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World Energy &
Meteorology Council

Norwich, 17 February 2018

Climate and Renewable Energy

Prof. Alberto Troccoli (WEMC and University of East Anglia)



www.wemcouncil.org



info@wemcouncil.org



+44 (0)20 3286 3250



@WEMCouncil

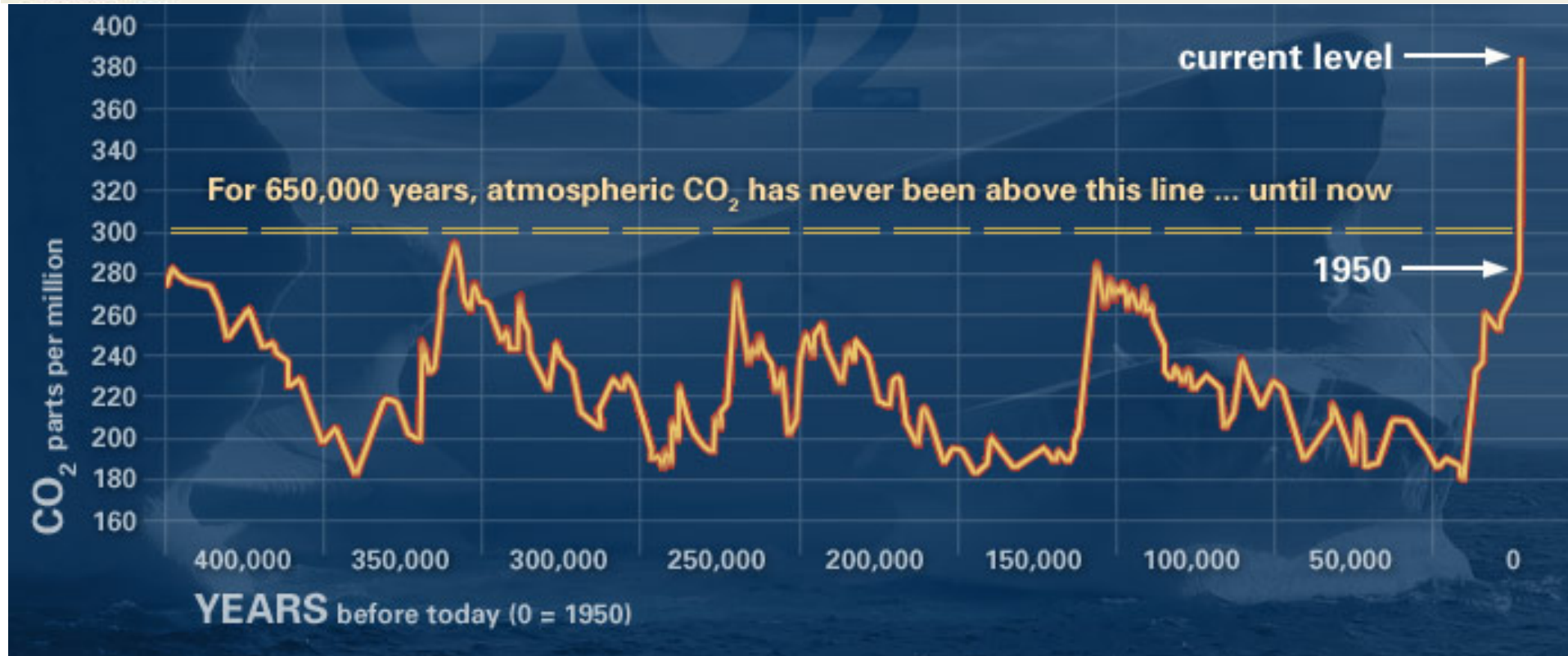
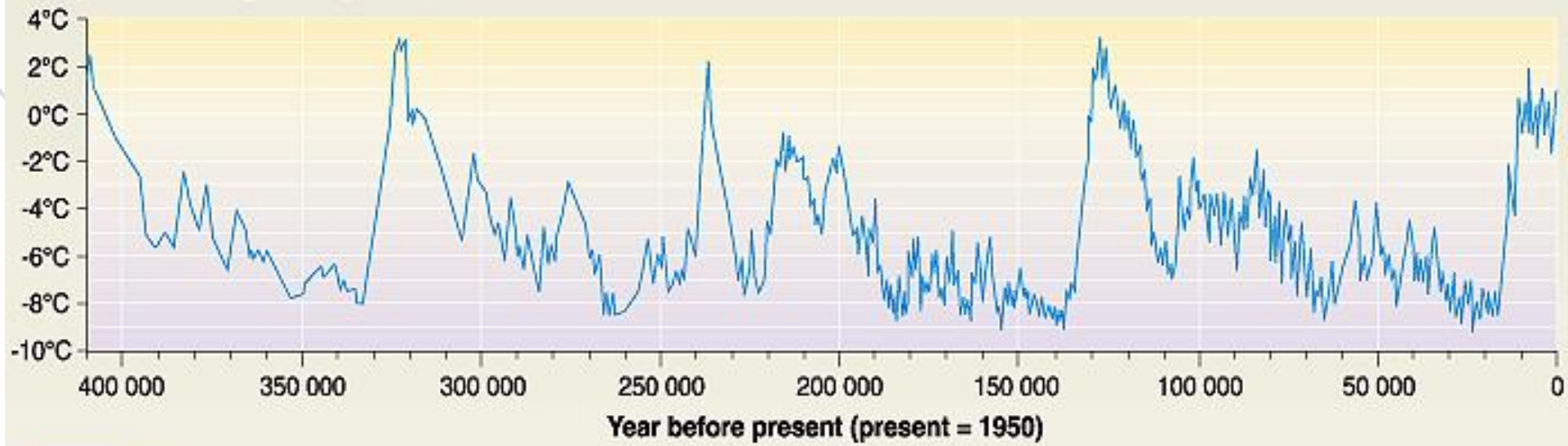


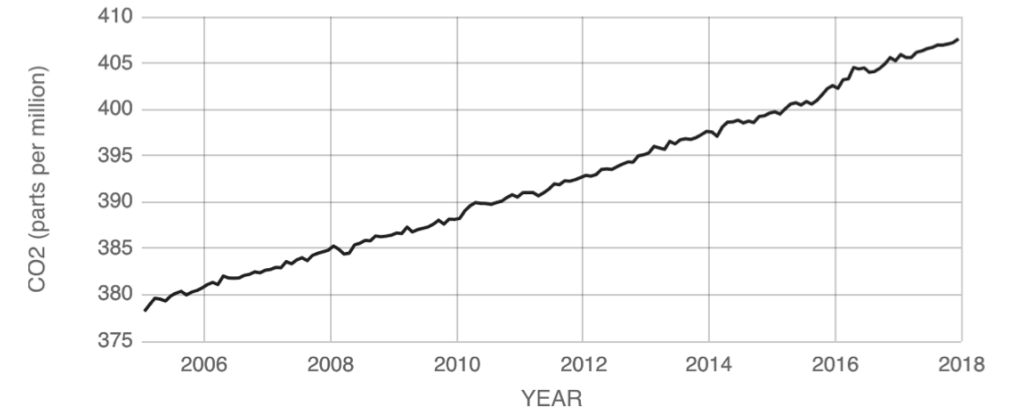
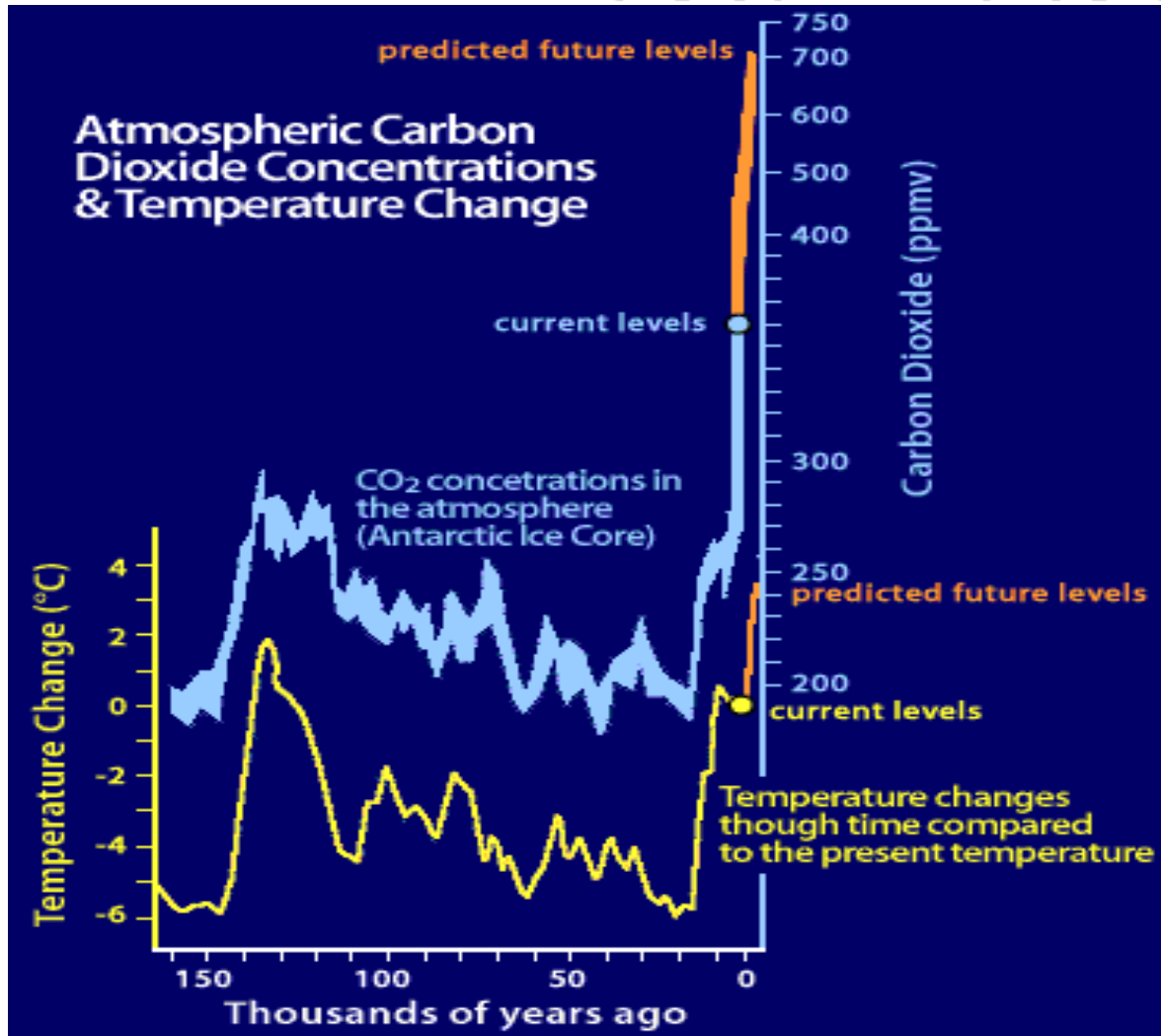
- The evolving relationship between **Energy and Climate**
- How **Weather/Climate** impacts **Energy**
- A **Copernicus Climate Change Service** for **Energy**: the European Climatic Energy Mixes



