Centre for Energy and Environmental Markets

UNSW SYDNEY

Tariff Design and Assessment Tool Workshop

3 Dec 2018, UNSW Sydney, Asia-Pacific Solar Research Conference (APSRC 2018)

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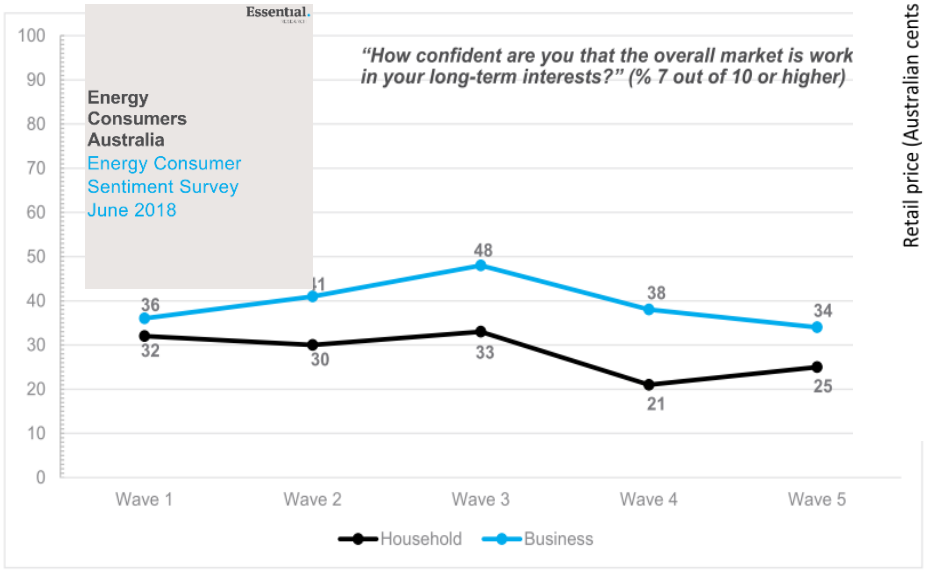
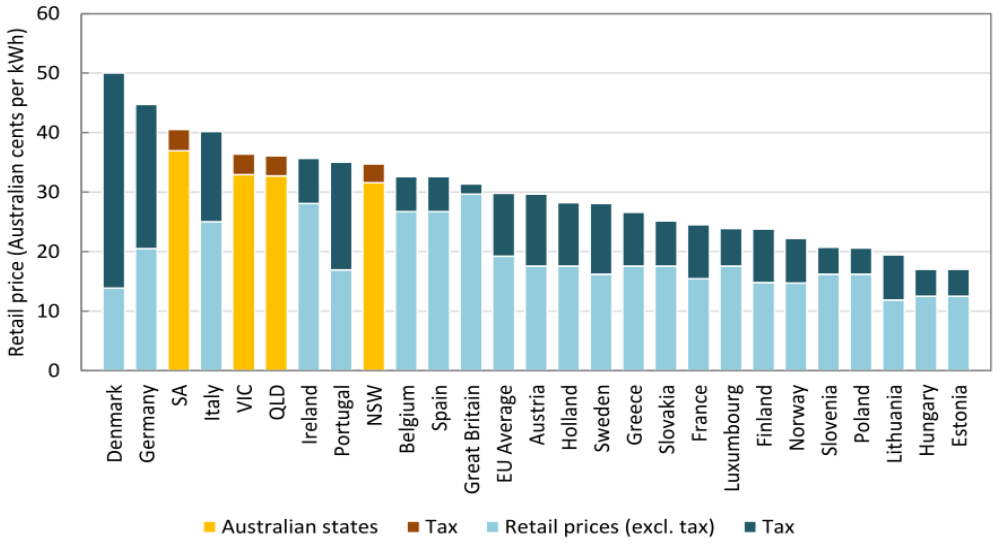
The challenge –
our failure to serve the long-term interests of consumers



International retail electricity price comparison

(ACCC Retail Price Competition Inquiry, 2017)

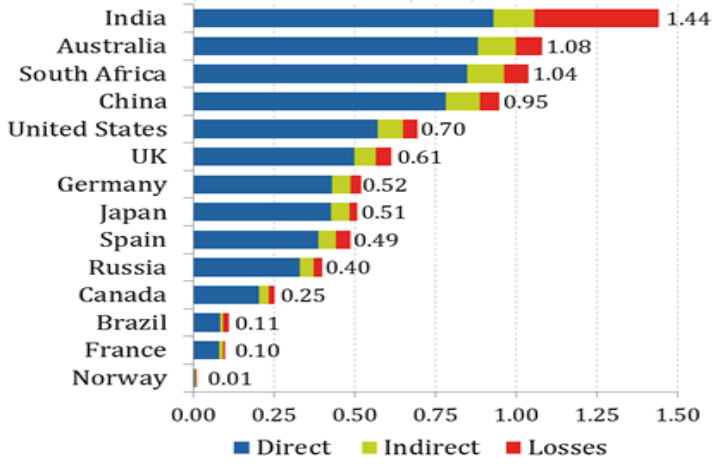
Figure 1.9: Comparison of residential electricity prices (before and after tax) (Australian cents per kWh) (May 2017 prices in Australia, 2015 prices in European countries)[62]



(ACCC, 2017)

Electricity emissions intensity comparison

(shrink that footprint)



Australian residential energy prices index

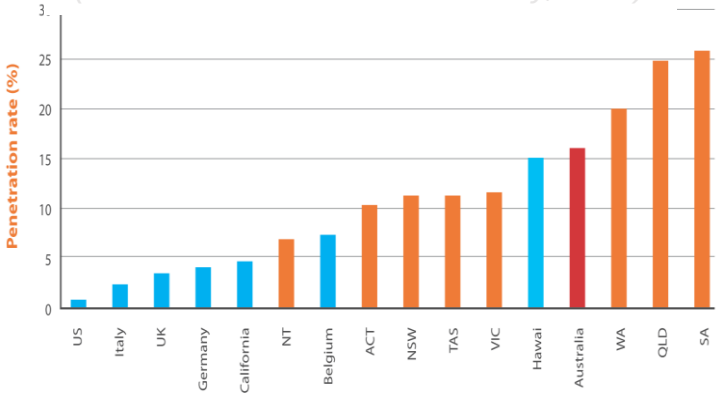
(Australian Energy Statistics Update 2017)

The opportunity - a greater role for energy-users in our energy future

- A growing appreciation of our diverse energy users and contexts
  - Citizens, consumers, customers…. now increasingly possible partners, competitors, communities, collectives
  - Contexts – housing types, vulnerable consumers…
- New opportunities for energy users to engage
  - PV, Storage, demand-side participation, energy efficiency
- Improving regulatory, market and policy efforts to appropriately facilitate end-user engagement enga
  - From assumptions of rational, utility maximising individual customers driven by prices… to a more complex appreciation of energy decision making, individual yet also collective goals and actions, and hence coordination, sharing
- *New ways to explore these challenges & opportunities; learn, disseminate and broaden the conversation*

Australia's residential PV penetration

(Finkel Review into NEM Security, 2017)



Open data, tools … and processes

Energy scientists must show their workings

Public trust demands greater openness from those whose research is used to set policy, argues **Stefan Pfenninger**.

The global transition towards a clean and sustainable energy future is well under way. New figures from Europe this month show that the continent is on track to reach its goal of a 20% renewable-energy share by 2020, and renewable capacity in China and the United States is also rising. But many technical, political and economic uncertainties remain, not least in the data and models used to underpin such policies. These uncertainties need open discussion, and yet energy strategies all over the world are based on research not open to scrutiny.

Researchers who seek, for example, to study the economic and energy model used by the US government (called NEMS) are met with a forbidding warning. On its website, the Energy Information Administration, which is developing the model, pronounces: "Most people who have requested NEMS in the past have found out that it was too difficult or rigid to use."

At least NEMS (National Energy Modelling System) is publicly available. Most assumptions, systems, models and data used to set energy policy are not. These black-box simulations cannot be verified, discussed or challenged. This is bad for science, bad for the public and spreads distrust. Energy research needs to catch up with the open-software and open-data movements. We energy researchers should make our computer programs and data freely accessible, and academic publishing should shun us until we do.

Our community's models are relevant to policy because they explore alternative scenarios or seek to understand the technical constraints on deploying new energy technologies. It is modelling for insight (by an academic exploring a range of qualitatively different scenarios for a clean energy supply, say) and for numbers (as in a government agency deciding on the remuneration level of a technology-support scheme).

Trust in this research matters because it contributes to policies on

BLACK-BOX **SIMULATIONS** CANNOT BE **VERIFIED,** DISCUSSED OR **CHALLENGED.**

that remain hidden, like the costs of technologies, can largely determine what comes out of such models. In the United Kingdom, opaque and overly optimistic cost assumptions for onshore wind went into models used for policymaking, and that may well have delayed the country's decarbonization.

This closed culture is alien to younger researchers, who grew up with collaborative online tools and share code and data on platforms such as GitHub. Yet academia's love affair with metrics and the pressure to publish set the wrong incentives: every hour spent on cleaning up a data set for public release or writing open-source code is time not spent working on a peer-reviewed paper.

Nevertheless, some academic-led projects are pushing towards more openness. The Enipedia project is building a worldwide open database on power plants, with data such as their locations and emissions. The Open Power System Data project gathers data such as electricity consumption from government agencies and transmission-network operators, and pushes for clarity on the licensing under which these data are made available. The Open Energy Modelling Initiative is emerging as a platform for coordinating and strengthening such efforts.

Regulation can also help. The European Union has mandated open access to electricity-market data, resulting in the creation of the ENTSO-E Transparency Platform to hold it, and there are good arguments for the creation of national energy-data agencies to coordinate the collection and archiving of a range of important data.

The vast majority of published research is still untouched by these fledgling initiatives. Only one energy journal — *Energy Economics* — currently requires data and models alongside submissions. Other journals should follow suit.

The open sharing of code and data is also important because it

openmod open energy modelling initiative

Openmod in a nutshell

The Open Energy Modelling (openmod) Initiative promotes open energy modelling in Europe.

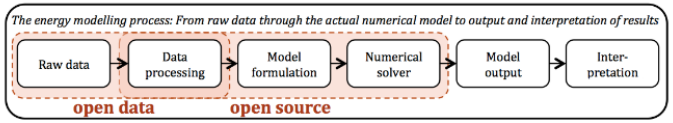
Energy models are widely used for policy advice and research. They serve to help answer questions on energy policy, decarbonization, and transitions towards renewable energy sources. Currently, most energy models are black boxes – even to fellow researchers.

"Open" refers to model source code that can be studied, changed and improved as well as freely available energy system data.

We believe that more openness in energy modelling increases transparency and credibility, reduces wasteful double-work and improves overall quality. This allows the community to advance the research frontier and gain the highest benefit from energy modelling for society.

We, energy modelers from various institutions, want to promote the idea and practice of open energy modeling among fellow modelers, research institutions, funding bodies, and recipients of our work.

The idea of openmod



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Open Source Tools

CEEM's researchers believe in the value of open source modelling in the Energy and Environmental research space. In this regard, we have developed a series of open source tools which are listed below. For a list of some of our under development tools you can refer CEEM's Github page.

NEMOSIS - NEM Open Source Information Service:

Open-source access to Australian National Electricity Market data.

Links: Github

NEMO - National Electricity Market Optimiser Tool:

NEMO, the National Electricity Market Optimiser, is a chronological dispatch model for testing and optimising different portfolios of conventional and renewable electricity generation technologies. It has been developed since 2011 and is maintained by Ben Elliston through his PhD at CEEM. NEMO is available under a free software license (GPL version 3) and requires no proprietary software to run, making it particularly accessible to the governments of developing countries, academic researchers and students. The model is available for others to inspect and to validate results.

Links: Github, OzLabs

TDA - Tariff Design and Analysis Tool:

We have developed a modelling tool to assist stakeholders wishing to contribute to network tariff design in the Australian National Electricity Market. It is an open source modelling tool to assist stakeholders in assessing the implications of different possible network tariff designs, and hence facilitate broader engagement in the relevant rule making and regulatory processes in the NEM. Our tool takes public energy consumption data from over 5000 households in NSW, and allows users test a wide range of existing, proposed and possible tariffs structures to see their impacts on network revenue and household bills. Demographic survey data of the households allows you to explore the impacts of these tariffs on particular household types – for example, families with young children. The tool can also show how well different tariffs align these household bills with a households' contribution to network peak demand. The tool and data are open source – you can check, validate and add your own data sets; test existing or even design your own tariffs, and validate and even modify the underlying algorithms.

Links: Project page, Github, Researchgate

Local Solar Sharing Scheme Model:

Intended for modelling embedded networks, local solar and peer to peer electricity networks. This software was developed by Naomi Stringer, Luke Marshall and Rob Passey at CEEM. A working build with a simple user interface for OSX can be found here.

Links: Github

NemLite - Open Source model of NEM Dispatch Engine:

Intended to replicate the performance of the National Electricity Market Dispatch Engine (NEMDE).

Links: Github

The Day

Tariff Design and Assessment Tool: Progress and Next Steps

This project, funded by Energy Consumers Australia, builds on the earlier work in developing a tool that stakeholders can use to assess the impacts of different network tariff proposals on end-users. It will extend the functionality of the existing tool by incorporating retail tariffs, incorporating the impact of DER and DR, as well as a range of other enhancements. Navid will present the progress to date and seek feedback.

