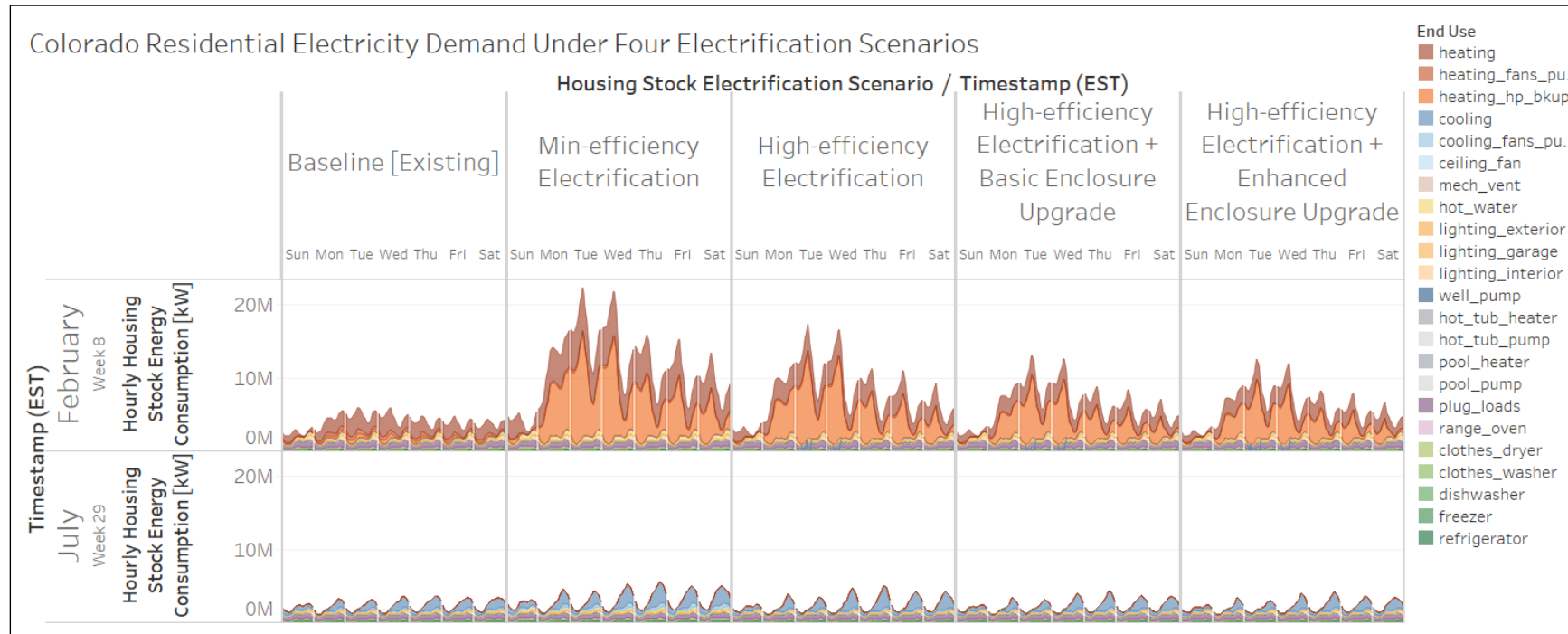


ResStock *and* End-Use Savings Shapes for the U.S. Housing Stock



Performing Organization(s): NREL

PI Name and Title: Anthony Fontanini, Senior Researcher (ResStock Core/ResStock Development)
and Elaina Present, Researcher (End-Use Savings Shapes)

PI Tel and/or Email: Anthony.Fontanini@nrel.gov and Elaina.Present@nrel.gov

WBS #: All of 1.5.1.32 (ResStock Core), Part of 3.4.6.57 (EULP & EUSS), and a smattering of others

Project Summary

Objective and Outcome

- EULP - Understand how and when energy is used in homes today
- EUSS - Understand how and when energy is used in homes under “what if” energy efficiency and electrification scenarios
- ResStock Core - Maintain and continuously improve our ResStock tool for U.S. building stock energy modeling so that we can create credible, consistent, accessible, useful datasets to support stakeholder decision-making

Team and Partners

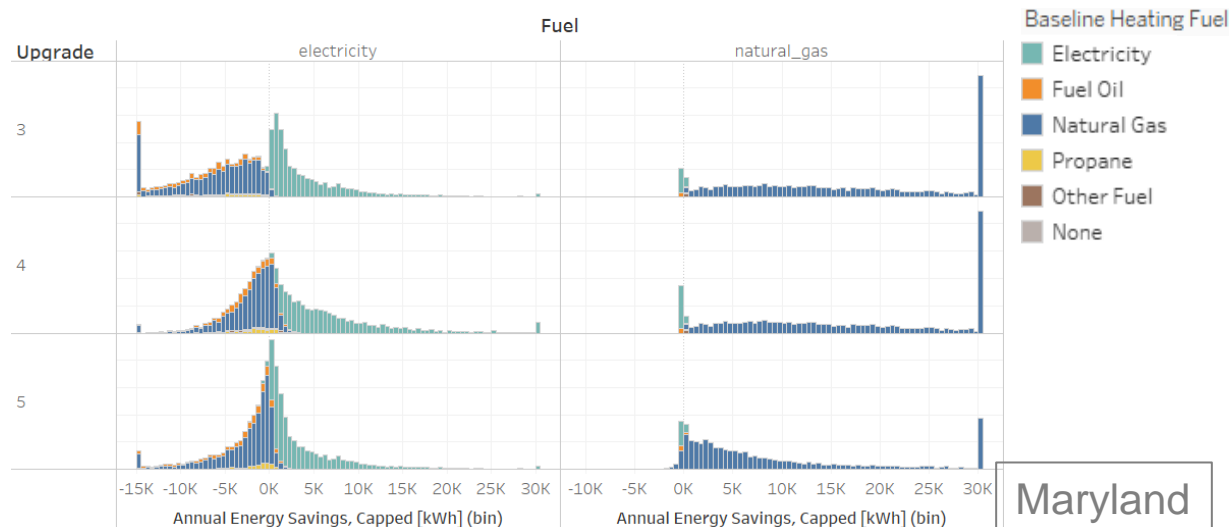
Current: NREL

5 primary contributors (Residential EULP/EUSS)

5 primary contributors (ResStock Core)

Recent: major collaboration with LBNL and ANL, and support from our 90+ member Technical Advisory Group through fall 2021

Energy Savings Distribution (Non-Zero)



Stats

Performance Period: 10/1/20 – 10/31/24

DOE budget:

EULP FY21 – \$3,382k

EUSS FY22 – \$500k

EUSS FY23 – \$775k (residential only)

- Future Milestone 1: 6/30/23 – draft sub-state fact sheets
- Future Milestone 2: 9/1/23 – public hosting of fact sheets
- Future Milestone 3: 10/31/23 – publish end-use savings shapes dataset

ResStock Core FY23 - \$500k

- Future Milestone 1: 7/20/23 – progress presentation
- Future Milestone 2: 10/20/23 – documentation of RECS 2020 integration and summary of annual development efforts

Problem: Lack of Credible Information in Support of BTO Goals

Increase building energy efficiency • Accelerate building electrification • Prioritize equity, affordability, and resilience

Achieving BTO's goals requires large-scale retrofitting of the current U.S. residential building stock.

A **lack of credible, relevant, and accessible information** on the potential impacts of energy efficiency and electrification measures contributes to **inaction** by cities, states, utilities, and other major stakeholders.

For example, will electrification of buildings...

- Reduce carbon emissions in my city?
- Make our residents' bills increase?
- Overload the grid?

