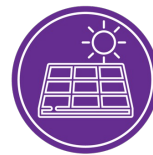
C3S Energy Indicators and Streams

Indicators



Conversion models
from climate variables
to energy indicators
(statistical & dynamical
models)

PV Solar power
generation



Wind power generation
(onshore and offshore)



Electricity Demand



Hydropower generation
(run-of-river and reservoir)



Streams

Historical

Seasonal Forecasts

Projections

2100

1979

Present +6 months



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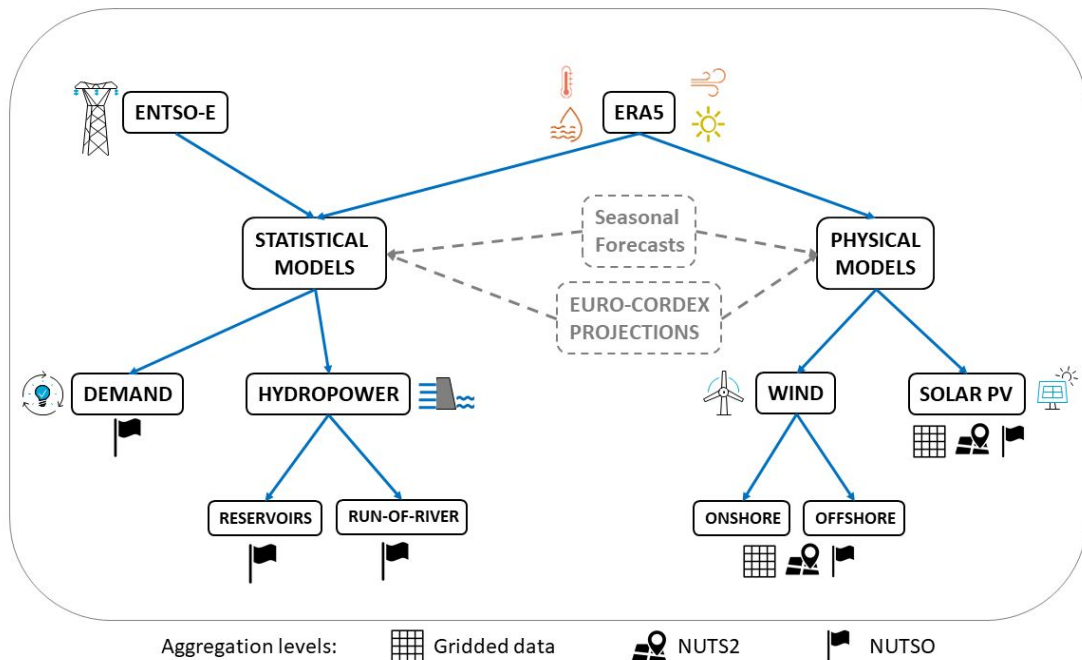


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C3S Energy Modelling Strategy

The energy conversion models are:

- Trained over the historical period, using measured data, esp. from ENTSO-E Transparency portal
- Applied to the seasonal forecast and projection streams, as well as back in time for historical
- Applied to any location in Europe even if no specific information is available (installed systems or time series of generation)



Dubus et al. (2023, to appear)

→ The flexibility of the conversion models is favoured over accuracy



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C3S Energy – Climate Indicators by Stream

Table 3: Summary of products to be delivered by C3S Energy. Note on abbreviations used in the Table: EC stands for ECMWF, MF for Météo-France, MO for Met Office, E-Cordex: Euro-Cordex, BA: Bias-Adjusted, C&C: Country and Cluster (the latter are sub-country regions/areas), B.o.: Based on.

Variable	Timescale	Source	Highest Temporal Resolution	Highest Spatial Resolution	Spatial Aggregation
CLIMATE INDICATORS					
Temperature	Historical	ERA5	1 hour	0.25 deg	C&C
	Seasonal	EC, MF, MO	1 day	1 deg	Country
	Projection	E-Cordex (BA)	3 hour	0.25 deg	C&C
Precipitation	Historical	ERA5	1 hour	0.25 deg	C&C
	Seasonal	EC, MF, MO	1 day	1 deg	Country
	Projection	E-Cordex (BA)	1 day	0.25 deg	C&C
Wind (10 m and 100 m)	Historical	ERA5	1 hour	0.25 deg	C&C
	Seasonal	EC, MF, MO	6 hours	1 deg	Country
	Projection	E-Cordex (BA)	3 hour	0.25 deg	C&C
Solar Radiation at surface	Historical	ERA5 (BA)	1 hour	0.25 deg	C&C
	Seasonal	EC, MF, MO	1 day	1 deg	Country
	Projection	E-Cordex (BA)	3 hour	0.25 deg	C&C
Mean Sea Level Pressure	Historical	ERA5	1 hour	0.25 deg	Country
	Projection	Euro-Cordex	1 day	0.25 deg	Country



