The Potential of Atmospheric Science to Guide the Transformation of the Power System

Melinda Marquis

AMS Perspective

UVIG Forecasting Workshop
Session 1: Meteorology, Climate and the Electric Sector, June 20-22, 2017

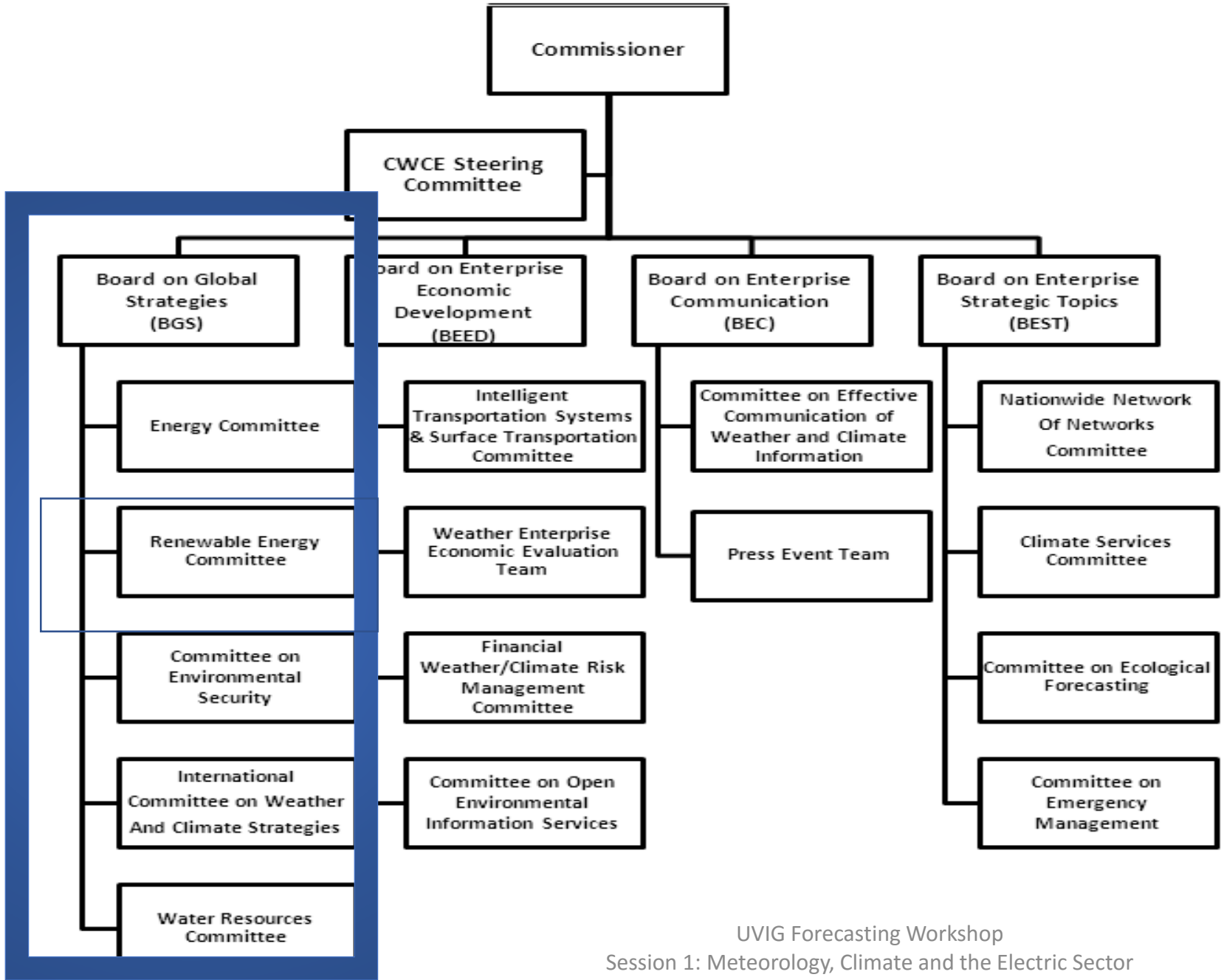
American Meteorological Society Renewable Energy Committee

AMS Renewable Energy Committee

Purpose:
Promote intelligent integration of weather, climate, and atmospheric science on the siting, performance, and reliability of renewable energy sources by closely interacting with the renewable energy industry toward the mutual benefit of all parties.

