End Use Forecasting Tools & Data: Itron MetrixLT & NREL ResStock

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Principal Forecaster

Load Forecasting Task Force
May 26, 2022
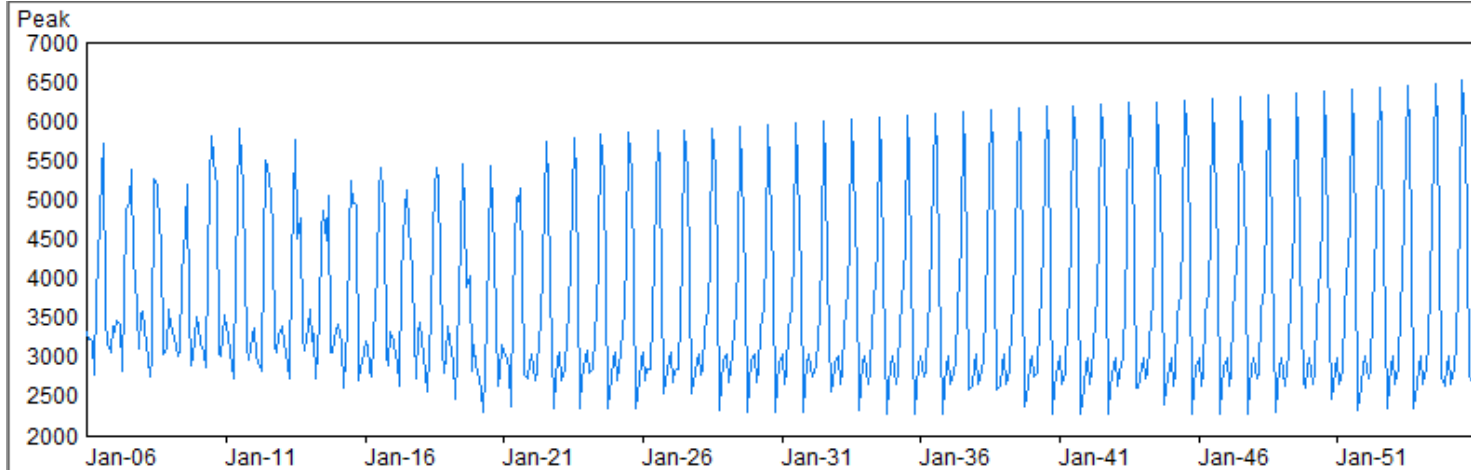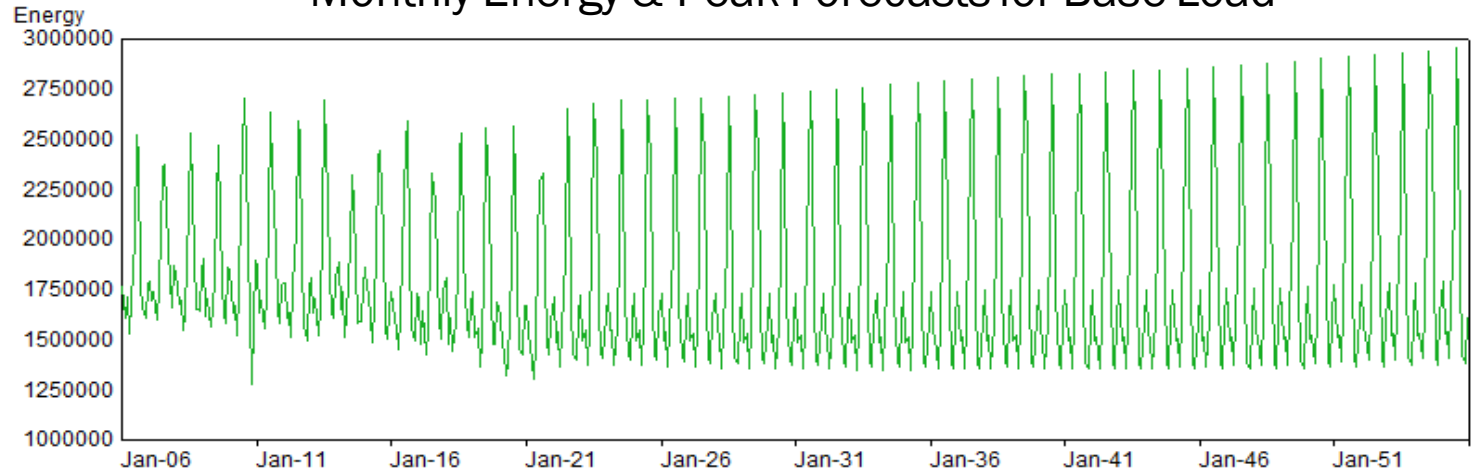
(1) Hourly Load Forecasting Tool

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Need for a comprehensive hourly load forecasting tool

- New electric technologies have 'non-conforming' hourly profiles – they are significantly different than the current hourly profiles of zonal and system loads and are evolving over time.
- Net demand must account for power withdrawals as well as power injections.
  - Injections: Behind-the-meter solar, energy storage discharge
  - Withdrawals: electric vehicle charging, energy storage charging, large data centers
- Electrification trends will modify the hourly loads in residential and commercial buildings
  - Replacement of heating technologies from fossil to electric with significant adoption of heat pumps
  - Replacement of cooling technologies from central and room AC with heat pumps
  - Replacement of fossil fueled water heating, cooking and clothes drying equipment with electric
- Over time, the typical hourly profile of net load, the hour of the coincident peak, and the relative sizes of winter and summer peaks will gradually change.
- The final system and zonal peaks can be best determined by applying monthly or annual energy to per unit hourly profiles for all contributors to the forecast, and only then finding the date, hour and magnitude of the peak loads.

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MetrixLT Features

- **Hourly load forecasts**
  - Imports daily, monthly or annual class or end use energy forecasts and per-unit hourly load profiles for class or end uses
  - Scales hourly loads in future years consistent with energy forecasts
  - In conjunction with MetrixND (or other software), produces weather-sensitive hourly load forecasts
- **Trended weather and weather-sensitive forecasts for climate impact studies**
  - Imports daily weather pattern of temperature – dry bulb, wet bulb, heat indexes, etc.
  - Using trend parameters, produces future daily temperature with increasing or decreasing trends and trended heating and cooling degree days.
- **Produce aggregate hourly loads at system level and find the resulting coincident peak hour**
- **Data reporting and visualization tools**

