Enhanced System Planning Project

C4NET | ESP Enhanced System Planning

C4NET Project Overview

Fairly integrating CERs into the NEM: Consumers' policy perceptions

Work Package 1.3.2

January 2025

C4NET

Table of Contents

1. Purpose of the report

The Enhanced System Planning (ESP) project is a significant and collaborative research project aimed at informing electricity planning below transmission level in Australia beyond 2030. Its focus is on building methodologies and approaches for bottom-up modelling and to highlight the opportunities presented through the distribution system and by integrating Consumer Energy Resources (CER) and Distributed Energy Resources (DER), with the goal of informing whole of system planning. The ESP seeks to inform gaps that would emerge if the Australian Energy Market Operator's (AEMO) current Integrated System Plan (ISP)[1] is expanded beyond its current scope to take a more whole-of-system approach in alignment with the energy and Climate Change Ministerial Council's (ECMC) recommendations for enhancing energy demand forecasting in the ISP[2]. The ESP Project is targeted at addressing the distribution system considerations aspect of this expanded scope, with particular focus on bottom-up modelling approaches from the low voltage distribution system upwards, as outlined in *Figure 1*. For the bigger picture of integration with the ISP see *Appendix Two.*

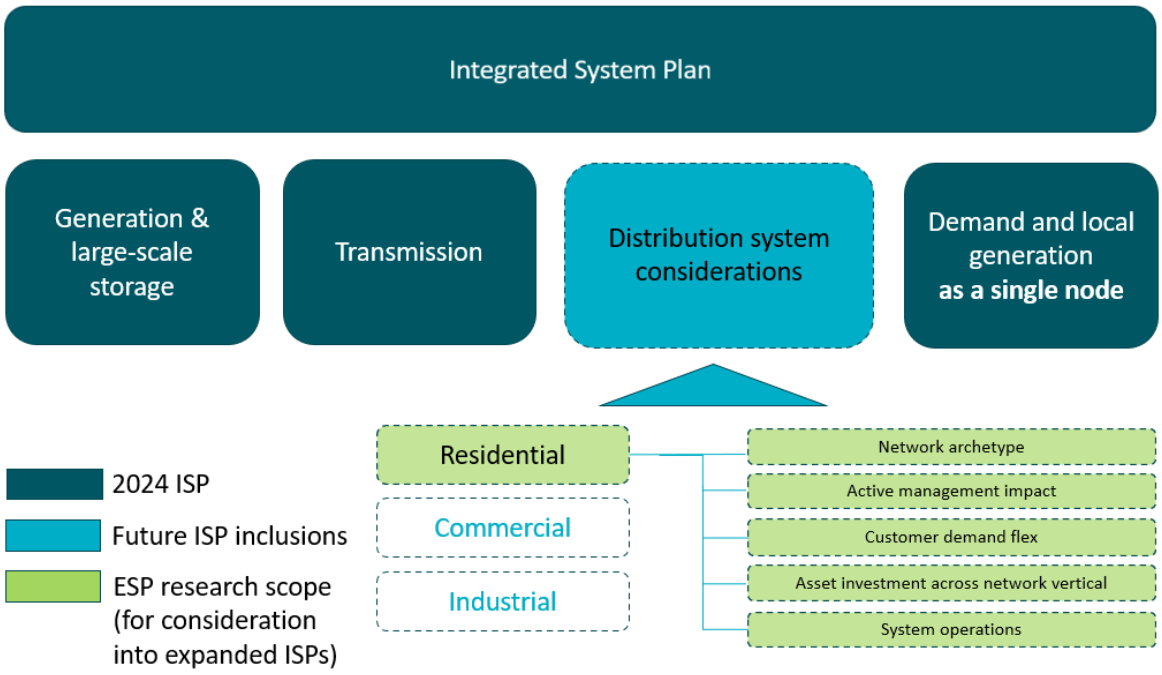


Figure 1 Distribution system components of whole of system planning

This has been addressed through fifteen projects across three distinct work packages:

- **Work package one:** Key inputs, methodologies, and demand network implications of electrification to inform foundational elements of bottom-up modelling.
- **Work package two**: Impact of flexibility options within distribution networks Techno-economic implications of future architectures.

