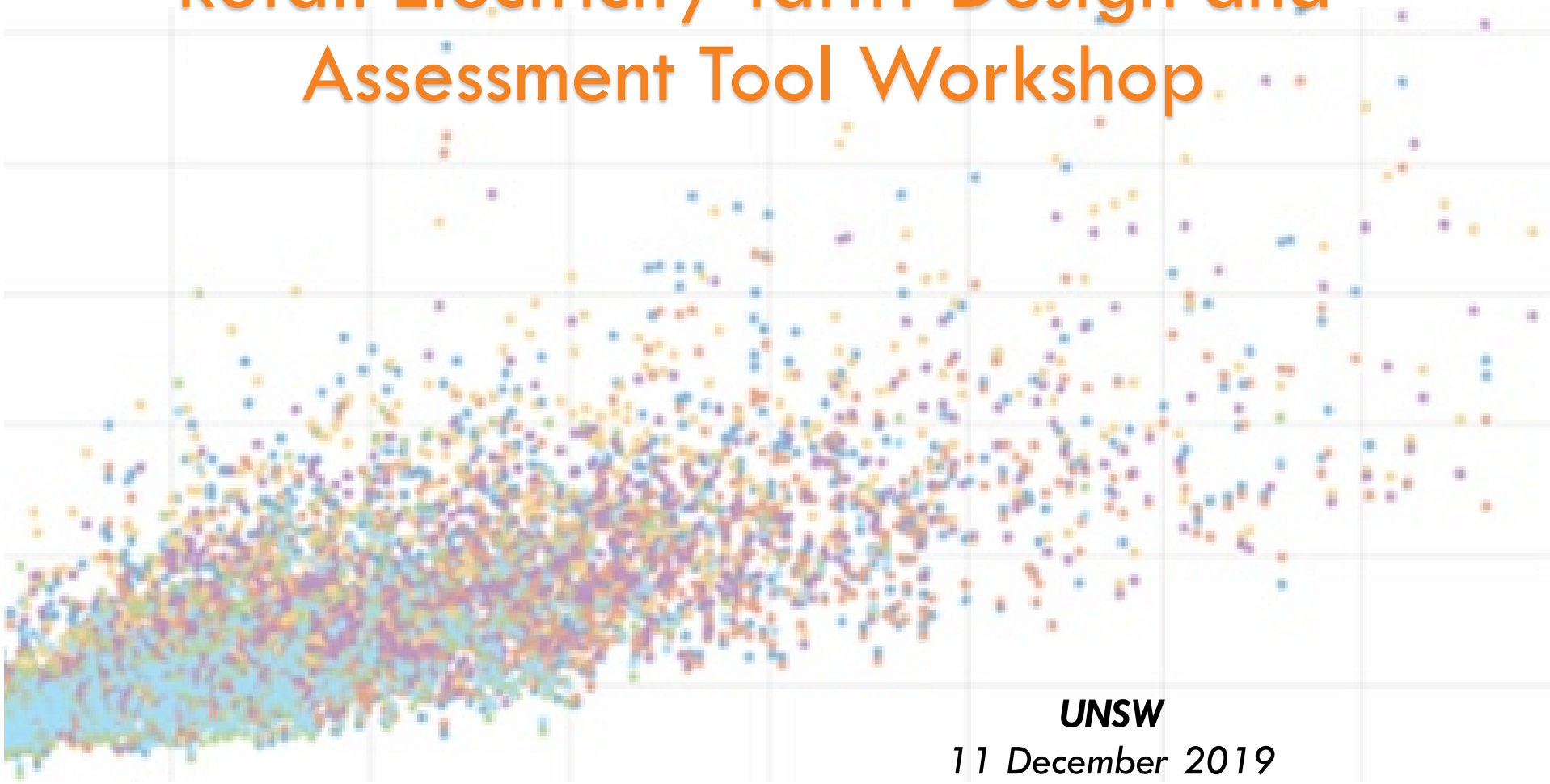
Centre for Energy and Environmental Markets

UNSW SYDNEY

Retail Electricity Tariff Design and Assessment Tool Workshop



UNSW

11 December 2019

Sydney, Australia

Welcome from the SPREE/CEEM Distributed Energy Modelling and Analysis Team

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github.com/unsw-ceem

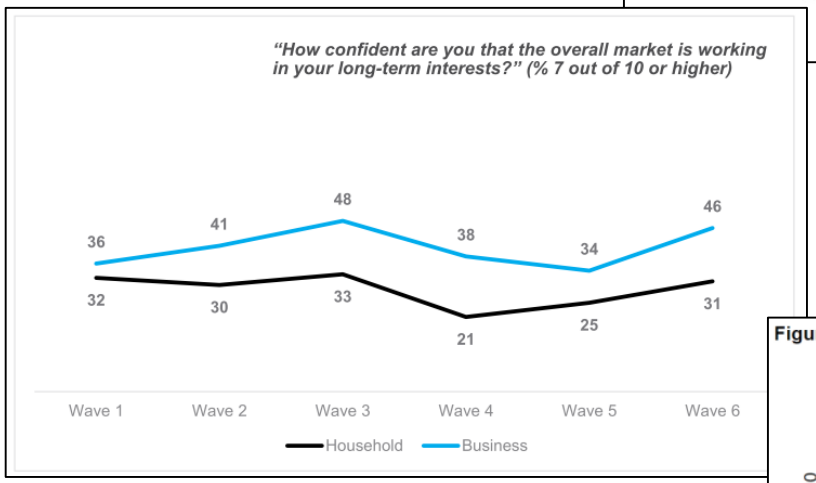
The electricity sector – start at the 'ends'

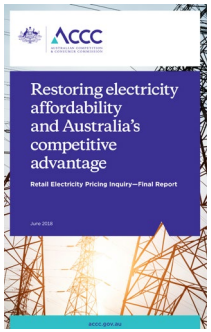
- Consumers apparently at the centre of the National Electricity Objective
  - … although they aren't so sure
    - … with some reason

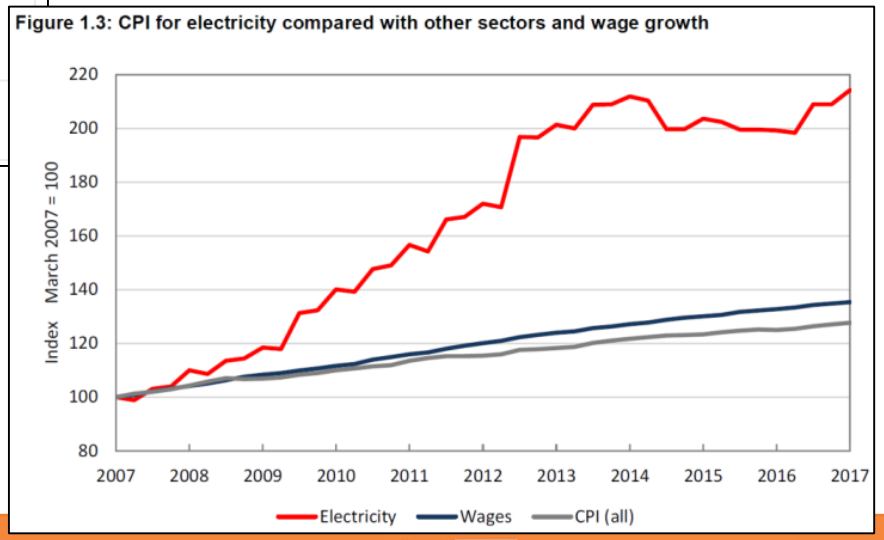
> *"To promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to –*
>
> - *price, quality, safety, reliability, and security of supply of electricity; and*
> - *the reliability, safety and security of the national electricity system."*
>
> National Electricity Law (Schedule to the National Electricity (South Australia) Act 1996), s.7

Essential.

Energy Consumers Australia
Energy Consumer Sentiment Survey
December 2018

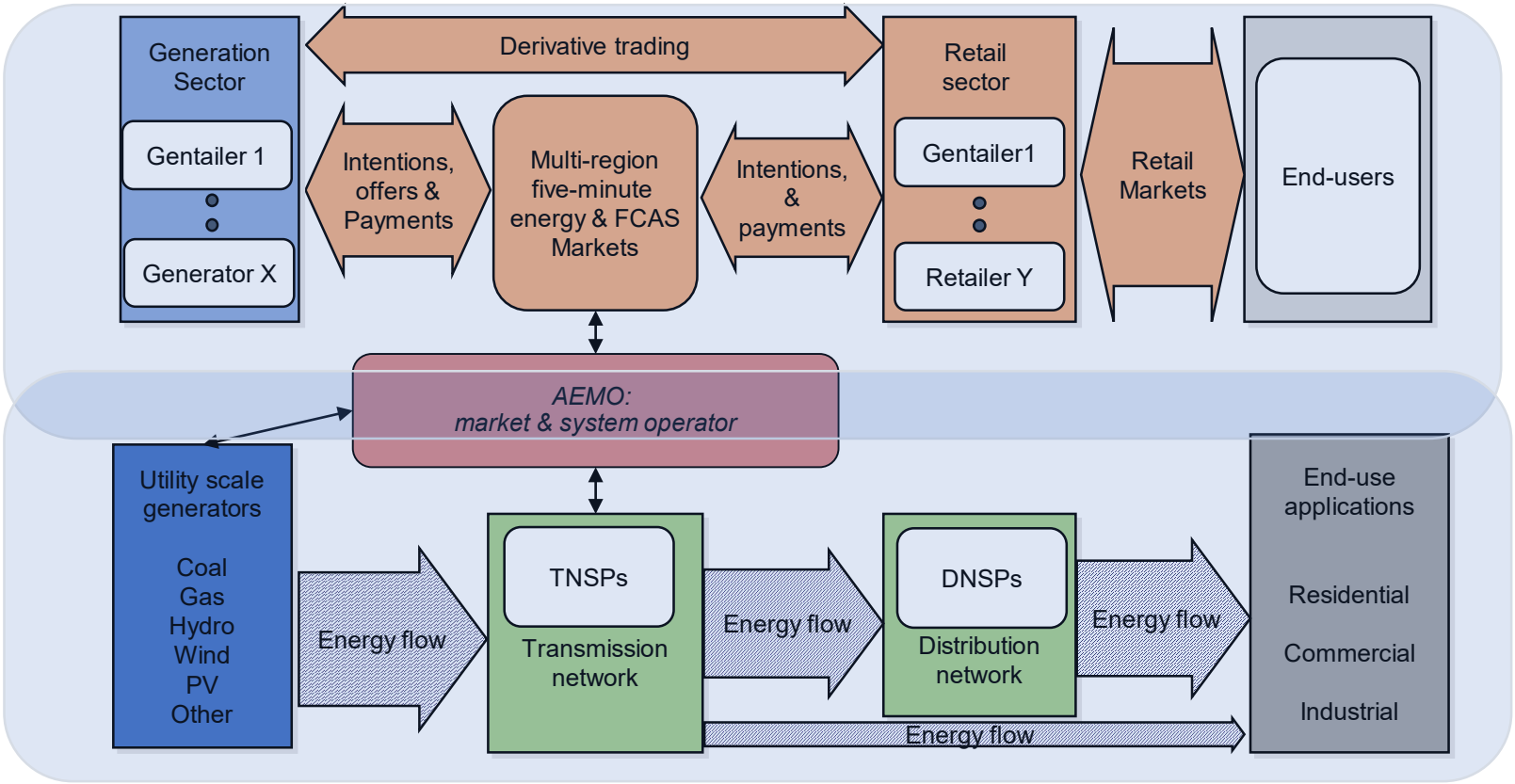






The Australian National Electricity Market (NEM)

