



Climate Change

# Climate services in support of the energy transformation

EGU

11 April 2018, Vienna, Austria

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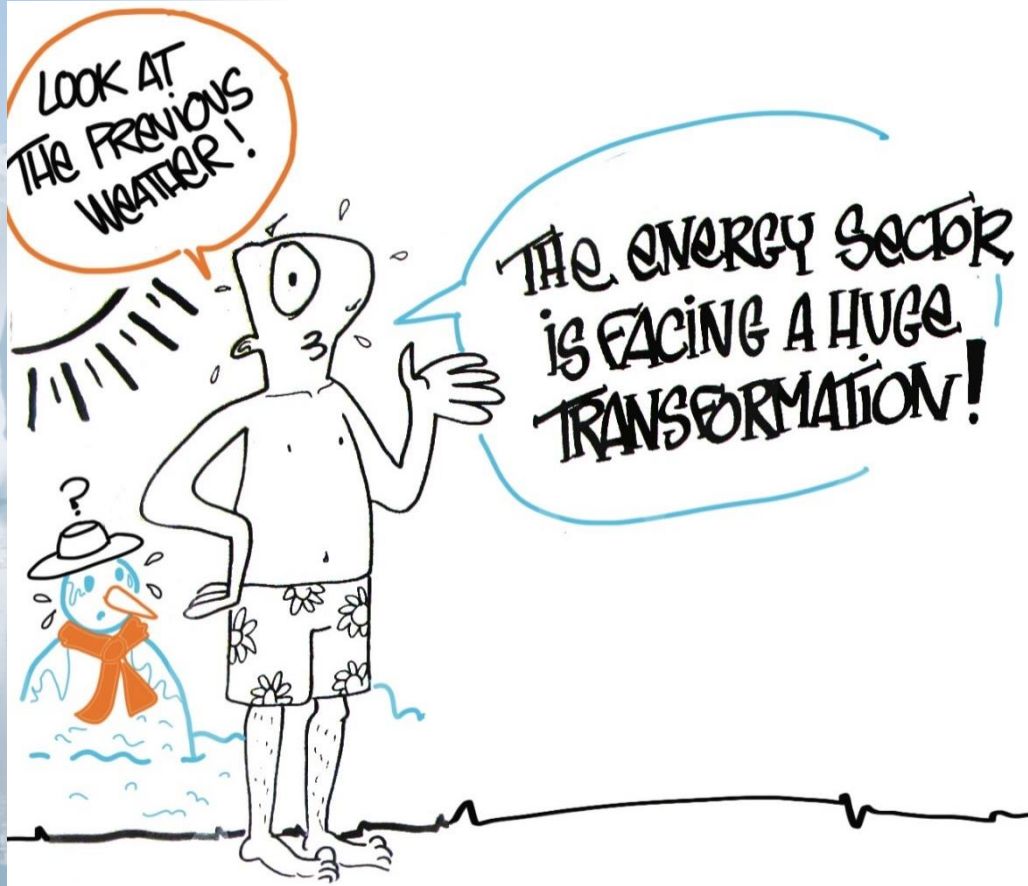
# Outline

- Background of the C3S European Climatic Energy Mixes (ECEM)
- Climate Variables
- Energy Variables
- The ECEM demonstrator



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# Motivation



The C3S European Climatic Energy Mixes (ECEM) has developed a demonstrator to assess how well **different energy supply mixes** in Europe will meet demand, over different time horizons, focusing on the role climate has on the mixes

**CECMWF**

**UEA**  
University of East Anglia



 **University of Reading**

  
Met Office

 **ARMINES**

**ENEA**

 **Copernicus**  
Europe's eyes on Earth

 **European Commission**





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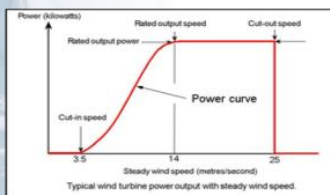
# The ECEM Approach

## Calibrated Climate Variables

Temperature  
Rainfall  
Wind Speed  
Cloud Cover  
Solar Radiation  
Others ?  
River Discharge

+Ancillary

Define models & transfer functions  
Select / Gather relevant datasets



## Energy Variables

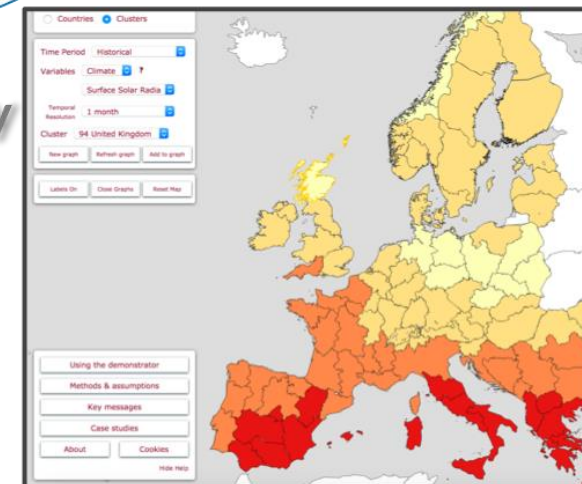
Hydro Power  
Demand  
Wind Power  
Solar Power  
Thermal Power

- Skill & Reliability
- Assessment of Seasonal Forecasts of Energy Variables

+ Extreme Events Case Studies



- Sub-Country Scale
- Historical Period
- Seas. Fcst
- Clim. Proj.