[1] 2024 Integrated System Plan (ISP), Australian Energy Market Operator, June 2024
[2] Review of the Integrated System Plan: ECMC Response, ECMC, April 2024

- **Work package three:** Active distribution network considerations for whole-of-system planning implications: technical, economic and policy.

As a key project of work package one, Deakin University undertook an independent research project: *Fairly integrating CERs (Consumer Energy Resources) into the NEM: Consumers' policy perceptions*[3]. CERs are consumer-owned technologies that allow households to generate energy (e.g., rooftop photovoltaics), store energy (e.g., electric vehicles, household batteries), and/or shift how they use energy (e.g., smart electric hot water systems). AEMO's modelling of future energy scenarios[4] indicates that it is essential for rapid uptake of CERs to decarbonise Australia's energy system. Examining how consumers adopt and coordinate the use of CERs is required to maximise their beneficial effect while minimising their adverse impact on the electricity supply system. In this respect consumers' understanding and perceptions of policy approaches is key to the success of the proposed energy transition and forecasted expectations.

The Deakin University research project (see *Appendix One*) explored customer preferences with regard to:

- different policies to encourage the adoption of EVs, home EV chargers, home batteries, and the electrification of gas appliances for space heating, water heating, and cooking.
- delegating control on how some of their appliances use power in exchange for lower power bills. The control related to electric vehicle (EV) charging, electric space heating and electric water heating. It also examined customer opinions and perceived fairness for the policy scenarios that are used to exercise such control.

This report is designed to inform stakeholders in their understanding of customer preference for the adoption and control of CERs.

In addition, C4NET has sought through this report to summarise and evaluate the research, identify any opportunities or limitations with the approach taken, and highlight any observations or insights for distribution network service providers (DNSPs), regulators and policy makers and market operators and for future research. This has also been done taking into consideration broader consultation and a range of stakeholder views and seeks to maintain a focus on consumers as the beneficiaries of an integrated energy system.

[3] Note the original title of this research was "Fairly integrating DERs into the NEM: Consumers' policy perceptions", for consistency across projects we have renamed this "Fairly integrating CERs into the NEM: Consumers' policy perceptions" replacing DER with CER in recognition of C4NET's distinction that CER sits behind the meter, while DER sits on the network.

[4] https://aemo.com.au/-/media/files/major-publications/isp/2024/2024-integrated-system-plan-isp.pdf?la=en

2. Project Summary

The *Fairly integrating CERs (Consumer Energy Resources) into the NEM: Consumers' policy perceptions*[5] research project sought to understand how customers perceive policies aimed at motivating CER adoption, how much control customers want over different CERs and their perception of policies for managing the import/export of electricity between CERs and the electricity network. Rapid uptake of CERs is essential to achieve Australia's decarbonisation objectives. As the customers use CERs, the import and export of electricity between their premises and the electricity network will change. Adverse impact arises when the import or export of electricity, in aggregate from customers, exceeds the capacity of the supply network. For example, electric vehicle (EV) charging at peak usage time could result in the overloading of the supply transformer. On the other hand, EV charging at peak solar PV generation period could alleviate the overvoltage issue caused by solar PV export. Coordinating the use of CERs, often referred to as CER orchestration, in accordance with the network and electricity supply conditions is likely to reduce the overall decarbonisation costs for Australia. As CERs are purchased by customers, it is necessary to establish policies to motivate their adoption including customer acceptance of delegating some control of their CERs to minimise adverse impact on the supply network.