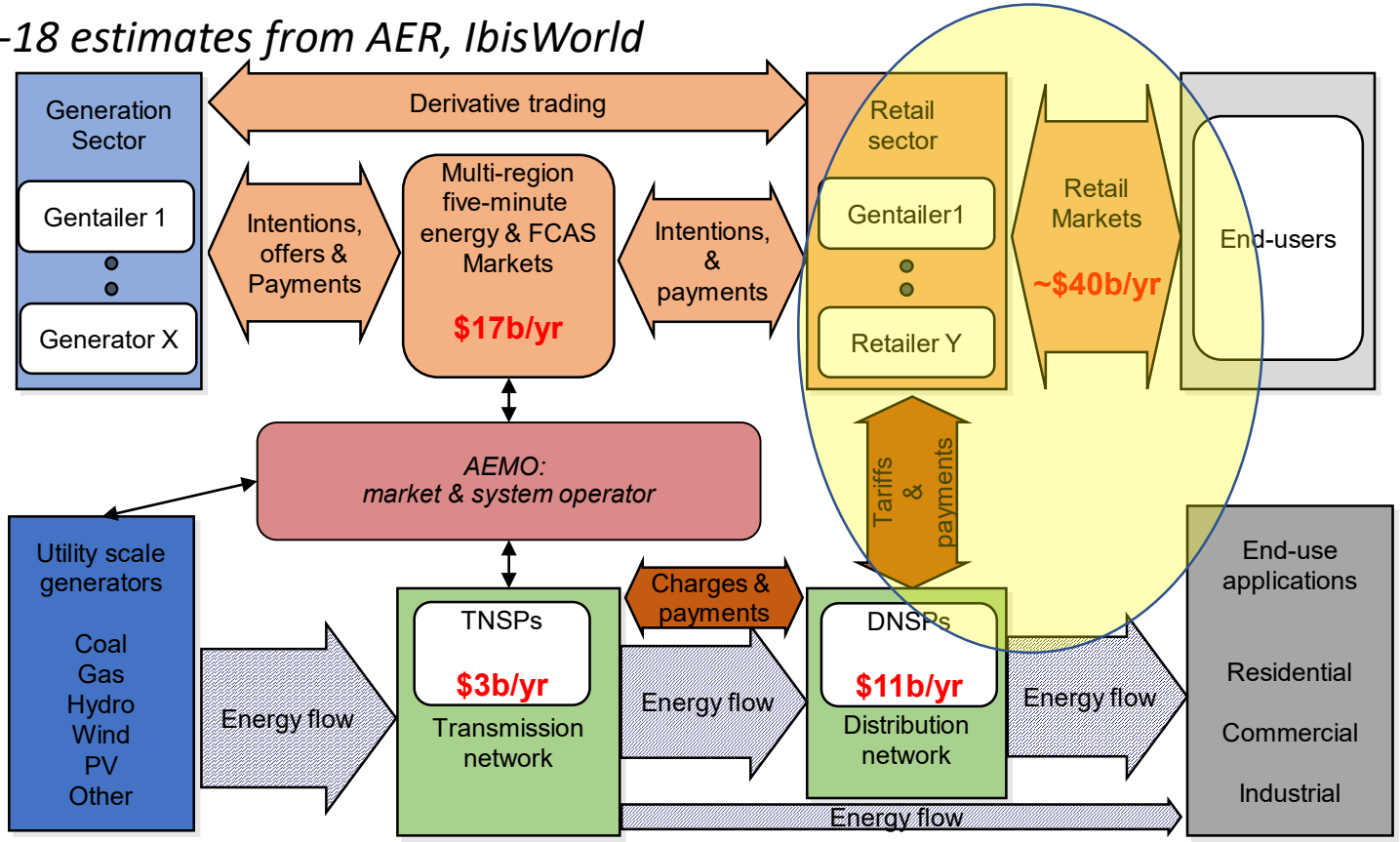
- *Not national, and mostly a power system*



(adapted from Outhred, The Australian National Electricity Market, 2010)

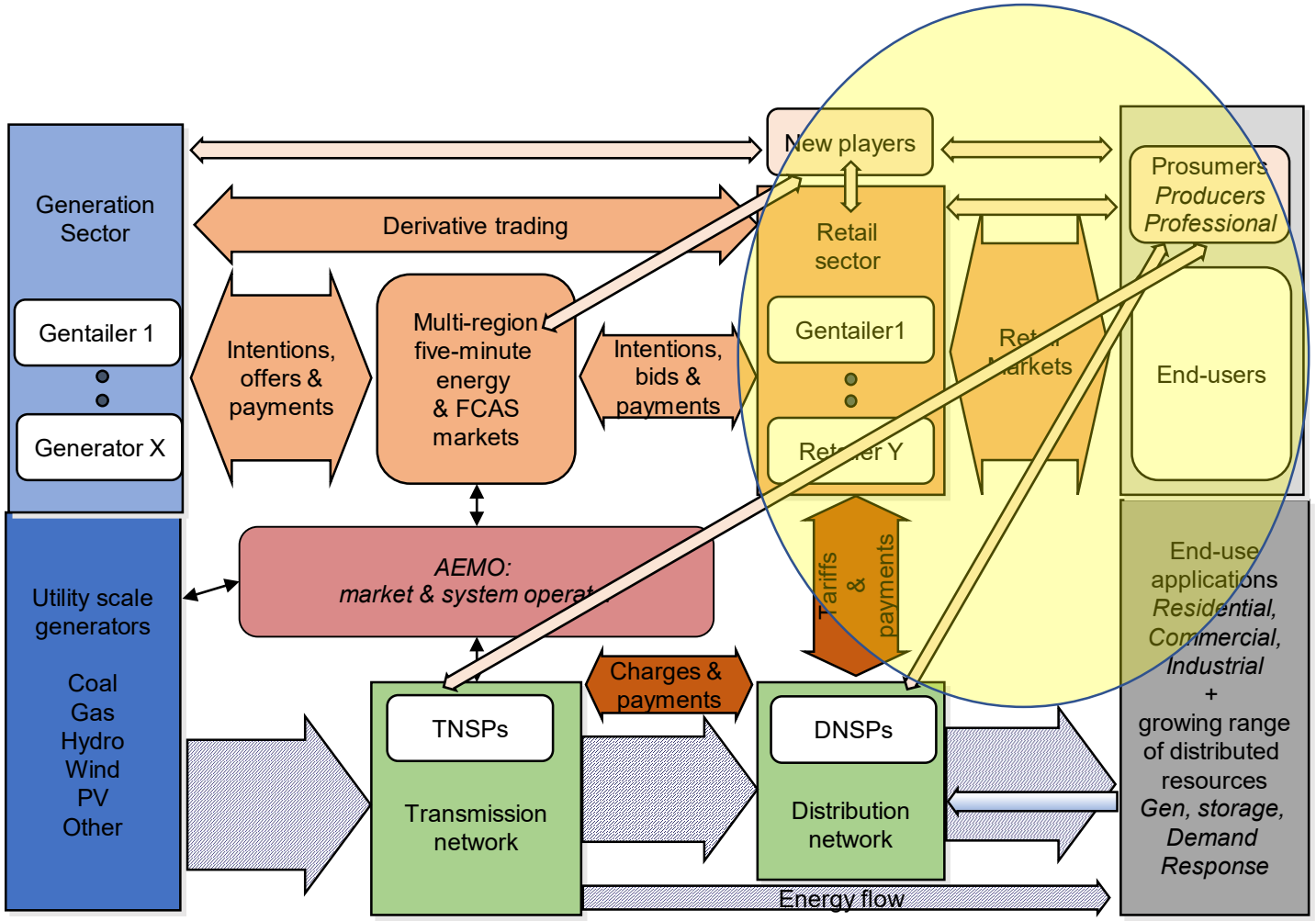
The NEM's energy user 'interface'

- *2017-18 estimates from AER, IbisWorld*



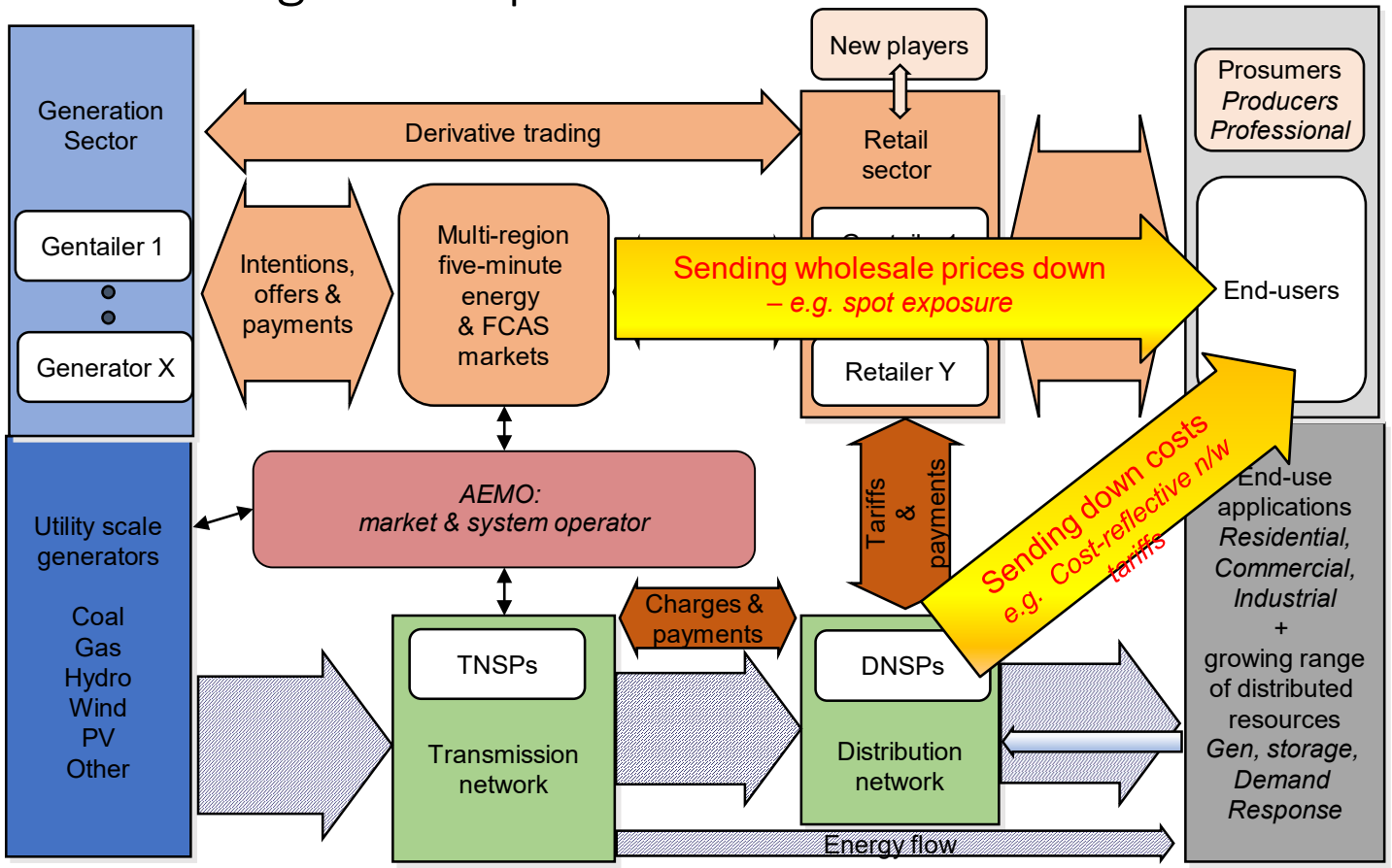
(adapted from Outhred, The Australian National Electricity Market, 2010)

