

Representative Appliances in Energy Datasets

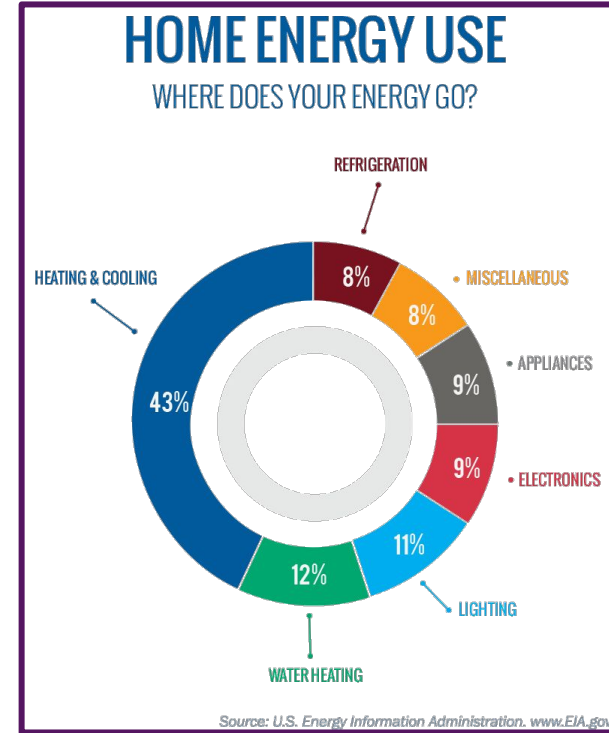
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Date: 12/13/2021

Building Energy Usage

Buildings use a lot of energy

Global warming is a threat to Earth

How can technology help?



Motivation

Overview

Related
Work

Preliminary
Results

Moving
Forward

Non-Intrusive Load Monitoring (NILM)

Non-intrusive Load Monitoring: Disaggregate building-scale loads

Aggregate load: total building energy

Disaggregate load: energy used by a single device

NILM Benefits:

- Up to 15% reduction in energy consumption
- Balance grid supply & demand
- Economic and environmental concerns



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NILM uses real data



Motivation

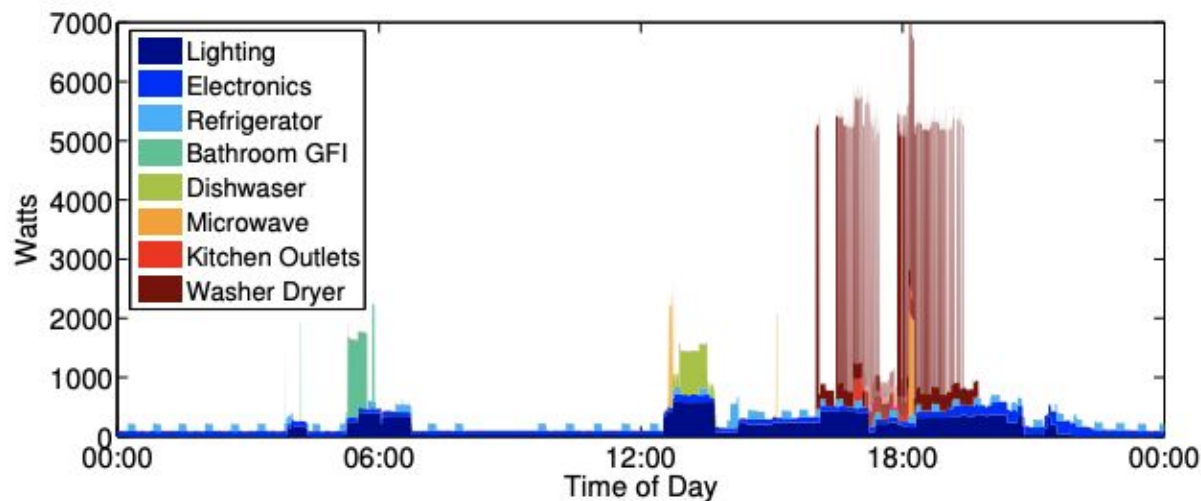
Overview

**Related
Work**

**Preliminary
Results**

**Moving
Forward**

REDD Dataset (2011)



