THE CLIMATE RESILIENT GRID FORUM

Marjorie McGuirk, Stephanie C. Herring, and Jenny Dissen

The U.S. Energy Information Administration forecast that nonhydroelectric renewables would rise, from 2% in 2005 to a total of 10% of electricity generated in 2018 (DOE 2004). Wind, solar, and hydropower are not only essential for meeting energy demand, they are also cost competitive with conventional generation (Lazard 2018). Calling renewables "a foregone conclusion," industry representatives are raising the level of investment in efficient transmission lines and new systems of microgrids. Climate and environmental intelligence is providing essential information in this decision-making process, with the grid on the frontlines.

CLIMATE RESILIENT GRID: A FORUM ON ENERGY, CLIMATE, AND THE GRID

What: More than 70 invited energy industry professionals attended or spoke about the role of renewables, the role and value of environmental information in the energy generation and delivery system, and opportunities for catalyzing climate services to serve the energy industry.
When: 14–15 June 2017
Where: Asheville, North Carolina

The Climate Resilient Grid: A Forum on Energy, Climate, and the Grid convened thought leaders from industry, government, and academia to determine the use of environmental and climate data for meeting industry needs in both energy delivery and bringing renewables online for an integrated energy future.[1] Utilities executives shared perspectives on their climate risks and vulnerabilities, use of climate data, the current state of their grid, and the future of renewables in their portfolio. Solution providers shared their use of environmental information in asset planning, resilience strategy, and load planning. Thought leaders discussed the critical use of renewables and the right mix of energy to build an adaptive infrastructure, while reducing carbon dioxide. In all, the thought leaders and energy executives noted the role of a changing climate and its corresponding data in energy delivery challenges, and in integrating renewables into the grid. Raising the level of renewables requires efficient transmission lines and new systems of microgrids, which in turn requires climate data, analytics, and environmental intelligence.

Supported by the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (NCEI), the Cooperative Institute for Climate and Satellites–North Carolina (CICS-NC), and CASE Consultants

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[1] Presentations available at www.caseconsultantsinternational.com.

International (CASE), and spearheaded by the American Meteorological Society's (AMS) Committee on Climate Services, the meeting served to explore challenges posed by climate and energy, striving to seek solutions. NCEI[2] and CICS-NC built upon a history of engaging with the energy sector (Arguez et al. 2013) to continue support for climate data research applications. CASE, CICS-NC, and the AMS Climate Services Committee provided subject matter expertise and strategic input.

THE VALUE OF ENVIRONMENTAL INFORMATION. Broadly speaking, the energy system consists of power generation, transmission and distribution lines, and consumption components. With instantaneous supply and demand, each component of a power system requires advanced analytics that maximize efficiency. Weather and climate factor into both operating the components efficiently and into planning the energy assets effectively in the long term.

Weather and climate impact every component of the energy system and environmental data "is used across the enterprise for risk assessment," Daniel Kassis of energy-based holding company SCANA said. CEO and founder of the Resilient Grid, Michael Legatt, added, "We need climate scientists to make it clear that we are heading for a new normal and any system as complex as the energy grid requires understanding that variability and uncertainty are inherent in the complexity of how the energy generation and delivery system works."

The power industry relies on quality observational data to choose what power plants to build, select transformer size, prepare for summer daily demand patterns, and optimize operational efficiency. An effective example of the many applications showing the value of publicly available data, the demand for authoritative products from NCEI, and how both the public- and private-sector service providers are supporting the energy sector, is the use of climate "normals" in rate setting.

Describing normals as "one of our most popular product lines," NCEI climate scientist Russ Vose explained that normals monitor changes in the climate, and also serve as a predictive tool, by showing trends in climate variables. As the climate continues to warm rapidly, however, historical trends are becoming less predictive of future patterns. These climate changes are coupled with changes in energy consumption patterns through an increased demand for air conditioning and a decrease for heating. Though NCEI's traditional climate normals are 30-year historical averages of climate variables, updated every 10 years, the warming trend is for the energy industry to ask for normals to be calculated differently (Arguez et al. 2013). Hence, NCEI now produces a range of alternative normals, covering 1-, 5-, and 30-year periods, and the industry self-selects the product that is most valuable to its decisions.

Continuing the discussion of normals, a representative of Philadelphia Gas Works confirmed the usefulness of alternative normals. Owned by the City of Philadelphia, the company has a rate structure that differs from utility-owned structures. With a warming trend in recent decades, the company began losing sales volume. To normalize revenue to the level granted in the company's most recent base-rate case, a real-time weather normalization adjustment is applied to each billing cycle. It applies a credit to customer bills when it is colder than normal, and a charge to bills when it is warmer. Clear, authoritative NOAA references to cite supported this most recent base-rate case, where the company proposed using 10-year weather normals to project pro forma revenues. Approximately 30 utilities have moved toward the most progressive weather normal, such as rolling weather averages and trending weather averages. NOAA's switch from 30-year normals to new, nontraditional normals was key. If they "had just stayed at 30-year normals the increase in rates would have been significantly different," Philadelphia Gas Works Vice President Gregory Stunder said.

