LOAD FORECASTING

Load Forecasting Initiative

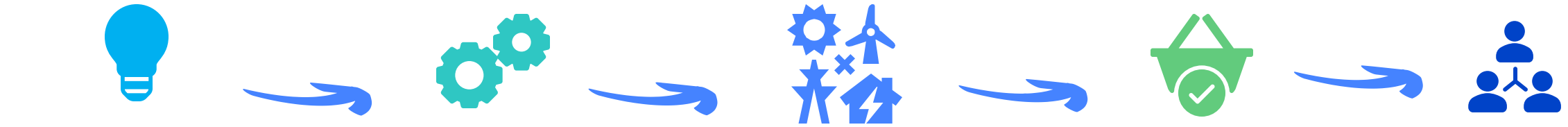
Kickoff Webcast – Feb 14, 2024

David Larson, PhD
Principal Investigator
DLarson@epri.com

Ashraf El-Messidi
Project Manager
AEl-Messidi@epri.com

Haresh Kamath
Director
HKamath@epri.com

Load forecasting is key for many grid decisions…



Decarbonization Strategies

Integrated Resource Planning

Resource Adequacy

Delivery System Planning

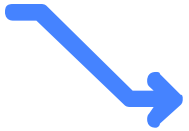
Real-Time Grid Operations

Improved forecasts will drive more efficient investment decisions and grid performance across timescales

Increased Customer Opportunities

Increased Asset Utilization

Reduced Operating Costs



Reduced Reliability Risks

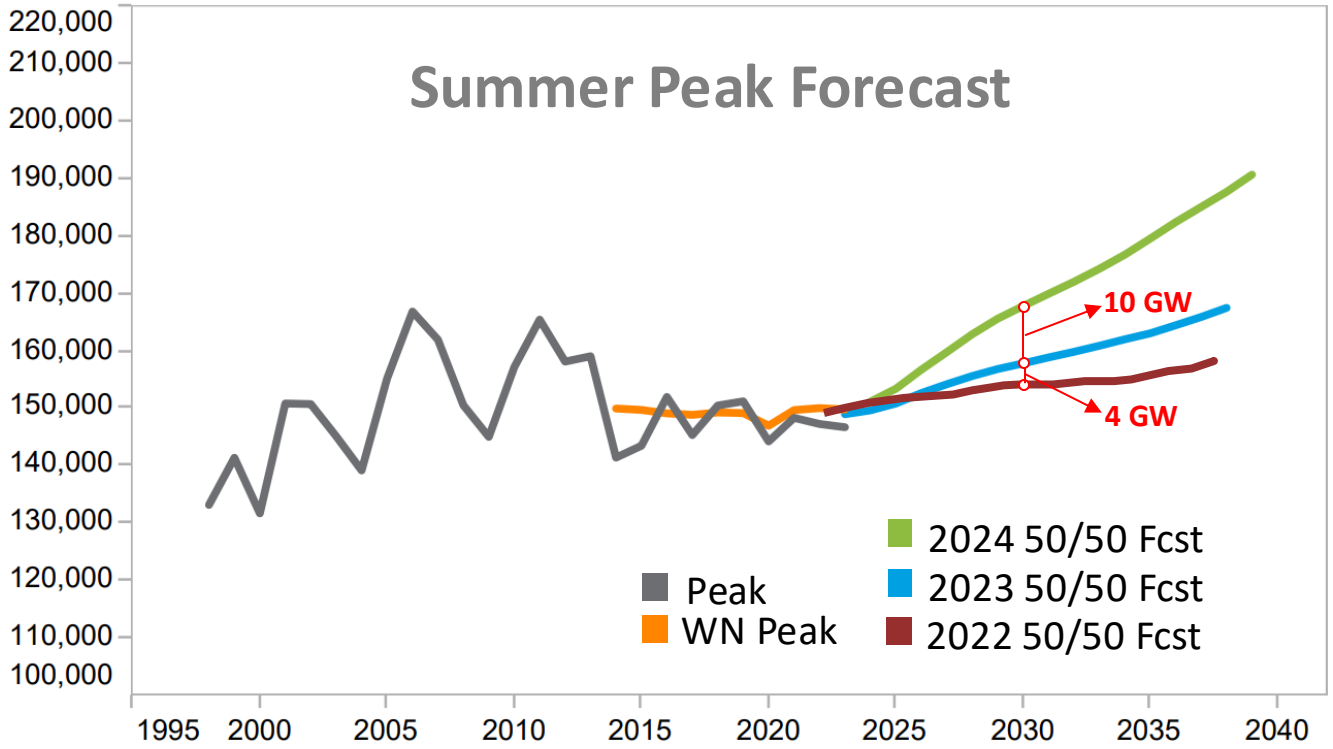
Load Forecasting: It's getting more complicated!