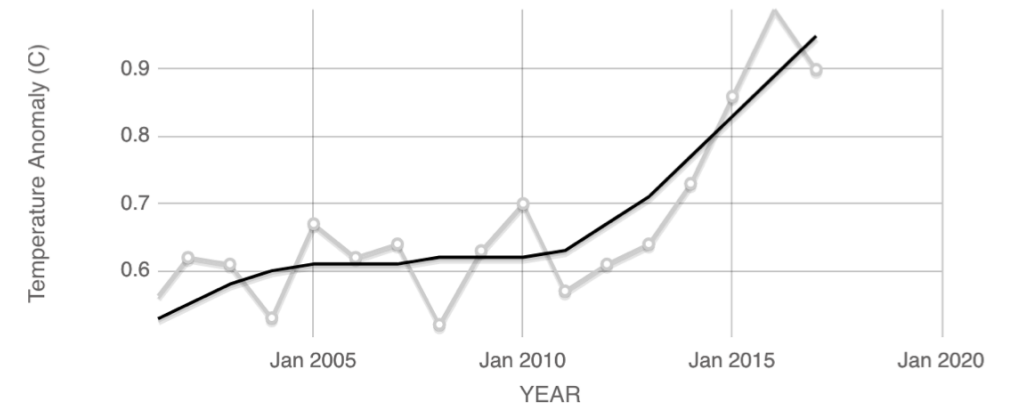
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Temperature change from present, °C





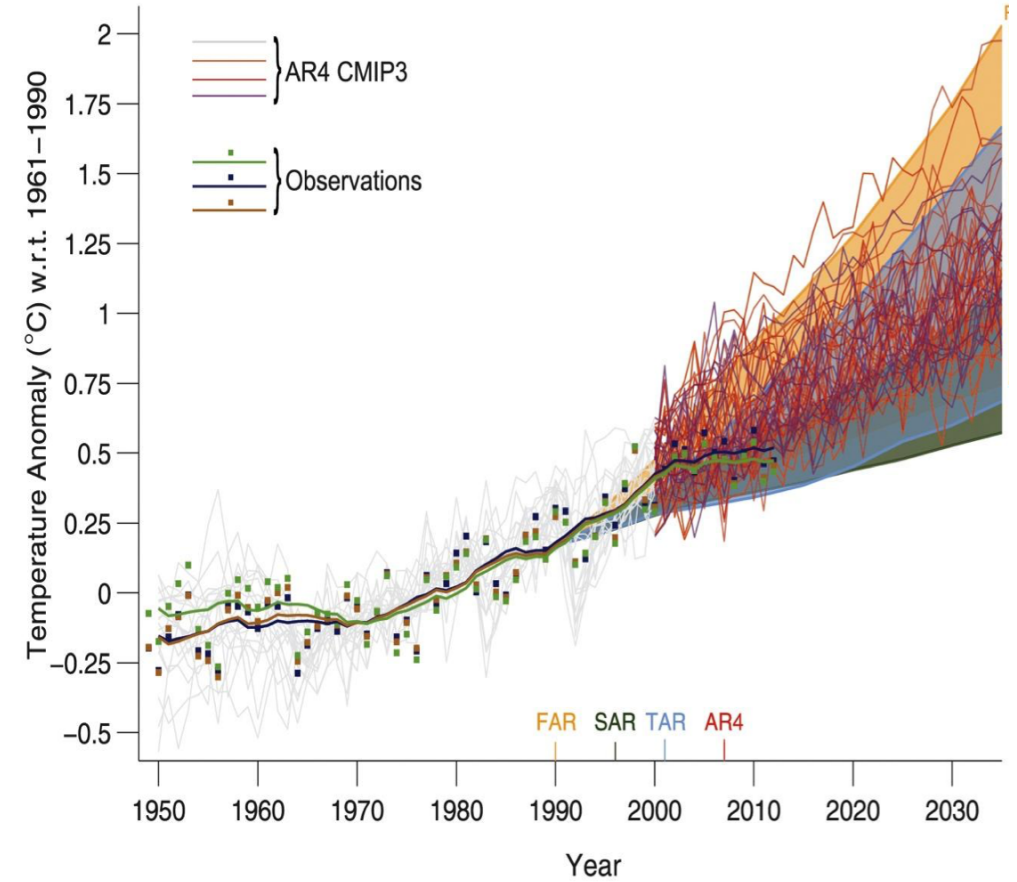
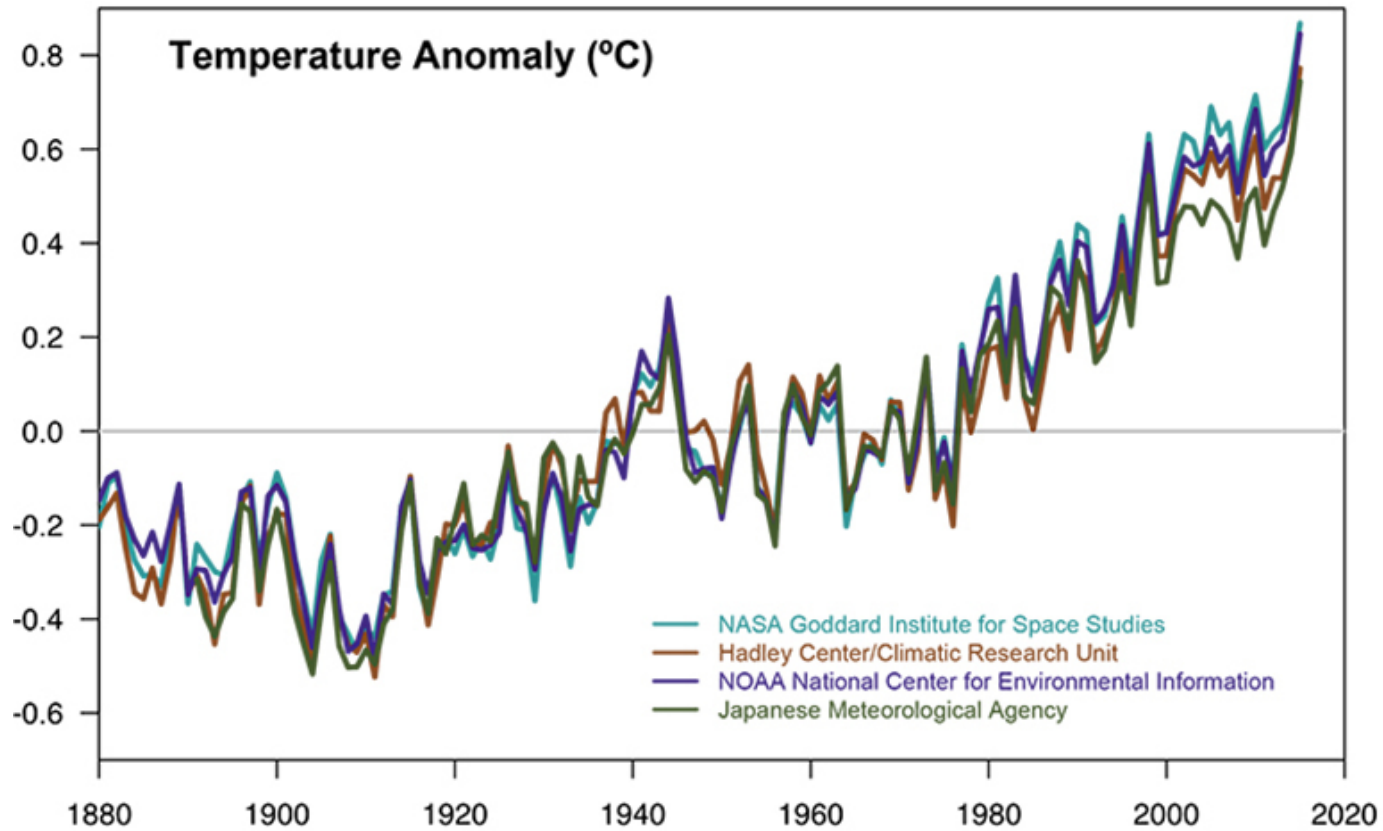
Source: climate.nasa.gov