[5] The research reports can be found here: www.c4net.com.au/projects/enhanced-system-planning-project

3. Research methodology, approach and findings

Customer surveys were the mechanisms used to assess customer perception and preference. Customer survey results were then analysed to extract the insights regarding motivations to adopt, third-party control and managing import/export from CERs.

3.1 Approach

Two surveys were conducted, the first one focussing on the influence of different policies on the adoption of EVs, home EV chargers, home batteries, and the electrification of gas appliances for space heating, water heating, and cooking. The second survey focused on third-party control and managing import/export of electric vehicle charging, electric space heating, and electric water heating.

3.1.1 Motivating to adopt

In the first survey, survey responses from 1,250 Victorian homeowners meeting prescribed selection criteria were analysed. These homeowners were recruited from an online panel provider from December 2023 –January 2024.

Respondents were asked to score their adoption intention based on four policy scenarios:

- *Purchase cost:* when zero emission technologies are 10% cheaper to buy.
- *Operating cost:* when zero emission technologies are 10% cheaper to run.
- *Infrastructure*: when zero emission technologies are easier to install/use.
- *Mandates*: when sale of non-zero emission technologies are banned by 2040.

For each of the focal technologies, respondents recorded their:

- *Current adoption profile:* That is, what products (example: hybrid car) they have purchased/used in the category (example: car) associated with each focal technology (example: EV).
- *Business as usual (BAU) adoption intentions:* That is, over the next 5 years, what they would purchase if they were going to buy/replace products from the category associated with each focal technology.

Respondents then gave their perceptions of Australia's energy system, whether the system is fair or unfair, and which parties (government, energy generators, energy distributors, energy retailers) are responsible for ensuring fairness of the energy system.

Next, respondents were randomly presented with one of four policy scenarios as per above. After reading the policy scenario, respondents:

- provided their opinion and perceived fairness of the policy.

- recorded their policy adoption intentions. That is, assuming the policy was enacted, what they would purchase over the next 5 years if they were going to buy/replace products from the category associated with each focal technology.

Respondents were then shown all policy scenarios and asked to rank them in order of preference.

The survey concluded after respondents gave their opinion of each focal technology and completed a series of psychographic and demographic questions.

3.1.2 Third-party control and managing import/export

In the second survey, survey responses from 1,406 Victorian homeowners meeting prescribed selection criteria were analysed. These homeowners were recruited from an online panel provider from May – June 2024.

Respondents were first asked to report – for each of the three product categories (car, space heating, water heating) their:

- *Current adoption profile:* That is, what products (example: hybrid car) they currently use in each category (example: car).
- *Business as usual (BAU) adoption intentions*: That is, over the next 5 years, what product they would purchase if they were going to replace/buy a new product in each category.

Respondents were then asked to choose their desired level of control for electric vehicle charging, electric space heating, and electric water heating, both before and after being presented with information about the general energy bill implications. The choices were:

- *Full control:* where they maintain complete control of their CER (accompanied by biggest increase in power bill due to grid upgrade).
- *Partial control:* where they set preferences for how their CER operates that are then enacted by technology or a third-party (accompanied by intermediate increase in power bill due to grid upgrade).
- *Energy-as-a-service*: where they relinquish CER control to a third-party in return for guaranteed access to specific CER benefits (accompanied by smallest increase in power bill due to grid upgrade).

Next, respondents were randomly presented with a policy scenario that described either a market-based mechanism or a mandated mechanism for managing CER imports/exports:

- *Mandated mechanism*: which would involve introducing import- and export-focused dynamic operating envelopes that vary the allowable size of CER imports and exports as a function of network supply and demand.

- *Market-based mechanism*: which would involve tariff reform to permit two-way pricing as per the Australian Energy Regulator's network tariff reform. For example, prices for electricity imports and exports would vary as a function of network supply and demand.

After reading the scenario, respondents:

- Provided their opinions and perceived fairness of the policy.
- Recorded their post-policy technology adoption intentions. That is, assuming the policy was enacted, what product they would purchase over the next 5 years if they were to replace/buy a new product in each of the three focal product categories.