Drivers Complicating Electric Demand Forecasting

- ↑ Electrification
- ↑ Decarbonization (H2, heat)
- ↑ Weather (extreme temps)
- ↑ Re-industrialization/On-shoring
- ↑ Digitalization (data centers, crypto)

- ↓ End-use efficiency
- ↓ Customer generation/storage
- ↓ Customer behaviors/rate structures

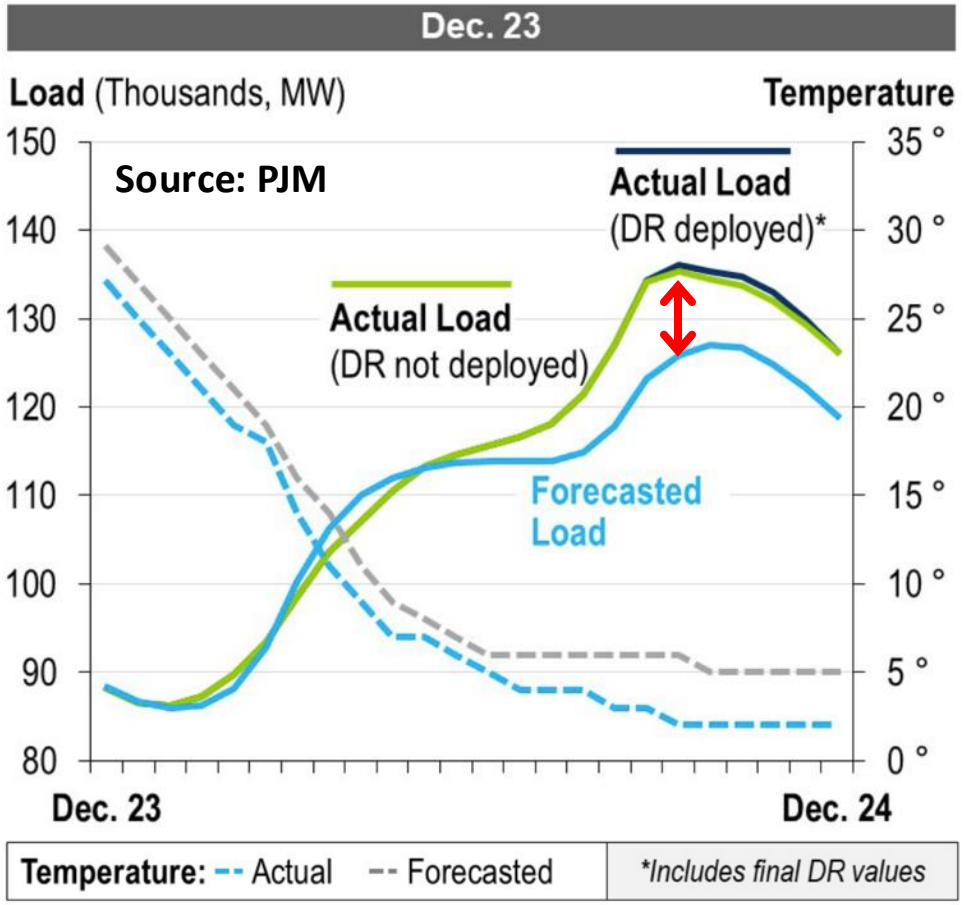
PJM Peak Load Forecast: 2022 vs. 2023 vs. 2024 Projections



Source: PJM 2024 Load Forecast Report
https://www.pjm.com/-/media/library/reports-notices/load-forecast/2024-load-report.ashx

Winter Storm Elliott: High short-term forecast errors

PJM **under-forecasted** peak load by ~8%[1]



"The load **forecasting tools had never experienced similar weather conditions and load levels to Elliott**, therefore the data history wasn't available to the tools to perform accurate load forecasting" – SPP report[2]

"Abnormally high load forecasting errors occurred due to a **lack of historical data for similar extreme conditions** in December" – MISO report[3]

1: PJM: "Winter Storm Elliot: Event Analysis and Recommendation Report", July 17, 2023
2: SPP: "Review of SPP's Response to the Dec. 2022 Winter Storm", April 17, 2023
3: MISO: "Overview of Winter Storm Elliot December 23, Maximum Generation Event", January 17, 2023

Extreme temperatures with new technologies can fool forecasting algorithms.