Problem: Information Is Limited, Good Information Is Expensive

- **Utility-funded metering studies (Northwest End Use Load Research Project, CA End Use Surveys)**
 - **Very expensive** (estimated \$100M cost for nationally comprehensive study)
 - Limited in geographic scope – only available for a fraction of U.S.
 - Out of date quickly
 - Difficult to apply what-if scenarios to measured data
- **EPRI Load Shape Library**
 - **Confidence and precision levels are unknown**
 - Collected from a range of sources dating back to 2000
- **Scaling prototype model load shapes**
(DOE Prototypes, DOE Reference Buildings, DEER Prototypes)
 - Widely used by industry and academia (368 citations)
 - **Little or no calibration** to measured data
 - Minimal diversity

Alignment and Impact

We are putting information in the hands of decision makers

To reduce barriers and enable work toward BTO energy efficiency, electrification, and equity goals

What ResStock datasets can provide

Housing stock characterization

When and how homes use energy

Potential impacts of energy efficiency

Information on time-sensitive value of energy resources

Potential impacts of building electrification

Key use cases

Electrification prioritization

Emissions analysis

Decarbonization planning

Utility integrated resource plans and load forecasts

Policy and rate design

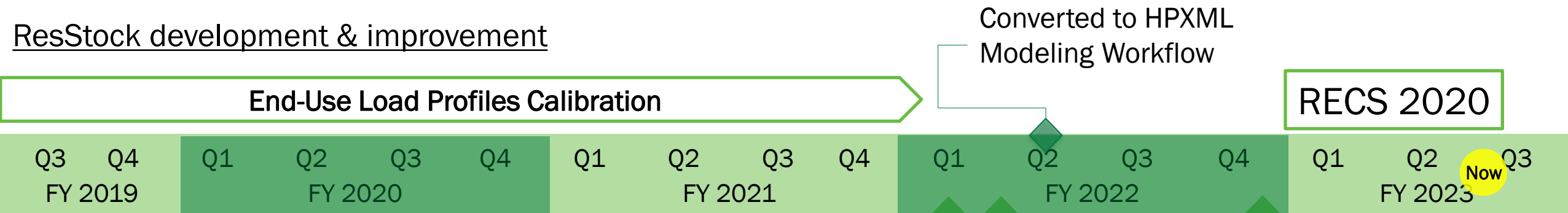
Approach – Our ResStock Tool & its Models and Datasets



Hundreds of thousands of representative, statistically generated residential energy models run using a supercomputer & cloud computing

Major efforts since last BTO Peer Review in April 2019

ResStock development & improvement



Publicly available datasets from results of ResStock runs

End-Use Load Profiles (EULP)

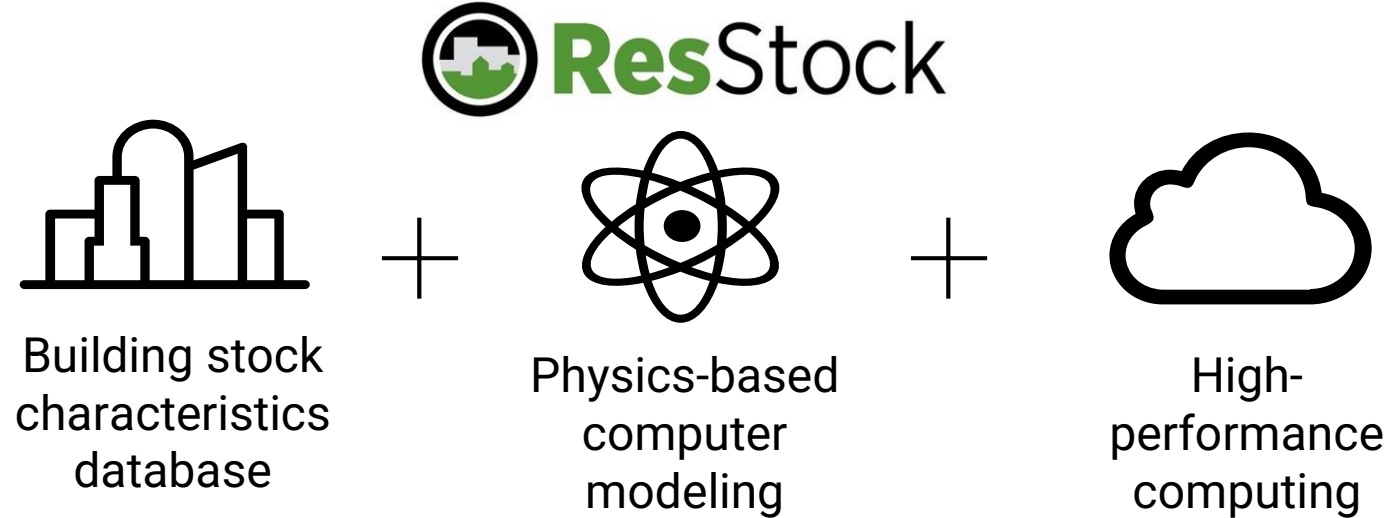
Public database of 550,000 individual home models and their energy end-use load profiles

Typology
Dashboards

End-Use Savings Shapes (EUSS) Round 1

Adds measure impact profiles for energy efficiency and electrification packages

Approach – ResStock Workflow Overview



credible, comprehensive, accessible

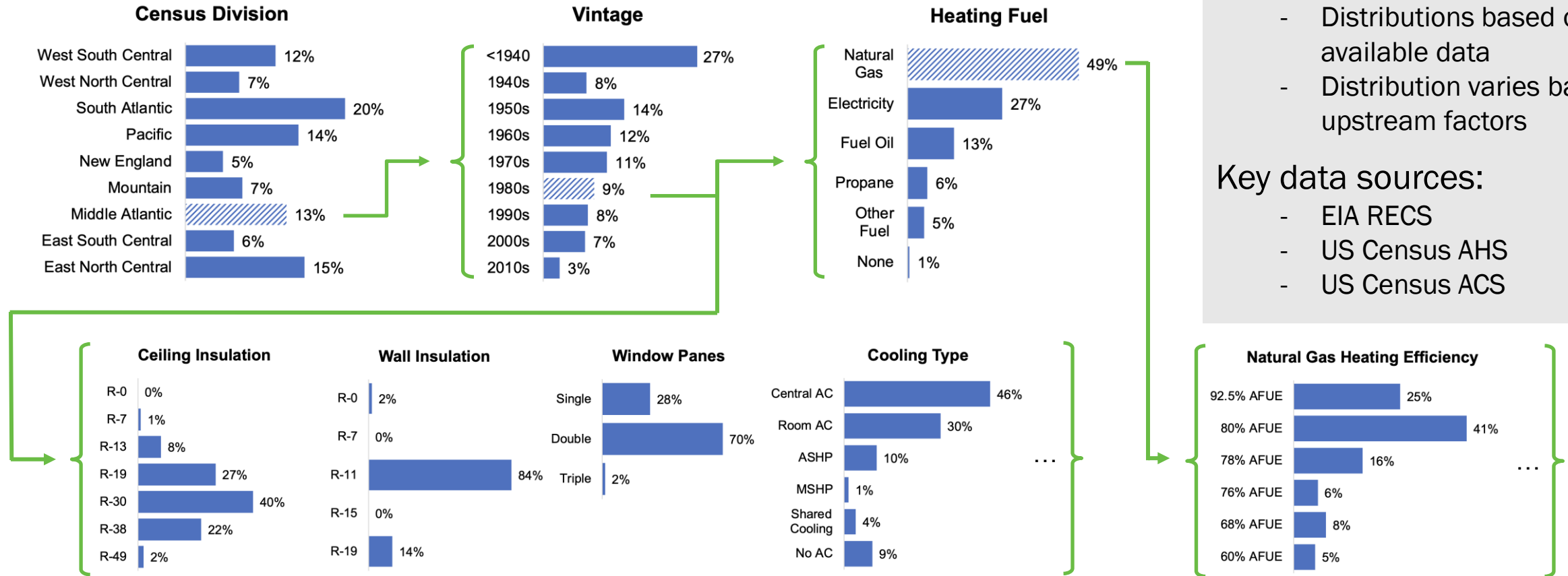
1. Describe the U.S. building stock quantitatively
 2. Sample the description
 3. Model the samples (typically 550,000 models)
 4. Model changes to the samples – energy efficiency, electrification, etc.
 5. Publish description, samples, models, results, aggregations, visualizations, and documentation
- Includes extensive comparisons to other datasets.*