**ECEMWF**



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# Variable distributions for bias-adjustment

- Normal Distribution for Air Temperature
  - Gamma Distribution for Precipitation (fits much better when a low threshold for daily precipitation is selected, 0.5-1.0mm)
  - Gamma Distribution for Dewpoint Depression (needed to produce RH)
  - Weibull Distribution for Wind Speed
  - Solar Irradiance (directly adjusted using satellite data, as very few direct observational sites)
- 
- Air Temperature and Precipitation from E-OBS
  - Wind Speed and Dewpoint Depression values from HadISD
  - Solar Irradiance from Helioclim-v3 satellite data

For additional details of datasets and distributions see Jones et al (2017)



Met Office

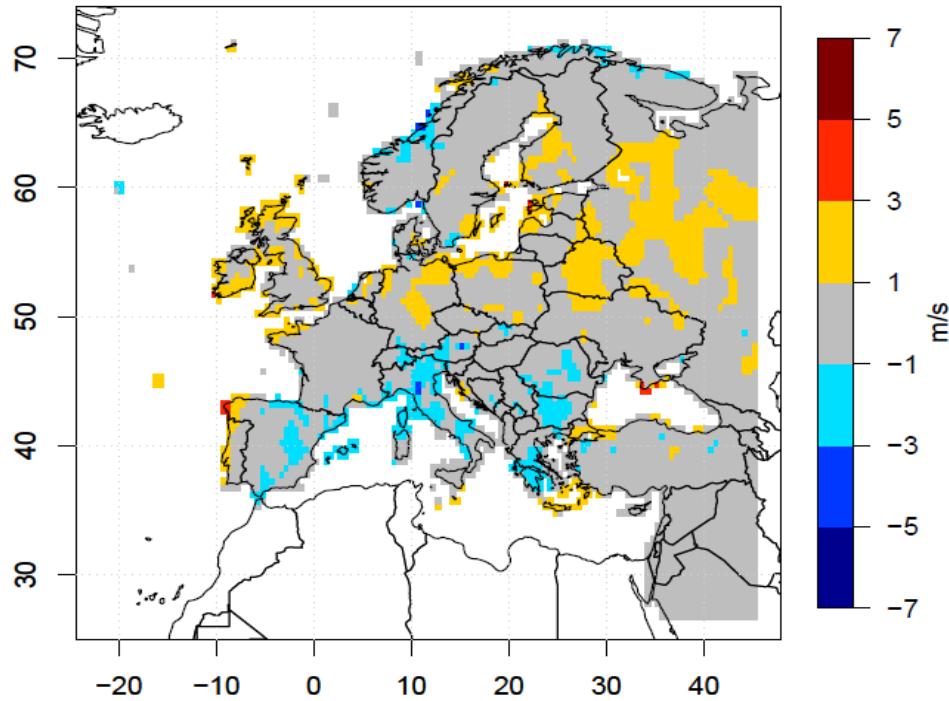




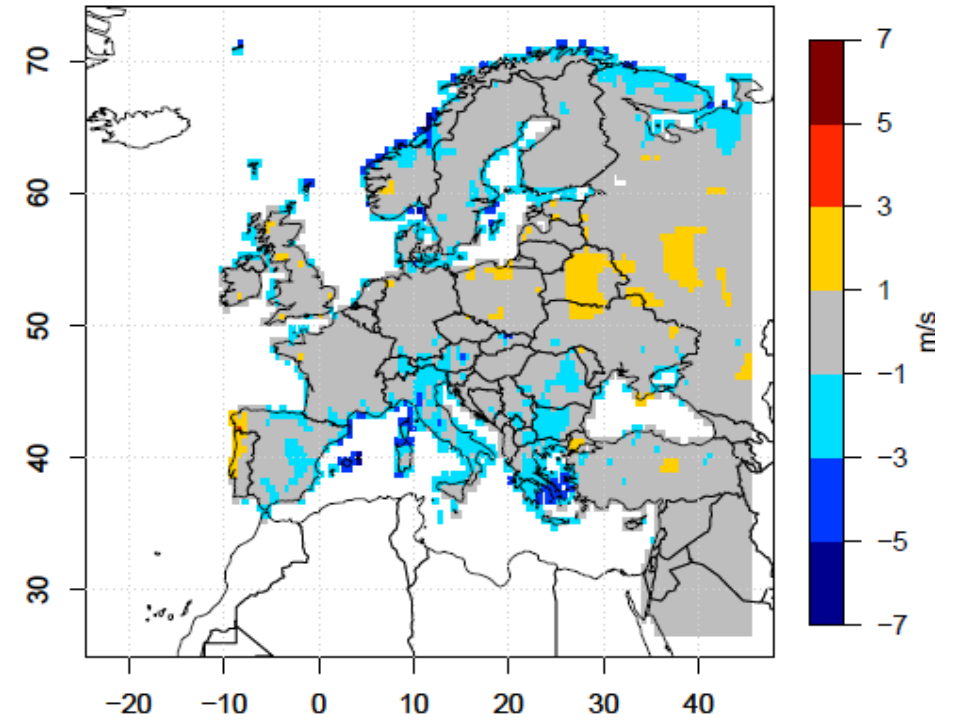
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# Unadjusted minus adjusted (Wind Speeds)

unadjERA1-adjERA1 Annual WS (1979-2016)



WFDEI-adjERA1 Annual WS (1979-2015)