Respondents were then shown both policy scenarios and asked to rank them in order of preference. The survey concluded after respondents completed a series of psychographic and demographic questions.

3.2 Inclusions, exemptions and limitations

The survey approach and questions were formulated following an extensive literature review process that sought to provide a baseline understanding of consumer perceptions to promote fair integration of CER into the NEM. As the ESP study looks out over 30 years and starts from post-2030, the surveys undertaken only measure today's sentiment and this will almost certainly change in future. However, understanding where consumer sentiment is today helps inform what needs to be addressed to bring consumers along in the transition ahead.

In addition, there are inherent challenges in any stated intent/survey responses by consumers relative to what they finally act on. Understanding where consumers are today provides insights into perceptions that exist today and where better information, facts, incentives or directives may play out, or what the reaction to them may be, in future.

Finally, the surveys were completed by members of an online participant panel. The perceptions of consumers who may be underrepresented on these panels – such as those with limited access to the internet – may therefore also be underrepresented in the participant samples that were recruited.

3.3 Base assumptions

The survey respondents were chosen from individuals who met all the following criteria:

- Aged 18 years or older.
- Currently reside in Victoria.
- Live in a freestanding house or townhouse/duplex.
- Own their home outright or with a mortgage.
- Joint or main decision maker in choosing energy products/services for their household.

- Passed a comprehension check that assessed their understanding of the policy scenario they had been assigned to evaluate.

The sociodemographic profile of the respondents covered variables including gender, age, location, education, financial wellbeing, culturally and linguistically diverse and political identity.

3.4 Researcher findings

The researchers found:

- New and familiar technologies were perceived differently, with new technologies (EV's, home EV chargers, batteries) perceived less favourably than familiar technologies (reverse cycle air conditioning for heating, electric water heating, induction cooktops, electric ovens). There were higher business as usual intentions to adopt or replace familiar products within the next 5 years than there were for new technologies.
- Lower operating costs favourably influenced new technology adoption and was both popular and seen as fair.
- Mandates favourably influenced familiar technology adoption but were neither popular nor seen as fair and were the least preferred of the policy options put to respondents.
- Adopter category and environmental worry influenced adoption intentions across all technologies
- Lower operating cost was perceived positively by harder to reach segments, whereas mandates were not.
- Better educated, politically progressive, younger men are the "bullseye" segment for adoption of new technologies, whereas the more familiar technologies had fewer demographic predictors.
- Consumer's starting point was a preference to maintain full control of their CER assets. However, this significantly decreased once they were informed that relinquishing some control would help to minimise future energy bill increases.
- Market-based mechanisms to achieve control were favoured and perceived as fairer than mandated ones, but neither were strongly positive indicating begrudging acceptance rather than enthusiastic support.
- The existence of controls didn't affect intention to adopt EVs or electric water heating, but decreased intention to adopt electric space heating.

4. Observations, insights and key reflections for stakeholders

In reviewing the project's research reports and findings, C4NET has identified some observations, insights and key reflections for stakeholders. Outlined below we have summarised these for DNSPs, AEMO, policy makers and researchers, with a section highlighting observations in relation to consumer outcomes. While these are summarised for stakeholder type, this section should be read together ensure cross-sectoral awareness.

The full research report and findings are published on the C4NET website[6].

4.1 General Observations

With regard to control of CERs, consumers had a baseline preference for maintaining full control over their CER. Consumers indicated they would trade-off some CER control if this would reduce future energy bill increases. Market-based mechanisms were the preferred approach for CER control.

That almost half of respondents perceived that Australia's energy system is somewhat or very unfair is relevant for all stakeholders to understand. Interestingly, the "innovator" adopter was the only category to perceive the system as fair. Such perceptions may impact the uptake or use of CER and a deeper understanding of what is behind the perception may be worth further exploration.