Simple, fast

Simple & fast enough

Complex, slow

Approach – ResStock Technical Overview



100+ home characteristics

- Distributions based on best available data
- Distribution varies based on upstream factors

Key data sources:

- EIA RECS
- US Census AHS
- US Census ACS

We sample 550,000 homes from these housing characteristics distributions
– roughly 1/240 – then model them using open-source DOE models



and a big data
technology stack

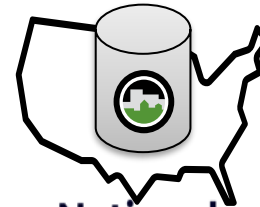
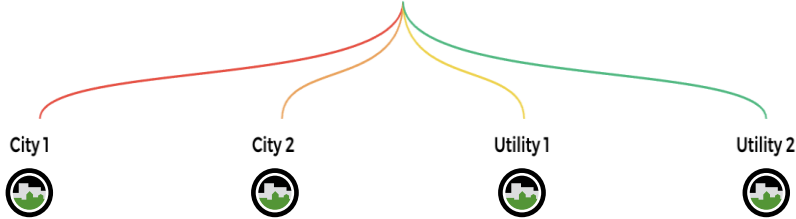
Approach – ResStock Model Deployment

 One ResStock run

Old paradigm:

**Custom
ResStock
Simulations**

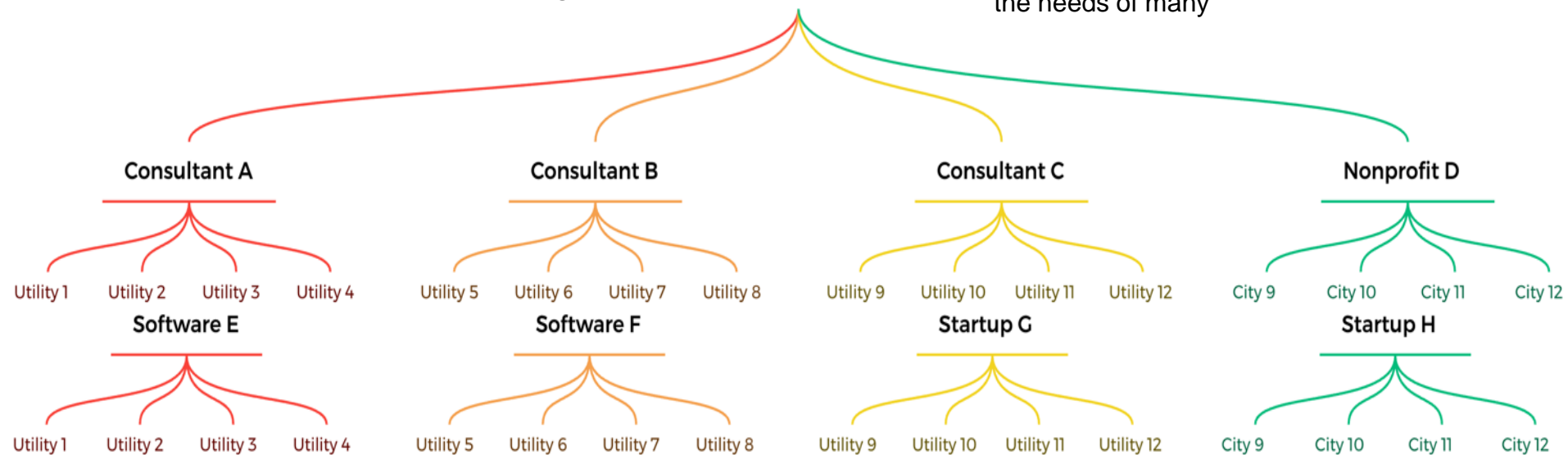
Numerous smaller-scale
ResStock runs custom-made
for different end users



**National
ResStock
Datasets**

Large-scale, robust
public datasets to meet
the needs of many

New paradigm:



FY23 ResStock Team Project Summary

2 core BTO-funded efforts: **EUSS/EULP & ResStock Core**

10 total BTO-funded efforts:

- 4 development-focused
- 6 analysis-focused

20 total DOE-funded efforts contributing to or leveraging ResStock

25 total projects using results from ResStock

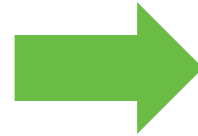
Variety of large and small efforts. Moving to our new paradigm is a work in progress.

Overview of EULP & EUSS – Public ResStock Datasets

End-Use Load Profiles (EULP)

Describes how and when energy is used in buildings **today**

Public database of 550,000 individual home models and their energy end-use load profiles



End-Use Savings Shapes (EUSS)

Describes how and when energy is used in “**what if**” scenarios

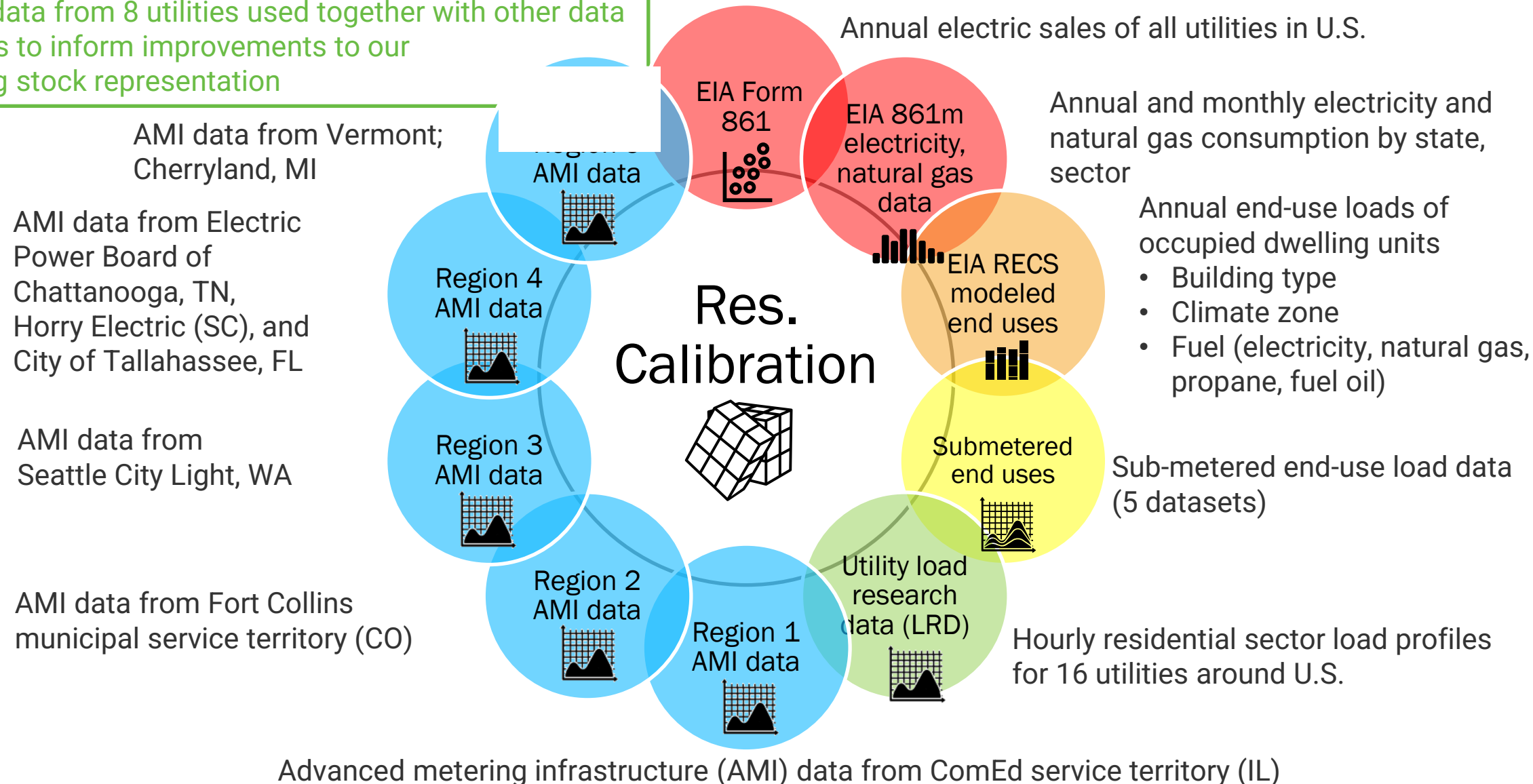
Adds measure impact profiles for energy efficiency and electrification packages