10 to 10:15am	**Project intro: Tariff Design Challenges** Iain MacGill
10:15 to 11am	**Tool Introduction and plans for new functionality** Navid Haghdadi
11 to 12pm	**Stakeholder panel and Q&A**
12 - 12:15pm	Break

PV on Apartment Buildings

This project, funded by Energy Consumers Australia, assesses the opportunities and challenges for PV deployment on apartments across Australia, and includes a comparative analysis of technical and financial arrangements and an exploration of the distribution of costs and benefits between owners and residents and between different households. Mike will present the findings from this project, discuss potential policy approaches and invite feedback to inform the focus of the final report.

12:15 to 1pm	**Dissemination of Findings and policy options** Mike Roberts
1 to 1:15pm	Lunch Provided: Grab sandwiches and a cuppa
1.15 to 2pm	**Stakeholder panel and feedback** (over sandwiches)
2pm to 2:15	Coffee break

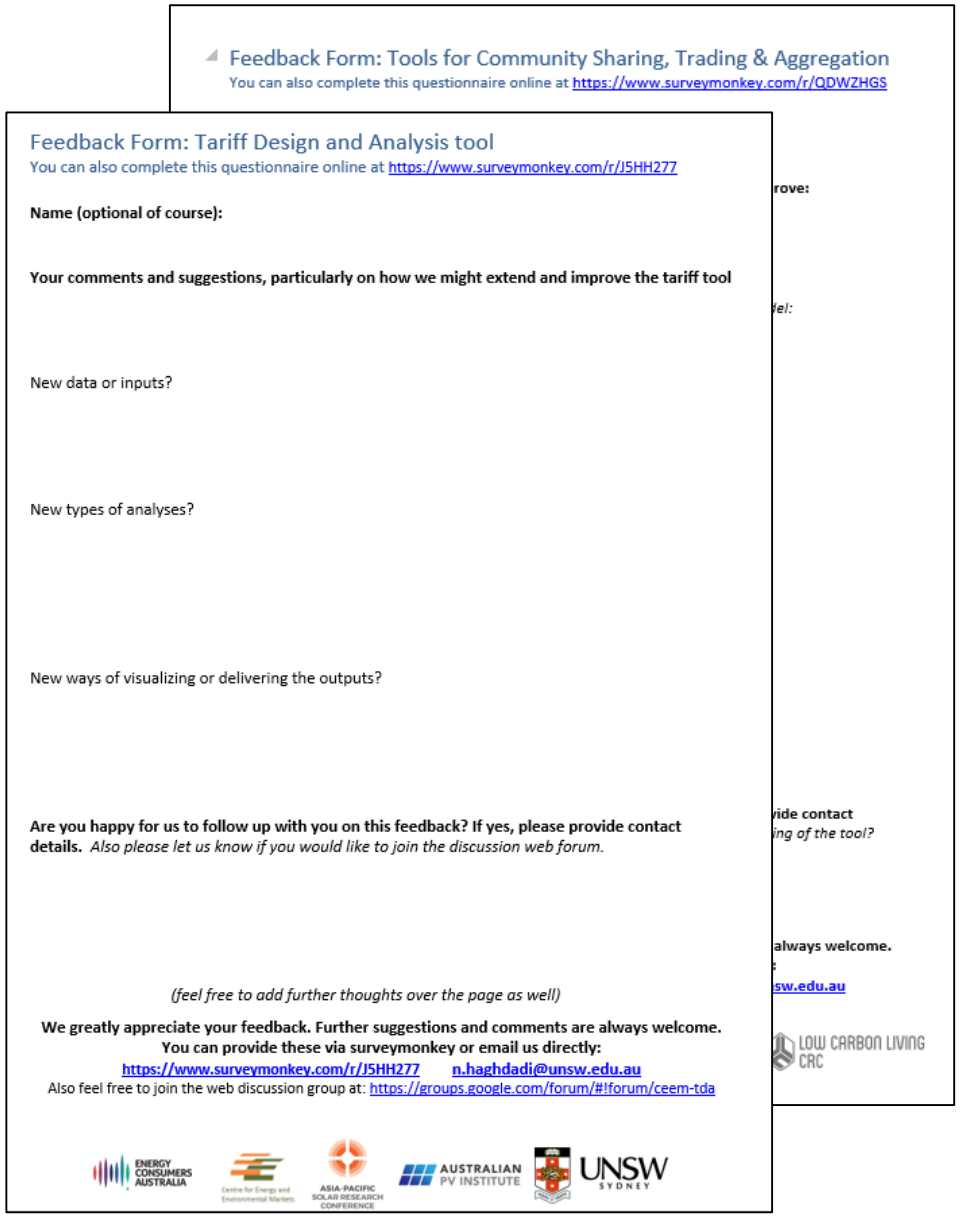
Tools for Community Sharing, Trading and Aggregation

Here we will showcase two new models that we have developed with funding from ECA and CRC for Low Carbon Living: one for embedded networks in apartment buildings and one for local network areas, including those owned by network operators. We are now developing a User Interface (UI) for both models to broaden accessibility to a range of different stakeholders. Both models will be demonstrated as will a proposed UI, and we are seeking feedback on the models and the UI.

2:15 to 2:45pm	**Model for Community Trading in Local Network Areas** Naomi Stringer
2:45 to 3:15pm	**Model for Community Aggregation in Embedded Networks** Mike Roberts
3:15 to 4:30pm	**User Interface and Functionality Options and stakeholder feedback** Luke Marshall

Our collective task

- Updating you on progress
- Panel contributions from some key stakeholders
- Discussion
- Your ideas, guidance, comments and suggestions on how we can improve our analysis and tools and impact



Feedback Form: Tools for Community Sharing, Trading & Aggregation

You can also complete this questionnaire online at https://www.surveymonkey.com/r/QDWZHGS

Feedback Form: Tariff Design and Analysis tool

You can also complete this questionnaire online at https://www.surveymonkey.com/r/J5HH277

Name (optional of course):

Your comments and suggestions, particularly on how we might extend and improve the tariff tool

New data or inputs?

New types of analyses?

New ways of visualizing or delivering the outputs?

Are you happy for us to follow up with you on this feedback? If yes, please provide contact details. *Also please let us know if you would like to join the discussion web forum.*

(feel free to add further thoughts over the page as well)

We greatly appreciate your feedback. Further suggestions and comments are always welcome. You can provide these via surveymonkey or email us directly:

https://www.surveymonkey.com/r/J5HH277 n.haghdadi@unsw.edu.au

Also feel free to join the web discussion group at: https://groups.google.com/forum/#!forum/ceem-tda

ENERGY CONSUMERS AUSTRALIA · Centre for Energy and Environmental Markets · ASIA-PACIFIC SOLAR RESEARCH CONFERENCE · AUSTRALIAN PV INSTITUTE · UNSW SYDNEY

LOW CARBON LIVING CRC

Tariff Design and Assessment Tool: Progress and Next Steps

PROJECT OVERVIEW			
Grant no	AP 814	Date of report	11 / 01 / 2018
Grant recipient	UNSW		
Project title	Tariff Assessment Tool		

PROJECT OUTCOMES: *outline the project outcomes during the reporting period*

Describe the intended project outcome/s, and whether they were met. Where the outcomes were different from those proposed in the grant application, explain the reasons for the variation

The research project aimed to provide **tools and stakeholder engagement** in order to build **knowledge and capacity for effective evidence-based advocacy around network tariff design and regulation**.

An open source tool was developed with stakeholder input via the reference committee, at three workshops in Canberra, Sydney and Melbourne, and made available for free download via the CEEM website.

Stakeholder engagement was established via the reference committee, the workshops and direct consultations with key stakeholders. Knowledge and capacity for stakeholders to engage in advocacy was built via:

- a series of presentations of industry perspectives and discussion around the challenges and opportunities of tariff design at the project workshops
- demonstration and training around the tool at the workshops and during further focused training with key stakeholders
- dissemination of peer reviewed research papers on tariff design and regulation using the tool as the basis for the analysis.

944	2017/18	UNSW	An expanded open source modelling tool for assessing how different network and retail tariffs, and distributed energy options, impact on small energy consumers	The proposed project would deliver on these three major extended capabilities as well as ongoing tool development in response to changing approaches to network tariff design.

- 10:15 – 11am Tool Introduction and plans for new functionality
  Navid Haghdadi

- 11:00 – 12pm Stakeholder Panel

  Bob Telford, AER
  Craig Chambers, ARENA

  Q&A and Discussion

Agenda

- Introduction to the TDA tool
  - Aim
  - Quick tour
- Status report
  - Development
  - Moving to Python
  - Moving to API
  - Adding new functionalities
- Plans for improvement
  - Retail price and analysis
  - Distributed energy analysis
  - Demand response analysis
- Feedback and Questions

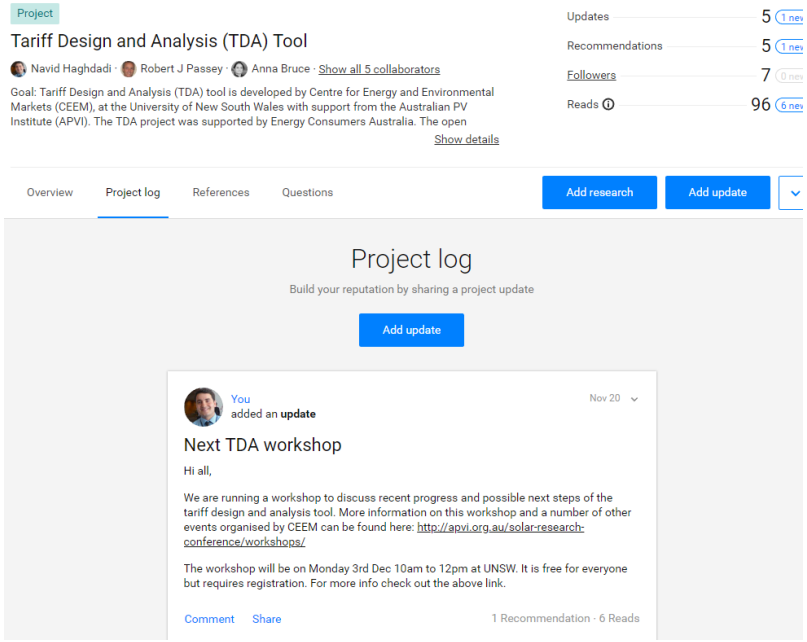
Tariff Design and Analysis tool

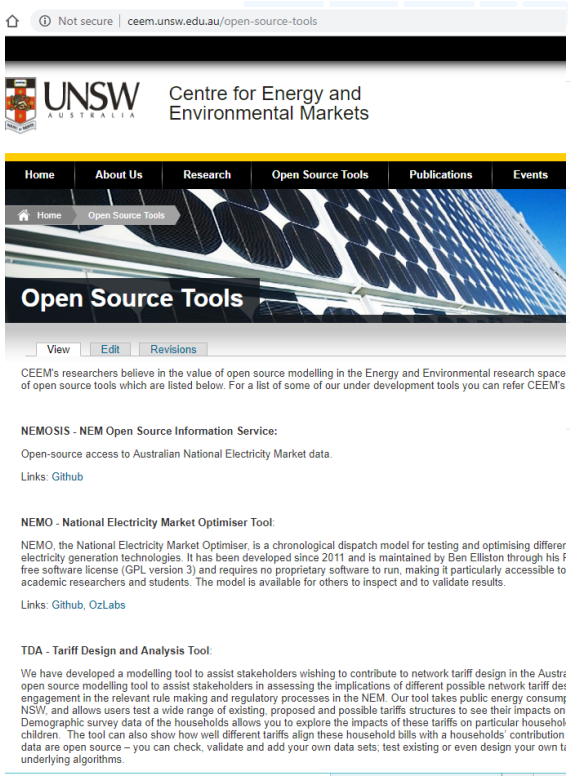
The open source TDA tool aims to assist stakeholders to investigate how different tariff structures impact on the expected bills of different types of residential consumers, while also estimating how well the tariffs align these customer bills with their impact on longer-term and wider electricity industry costs.

