

End-use Load Profiles for the U.S. Building Stock

Technical Advisory Group meeting #1
November 27, 2018

Eric Wilson, NREL
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Agenda

- Meeting housekeeping items
- U.S. DOE Building Technologies Office
- Project background, overview, and team
- Project timeline and outcomes
- Technical Advisory Group members and responsibilities
- Overview of EPRI Conditional Demand Analysis
- Overview of Northeast Energy Efficiency Project (NEEP) regional research

Meeting housekeeping items

- We're recording the webinar and will post it on our web site.
- Because of the large number of participants, everyone is in listen-only mode.
- **Please use the chat box to send us your questions** and comments any time during the webinar.
- Moderated Q&A will follow, with the presenters responding to questions typed in the chat box.
- The recording and webinar slides will be posted on the project website (once created).

US Department of Energy Building Technologies Office

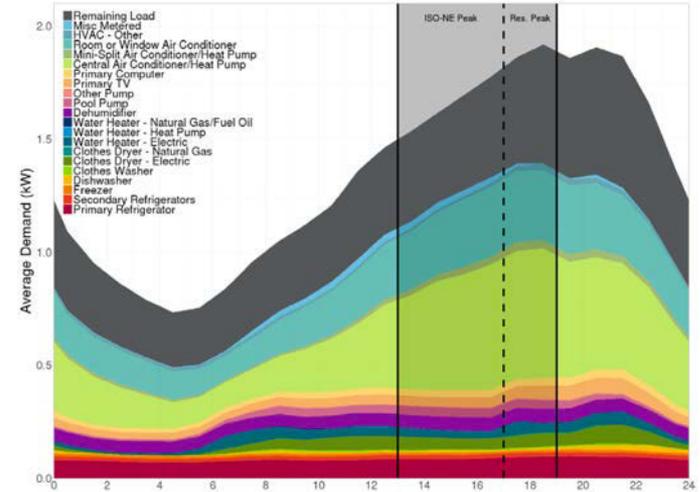
Monica Neukomm

Background

End-use load/savings profiles are...

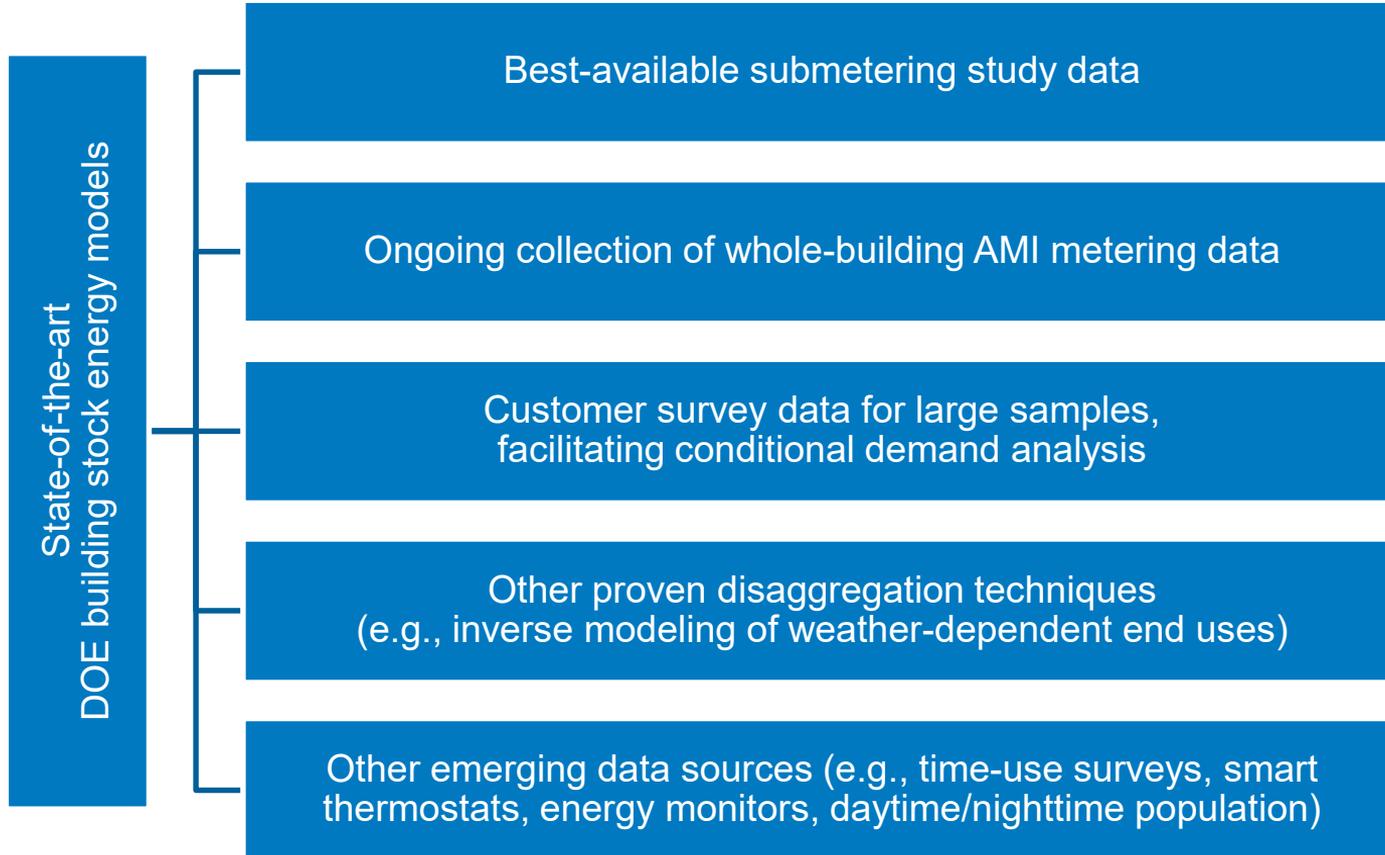
- the **most essential** data resource currently missing for Time-Sensitive Valuation of Energy Efficiency (TSV-EE)
- needed for **R&D prioritization, utility resource and distribution system planning, state and local energy planning and regulation**
- critical for widespread adoption of **grid-interactive and efficient buildings.**