“We want to assess potential energy and cost savings for municipal buildings after electrification and energy conservation measure implementations.”

Zahra Seblini, City of Detroit’s Office of Sustainability

EULP Approach to ResStock Model Improvement

Meter data from 8 utilities used together with other data sources to inform improvements to our building stock representation

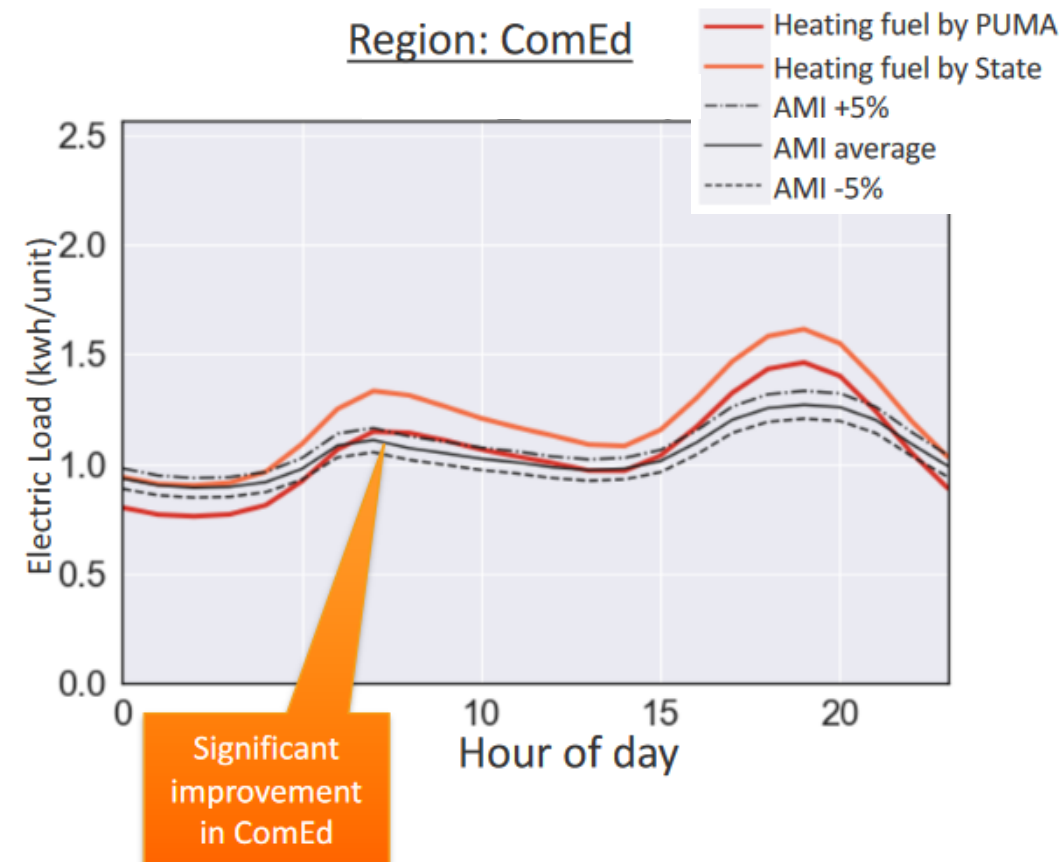


EULP ResStock Model Improvement and Calibration Process

- Not automated tuning to minimize error
- Examined comparisons of our results to other datasets to find areas needing improvement, then found and analyzed stock data with increased **accuracy, diversity, or resolution**
- All model updates overseen by 70+ member Technical Advisory Group and thoroughly documented in our [Methodology and Documentation](#) report

Example: Model Improvement Informed by Measured Data

- Observed our electric load results in winter higher than utility data
- Revised geographic resolution of modeled heating fuel distribution to PUMA rather than state level
- Observed closer alignment between our load results and utility data.



EUSS Residential Round 1 Overview

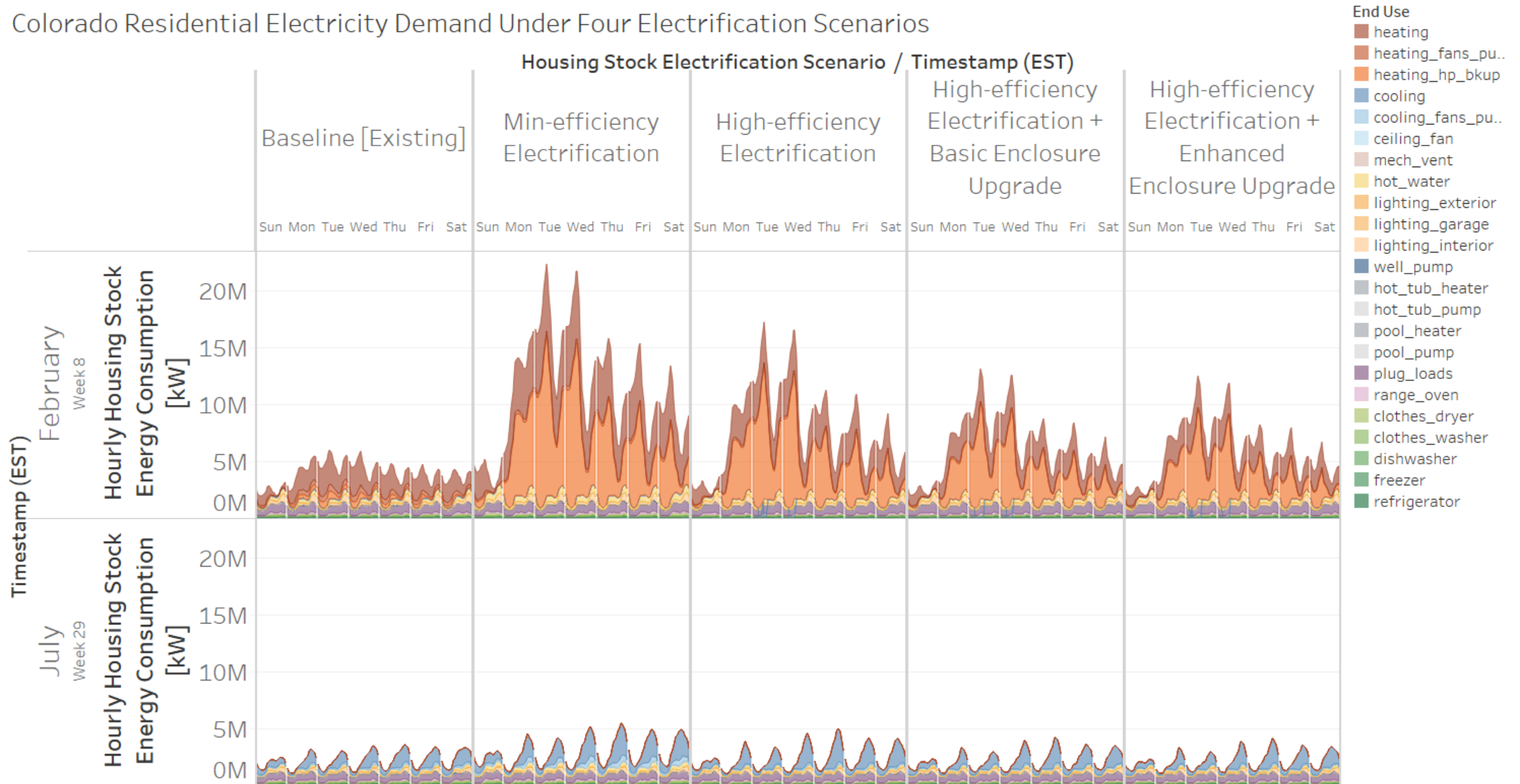
- 15-minute resolution
- 48 states + DC
- 3 weather years: AMY 2018, AMY 2012, TMY3
- 550,000 representative dwelling units for each run
- End-use energy consumption & savings
- Avoided emissions

