Climate Service and Technology: a Key Tool of Climate Change Adaptation for the Energy Sector

Alberto Troccoli
World Energy & Meteorology Council (UK)
University of East Anglia (UK)
Outline

- The evolving relationship between Energy and Climate
- How Weather/Climate impacts Energy
- Climate Services for Energy
Together we work with a wide range of scientists, organizations and experts in the energy, weather and climate sectors
WEMC: Our primary goal is to enable improved sustainable energy for a low carbon economy 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
The energy industry has a multi-decadal experience in dealing with meteorological variables. So, what’s the big deal?

The landscape, in both climate and energy spaces, is changing rapidly.
RE Share of Global Electricity Production

Non-renewables 76.3%

Renewable electricity 23.7%

Hydropower 16.6%

Wind 3.7%

Bio-power 2.0%

Solar PV 1.2%

Geothermal, CSP and ocean 0.4%

Based on renewable generating capacity at year-end 2015. Percentages do not add up internally due to rounding.

REN21 Renewables 2016 Global Status Report
Strong growth in renewables

Renewable Energy Power Capacity and Electricity Generation

IRENA (2016)
CO2 emissions and temperature

IPCC AR5 (2013)
Disasters due to natural events

EM-DAT (2016)
Simplified Energy & Climate feedback

Energy

Emissions

Meteorology
Weather, Climate & Water

Impacts
Energy industry is multi-faceted – a selection
Climate impact on coal mines

Love et al. (2014)
Climate impacts on hydro-power

Masinga Dam Water levels in different Years

From Christopher Oludhe (2015)
The 2003 heatwave in France had serious consequences on the cooling of nuclear reactors. The overall cost of the heat wave for EDF was around €330 million.

Dubus (2009)
A selection of publications

World Bank (2010)

WBCSD (2014)

WEC (2014)

ICEM (2014)
Global changes in streamflow projections

Change in streamflow for RCP8.5, 2040–2069 (2050s) vs 1971–2000

Reductions in usable capacity for 61–74% of the hydropower plants

van Vliet et al. (2016)
Global changes in water temperature projections

Change in water temperature for RCP8.5, 2040–2069 (2050s) vs 1971–2000

Reductions in usable capacity for 81–86% of the thermoelectric power plants

van Vliet et al. (2016)
Percentage difference in monthly solar radiation in El Niño relative to La Niña

Davy and Troccoli (2012)
Addressing the ever variable nature of climate
Meteorological Services

Weather
- National Meteorological & Hydrological Services
- E.g. Wind and Solar Energy Forecasting Systems

Climate
- E.g. Global Framework for Climate Services (GFCS)
- E.g. EU Copernicus Climate Change Services (C3S)
Weather Services

- Very mature: 30+ years of experience
  - Also financial products since late 1990’s

- Products well understood by many users
  - Relatively easy to identify needs
  - Users wish to be updated about latest developments in weather products but otherwise develop their own services
  - Regular (e.g. annual) users meetings and/or specific training normally offered by weather service providers
Climate Services

- Relatively recent: ca. 10 years
  - First products from International Research Institute (IRI)
- Services still under developments
  - Large uncertainties in climate forecast/projections makes it more difficult for users to ascertain real value of climate information
  - Need to provide concrete examples of how to use climate information in practice
But...

What is a Climate Service?

A set of actions/tools aimed at helping ‘people’ make the best use of climate information so as to improve their ‘business’
GFCS provides a worldwide mechanism for coordinated actions to enhance the quality, quantity and application of climate services. **Energy has been recently adopted as a priority area**

See Energy exemplar at: [http://tiny.cc/GFCS_Energy_Exemplar](http://tiny.cc/GFCS_Energy_Exemplar)

More info at: [http://gfcs.wmo.int/](http://gfcs.wmo.int/)
Global Framework for Climate Services

- Established during the 3rd World Climate Conference in 2009
  - Endorsed by 13 heads state or government, 81 ministers and 2,500 scientists

- Partners Advisory Committee

- 10-year initial implementation plan designed over three years by dozens of experts, backed by initial financing
Areas of focus for energy

1. Identification & Resource Assessment
2. Impact assessments (incl. infrastructure and environment)
3. Site Selection & Financing
4. Operations & Maintenance
5. Energy Integration
   ✓ Market trading (incl. supply and demand forecasts) & Insurance
   ✓ Energy efficiency
A major EU programme

Copernicus is harnessing world leading science and technology to equip society to understand and adapt to our changing environment.

Six Information Services: Land, Marine, Atmosphere, Climate, Security and Emergency

Make use of satellite, reanalysis and forecast data via data stores

Funding: €4.3 billions for 2014-2020

Data is full, free and open to all
Seven services: 2x Energy, 2x Water, 1x Agriculture, 1x Cities, 1x Insurance

Aim: to achieve operational climate services co-designed and co-developed with final users

- Proof of concept/Pre-Operational
- Operational ca 20 climate variables 5-6 sectors
- Operational ca 30 climate variables ca 10 sectors

Stage 0/1: 2015
Stage 2: 2017
Stage 3: 2019

We are here
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
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.
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.
European Climatic Energy Mixes (ECEM)

★ Energy Mix assessment for:
★ Present day
★ Seasonal Forecasts
★ Climate Projections
European Climatic Energy Mixes (ECEM)

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

- **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. Fcest**
- **Clim. Proj.**

+ **Ancillary**

+ **WEMC**
  - World Energy & Meteorology Council
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

ECEM: http://ecem.climate.copernicus.eu/
An online interactive tool to test energy mixes

ECEM: http://ecem.climate.copernicus.eu/
Energy and Meteorology are closely connected

Energy systems are already experiencing sizeable impacts, which are likely to become more severe

Climate services are emerging as robust useful tools for Energy planning, and operations/maintenance

There is a strong need:
  – to improve knowledge of meteorological data and processes
  – to improve access to meteorological and energy data for improved products
Get in touch!

info@wemcouncil.org

www.wemcouncil.org

School of Environmental Sciences
University of East Anglia
Norwich NR4 7TJ, UK

WEMCouncil