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Monthly Energy & Peak Forecasts for Base Load
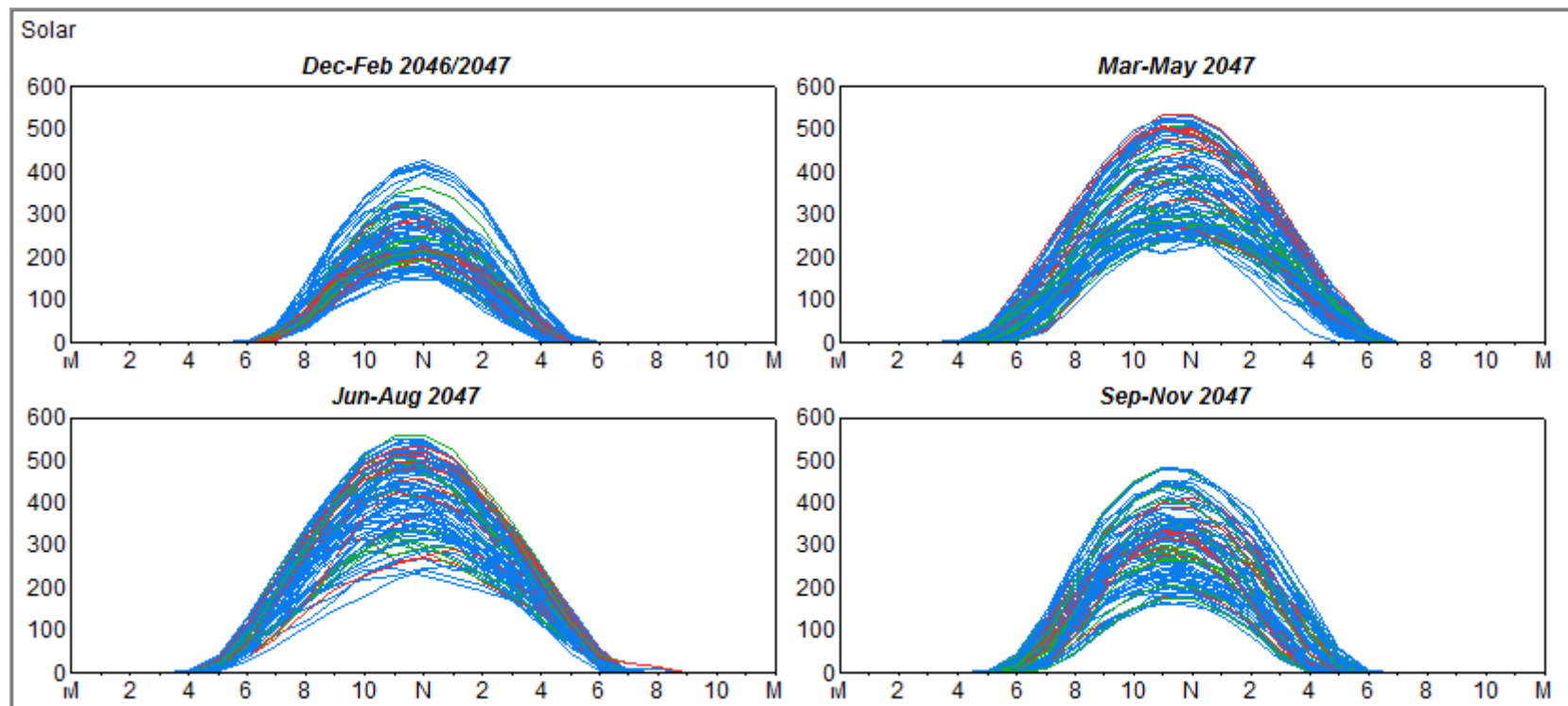
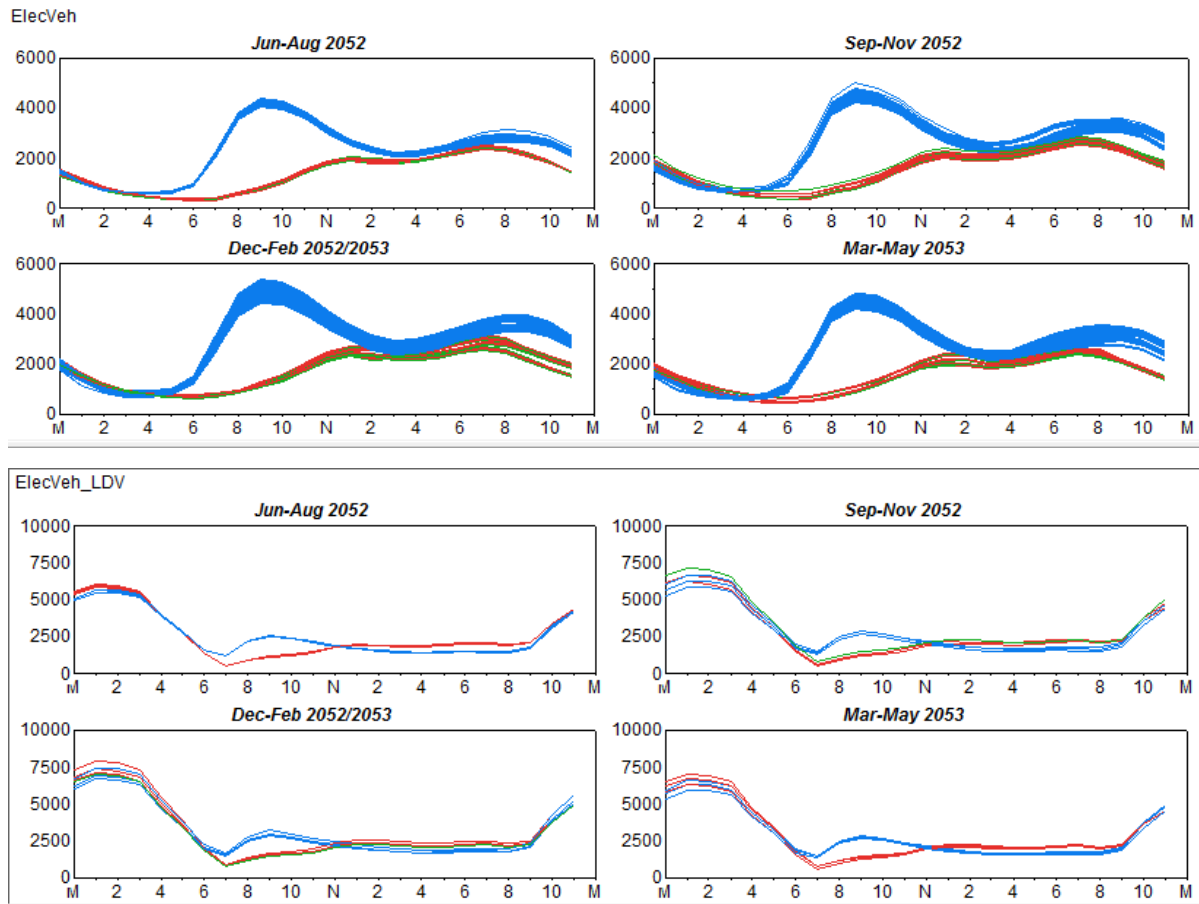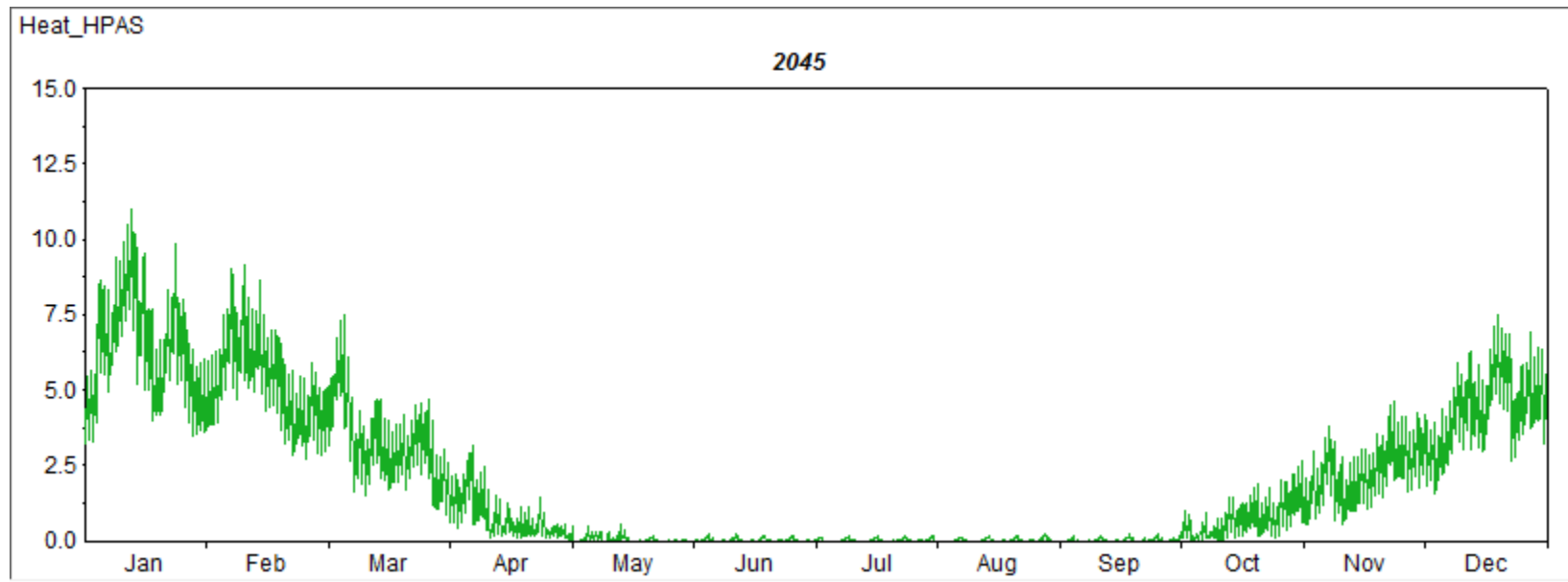# Hourly Load Forecast of Base Load for a Single Year

2035
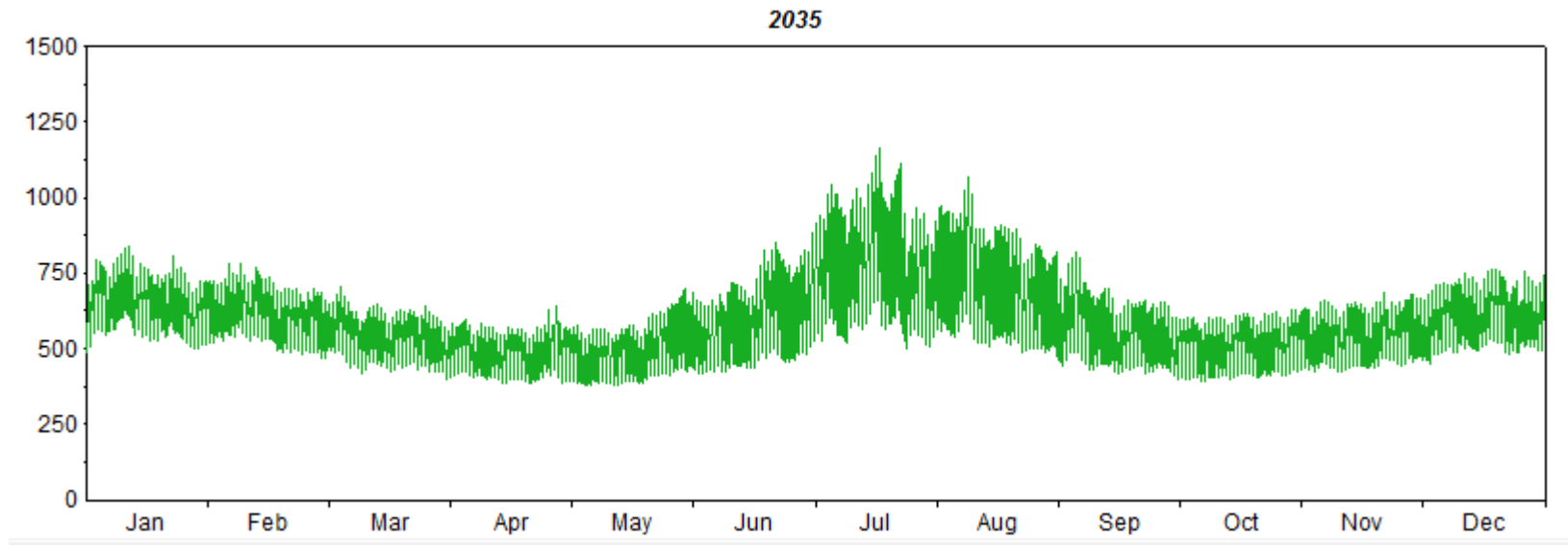
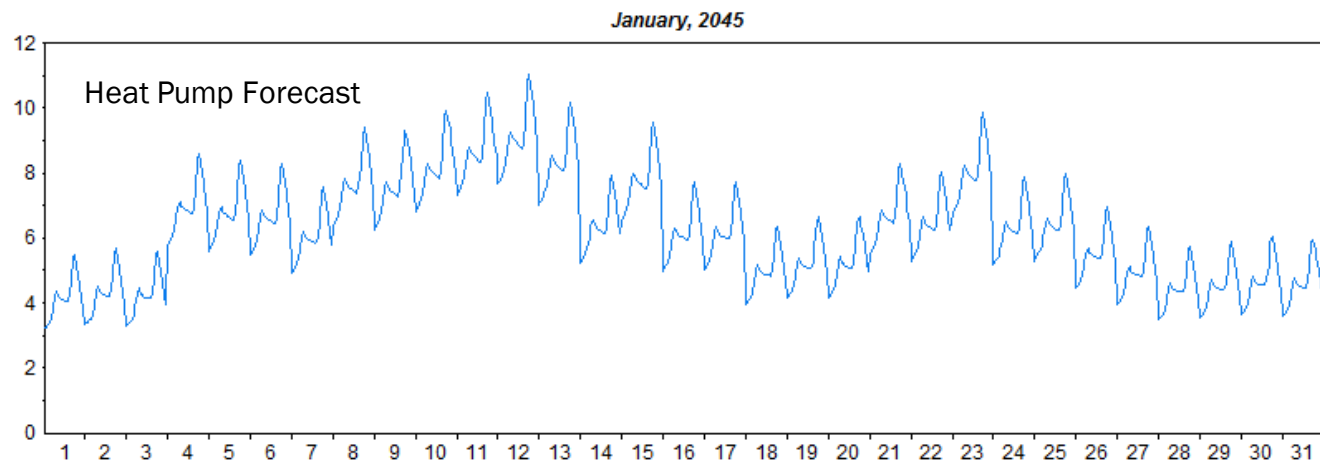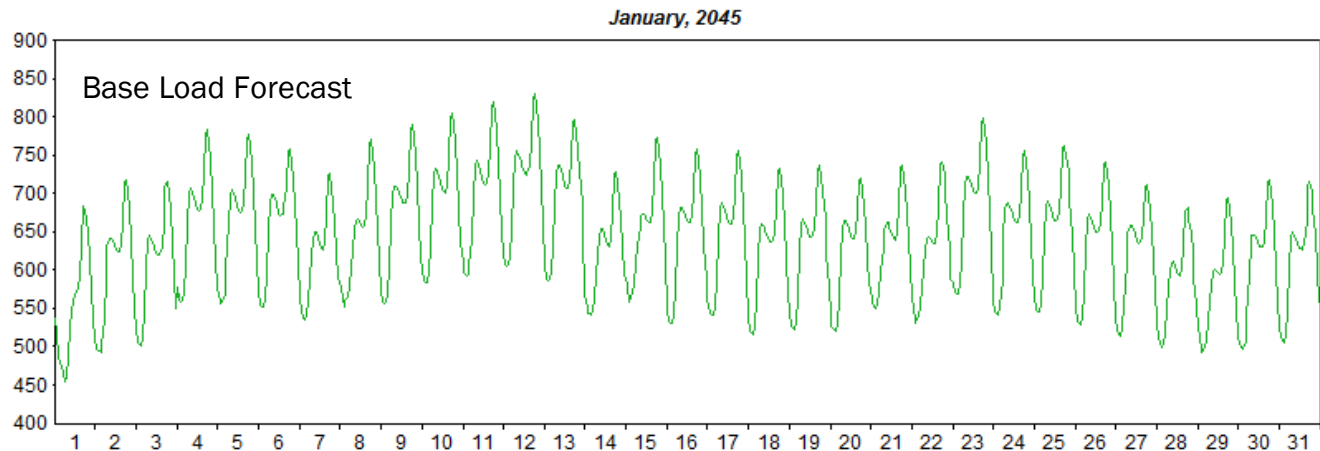# Hourly Load Forecast of BTM Solar for a Single Year