Tariff Design and Assessment (TDA) tool

Where to find it?

https://github.com/UNSW-CEEM/TDA_Matlab
http://ceem.unsw.edu.au/open-source-tools
https://www.researchgate.net/project/Tariff-Design-and-Analysis-TDA-Tool

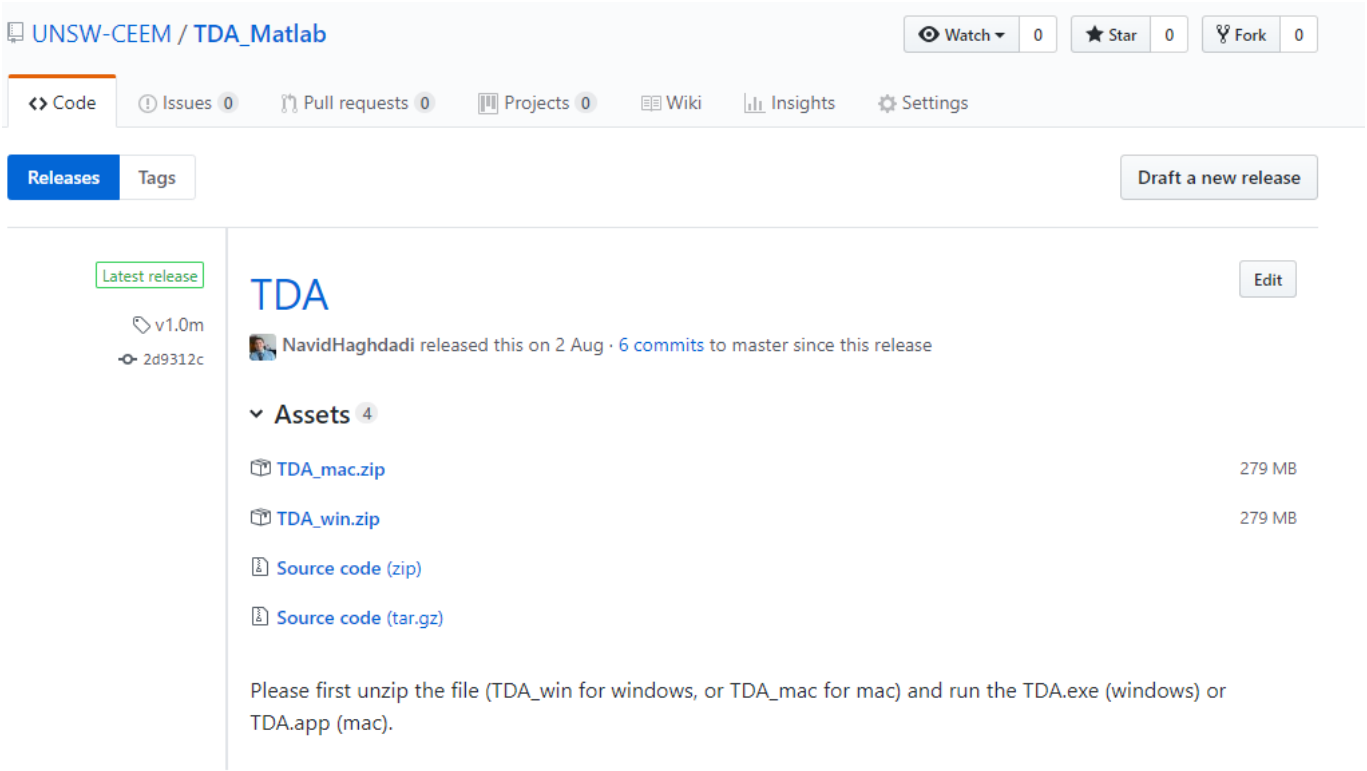




Tariff Design and Assessment (TDA) tool

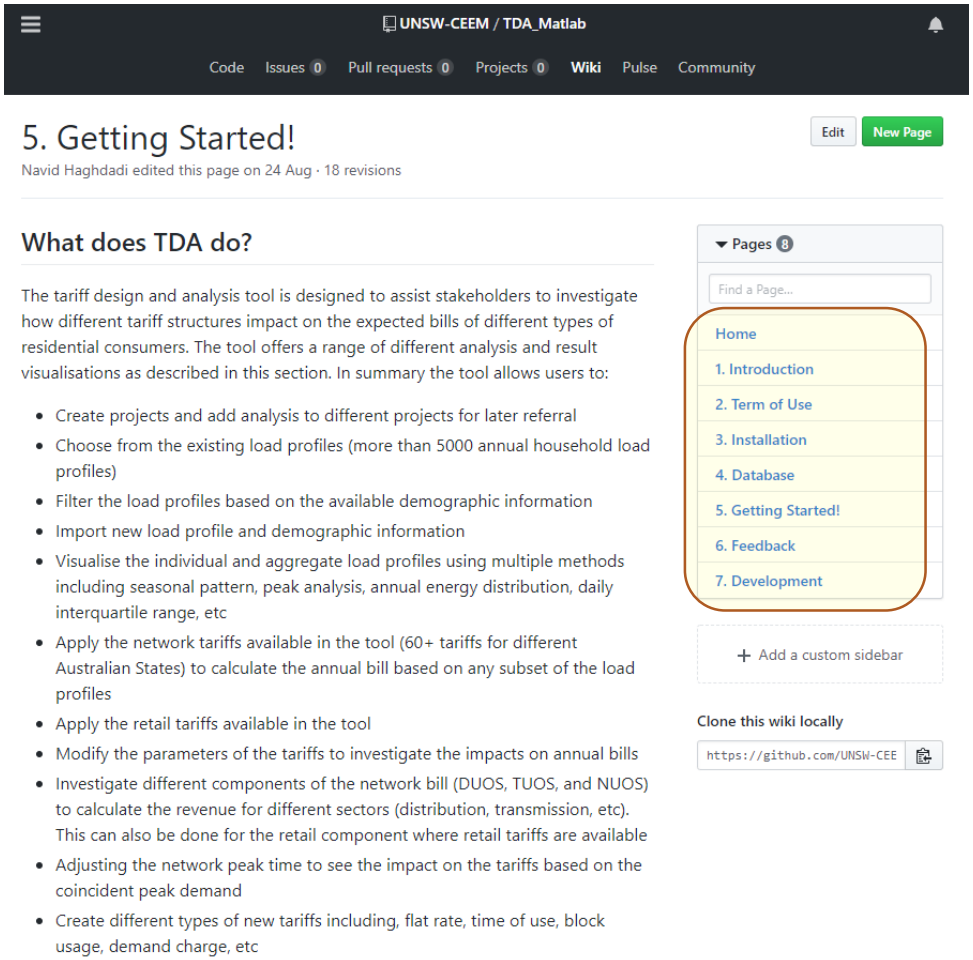
How to install it?

https://github.com/UNSW-CEEM/TDA_Matlab/releases



Tariff Design and Assessment (TDA) tool

How to find more information about it?

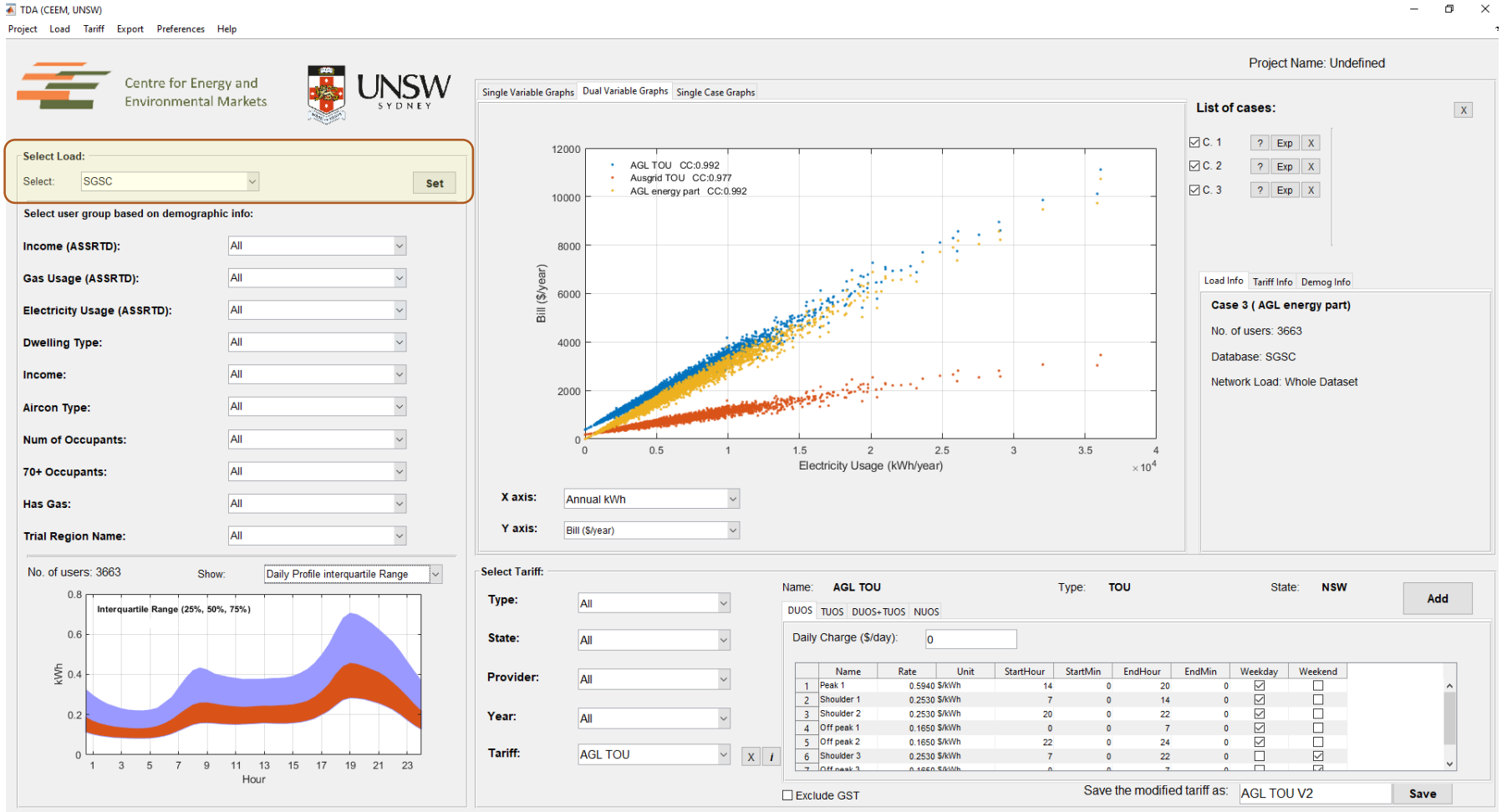


Tariff Design and Assessment (TDA) tool

What does the previous version do?

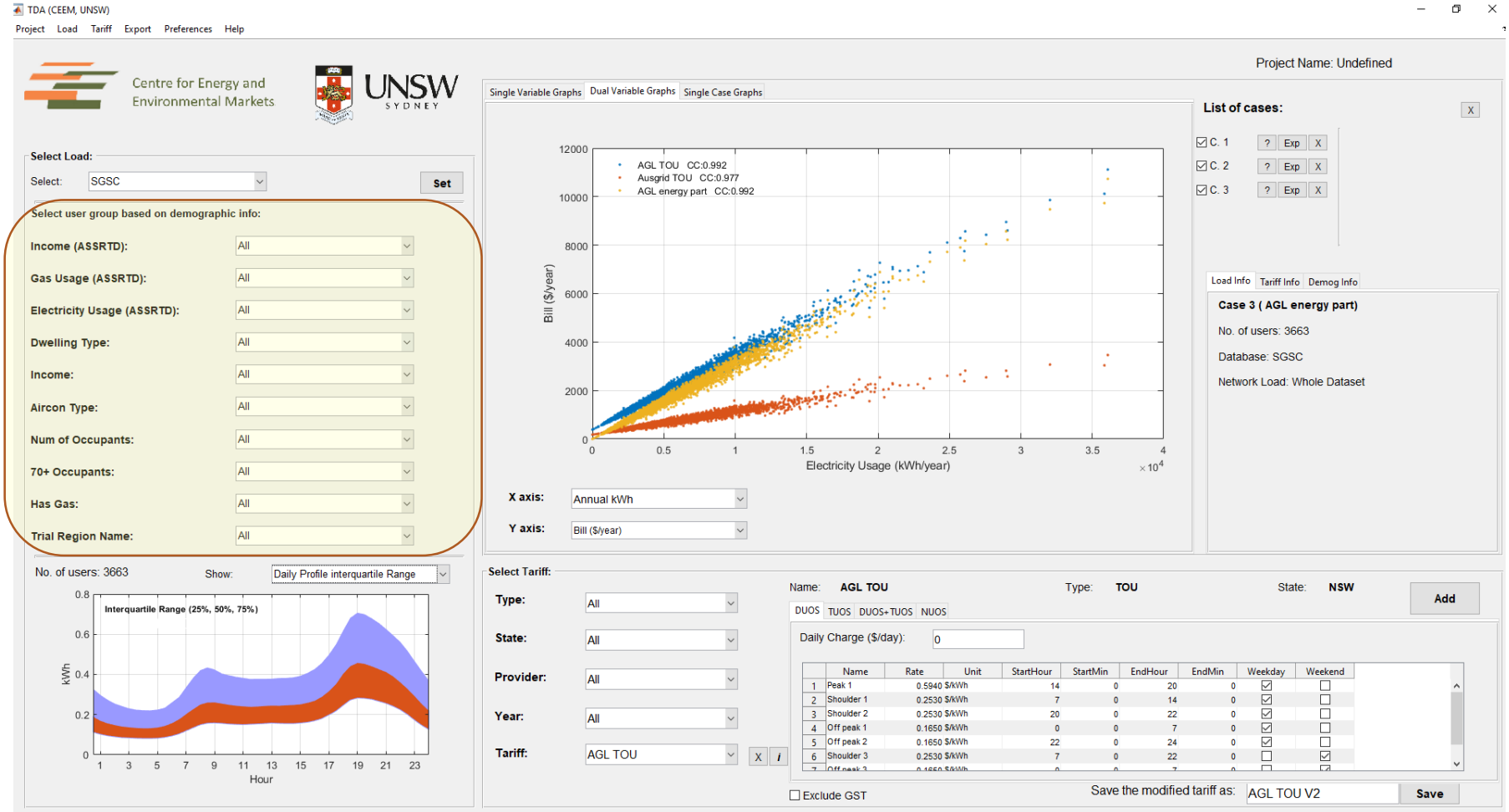
Tariff Design and Assessment (TDA) tool

Select load from a range of existing load profiles, or upload your own set of loads!