Additional areas where industry leaders expressed interest in improved environmental information included sea level rise, inland and coastal inundation, improved temporal resolution, solar irradiance, temperature extremes, the "new normal," extreme weather, and extended historical data including paleoclimatological data. For more details on these specific examples see the online supplement.

Long-term thinking involves transitioning to a new normal. Legatt stated that, "We need climate scientists to make it clear that we are heading for a new normal" and any system as complex as the energy grid, requires understanding that variability and uncertainty are inherent in complex work. In making transformational changes for climate resiliency it is important to distinguish between reliability of (as in hardening against short-term outages) and resilience

[2] NCEI, with headquarters in Asheville, North Carolina, provides access to the world's most comprehensive archive of atmospheric, coastal, oceanic, and geophysical data (www.ncei.noaa.gov).

in a longer-term context. Even if energy companies improve resiliency against extremes of weather and transition to a new normal, unexpected rapid change can greatly increase risks. Scenario plans, with supportive data, are needed to decrease risks and increase long-term resiliency.

KEYNOTE. It was in the realm of scenario planning that the keynote speaker, AMS Past President Alexander "Sandy" MacDonald, presented his research findings (MacDonald 2016). The NOAA-supported study (NOAA 2016) used decades of high-resolution assimilation model data with concurrent electric load data to optimize nation-scale power systems, applying linear programming to minimize overall system costs (Clack et al. 2015). The study found that the contiguous United States can use predominantly carbon-free power sources (Shepherd 2016). Wind and solar are most effective on large scales, and the United States (and other global political entities such as the European Union) is large enough to benefit from the "scale of weather." Variability of wind and solar requires an enabling technology—namely high-voltage direct-current (HVDC) transmission.[3] A nation-wide HVDC overlay, or "supergrid" would be cost effective for moving clean power both long and short distances and would offer substantial savings over the current approach of increasing wind and solar generation within relatively small areas for balancing the energy load. Noteworthy, the cost schema did not include government subsidies nor environmental externalities factors, making the results importantly impressive.

THE ROLE FOR NOAA AND FEDERAL INVESTMENTS IN ENVIRONMENTAL DATA.

Industry leaders stated the need to make new investments to improve both short- and long-term resilience. However, to get funding to support resilience efforts, they must often make a rate case to a utility regulator in their region. An important component of a utilities' justification are the data provided by NOAA because they are regarded as authoritative. While NOAA provides observational data, as well as predictions and projections of future climate that help address some of these information needs, this meeting made it clear that private-sector service providers are using NOAA's information to develop tailored services for specific energy-sector clients. As utility industry executive Michael McPeck put it, "there is a tremendous amount of data but tapping it correctly presents problems," and these client-specific challenges will be addressed through private-sector providers.

Participants stated that they need that "third-party-respected source" of independent measurements that come from NOAA; that it is very useful and informative for industries, adding that "constituents want us to use the trusted NOAA data in [our] weather models." The speakers also found it very useful to be able to refer to the NOAA publications on new weather normals (Arguez et al. 2013), which they called "an incredibl[y] helpful reference for us," adding that "it says NOAA recognizes that this has changed explicitly for planning in the utility industry." Gas executive Pearl Donohoo-Vallettare added that, "There is a lot of acceptance for our measured data, but when we need independent measurement NOAA is a great reference, and what they did with the transition from the 30-year to the other progressive normals really was a shot in the arm for us, and I think you can clearly see that there wasn't a progression to different types of normals until the last 5 years."

Perhaps one of the most important conclusions drawn from this meeting is that there continues to be a high return on investment for federally funded environmental information in the energy sector. Industry leaders gave clear statements of their need for authoritative and transparent data. Federal agencies are most often considered the best sources of reliable data and information, especially as they add scientific rigor and transparency.

IN SUMMARY. Geographical areas across the country experience dramatically different threats and risks to their energy infrastructure. For example, wildfires pose more of a threat in the West, and ice storms accompanied by strong winds and flooding pose more of a threat in the East. The nation's grid has been seeing over the last few years a substantial change in the need to respond to climate events that are affecting the system.

In making transformational changes for climate resiliency it is important to distinguish between reliability of (as in hardening against short-term outages) and resilience on the grid in a longer-term context. Data providers thus have a responsibility to help ensure decision-makers are aware of the data that already exist, and what is being developed (Arguez

[3] High-voltage direct-current (HVDC) technology was first used for electric power transmission over 70 years ago. It has been substantially improved in recent decades. HVDC cables are manufactured in the United States.

et al. 2013). Though decision-makers are excited to discover a new dataset on the NCEI website, it is incumbent upon NCEI to make it known, make it accessible and discoverable, and make it understood and useful. A critical role of climate solution providers is bridging between the scientists and data providers and the decision-makers.