The evolving NEM – 'interface' not getting simpler



(adapted from Outhred, The Australian National Electricity Market, 2010)

Integrating ‘utility’ and ‘consumer’ operational and investment decision making – send prices down



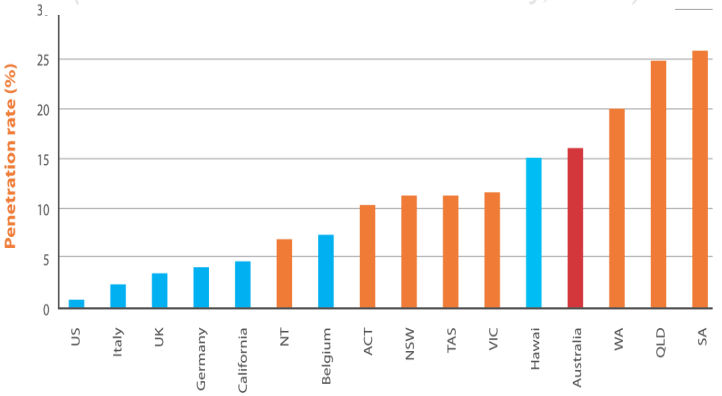
(adapted from Outhred, The Australian National Electricity Market, 2010)

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)



NEW ENERGY COMPACT: DRAFT 3.0 FOR CONSULTATION

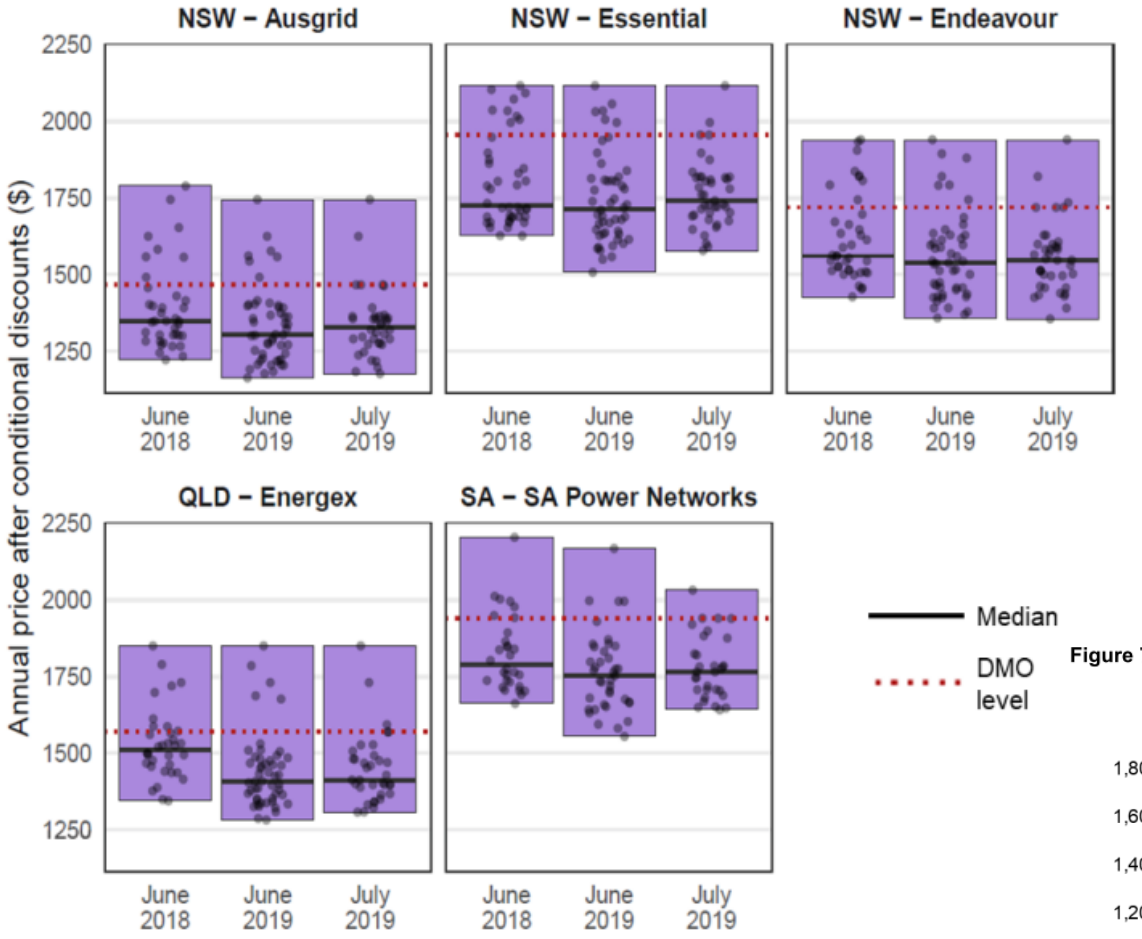
November 2019

VISION

"An inclusive, sustainable energy system that actively improves outcomes for all"

GUIDING PRINCIPLES

Figure 1: All retailers' residential flat rate market offers as at 1 June 2018, 1 June 2019 and 12 July 2019 (all available discounts applied)



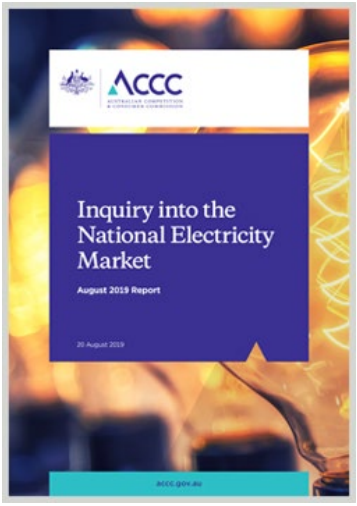
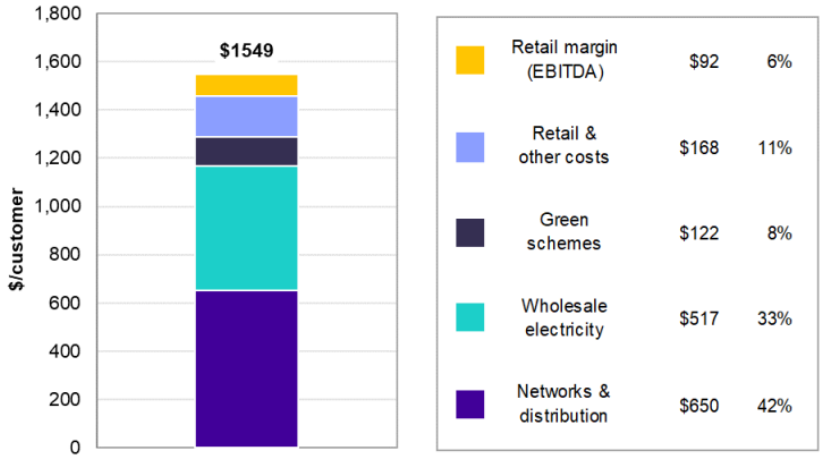


Figure 7: Components of a residential customer bill across the NEM, 2017–18, real $2017–18, excluding GST[11]



UsersTCP

User-Centred Energy Systems

About Us

The User-Centred Energy Systems mission is to provide evidence from socio-technical research on the design, social acceptance and usability of clean energy technologies to inform policy making for clean, efficient and secure energy transitions

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.

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

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

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.

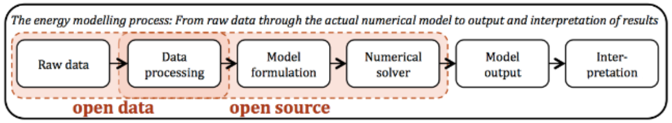
Energy models are widely used for policy advice and research. They serve to help answer questions on energy policy, decarbonization, and transitions towards renewable energy sources. Currently, most energy models are black boxes – even to fellow researchers.

