Load Forecasting and Resource Planning for Extreme Cold

James F. Wilson*
Principal, Wilson Energy Economics

participating on behalf of
Southern Alliance for Clean Energy and Vote Solar

Florida Public Service Commission
Workshop on Ten-Year Site Plans
June 1, 2022

** Economist and independent consultant; see last slides for additional speaker information.*
Views expressed are my own and not necessarily those of any client.

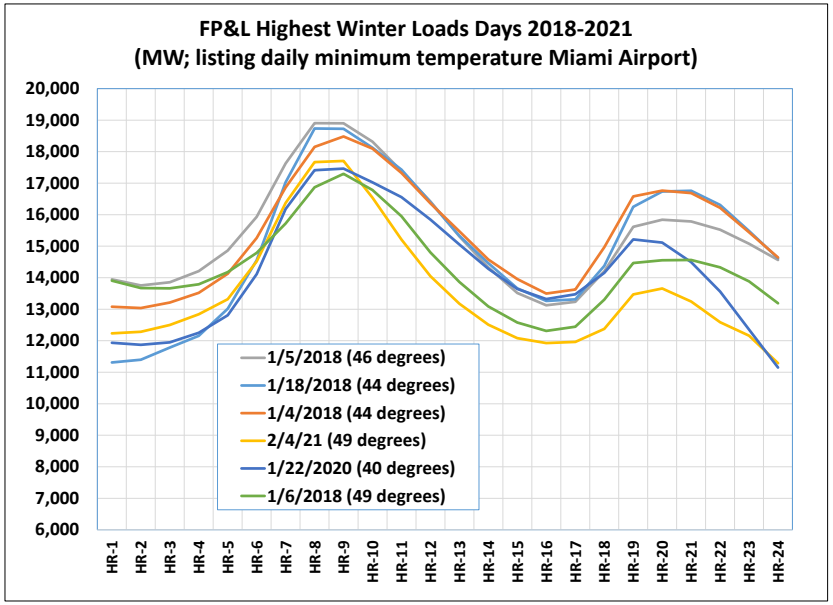
Topics

1. Recent extreme winter events in Texas and elsewhere: primary causes and recommendations
2. Standard industry practices in load forecasting and resource adequacy analysis for extreme cold:
   - Forecasting the likelihood of extreme cold and its impact on loads
   - Evaluating capacity reserve needs given the risk of extreme cold events
3. Comments on Florida Power and Light's proposed approach to winter peak load forecasting and resource adequacy planning
4. Demand-side opportunities for extreme cold preparation

From Virginia to Texas and Beyond, Loads Can Spike Under Extreme Cold

- Rarely-used electricity-based space heating is the main cause
  - *Regions further north, while colder, are less reliant on electricity for space heating and generally do not experience such load spikes*

- Typical pattern under extreme cold: A steep morning peak, a lower and flatter evening peak
- Forecasting such load spikes is challenging because the most extreme cold occurs so rarely
- Temperatures in the teens can also lead to cold-related plant outages



1. Recent Extreme Winter Events in Texas and Other Regions: Causes, Actions

- Texas, February 2021: temperatures fall to single digits, about 100 consecutive hours below freezing (extreme, but not unprecedented cold). Power plant outages over two days average 49% of the all-time peak load due to cold-related causes, fuel supply disruptions, other factors.
- Analysis by the North American Electric Reliability Corporation (NERC) and Federal Energy Regulatory Commission (FERC) led to many recommendations for better preparedness (some details in an appendix slide). Inadequate installed capacity was not considered a cause of the problems, nor was building more capacity a recommended action.
- FP&L has been pursuing the NERC and FERC recommendations (per responses to Staff 2nd Data Request).