10 Measure Packages of Energy Efficiency and Electrification

1	Basic enclosure
2	Enhanced enclosure
3	Heat pumps, min-efficiency, electric backup
4	Heat pumps, high-efficiency, electric backup
5	Heat pumps, min-efficiency, existing heating as backup
6	Heat pump water heaters
7	Whole-home electrification, min-efficiency
8	Whole-home electrification, high efficiency
9	Whole-home electrification, high efficiency + basic enclosure package
10	Whole-home electrification, high efficiency + enhanced enclosure package

EUSS Residential Round 1 – Data Example

Colorado Residential Electricity Demand Under Four Electrification Scenarios



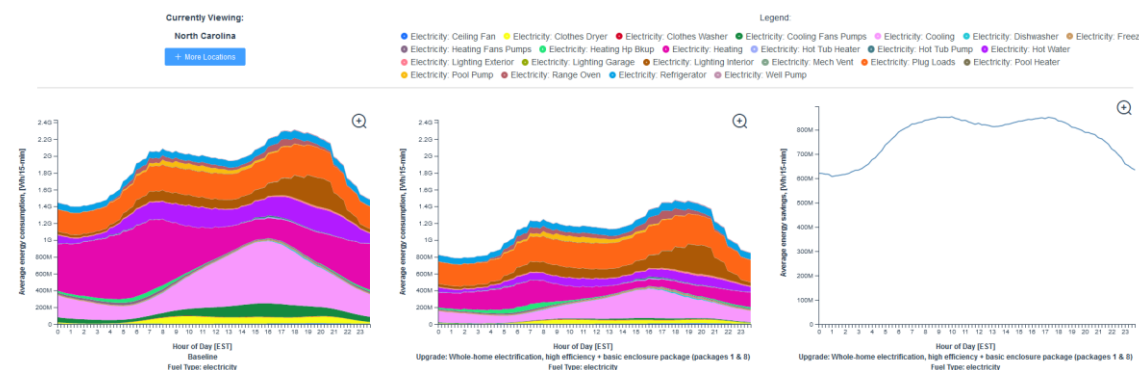
Data Access Paths for EULP & EUSS Public Datasets

Open Energy Data Initiative (OEDI)

- Metadata and Annual files
 - Each modeled home's characteristics, measure applicability, and annual results, for each measure package
 - Excel-friendly at the state level (.csvs < 200 MB)
- Pre-aggregated timeseries files
 - Geographic levels: climate zones, states, ISO/RTO
 - Geography-total energy consumption, pre and post measure, energy savings, carbon emissions & avoided carbon emissions
 - 15-minute results
 - Excel-friendly (approx. 50 MB)
- Individual Model Files
 - Model-level inputs, weather data, schedules, & outputs
 - Not Excel-friendly

Web Data Viewer

- Graphical User Interface



- Custom Data Download & Aggregation Tool
 - Filter on any characteristic (e.g., location, vintage, wall type)
 - Download aggregated residential loads from that filter