"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



Home | About Us | Research | Open Source Tools | Publications | Events | Contact us

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:

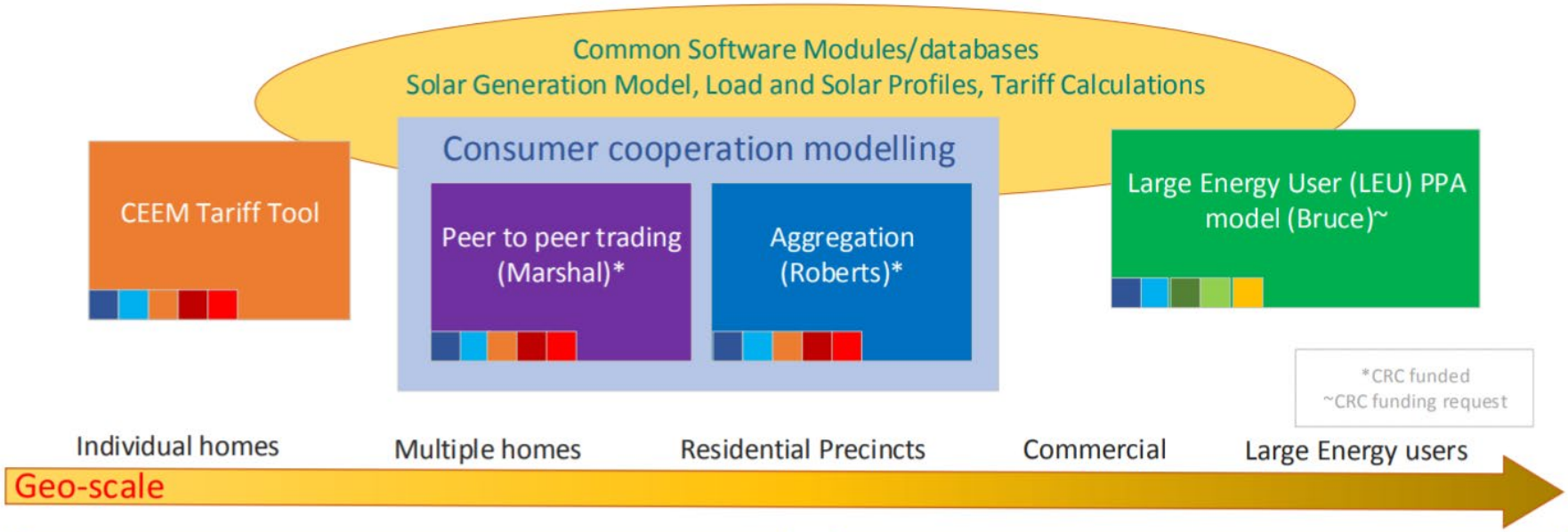
Intended for modelling embedded networks, local solar and peer to peer electricity networks. This software was developed by Naomi Stringer, Luke Marshall and Rob Passey at CEEM. A working build with a simple user interface for OSX can be found here.

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



Project Aims

- Models energy and financial trading in local communities
- Evaluates: Energy flows, Carbon accounting, Financial flows
- Models energy and financial flows in embedded networks
- Models economic effects of different household and network tariffs

Expected User Groups

- Local Government
- Energy Retailers
- Medium to Large energy users
- Consultants
- Buyer's groups
- Energy Networks
- Community Groups
- Regulators

Tariff Design and Assessment Tool: Progressively greater ambition…

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.

The current version of the tool (publicly available for download) has been designed to assist stakeholders to investigate how different tariff structures impact on the expected bills of different types of residential consumers. The tool offers a range of different analysis and result visualisations. In summary the tool allows users to:

- Create projects and add analysis to different projects for later referral
- Choose from the existing load profiles (more than 5000 annual household load profiles)
- Filter the load profiles based on the available demographic information
- Import new load profile and demographic information
- Visualise the individual and aggregate load profiles using multiple methods including seasonal pattern, peak analysis, annual energy distribution, daily interquartile range, etc
- Apply the network tariffs available in the tool (60+ tariffs for different Australian States) to calculate the annual bill based on any subset of the load profiles
- Apply the retail tariffs available in the tool
- Modify the parameters of the tariffs to investigate the impacts on annual bills
- Investigate different components of the network bill (DUOS, TUOS, and NUOS) to calculate the revenue for different sectors (distribution, transmission, etc). This can also be done for the retail component where retail tariffs are available
- Adjusting the network peak time to see the impact on the tariffs based on the coincident peak demand
- Create different types of new tariffs including, flat rate, time of use, block usage, demand charge, etc
- Compare the results of multiple analyses in different visualisation platforms including single variable comparison, dual variable comparison, and individual cases
- Export the figures, and copy them into clipboard to incorporate in any report
- Export the results to excel file to do further analysis on the results outside the tool

1. Continued collaboration with advocacy stakeholders, networks and the regulator to continue to develop the existing Tariff Design and Analysis Tool in response to emerging tariffs and trends such as uptake of demand-side technologies and retail market developments.
2. Use of the improved version of the Tariff Design and Analysis Tool for the network tariff determinations over the coming two years.
3. Workshops to facilitate (i) stakeholder input to the tool and (ii) demonstration of the tool to improve stakeholder capacity to use the tool and build knowledge about tariff design and regulation. These events are also expected to result in increased engagement in and collaboration on consumer-focussed tariff advocacy, specifically over the next 18 months during the next round of regulatory process.
4. Ongoing IT and tool development support to assist interested stakeholders to effectively use the software. The tool is made freely available and is designed so that interested stakeholders can download and run it on their own computers. As more, and different types of, stakeholders use the Tool, it will require increased maintenance and adjustments to make it accessible to this broader audience.
5. Addition of new features to the tool, in addition to the three major features discussed above, including the following:

- Extension of the tool to include multi-year analysis
- The addition of sensitivity analysis for the tariff component to explore the impact of adjusting components for different user groups
- Improved statistical analysis to explore the confidence interval of the analysis results
- Automatic unsupervised classification (clustering) of the user profiles to generate distinct user groups based on the impact of tariffs and load pattern
- Clustering of retail tariffs into distinctive groups to use as representative tariffs, which reduce the complexity of applying large numbers of similar tariffs
- A new set of charts and figures for enhanced result visualisation

Workshop Agenda

- 10 - 10:15
  Welcome and introduction to the project- *Iain MacGill*
- 10:15 - 10:30
  Introduction to the TDA Tool - *Navid Haghdadi*
- 10:30 - 10:50
  Demo of the new version - *Nick Gorman*
- 10:50 – 11:10
  Use case presentation - *Rob Passey*
- 11:10 – 11:25
  Tariff analysis for individual user - *Anna Bruce*
- 11:25 – 12
  Feedback and Questions
- 12pm – 1pm
  Continue the discussion over lunch

Tariff Design and Analysis tool – *the previous version*

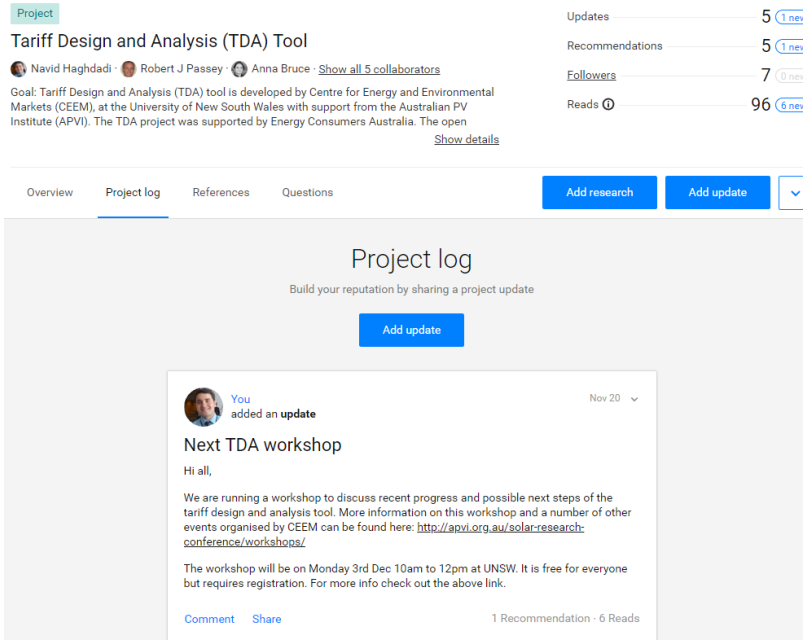
The open source TDA tool aims to assist stakeholders to investigate how different tariff structures impact on the expected bills of different types of residential consumers, while also estimating how well the tariffs align these customer bills with their impact on longer-term and wider electricity industry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