EPRI Load Forecasting Initiative

Contact: Larson, David <dlarson@epri.com>

Executive Summary

Improved load forecasts at operational and planning timescales* will drive more efficient investment decisions and better grid performance.

EPRI proposes a 24-month initiative to address critical needs in load forecasting that will work across three areas:

01 **Industry Coordination**
Enable knowledge-sharing and collaboration among utilities, ISOs/RTOs, etc.

02 **Long-Term Forecasting (Planning)**
Develop methodologies and guidance to incorporate new load drivers

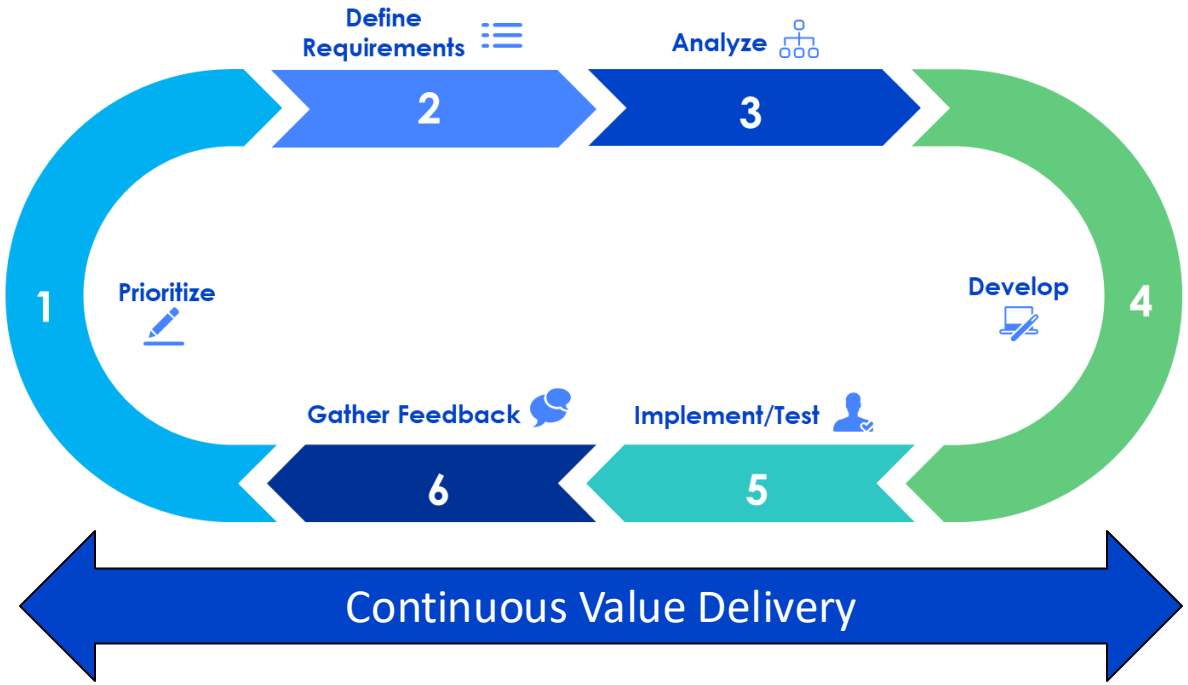
03 **Short-Term Forecasting (Operations)**
Develop methodologies and guidance to mitigate changes in forecast accuracy