Tariff Design and Assessment (TDA) tool

Filer the load profiles by the demographic information



Tariff Design and Assessment (TDA) tool

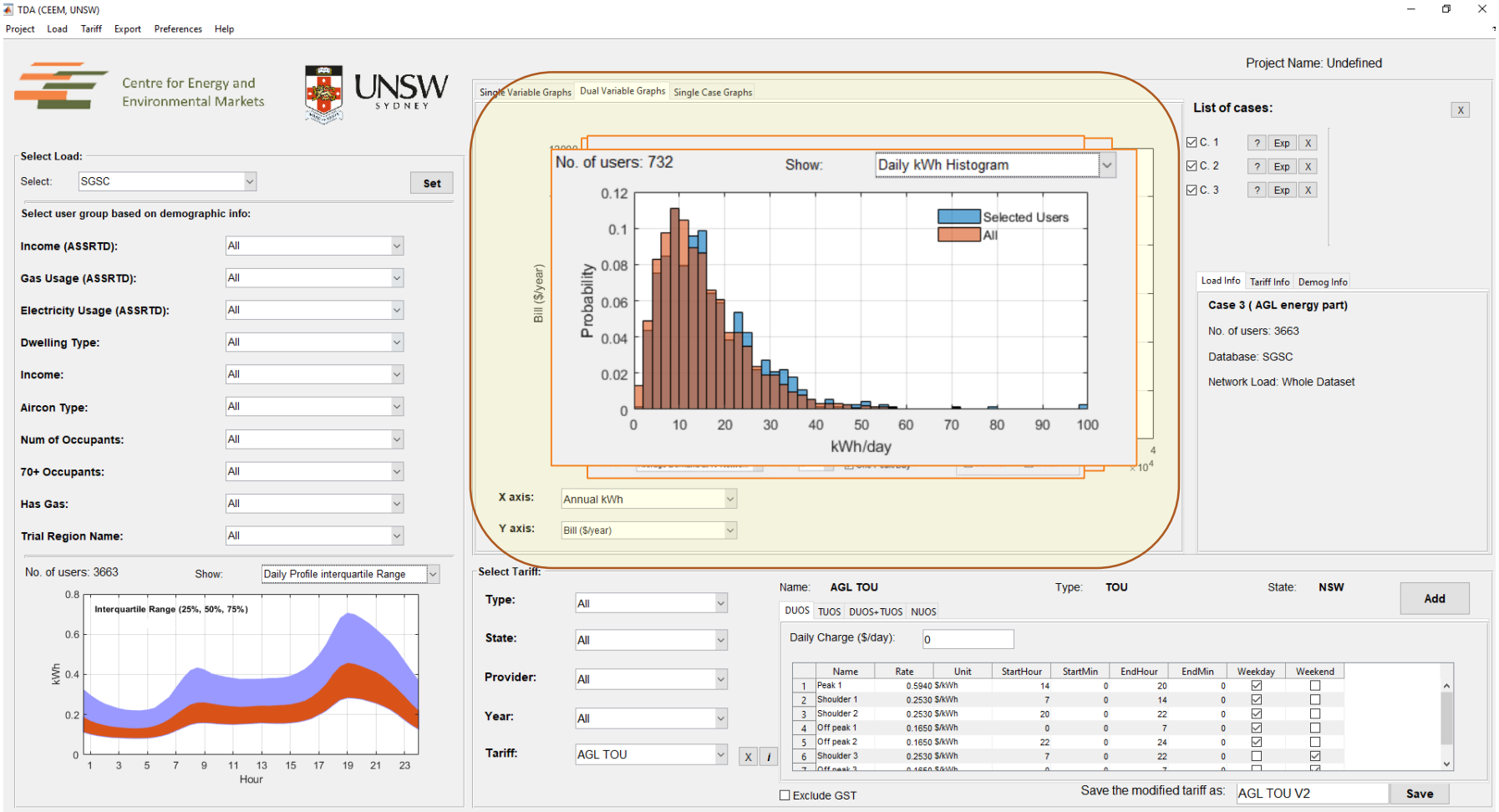
Get quick analysis of the set of selected loads

Tariff Design and Assessment (TDA) tool

Add a network tariff (and some limited retail tariffs) and optionally change any parameters

Tariff Design and Assessment (TDA) tool

Visualize the results of the analysis by a range of different graphing options

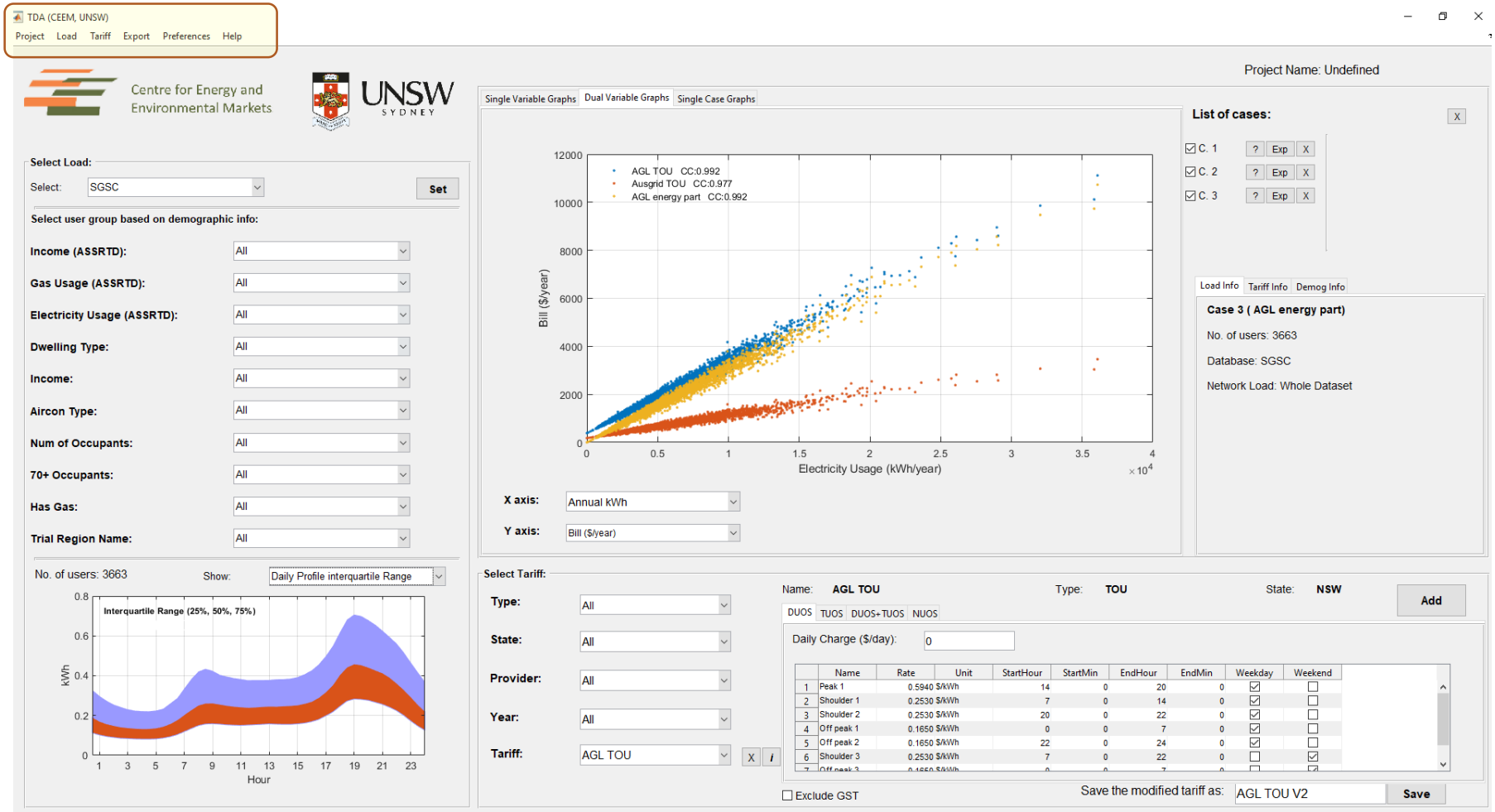


Tariff Design and Assessment (TDA) tool

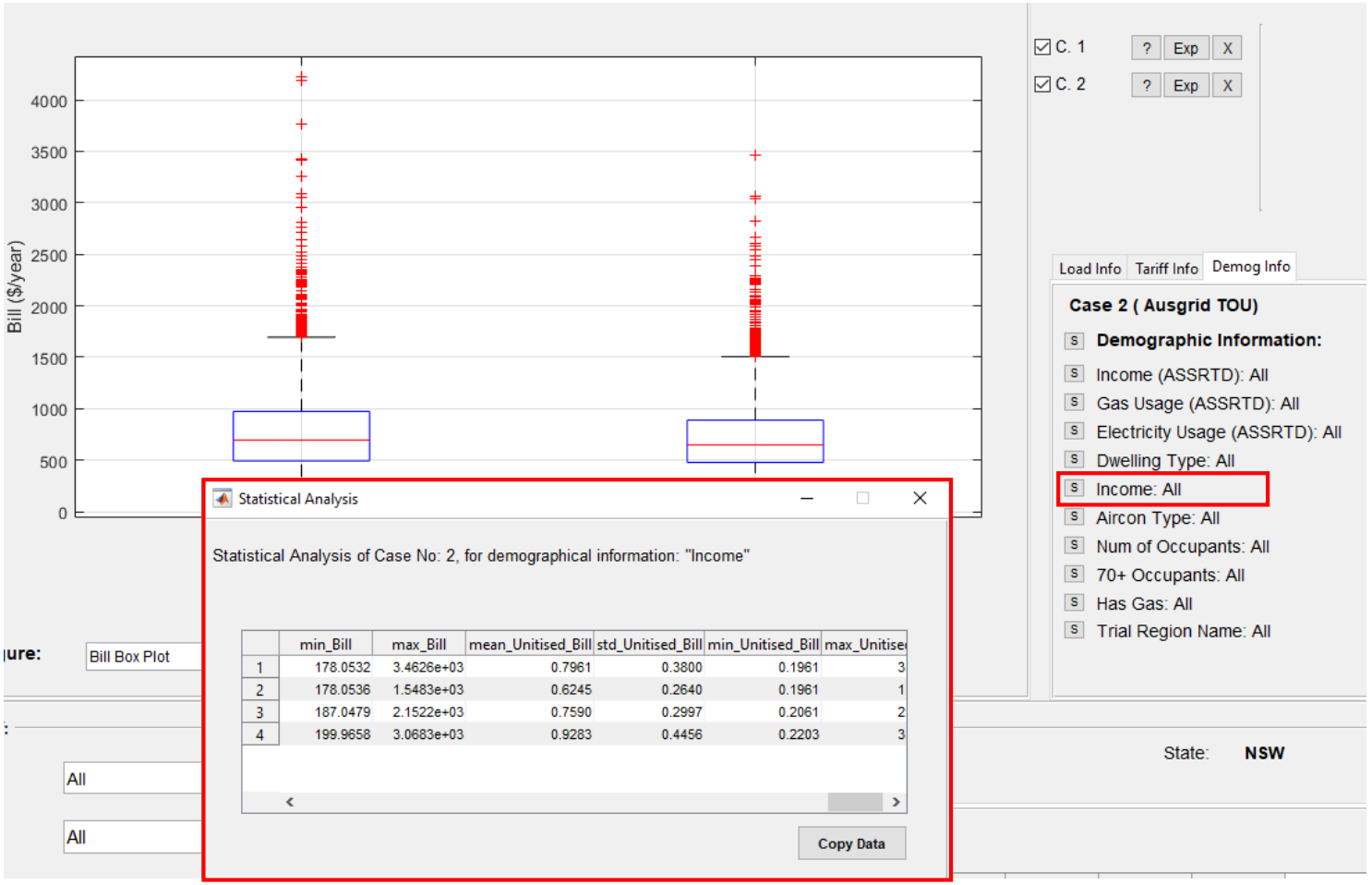
Add up to 10 analysis case and compare the results

Tariff Design and Assessment (TDA) tool

Add tariffs, loads and projects; exports the results to excel, and change the preferences in the context menu