2. Standard Practices in Load Forecasting and Resource Adequacy Analysis

Capacity Requirement = Peak Load Forecast + Reserve Margin

1. Peak Load Forecasting: Two Key Elements
   - A Long-Term 50-50 ("P50") or Median Forecast
   - Analysis of how *high* peak loads might rise over this forecast under the most extreme weather, and how *frequent* the most extreme weather and resulting high loads are expected to occur going forward; key inputs to the reserve margin analysis (more details in an appendix)
2. Probabilistic Simulation to Determine the Reserve Margin Over P50 Forecast to Satisfy a Resource Adequacy Criteria
   - Probabilistic simulation of extreme winter loads, power plant outages, and other risks to determine the summer and winter reserve margins to satisfy a probabilistic resource adequacy criteria ("one day in ten years")

3. Comments on FP&L's Proposal re: Resource Adequacy Planning

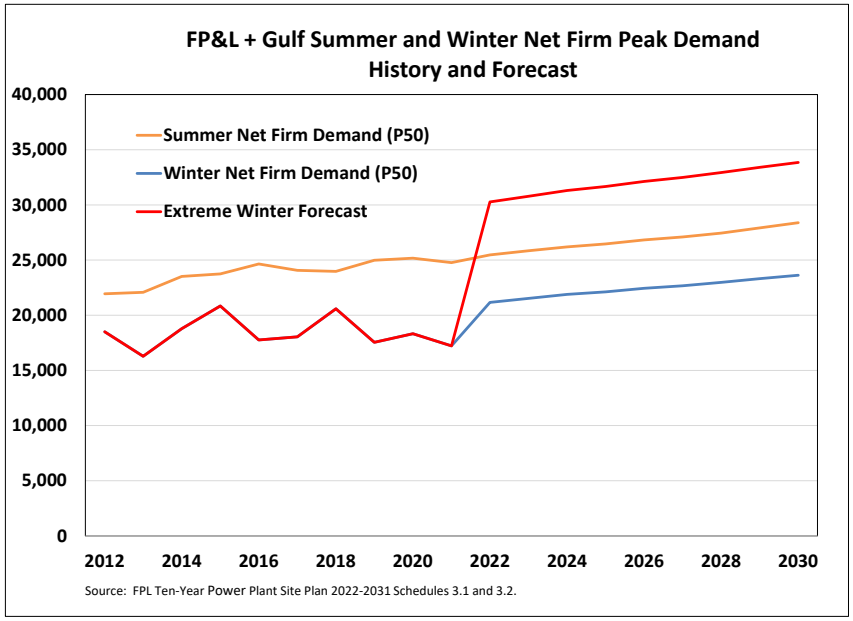
FP&L's proposal does not follow this standard approach.

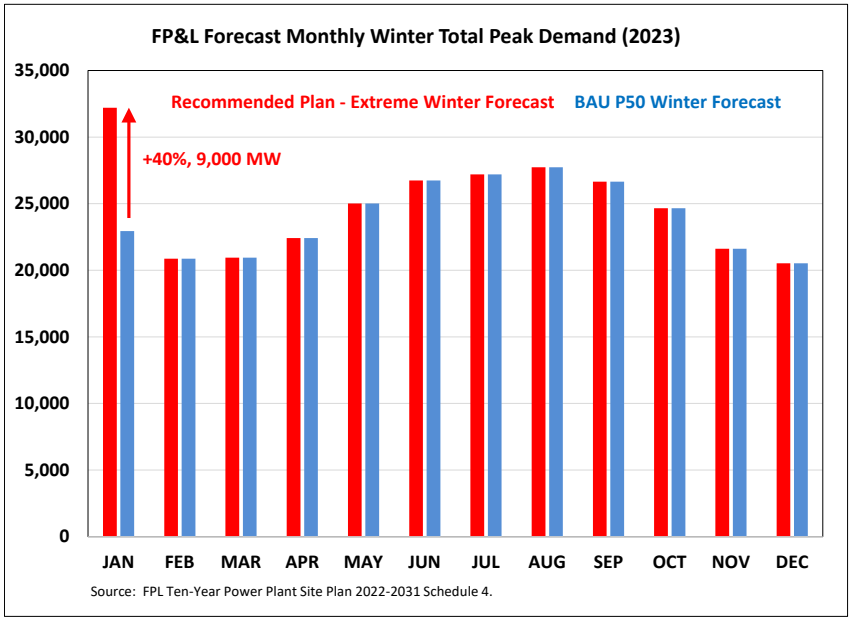
1. FP&L developed its Recommended Plan Extreme Winter Peak load "forecast" (Schedule 4) employing a questionable methodology, and the value is very extreme.
2. FP&L did not evaluate the winter reserve margin needed to meet a resource adequacy criteria; instead, the extreme winter peak forecast is apparently used as an installed capacity requirement (Schedule 7).
   - *Among other shortcomings, this approach gives no recognition to many considerations that affect resource adequacy, such as power plant availability in peak hours, assistance from neighboring regions, possible fuel supply limitations, to name a few.*