Motivation

Overview

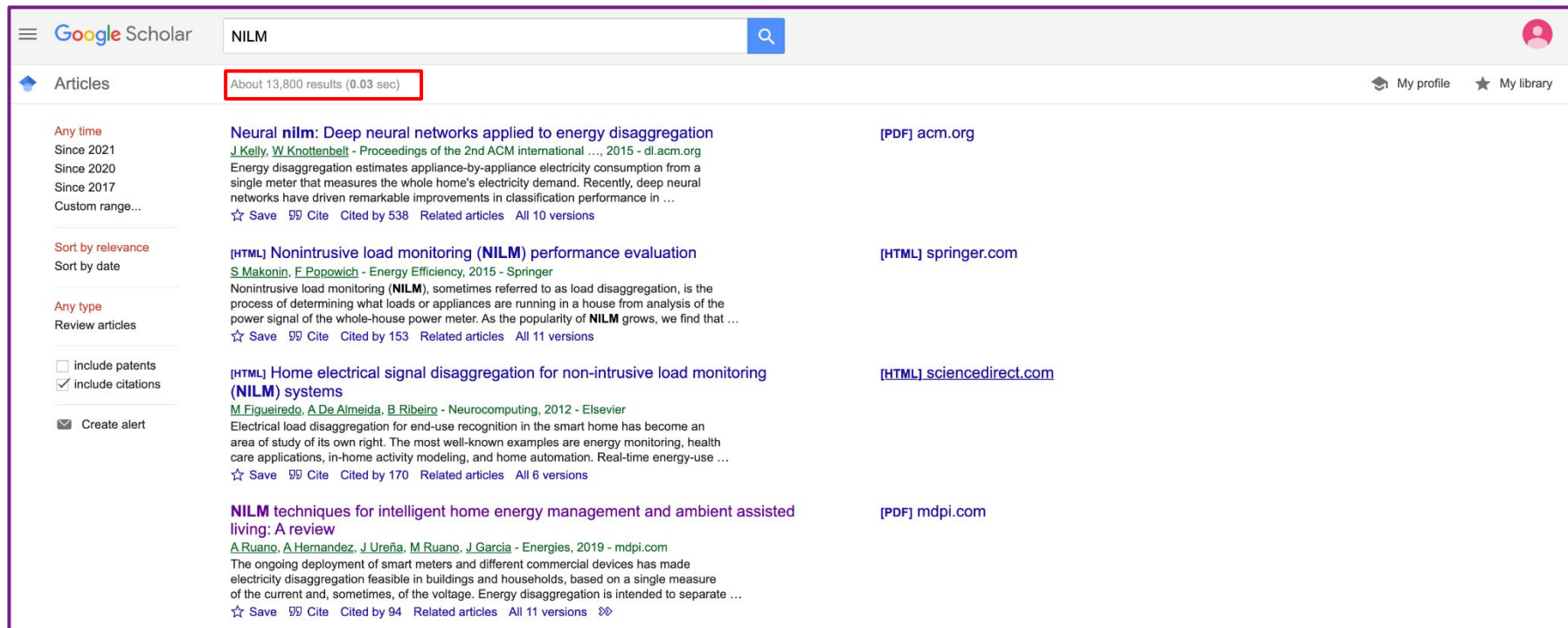
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Dataset	Houses
REDD (2011)	6
Smart* (2012)	3
AMPds (2013)	1
iAWE (2013)	1
UK-DALE (2014)	5
SustData (2014)	50
Dataport (2014)	722
DRED (2015)	1
PLAID (2017)	64
MORED (2020)	13

Only a few datasets for all this work:



The screenshot shows a Google Scholar search for 'NILM'. The search bar at the top contains 'NILM' and a magnifying glass icon. Below the search bar, the results are listed. A red box highlights the text 'About 13,800 results (0.03 sec)' in the top right corner of the search results area. The left sidebar contains filters for 'Any time', 'Sort by relevance', 'Any type', and 'include citations'. The main content area displays three articles, each with a title, authors, a brief description, and a link to the full text.

Google Scholar

NILM

Articles

About 13,800 results (0.03 sec)

My profile My library

Any time

Since 2021

Since 2020

Since 2017

Custom range...