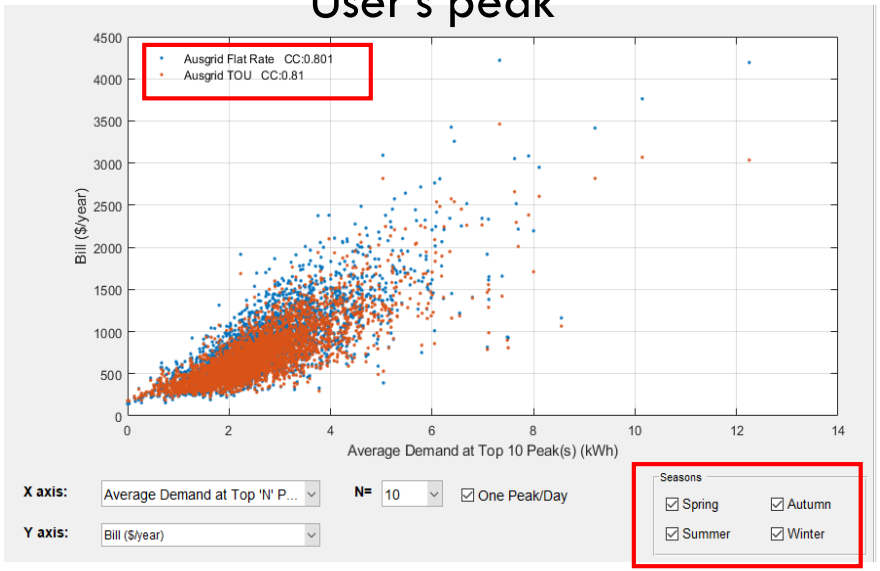
Use case example: Comparison of tariffs



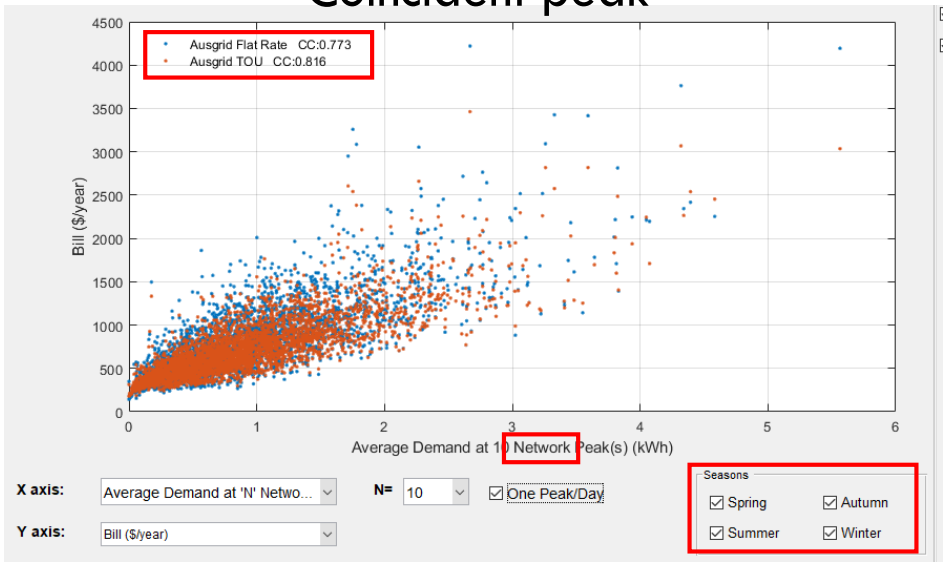
	min_Bill	max_Bill	mean_Unitised_Bill	std_Unitised_Bill	min_Unitised_Bill	max_Unitise
1	178.0532	3.4626e+03	0.7961	0.3800	0.1961	3
2	178.0536	1.5483e+03	0.6245	0.2640	0.1961	1
3	187.0479	2.1522e+03	0.7590	0.2997	0.2061	2
4	199.9658	3.0683e+03	0.9283	0.4456	0.2203	3

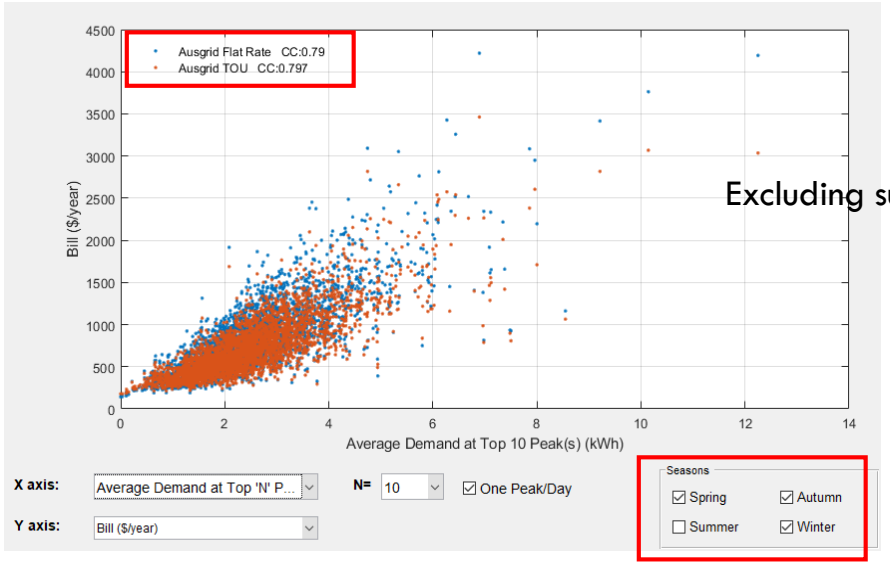
Use case example: Comparison of tariffs

User's peak



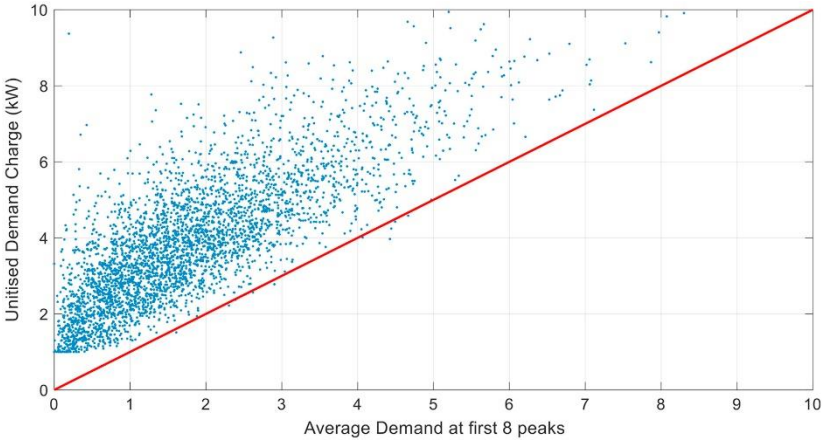
Coincident peak



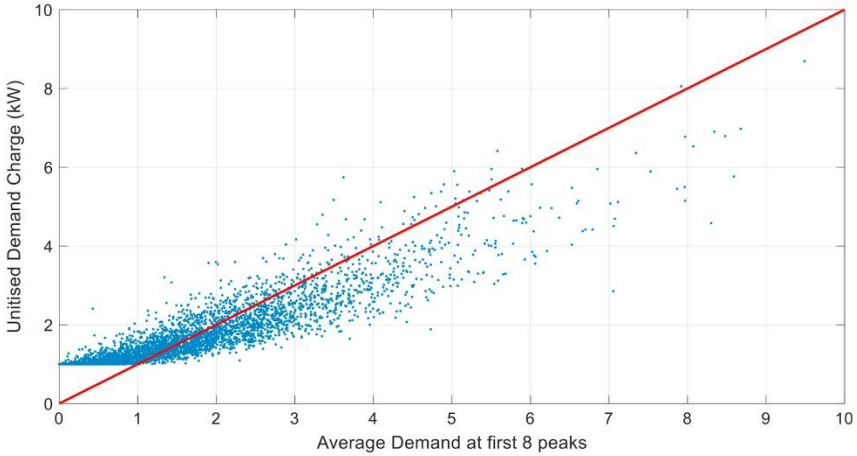


Excluding summer peaks

Use case example: Assessing tariffs



Unitised Standard Demand Charge vs Average Demand at Time of Eight Highest network Peaks.



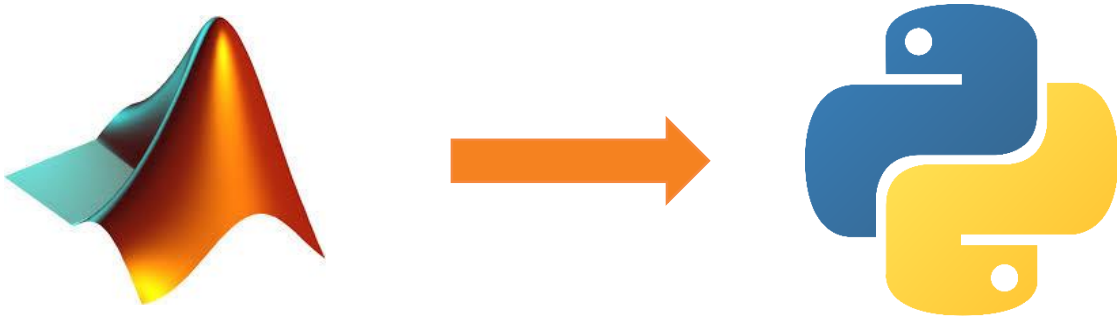
Unitised Demand Charge (applied to customer demand at time of 12 monthly network peaks) vs Average Demand at Time of Eight Highest Network Peaks.

Passey, R., Haghdadi, N., Bruce, A., & MacGill, I. (2017). Designing more cost reflective electricity network tariffs with demand charges. *Energy Policy*, *109*, 642-649.

New Developments

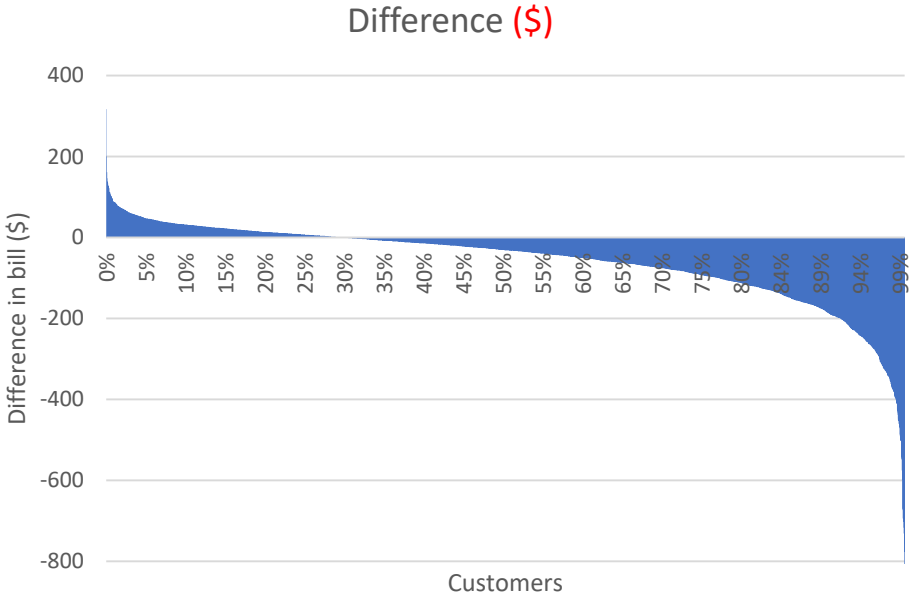
- Moving to Python
- More Analyses and Visualisation features
- Retail Tariffs (and Categorising them)
- Network, Wholesale, Retail Tariff Combined Analysis
- Distributed Resources/Response:
  - PV
  - Battery
  - Appliances
  - Demand response
  - Energy Efficiency
- Load Clustering

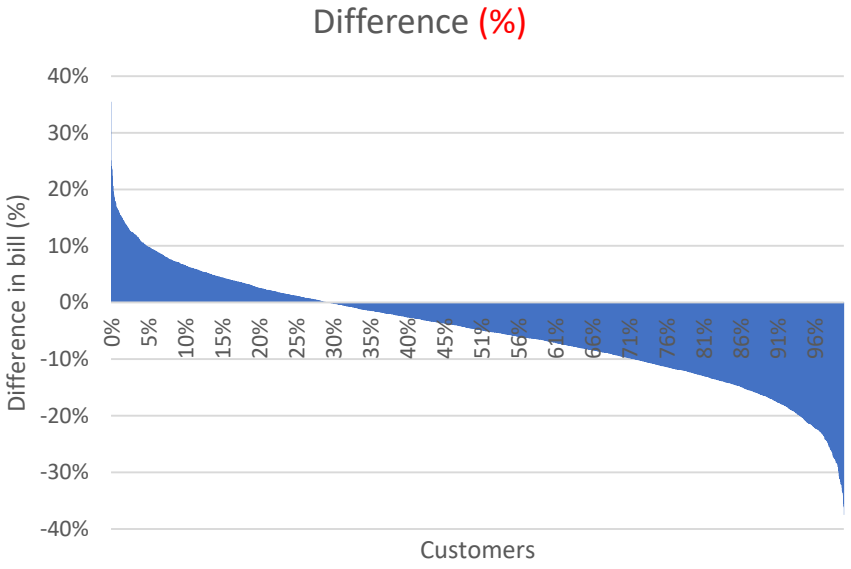
New Development: Converting to Python



- Even more open source!
- Easier collaboration in non-academic environment
- Reduced size