3	5161.02	51205.6	37301	215291	1416.71	1654.48	5463.69	3620.59	1073.37	10142.4	723.73	89680.5	0	222.518	0	891526	20163	1053.27	0	66.491	377.019	575.357	1216.14	26.2558	0	1773001	202.028	62012.7	121.202	210.188
3	5161.02	52468.8	37571.2	218043	1416.71	1654.48	7281.61	3620.59	1073.37	10142.4	723.73	89633	0	222.518	0	996.369	20163	1053.27	0	79.7608	108.642	290.091	1216.14	26.2558	0	1811541	202.028	106447	121.202	210.188
5	5161.02	53438.6	39413.6	223429	1416.71	1654.48	7224.95	3620.59	1073.37	10142.4	723.73	89558.7	0	222.518	0	854.48	20163	1053.27	0	91.3985	128.157	390.856	1216.14	26.2558	0	1846911	202.028	82920.5	121.202	210.188
5	5161.02	54265.7	40362	226596	1416.71	1654.48	6537.3	3620.59	1073.37	10142.4	723.73	89501.8	0	222.518	0	861.502	20163	1053.27	0	101.546	0	655.259	1216.14	26.2558	0	1874552	202.028	47527.9	121.202	210.188
9	5161.02	55519.2	42055.5	237440	1746.49	2011.14	4988.38	3537.78	1073.37	10142.4	694.916	89369.6	0	299.274	0	1372.88	19646	818.403	0	112.474	88.9858	655.259	956.775	52.3697	0	1921731	245.101	44258.7	95.5143	280.369
6	5161.02	56755.3	42192.8	241860	1746.49	2011.14	8120.83	3537.78	1073.37	10142.4	694.916	89326.2	0	299.274	0	2674.34	19646	818.403	0	122.905	102.256	655.259	956.775	52.3697	0	1958920	245.101	48461.3	95.5143	280.369
8	5161.02	57597.9	43451.9	246344	1746.49	2011.14	9784.27	3537.78	1073.37	10142.4	694.916	89345.4	0	299.274	0	2420.34	19646	818.403	0	133.975	76.7804	655.259	956.775	52.3697	0	1988765	245.101	56193.8	95.5143	280.369
11	5161.02	58320.6	44174.9	249295	1746.49	2011.14	10343.4	3537.78	1073.37	10142.4	694.916	89332.3	0	299.274	0	3197.34	19646	818.403	0	145.542	111.197	655.259	956.775	52.3697	0	2014270	245.101	62910.3	95.5143	280.369
5	5161.02	60433.5	48027.2	263762	2821.31	3250.85	11711.2	3263.93	780.63	10217.2	717.918	90275.9	0	607.265	0	4343.35	19440.2	875.788	0	198.763	204.653	795.905	1021.85	181.946	0	2088770	396.746	73061.1	102.398	560.1
71	5161.02	61093	48564.5	262749	2821.31	3250.85	14941.9	3263.93	780.63	10218.2	717.918	90314.6	0	607.265	0	5253.52	19440.2	875.788	0	221.755	102.256	618.288	1021.85	181.946	0	2109422	396.746	84785.4	102.398	560.1
9	5161.02	61661.6	49388.2	266955	2821.31	3250.85	15611.6	3263.93	780.63	10236.1	717.918	90570.8	0	607.265	0	6637.3	19440.2	875.788	0	240.631	89.0568	732.891	1021.85	181.946	0	2130349	396.746	98553.6	102.398	560.1
3	5161.02	61973.9	49510	267929	2821.31	3250.85	19994	3263.93	780.63	10238	717.918	90641.3	0	607.265	0	7947.47	19440.2	875.788	0	258.939	128.157	1010.28	1021.85	181.946	0	2141964	396.746	111442	102.398	560.1
11	5161.02	63993.3	53971.2	280494	4016.71	4639.47	24762	3537.78	1073.37	12821.8	749.638	92296.5	0	1116.95	0	9944.56	19440.2	1005.09	0	238.715	313.224	1239.42	1149.44	310.315	0	2215677	565.564	117954	114.39	1046.68
4	5161.02	64372.5	53924.5	279022	4016.71	4639.47	30782.4	3537.78	1073.37	12868.5	749.638	92419.7	0	1116.95	0	13100.5	19440.2	1005.09	0	251.63	222.748	1445.63	1149.44	310.315	0	2224442	565.564	124086	114.39	1046.68
8	5161.02	64620.4	54013.6	281764	4016.71	4639.47	33172.9	3537.78	1073.37	13952.8	749.638	93861.4	0	1116.95	0	17167.3	19440.2	1005.09	0	269.654	0	1935.69	1149.44	310.315	0	2234161	565.564	138282	114.39	1046.68
2	5161.02	64594.7	54050.2	281072	4016.71	4639.47	36722.6	3537.78	1073.37	14061.3	749.638	94044.9	0	1116.95	0	17859.8	19440.2	1005.09	0	288.317	353.46	1572.93	1149.44	310.315	0	2234499	565.564	155193	114.39	1046.68
7	5161.02	66421.1	58003.5	283187	3424.46	3960.54	43110.7	4260.54	1250.85	29489.9	920.824	102046	0	1939.95	0	21030	20163	1452.54	0	295.91	755.244	1378.43	1664.19	749.709	0	2300587	480.623	174034	165.766	1817.04
2	5161.02	66528.6	57813.9	282018	3424.46	3960.54	46140	4260.54	1250.85	29426.9	920.824	102079	0	1939.95	0	24434.9	20163	1452.54	0	310.457	217.568	1090.61	1664.19	749.709	0	2302458	480.623	184041	165.766	1817.04
9	5161.02	66626.2	57773.4	283931	3424.46	3960.54	48960.6	4260.54	1250.85	33369.8	920.824	104918	0	1939.95	0	25307.3	20163	1452.54	0	317.34	365.523	1467.56	1664.19	749.709	0	2309311	480.623	190803	165.766	1817.04
3	5161.02	66552.1	57479.7	284059	3424.46	3960.54	49088.2	4260.54	1250.85	33002.5	920.824	104627	0	1939.95	0	26446	20163	1452.54	0	326.585	0	2474.15	1664.19	749.709	0	2306490	480.623	178740	165.766	1817.04
3	5161.02	68228.6	62614.6	287387	1416.71	1654.48	43125	4544.56	1250.85	45837.3	1044.07	115650	0	3286.69	0	25714.1	21601	1819.13	0	1081.6	489.848	4474.06	2105.64	1192.51	0	2371624	202.028	181987	210.188	3078.38
4	5161.02	67659.6	61497.6	284594	1416.71	1654.48	44486.7	4544.56	1250.85	43728.6	1044.07	113976	0	3286.69	-300.73	24268.8	21601	1819.13	0	793.938	396.533	6652.93	2105.64	1192.51	0	2352182	202.028	186155	210.188	3078.38
4	5161.02	67132.2	61497.6	283315	1416.71	1654.48	45245.5	4544.56	1250.85	43414	1044.07	112171	0	3286.69	-1923.2	23225.4	21601	1819.13	0	922.774	160.728	8295.91	2105.64	1192.51	0	2329459	202.028	179910	210.188	3078.38
8	5161.02	67132.2	61497.6	283315	1416.71	1654.48	45245.5	4544.56	1250.85	43414	1044.07	112171	0	3286.69	-1923.2	23225.4	21601	1819.13	0	845.255	703.017	8942.58	2105.64	1192.51	0	2295140	202.028	179088	210.188	3078.38
5	5161.02	65719.9	61354.3	28354	1416.71	1654.48	43232	4544.56	1250.85	43232	1044.07	112171	0	3286.69	-1923.2	23225.4	21601	1819.13	0	778.185	485.59	6731.7	2105.64	1138.01	0	2283001	202.028	187274	210.188	5879.17
6	5161.02	63929.1	49172.7	274070	1416.71	1654.48	42713.8	3413.56	780.63	45560.8	790.073	115659	0	6276.52	-6643.6	19071	21775.8	1819.13	0	728.239	367.155	7002.42	2105.64	1138.01	0	2209033	202.028	172133	210.188	5879.17
3	5161.02	62026.5	45468.3	268110	1416.71	1654.48	50870	3413.56	780.63	45427.4	790.073	115639	0	6276.52	-6734.1	18239.2	21775.8	1819.13	0	675.088	99.843	7399.8	2105.64	1138.01	0	2143693	202.028	184992	210.188	5879.17
9	5161.02	59976.3	41901	259530	1416.71	1654.48	50138.3	3413.56	780.63	43774.6	790.073	114420	0	6276.52	-7699.3	16584.5	21775.8	1819.13	0	625.739	146.465	7858.07	2105.64	1138.01	0	2070792	202.028	185101	210.188	5879.17
7	5161.02	59380.7	41794.7	248726	1144.31	1324.21	50659.4	2479.91	354.964	47261.6	780.63	116100	0	9053.52	-8817.9	14813.1	21775.8	1767.07	0	581.175	148.806	9456.84	2045.18	1061.3	0	2056667	160.089	187358	203.589	8474.23
8	5161.02	57212.2	36508.8	240862	1144.31	1324.21	51572	2479.91	354.964	46417.7	780.63	115535	0	9053.52	-9767.1	14328.8	21775.8	1767.07	0	539.308	195.712	7381.64	2045.18	1061.3	0	1974060	160.089	206138	203.589	8474.23
5	5161.02	54977.5	33050.6	231522	1144.31	1324.21	54548.2	2479.91	354.964	46211.4	780.63	115337	0	9053.52	-11718	12168.5	21775.8	1767.07	0	507.233	812.226	5796	2045.18	1061.3	0	1896923	160.089	208621	203.589	8474.23
2	5161.02	52339.5	27671.9	221720	1144.31	1324.21	52233.7	2479.91	354.964	45110.2	780.63	114659	0	9053.52	-13703	11339	21775.8	1767.07	0	474.449	625.314	5370.3	2045.18	1061.3	0	1803894	160.089	215430	203.589	8474.23
4	5161.02	52465.7	26781.6	222831	899.759	1035.59	53175.4	2479.91	603.148	44606.6	630.025	115124	0	9495.65	-15759	11802.2	21601	1819.13	0	458.199	0	5702.97	2105.64	1138.01	0	1805154	126.383	223602	210.188	8895.25
4	5161.02	50715.3	24345.1	215085	899.759	1035.59	56724.3	2479.91	603.148	43912.9	630.025	114712	0	9495.65	-17846	11769.5	21601	1819.13	0	437.265	65.4976	5993.06	2105.64	1138.01	0	1745159	126.383	231113	210.188	8895.25
6	5161.02	49445.8	22207.5	211398	899.759	1035.59	58966.9	2479.91	603.148	43612.4	630.025	114349	0	9495.65	-19225	11936.6	21601	1819.13	0	418.106	441.168	8064.36	2105.64	1138.01	0	1702787	126.383	215378	210.188	8895.25
6	5161.02	47911.4	19853.8	205557	899.759	1035.59	53367.9	2479.91	603.148	43239.5	630.025	114070	0	9495.65	-20549	10869.7	21601	1819.13	0	397.669	310.67	10115.3	2105.64	1138.01	0	1651577	126.383	214043	210.188	8895.25
7	5161.02	48126	1																											

