Long Term Probabilistic Load Forecasting at NCEMC

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Agenda

• Introduction
• Multiple Linear Regression
• Forecasting Process
• Results
• Takeaways
Many Masters to Serve
NCEMC Service Territory

1. Albemarle EMC, Hertford
2. Blue Ridge Electric, Lenoir
3. Brunswick EMC, Shalotte
4. Cape Hatteras Electric Cooperative, Buxton
5. Carteret-Craven Electric Cooperative, Morehead City
6. Central EMC, Sanford
7. Edgecombe-Martin County EMC, Tarboro
8. Energy United, Statesville
9. Four County EMC, Burgaw
10. French Broad EMC, Marshall
11. Halifax EMC, Enfield
12. Harkers Island EMC, Harkers Island
13. Haywood EMC, Waynesville
14. Jones-Onslow EMC, Jacksonville
15. Lumbert River EMC, Red Springs
16. Pee Dee EMC, Wadesboro
17. Piedmont EMC, Hillsborough
18. Pitt & Greene EMC, Farmville
19. Randolph EMC, Asheboro
20. Roanoke Electric Cooperative, Rich Square
21. Rutherford EMC, Forest City
22. South River EMC, Dunn
23. Surry Yulee EMC, Dobson
24. Tidelands EMC, Pantego
25. Tri-County EMC, Dudley
26. Union EMC, Monroe
27. Wake EMC, Wake Forest

★ Cooperative Headquarters

★ North Carolina Electric Membership Corporation
A Touchstone Energy® Partner
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★ North Carolina Association of Electric Cooperatives, Inc.
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★ Tri-Club Electric Membership Association, Inc.
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IEEEPES Power & Energy Society®
Forecasting at NCEMC

• Company Functions

- Asset Management
- Resource Planning
- Portfolio Management
- Transmission Services
- Regulatory Affairs
- Wholesale Rates

• Types of Forecasts
Long Term Load Forecasting

• Business needs
  – Power Supply
  – System Planning
  – Risk Management
  – Portfolio Analysis

• Challenges
  – Data Quality
  – Weather Diversity
  – Time Constraints
  – Regulatory Requirement
Long Term Forecasting at NCEMC

• Several decades of evolution
  – Since formation of cooperative

• Past implementation
  – Using monthly data
  – Moved to hourly data using ARIMAX model

• Desire for improvements in LTLF
  – All forecasts can be improved
  – More reasonable load shapes
  – Easier to understand and explain
Multiple Linear Regression
Pay attention to Patterns in Data

Forecast Trend Drivers
GDP ($Mil) and Households (Thousands)
Load-Temperature Relationship

- Nonlinear
- Changes throughout year
- Changes hourly
- By month
  - October
  - January
  - July
  - April
Forecasting Process

• Started with a short-term forecasting model
  – Hong (2010), Short Term Electric Load Forecasting, NCSU PhD Dissertation

• Augmented the STLF model substituting GDP for trend variable

• Developed weather and economy scenarios
Long Term Load Forecasting

• Low resolution monthly data

• Inaccurate forecasts

• Unexplainable errors

• Point Forecast
Long Term Load Forecasting

• 1 to 50 years ahead, typically 10 to 30 years
• Planning, rates, finance, DSM, portfolio and risk management
• Weather data quality issues
• Unfair to judge LT forecasts via point forecasts
• Probabilistic approach preferred
Results

Monthly Energy Forecasts (MWh)
Results

Monthly Peak Forecasts (MW)
Results

Monthly Energy Normalization (MWh)
Results

Monthly Peak Normalization (MW)
Budget to Actuals

Demand

- Actual
- Weather Normalized
- Typical
- 2013 Mild Weather Low Growth
- Severe

Energy

- Actual
- Weather Normalized
- Typical
- 2013 Mild Weather Low Growth

MW

GWh
Process Improvements

- Smart Grid brings high resolution data
- Hourly data can have quality issues due to human, meter and communication errors
- Weather and Economy data quality most uncontrollable components
- Increasing weather stations to 25 from 6 improved accuracy
Takeaways

• Data quality issues and solutions
• Hourly data improves accuracy
• Scenario based forecast provides range of options for planners and portfolio managers
• Potential to expand hierarchies to individual customer level using smart meter data
• Never-ending process of improvement
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