Australia's National Science Agency

Weather sensitivity analysis and identifying battery installations

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Energy + Data61

The NEAR Program

Australian Government
Department of the Environment and Energy

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

DATA 61

Weather sensitivity analysis

Objective

Measure a relationship between residential load behaviour and weather

- The outputs should be capable of directly feeding into AEMO's long-term forecasting as a metric for how much weather events will affect particular sub-regions and for a given point in time
- Outputs of this work are generated through demand modelling on sample residential consumption data for the intention to better understand the underlying trends in consumer behaviour

Method

Pre-process data

- MSATS interval meter
- Select Melbourne & Wyndham consumption + weather
- Sample 1000 households from each

Generate model

- Multi-variate first degree polynomial regression chosen for 'white box' outcomes
- The model is fitted per household
- Model is fitted for each season
- Feature coefficients will represent a household's response to weather

Feature selection

- Based on R^2, MAE, NMAE and MAPE the following features were chosen:

-The previous 24 hours of consumption
-Air temperature -CDD -HDD
-Day of week -Weekend

Assess goodness of fit

- Assess distribution of various metrics across all linear models
  - R^2
  - Mean Absolute Error
  - Mean Squared Error
  - Mean Absolute Percentage Error

Analyse results

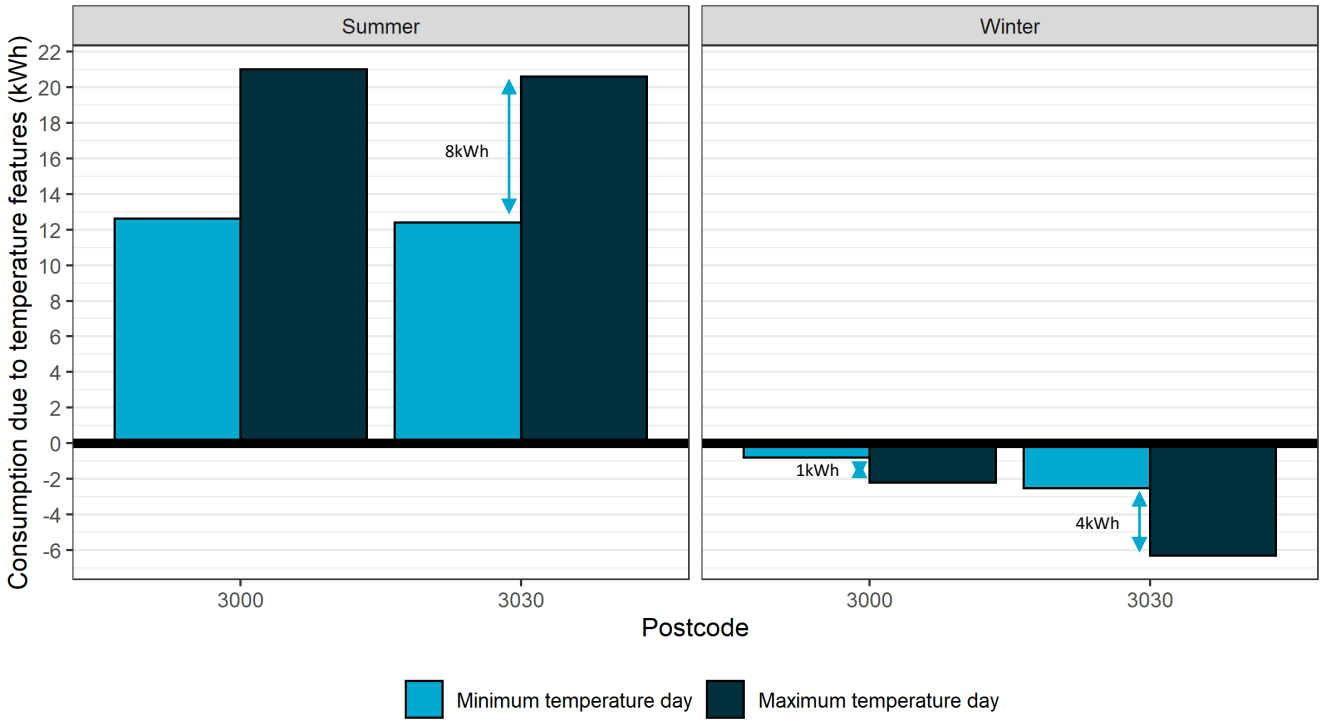
- Assess differences between coefficients across features and seasons
- Assess differences in typical consumption for various regions