FP&L's Extreme Winter Peak Forecast

FP&L's Extreme Winter Forecast is 40% above BAU; details of the methodology were not available.

- What are the appliances that could suddenly add over 9,000 MW??

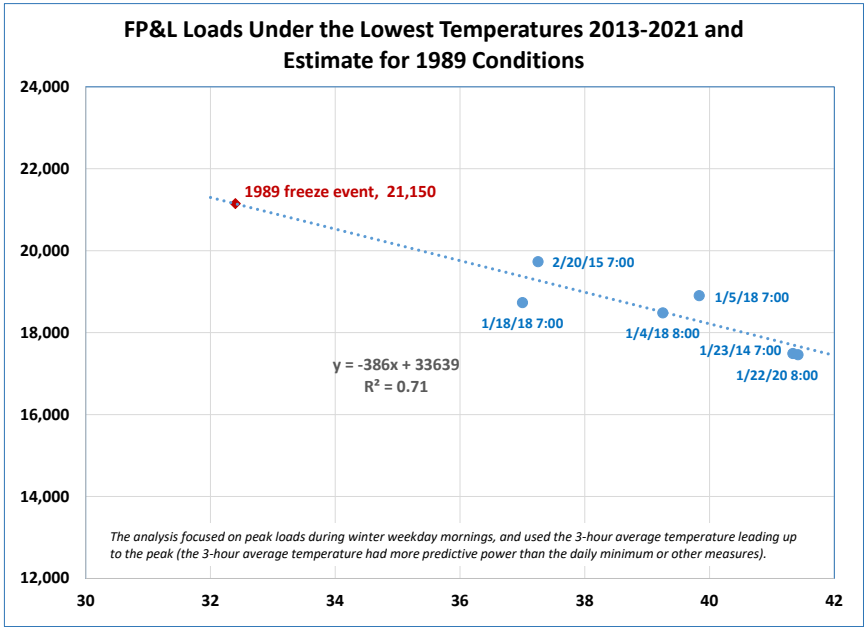




Estimate of Extreme Winter Peak Load (FP&L w/o Gulf)

Using FP&L load and temperature data for 2013 to 2021, I analyzed how loads rise under the coldest temperatures, to estimate the loads under conditions analogous to the 1989 Christmas Freeze.

This analysis suggests FP&L loads could rise to 21,150 MW, almost 1,500 MW higher (7%) than the highest winter peak loads seen recently (e.g., February 2015).



This is an estimated extreme peak, not a planning target!

FP&L's Proposal re: Winter Peak Resource Adequacy Planning: Summary

- Does not follow standard industry practices
- Extreme Winter "Forecast" is based on a non-transparent, highly questionable methodology, and is far too high
- The usual probabilistic analysis of resource adequacy to determine a reserve margin has not been performed
- The proposal could lead to construction of unneeded, "one day in thirty year" power plants and unnecessary cost to customers
- The potential for very rare, very extreme load spikes warrants further analysis; and demand-side approaches should be considered