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C3S Energy – Energy Indicators by Stream

ENERGY INDICATORS					
Electricity Demand	Historical	B.o. ERA5	1 day	Country	Country
	Seasonal	B.o. EC, MF, MO	1 day	Country	Country
	Projection	B.o. E-Cordex	1 day	Country	Country
Wind Power (onshore and offshore)	Historical	B.o. ERA5	1 hour	0.25 deg	C&C
	Seasonal	B.o. EC, MF, MO	6 hours	1 deg	Country
	Projection	B.o. E-Cordex	3 hour	0.25 deg	C&C
Solar Power (PV)	Historical	B.o. ERA5	1 hour	0.25 deg	C&C
	Seasonal	B.o. EC, MF, MO	1 day	1 deg	Country
	Projection	B.o. E-Cordex	3 hour	0.25 deg	C&C
Hydro Power (Run-of-River and Reservoir)	Historical	B.o. ERA5	1 day	Country	Country
	Seasonal	B.o. EC, MF, MO	1 day	Country	Country
	Projection	B.o. E-Cordex	1 day	Country	Country



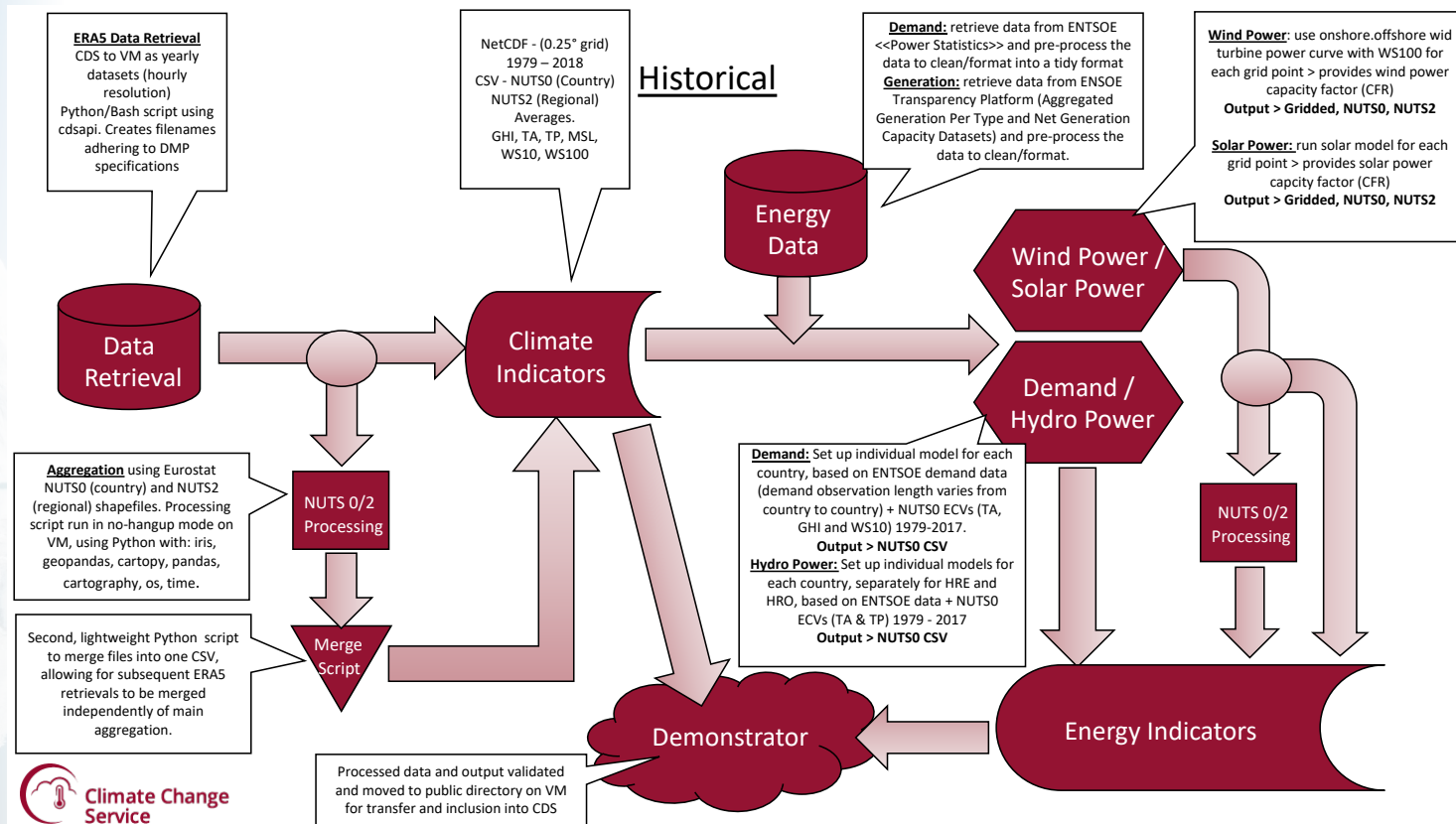
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C3S Energy – Historical Stream Workflow