Sort by relevance

Sort by date

Any type

Review articles

☐ include patents

☒ include citations

☒ Create alert

Neural nilm: Deep neural networks applied to energy disaggregation [PDF] acm.org
[J Kelly, W Knottenbelt](#) - Proceedings of the 2nd ACM international ..., 2015 - dl.acm.org
Energy disaggregation estimates appliance-by-appliance electricity consumption from a single meter that measures the whole home's electricity demand. Recently, deep neural networks have driven remarkable improvements in classification performance in ...
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[HTML] Nonintrusive load monitoring (NILM) performance evaluation [HTML] springer.com
[S Makonin, F Popowich](#) - Energy Efficiency, 2015 - Springer
Nonintrusive load monitoring (NILM), sometimes referred to as load disaggregation, is the process of determining what loads or appliances are running in a house from analysis of the power signal of the whole-house power meter. As the popularity of NILM grows, we find that ...
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[HTML] Home electrical signal disaggregation for non-intrusive load monitoring (NILM) systems [HTML] sciencedirect.com
[M Figueiredo, A De Almeida, B Ribeiro](#) - Neurocomputing, 2012 - Elsevier
Electrical load disaggregation for end-use recognition in the smart home has become an area of study of its own right. The most well-known examples are energy monitoring, health care applications, in-home activity modeling, and home automation. Real-time energy-use ...
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NILM techniques for intelligent home energy management and ambient assisted living: A review [PDF] mdpi.com
[A Ruano, A Hernandez, J Ureña, M Ruano, J Garcia](#) - Energies, 2019 - mdpi.com
The ongoing deployment of smart meters and different commercial devices has made electricity disaggregation feasible in buildings and households, based on a single measure of the current and, sometimes, of the voltage. Energy disaggregation is intended to separate ...
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How Representative are these NILM Datasets?



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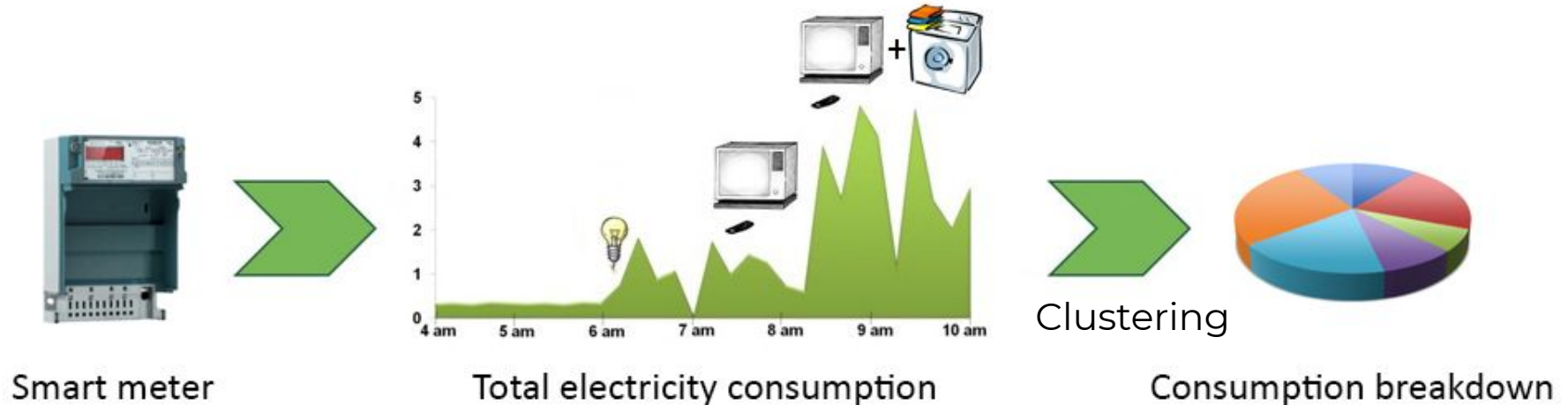
Moving
Forward