Existing profiles are often **outdated, regionally limited, based on small sample size, and limited to a subset of the building stock** because of the high cost of the historical sub-metering approach.

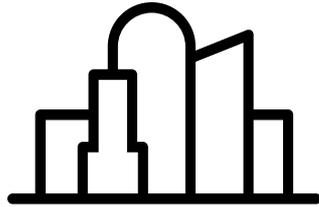


Source: Navigant Massachusetts RES 1 Baseline Load Shape Study

Solution: a hybrid approach

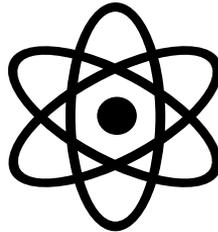


Background: DOE Building Stock Models



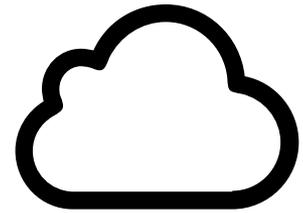
Building stock
characteristics
database

+



Physics-based
computer modeling

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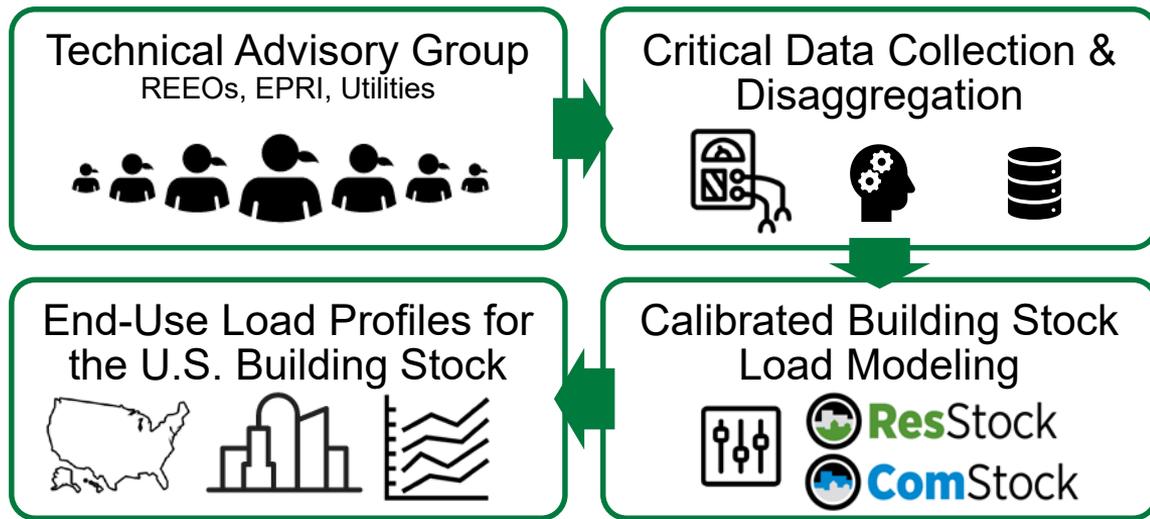