At the close of the session, three key discussion areas emerged, serving as an opportunity for continued engagement with this sector. The first centered on the availability of water quantity and temperature data, both of which are important for power generation. The second centered on effective integration of authoritative climate information in planning and risk management areas, for example in load planning, development and integration of potential new design standards, in analyzing long-term risks to assets, and how climate change risks can be considered in rate or regulatory procedures filing. And the third discussion area centered on big data gaps. Access to high-resolution, precise, and accurate past data records continues to be a need but understanding projections of future changes is also needed. Responses to these discussion areas and other important questions will be the focus for a future follow-on engagement with this sector.

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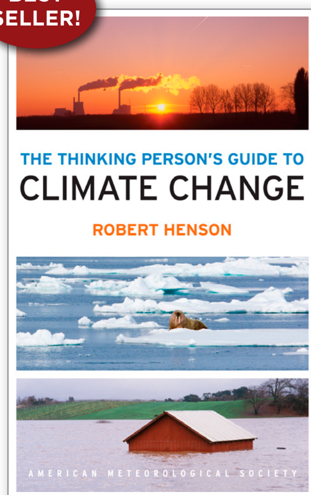

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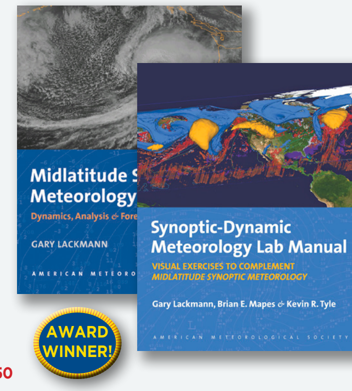

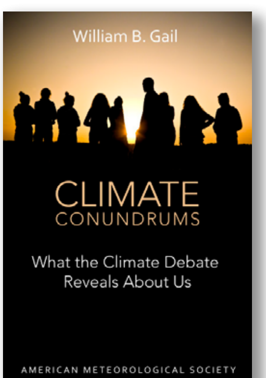

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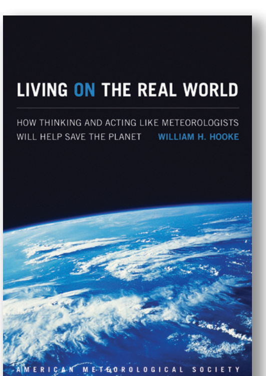

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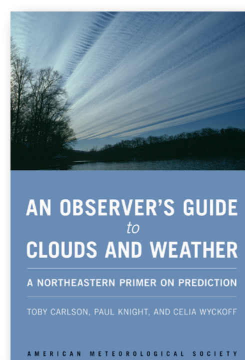

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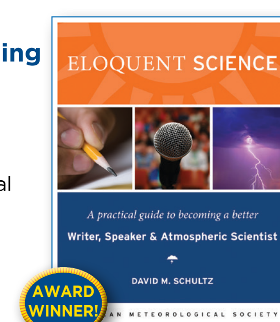

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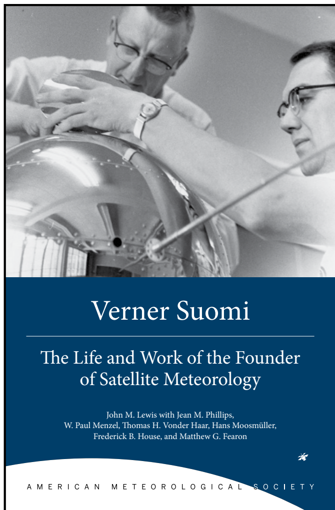

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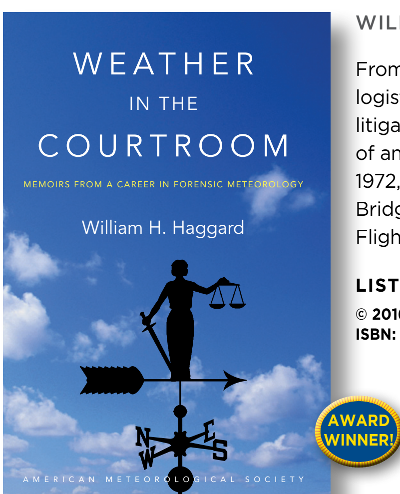

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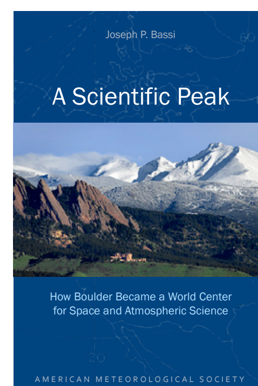

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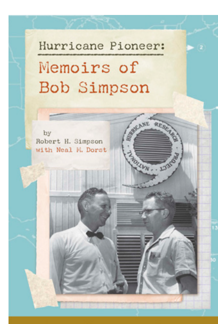

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