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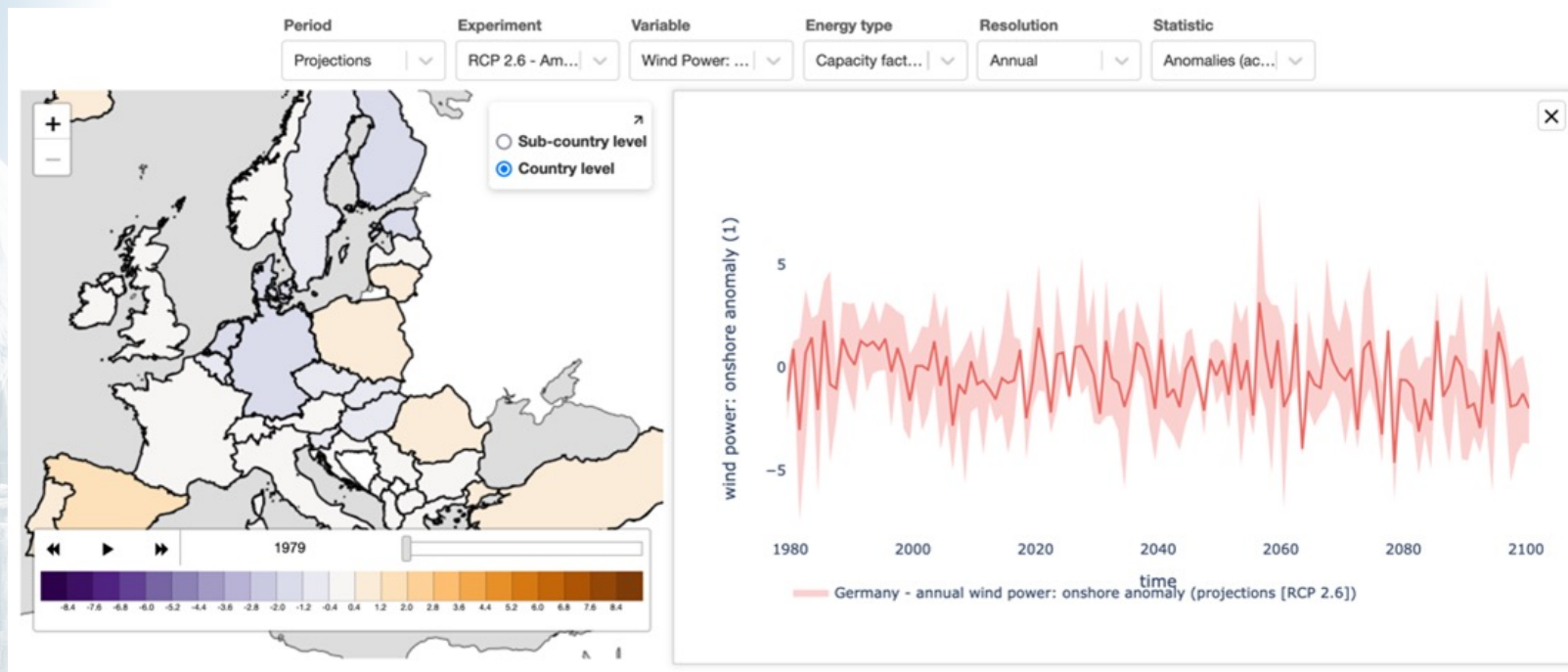
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C3S Energy – European Energy and Climate Data Explorer



Current operational C3S Energy CDS toolbox

<https://cds.climate.copernicus.eu/cdsapp#!/software/app-energy-explorer-europe?tab=app>



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C3S Energy – PECD Zones

**Different levels of
data aggregation
for the PECD**