Plan for Analysis

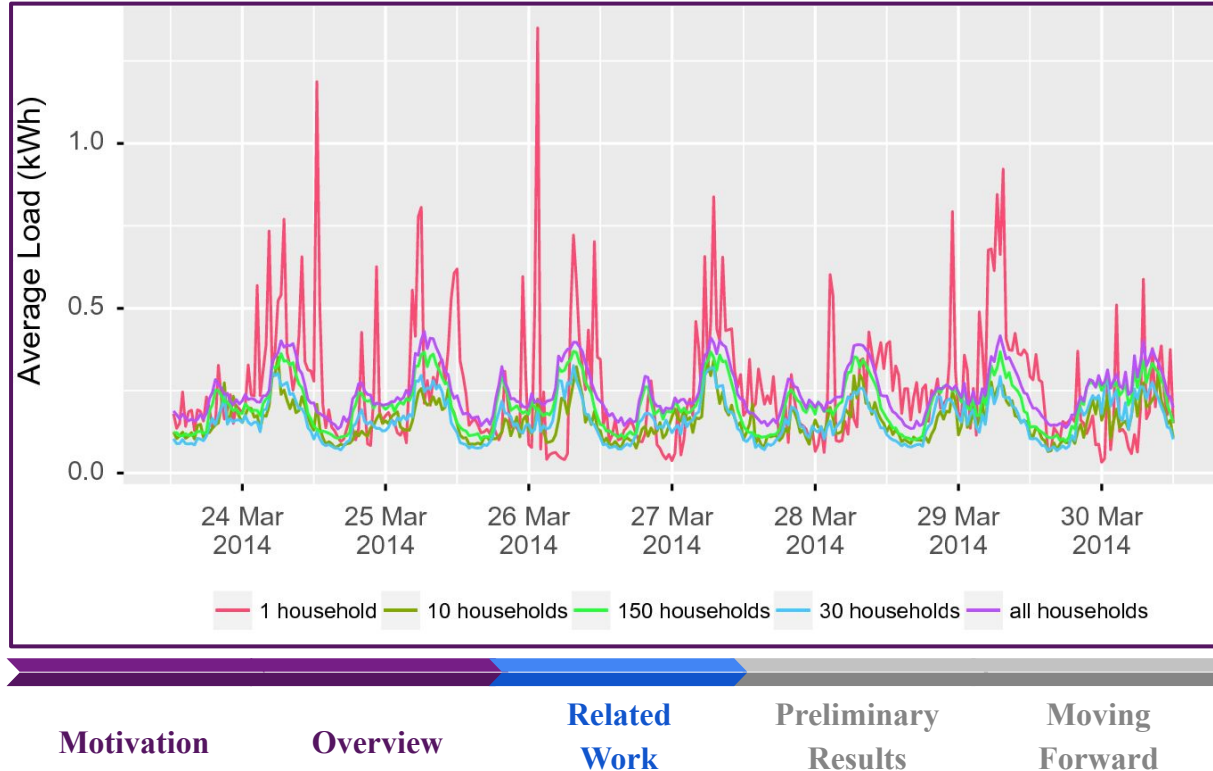
1. Extract data from largest available NILM dataset (Dataport)
2. Cluster appliances to see if all are similar
 - a. Hierarchical clustering with Dynamic Time Warping
 - b. Agglomerative clustering with complete & ward linkage
 - c. Affinity Propagation
3. Assuming different, how different?
 - a. Determine significance of variance
4. If there are major outliers, does removing them and running clustering yield better results on NILM tasks? Are some datasets more impacted by outliers?