Hourly Loads for EVs – Managed & Unmanaged - for a Single Year
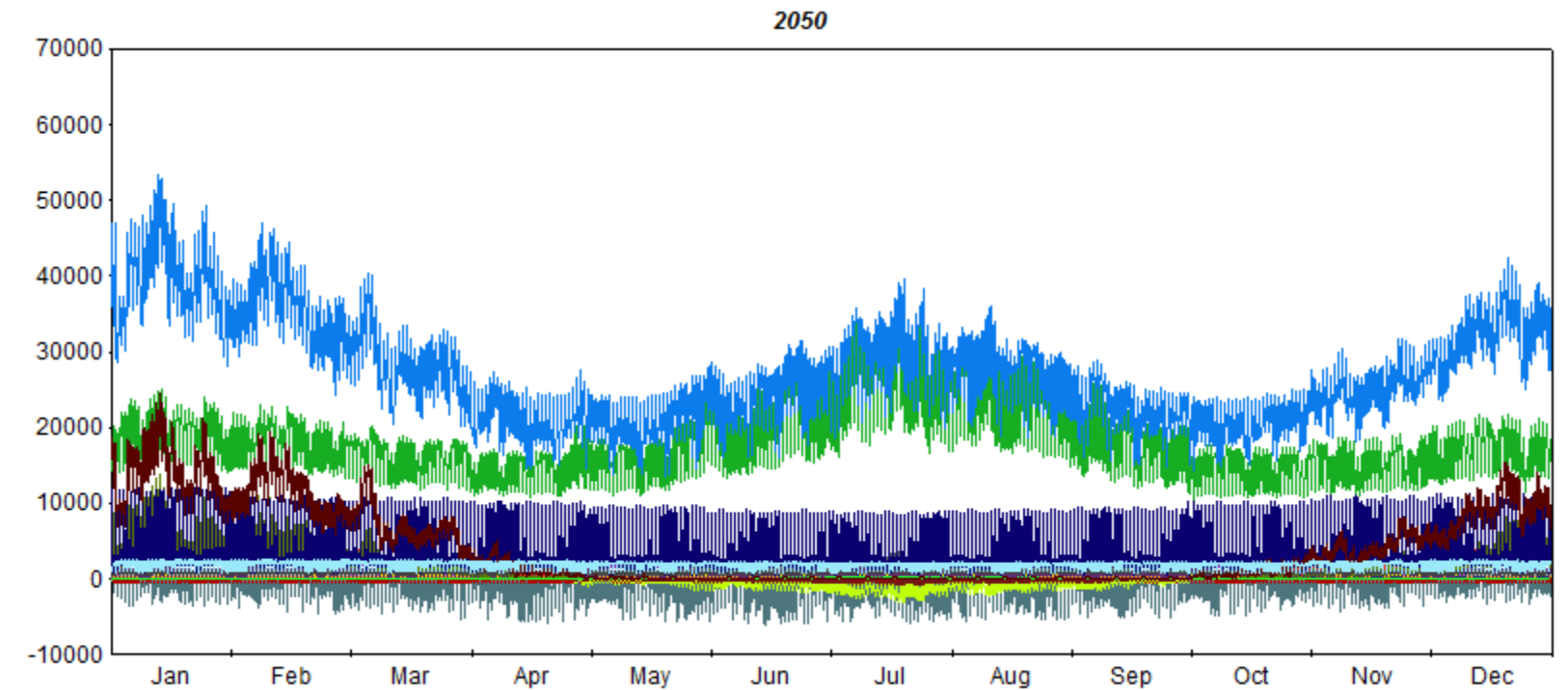
Hourly Load Forecast of Heat Pumps for a Single Year
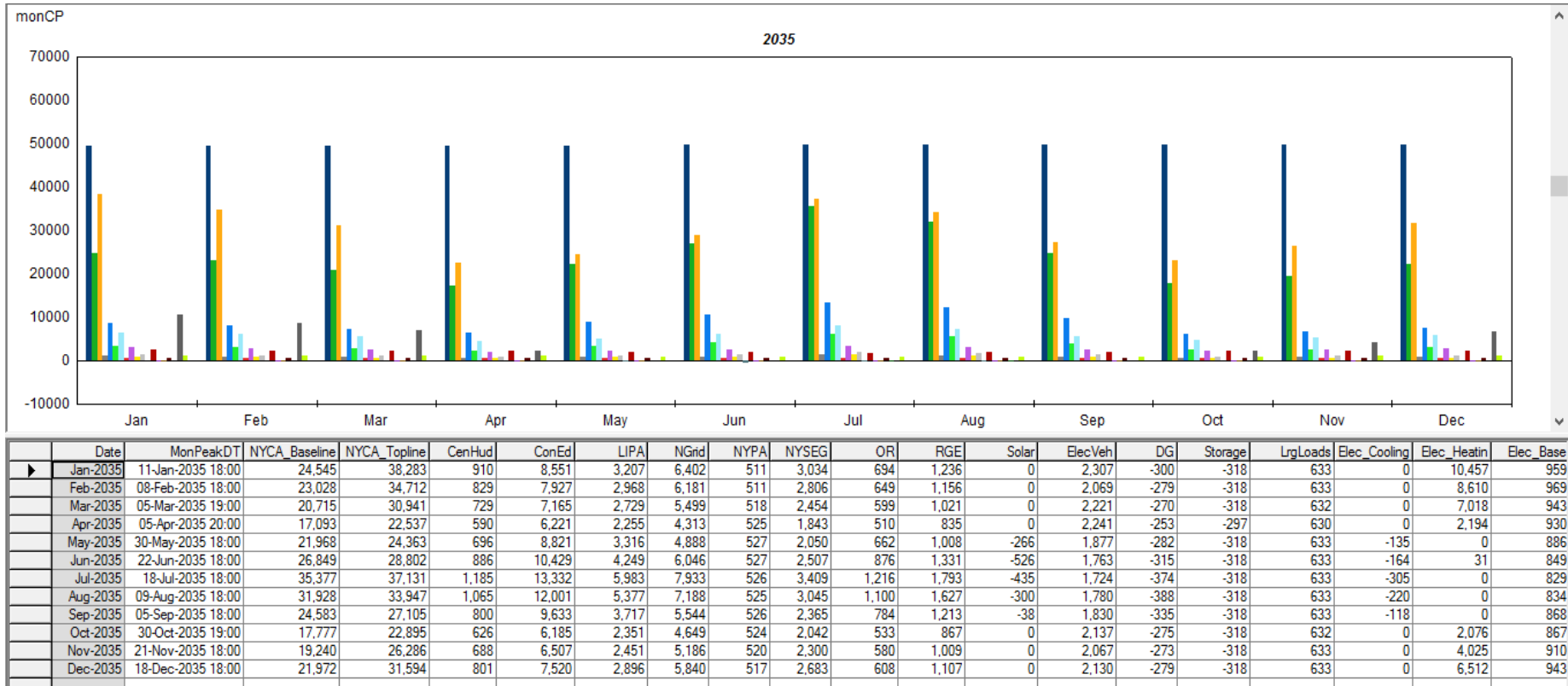
Proper Daily Alignment of Weather-Sensitive Load Forecasts

System Forecast & Build-up of All Components for a Single Year

2050

Report of Monthly System Coincident Peaks & Each Component

Date	MonPeakDT	NYCA_Baseline	NYCA_Topline	CenHud	ConEd	LIPA	NGrid	NYPA	NYSEG	OR	RGE	Solar	ElecVeh	DG	Storage	LrgLoads	Elec_Cooling	Elec_Heating	Elec_Base
Jan-2035	11-Jan-2035 18:00	24,545	38,283	910	8,551	3,207	6,402	511	3,034	694	1,236	0	2,307	-300	-318	633	0	10,457	959
Feb-2035	08-Feb-2035 18:00	23,028	34,712	829	7,927	2,968	6,181	511	2,806	649	1,156	0	2,069	-279	-318	633	0	8,610	969
Mar-2035	05-Mar-2035 19:00	20,715	30,941	729	7,165	2,729	5,499	518	2,454	599	1,021	0	2,221	-270	-318	632	0	7,018	943
Apr-2035	05-Apr-2035 20:00	17,093	22,537	590	6,221	2,255	4,313	525	1,843	510	835	0	2,241	-253	-297	630	0	2,194	930
May-2035	30-May-2035 18:00	21,968	24,363	696	8,821	3,316	4,888	527	2,050	662	1,008	-266	1,877	-282	-318	633	-135	0	886
Jun-2035	22-Jun-2035 18:00	26,849	28,802	886	10,429	4,249	6,046	527	2,507	876	1,331	-526	1,763	-315	-318	633	-164	31	849
Jul-2035	18-Jul-2035 18:00	35,377	37,131	1,185	13,332	5,983	7,933	526	3,409	1,216	1,793	-435	1,724	-374	-318	633	-305	0	829
Aug-2035	09-Aug-2035 18:00	31,928	33,947	1,065	12,001	5,377	7,188	525	3,045	1,100	1,627	-300	1,780	-388	-318	633	-220	0	834
Sep-2035	05-Sep-2035 18:00	24,583	27,105	800	9,633	3,717	5,544	526	2,365	784	1,213	-38	1,830	-335	-318	633	-118	0	868
Oct-2035	30-Oct-2035 19:00	17,777	22,895	626	6,185	2,351	4,649	524	2,042	533	867	0	2,137	-275	-318	632	0	2,076	867
Nov-2035	21-Nov-2035 18:00	19,240	26,286	688	6,507	2,451	5,186	520	2,300	580	1,009	0	2,067	-273	-318	633	0	4,025	910
Dec-2035	18-Dec-2035 18:00	21,972	31,594	801	7,520	2,896	5,840	517	2,683	608	1,107	0	2,130	-279	-318	633	0	6,512	943

Current & Future Uses of Hourly Load Model

- Hourly forecasts in development this year to gain experience and compare results to alternative methods

- Need more insight into evolution of EV patterns and storage charging & discharging patterns.

- Load Diversity across areas is one topic for further work.

