Energy & Meteorology and the European Climatic Energy Mixes (ECEM)

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University of East Anglia & World Energy Meteorology Council
Our primary goal is to enable improved sustainable energy for a low carbon economy and resilience of energy infrastructures, as well as efficiency of energy systems, under ever changing weather and climate.
WEMC work focuses on

Enhancing productivity and policy formulation for the energy industry

Achieving improved adoption of weather, climate and other environmental information by the energy industry

Maximizing the exchange of relevant information between developed and developing countries

http://www.wemcouncil.org/
Energy and meteorology go hand in hand

- **Passing clouds**
  - Drop in solar power

- **Hurricanes**
  - Disruptions to oil rig operations

- **El-Niño**
  - Changes in Demand Patterns

- **Long term changes**
  - Renewable Resource Assessment

Time scales:
- Seconds
- Minutes
- Days
- Months
- Seasons
- Years
- Decades
Increasing share of power supply from variable renewable energy (RE) sources. Demand variability is also increasing. The transformation is taking place against a variable and changing climate.
C3S ECEM in brief

- Budget: €1.6 m
- Length: 27 mth (from Nov 2015)
- Six partners: UEA (lead) EDF, U Reading, Met Office, ARMINES and ENEA

Target: proof-of-concept or demonstrator

Stakeholder engagement central to ECEM

- Five stakeholder workshops, one every 6 months
- A tailored engagement plan

Integration of energy & climate information for energy mixes assessment

- Is climate important for energy planning?
- What can climate R&D learn from interaction with energy sector and make output more easily adopted by the industry/policy makers?

European Climatic Energy Mixes (ECEM) is developing 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.
Issues considered by e-Highway 2050

- Technical
- Economic/financial
- Political/socio-political and environmental
- Research, development and deployment (RD&D)

However climate not very prominent in eHW2050 even though ...
Target

★ Energy Mix assessment for:
★ Present day
★ Seasonal Forecasts
★ Climate Change

What is the demand?... Which suppliers?
Five Scenarios (from e-Highway 2050)

Five scenarios

- 100% RES
- Large scale RES
- Fossil & nuclear
- Big & market
- Small & local

- 35% ≤ 100%
- 35%
- 60%
- 5%
- DistG

- 100% Renewable Energy Sources (RES)
- < - 80% Greenhouse Gas Emissions

- +15%
- Ref scenario

- -30%

- Big and market
- Large scale RES &
- Large fossil fuel

- 100% RE &
- Small & local

10-19/10/2016, SIS Workshop, Reading (UK)
From Climate variables to Energy systems

Calibrated Climate Variables
- Temperature
- Rainfall
- River Discharge
- Wind Speed
- Cloud Cover
- Solar Radiation
- Humidity

Energy Variables
- Hydro Power
- Wind Power
- Solar Power
- Thermal Power
- Demand

Define models & transfer functions
Select / Gather relevant datasets

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

+ Extreme Events Case Studies
Impacts of Climate Variability & Change on Energy Variables

- Sub-Country Scale
- Historical Period
- Seas. Fcst
Multi-faceted Stakeholder Engagement

- Workshops
- Advisory Committee
- Survey
- Presentation at events
- Webinars
- Web site
- Twitter
The European Copernicus Climate Change Service (C3S) programme, funded by the European Commission and operated by the European Centre for Medium-range Weather Forecasts, aims to deliver cutting-edge climate and sectoral information for the society facing climate change adaptation and mitigation. As part of the C3S programme, several demonstration products are being developed and trialled for the energy sector.

This symposium brings together leading climate and energy scientists, industry practitioners and policy makers, to present and explore newly emerging tools and opportunities for managing climate information for the energy sector. Attendees will also be given hands-on access to the latest developments from the C3S energy-climate services prototypes and invited to shape the ongoing development of forthcoming publically-available C3S products.

For more info, please contact: Robert.Vautard@cea.fr & A.Troccoli@uea.ac.uk
Stakeholder Engagement: Workshops
Stakeholder Engagement: Committee & GFCS

★ Advisory Committee
★ Christoph Grafe (Eurelectric)
★ Rafael Sanchez Duran (Endesa)
★ Virginie Dordonnat (RTE)
★ Fabio Monforti-Ferrario (JRC)
★ Sophie Voirin (Climpact-Metnext)
★ Steve Dorling (WeatherQuest)
★ Isadora Jimenez (BSC)

★ Close links with the Global Framework for Climate Services
Climate Variables: Bias-Adjustment

Fit of 10 m observations to Weibull distribution

Jan (Obs Weibull AIC GOF)  Jul (Obs Weibull AIC GOF)

Low number (blue) good fit; high number (red) poor fit
The DATA ISSUE:
There is no single reference database for energy
Many data sources, inconsistencies between them, incompleteness, access rights (few open data) ...

→ Need high level support to make things evolve
→ ECEM will demonstrate that good data allows good service!
Challenge: identify role of climatic factors

**France**

- Yearly Consumption (GWh)
- Population
- National Average Temperature

**Italy**

- Yearly Consumption (GWh)
- Population
- National Average Temperature
Historical monthly generation

**Monthly hydropower production in Norway**

- Statistical models: no big differences between different models (MLR, SVR, GAM, CARTs ...) ➔ ideal for monthly time scales @ country level
- Where no data is available for learning, observed predictands necessary to use physical models

**Monthly solar generation in Germany**

**Achieved so far:**

- Historical period, statistical models for demand and generation (Hydro, Solar, Wind), monthly & country level
- Historical period, GAM model for demand, daily & country (Fr, It, Au)
Solar Power Load Factor: France

Density plot of machine learning models vs RTE data 2014 for solar

Physical models

Statistical models

Results of machine learning models in 2014

17-19/10/2016, SIS Workshop, Reading (UK)
Wind Power Load Factor: France

Density plot of machine learning models vs RTE data 2014

Results of GAM and SVM models on 2014

Capacity factor 2013–2014: RTE vs method 1 & 2

Capacity Factor

Date

RTE

cor = 0.669

r = 0.8562

cor = 0.959

r = 0.8562

Results of GAM and SVM models on 2014

Capacity Factor

janv.  mars  mai  juil.  sept.  nov.  janv.

RTE

GAM

SVM

Density

N = 966  Bandwidth = 0.00909

Density

N = 730  Bandwidth = 0.035

Density

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Density

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Density

N = 966  Bandwidth = 0.00909
The purpose of the ECEM demonstrator is to enable the energy industry and policymakers to assess how well different energy supply mixes in Europe will meet demand, over different time horizons (from seasonal to long-term decadal planning), focusing on the role climate has on the mixes.
An online interactive tool to test energy mixes
An online interactive tool to test energy mixes
Integration of energy & climate information for energy mixes assessment

★ Is climate important for energy planning?

★ What can climate R&D learn from interaction with energy sector and make output more easily adopted by the industry/policy makers?
Get involved

ECEM/CLIM4ENERGY Workshop
Barcelona (Spain), 22-23 February 2017

http://ecem.climate.copernicus.eu/

4th International Conference
Energy & Meteorology
Weather and Climate for the Energy Industry
SAVE THE DATE
12-16 June 2017
Beijing, China

http://www.wemcouncil.org/
Thank you