Source: climate.nasa.gov



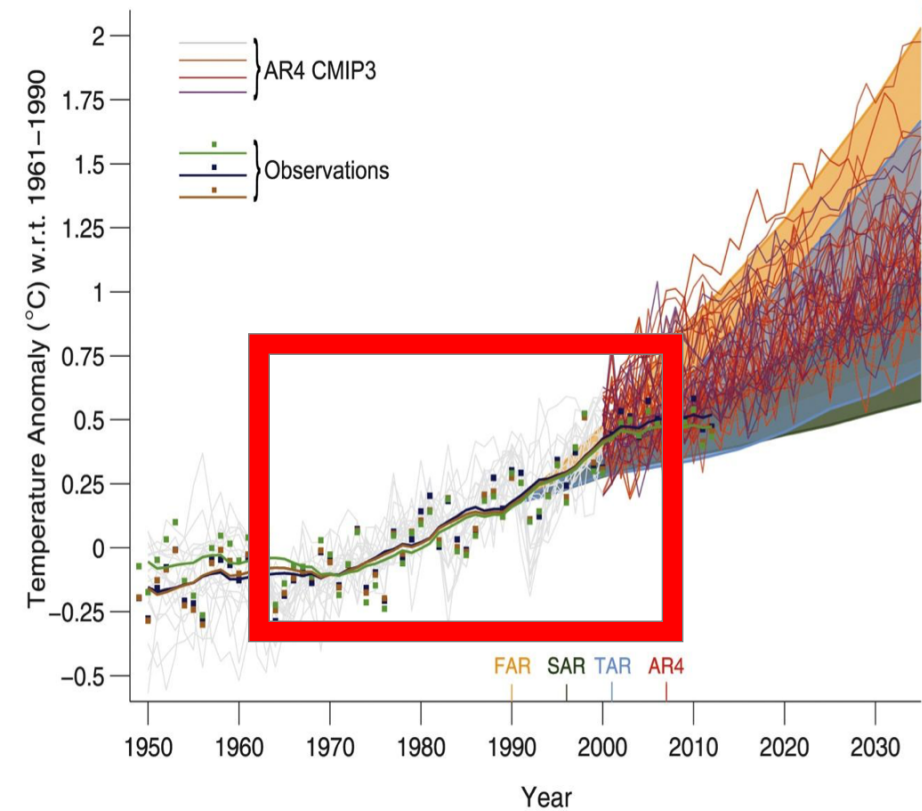
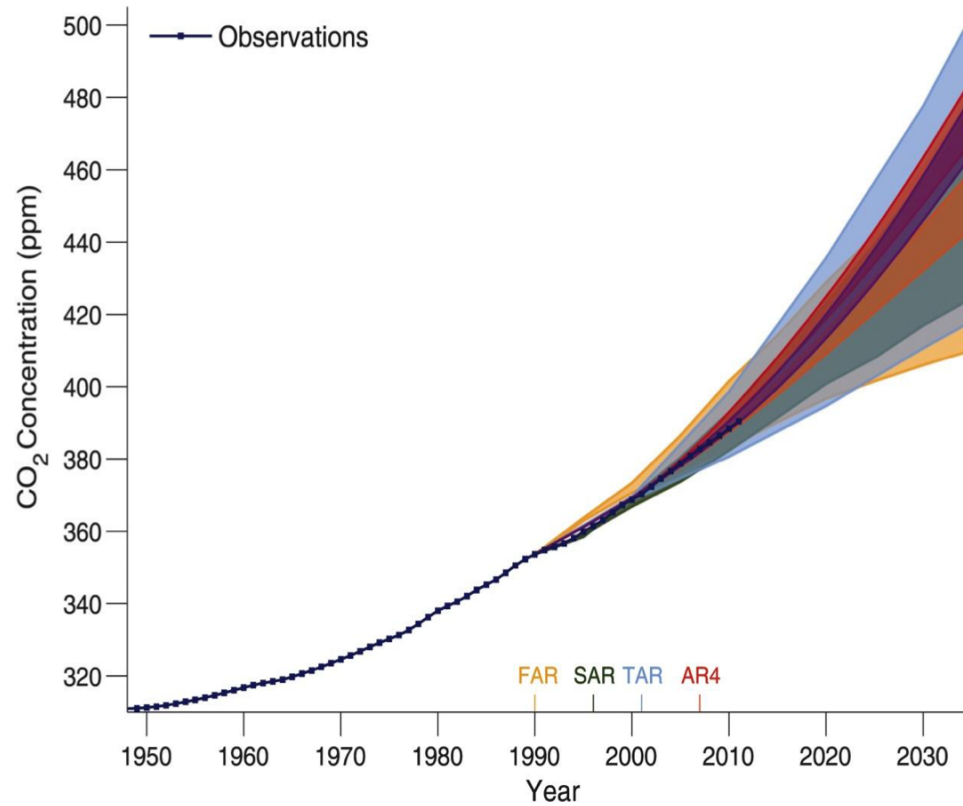
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CO₂ emissions and temperature

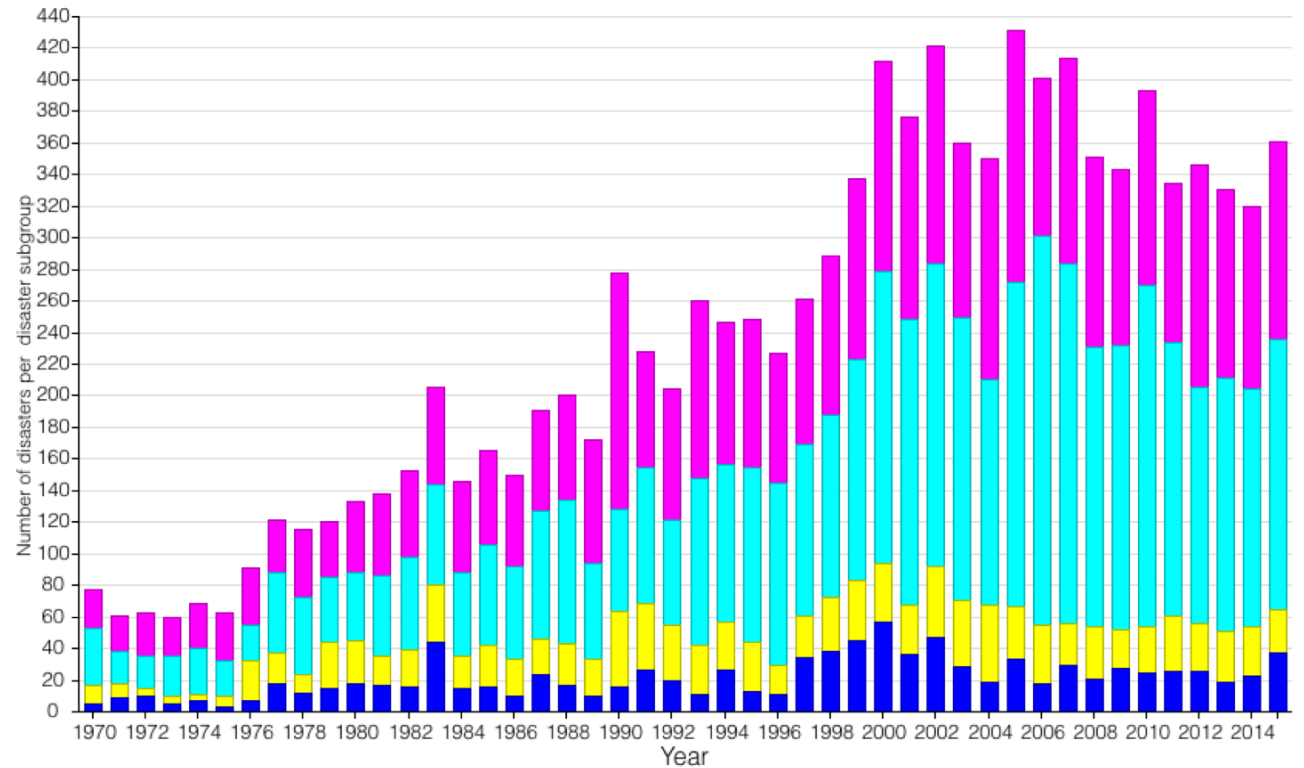
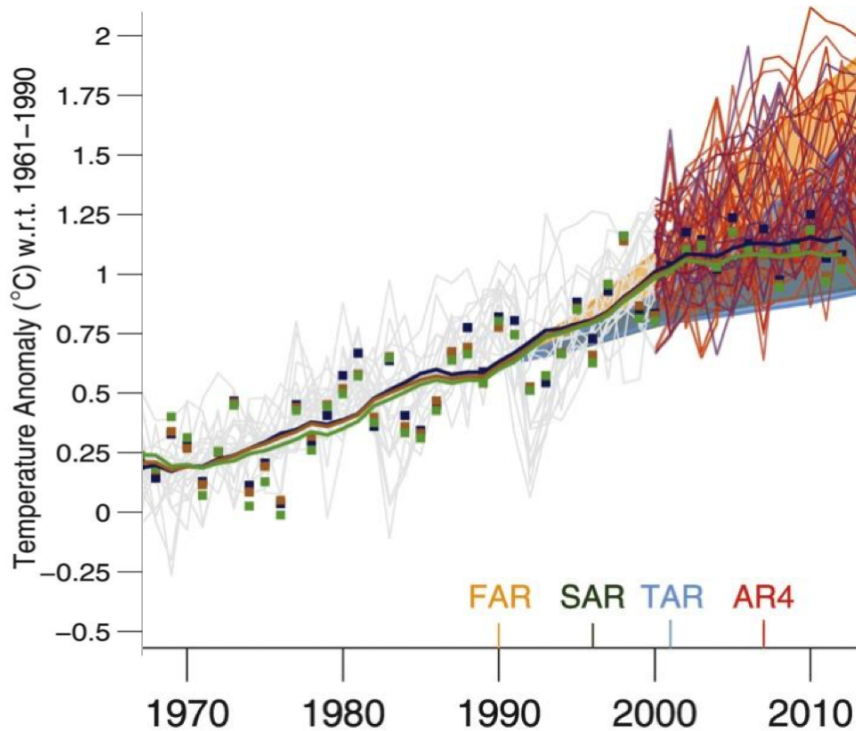
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IPCC AR5 (2013)