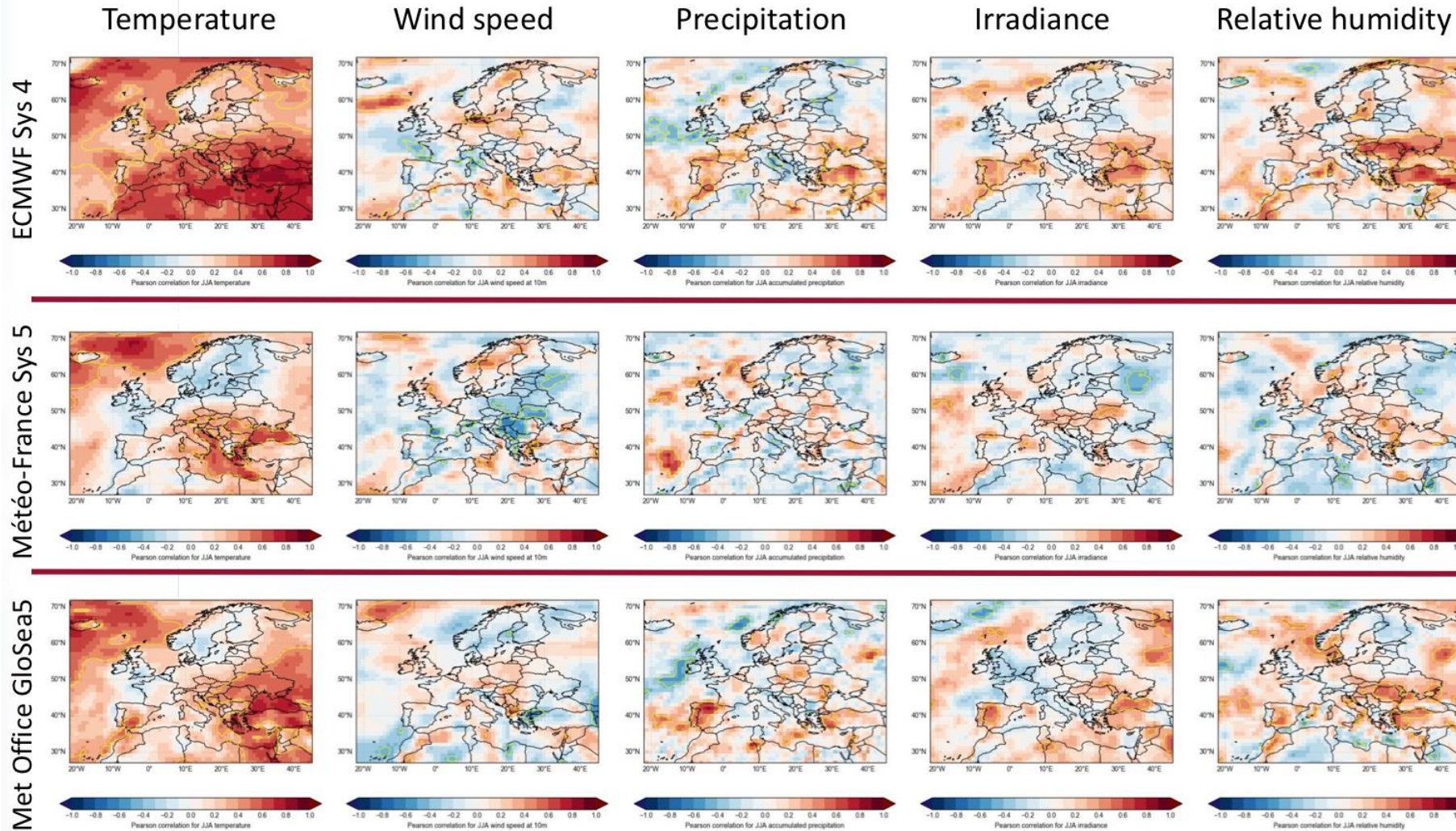






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# Seasonal forecasting skill: correlations for summer



Bett et al. (2018a)