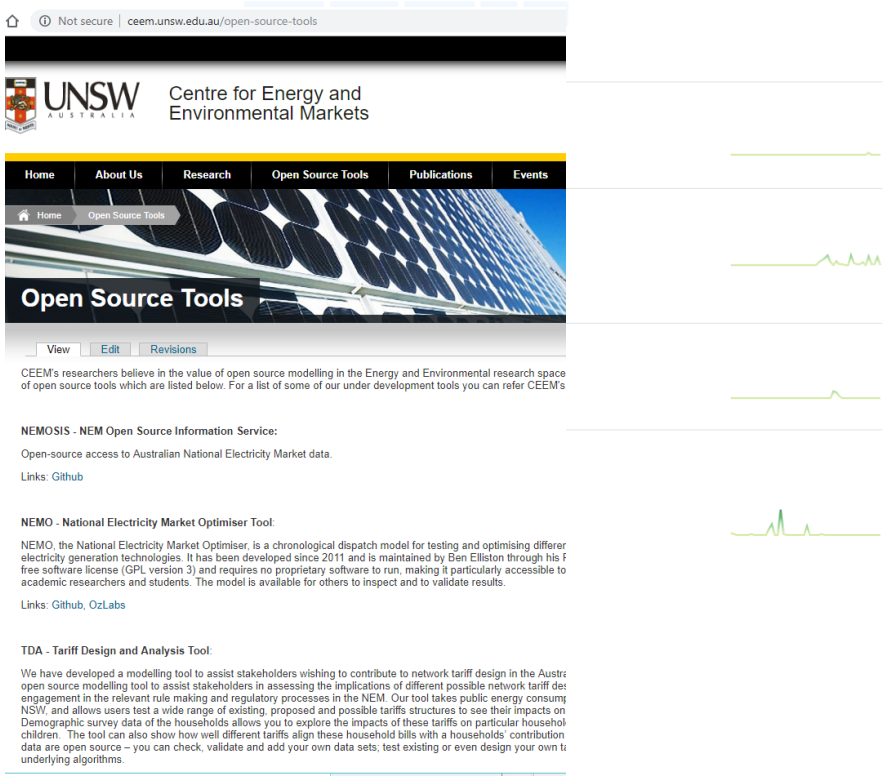
Tariff Design and Assessment (TDA) tool

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

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



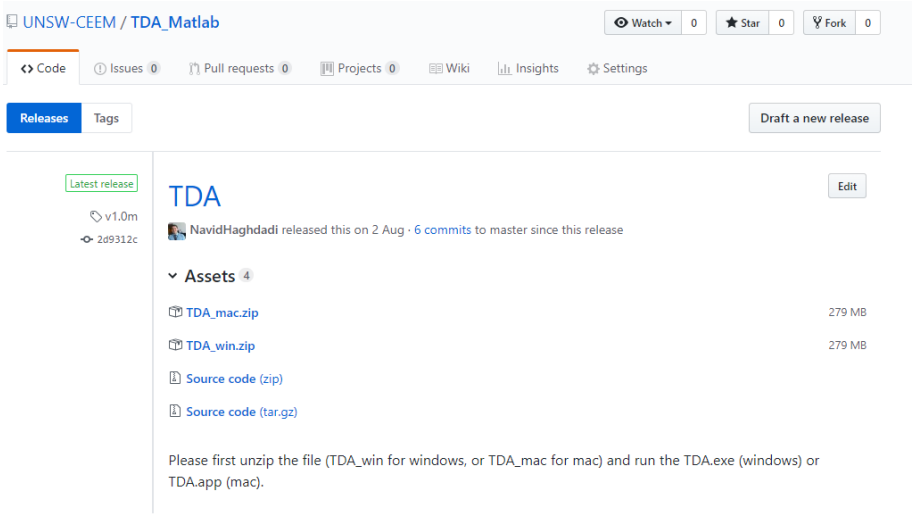


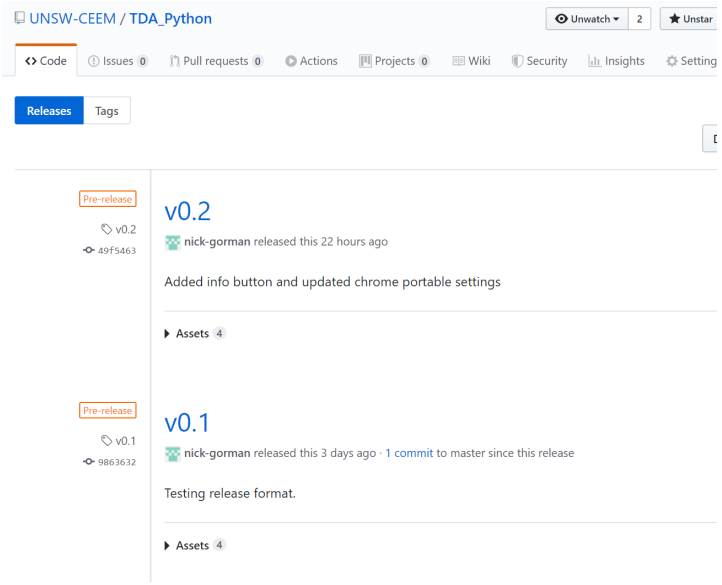
Tariff Design and Assessment (TDA) tool

How to install it?

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

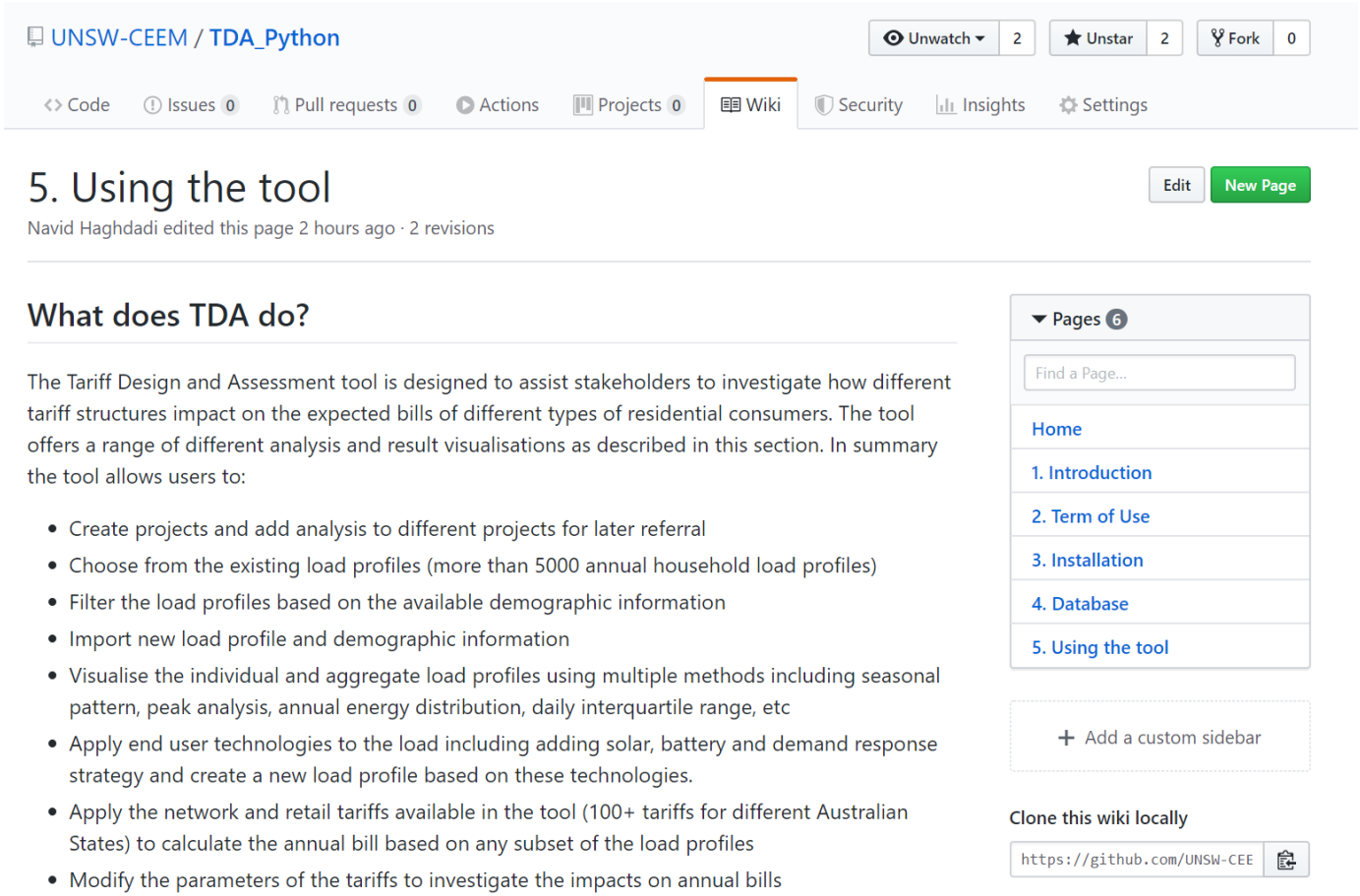
https://github.com/UNSW-CEEM/TDA_Python/releases





Tariff Design and Assessment (TDA) tool

How to find more information about it?

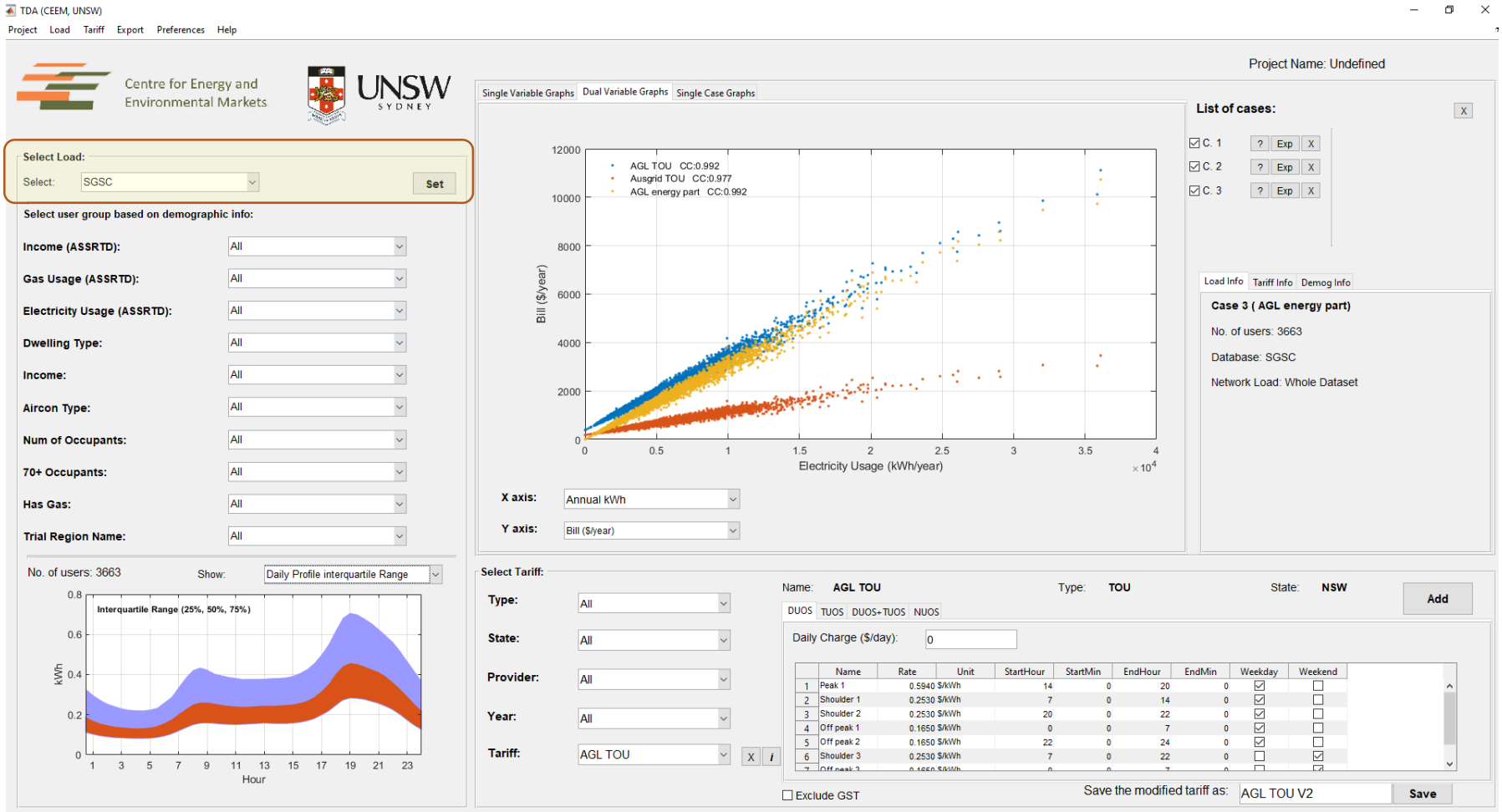


Tariff Design and Assessment (TDA) tool

What does the previous version do?