Co-Chairs:
Justin Sharp and Jerry Crescenti

The AMS **Policy Statement** on Energy Sector and Earth Observations, Sciences, and Services



AMS REC Planning to Hold an Energy Summit

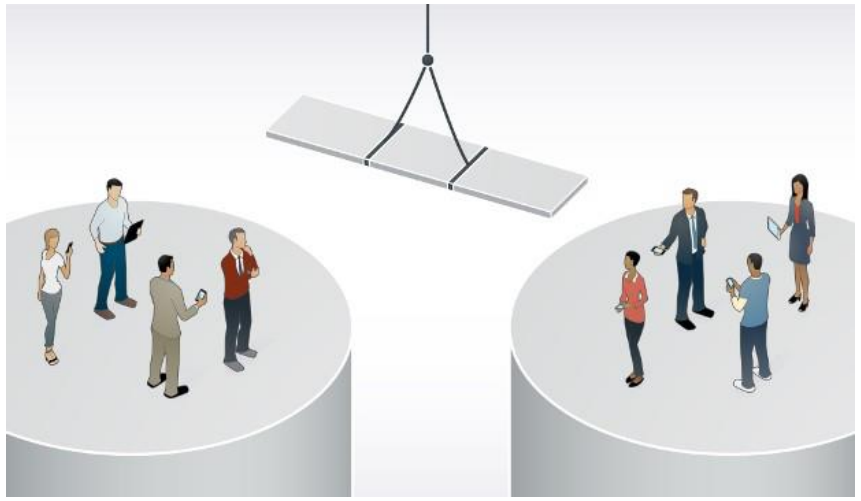
- Committed to organizing a productive meeting that complements and adds value to existing meetings, especially the UVIG forecasting meeting
- Atmospheric science is currently underutilized by the energy sector. Continuing underutilization will lead to sub-optimal results and higher electric prices.
- Plans to draft a white paper explaining how atmospheric science could be more fully implemented in the energy sector, prior to summit meeting.
- During the summit meeting, the white paper may be revised and ratified.
- Aim to provide a guide to policy-makers and industry executives on how meteorology can be leveraged throughout the entire cycle of the power system: generation and transmission planning, system operations, market design and practices, financing, policymaking, etc.

Wind and Solar Power are ”Weather-fuels” with characteristics different from those of fossil fuels