4. Possible Demand-Side Approaches for Extreme Cold Preparation

- The most extreme cold that creates the extreme load spikes is expected to occur only very rarely if at all, and does not arrive by surprise; it is forecasted days in advance
- In other regions, many schools, stores, restaurants, offices, and other facilities do not have heating equipment to maintain comfortable temperatures under the most extreme cold, and choose to open late or stay closed when rare and extreme cold is in the forecast
- A program to obtain voluntary commitments to keep usage very low when very extreme cold is forecast (with bill incentives, measurement, testing, and enforcement) could be a cost-effective alternative to generating capacity that is almost never needed

FYI: My Recent Work on Electric Load Forecasting and Resource Planning

1. Georgia: Testimony in Georgia Power Company IRP cases (May 2022; May 2019)
2. Alabama: Testimony in Alabama Power Company's application for CPCN (March 2020; September 2020)
3. South Carolina: Testimony in Duke Energy IRP cases (April 2021; February 2021; October 2019; September 2019)
4. North Carolina: Testimony in Duke Energy IRP and avoided cost cases (March 2021; March 2019; February 2019; February 2017)
5. Virginia: Testimony on Virginia Electric and Power Company IRP cases (October 2020; September 2020; April 2019; September 2018; August 2018; September 2017; August 2017; October 2016; August 2016)
6. California: Testimony on San Diego Gas & Electric Company's 2022 Electric Sales Forecast (October 2021)
7. Nova Scotia: Testimony on Nova Scotia Power's 2021 Load Forecast Report (July 2021)
8. New England: Testimony on ISO New England's Energy Security proposal (May 2020)
9. PJM: Testimony in FERC cases, presentations and participation in PJM stakeholder processes (2008-2022)

Other relevant work and additional details are available in CV at www.wilsonenec.com

Speaker Information

James F. Wilson
Principal, Wilson Energy Economics
4800 Hampden Lane Suite 200
Bethesda, MD 20814
301-535-6571
jwilson@wilsonenec.com
www.wilsonenec.com

James Wilson is an economist with over 35 years of consulting experience in the electric power and natural gas industries. His work has pertained to the economic and policy issues arising from the interplay of competition and regulation in these industries, including restructuring policies, market design, market analysis and market power. Recent engagements have involved resource adequacy and capacity markets, contract litigation, rate cases, modeling of utility planning problems, and many other economic issues arising in these industries. Mr. Wilson has been involved in electricity restructuring and wholesale market design for over twenty years in PJM, New England, Ontario, California, Russia, and other regions. He also spent five years in Russia in the early 1990s advising on the reform, restructuring, and development of the Russian electricity and natural gas industries for the World Bank and other clients.

Prior to founding Wilson Energy Economics, Mr. Wilson was a Principal at LECG, LLC. He holds a B.A. in Mathematics from Oberlin College and an M.S. in Engineering-Economic Systems from Stanford University.

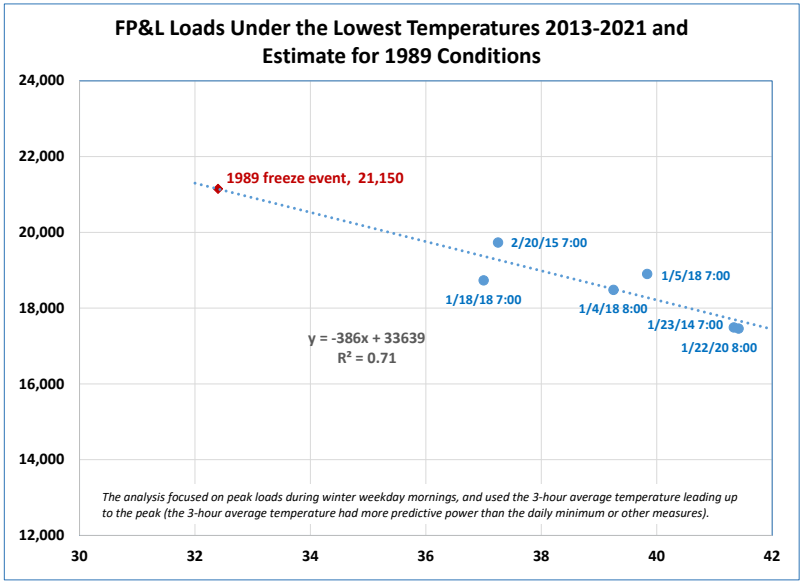
Appendix: Further Details of NERC and FERC Recommendations