High-performance
computing

- DOE-funded, NREL-developed models of the U.S. building stock
- 100,000s of statistically representative physics-based building energy models (BEM)
- Use DOE's flagship BEM tools OpenStudio and EnergyPlus
- Produce hourly load profiles, but calibration to-date has focused on annual energy consumption

Project Overview

1. Establish technical advisory group
2. Identify load profile use cases, data requirements, existing data sources, and critical gaps
3. Address data gaps with critical data collection and disaggregation techniques
4. Incorporate stochastic occupancy into ComStock/ResStock
5. Calibrate ComStock and ResStock statistical building stock models
6. Publish end-use load profiles and documentation



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Project Team – Labs

NREL



Eric Wilson
(PI)



Andrew Parker
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Dr. Lieko Earle



Henry Horsey



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Noel Merket

LBL



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Frick (Co-PI)



Lisa
Schwartz



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Hong

Argonne



Dr. Ralph
Muehleisen

Project Team – Industry

Northeast
Energy
Efficiency
Partnerships
(NEEP)



Elizabeth Titus



Claire Miziolek

Electric Power
Research
Institute
(EPRI)



Chris Holmes



Krish Gomatom

...and many others on the technical advisory group

Technical Advisory Group (TAG) Members (1)

Regional Energy Efficiency Organizations

- Midwest Energy Efficiency Alliance
- Northwest Energy Efficiency Alliance
- Northeast Energy Efficiency Partnerships
- Southeast Energy Efficiency Alliance

Regulators

- Georgia Public Service Commission
- Hawaii Public Service Commission
- Indiana Utility Regulatory Commission
- Michigan Public Service Commission

Utilities and RTOs

- Ameren
- Bonneville Power Administration
- Commonwealth Edison
- Consolidated Edison
- CPS Energy
- DTE Energy
- Duke Energy
- Indiana Power & Light
- PacifiCorp
- PJM
- Southern Company
- Xcel Energy

TAG Members (2)

Consultants

- Cadmus
- Elevate Energy
- Energy Futures Group
- The Greenlink Group
- ICF
- Navigant
- Solar Investment, Inc
- Seventhwave
- Synapse Energy Economics
- TRC Solutions
- Tom Eckman
- Oracle

Research

- Electric Power Research Institute
- Clarkson University
- Pacific Northwest National Laboratory