Disasters due to natural events

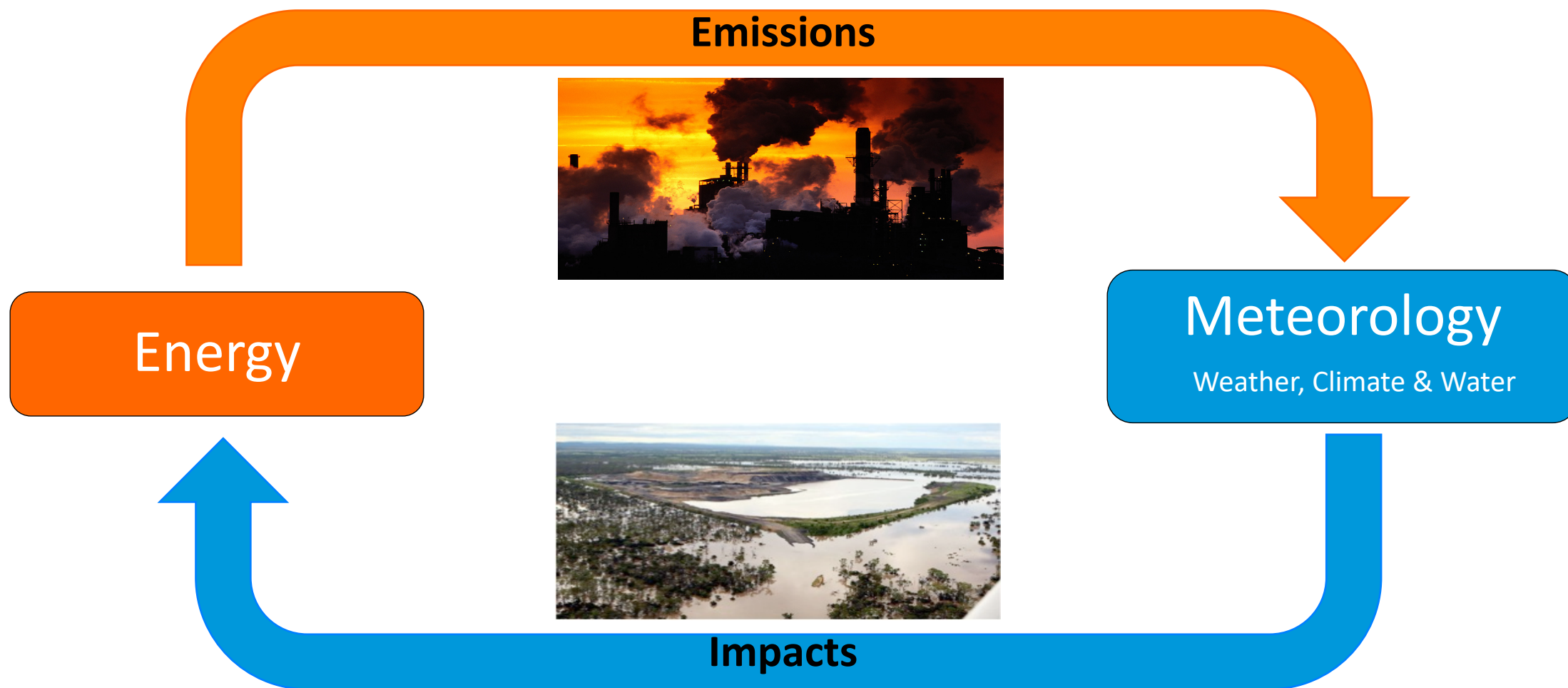
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EM-DAT (2016)

Simplified Energy & Climate feedback

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Climate impact on coal mines

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Climate impacts on hydro-power

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Masinga Dam Water levels in different Years



Climate impact on nuclear power

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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

Energy and meteorology go hand in hand

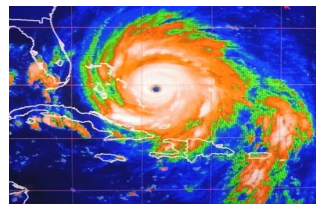
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Passing clouds



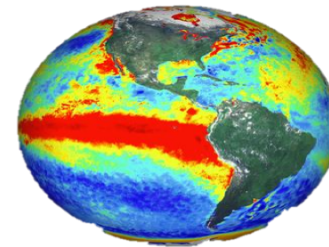
Drop in solar power



Hurricanes



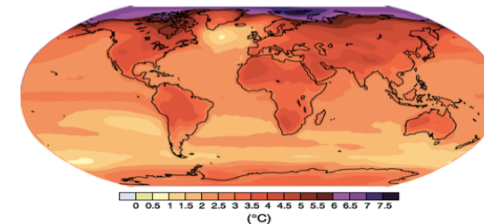
Disruptions to oil rig operations



El-Niño



Changes in Demand Patterns



Long term changes



Renewable Resource Assessment

Seconds

Minutes

Days

Months

Seasons

Years

Decades

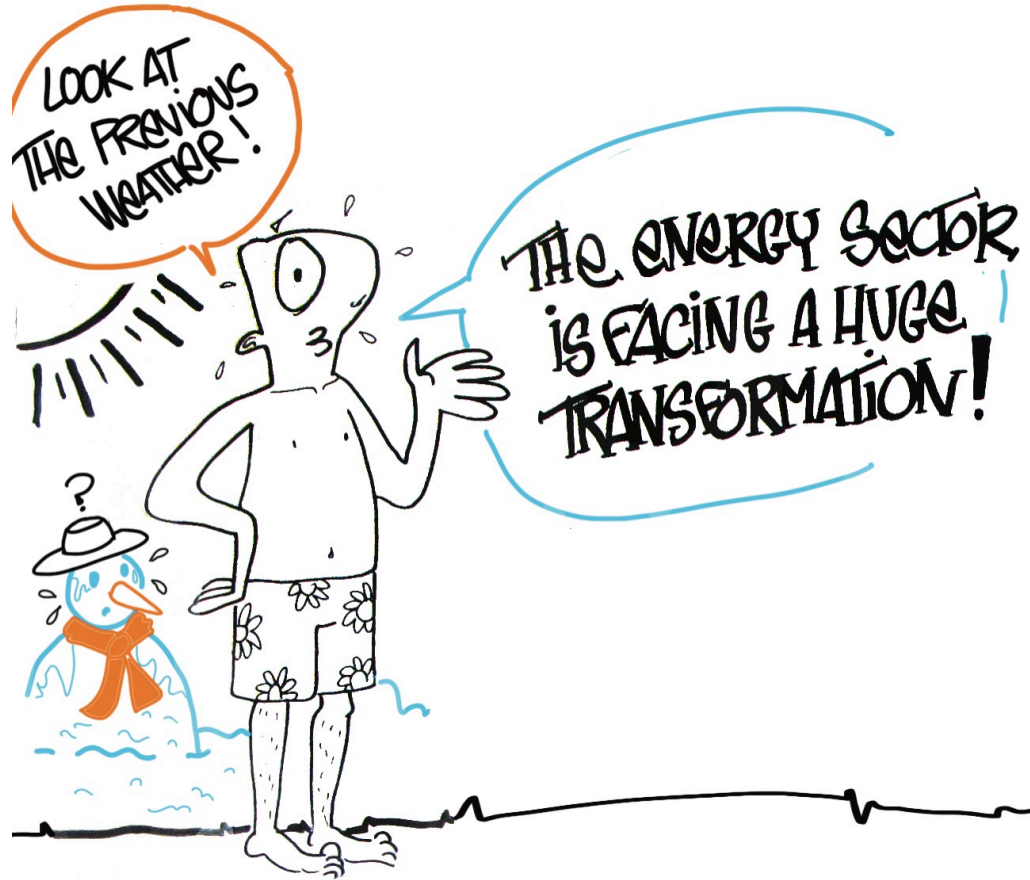
Climate impacts Energy in many ways

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Huge transformation for Energy

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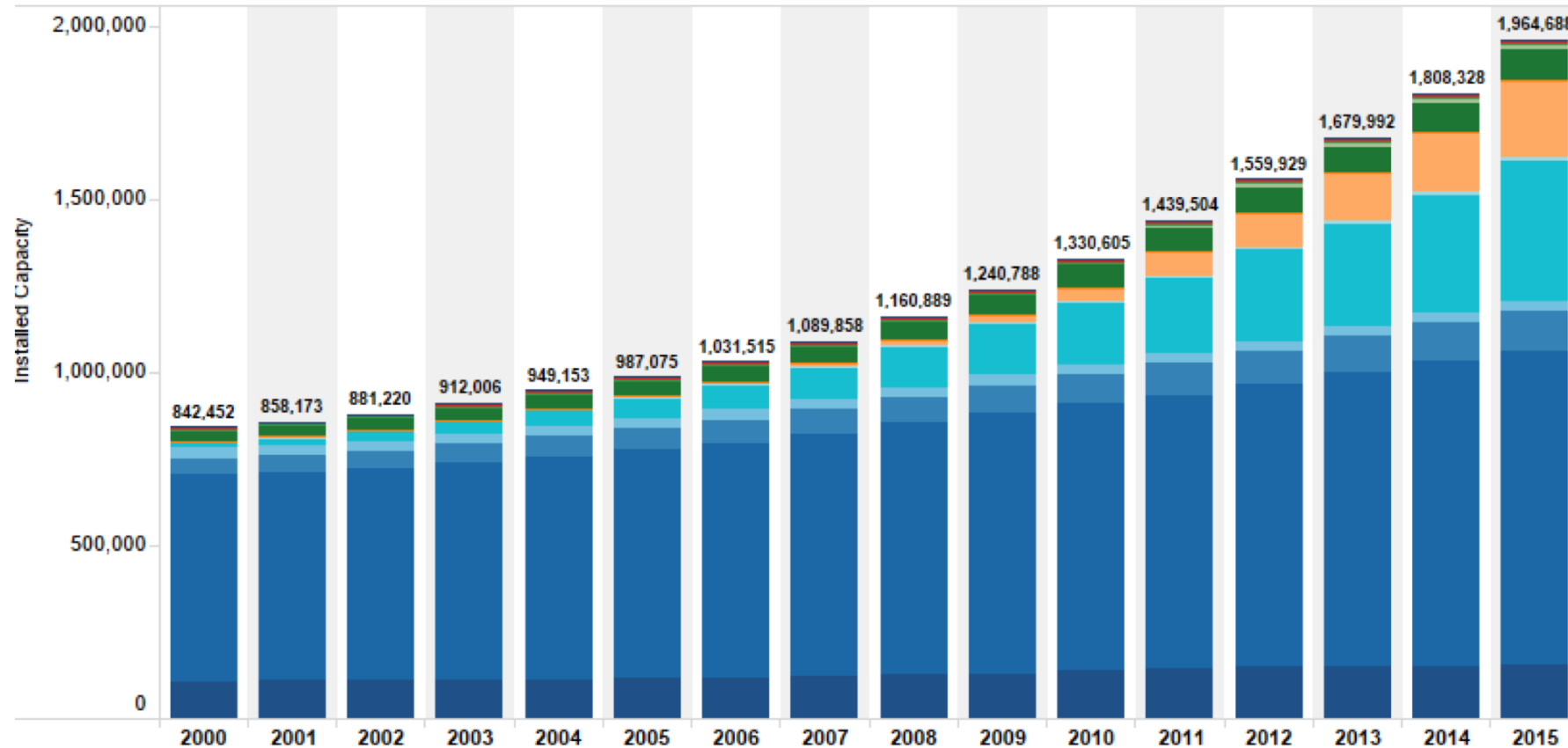


Increasing share of power supply from variable renewable energy sources. Demand variability is also increasing.

The transformation is taking place against a variable and changing climate.