- Analysis by NERC and FERC lead to many recommendations, including: weatherization; operating plans and action plans for extreme conditions; improved reporting of power plant status; evaluation of electric import capability; identification of natural gas supply chain risks; dual fuel assessments; protect critical infrastructure from load shedding; preparations for de-icing; plans to request emissions waivers; training; fuel delivery system flexibility to meet changing loads; energy efficiency incentives; rapid-deploying demand response.
  - FERC, NERC, and Regional Entity Staff, *The February 2021 Cold Weather Outages in Texas and the South Central United States*, November 2021
  - NERC, *Cold Weather Preparations for Extreme Weather Events: Recommendations to Industry*, August 2021
  - FERC, *Order Approving Cold Weather Reliability Standards*, 176 FERC ¶ 61,119, August 24, 2021

Appendix: Approaches to Forecasting Winter Load Spikes Under Extreme Cold

1. Forecasting winter extreme peak loads is challenging due to a lack of recent instances of extreme cold in most regions.

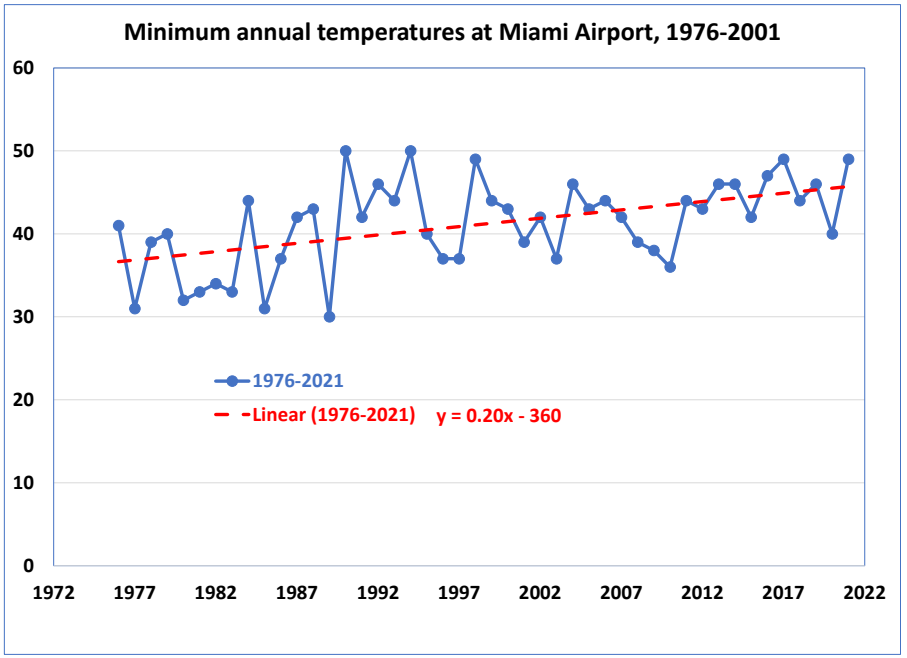
- Regression approaches are used to understand the impact of weather (temperatures over one or more hours) on load by time of day
- The regressions focus on extreme cold because the relationship changes at the lowest temperatures (when all heating appliances are in use, and some facilities may choose to open late or remain closed)



Appendix: Approaches to Forecasting Winter Load Spikes (cont'd)

2. Estimating the likely future frequency of extreme cold

   - Historical weather data for multiple stations is typically used (load-weighted averages)
   - Long-term trends should be reflected – annual minimum temperatures are trending upward (at the FP&L weather stations, by about one degree every five or six years since 1976)



Appendix: Extreme Cold Across the South and in Florida