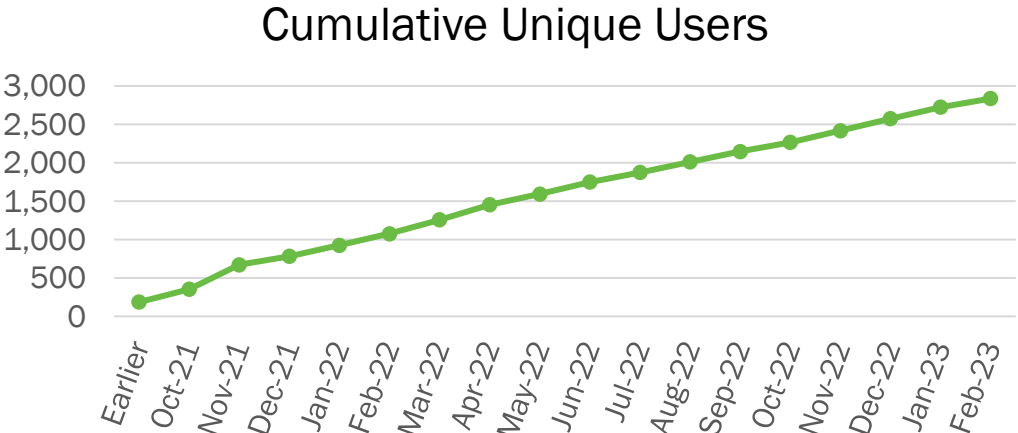
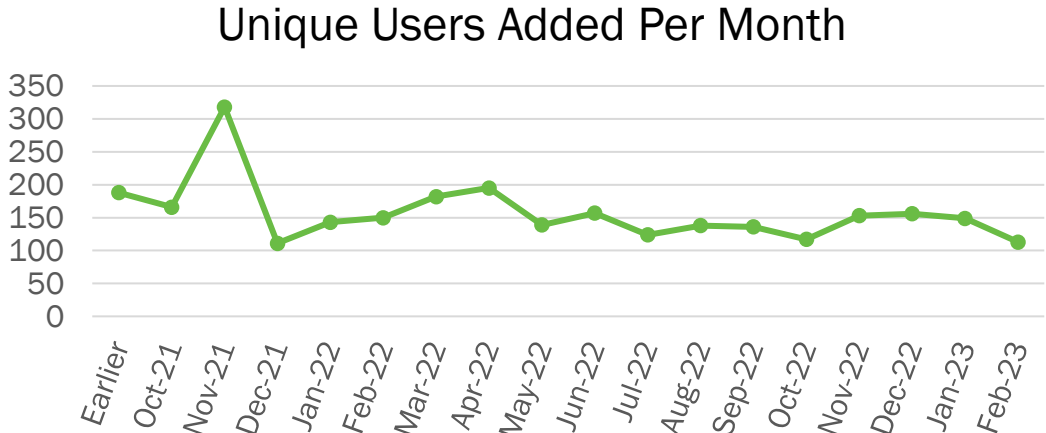
Yes!

- Data integrated into Willdan/Integral Analytic's DSMore tool, used for IRP and utility program planning at utilities representing **26 million utility customers**
- Cedar Falls Utilities using to see what the **impact of electrifying heating** in community may look like **from an electric grid perspective, with a focus on dual fuel systems**, in response to IRA incentives
- WattCarbon and other startups using to help large commercial building owners **implement carbon reduction plans**
- United Power co-op using in design of **rebate programs**
- NYISO and ISO-NE incorporating into long-term **load forecasts for 35 million people**
- U.S. EPA using in their **Home Upgrade modeling**
- CPUC & CA Public Advocates Office using to **simulate bill impacts** of a rate designed to **promote electrification**
- Rewiring America using to create **state-by-state deployment prioritizations** for IRA Efficiency Rebates
- MN Dept of Commerce using to inform **creation of regulatory pathways for natural gas utilities**

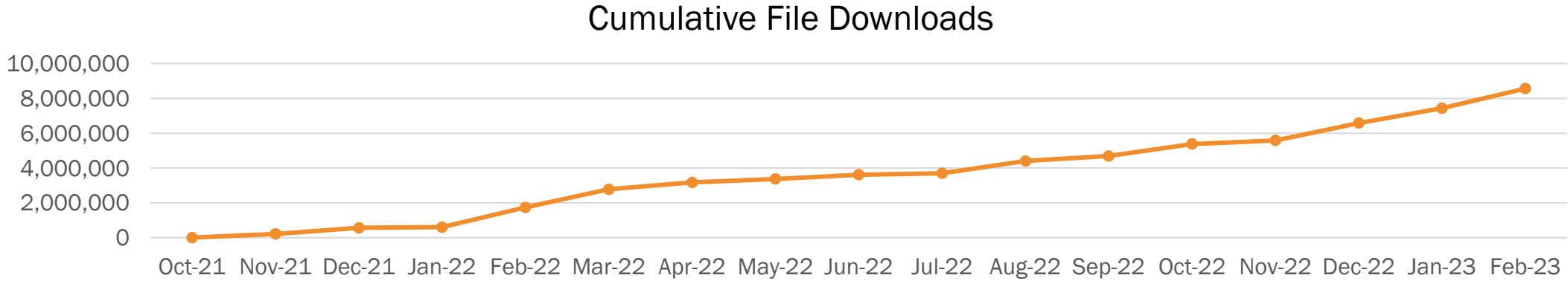
Currently, the datasets are being used across utility planning, utility rate design, load forecasting, decarbonization planning, and market sizing by entities such as the Minnesota Department of Commerce, the California Public Utility Commission, the New York Independent System Operator, and RMI.