New Developments: Comparison of tariffs

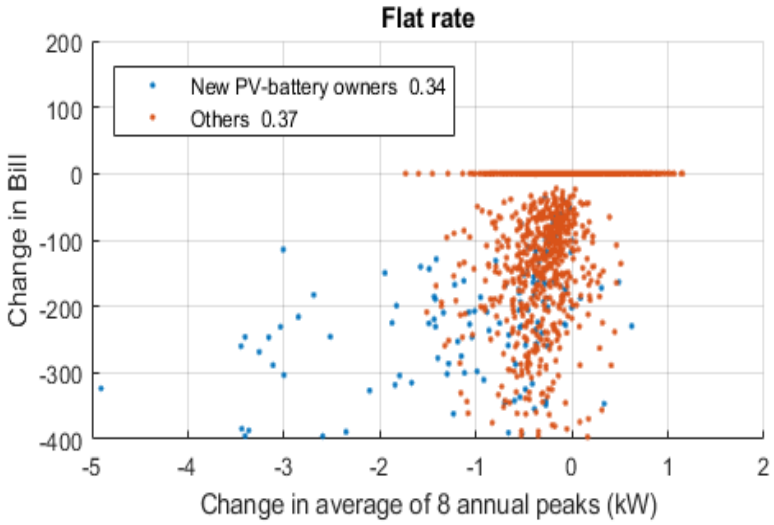


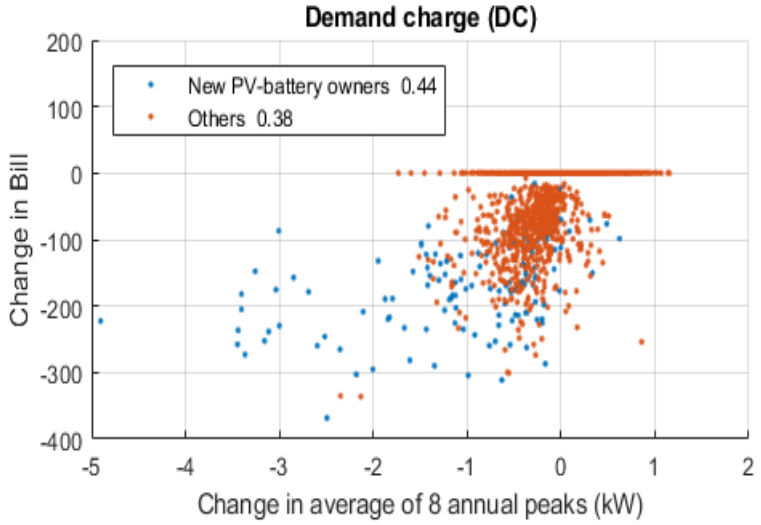


Going from Ausgrid Flat rate tariff (2017/18) to Time of use (2017/18)

New Developments: Distributed resources

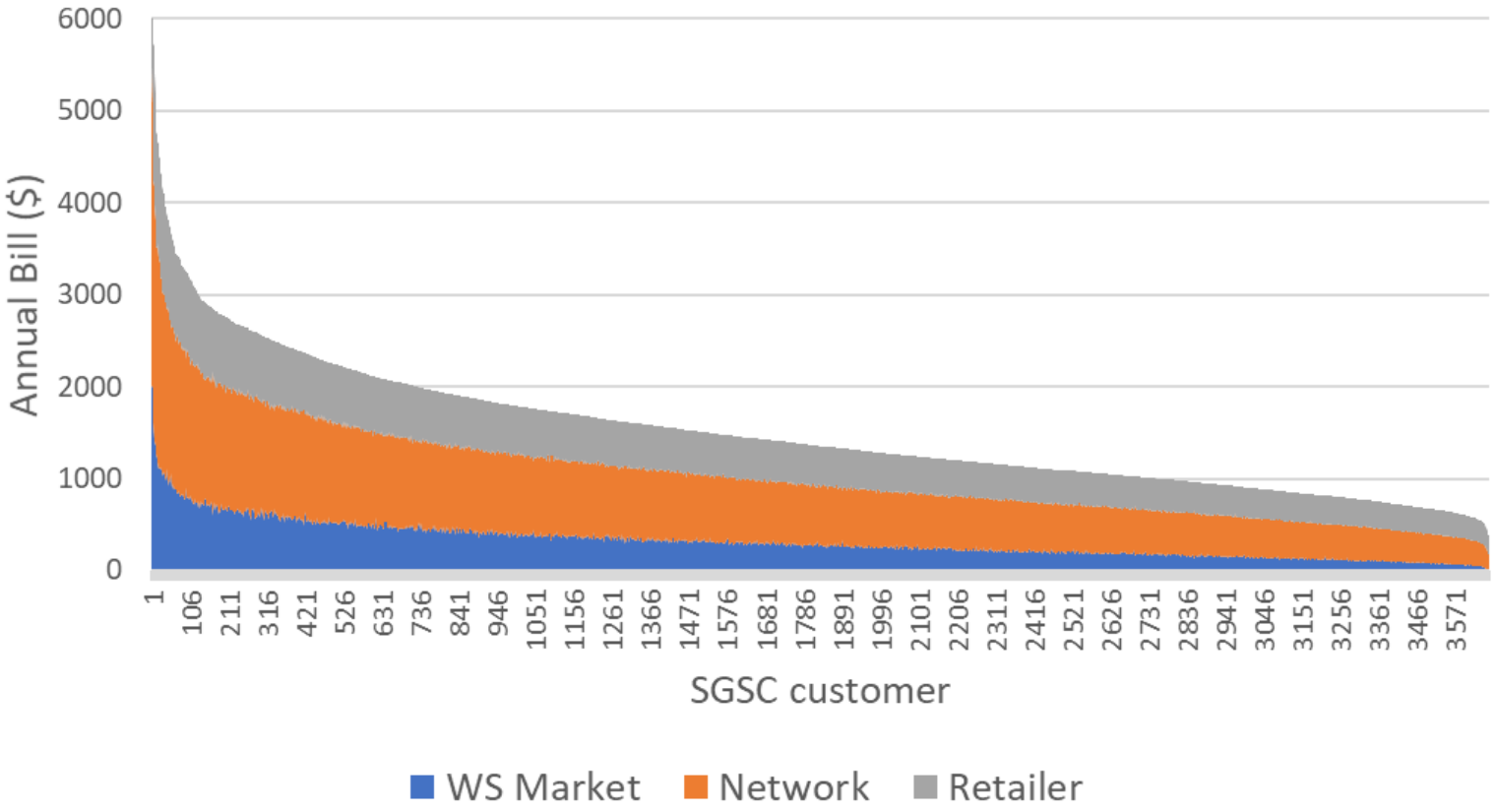
PV and battery impact on peak and other users





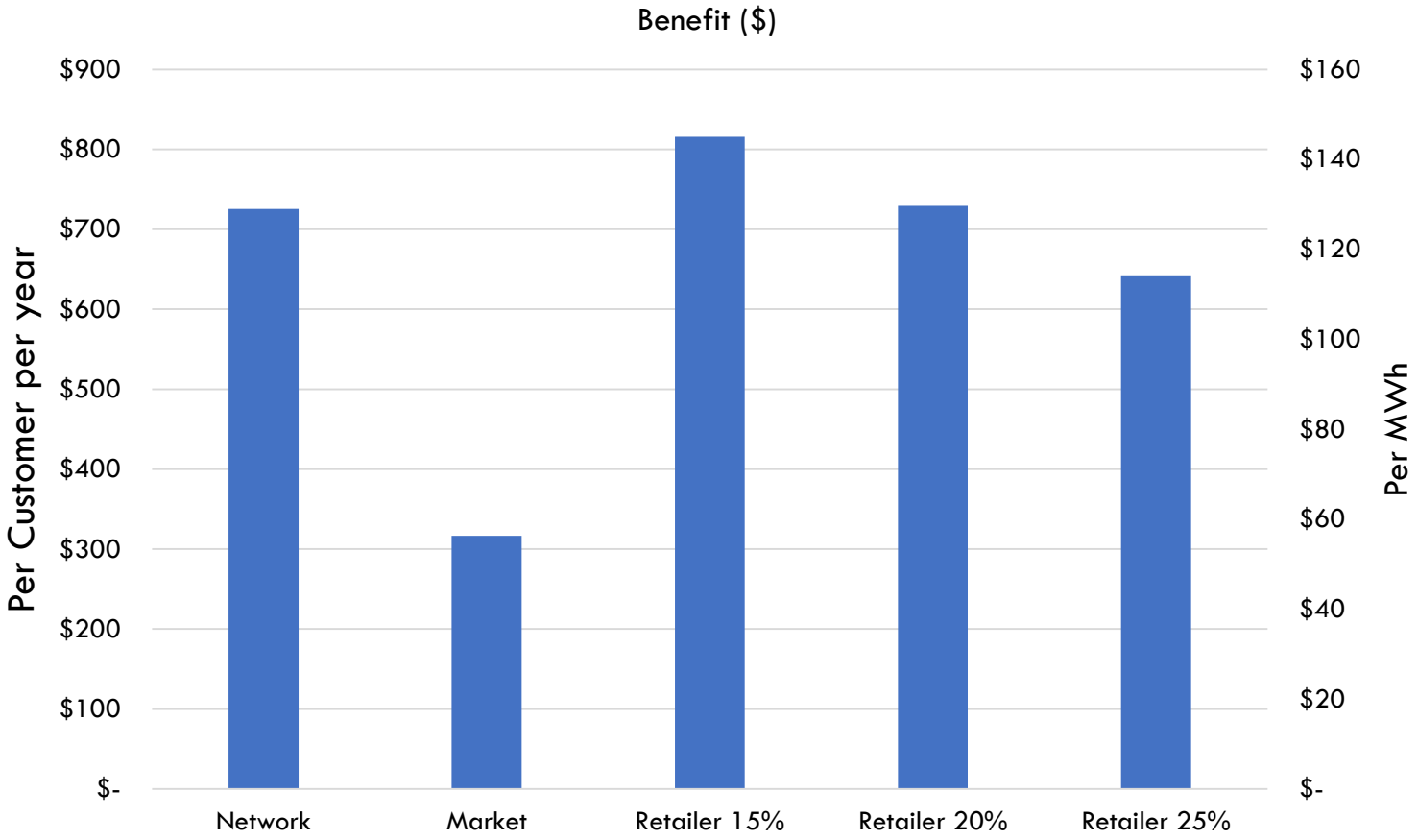
Preliminary results, using SAPN network tariffs for SGSC homes, 15% of customers having PV and battery

New Development: Comparison of the network, wholesale and retail revenue



WS price and SGSC load profile are for 2013, but retail tariff is for 2018

New Development: How about different discount levels?

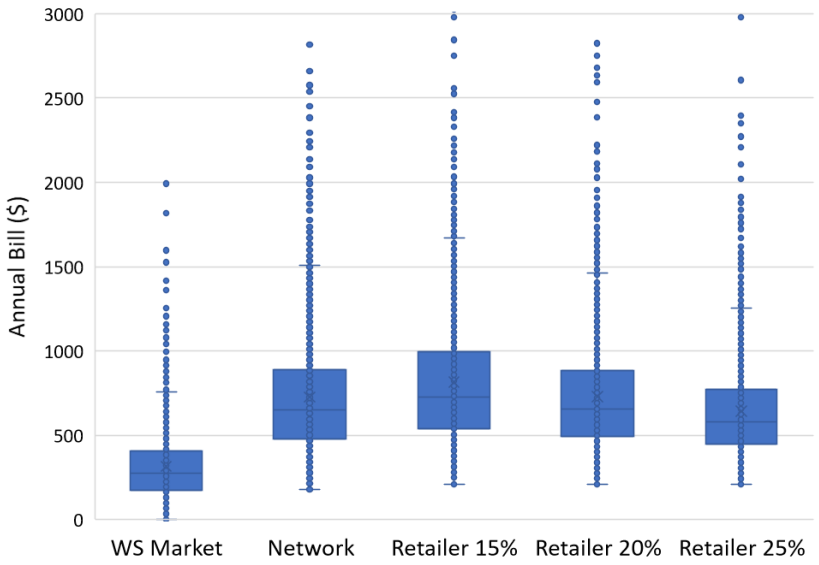


WS price and SGSC load profile are for 2013, but retail tariff is for 2018

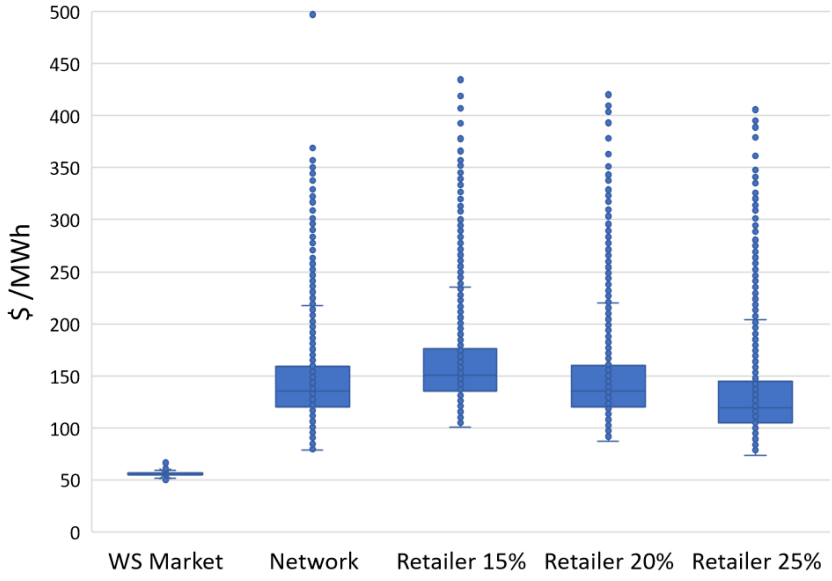
New Development: How about different discount levels?