University of  
Reading



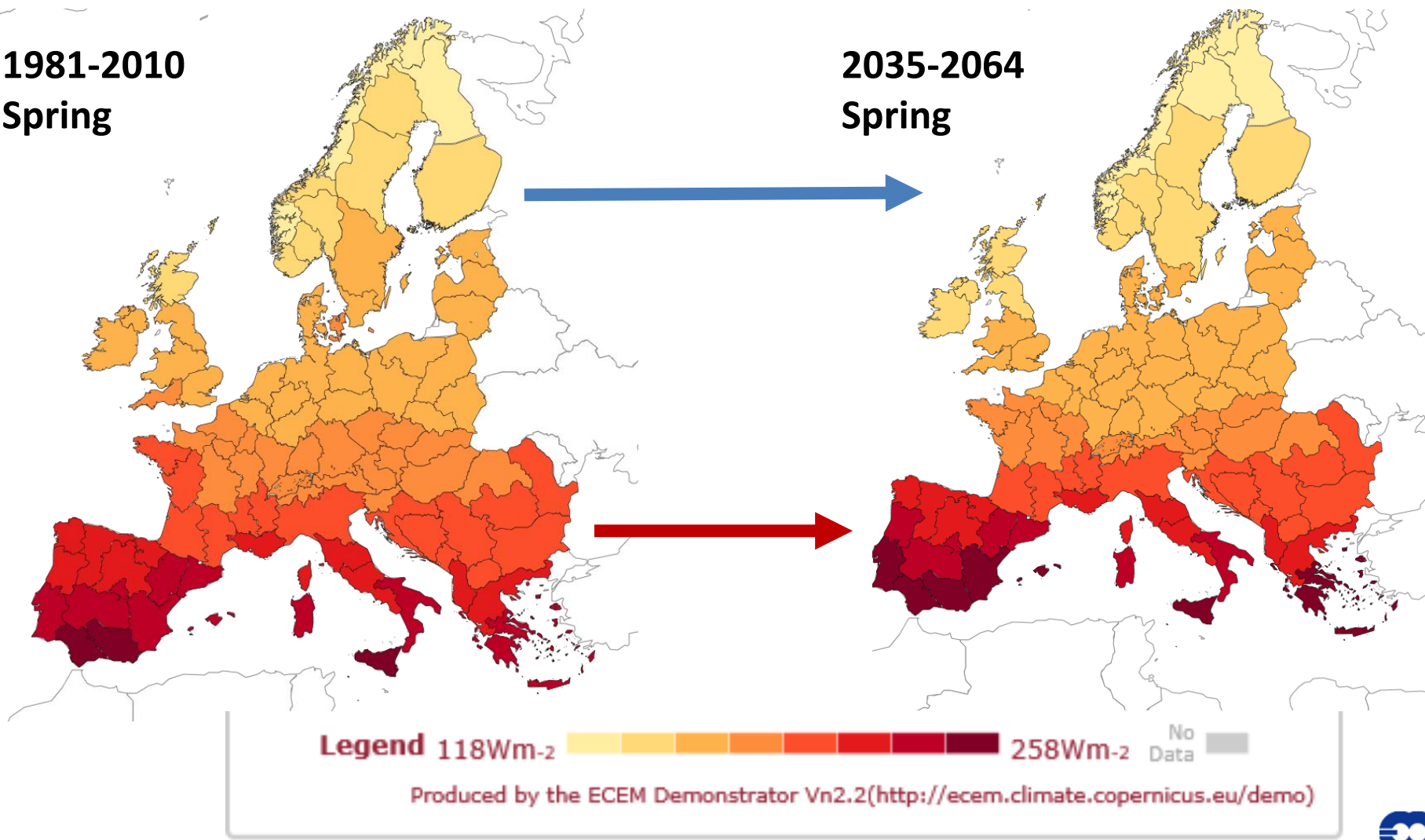


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# Climate Projection (RCP 8.5) Radiation

1981-2010  
Spring

2035-2064  
Spring



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**UEA**  
University of East Anglia

**edf**

**University of Reading**

**Met Office**

**ARMINES**

**ENEA**

**Copernicus**  
Europe's eyes on Earth

**European Commission**

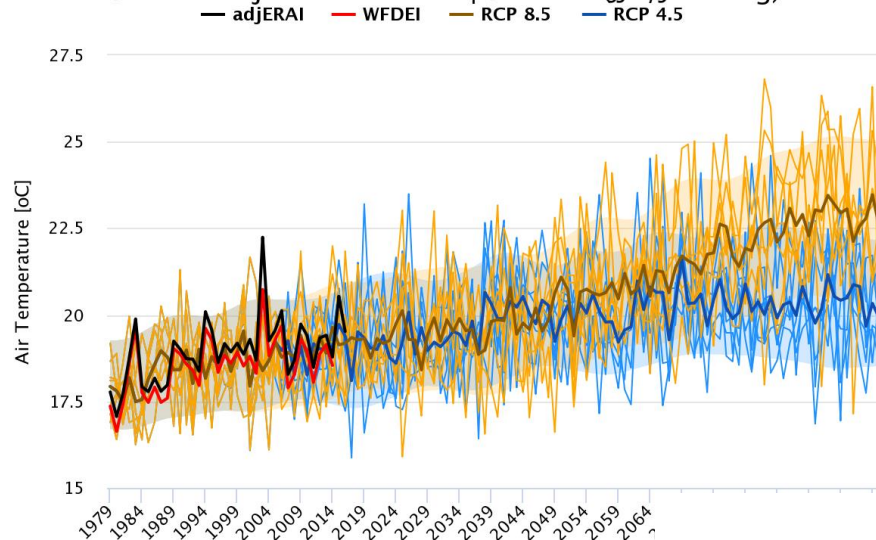




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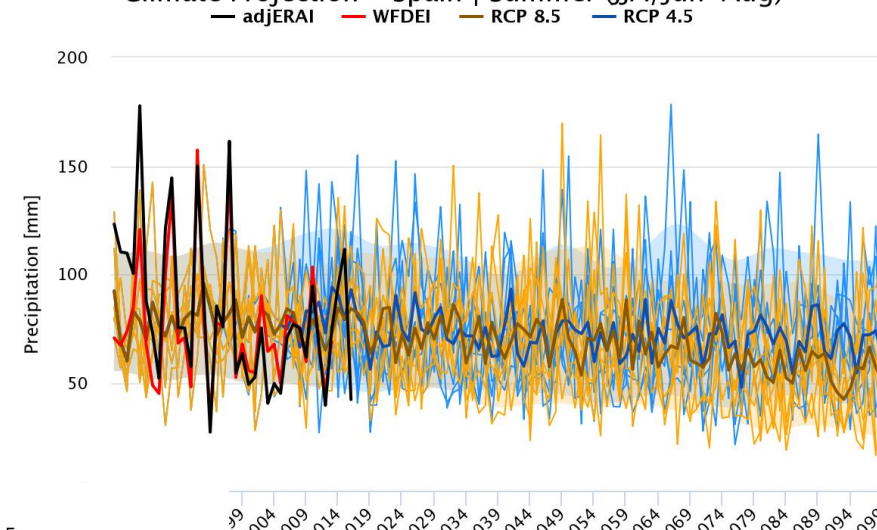
# Climate Projection timeseries

Climate Projection – France | Summer (JJA/Jun–Aug)



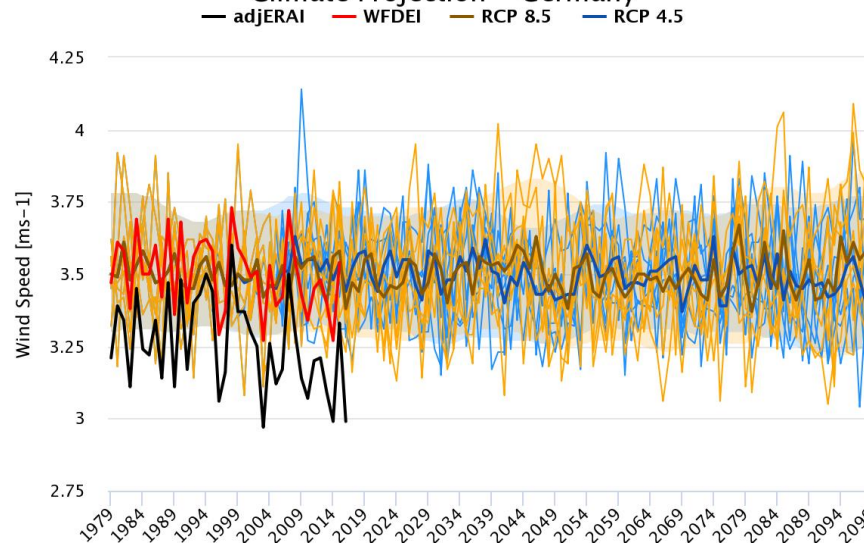
Produced by the ECEM Demonstrator Vn2.2 (<http://ecem.climate.copernicus.eu/demo>)