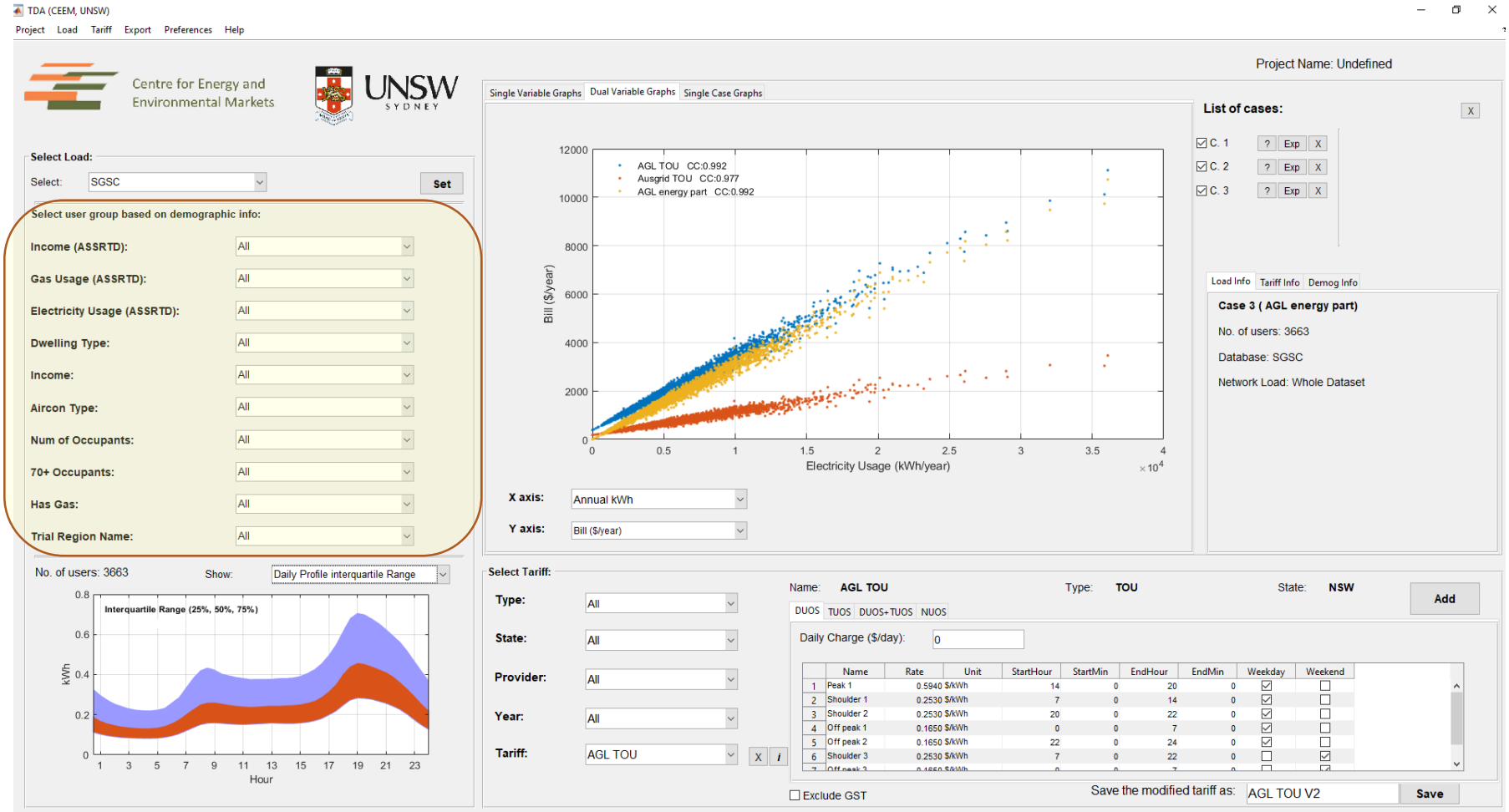
Tariff Design and Assessment (TDA) tool

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



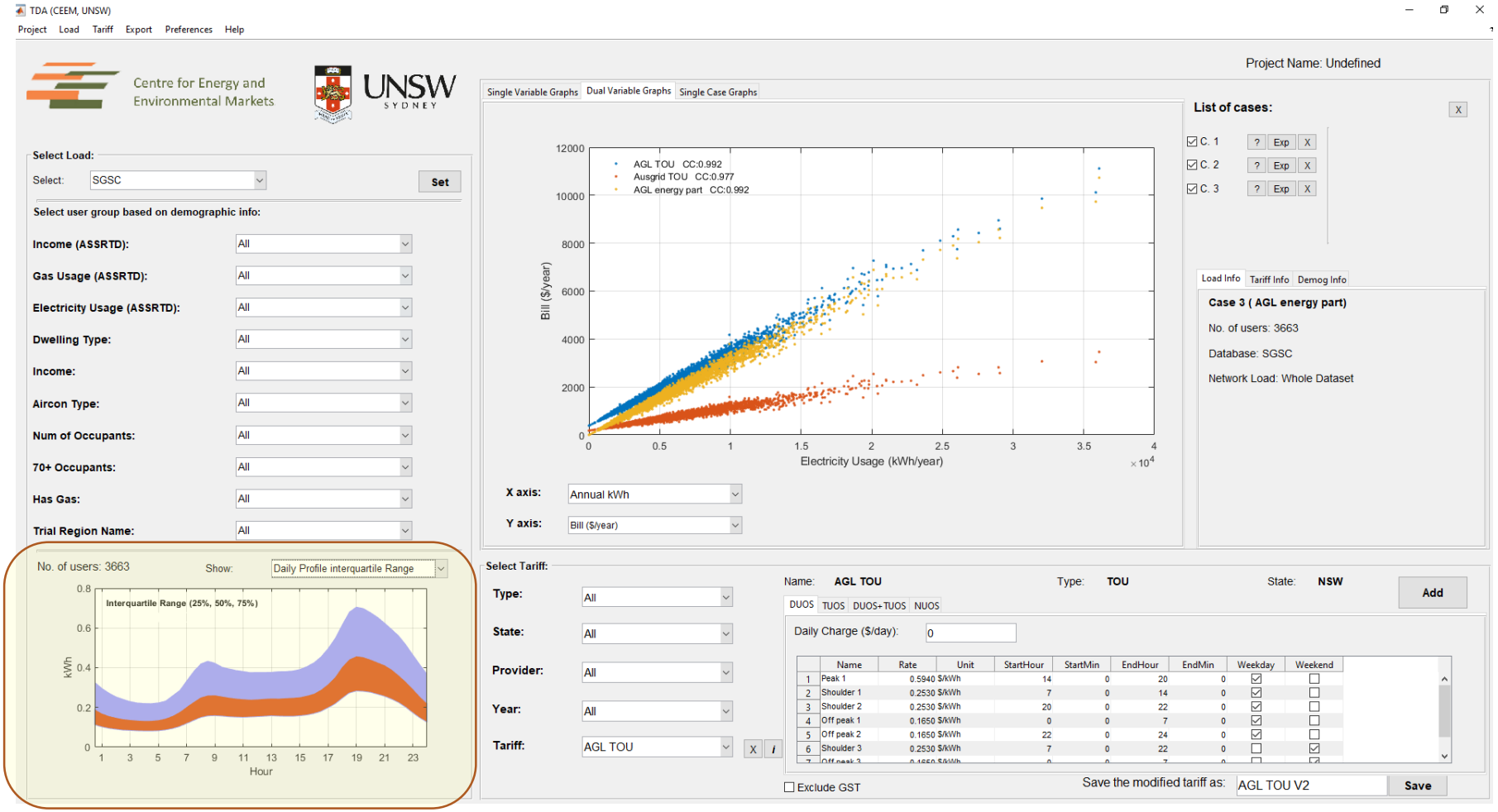
Tariff Design and Assessment (TDA) tool

Filer the load profiles by the demographic information



Tariff Design and Assessment (TDA) tool

Get quick analysis of the set of selected loads

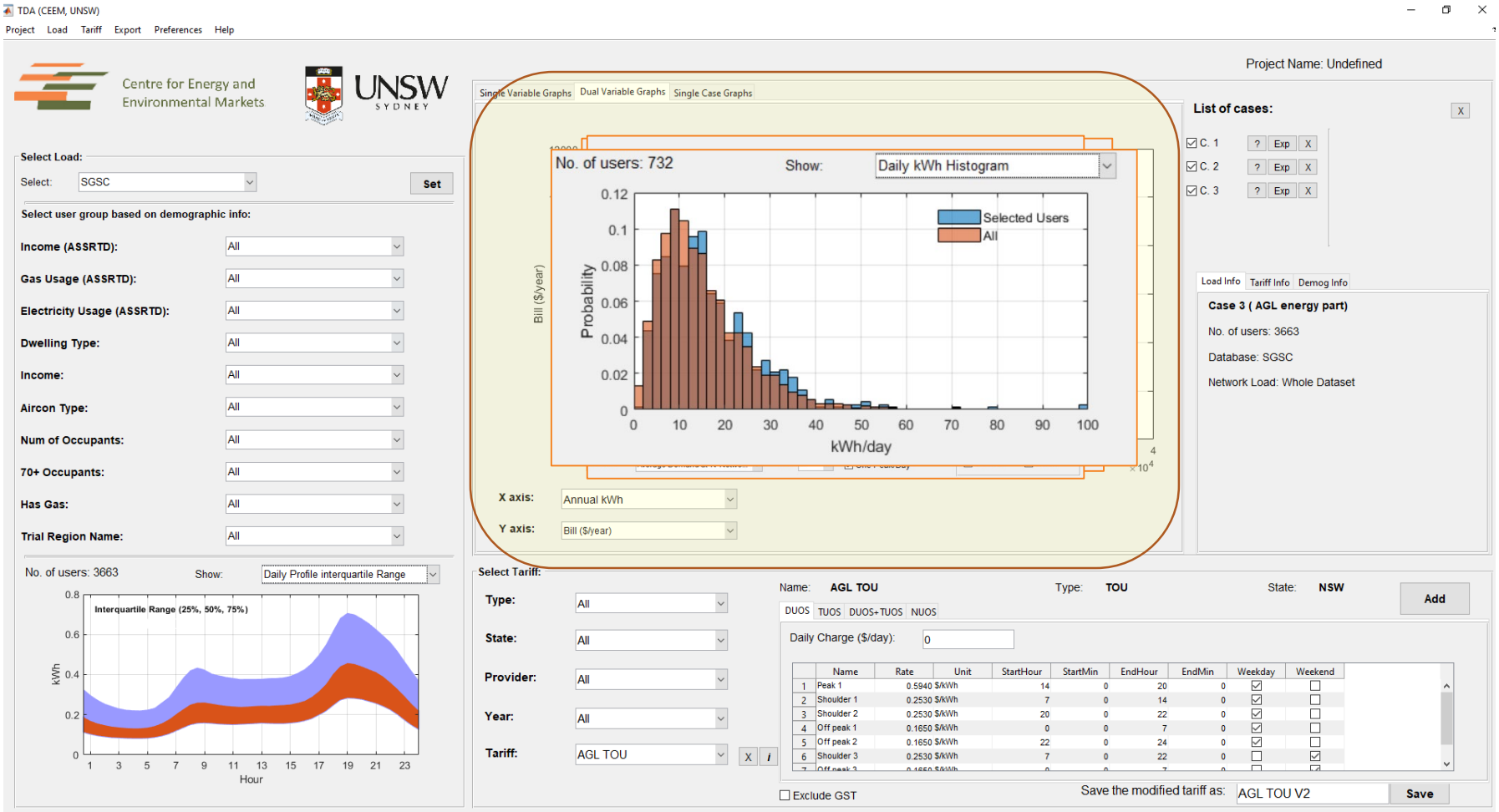


Tariff Design and Assessment (TDA) tool

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

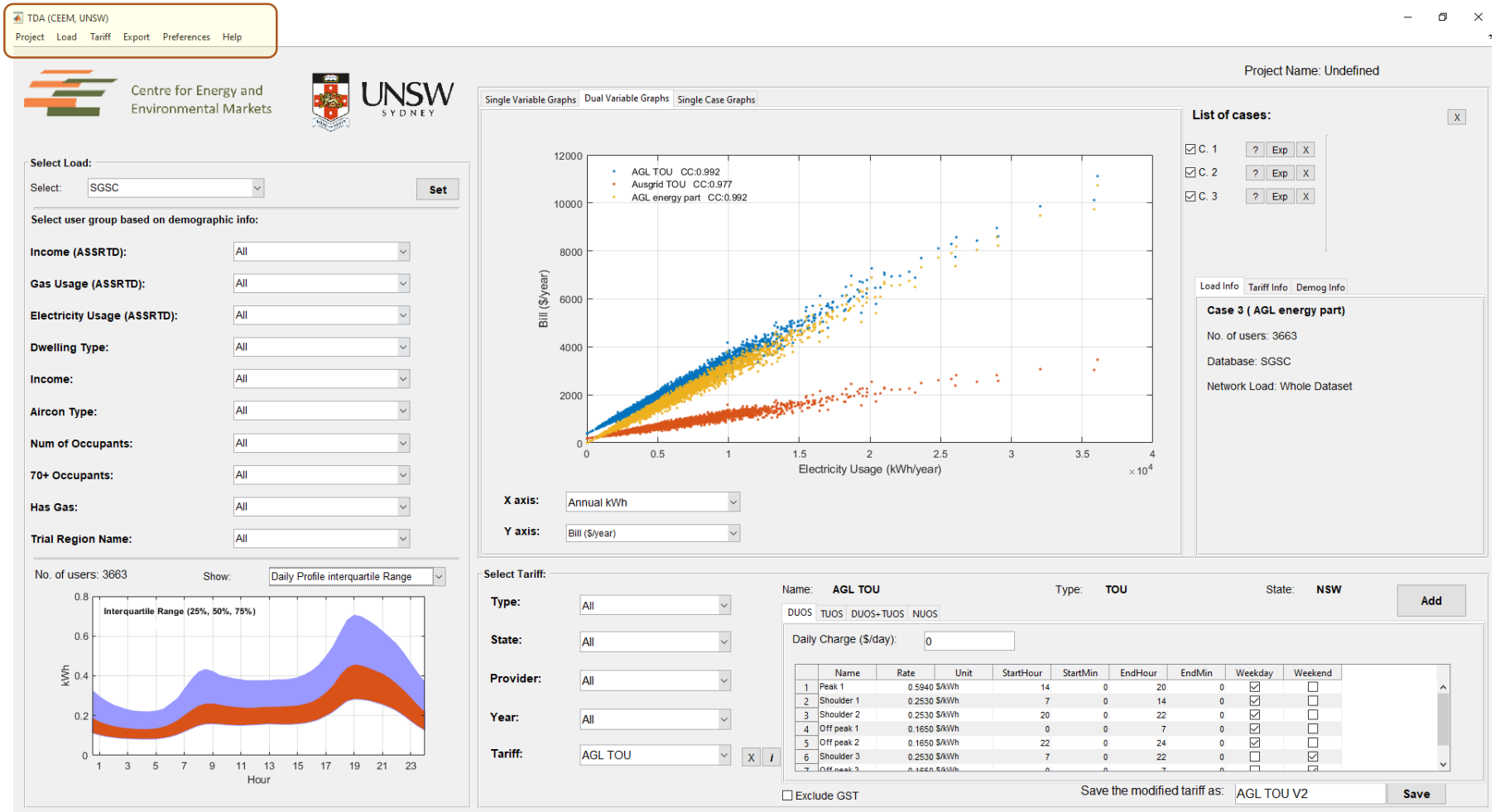