The implications of the research findings on various stakeholders are discussed below.

4.2 DNSPs

Gaining consumer feedback on trade-offs between price and service offering is a key activity conducted by DNSPs particularly during the 5-yearly electricity distribution price review process. The insights from the Deakin University surveys could provide useful input into DNSP's customer consultation processes.

DNSPs may have a preference for mandated CER control so they can conduct their network planning in a deterministic manner. The research report findings, however, point to consumer preference for market-based (e.g. tariffs) over mandated mechanisms (e.g. operating envelopes). A market-based approach for CER control will introduce a degree of uncertainty as customer behaviours will vary depending on their sociodemographic profile (as demonstrated by the survey analysis) and other factors. One possible DNSP approach would be to include the uncertainty as a probability in its planning, starting with a low probability and adjust the probability progressively as revealed through customer's actual behaviour.

[6] www.c4net.com.au/projects/enhanced-system-planning-project

Additional consideration could be given to how to utilise standards (or inform standard development) to develop approaches that provide a balance of network and consumer benefit, with minimal impact on consumers. For example, standardising electric storage hot water system remote control specifications to enable supply utilities bring forward water heating from nighttime to midday when there is excess solar PV generation.

Given the perceptions of lack of fairness, DNSPs may wish to consider this in their communications and engagement with customers. A better appreciation of the communal value of distribution infrastructure and how it benefits consumers may help build trust and better acceptance of future decisions and programs.

4.3 AEMO

AEMO's Integrated System Plan (ISP) investigates a number of possible future energy scenarios for Australia. The "Step Change" scenario, considered by energy industry stakeholders to be the most likely scenario to play out, relies on a very strong contribution from consumers in the transformation, with rapid and significant continued investments in CER which are highly orchestrated through aggregators or other providers with the benefits passed on to consumers. The research report findings indicate that significant investments in CERs, their orchestration with regard to network and energy market needs, will not occur naturally without a significant understanding and trust of consumer expectations and perceptions, and considering the drivers behind the purchase of their CER assets. Further, a deeper understanding of what is needed for consumers to willingly or preferentially facilitate orchestration (system based or via incentives) may help achieve the desired adoption rates and engagement with the system.

4.4 Policy makers

For motivating customers to adopt CERs, the key insights are:

- New and familiar technologies are perceived differently. Customer BAU adoption of familiar technologies (reverse cycle air conditioners for heating, electric water heating, induction cooktops, electric ovens) is higher than new technologies (EVs, home EV chargers, batteries). Additional policies may therefore be required to accelerate the adoption of new (vs. familiar) technologies.
- Lower operating cost favourably influences new technology adoption and is both popular and seen as fair.
- Mandates favourably influence familiar technology adoption but are neither popular nor seen as fair for new technologies.
- Customer adopter categories, levels of environmental worry, and demographics (gender, age, education and political inclination) are key factors affecting adoption of new technologies.

For CER control, five main learnings are:

- Consumers have a baseline preference for maintaining full control over their CER. This doesn't come as a surprise as a primary motivation for consumers to adopt CERs is to have greater control over their own energy supply. Conceding control of their CERs, even partially, goes against this ideology.
- Consumers will trade-off some CER control if this will reduce future energy bill increases but note greater acceptance of controls with electric hot water and EVs than with electric space heating.
- Energy-as-a-service offerings are less preferred than partial CER control.
- Highlighting the personal energy bill-related implications of maintaining full CER control will be essential to bolstering support for initiatives that reduce (without eliminating) CER control.
- Aligning customer self-interest to the broader system benefits could be challenging but will be a key success factor for new policy development.

Two main learnings on managing CER imports/exports in the context of potential price increases:

- Market-based mechanisms will likely attract greater support than mandated mechanisms, such as the implementation of dynamic export functions in Victoria, although consumers are unlikely to be widely enthusiastic for their introduction.
- Policy makers must remain attentive to the potential for energy market reform to slow the adoption of low emission technologies if these market reforms are perceived by customers to be unfair.