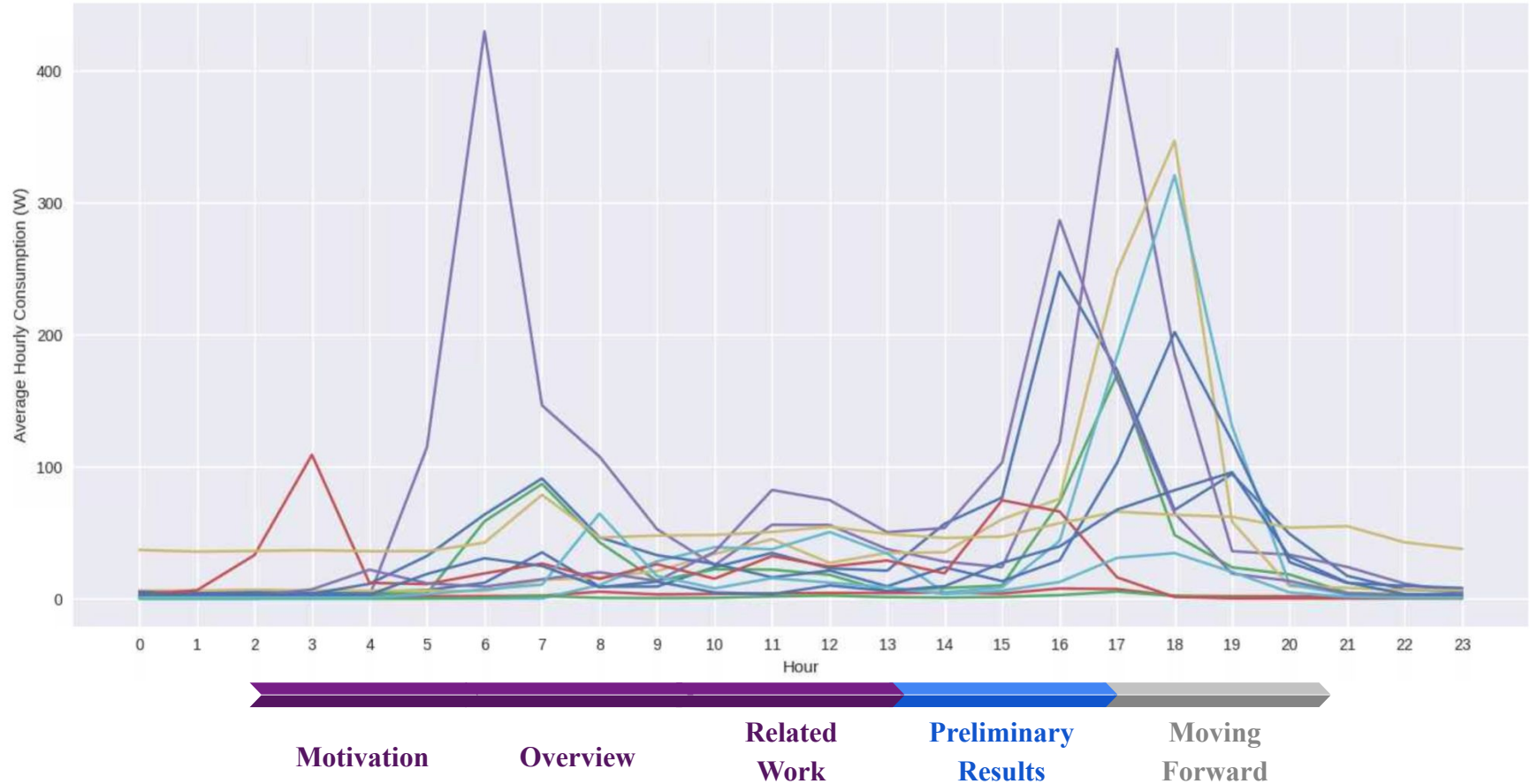
Clustering to Disaggregate



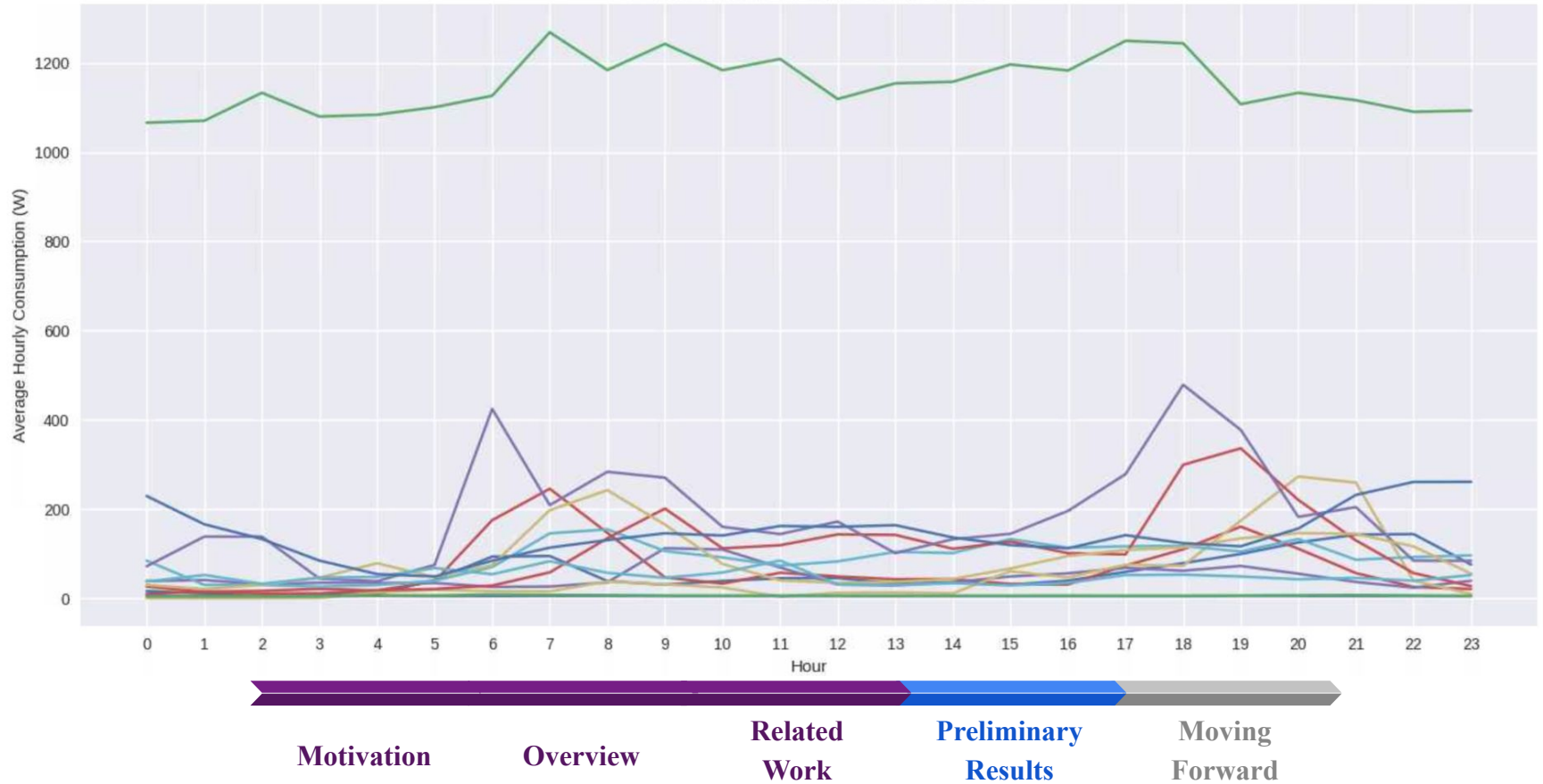