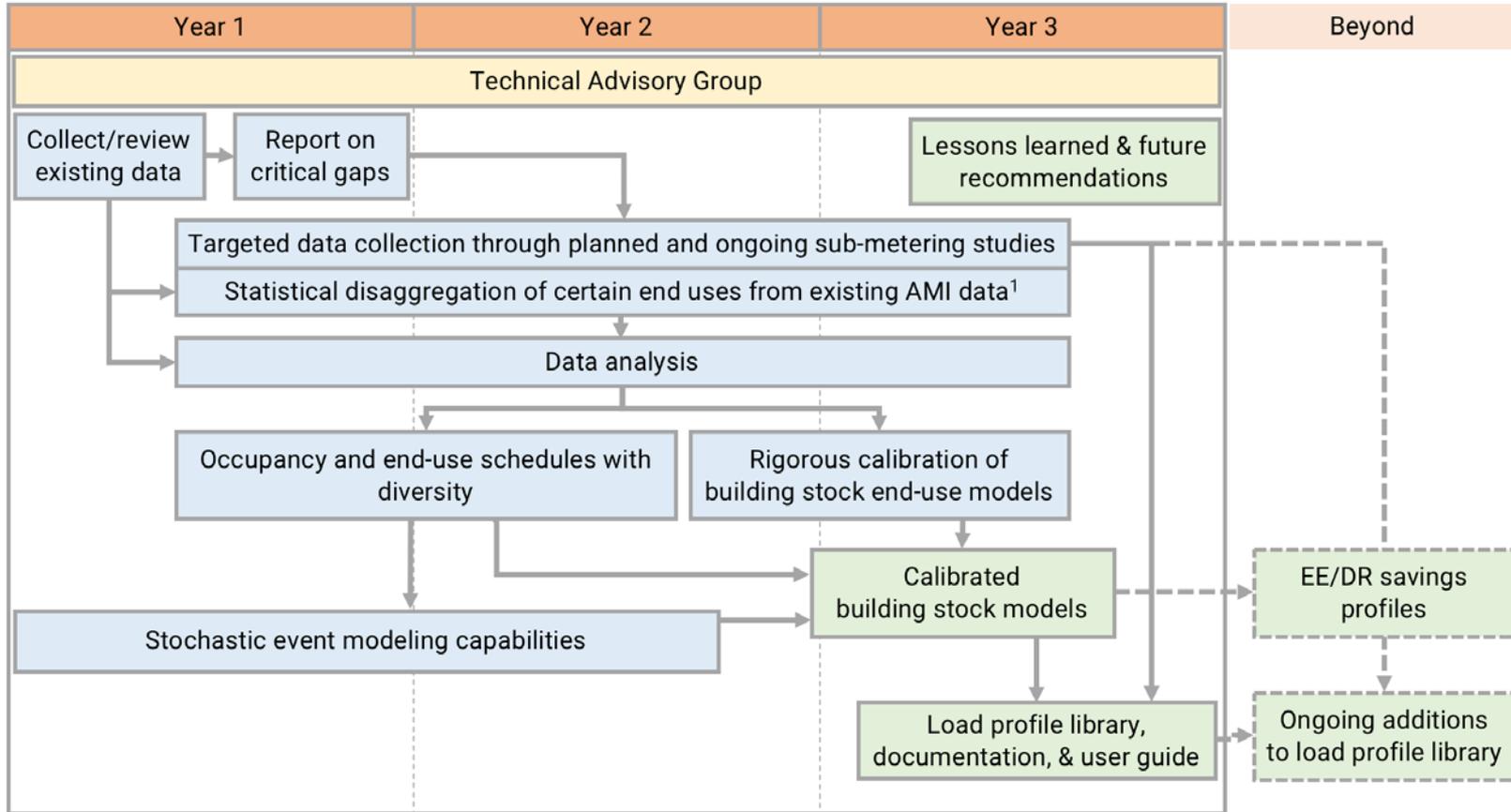
NGOs

- ACEEE
- Environmental Defense Fund
- National Association of State Energy Officials (NASEO)

Government

- US Department of Energy
- New York State Energy Research and Development Authority (NYSERDA)
- City of New York
- City of Boulder

Project Timeline



¹ For example, conditional demand analysis, or inverse (changepoint/degree day) models (KEMA 2009)

Project Outcomes

The project will result in:

- **Validated end-use load profiles** for U.S. building stock at both aggregate and individual building scales
- Calibrated building stock end use **models with ability to estimate EE/DR savings profiles for existing and emerging technologies**
- **Documentation** of load profile use cases, critical gaps, model methodology, and user guide



Building Types

- Small Office
- Medium Office
- Large Office
- Stand-alone Retail
- Strip Mall
- Primary School
- Secondary School
- Outpatient Healthcare
- Hospital
- Small Hotel
- Large Hotel
- Warehouse (non-ref.)
- Quick Service Restaurant
- Full Service Restaurant
- Mid-rise Apartment
- High-rise Apartment
- Supermarket

End-Uses

- Heating
- Cooling
- Interior Lighting
- Exterior Lighting
- Interior Equipment
- Exterior Equipment
- Fans
- Pumps
- Heat Rejection
- Humidification
- Heat Recovery
- Water Systems
- Refrigeration
- Generators



Building Types

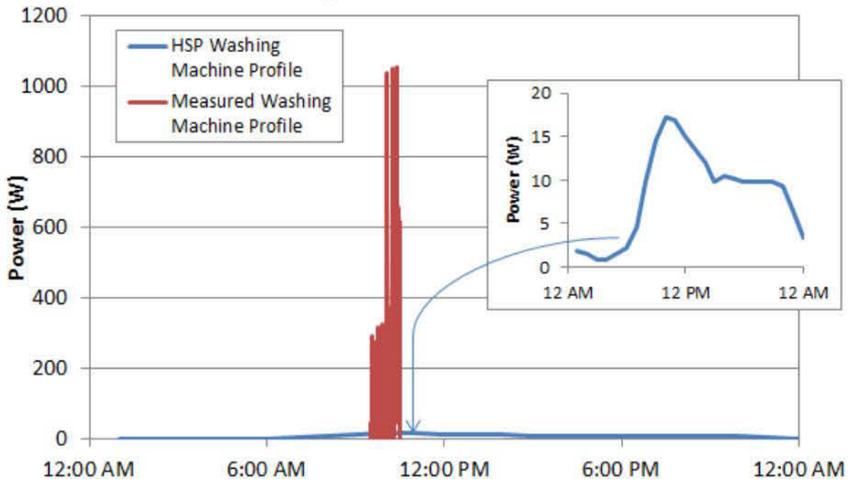
- Single-Family Detached
- Multifamily (low-rise)
 - Single-Family Attached
 - 2 - 4 Units
 - 5+ Units