Expand to more regions and more years

The generated dataset

House	Temperature	Lags x 48	HDD	CDD	Intercept	MSE	R^2
NMI123	…	…	…	…	…	…	…
NMI234	…	…	…	…	…	…	…
NMI345	…	…	…	…	…	…	…
NMI456	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…
NMI678	…	…	…	…	…	…	…
NMI789	…	…	…	…	…	…	…
NMI890	…	…	…	…	…	…	…
NMI901	…	…	…	…	…	…	…
NMI012	…	…	…	…	…	…	…

Early results: Differences between ‘average’ households



*Composite of 2,000 NMIs

**Winter Min – 28/08/2019, Winter Max – 10/08/2019, Summer Min – 13/02/2019, Summer Max – 25/01/2019

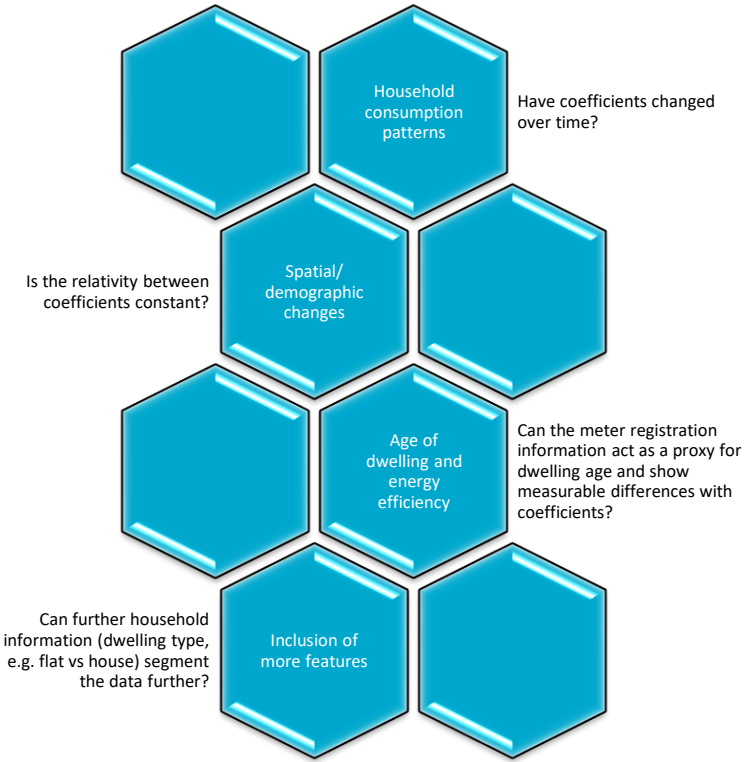
*** 86% of dwellings in postcode 3000 are apartments and flats, 83% of dwellings in postcode 3030 are separate houses

Geospatial analysis

Geospatial & Geospatial analysis

Temporal & Geospatial analysis

Extended research



Next steps

Refine and improve model and outputs

- Assessments of goodness of fit

Expand to more NMIs

- Calculate for more NMIs in a postcode, for NMIs in different postcodes, and for other historical years

Work with AEMO long-term forecasters to analyse key NEM peak demand events

- Determine the drivers on these days that are spatial, cooling/heating load related or linked closely to changes in weather fronts

Include demographics

- Utilise ABS statistics to conclude key demographics that effect weather sensitivity

Assess some of the current barriers facing the work

- For example, currently the modelling process is setup only for interval meter households – there will need to be considerations for how we might expand this into other areas where interval meter penetration is lower

Identifying battery installations

The grand goal

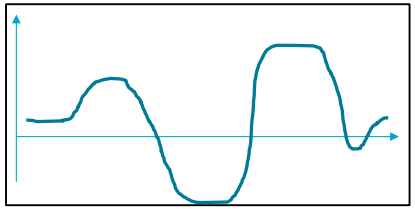
Identify all battery installations in Australia with interval meters

Our goal

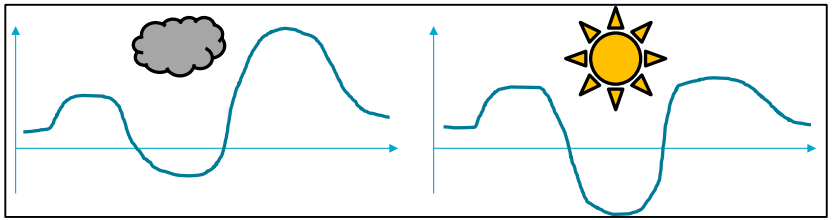
Develop algorithms which can identify with some confidence a high percentage of battery installations in Australia