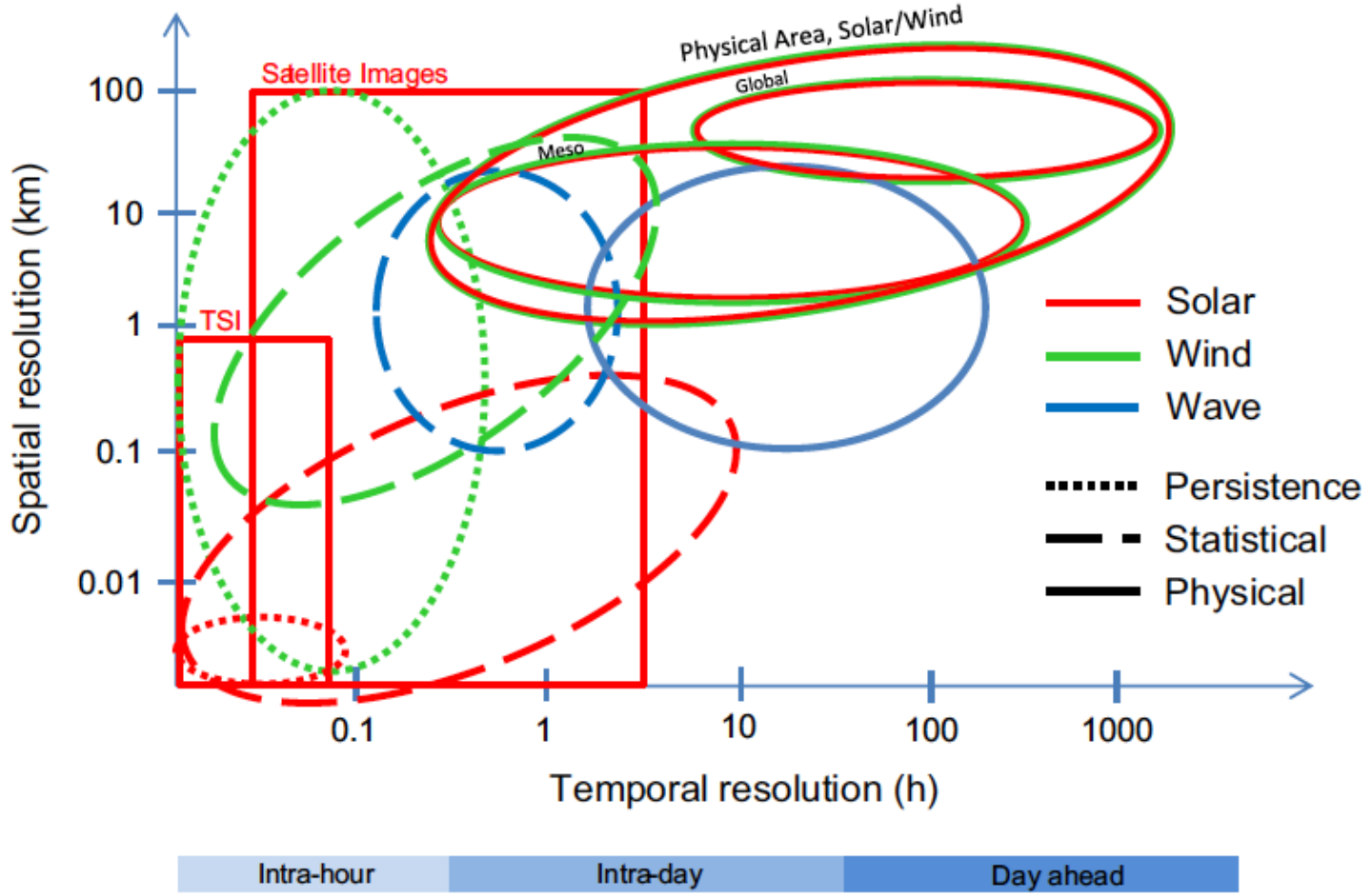
Today, fossil fuels are the primary fuels. Tomorrow, the weather will be the main fuel.

AMS Energy Summit and White Paper Topics

- Value in integrating weather and climate information into all aspects of the power system.
- This would require breaking down silos that currently exist among various areas of expertise: engineers, resource assessors, financiers, transmission planners, grid operators, markets, regulators, policy-makers and atmospheric scientists.
  - Forecasting
  - Optimized siting generation and transmission
  - Systems approach
  - Impacts of climate and climate change on grid