Strong growth in renewables

Renewable Energy Power Capacity and Electricity Generation



IRENA (2016)







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Wind power: an old technology

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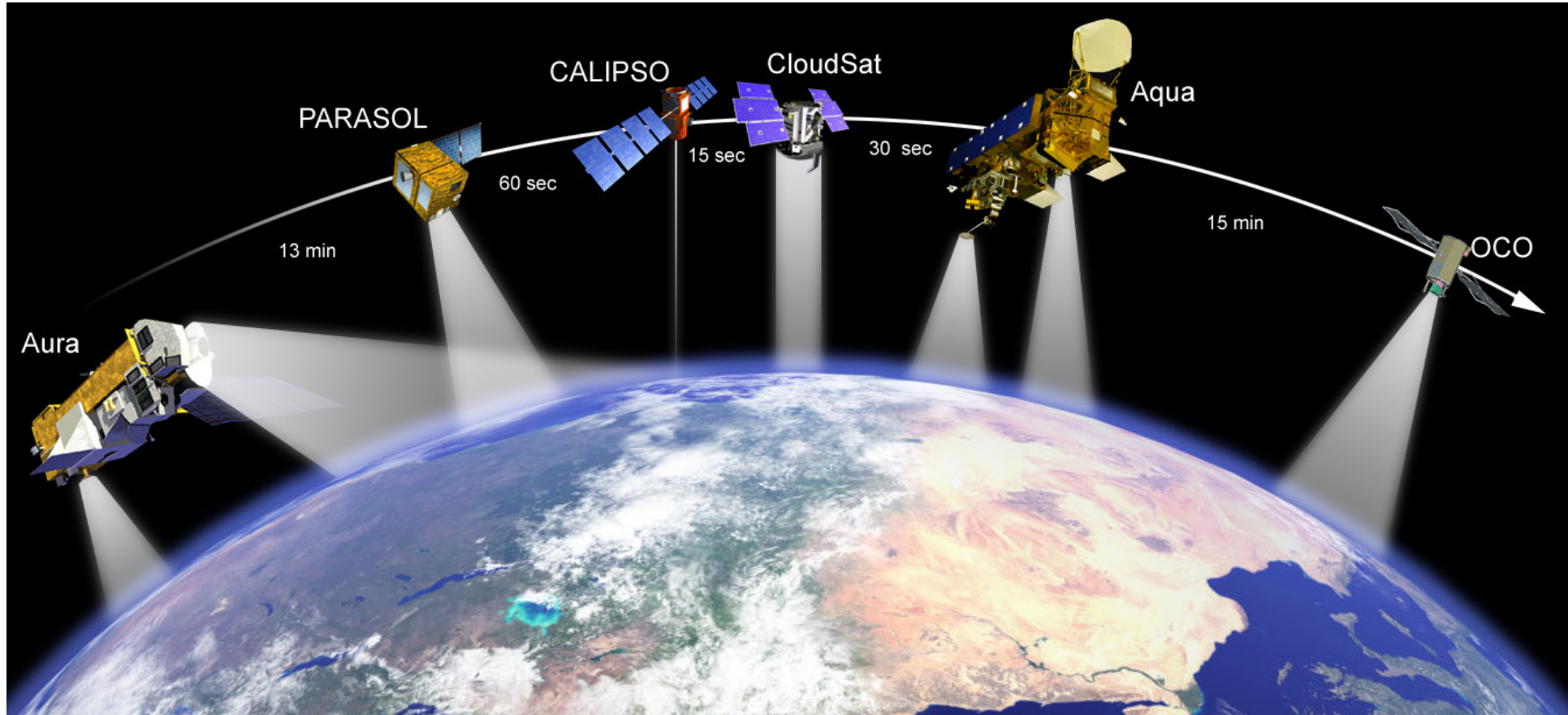




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Solar power is an old concept too





Earth from the Ground

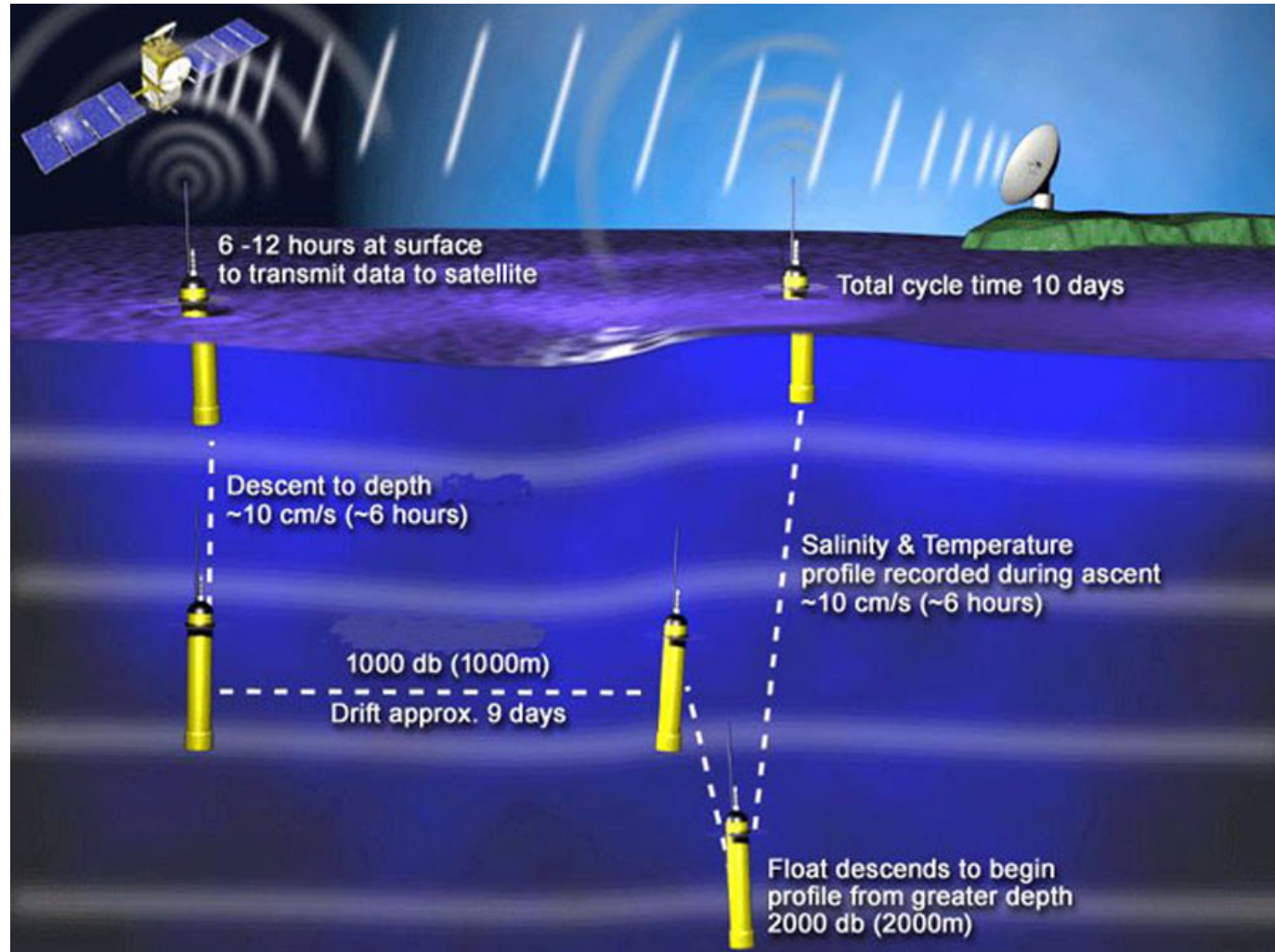
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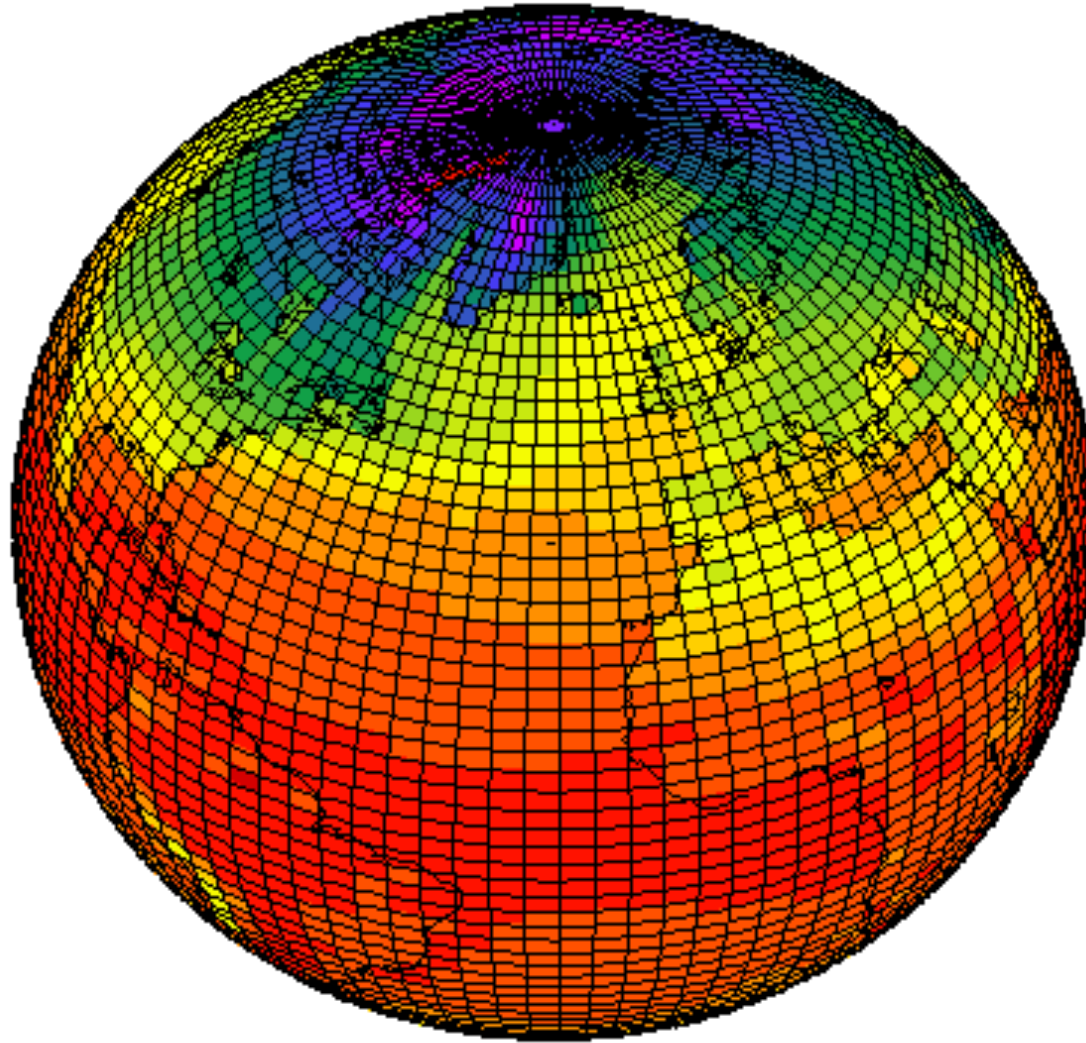
Monitoring the Oceans