White box approaches

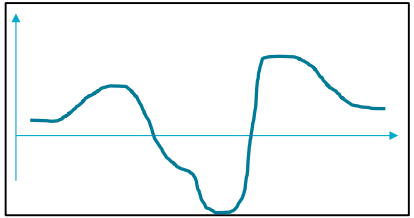
Night time export



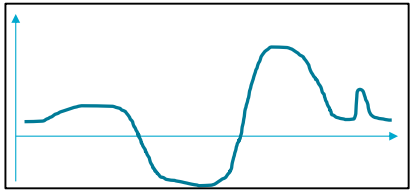
Night-time discharging on sunny days



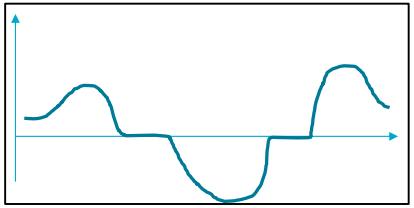
Weird solar shapes



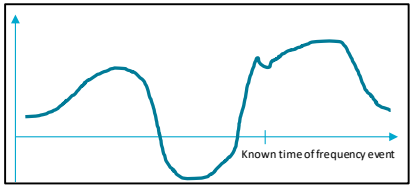
Overnight charging



Sustained zeroes

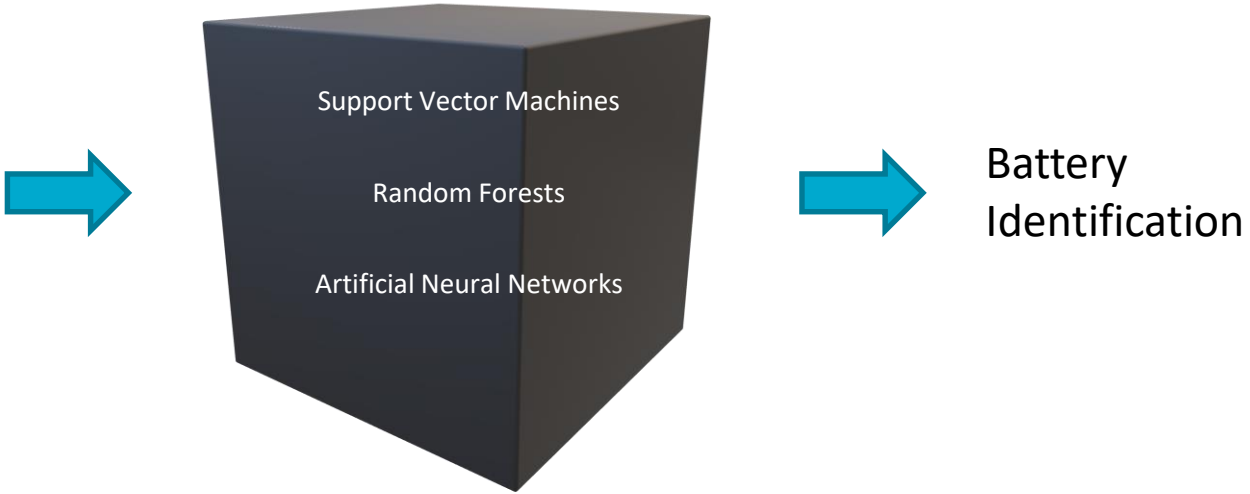


Frequency events



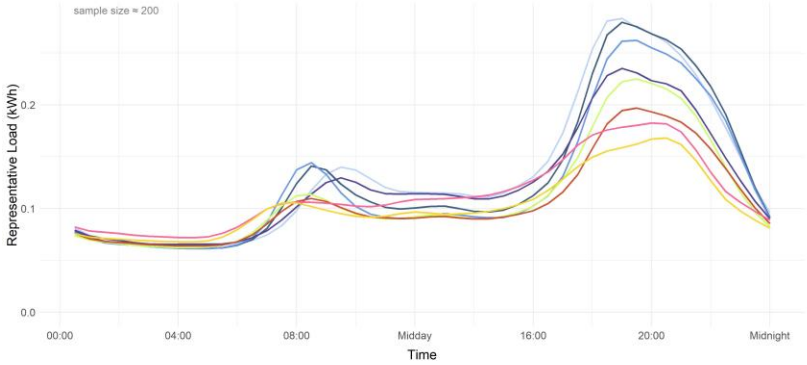
Black box approaches

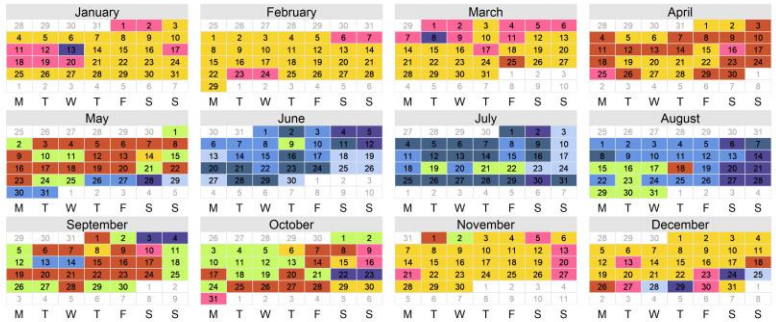
- Time series features
- Weather features
- Known battery households
- Unknown battery households