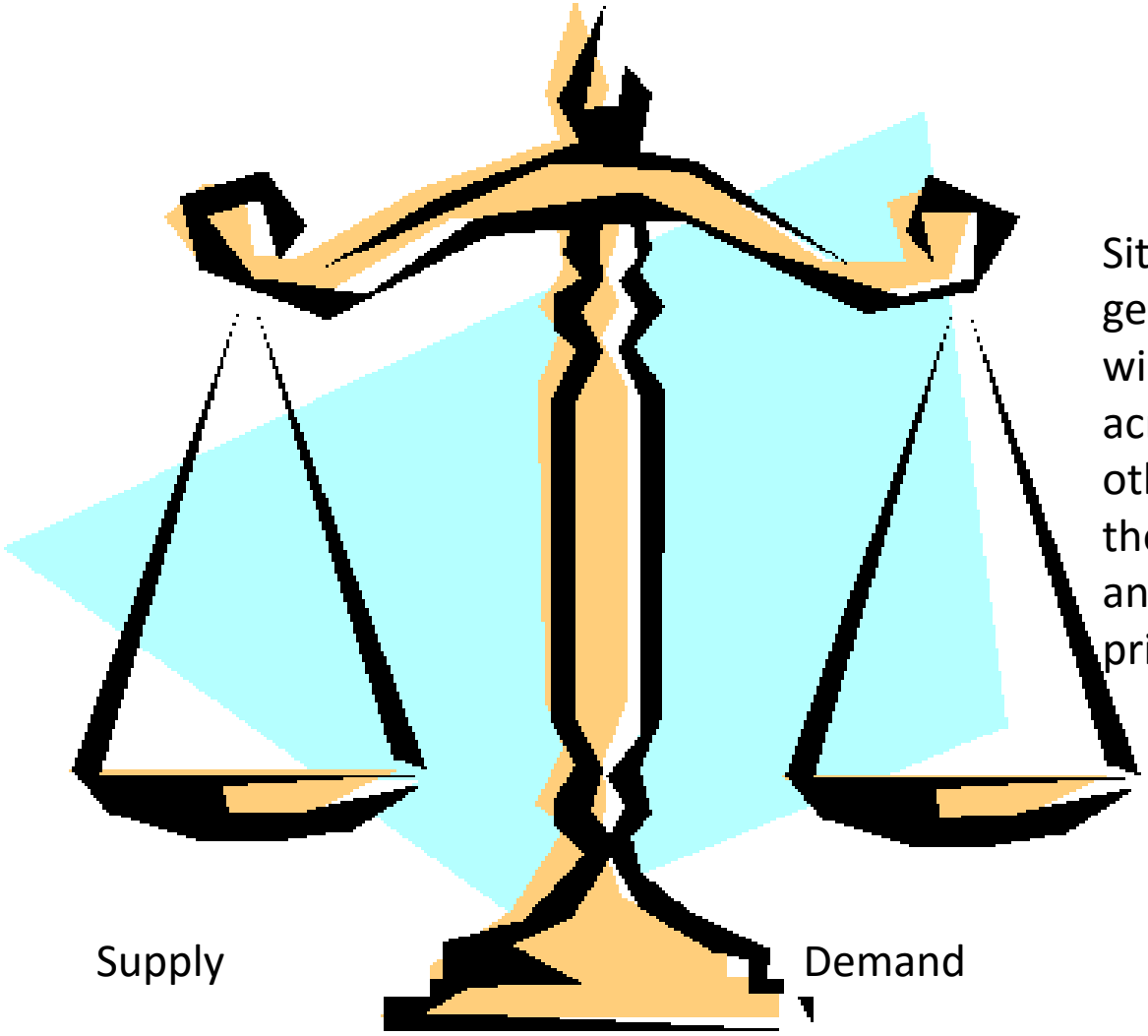
Renewable Energy Forecast Methods



From Widén et al. 2015, Renewable and Sustainable Energy Reviews, 44, 356-375.

A Systems Approach is Needed to Transform the Power System to One that is Primarily Fueled by Weather

Current siting is incentivized by policies (PTC & ITC) reward the greatest power production (AEP). Current policies do not take into account whether the expect power will help meet load, especially during peak demand or during anomalous weather conditions.



Siting future wind and solar generation plants informed by hov wind and solar resources vary across space and time, with each other and with load, woud obviate the need for unnecessary back-up and therefore yield reduces power prices.

Climate Change Impacts on Power System

- Extreme weather events are affecting energy production and deliver facilities, causing supply disruptions of varying lengths and magnitudes and affecting other infrastructure that depends on energy supply. The frequency and intensity of certain types of extreme weather events are expected to change.
- Higher summer temperatures will increase electricity use, causing higher summer peak loads, while warmer winters will decrease energy demands for heating Net electricity use is projected to increase.
- Changes in water availability, both episodic and long-lasting, will constrain different forms of energy projection.
- In the longer term, sea level rise, extreme storm surge events, and high tides will affect coastal facilities and infrastructure on which many energy systems, markets, and consumers depend.
- As new investments in energy technology occur, future energy systems will differ from today's in uncertain ways,. Depending on the character of changes in the energy mix, climate change will introduce new risks as well as opportunities.