*we are defining “planning timescales” as >1-year ahead

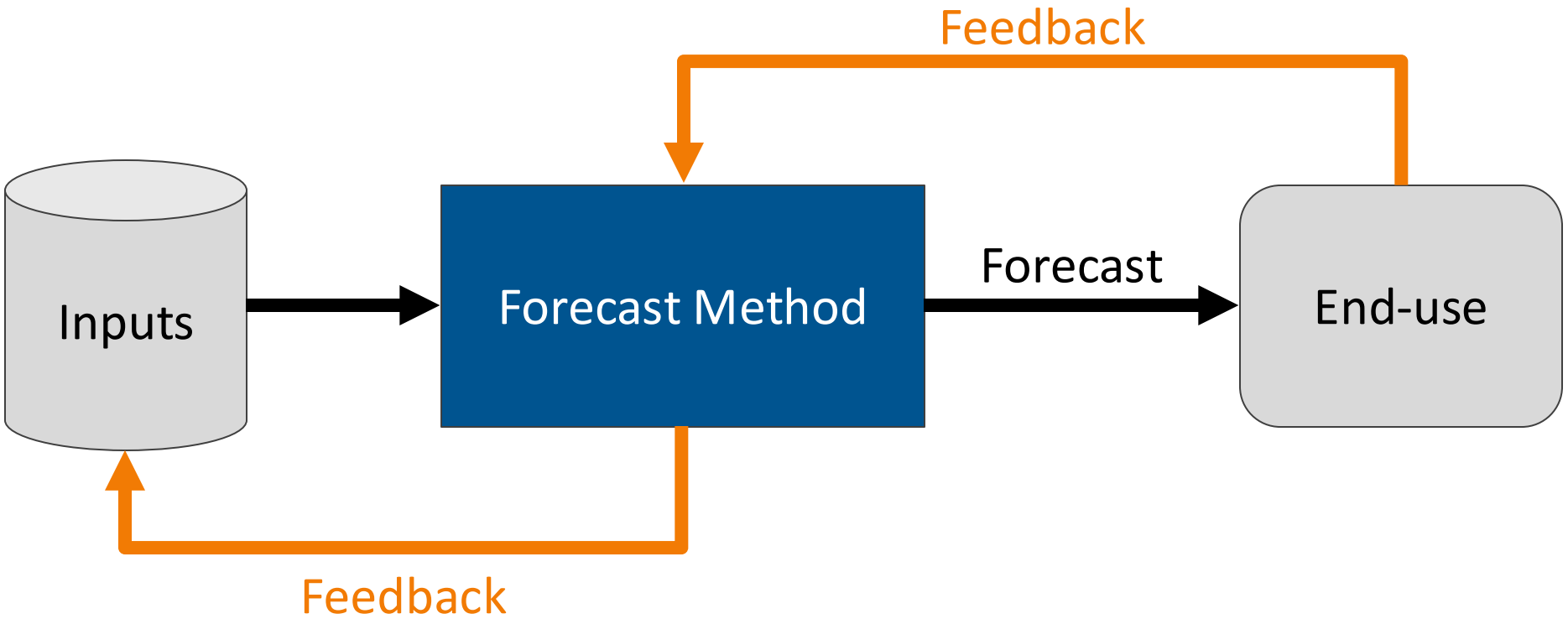
Plan is to run the project in an iterative manner

- **Regular feedback** from members to guide the direction of the deliverables throughout the project
- **Consistent value delivery via several interim deliverables** throughout the project that align with member expectations
- **Results available to all EPRI members**, with some public deliverables available to non-members

Iterative Development



Goal: improved outcomes from improved forecasts



Consider how forecasts are created *and* used

Load Forecasting Initiative will consist of 3 workstreams:

01

Industry Coordination

02

Long-Term Forecasting (Planning)

03

Short-Term Forecasting (Operations)

Goal is to tackle high priority, high impact topics

WS1: Industry Coordination

WS1 (Industry Coordination)

- **Load Forecasting Interest Group (IG):**
  - Free to join for EPRI members
  - Regular webcasts on topics of interest (presentations + discussions)
  - **First IG meeting in March/April** (4–6 meetings per year)

- **Survey of forecasting practices:**
  - Include forecasters and end users
  - Results organized into a guidebook
  - **2024 deliverable: report (guidebook)**

WS2: Long-Term Forecasting (Planning)