Battery Identification

Clustering



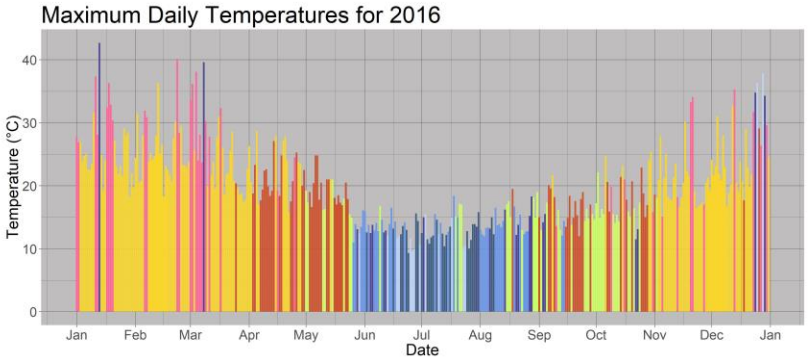


Day Cluster

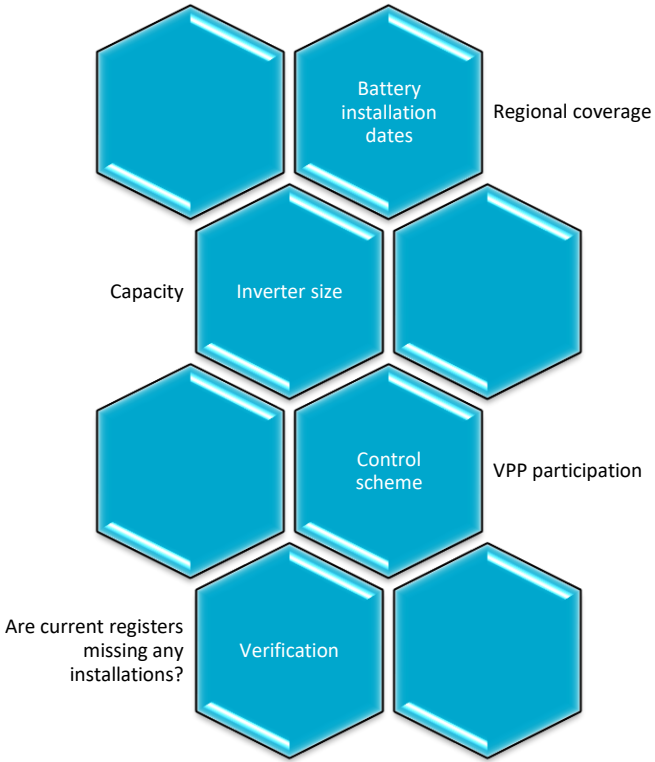
- Winter 1, n = 15, median max temp = 12.1°C
- Winter 2, n = 27, median max temp = 12.6°C
- Winter 3, n = 36, median max temp = 13.9°C
- Winter 4, n = 20, median max temp = 14°C
- Spring 1, n = 43, median max temp = 16.2°C
- Autumn 1, n = 61, median max temp = 18.8°C
- Summer 1, n = 36, median max temp = 29°C
- Summer 2, n = 128, median max temp = 22.95°C

VIC Public Holidays:

New Year's Day	01/01
Australia Day	26/01
Labour Day	14/03
Good Friday	25/03
Easter Sunday	27/03
Easter Monday	28/03
ANZAC Day	25/04
Queen's Birthday	13/06
AFL Grand Final Friday	30/09
Melbourne Cup	01/11
Christmas Day	25/12 & 27/12
Boxing Day	26/12



Extended research



Summary

Summary

Weather sensitivity analysis

- Despite the large delays, initial modelling looks promising
- Room to extend analysis both geospatially and temporally

Identifying battery installations

- Work recently started
- With batteries identified additional features can be discovered including geospatial and temporal mappings

Both

- Will assist AEMO's understanding of usage pattern changes from residential customers for their analyses as well as the historical uptake and penetration of battery systems

Thank you

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