Increase in Cooling Demand and Decrease in Heating Demand

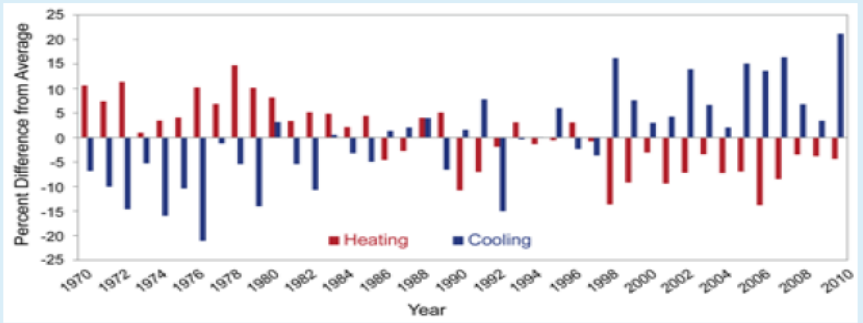
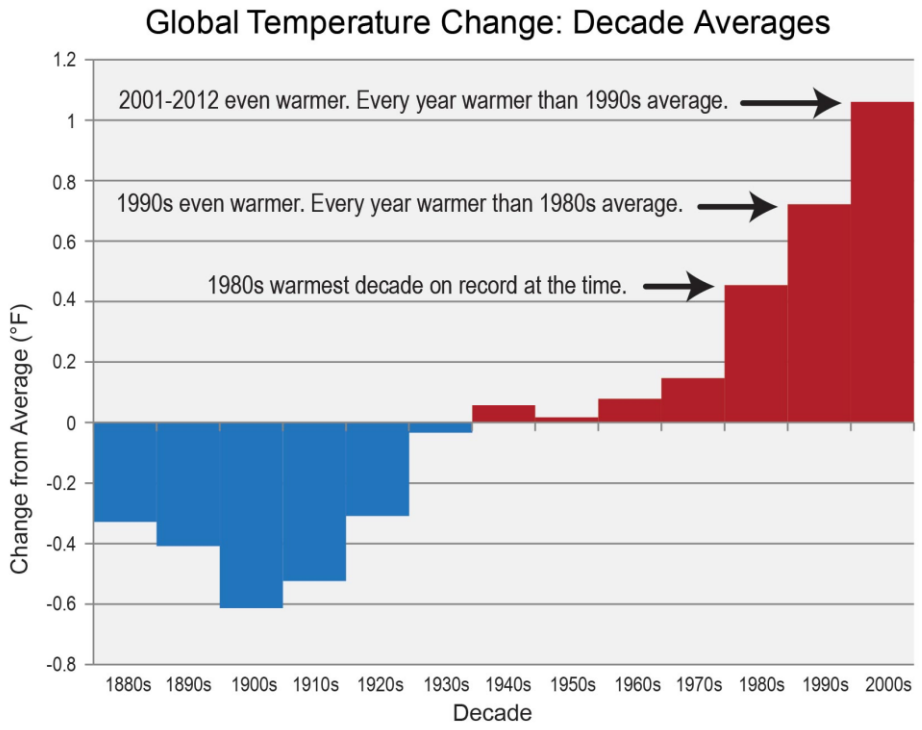


Figure 4.2. The amount of energy needed to cool (or warm) buildings is proportional to cooling (or heating) degree days. The figure shows increases in population-weighted cooling degree days, which result in increased air conditioning use, and decreases in population-weighted heating degree days, meaning less energy required to heat buildings in winter, compared to the average for 1970-2000. Cooling degree days are defined as the number of degrees that a day's average temperature is above 65°F, while heating degree days are the number of degrees a day's average temperature is below 65°F. As shown, the increase in cooling needs is greater than the decrease in heating needs (Data from NOAA NCDC 2012[16]).

The Third National Climate Assessment, Chapter 4: Energy Supply and Use.

Climate Change Impacts on the Power System



As the Earth system warms, the temperature gradient from the equator to poles decreases. How will this impact winds and solar irradiance (e.g., clouds) and therefore the fuel for wind and solar plants?

The AMS REC white paper and Energy Summit will help to bring together the multiple disciplines and areas of expertise needed to transform the energy sector to one that will increasingly use weather-fuels.