- Expect to be used as primary tool for future long term forecasts

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(2) NREL ResStock & ComStock 'Data Lakes'

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NYISO's Interest in ResStock & ComStock

1. Supports continued development of SAE models for long term energy forecasts

2. Provides hourly end use data for use in MetrixLT

3. Supports development of Building Electrification forecasts for heat pumps & other technologies

4. More consistent, timely and detailed than RECS and CBECS

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Primary Topics

1. Metadata: 2018 Building & Equipment Characteristics by PUMA$_1$ Region, End Use & Fuel Type

2. Load Data: End Use Load Data at 15 MPI by PUMA & Fuel Type, Choice of 2018 Weather or TMY

3. Downloading Results for Individual Sites & Geographic Regions, Including PUMA, County, State & ISO/RTO Region, From the AWS Data Lake

1. PUMA stands for Public Use Microdata Area. They are non-overlapping areas that partition each state into areas of no fewer than 100,000 people. NY has 62 counties and 145 PUMAs.

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American Community & Housing Surveys + *Energy Plus Building Simulation Program* + *Terra-Bytes of Data & Fast Computers* = *Residential Energy, Peak & Hourly Load Data Representative of Every County in US*

1. Data Viewer
2. Building Characteristics
3. State Fact Sheets
4. Datasets
5. FAQ
6. Publications
7. Typology

https://resstock.nrel.gov/

Ongoing building energy research program at NREL has already resulted in numerous studies & published papers, with many more to come.

ResStock Heat Pump Cost-Effectiveness Estimates

NREL Building Stock Analysis

☆ 0   👁 239

EFS Equipment Stock Scenarios

NREL Building Stock Analysis

☆ 0   👁 124

ResStock results for Tribal Energy Atlas

NREL Building Stock Analysis

☆ 0   👁 109

Cost-Effective Savings Potential - Drill-and-Fill

NREL Building Stock Analysis

☆ 0   👁 95

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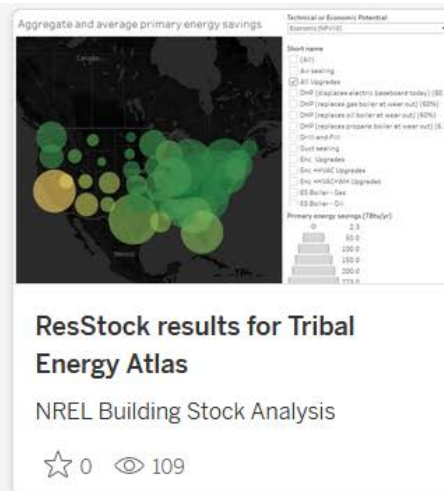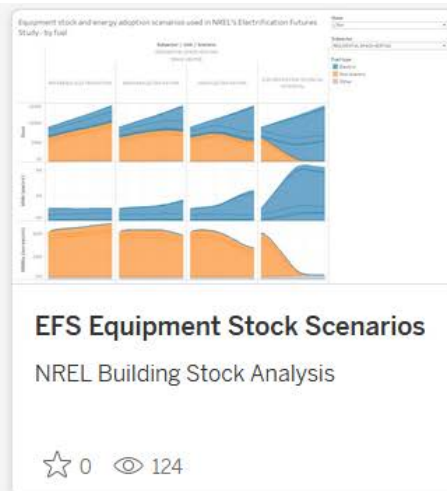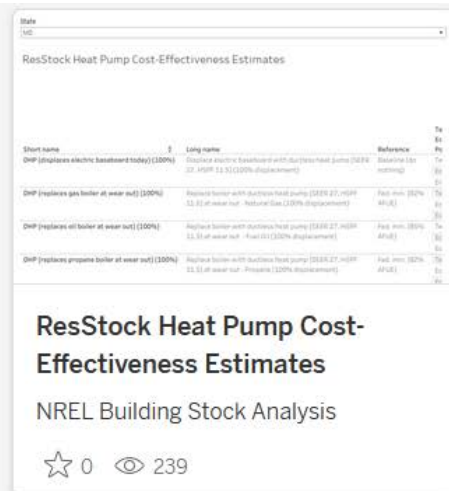
(2a) Metadata: 2018 Building & Equipment Characteristics by PUMA Region, End Use & Fuel Type

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Public Datasets

(1) Select Datasets, Weather Year, then Metadata

End Use Load Profiles for the U.S. Building Stock

This dataset describes the timeseries energy consumption of the U.S. residential building stock at the end-use level. For details on how it was created and validated, please see the project's final report. For instructions on how to access pre-created aggregate data files, please visit the End Use Load Profiles for the U.S. Building Stock project website. For commercial building stock data, please see the ComStock data viewer. Two versions of this dataset have been created: one with actual weather data from 2018, and another with typical (TMY3) weather data. The TMY3 *15-min* energy data should not be used for larger geographies because weather events are not regionally aligned. Multiple geographic views of the dataset have been created, one by state, and one for each Census region by PUMA.

Releases

Select a Data Viewer link below to go to the Data Viewer or Building Characteristics Viewer.

Publication date	Release #	Building stock represented	Upgrades applied	Weather year	Data Viewer Links - Annual and Timeseries Energy	Data Viewer Links - Building Characteristics	Data Table with Characteristics and Annual Energy Use (metadata.tsv)	Supplemental Data and Dictionaries	Input building characteristics
October 2021	1	U.S. residential sector circa 2018	None	amy2018	by_state, by_puma_northeast, by_puma_midwest, by_puma_south, by_puma_west	by_state, by_puma_northeast, by_puma_midwest, by_puma_south, by_puma_west	metadata	suppl_data_dict	github
October 2021	1	U.S. residential sector circa 2018	None	tmy3	by_state, by_puma_northeast, by_puma_midwest, by_puma_south, by_puma_west	by_state, by_puma_northeast, by_puma_midwest, by_puma_south, by_puma_west	metadata	suppl_data_dict	github

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(2) We are now at a Data Portal of Amazon Web Service Data Lake......

Download the Metadata.tsv file (tab separated variables). It will take awhile as it contains PUMA records for the entire US. There are 33,711 records just for NY, distributed across 140 PUMAs.

Building Characteristics Assigned Randomly, with Means Based on ACS & Other Data

Conditional Probability Distributions
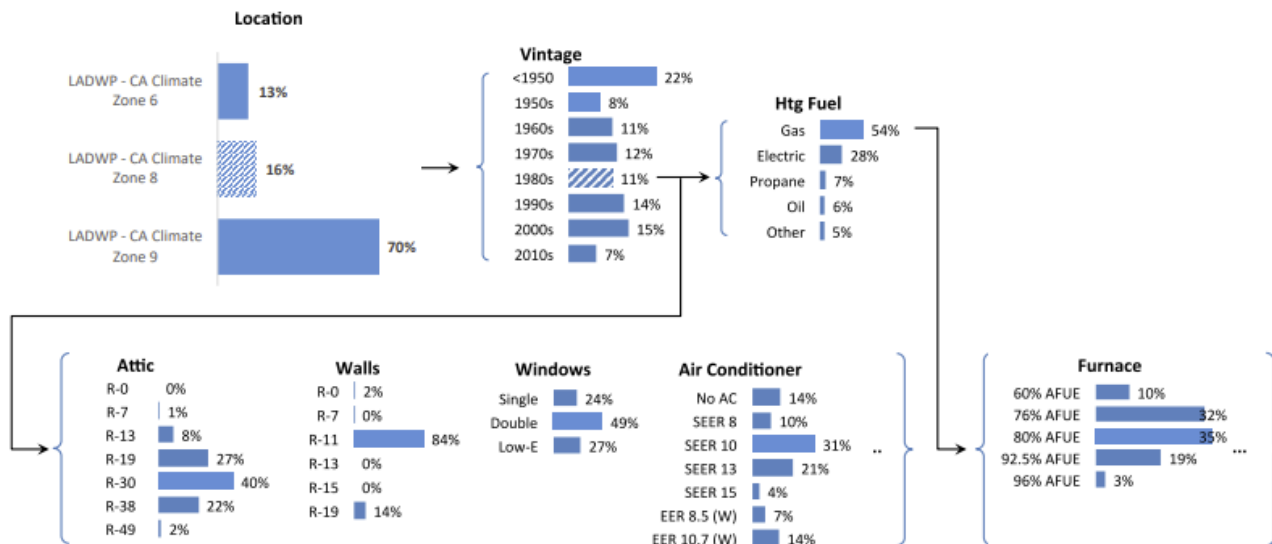
- Conditional probabilities for all building types, structures, and HVAC saturations are obtained from ACS, AHS, RECS, and other similar national databases.
- This ensures that any given PUMA contains buildings, equipment and energy characteristics consistent with actual structures & energy metrics.

End-Use Load Profiles – A New Public Dataset for U.S. Residential and Commercial Buildings
Elaina Present, NREL
April 15, 202

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ResStock metadata is a sample of a sample!

ResStock sample selection is a very elaborate process in order to represent several hundred different attributes

Figure 5. Residential Cold/Very-Cold typology segments

Figure 2. Sample structure of parameter dependencies in ResStock

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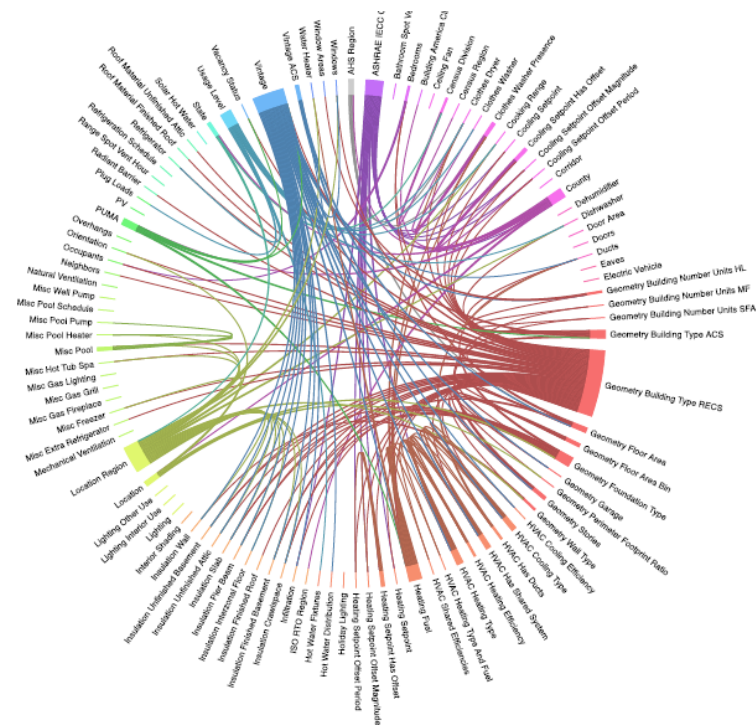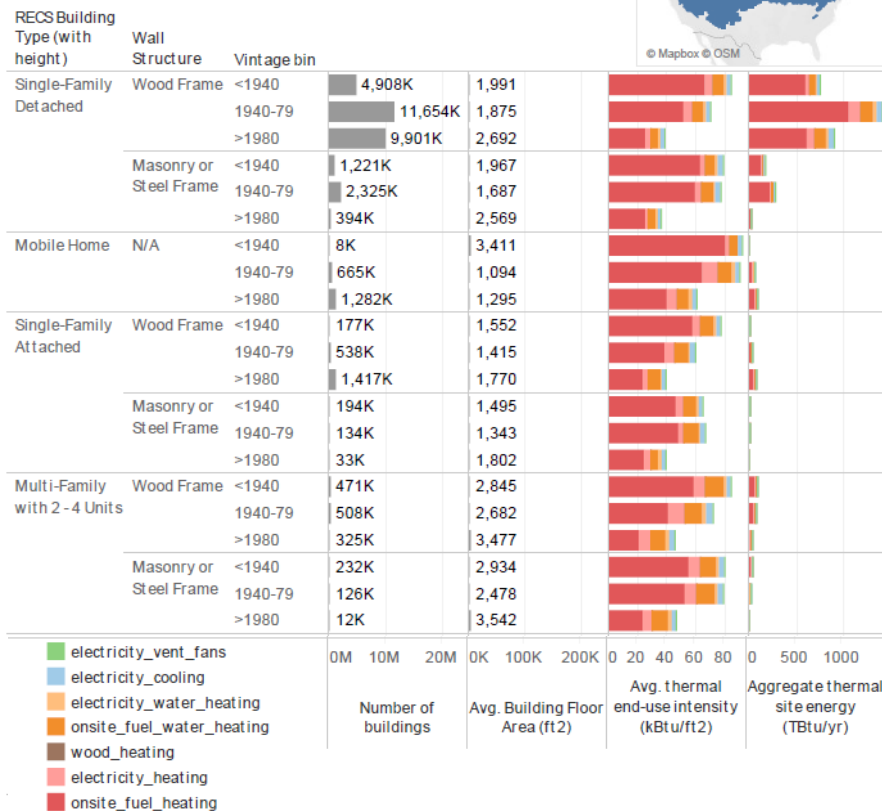
Heating Fuel Type & Technology