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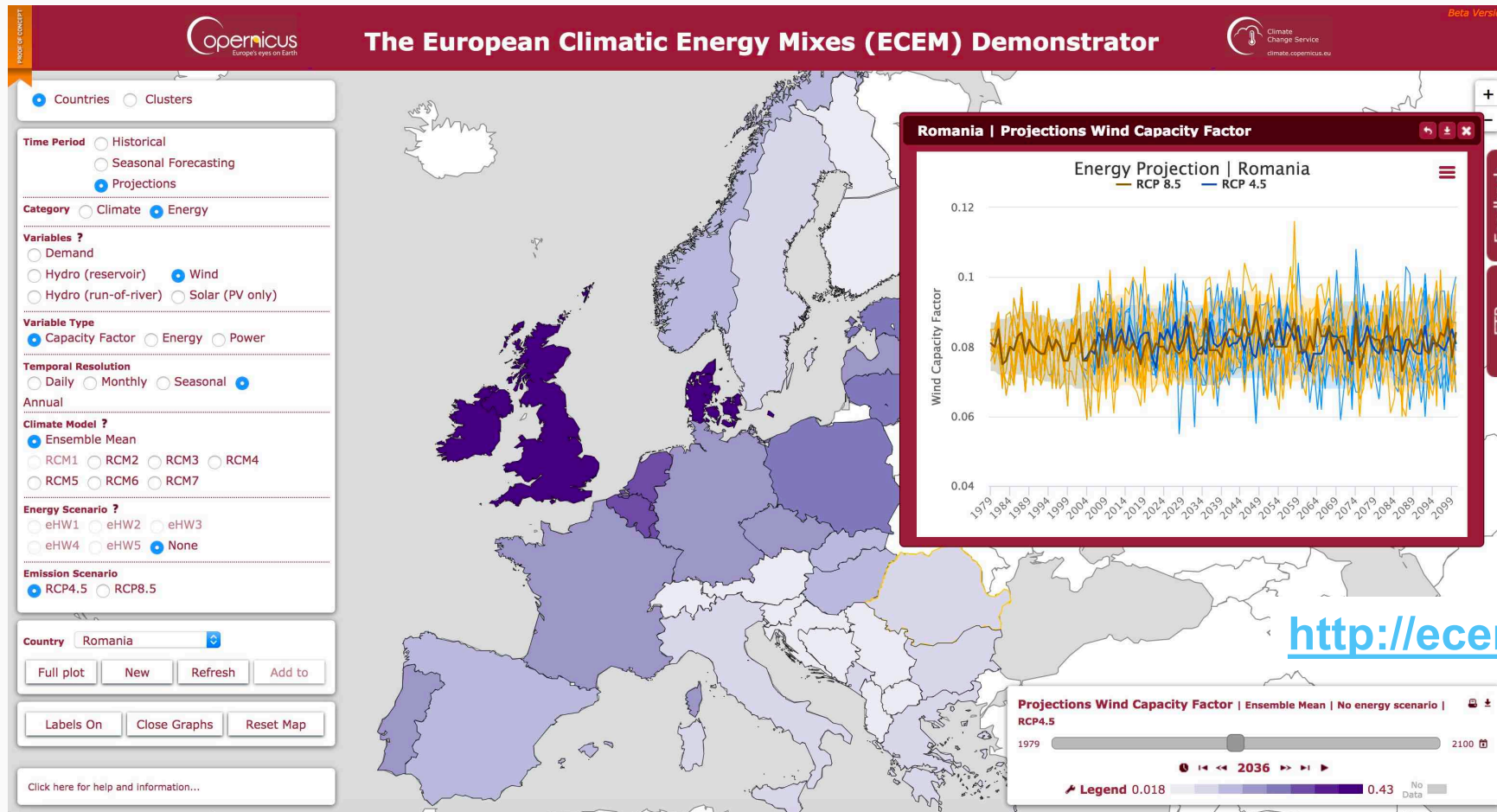


Modelling the Climate

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An online interactive tool to test energy mixes



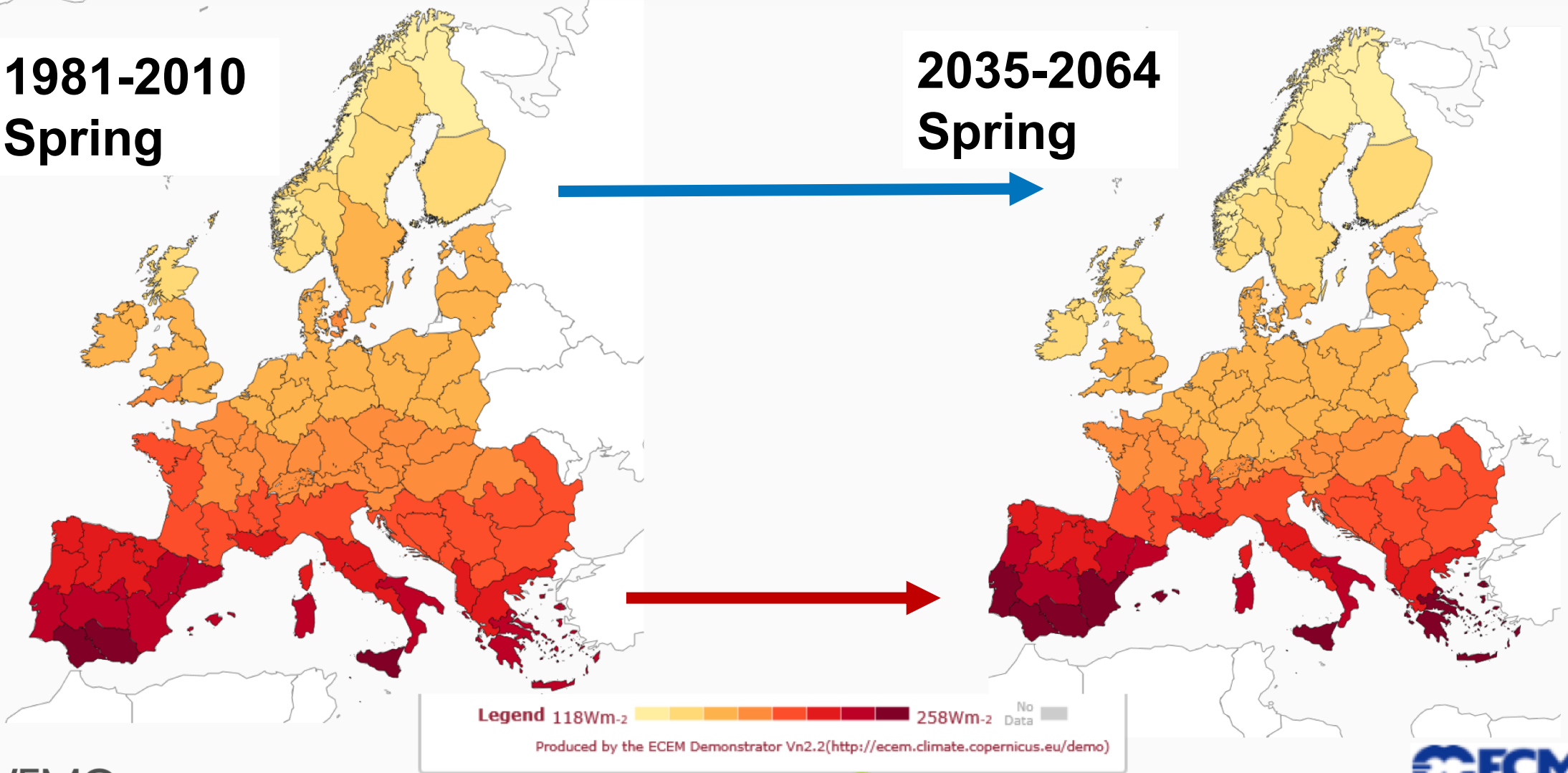
<http://ecem.climate.copernicus.eu/demo>