Climate Projection – Spain | Summer (JJA/Jun–Aug)



Produced by the ECEM Demonstrator Vn2.2 (<http://ecem.climate.copernicus.eu/demo>)

Climate Projection – Germany



Produced by the ECEM Demonstrator Vn2.2 (<http://ecem.climate.copernicus.eu/demo>)

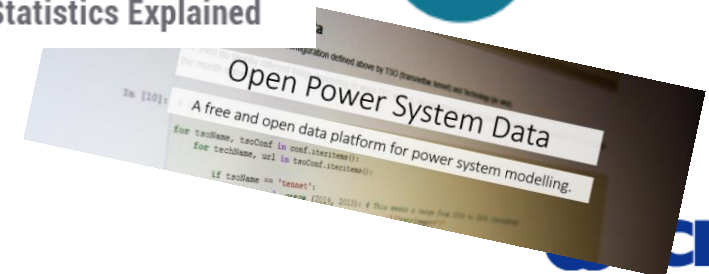
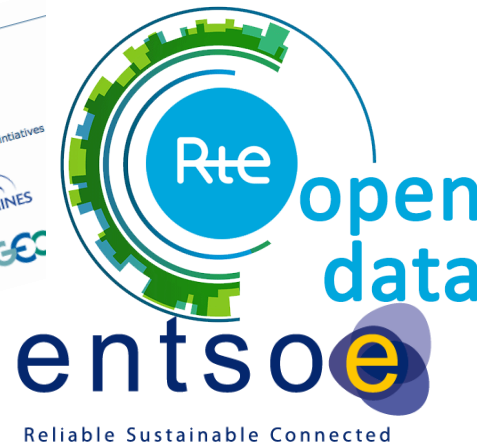


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Ensuring we use the most accurate  
Energy data

## The Energy data challenge:

- There is no single reference database for energy
  - Many data sources, inconsistencies between them, incompleteness, access rights (minimal open/free access data) ...
- ➔ Need strong support to collect & organise the huge amount of energy data required for a useful service
- ➔ **ECEM is demonstrating that good data allows a good service!**



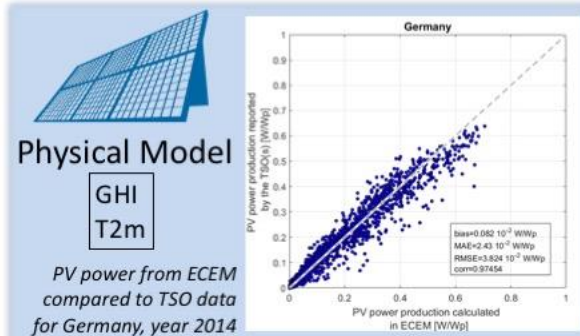




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# Energy Conversion – A summary

A mix of **physical & statistical** models, based on energy data availability

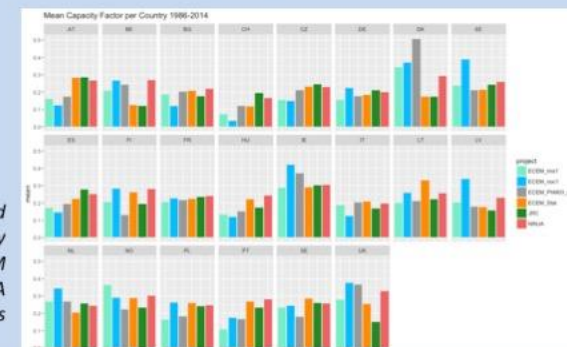


Physical Models:

- Simplified: 1 single wind turbine type
- Accurate: actual European fleet (from thewindpower.net)

Statistical Models (SVR)

WS@10m

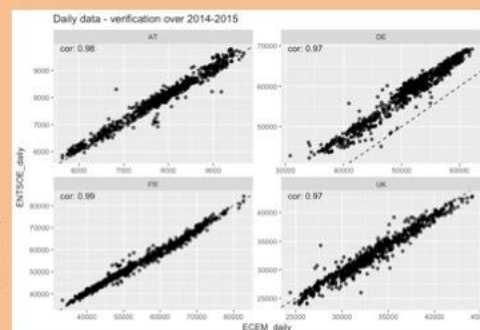


Country mean wind power capacity factor for ECEM models, and NINJA and JRC datasets



T2m  
GHI  
RH  
WS@10m

ECEM vs ENTSO-e daily demand 2014-2015 for AT, DE, FR and UK

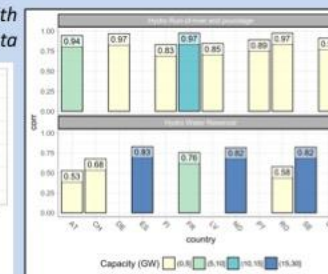


Statistical Models (RnF)

Run-of Hydro power capacity factor for France, 2015-2016, compared to ENTSO-e data