Row Labels	Sum of 8_weight
Electricity ASHP	192,978
Electricity Baseboard	275,061
Electricity Electric Boiler	4,358
Electricity Electric Furnace	212,349
Electricity Electric Wall Furnace	4,116
Electricity Shared Heating	230,993
Fuel Oil Fuel Boiler	502,906
Fuel Oil Fuel Furnace	922,277
Fuel Oil Fuel Wall/Floor Furnace	51,090
Fuel Oil Shared Heating	399,758
Natural Gas Fuel Boiler	656,417
Natural Gas Fuel Furnace	2,508,235
Natural Gas Fuel Wall/Floor Furnace	710,170
Natural Gas Shared Heating	900,969
None	283,293
Other Fuel Shared Heating	27,361
Propane Fuel Boiler	15,012
Propane Fuel Furnace	181,356
Propane Fuel Wall/Floor Furnace	60,048
Propane Shared Heating	23,729
Grand Total	**8,162,479**

Cooling Technology

Row Labels	Sum of 8_weight
Central AC	3,473,612
Heat Pump	227,603
None	1,340,922
Room AC	3,120,342
Grand Total	**8,162,479**

ResStock metadata provides a rich collection of structure types, building construction types and HVAC equipment that is representative of the ACS, AHS, & RECS frequencies for those characteristics. Also modeled are equipment efficiency, insulation levels, home size and other end uses and equipment.

Building & Equipment Characteristics in Each PUMA Are Consistent With ACS Data
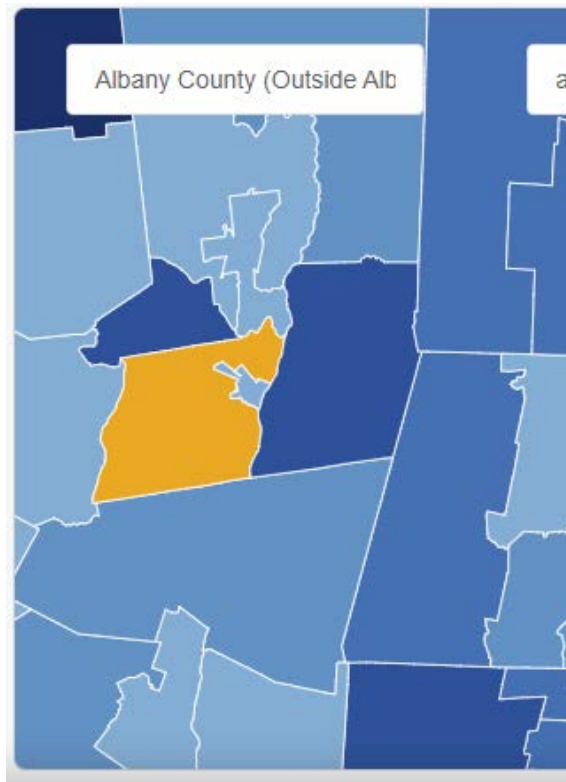
Albany County (Outside Albany City) PUMA
Fuel Type: All Fuels   **Upgrade:** Baseline

Vintage	Households
1940s	4,116
1950s	6,053
1960s	5,327
1970s	6,295
1980s	3,148
1990s	1,937
2000s	726
2010s	484
<1940	23,487
Total	51,573

Space Heating Fuel	Households	Saturation
Electricity	12,349	23.94%
Fuel Oil	2,421	4.69%
Natural Gas	36,320	70.42%
Other Fuel	242	0.47%
Propane	242	0.47%
Total	51,574	100.00%

Water Heating Fuel	Households	Saturation
Electricity	11,380	22.07%
Fuel Oil	2,179	4.23%
Natural Gas	37,772	73.24%
Propane	242	0.47%
Total	51,573	100.00%

The National sampling proportion is about 1 : 242. This PUMA is represented by about 213 individual samples, with the saturations as indicated. The energy data in metadata has *not* been expanded from sample to the entire population.

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Comparison of NY Electric Space Heat Saturations – ACS vs ResStock

American Community Survey – About 220,000 sampled homes in NY

Utility	10 to 19 Unit	2 Unit	20 to 49 Unit	3 or 4 Unit	5 to 9 Unit	50 or more Un	Mobile Home	SF Attached	SF Detached	Total
Central Hudson Gas and Electric	48.06%	19.18%	42.39%	25.97%	27.61%	45.66%	0.82%	19.10%	6.64%	13.66%
Consolidated Edison	13.32%	5.39%	11.01%	6.61%	12.16%	17.25%	5.77%	4.74%	3.78%	10.74%
Long Island Power Authority	21.16%	8.58%	19.66%	22.06%	24.88%	30.46%	2.63%	23.33%	2.47%	6.36%
National Grid	48.61%	10.64%	43.49%	27.95%	36.45%	42.79%	4.90%	18.04%	5.90%	12.58%
NYS Electric and Gas	33.49%	7.42%	37.87%	22.95%	31.70%	45.71%	4.27%	18.03%	5.99%	10.40%
Orange and Rockland Utilities	19.53%	16.95%	22.25%	15.65%	24.04%	19.88%	0.00%	12.53%	4.63%	9.66%
Rochester Gas and Electric	37.54%	14.70%	43.13%	27.57%	32.38%	46.06%	3.32%	13.96%	7.18%	13.76%
Total	**20.21%**	**7.34%**	**14.15%**	**13.69%**	**20.48%**	**19.69%**	**4.21%**	**9.89%**	**4.90%**	**10.63%**

ResStock – About 33,700 sampled homes in NY

Average Residential Electric Usage - kWh										
Utility	10 to 19 Unit	2 Unit	20 to 49 Unit	3 or 4 Unit	5 to 9 Unit	50 or more Un	Mobile Home	SF Attached	SF Detached	Grand Total
Central Hudson Gas and Electric	25.00%	19.67%	38.10%	20.69%	44.23%	57.89%	2.27%	22.22%	6.21%	12.62%
Consolidated Edison	16.02%	5.08%	13.26%	6.29%	13.83%	18.29%	0.00%	4.33%	3.36%	11.42%
Long Island Power Authority	28.71%	6.02%	24.39%	9.09%	19.57%	21.79%	0.00%	17.06%	2.54%	5.52%
National Grid	51.43%	19.85%	47.71%	28.75%	52.67%	55.03%	1.52%	10.30%	6.42%	14.25%
NYS Electric and Gas	37.63%	13.13%	58.33%	20.80%	42.53%	41.07%	4.36%	14.81%	6.14%	11.62%
Orange and Rockland Utilities	24.39%	19.67%	30.43%	14.29%	25.37%	14.71%	5.00%	5.41%	3.76%	8.93%
Rochester Gas and Electric	40.43%	20.00%	51.22%	21.21%	38.68%	35.14%	5.66%	9.09%	8.11%	14.16%
Grand Total	**23.00%**	**9.52%**	**16.94%**	**12.14%**	**25.35%**	**20.40%**	**2.84%**	**7.47%**	**5.04%**	**11.27%**

This initial review shows that ACS & ResStock saturations are similar. Confidence margins not yet available for either sample.

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Tips for Working With Metadata

- Metadata is comprised of individual sites with a unique building ID. Each site has a weight of 242.131. Multiply site energy data by weight to expand usage to population.

- Metadata reports annual energy by end use & fuel type but no hourly loads. All energy data is in kWh, even Gas, Oil, & other fuel types.

- Append numbers to field names & make a data dictionary for easier selection of fields to summarize or tabulate.

- Geo fields allow you to select State, County, PUMA, ISO/RTO & other areas.

- Since end use energy by fuel type is available for each site, we can directly calculate UEC, Saturations, Intensity and Total Usage. Square Footage data is also available.

- Heating & cooling end uses include several distinct technologies – furnaces, heat pumps, RAC, CAC, etc.

- Utility service territories are not provided. However, you can assign these yourself using County or PUMA lists.

New York ISO

Number of All Sample Sites

69_in.hvac_heating_type_and_fuel (All)

Sample vs Population Households

Count of 8_weight — Column Labels

Row Labels	10 to 19 Unit	2 Unit	20 to 49 Unit	3 or 4 Unit	5 to 9 Unit	50 or more Un	Mobile Home	Single-Family	Single-Family	Grand Total
Central Hudson Gas and Electric	24	61	21	58	52	19	44	36	644	959
Consolidated Edison	980	1,969	2,473	1,446	998	4,740	31	1,085	1,995	15,717
Long Island Power Authority	101	216	82	88	92	156	24	170	3,350	4,279
National Grid	140	519	109	313	243	169	329	165	3,534	5,521
NYS Electric and Gas	93	495	72	226	174	112	275	108	2,850	4,405
Orange and Rockland Utilities	41	61	23	77	67	34	20	74	611	1,008
Rochester Gas and Electric	47	105	41	99	106	74	53	88	1,209	1,822
Grand Total	**1,426**	**3,426**	**2,821**	**2,307**	**1,732**	**5,304**	**776**	**1,726**	**14,193**	**33,711**

Number of Households in Population

69_in.hvac_heating_type_and_fuel (All)