Climate Projection (RCP 8.5) Radiation

**1981-2010
Spring**

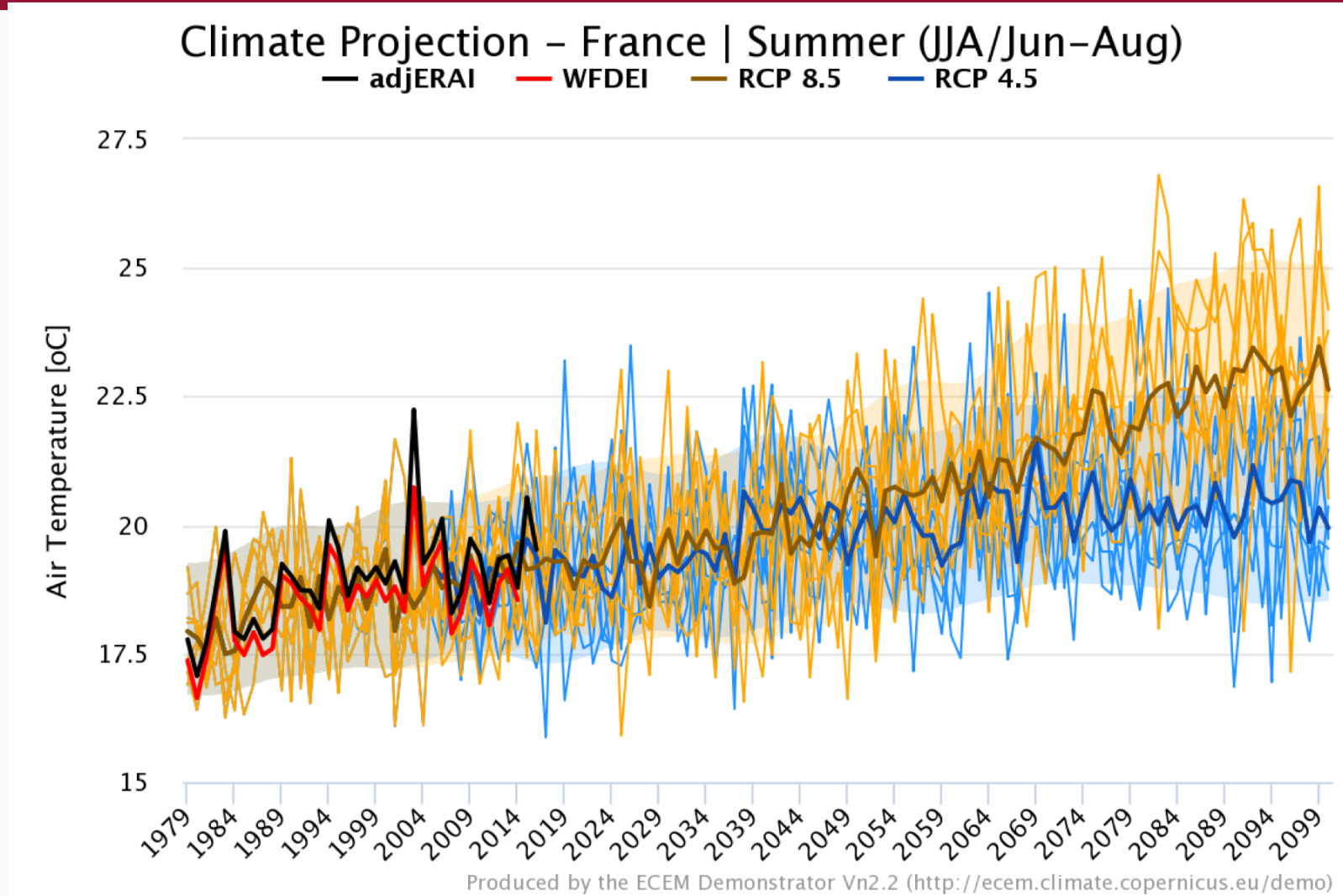
**2035-2064
Spring**



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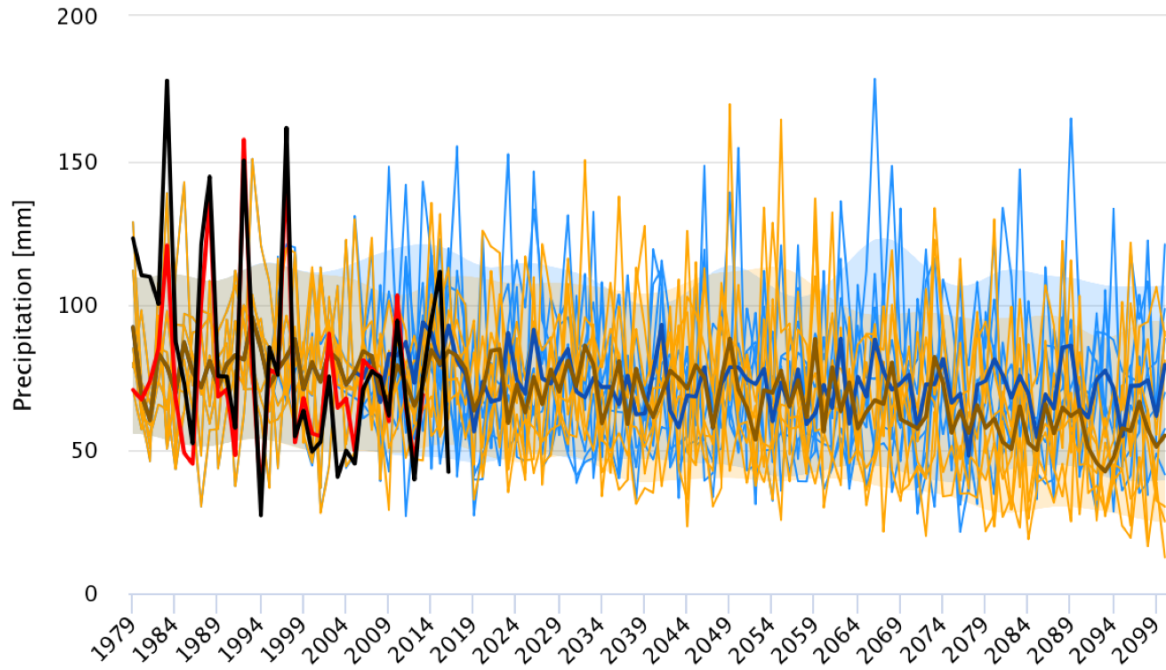
Climate Projection time series – Temperature



Climate Projection time series – Precip and Wind

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

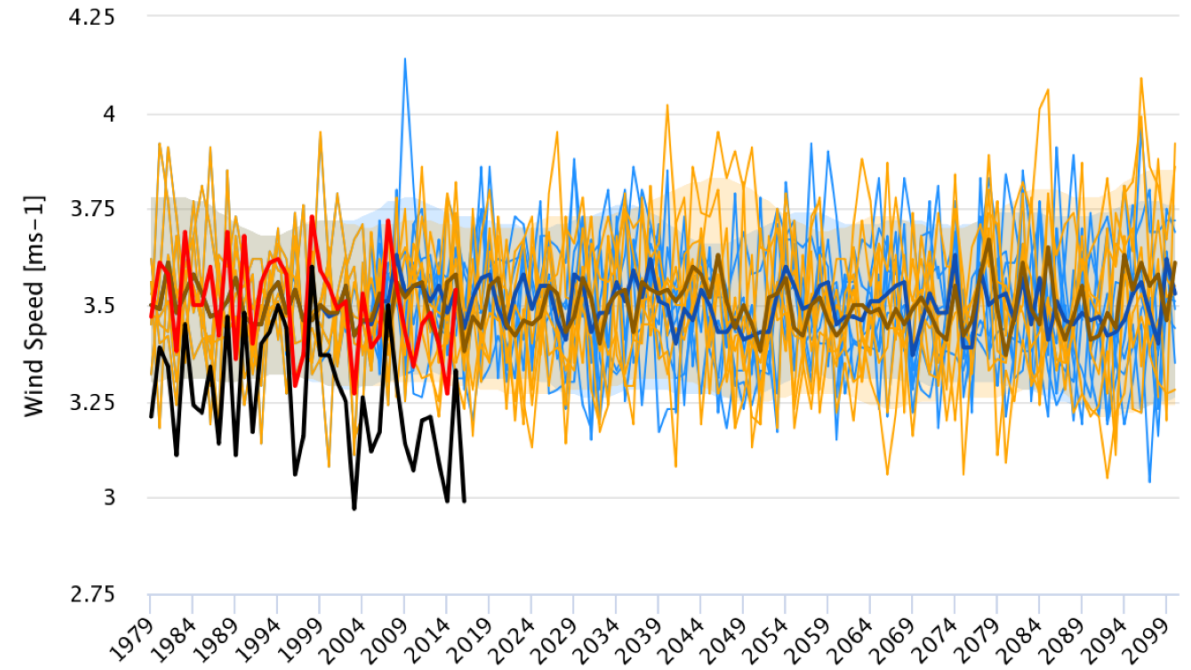
— adjERA1 — WFDEI — RCP 8.5 — RCP 4.5



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

Climate Projection – Germany

— adjERA1 — WFDEI — RCP 8.5 — RCP 4.5



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

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>

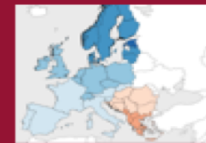
Date of publication: 12 June 2017



EUROPEAN CLIMATIC ENERGY MIXES (ECM)

EVENT CASE STUDY ECM CS 001

Winter 2009-2010



*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 2010 saw amongst the coldest seasonal temperatures and highest power demand in recent history across much of northern Europe, which can be seen in the ECM demonstrator
- 2 The impact of a winter like 2010 would be greater today given the increase of renewables in the energy mix. For the UK, the ECM historical reanalysis shows a significant drop in wind power capacity factor if 2010 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 has been valuable for gaining insight into the winter 2010 event and can be used to study other extreme events
- 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 reanalysis dataset provides the ability to:
 - Investigate an event or type of event in the context of recent history
 - Ask 'what if' questions based on today's energy mix and the climate drivers
- 2 The Demonstrator can be useful for anticipating future risks through:
 - Seasonal forecasts
 - Climate projections

For more information visit
www.ecem.climate.copernicus.eu
or contact the ECM team at
support@ecem.climate.copernicus.eu

Version 2, Date of publication: 1 September 2017



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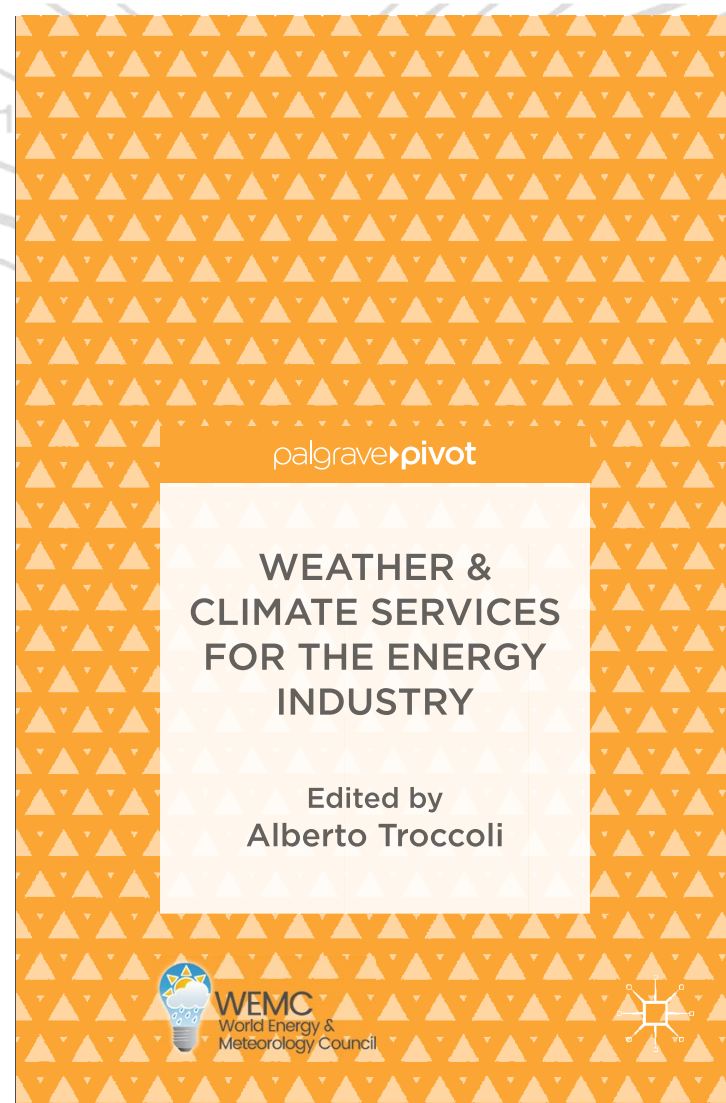
University of
Reading