Tariff Design and Assessment (TDA) tool

Add up to 10 analysis case and compare the results

Tariff Design and Assessment (TDA) tool

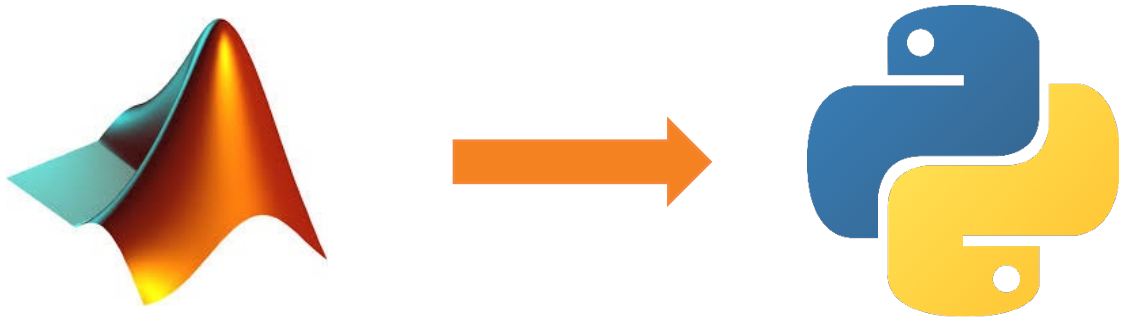
Add tariffs, loads and projects; exports the results to excel, and change the preferences in the context menu



New Developments

- Moving to Python
- More Analyses and Visualisation features
- Retail Tariffs and wholesale market price
- Network, Wholesale, Retail Tariff Combined Analysis
- Distributed Resources/Response:
  - PV
  - Battery
  - Demand response