Counties were assigned to Utilities by NYISO

Sum of 8_weight — Column Labels

Row Labels	10 to 19 Unit	2 Unit	20 to 49 Unit	3 or 4 Unit	5 to 9 Unit	50 or more Un	Mobile Home	Single-Family	Single-Family	Grand Total
Central Hudson Gas and Electric	5,811	14,770	5,085	14,044	12,591	4,600	10,654	8,717	155,932	232,204
Consolidated Edison	237,288	476,756	598,790	350,121	241,647	1,147,701	7,506	262,712	483,051	3,805,573
Long Island Power Authority	24,455	52,300	19,855	21,308	22,276	37,772	5,811	41,162	811,139	1,036,079
National Grid	33,898	125,666	26,392	75,787	58,838	40,920	79,661	39,952	855,691	1,336,805
NYS Electric and Gas	22,518	119,855	17,433	54,722	42,131	27,119	66,586	26,150	690,073	1,066,587
Orange and Rockland Utilities	9,927	14,770	5,569	18,644	16,223	8,232	4,843	17,918	147,942	244,068
Rochester Gas and Electric	11,380	25,424	9,927	23,971	25,666	17,918	12,833	21,308	292,736	441,163
Grand Total	**345,279**	**829,541**	**683,052**	**558,596**	**419,371**	**1,284,263**	**187,894**	**417,918**	**3,436,565**	**8,162,479**

Sampled Households with Gas or Electric Heating Systems

69_in.hvac_heating_type_and_fuel   (Multiple Items)

Count of 8_weight	Column Labels									
Row Labels	10 to 19 Unit	2 Unit	20 to 49 Unit	3 or 4 Unit	5 to 9 Unit	50 or more Un	Mobile Home	Single-Family	Single-Family	Grand Total
Central Hudson Gas and Electric	6	12	8	12	23	11	1	8	40	121
Consolidated Edison	157	100	328	91	138	867		47	67	1,795
Long Island Power Authority	29	13	20	8	18	34		29	85	236
National Grid	72	103	52	90	128	93	5	17	227	787
NYS Electric and Gas	35	65	42	47	74	46	12	16	175	512
Orange and Rockland Utilities	10	12	7	11	17	5	1	4	23	90
Rochester Gas and Electric	19	21	21	21	41	26	3	8	98	258
Grand Total	328	326	478	280	439	1,082	22	129	715	3,799

Number of Sample Sites - Nat Gas Heating Systems

69_in.hvac_heating_type_and_fuel   (Multiple Items)

Note: structure types include Single Family Attached & Single Family Detached.

Count of 8_weight	Column Labels									
Row Labels	10 to 19 Unit	2 Unit	20 to 49 Unit	3 or 4 Unit	5 to 9 Unit	50 or more Un	Mobile Home	Single-Family	Single-Family	Grand Total
Central Hudson Gas and Electric	14	23	7	24	18	6	2	21	100	215
Consolidated Edison	504	1,636	1,187	1,126	606	2,284	18	955	1,455	9,771
Long Island Power Authority	58	154	51	58	62	85	2	131	1,451	2,052
National Grid	64	380	54	200	103	69	53	144	1,971	3,038
NYS Electric and Gas	51	405	25	157	91	62	66	88	1,675	2,620
Orange and Rockland Utilities	30	44	12	63	46	26	2	67	388	678
Rochester Gas and Electric	25	81	16	77	63	45	18	80	945	1,350
Grand Total	746	2,723	1,352	1,705	989	2,577	161	1,486	7,985	19,724

| 69_in.hvac_heating_type_and_fuel | (Multiple Items) | | | **Number of Households in Population With Electric Heating Systems** | | | | | | |

Sum of 8_weight	Column Labels									
Row Labels	**10 to 19 Unit**	**2 Unit**	**20 to 49 Unit**	**3 or 4 Unit**	**5 to 9 Unit**	**50 or more Unit**	**Mobile Home**	**Single-Family Attached**	**Single-Family Detached**	**Grand Total**
Central Hudson Gas and Electric	1,453	2,906	1,937	2,906	5,569	2,663	242	1,937	9,685	29,298
Consolidated Edison	38,015	24,213	79,419	22,034	33,414	209,928		11,380	16,223	434,625
Long Island Power Authority	7,022	3,148	4,843	1,937	4,358	8,232		7,022	20,581	57,143
National Grid	17,433	24,939	12,591	21,792	30,993	22,518	1,211	4,116	54,964	190,557
NYS Electric and Gas	8,475	15,739	10,170	11,380	17,918	11,138	2,906	3,874	42,373	123,971
Orange and Rockland Utilities	2,421	2,906	1,695	2,663	4,116	1,211	242	969	5,569	21,792
Rochester Gas and Electric	4,600	5,085	5,085	5,085	9,927	6,295	726	1,937	23,729	62,470
Grand Total	**79,419**	**78,935**	**115,739**	**67,797**	**106,296**	**261,986**	**5,327**	**31,235**	**173,124**	**919,856**

| 69_in.hvac_heating_type_and_fuel | (Multiple Items) | | | **Number of Households in Population With Nat Gas Heating Systems** | | | | | | |

Sum of 8_weight	Column Labels									
Row Labels	**10 to 19 Unit**	**2 Unit**	**20 to 49 Unit**	**3 or 4 Unit**	**5 to 9 Unit**	**50 or more Unit**	**Mobile Home**	**Single-Family Attached**	**Single-Family Detached**	**Grand Total**
Central Hudson Gas and Electric	3,390	5,569	1,695	5,811	4,358	1,453	484	5,085	24,213	52,058
Consolidated Edison	122,034	396,126	287,410	272,640	146,731	553,027	4,358	231,235	352,301	2,365,862
Long Island Power Authority	14,044	37,288	12,349	14,044	15,012	20,581	484	31,719	351,332	496,853
National Grid	15,496	92,010	13,075	48,426	24,939	16,707	12,833	34,867	477,240	735,594
NYS Electric and Gas	12,349	98,063	6,053	38,015	22,034	15,012	15,981	21,308	405,569	634,383
Orange and Rockland Utilities	7,264	10,654	2,906	15,254	11,138	6,295	484	16,223	93,947	164,165
Rochester Gas and Electric	6,053	19,613	3,874	18,644	15,254	10,896	4,358	19,370	228,814	326,877
Grand Total	**180,630**	**659,323**	**327,361**	**412,833**	**239,468**	**623,972**	**38,983**	**359,807**	**1,933,416**	**4,775,792**

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69_in.hvac_heating_type_and_fu (Multiple ms)   **Electricity - Average Heating Usage per Household - kWh**

Average of 168_out.electricity.he Column La

Row Labels	10 to 19 Unit	2 Unit	20 to 49 Unit	3 or 4 Unit	5 to 9 Unit	50 or more Unit	Mobile Home	Single-Family Attached	Single-Family Detached	Grand Total
Central Hudson Gas and Electric	7,421	12,646	2,822	10,022	7,526	3,094	3,911	10,115	15,224	10,248
Consolidated Edison	6,788	11,747	6,053	9,109	8,096	4,519		9,728	20,689	6,648
Long Island Power Authority	2,835	6,950	6,396	7,927	3,591	3,382		8,897	16,459	9,324
National Grid	7,191	12,407	5,914	11,507	9,009	5,269	15,483	12,094	22,433	12,906
NYS Electric and Gas	6,192	13,075	5,024	12,142	9,132	4,320	10,250	9,962	20,320	12,815
Orange and Rockland Utilities	6,728	13,056	3,439	7,304	7,371	2,919	5,513	6,614	20,483	10,793
Rochester Gas and Electric	7,138	13,471	11,252	11,213	7,600	7,777	14,736	11,257	20,481	13,742
Grand Total	**6,493**	**12,222**	**6,098**	**10,481**	**8,248**	**4,596**	**11,548**	**9,904**	**20,309**	**9,637**

69_in.hvac_heating_type_and_fuel   (Multiple ms)   **Natural Gas - Average Heating Usage per Household - kWh**

Average of 216_out.natural_gas.heat Column La

Row Labels	10 to 19 Unit	2 Unit	20 to 49 Unit	3 or 4 Unit	5 to 9 Unit	50 or more Unit	Mobile Home	Single-Family Attached	Single-Family Detached	Grand Total
Central Hudson Gas and Electric	7,366	16,950	4,902	14,237	10,045	7,482	5,314	16,538	30,272	20,836
Consolidated Edison	11,663	16,803	10,708	16,769	12,824	9,455	55,497	21,918	37,853	17,535
Long Island Power Authority	7,656	13,945	8,315	14,437	11,800	9,228	6,152	14,640	33,156	27,002
National Grid	10,472	19,230	8,517	16,367	11,467	8,552	18,739	21,286	38,822	30,961
NYS Electric and Gas	11,257	20,494	10,271	17,197	12,617	10,590	21,441	21,276	39,226	31,537
Orange and Rockland Utilities	9,819	15,084	12,522	12,382	8,776	7,859	24,962	14,833	34,593	25,018
Rochester Gas and Electric	11,993	19,836	10,718	15,762	12,401	11,142	19,389	19,766	36,383	30,286
Grand Total	**11,078**	**17,592**	**10,508**	**16,439**	**12,334**	**9,459**	**23,783**	**20,666**	**37,099**	**23,614**
Estimated Heat Delivered @ 85% Eff	9,416	14,954	8,932	13,973	10,484	8,041	20,216	17,566	31,534	20,072

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Number of Households in Population With Electric Heating Systems

69_in.hvac_heating_type_and_fuel (Multiple Items)

Calculating Electric Space Heating Saturations

Sum of 8_weight	Column Labels									
Row Labels	10 to 19 Unit	2 Unit	20 to 49 Unit	3 or 4 Unit	5 to 9 Unit	50 or more Un	Mobile Home	Single-Family	Single-Family	Grand Total
Central Hudson Gas and Electric	1,453	2,906	1,937	2,906	5,569	2,663	242	1,937	9,685	29,298
Consolidated Edison	38,015	24,213	79,419	22,034	33,414	209,928		11,380	16,223	434,625
Long Island Power Authority	7,022	3,148	4,843	1,937	4,358	8,232		7,022	20,581	57,143
National Grid	17,433	24,939	12,591	21,792	30,993	22,518	1,211	4,116	54,964	190,557
NYS Electric and Gas	8,475	15,739	10,170	11,380	17,918	11,138	2,906	3,874	42,373	123,971
Orange and Rockland Utilities	2,421	2,906	1,695	2,663	4,116	1,211	242	969	5,569	21,792
Rochester Gas and Electric	4,600	5,085	5,085	5,085	9,927	6,295	726	1,937	23,729	62,470
Grand Total	**79,419**	**78,935**	**115,739**	**67,797**	**106,296**	**261,986**	**5,327**	**31,235**	**173,124**	**919,856**
Total Units in State	**345,279**	**829,541**	**683,052**	**558,596**	**419,371**	**1,284,263**	**187,894**	**417,918**	**3,436,565**	**8,162,479**

Electric Avg Heating Saturation (Calculated)

Average Residential Electric Usage - kWh

Row Labels	10 to 19 Unit	2 Unit	20 to 49 Unit	3 or 4 Unit	5 to 9 Unit	50 or more Un	Mobile Home	Single-Family	Single-Family	Grand Total
Central Hudson Gas and Electric	25.0%	19.7%	38.1%	20.7%	44.2%	57.9%	2.3%	22.2%	6.2%	12.6%
Consolidated Edison	16.0%	5.1%	13.3%	6.3%	13.8%	18.3%	0.0%	4.3%	3.4%	11.4%
Long Island Power Authority	28.7%	6.0%	24.4%	9.1%	19.6%	21.8%	0.0%	17.1%	2.5%	5.5%
National Grid	51.4%	19.8%	47.7%	28.8%	52.7%	55.0%	1.5%	10.3%	6.4%	14.3%
NYS Electric and Gas	37.6%	13.1%	58.3%	20.8%	42.5%	41.1%	4.4%	14.8%	6.1%	11.6%
Orange and Rockland Utilities	24.4%	19.7%	30.4%	14.3%	25.4%	14.7%	5.0%	5.4%	3.8%	8.9%
Rochester Gas and Electric	40.4%	20.0%	51.2%	21.2%	38.7%	35.1%	5.7%	9.1%	8.1%	14.2%
Electric Saturation	**23.0%**	**9.5%**	**16.9%**	**12.1%**	**25.3%**	**20.4%**	**2.8%**	**7.5%**	**5.0%**	**11.3%**

Divide (units of a cell with a given structure type & electric heating) by (Total units of that structure type).