Correlation with ENTSO-e data



ECEMWF

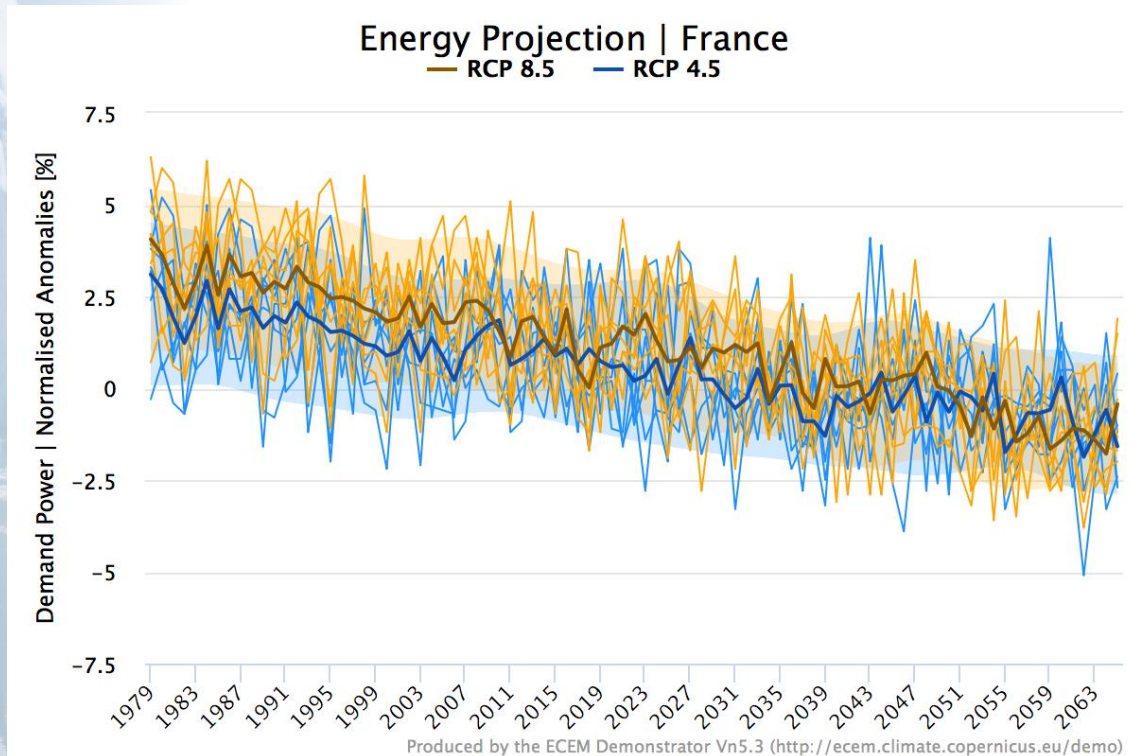




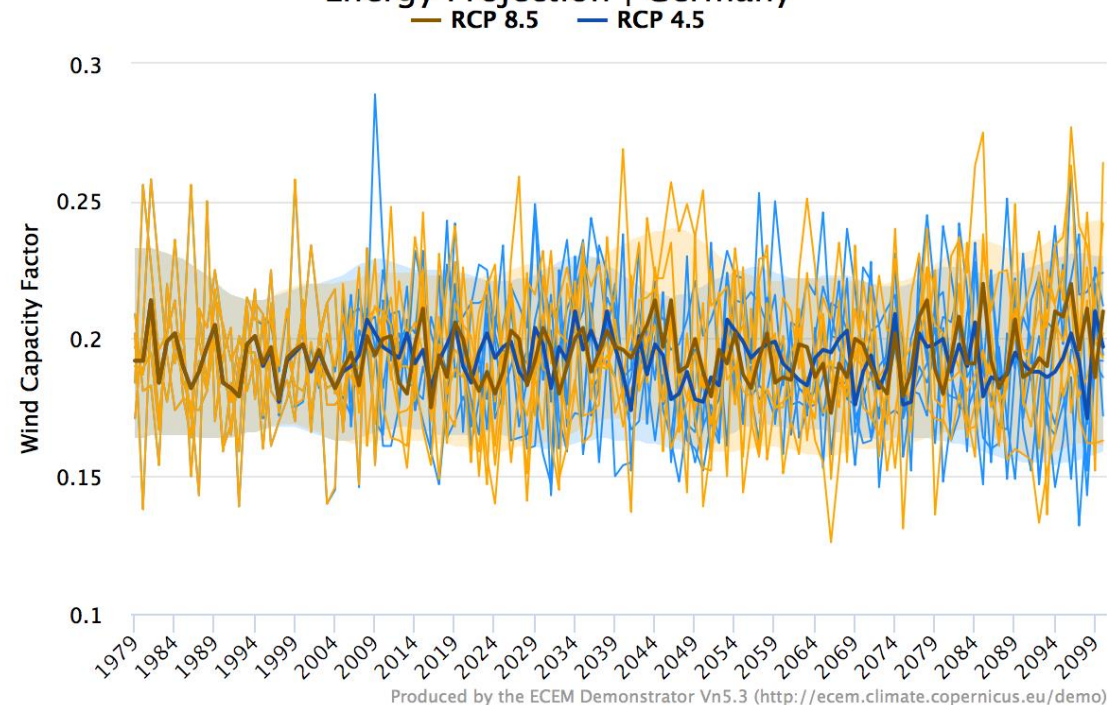
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# Energy Projections

## Demand



## Energy Projection | Germany



## Wind Capacity Factor



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# Multi-faceted Stakeholder Engagement & Communications