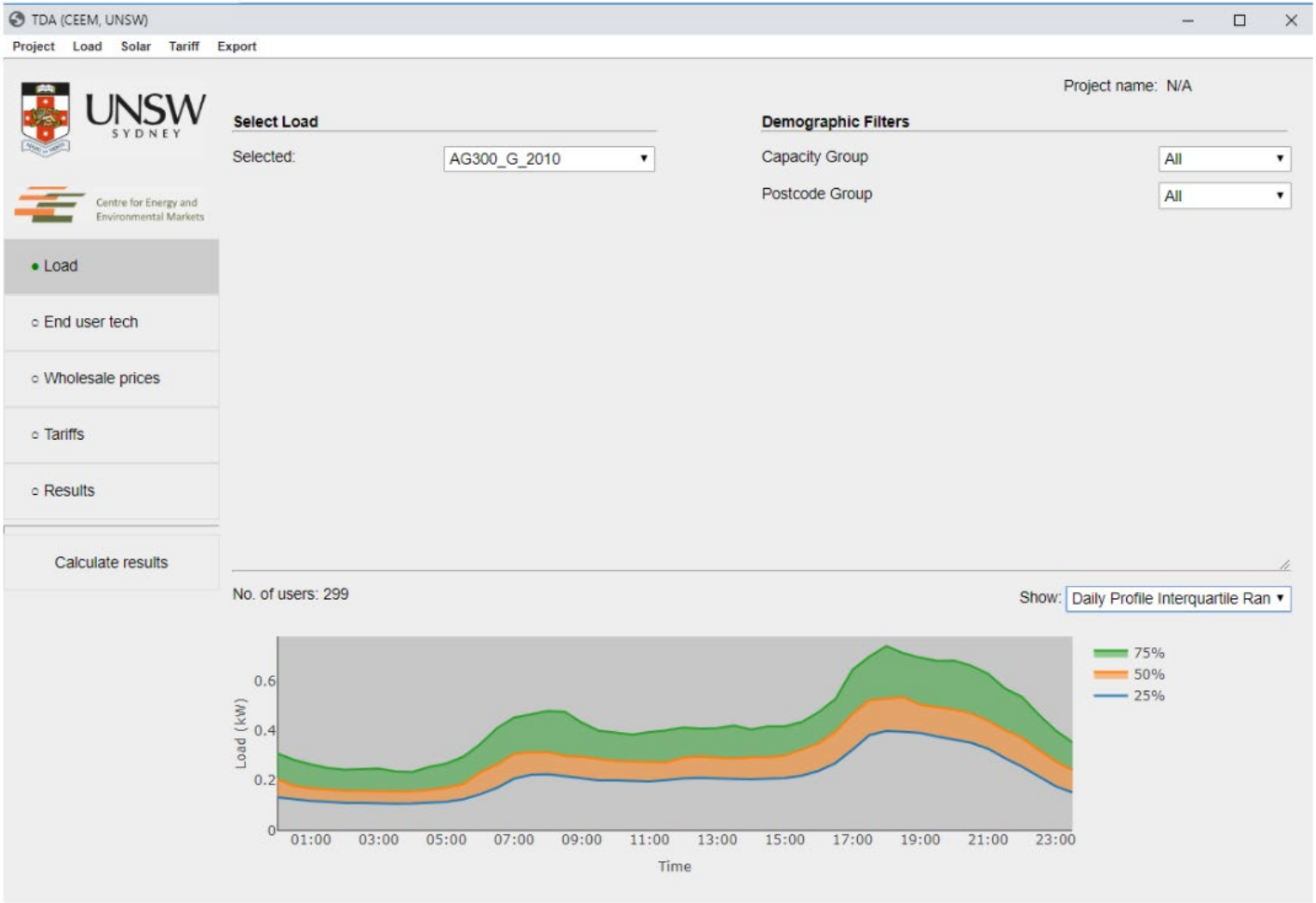
New Development: Converting to Python



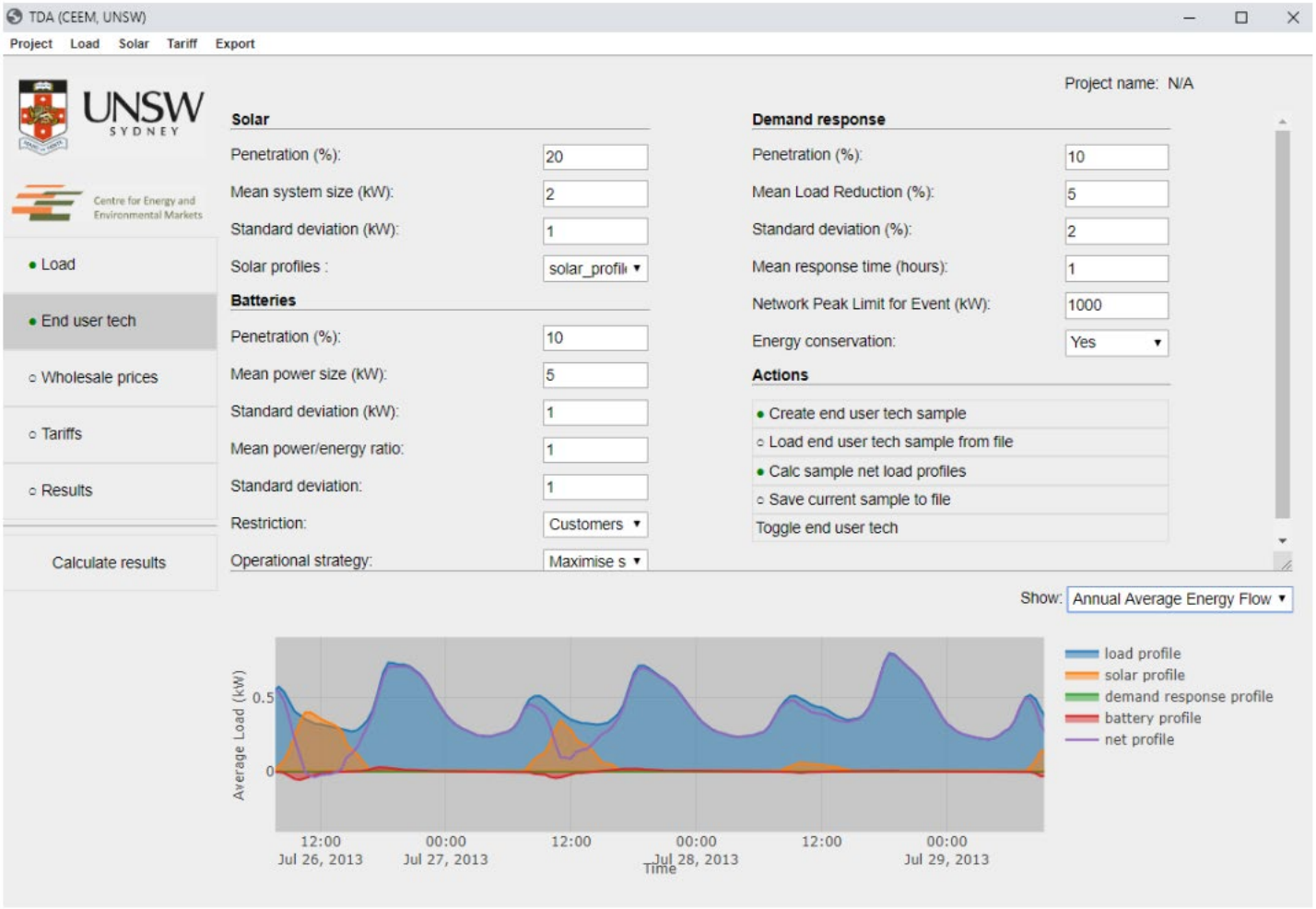
- Even more open source!
- Easier collaboration in non-academic environment
- Reduced size

New Development: Online list of tariffs with continues update

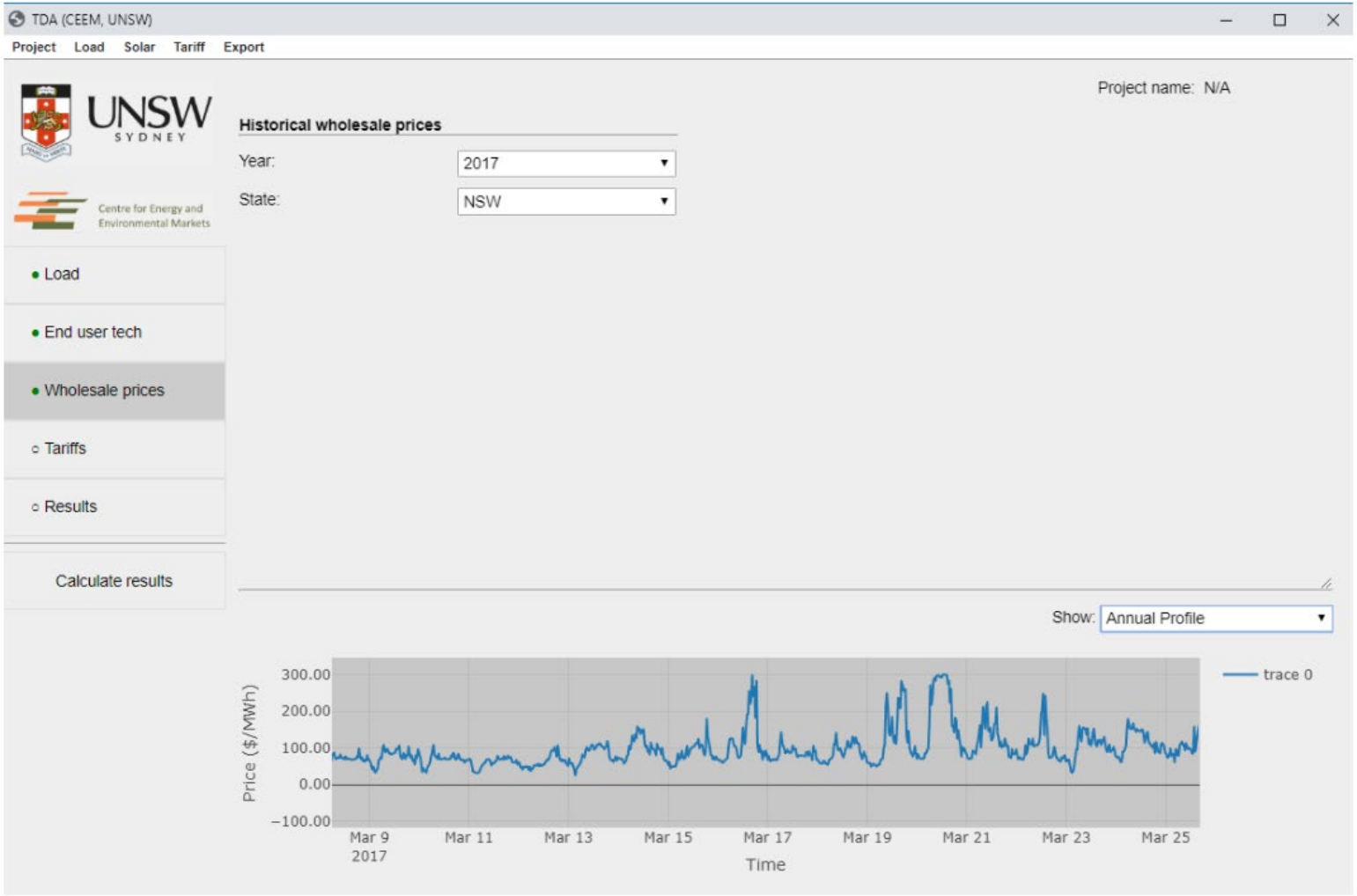
Python version features



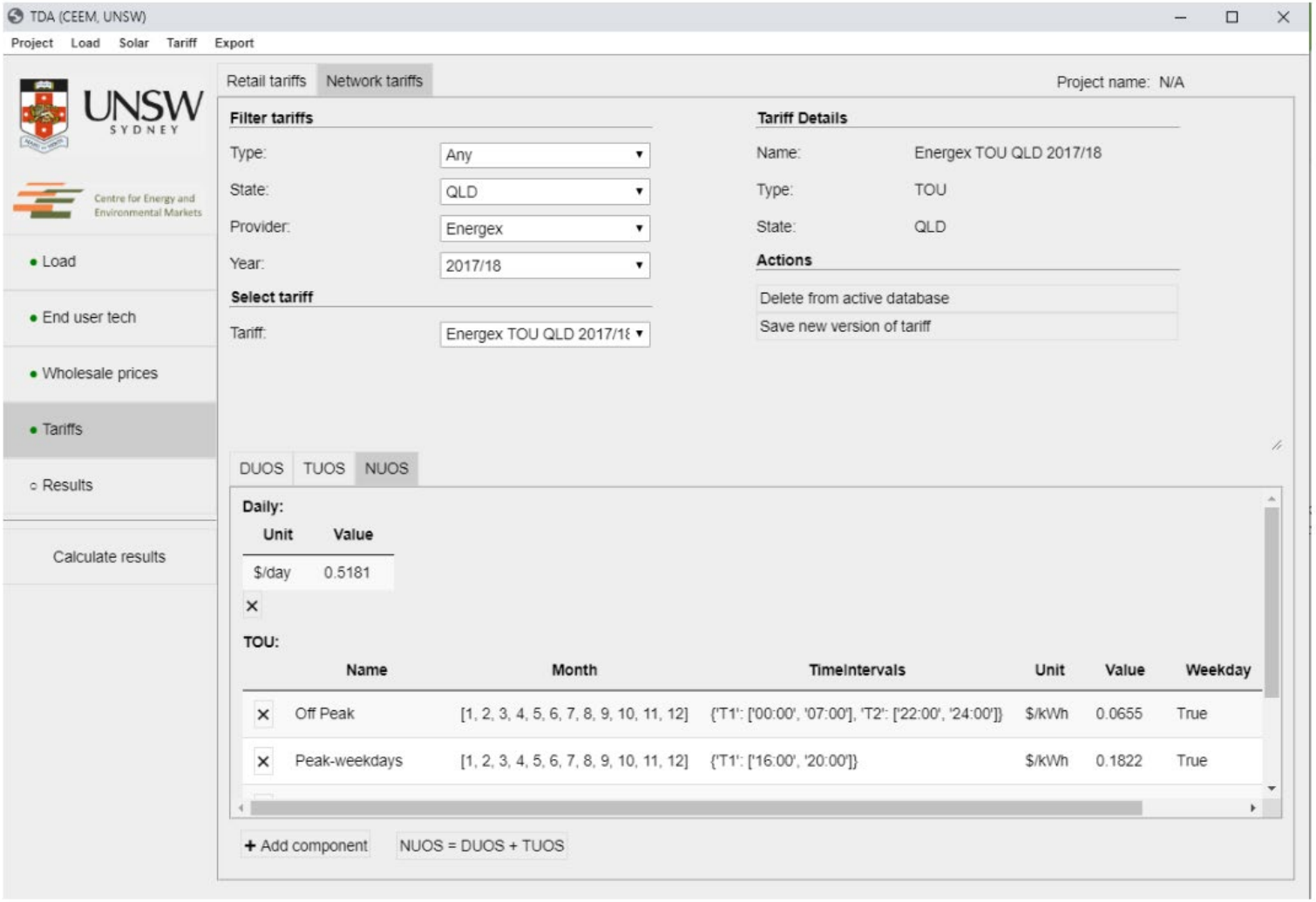
Python version features



Python version features



Python version features



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Q&A