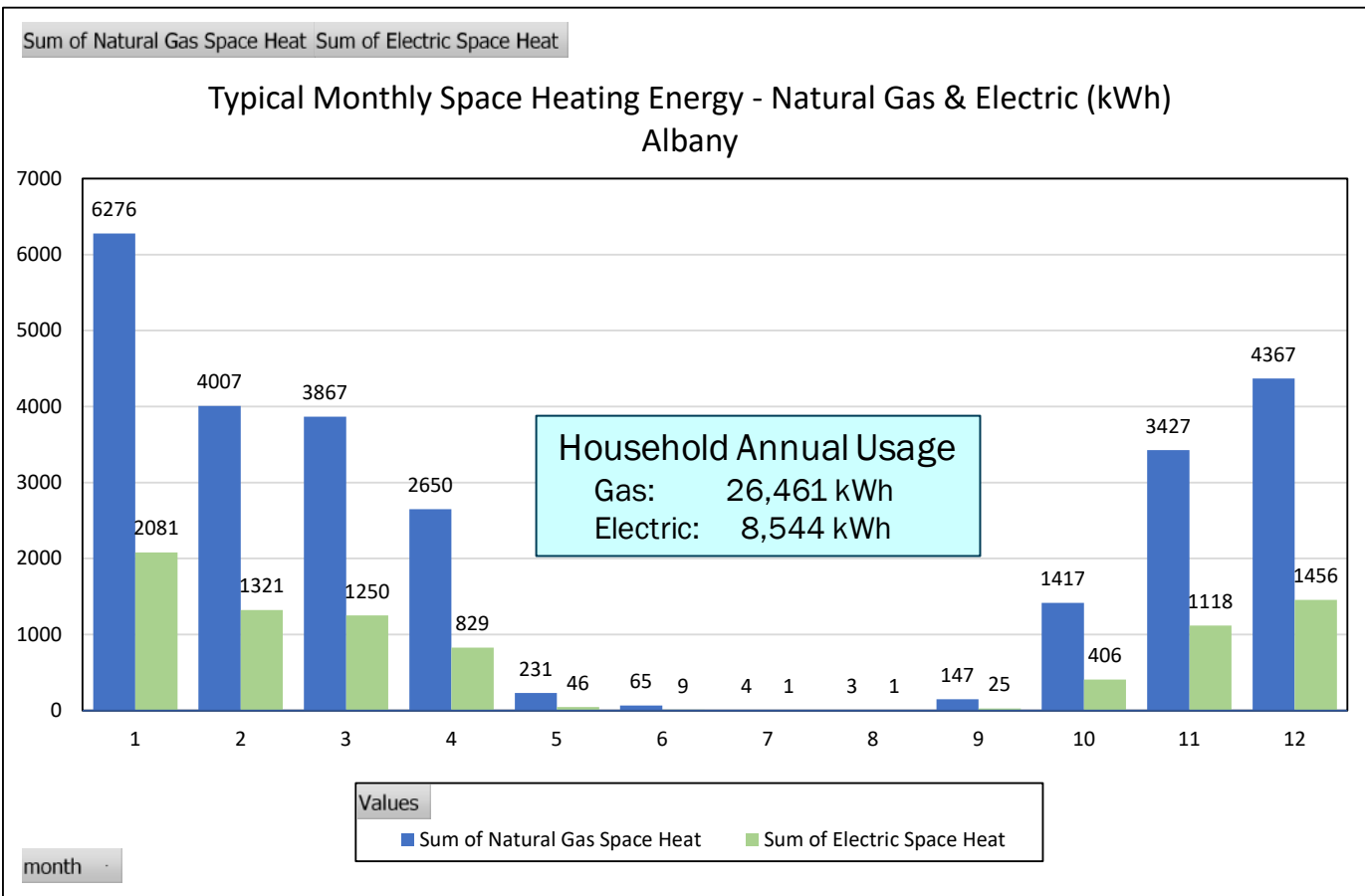New York ISO

Electric Avg HH Square Footage - Sample									

69_in.hvac_heating_type_and_fuel	(Multiple Items)								

Average of 9_in.sqft	Column Labels								
Row Labels	10 to 19 Unit	2 Unit	20 to 49 Unit	3 or 4 Unit	5 to 9 Unit	50 or more Un	Mobile Home	Single-Family	Single-Family	Grand Total
Central Hudson Gas and Electric	649	1,096	952	1,215	838	865	885	1,736	2,121	1,385
Consolidated Edison	827	1,116	877	1,050	918	949		1,744	2,185	1,004
Long Island Power Authority	836	2,127	892	991	842	824		2,241	2,353	1,635
National Grid	923	941	873	960	872	812	1,086	1,537	2,180	1,282
NYS Electric and Gas	829	913	869	877	872	814	1,197	1,667	2,048	1,304
Orange and Rockland Utilities	1,955	969	1,007	970	863	967	1,220	1,864	2,078	1,387
Rochester Gas and Electric	804	949	1,063	878	771	755	885	1,771	2,087	1,351
Grand Total	**879**	**1,044**	**888**	**981**	**874**	**922**	**1,116**	**1,824**	**2,149**	**1,186**

Distributions of square footage of homes is obtained from American Housing Survey. It is a smaller sample and not as geographically comprehensive as the American Community Survey.

New York ISO

Typical Monthly Space Heating Energy - Natural Gas & Electric (kWh)
Albany

Household Annual Usage
Gas: 26,461 kWh
Electric: 8,544 kWh

Source: NREL ResStock database

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Space Heating UEC & Other Energy Metrics for Albany County

Metric	Elec Heat	Oil Heat	Gas Heat	Propane Heat
N Pop.	12,591	9,685	59,322	1,937
Sum MWh	148,238	320,066	1,598,123	35,724
UEC: Avg kWh	11,773	33,048	26,940	18,443
Avg MMBTU	40.17	112.76	91.92	62.93
Max Pop kW	99,883	201,789	1,078,679	26,447
Max Avg kW	7.93	20.84	18.18	13.65
Avg BTUH	27,067	71,090	62,042	46,587

Why are Gas & Oil UECs & Capacities twice that of Electric UEC? All SF homes have similar sizes. A similar pattern was observed in MidAtlantic Electric Space Heat end use. Finally, our own SAE models return a Beta of 1.0 when the electric space heat UEC is set to about 8,000 kWh.

New York ISO

Heating UEC by Fuel & Structure Type

After accounting for structure type, square footage, furnace efficiency & relative share of building types, gas & electric space heat UEC are indeed very similar within SF & MF structures, without introducing behavioral or utilization differences.

Electric Avg Heating kWh - Population (Calculated)

Average Residential Electric Usage - kWh

Row Labels	10 to 19 Unit	2 Unit	20 to 49 Unit	3 or 4 Unit	5 to 9 Unit	50+ Units	Mobile Home	SF Attached	SF Detached	Grand Total
Central Hudson Gas and Electric	7,421	12,646	2,822	10,022	7,526	3,094	3,911	10,115	15,224	10,248
Consolidated Edison	6,788	11,747	6,053	9,109	8,096	4,519		9,728	20,689	6,648
Long Island Power Authority	2,835	6,950	6,396	7,927	3,591	3,382		8,897	16,459	9,324
National Grid	7,191	12,407	5,914	11,507	9,009	5,269	15,483	12,094	22,433	12,906
NYS Electric and Gas	6,192	13,075	5,024	12,142	9,132	4,320	10,250	9,962	20,320	12,815
Orange and Rockland Utilities	6,728	13,056	3,439	7,304	7,371	2,919	5,513	6,614	20,483	10,793
Rochester Gas and Electric	7,138	13,471	11,252	11,213	7,600	7,777	14,736	11,257	20,481	13,742
Grand Total	**6,493**	**12,222**	**6,098**	**10,481**	**8,248**	**4,596**	**11,548**	**9,904**	**20,309**	**9,637**
Electric Saturation	**23.0%**	**9.5%**	**16.9%**	**12.1%**	**25.3%**	**20.4%**	**2.8%**	**7.5%**	**5.0%**	**11.3%**
Avg Square Footage	**879**	**1,044**	**888**	**981**	**874**	**922**	**1,116**	**1,824**	**2,149**	**1,186**

NYISO is verifying the 2018 ACS saturation data and may need to update SF/MF shares in its SAE models.

Nat Gas Avg Heating kWh - Population (Calculated)

Average Residential Electric Usage - kWh

Row Labels	10 to 19 Unit	2 Unit	20 to 49 Unit	3 or 4 Unit	5 to 9 Unit	50+ Units	Mobile Home	SF Attached	SF Detached	Grand Total
Central Hudson Gas and Electric	7,366	16,950	4,902	14,237	10,045	7,482	5,314	16,538	30,272	20,836
Consolidated Edison	11,663	16,803	10,708	16,769	12,824	9,455	55,497	21,918	37,853	17,535
Long Island Power Authority	7,656	13,945	8,315	14,437	11,800	9,228	6,152	14,640	33,156	27,002
National Grid	10,472	19,230	8,517	16,367	11,467	8,552	18,739	21,286	38,822	30,961
NYS Electric and Gas	11,257	20,494	10,271	17,197	12,617	10,590	21,441	21,276	39,226	31,537
Orange and Rockland Utilities	9,819	15,084	12,522	12,382	8,776	7,859	24,962	14,833	34,593	25,018
Rochester Gas and Electric	11,993	19,836	10,718	15,762	12,401	11,142	19,389	19,766	36,383	30,286
Grand Total	**11,078**	**17,592**	**10,508**	**16,439**	**12,334**	**9,459**	**23,783**	**20,666**	**37,099**	**23,614**
Nat Gas Saturation	**52.3%**	**79.5%**	**47.9%**	**73.9%**	**57.1%**	**48.6%**	**20.7%**	**86.1%**	**56.3%**	**58.5%**
Avg Square Footage	**921**	**1,097**	**903**	**1,153**	**913**	**925**	**1,244**	**1,737**	**2,155**	**1,528**