WS2 (Planning): Load Drivers and Priorities

1. **Large point loads:** characterize dynamics of large load types (data centers, manufacturing, etc.) and trends, and study what data or modeling enhancements are needed, including flexibility of such loads and ways to consider flexibility in load forecasting
2. **Linking Dx & Tx forecasts:** evaluate top-down and bottom-up approaches that can be applied across both Dx & Tx to enable better matching (of assumptions and outputs), including data gaps that are key to enabling such approaches
3. **DERs, electrification, and other end-use technologies:** what data (real or simulated/synthetic) and modeling enhancements are needed to factor in these load drivers (e.g., BTM solar and batteries, EVs, heat pumps), including how to track and predict customer adoption and factoring in potential sources of load flexibility

WS2 (Planning): Load Drivers and Priorities (cont'd)

4. **Extreme events and climate change:** provide guidance on how to create climate-informed weather data (building upon Climate READi work) and modify inputs to capture extreme events of interest (e.g., longer historical datasets), and how to handle multiple scenarios/outputs
5. **Incorporating uncertainty:** look at ways to represent and incorporate uncertainty into both the inputs and outputs (forecasts), along with how the uncertainty info can be used for decision-making support at the different system levels and planning horizons
6. **Increased resolution and forecast horizons:** look at ways to modify methods to provide forecasts at finer spatial granularity (top-down and bottom-up approaches and their integrations) and for longer forecast horizons, including with what data is required; related to linking Dx & Tx

WS2 (Planning): Priorities for 2024

- **Large point loads:**
  - Trends and behaviors of large loads (e.g., data centers)
  - What data and/or modeling enhancements are needed

- **Linking T&D forecasts**:
  - Gaps and causes (data, assumptions, etc.) between T&D forecasts
  - Evaluate top-down and bottom-up approaches

2024 deliverables: reports on methods & data

WS3: Short-Term Forecasting (Operations)

WS3 (Operations): Load Drivers and Priorities

1. **Extreme events:** evaluate ways to augment model training (e.g., data augmentation to synthesize better training sets) and use multiple models (either combining N models or have models better tuned for certain conditions)
2. **Weather data/forecasts:** assess which numerical weather prediction (NWP) models to use and when, including ways to blend multiple weather forecasts (either to create a better singular forecast or provide multiple forecasts as inputs to the load forecasts)
3. **Incorporating uncertainty:** evaluate ways to represent uncertainty (e.g., probabilistic forecasts) and use uncertainty info for decision-making support, working with stakeholders to validate benefits
4. **DERs and non-conforming loads:** assess how these affect forecast accuracy and what data or modeling changes can help (based on scenarios where we do have sufficient data for evaluation, e.g., with vs without telemetry)
5. **Electrification:** assess how electrification of end-use technologies affect load (e.g., heat pumps) and what data or modeling changes can help (based on scenarios where we do have sufficient data for evaluation, e.g., visibility of who has heat pumps)

WS3 (Operations): 2024 Priorities

- **Extreme events:**
  - Augment model training and blending of multiple models for better performance in extreme/tail/out-of-sample events

- **Weather data/forecasts:**
  - What weather data to use and when, including blending/ensembles of multiple weather forecasts (e.g., NWP models)

- **Uncertainty information:**
  - Ways to represent and use uncertainty info for decision-making support

2024 deliverables: reports on methods & data

Next Steps and Getting Involved

We are looking for data partners…

- People who can help us validate our work on “real” data/systems

- Looking for diversity:
  - Utilities and ISOs/RTOs
  - Tx and Dx
  - Ops and Planning
  - Forecasters and end-users

Contact David Larson <dlarson@epri.com>

Next steps

- EPRI has started work on the 2024 priorities

- March/April = first Load Forecasting Interest Group meeting
  - Aiming for 4–6 meetings per year, based on member feedback

- April = first updates/results from the initiative
  - Subsequent updates every 2–3 months (2024–2025)

Watch for meeting announcements

Frequently Asked Questions (FAQ)

- **Q: Who will get access to the results?**
- **A:** EPRI members get everything (no separate funding required), but we also plan to have some public outputs for non-members.

- **Q: What about topic XYZ / what happens in 2025?**
- **A:** We will continue work in 2025, focusing on priorities not covered in 2024 (e.g., EVs and heat pumps).

- **Q: How do I get involved / stay informed?**
- **A:** EPRI members should join the Load Forecasting Interest Group. But we will also create a mailing list based on today's webcast.

Q&A

TOGETHER…SHAPING THE FUTURE OF ENERGY®

www.epri.com