Distribution of bills

Annual Bill ($)

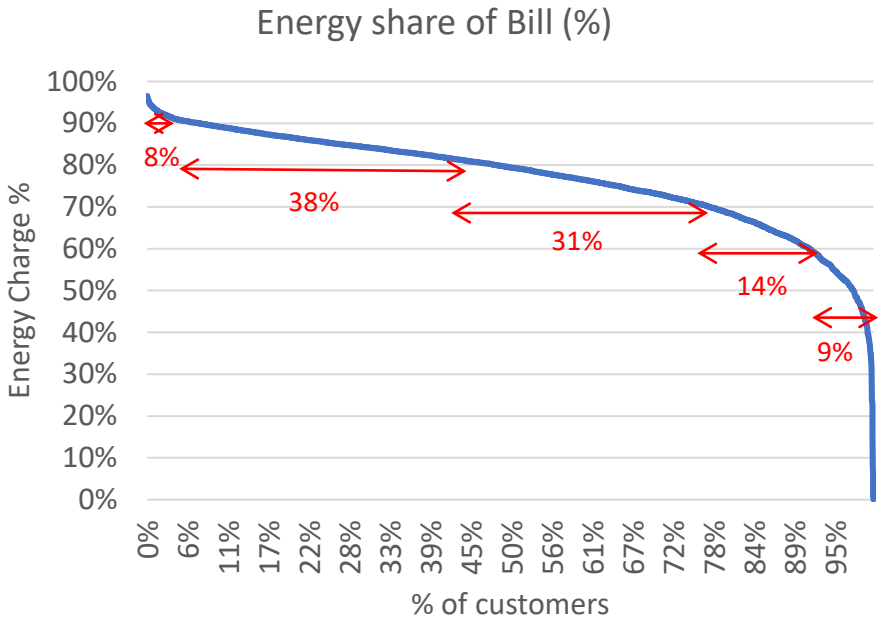


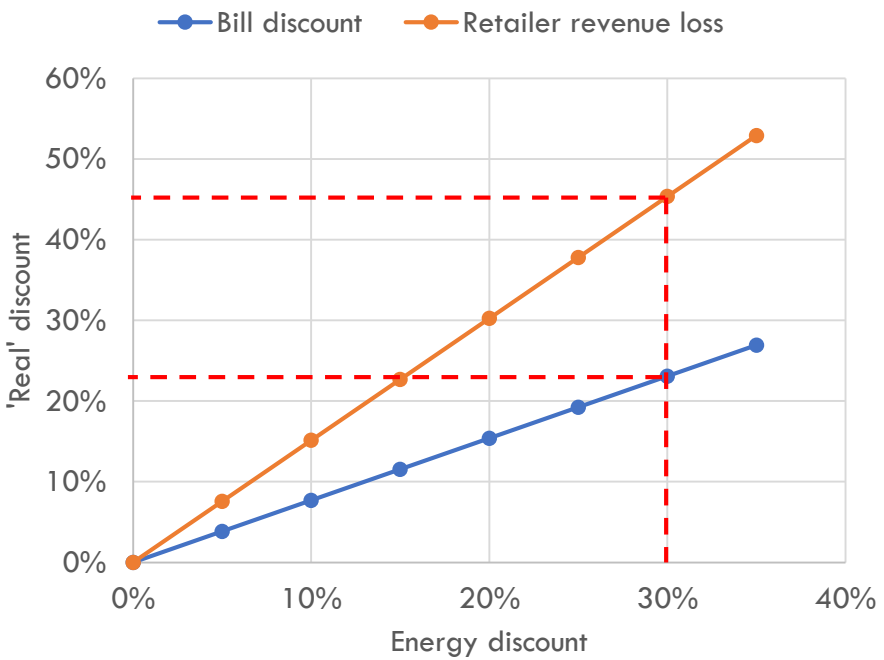
Annual Bill ($/MWh)



WS price and SGSC load profile are for 2013, but retail tariff is for 2018

New Development: Bill Discount, Energy Discount, Retailer Discount?



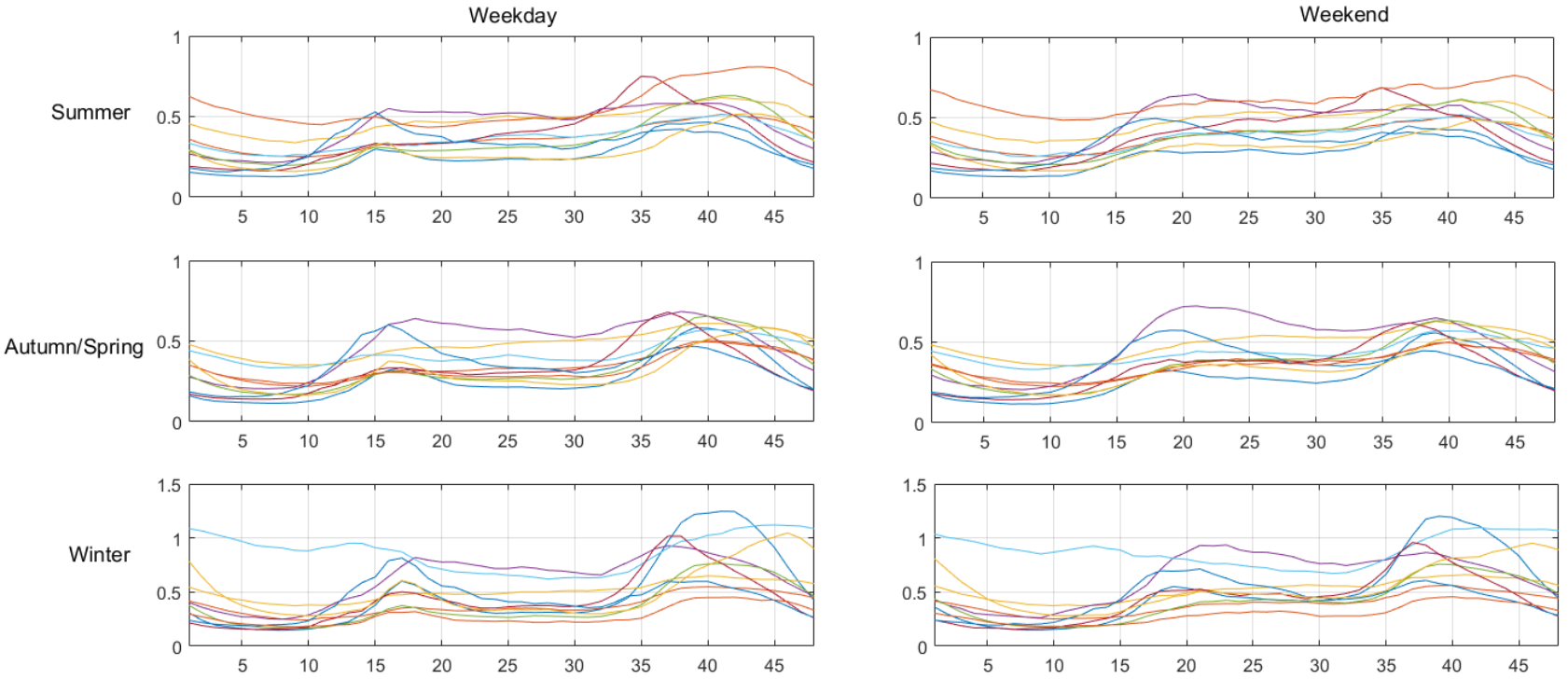


54% of customers have more than 30% of their bill from fixed charge

30% Energy Discount means 23% Bill discount, but 45% less revenue for retailer!

New Development: Clustering load profiles

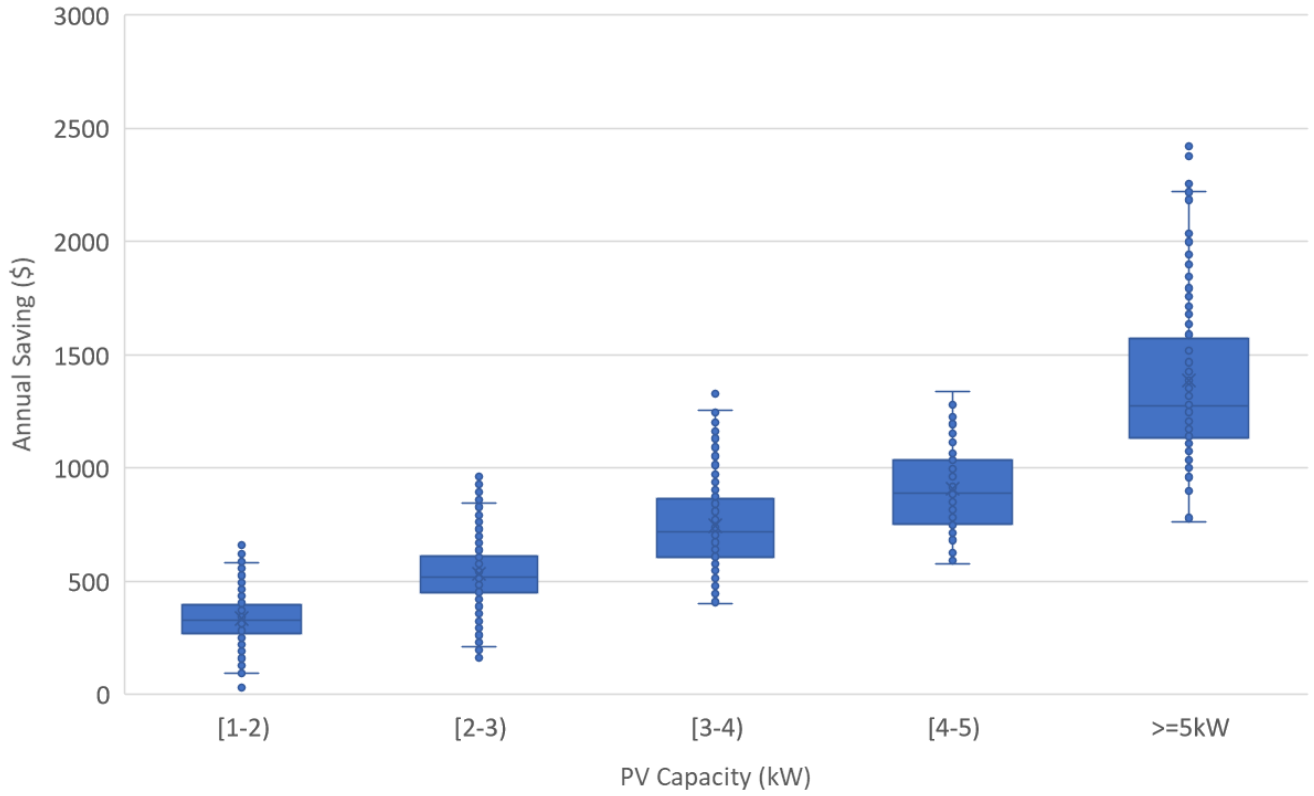
Generating groups of load profile based on daily pattern



More load profiles are [very] welcome!

New Development: Financial calculation of RE

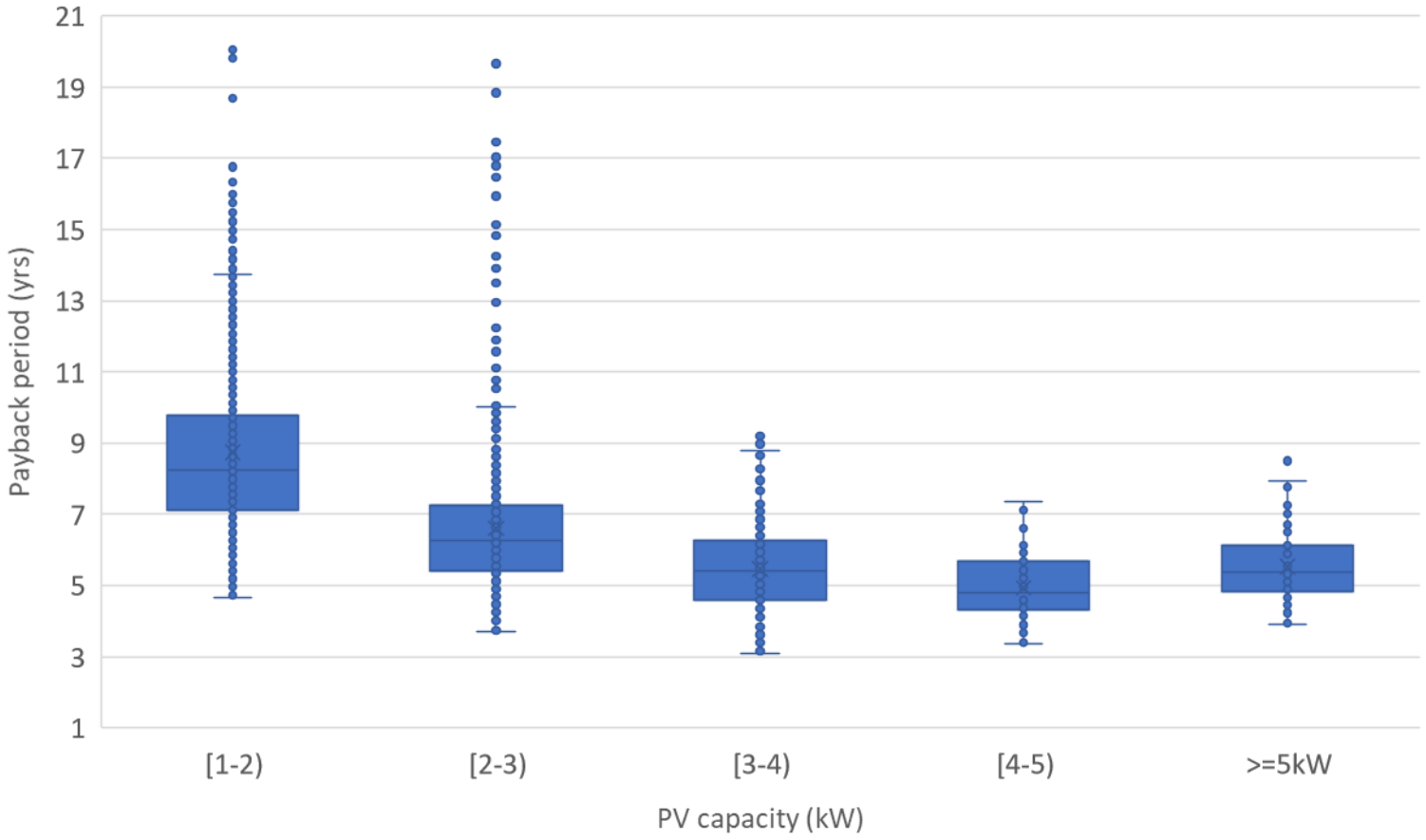
Annual saving of putting PV categorised by different size range