ISO

(2b) 2018 Aggregate Hourly Load Data by PUMA, Fuel Type & End Use

New York ISO

Select Data Viewer, then region of interest

Datasets

ResStock National Load Profiles by State 2018

ResStock National Load Profiles by State 2018

• public

Go →

ResStock National Load Profiles by PUMA Northeast 2018

ResStock National Load Profiles by PUMA Northeast 2018

• public

Go →

ResStock National Load Profiles by PUMA Midwest 2018

ResStock National Load Profiles by PUMA Midwest 2018

• public

Go →

ResStock National Load Profiles by PUMA South 2018

ResStock National Load Profiles by PUMA South 2018

• public

Go →

ResStock National Load Profiles by PUMA West 2018

ResStock National Load Profiles by PUMA West 2018

• public

ResStock National Load Profiles by PUMA Northeast TMY

ResStock National Load Profiles by PUMA Northeast TMY

• public

New York ISO

Select a 'PUMA' using mouse;
Select a Fuel Type;
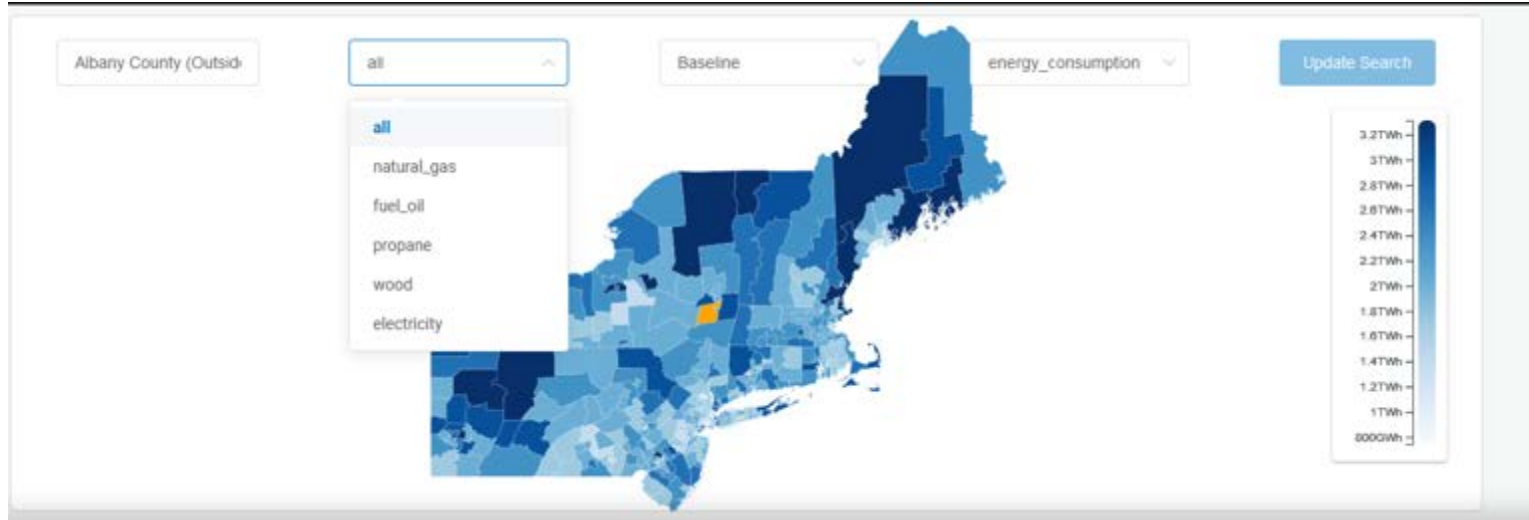
Scroll lower in window........

Select 'Explore Time Series'
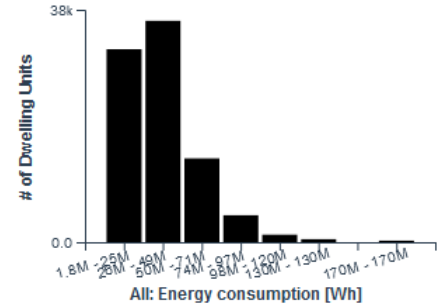
Select Fuel, Aggregation Type, Timeseries Range, Months & then..... follow the White Rabbit

.... Update Search

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Confidential - Do Not Distribute

Energy Use Is Calculated at 15 MPI For A Wide Range of End Uses

Average hourly electricity consumption in Jun - Aug by hour of day
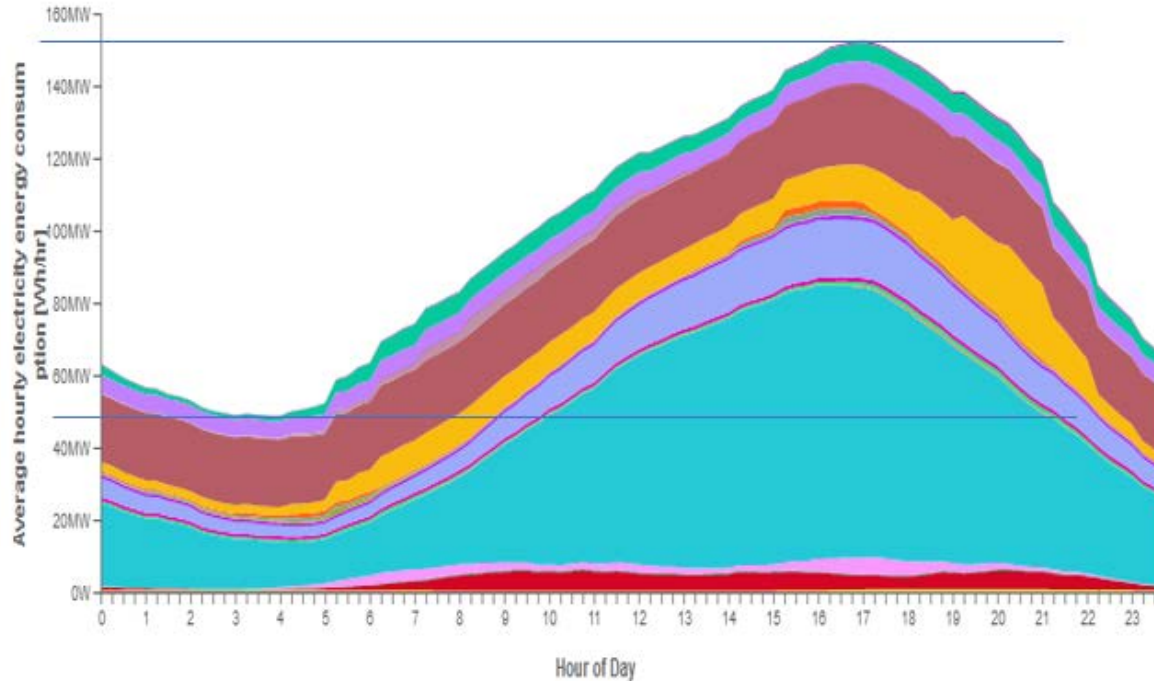
Chosen Search Parameters:

Location: Albany County (Outside Albany City) P UMA

Fuel Type: electricity

Upgrade: Baseline

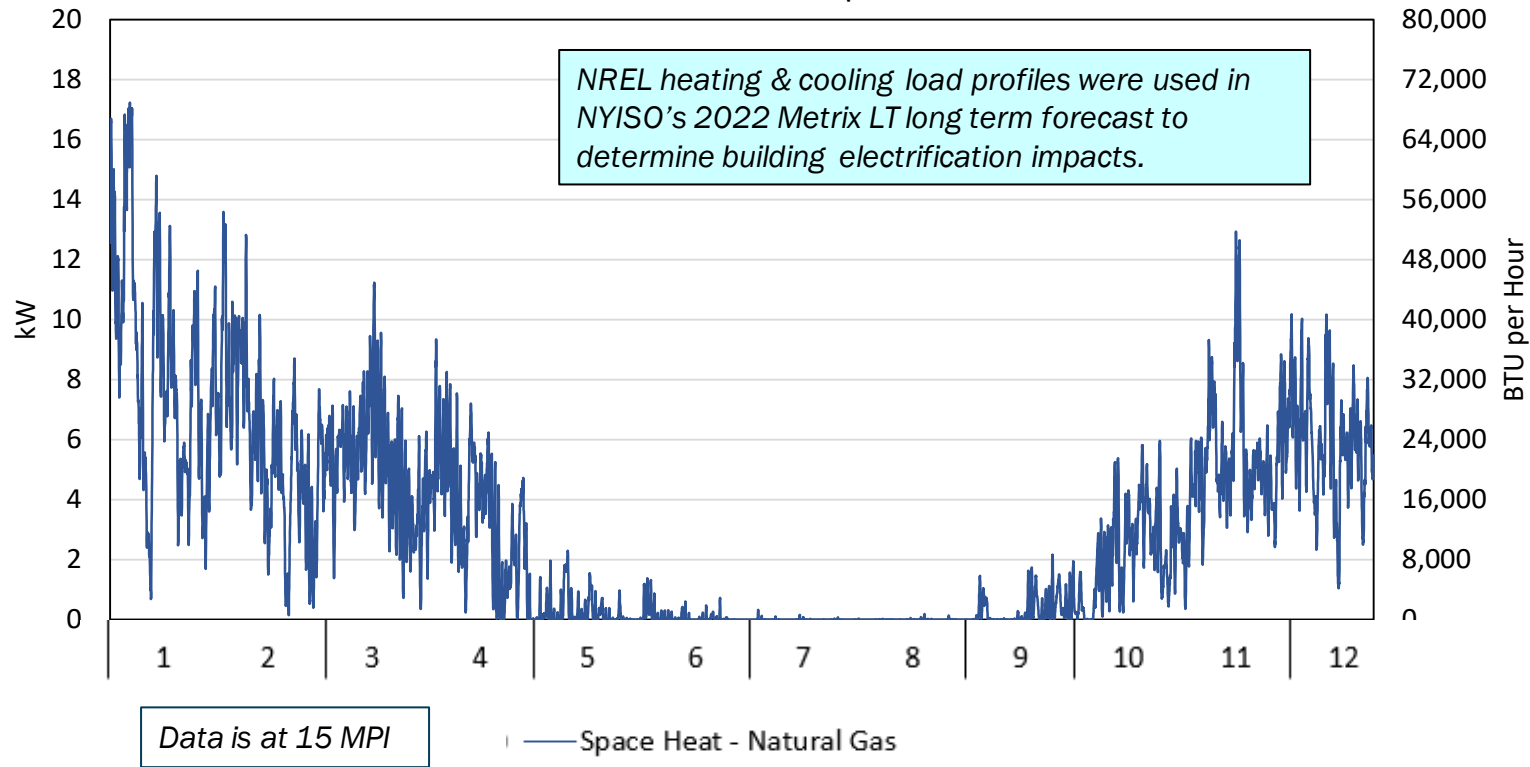**Output:** energy_consumption

Aggregation Type: average

Timeseries Range: day

Month Constraints: Jun to Aug

Close

'k ISO

Albany Natural Gas Space Heat - 2018 Hourly Loads
In kW & BTU per Hour

NREL heating & cooling load profiles were used in NYISO's 2022 Metrix LT long term forecast to determine building electrification impacts.

Data is at 15 MPI

Space Heat - Natural Gas

Source: NREL ResStock database

Our Mission & Vision

✓

🔍

Mission
Ensure power system reliability and competitive markets for New York in a clean energy future

Vision
Working together with stakeholders to build the cleanest, most reliable electric system in the nation

New York ISO