Find out more about C3S ECEM

For more information on the Copernicus Climate Change Service (C3S) European Climatic Energy Mixes (ECEM) project, and/or to provide your feedback, please visit:

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



To download it (it's free!), please visit:

<https://link.springer.com/book/10.1007%2F978-3-319-68418-5> or
<http://www.wemcouncil.org/wp/resources/>



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Final Thoughts

**ANYTHING WE DO REQUIRES
ENERGY**



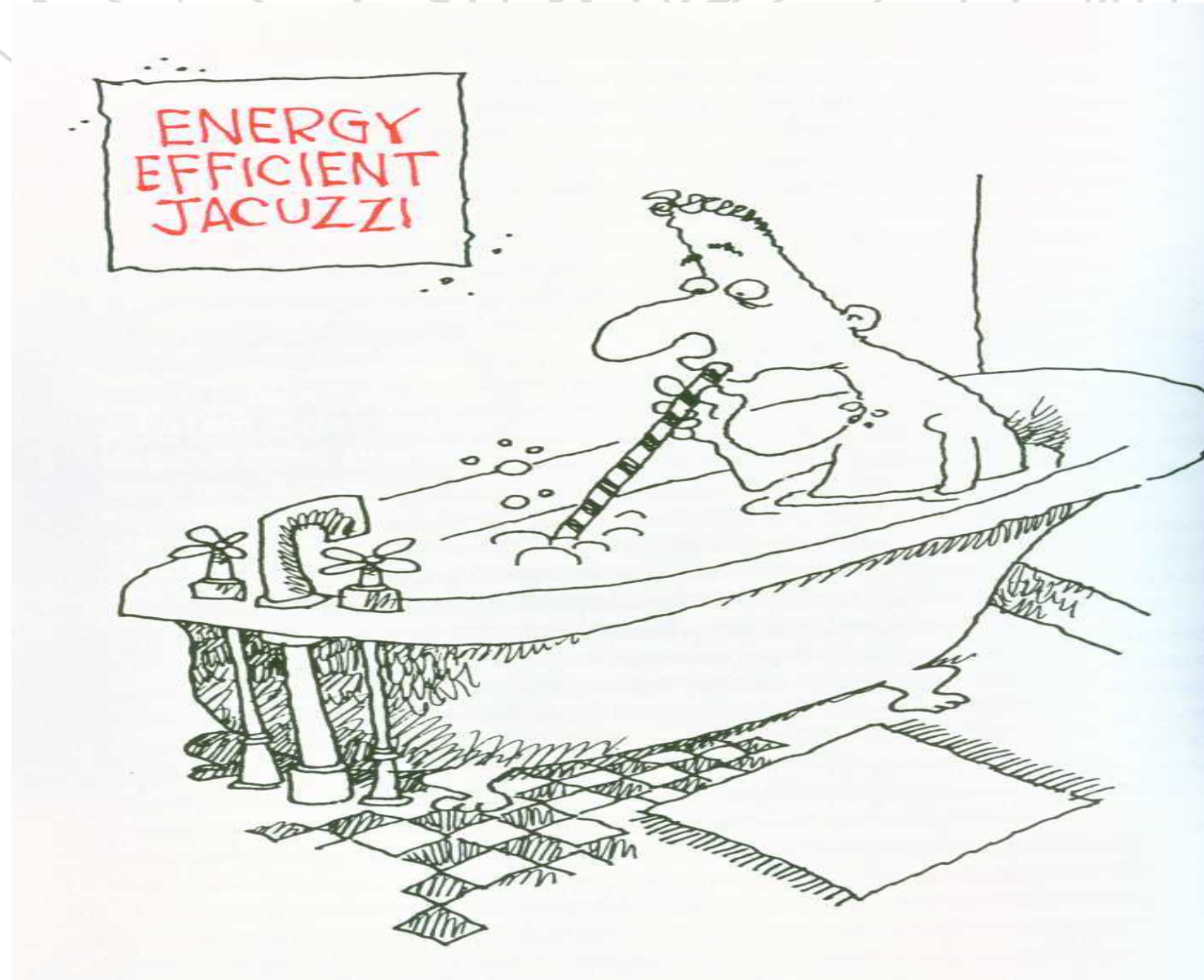
Even if your action won't
make a huge difference ...
think of what happened if
7 billion people did the
same thing.

**So, why not start making
your little contribution!**





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THINK BIG

How the Proposed Renewable Energy Network Might Look

-  Solar CSP
-  Wind
-  Hydro
-  Solar PV
-  Biomass
-  Geothermal





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Thank You



www.wemcouncil.org



info@wemcouncil.org



+44 (0)20 3286 3250

The Enterprise Centre, University Drive, University of East Anglia, Norwich NR4 7TJ. UK



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WEMC primary goal is to enable improved

Sustainable energy

For a low carbon economy

Resilience

Of energy
infrastructures

Efficiency

Of energy systems

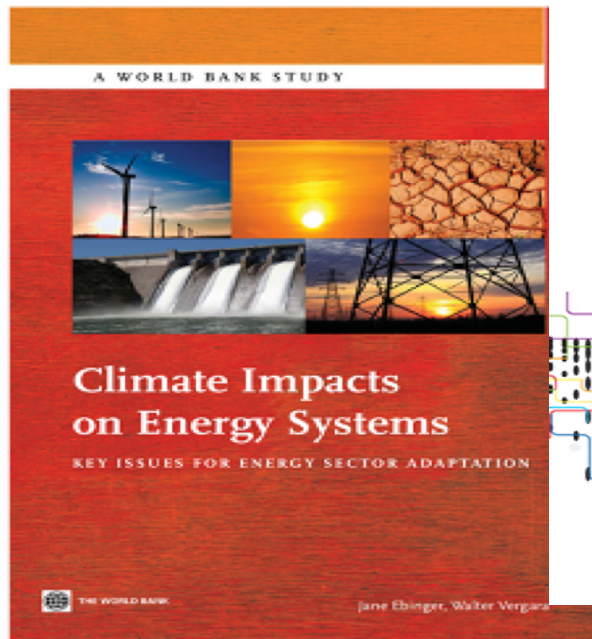


Under ever changing weather and climate

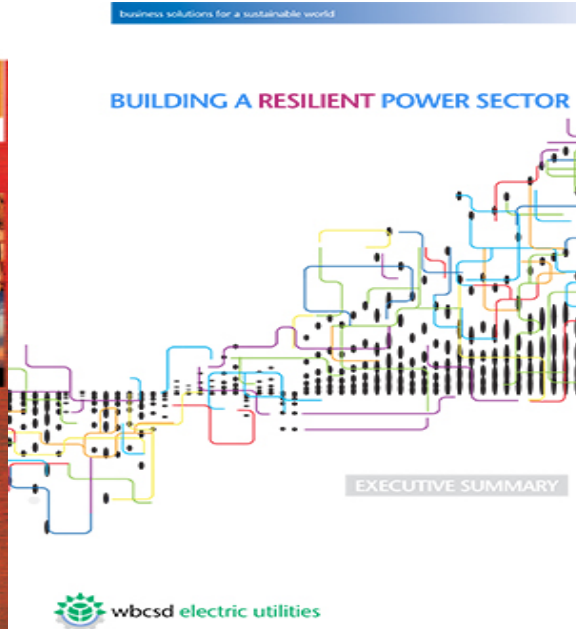
1. The **dissemination of information** on products, practices, and experiences in Energy & Meteorology including the promotion of our members' work
2. The **coordination of Special Interest Groups** leading to the production of reports, analyses and syntheses on key topics in Energy & Meteorology
3. The development and maintenance of **climate and energy demonstration tools** for the energy industry and the education of the general public
4. The **organisation of events** such as the International Conference Energy & Meteorology (ICEM), professional workshops, seminars and webinars

A selection of publications

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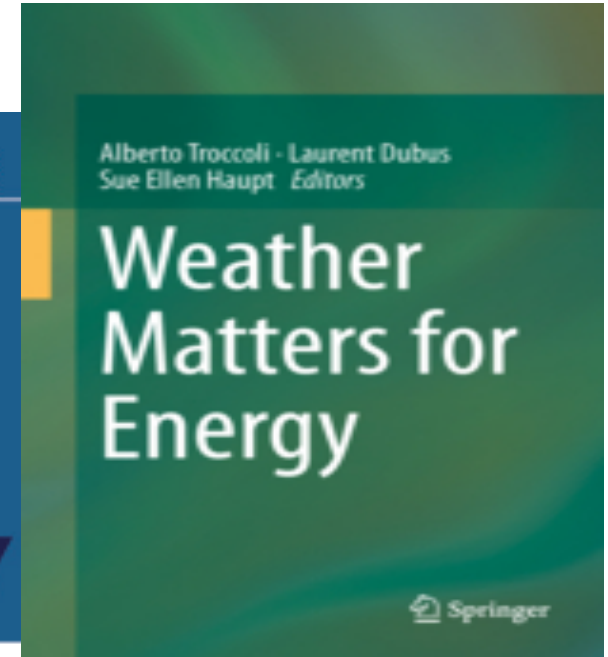
World Bank (2010)



WBCSD (2014)



WEC (2014)



ICEM (2014)