## Stakeholder Workshops



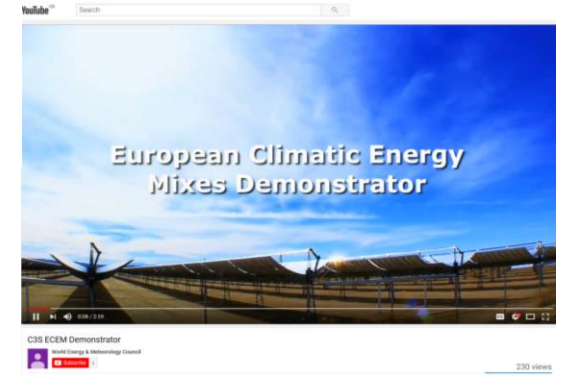
## Websites



## Press releases



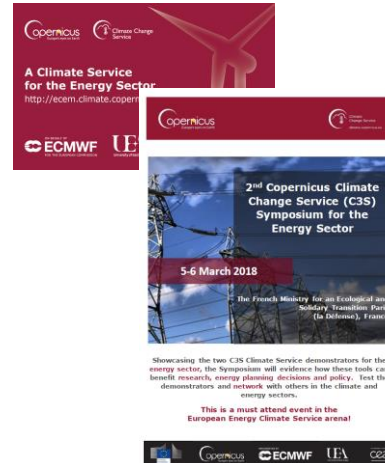
## Promotional video



## Social media

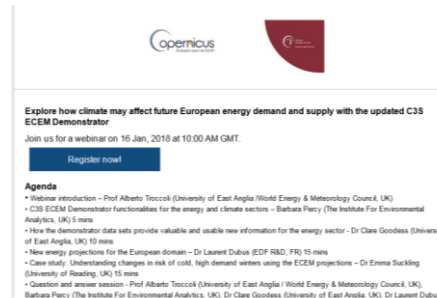


## Promotional material

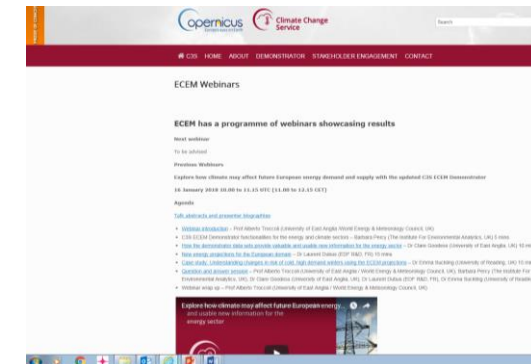


## One to one presentations

## Direct email



## Webinars/training

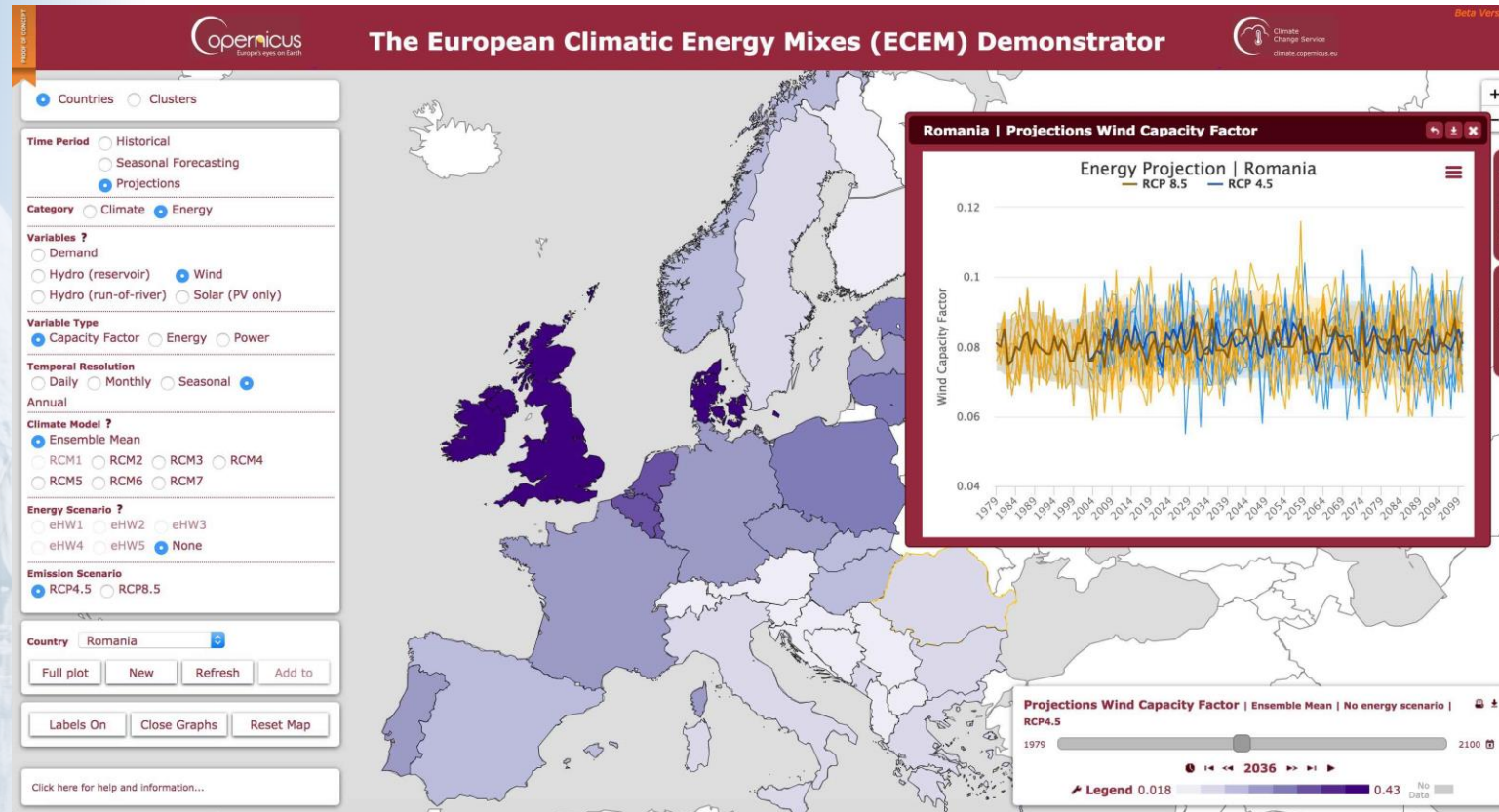






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# An online interactive tool to test energy mixes



<http://ecem.climate.copernicus.eu/demo>





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# General Documentation and Key Messages

**Using the demonstrator**

▼ Introduction

The main purpose of the ECEM Demonstrator is to enable the energy industry and policy makers to assess how well energy supply will meet demand in Europe over different time horizons, focusing on the role climate has on energy supply and demand.