Short-Term Load Forecasting



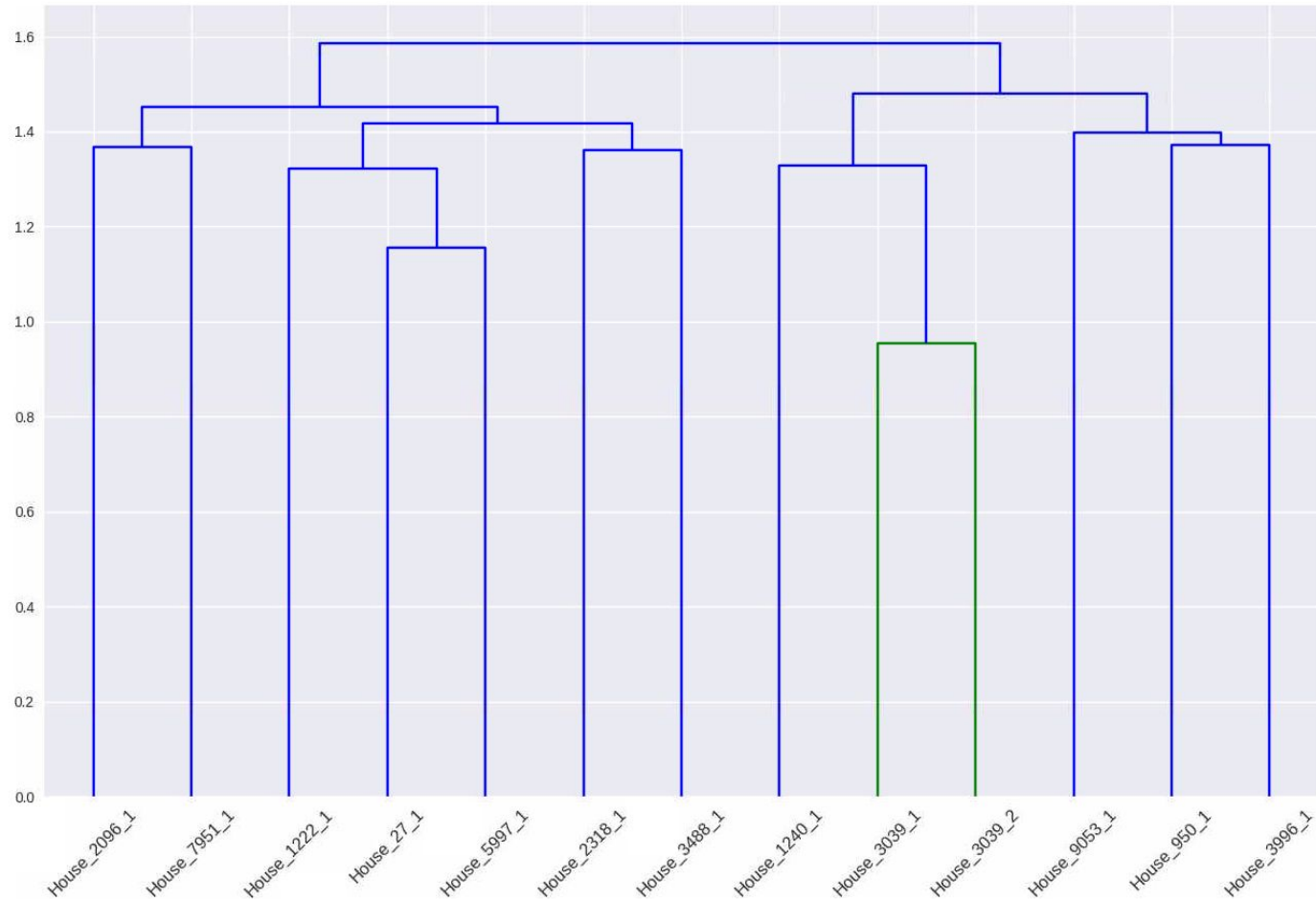
Preliminary Results: Hourly consumption of stove range