Data: 300 solar homes Ausgrid, 6 retail tariffs in NSW, PV cost retrieved from SolarChoice

New Development: Financial calculation of RE

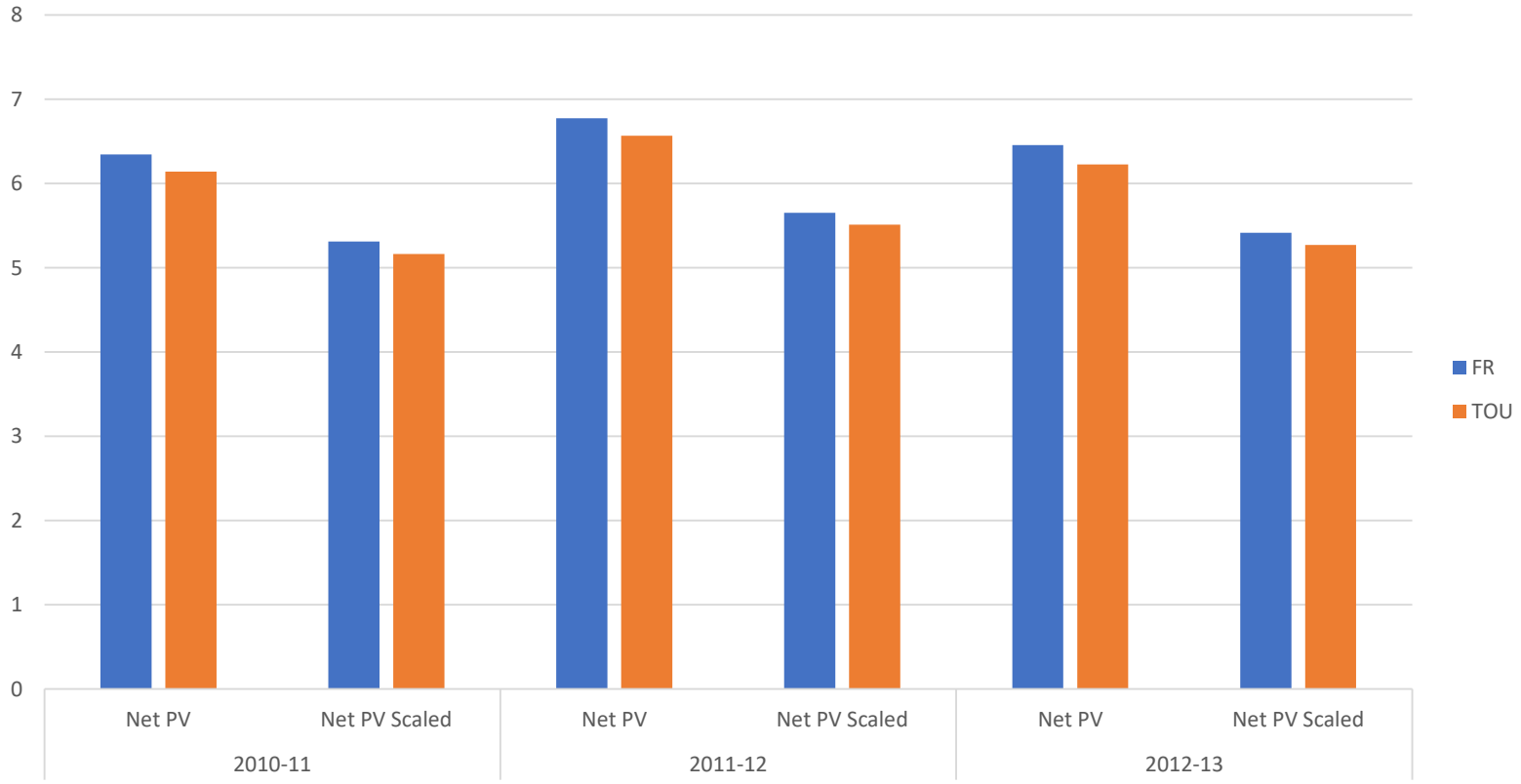
Payback period (years) of putting PV categorised by different size range



Data: 300 solar homes Ausgrid, 6 retail tariffs in NSW, PV cost retrieved from SolarChoice

New Development: Financial calculation of RE

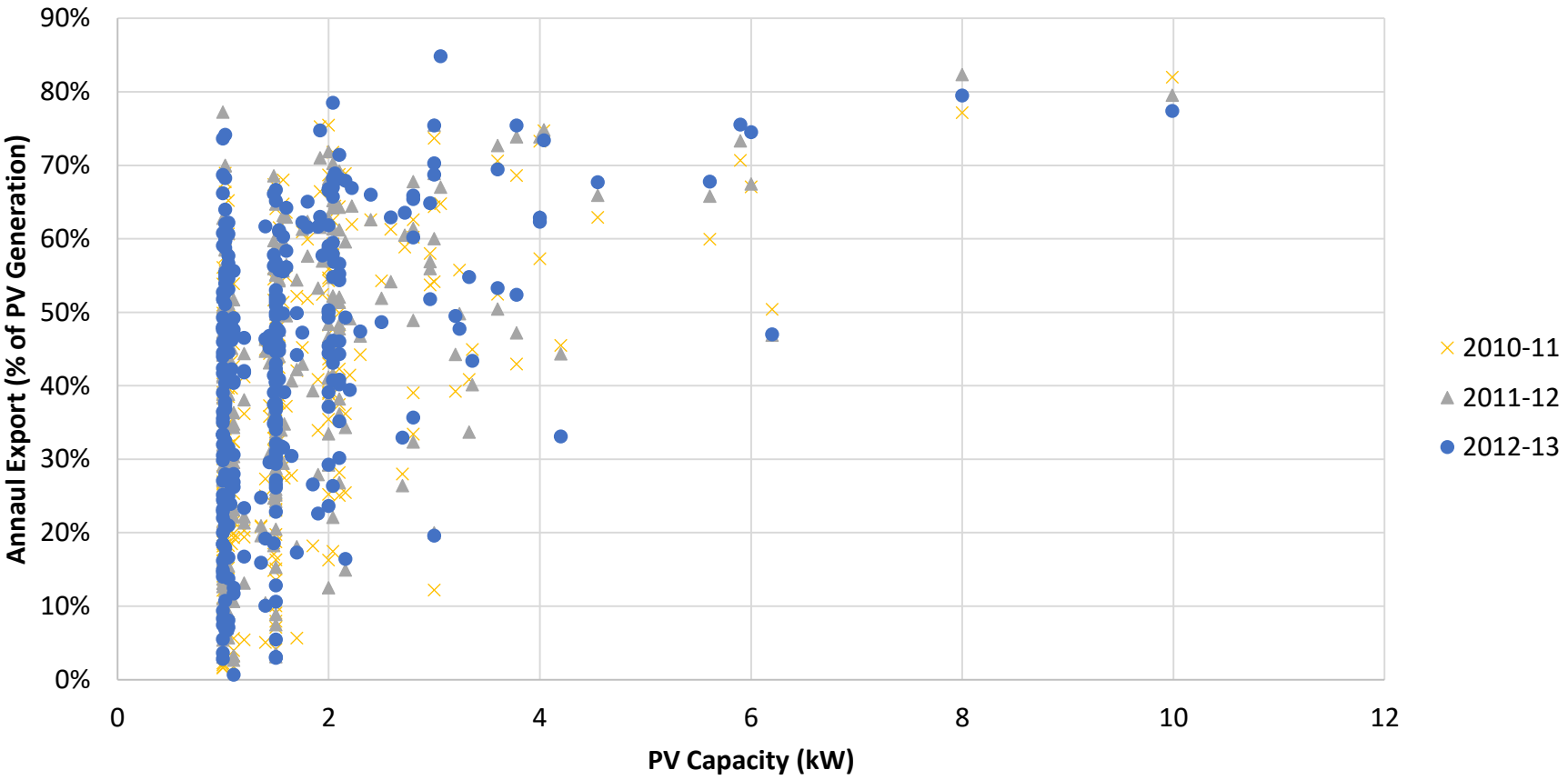
Payback period based on different years data and for scaling PV to 4 kW for flat rate and TOU tariffs



Data: 300 solar homes Ausgrid, 6 retail tariffs in NSW, PV cost retrieved from SolarChoice

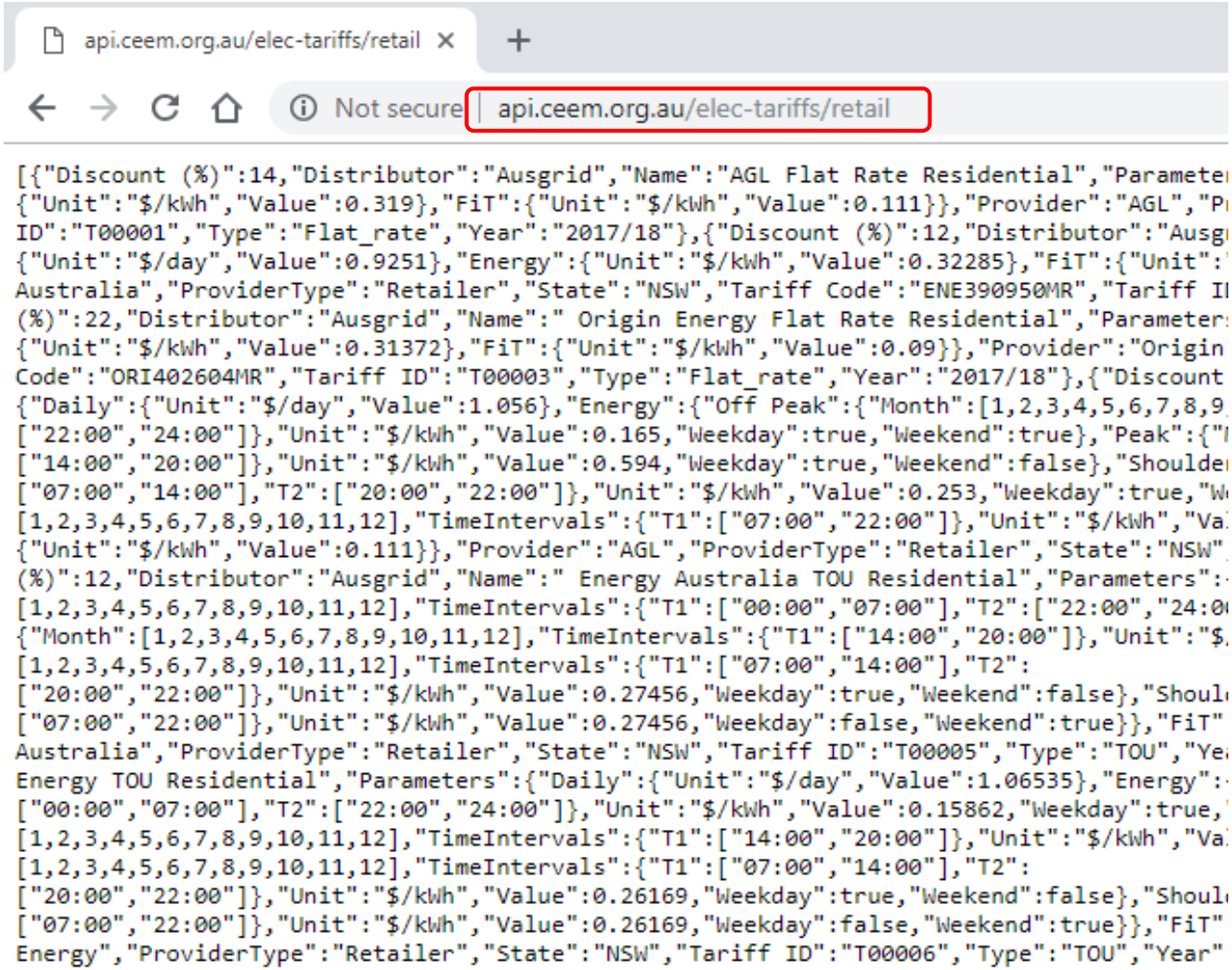
New Development: Financial calculation of RE

Percentage of export (100% - self consumption %) for different PV and load profiles



Data: 300 solar homes Ausgrid, 6 retail tariffs in NSW

New Development: Online list of tariffs with continues update



Join the discussion group at:
https://groups.google.com/forum/#!forum/ceem-tda

Take the online survey here:
https://www.surveymonkey.com/r/J5HH277

Q&A

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