It gives users the capability to explore high-quality climate and energy data sets and to easily:

- (i) produce maps and time series plots of these climate and energy variables,
- (ii) modify the appearance of these maps and plots, and
- (iii) download the underlying data and/or the maps and plots.

Different levels of help and guidance are provided including **Key Messages** and **Event Case Studies** which illustrate the types of information which the Demonstrator offers for the benefit of the energy sector. Documentation (Including **Variable Fact Sheets**) is provided on all the data sets embedded in the Demonstrator to ensure transparency and that users have appropriate information to judge the quality and reliability of these data for their own particular applications.

▼ Getting started

▼ Help menu

▼ Creating and modifying the map

▼ Creating and modifying time series

▼ Time slider and map legend

▼ Date range and temporal resolution

▼ Downloading data

▼ Downloading and printing graphs

▼ Zooming and resetting

▼ Absolute values and anomalies

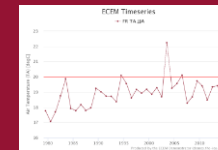
▼ Thresholds

Close

## EUROPEAN CLIMATIC ENERGY MIXES (ECEM)

### KEY MESSAGES ECEM KM 01

#### A warming Europe



A series of Key Messages for the European energy sector based on the analysis of data in the ECEM Demonstrator.

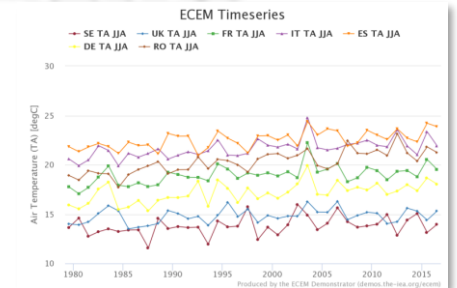


#### Key messages: A warming Europe

- Temperatures have risen consistently across Europe over the last ~40 years
- In countries such as Germany the warming has been strongest in winter whereas in Spain, for example, it is strongest in summer
- At the same time, variability from year-to-year and day-to-day persists, and cold events have continued to occur in recent years
- Temperature is a major driver of the ECEM models for energy demand and of solar and hydro supply thus these trends and patterns of variability will impact estimates of these energy variables

#### How do we know Europe is warming?

Warming trends are evident in time-series plots of historic air temperature data (°C) for 1979-2016 including those for the seven countries shown here (Sweden, UK, France, Italy, Spain, Germany and Romania). The plot below shows the trends for summer (June, July and August).



For more information visit  
[www.ecem.climate.copernicus.eu](http://www.ecem.climate.copernicus.eu)  
or contact the ECEM team at  
[support@ecem.climate.copernicus.eu](mailto:support@ecem.climate.copernicus.eu)

Date of publication: 25 June 2017



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# Variables and Event Case Studies Fact Sheets

## EUROPEAN CLIMATIC ENERGY MIXES (ECM)

### VARIABLE FACT SHEET ECM VFS E01

Energy demand

*A series of fact sheets which provide metadata for the climate and energy variables produced by ECM*



#### 1 General

- 1.1 Description
- 1.2 Units
- 1.3 Links
- 1.4 Data format
- 1.5 Keywords
- 1.6 Contact

#### 2 Dataset coverage

- 2.1 Geographic area
- 2.2 Temporal resolution
- 2.3 Time period
- 2.4 Spatial resolution

#### 3 Usage

- 3.1 License conditions
- 3.2 Citation(s)

#### 4 Lineage statement

- 4.1 Original data source
- 4.2 Tools used in production of indicators

#### 5 Data quality

For more information visit  
<http://ecem.climate.copernicus.eu>

Date of publication: 12 June 2017



## EUROPEAN CLIMATIC ENERGY MIXES (ECM)

### EVENT CASE STUDY ECM CS 001

High demand in winter  
2009/10



*A series of case studies based on extreme events which illustrate how the ECM demonstrator can be used by the energy sector to enhance understanding and support decision making.*



#### Boosting Decision Making

1 Winter 2009/10 saw high power demand due to extremely cold temperatures across much of northern Europe, as seen in the ECM demonstrator

2 The impact of another winter similar to 2009/10 is likely to be greater today because of the increase of weather-sensitive renewables such as wind in the energy mix. For the UK, the ECM historical dataset shows a significant drop in wind power if 2009/10 conditions occurred today

#### Scientific/ Technical Advances

1 ECM has brought together credible data from the climate and energy communities, processed in a consistent way over a range of time scales

2 The demonstrator tool provides valuable insight into the winter 2009/10 event and can be used to study the impact of other extreme weather events on European power systems

3 Analysis of the ECM datasets has revealed dependencies and risks across European countries and between energy and climate variables

#### Key Lessons

- 1 The ECM historical dataset allows:
  - Investigation of an event in the context of recent history
  - 'What if' questions to be assessed based on today's energy mix and the climate drivers
- 2 The demonstrator can help anticipate future risks through:
  - Seasonal forecasts
  - Climate projections

For more information visit  
[www.ecem.climate.copernicus.eu](http://www.ecem.climate.copernicus.eu)  
or contact the ECM team at  
[support@ecem.climate.copernicus.eu](mailto:support@ecem.climate.copernicus.eu)

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# A couple of upcoming Events

WMO-WEMC-GFCS-BCC TRAINING COURSE ON CLIMATE  
AND ENERGY – SHANGHAI, CHINA

MAY 18 – MAY 20



Applications of weather & climate information for the energy sector



WEMC  
World Energy &  
Meteorology Council



[http://www.wemcouncil.org/wp/event/  
training-course-on-climate-and-  
energy-2018/](http://www.wemcouncil.org/wp/event/training-course-on-climate-and-energy-2018/)

5<sup>th</sup> International Conference  
Energy & Meteorology

SHANGHAI  
CHINA, 22-24 MAY 2018

<http://www.wemcouncil.org/>



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Thank you for your attention



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