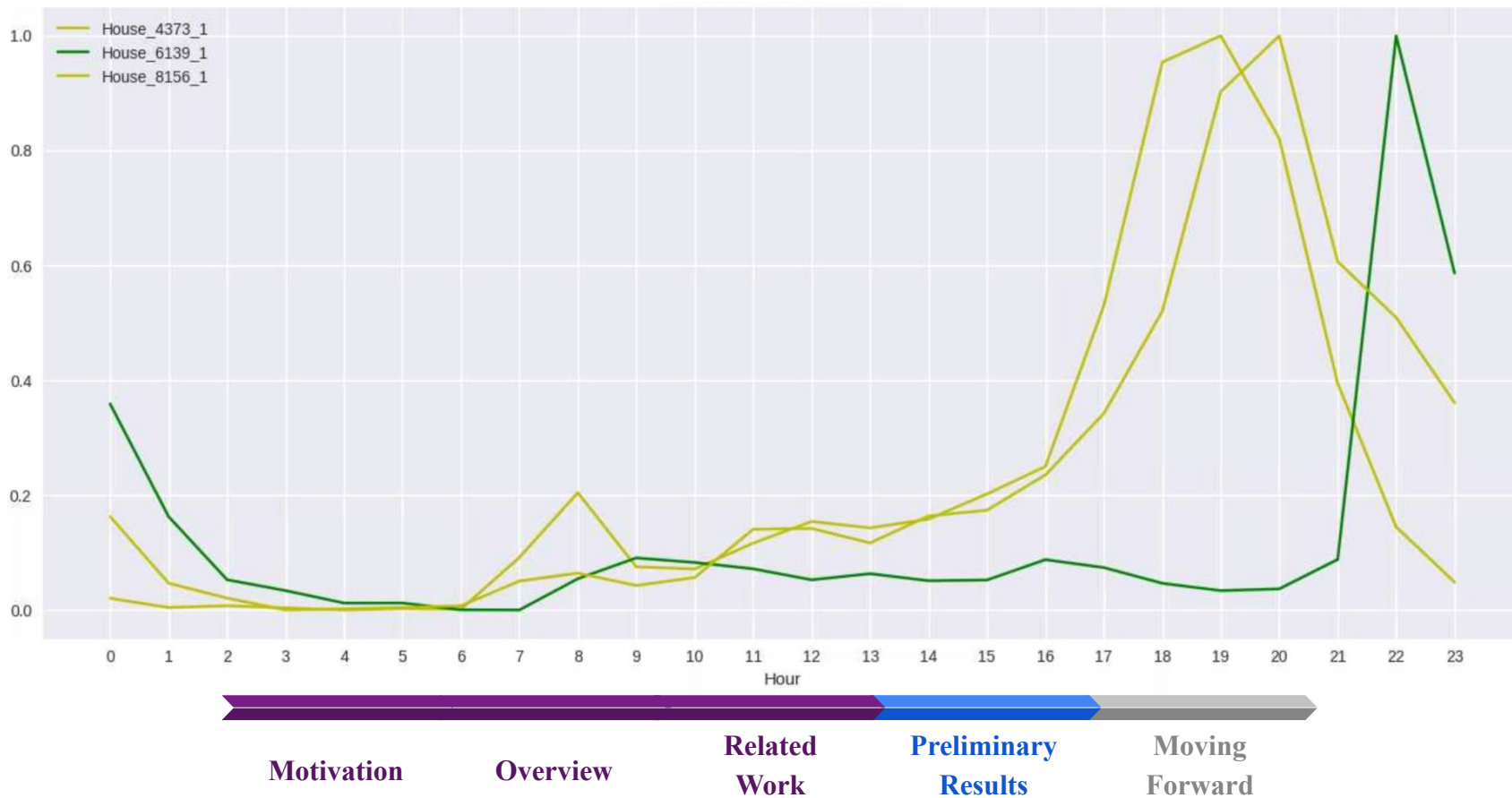
Preliminary Results: Hourly consumption of waterheater