End-Uses:

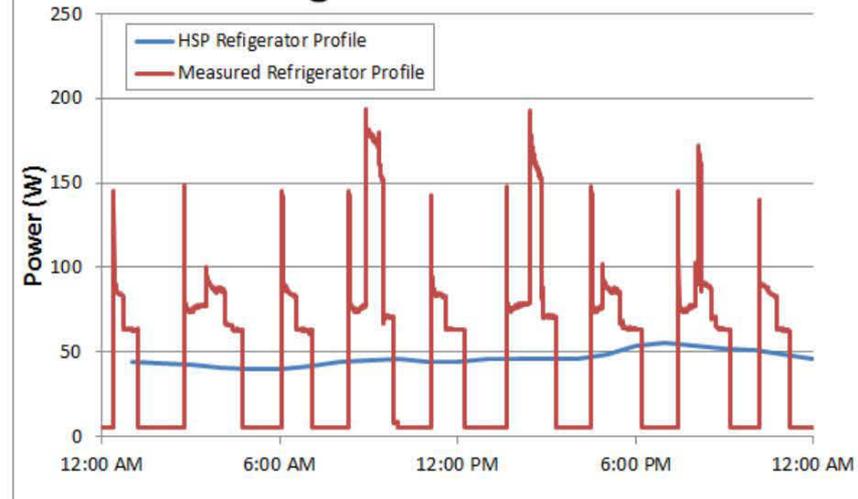
- Heating
- Cooling
- Furnace/AC fan
- Boiler pumps
- Vent. fans
- Water heating
- Interior Lights
- Exterior Lights
- Misc. plug loads
- Refrigerator
- Clothes washer
- Clothes dryer
- Dishwasher
- Cooking Range

Stochastic building loads

Washing Machine Load Profiles



Refrigerator Load Profiles



Key Milestones and Deliverables

- Year 1
- **Establish TAG**
 - **Publish Market Needs, Use Cases and Data Gaps report** that discusses applications of end-use load profiles, use cases and identify gaps in existing data
-
- Year 2
- **Produce working but uncalibrated model** of national residential and commercial building stocks that generates end-use load profiles
 - **Develop models to represent stochastic behavior** of discrete end-use events in building operation
-
- Year 3
- **Complete a calibrated model** of national residential and commercial building stocks that generates average and typical end-use load profiles
 - **Publish Technical Project Documentation** that describes technical details, assumptions and methodologies used to develop and calibrate the models and create end-use load profiles
 - **Publish User's Guide** describes approach, results, and applications (e.g., load forecasting, resource planning, program, and policy design)

TAG Responsibilities

- **Review materials provided in advance** of quarterly calls and annual meetings
- Be prepared to **contribute to thoughtful conversation** to guide review of technical choices and decision-making
- **Review two draft reports** and provide comments and feedback
- Help the project team produce useful and industry-accepted load profiles
- Help disseminate results

In-person TAG Meeting

March 5–6

Golden, Colorado

Based on polled availability, meeting will be:

- 12–5 pm on March 5
- 9am–1pm on March 6

The TAG meeting will use facilitated work groups to:

- Identify use cases
- Identify data sources
- Identify data gaps



In-person TAG Meeting March 5–6 Golden, Colorado

- Small meeting rooms will be available on morning of March 5 and afternoon of March 6 for side meetings, calls, etc.
- Call-in option will be available

Any **non-U.S. citizens**, contact Barbara.VanDyke@nrel.gov as soon as possible to complete paperwork (at least 30 days in advance)



Electric Power Research Institute (EPRI) - Conditional Demand Analysis

Chris Holmes

cholmes@epri.com

Northeast Energy Efficiency Partnerships (NEEP)

Questions?

Please use the chat box to send us your **questions** and comments any time during the webinar. You may want to **direct your question to a specific presenter**.

Thank you

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