Consistent Interest in the Datasets

Data Access Path 1:
Web Data Viewer



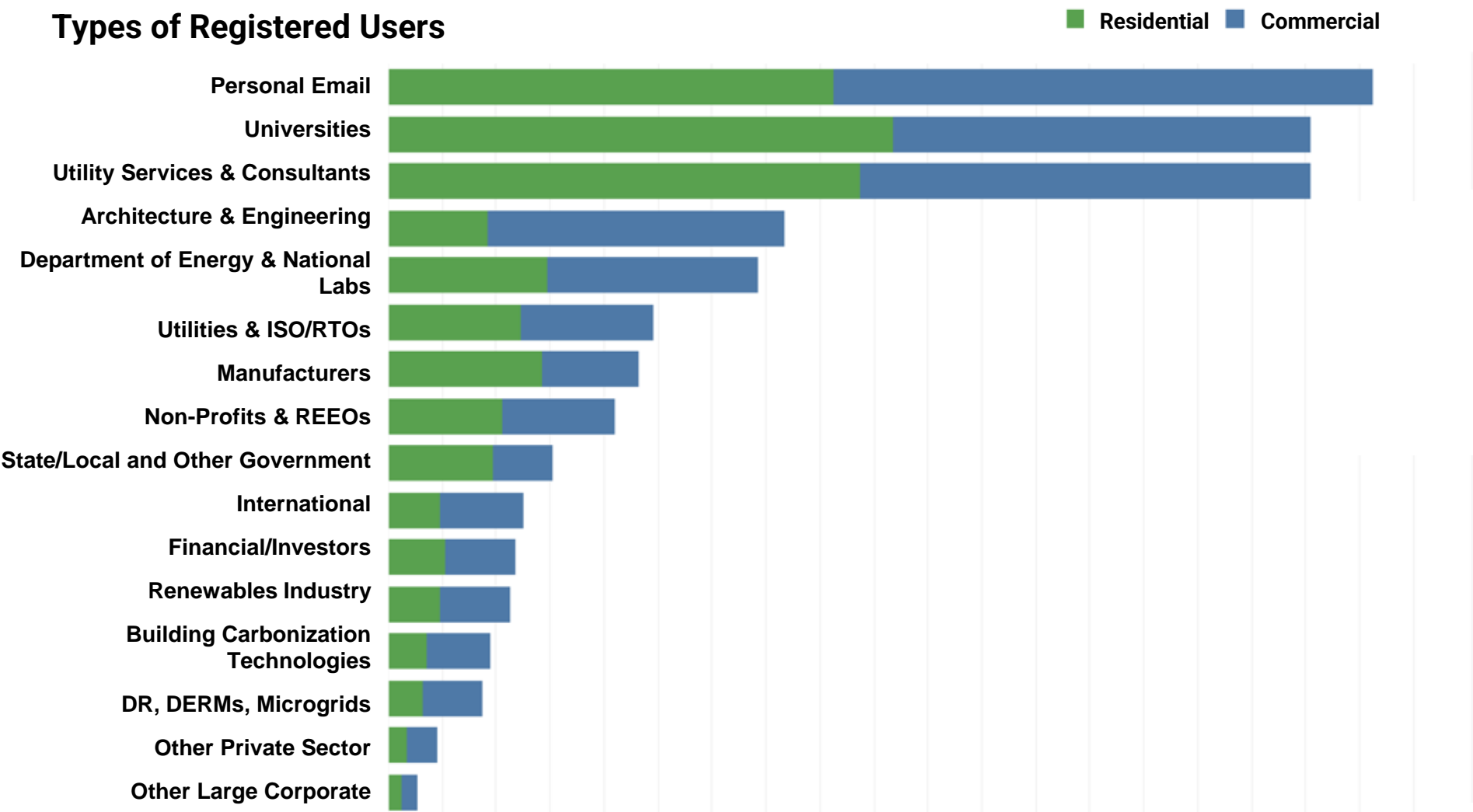
Data Access Path 2:
OEDI



Consistently #1 most downloaded of 2,648 datasets on Open Energy Data Initiative (OEDI) since publication

Note: Figures on this slide represent combined EULP & EUSS for both Residential and Commercial

Variety in Dataset Users



Number of unique users:

2,835

Number of organizations
(based on domain names):

1,101

Impact

“This is incredible. I've been wanting someone to do this since I started at NYSERDA, and here it is already completed.”

James Geppner, RetrofitNY
Senior Project Manager

Future Work

Development Plan Highlights

- Updating building characteristics informed by RECS 2020 – FY23
- Incorporate improved cold climate heat pump modeling currently in development for OpenStudio-HPXML – FY23
- Modeling electric vehicles and charging profiles
- Demographic correlations in the occupant schedules
- Geothermal heat pump modeling
- Grid-Aligned TMY weather files
- Future building stock scenarios

Planned Public Datasets (2023)

- Large run with annual outputs, with fact sheets and dashboards – Summer 2023
 - Likely 40-60 measure packages
- EUSS Residential Round 2 (timeseries) – Fall 2023
 - Likely 10 measure packages
 - To include improved heat pump models

The team is open to input on specifics of these planned public datasets

- Run with annual results: email load.profiles@nrel.gov ASAP (window of opportunity is nearly closed)
- Run with timeseries results: use input form available on our [website](#) (preferred), or email



Utility Companies:

The results of the EULP research effort will be tremendously helpful to Seattle City Light, allowing us to improve our load modeling of future residential and commercial electrification related to electric vehicles, heat pumps, and other end uses.

Michael Hamilton,
Seattle City Light



Utility DSM Consultants:

This dataset will be a very valuable resource for the utility demand side management industry.

Justin Spencer
Apex Analytics



Building Energy Modeling Industry:

We are excited to help our city and utility clients understand the local impacts of building electrification... with much more confidence than previously available methods such as California DEER or DOE prototype models.

Mudit Saxena,
CEO & President,
XeroHome / Vistar Energy Inc.



Technology Developers:

At Lunar Energy, we develop hardware and software products to enable whole-home electrification.

We're excited to engage with this critical dataset to help guide our product direction.

Randol Aikin,
Techno Financial Modeling Lead
Lunar Energy

Thank You

NREL

Elaina Present, Researcher III (EUSS) *and* Anthony Fontanini, Researcher IV (ResStock Core Development)

Anthony.Fontanini@nrel.gov and Elaina.Present@nrel.gov

WBS # All of 1.5.1.32 (ResStock Core), Part of 3.4.6.57 (EULP & EUSS), and a smattering of others

<https://resstock.nrel.gov/>

<https://www.nrel.gov/buildings/end-use-load-profiles.html>

REFERENCE SLIDES

Project Execution

◆ Milestone date

EUSS (Residential + Commercial)	FY 2023				FY24
Planned budget	\$1,200,000				
Spent budget	\$711,000				
	Q1	Q2	Q3	Q4	Q1
Past Work					
Q1 Milestone: Commercial progress update	◆				
Q2 Milestone: Draft Residential State-Level Dashboards		◆			
Q2 Milestone: Commercial end-use saving shapes dataset – cycle 1		◆			
Current/Future Work					
Q3 Milestone: Draft Residential Sub-State Fact Sheets			◆		
Q4 Milestone: Public hosting of available sub-state fact sheets and sub-state public dashboards				◆	
Q4 Milestone: Commercial end-use saving shapes dataset – cycle 2				◆	
Q1 Milestone: Residential end-use saving shapes dataset – cycle 2					◆

ResStock Core	FY 2023				FY24
Planned budget	\$500,000				
Spent budget	\$419,000				
	Q1	Q2	Q3	Q4	Q1
Past Work					
Q1 Milestone: Presentation on RECS 2020 integration and model development progress	◆				
Current/Future Work					
Q2 Milestone: Presentation on ResStock Q2 developments		◆			
Q3 Milestone: Presentation on ResStock Q3 developments			◆		
Q4 Milestone: Documentation of RECS 2020 integration and summary of annual ResStock development					◆

Team

EULP & EUSS - WBS 3.4.6.57

Elaina Present – PI

Chioke Harris – Senior contributor

Lixi Liu – Senior contributor^

Philip White – Senior contributor

Eric Wilson – Senior contributor, former PI (on DOE detail)

ResStock Core – WBS 1.5.1.32

Anthony Fontanini – PI

Joe Robertson – Senior contributor

Noel Merket – Senior contributor

Rajendra Adhikari – Senior contributor^

Rohit Chintala – Contributor

Prateek Munankarmi – Contributor

Janet Reyna – Senior contributor, former PI (on leave)

^Primary contributor on listed effort; additional contributor on alternative effort

Jenny Erwin – Project manager