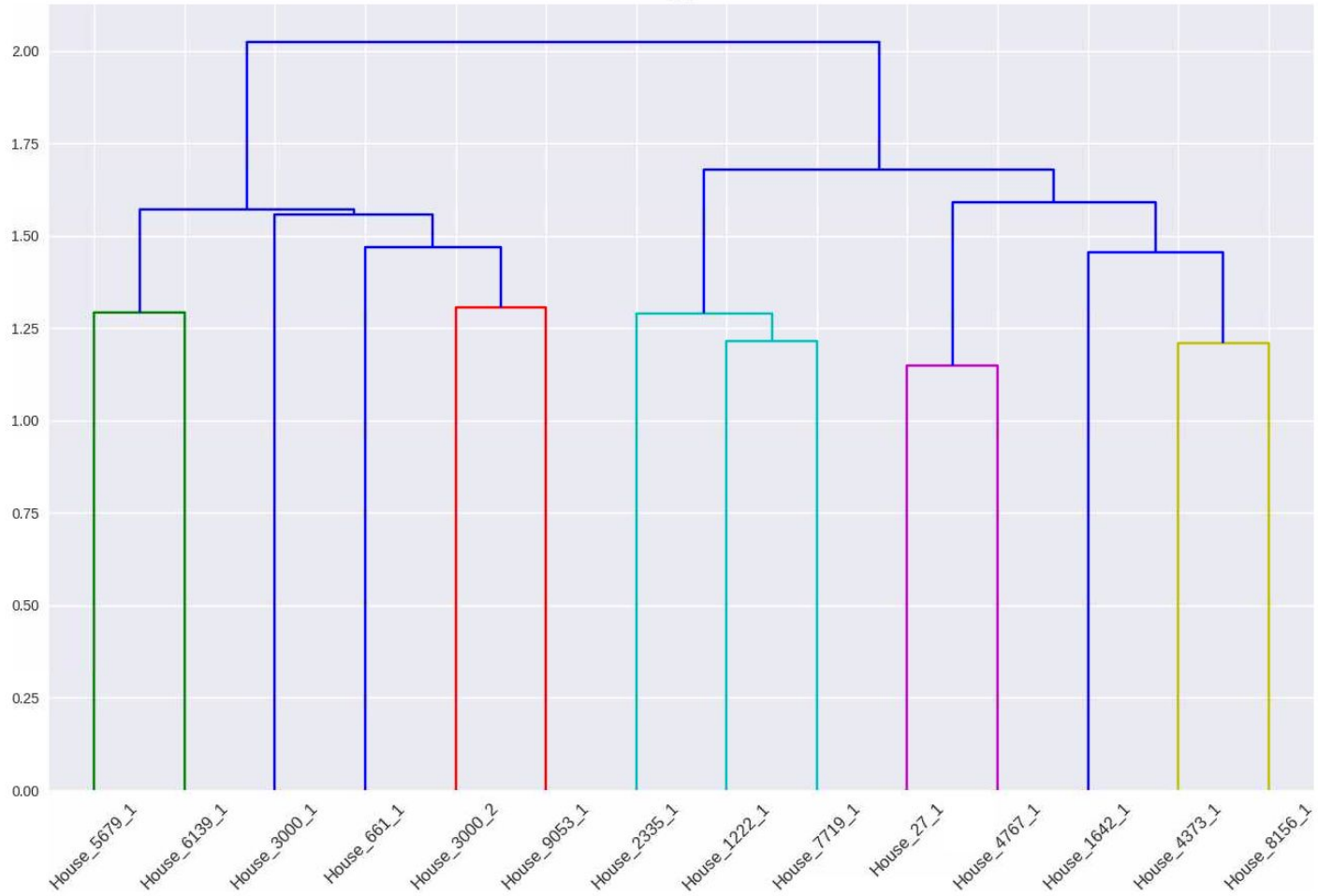
Preliminary Results: Dendrogram representing waterheater clusters



Preliminary Results: Hourly consumption of three car chargers



Preliminary Results: Dendrogram representing car charger clusters



Conclusions