4.5 Consumer

On-going building of understanding and awareness is essential, so consumers understand the trade-offs (if any) in them giving up some control over their CERs, combined with approaches to remove complexity and increase standardisation. This is particularly important before introduction of new policies promoting or regulating CER use and as new consumer technologies (such as home automation) are introduced that reduce consumer's ongoing control effort.

4.6 Research

As customer perception and preference do change over time, it is important that customer surveys are conducted on a regular basis and are integrated into AEMO's forecasting considerations. Further research could also support approaches to the development of new standards and understanding consumer preferences and drivers. This could build upon the extent of consumer research already summarised in a report by ACIL Allen for the Energy Security Board in 2022[7], combined with additional insights from subsequent research.

[7] https://esb-post2025-market-design.aemc.gov.au/customer-insights-collaboration, p.4-12

Appendix One

Researcher profile

Conducted by: Deakin University

Lead Researcher: Prof Josh Newton

Research Team: Dr Jubin Jacob John, Dr Jeff Rotman, Dr Jay Zenkic, Dr Virginia Weber

Better Consumption Lab, Deakin University

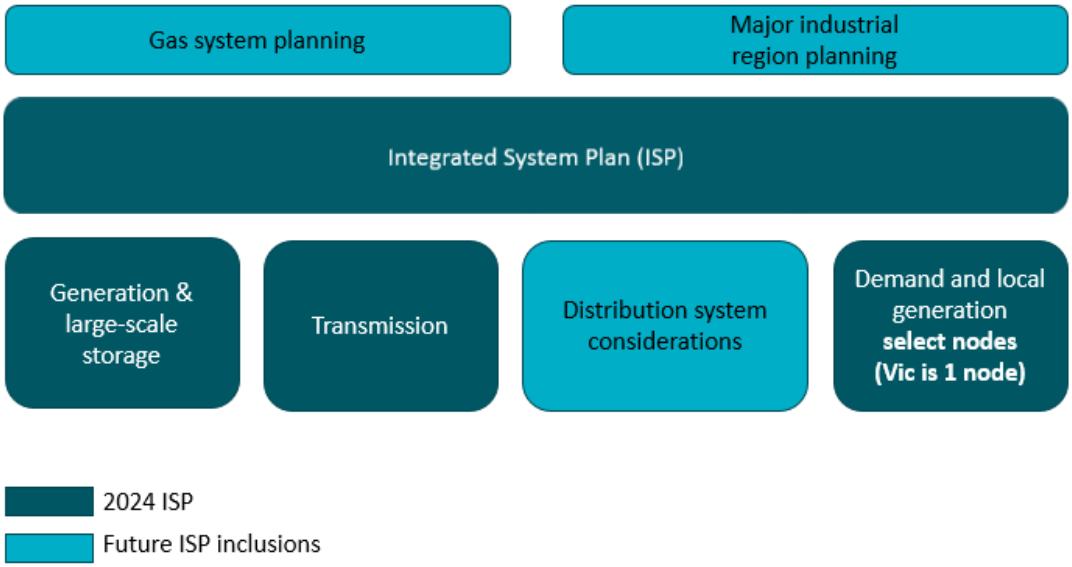
About C4NET

C4NET delivers multi-disciplinary solutions to the challenges the energy industry is facing. Working with complexity requires diverse skills, reliable data and new approaches, which C4NET facilitates by bringing together governments, industry and universities, creating new links across the sector.

Central to C4NET's program of work is the Enhanced System Planning (ESP) project, a significant and collaborative research project aimed at informing sub transmission level electricity planning beyond 2030, with a focus on building methodologies and approaches for bottom-up modelling and to highlight the opportunities presented through the distribution system and integrating Consumer Energy Resources (CER), to inform whole of system planning.

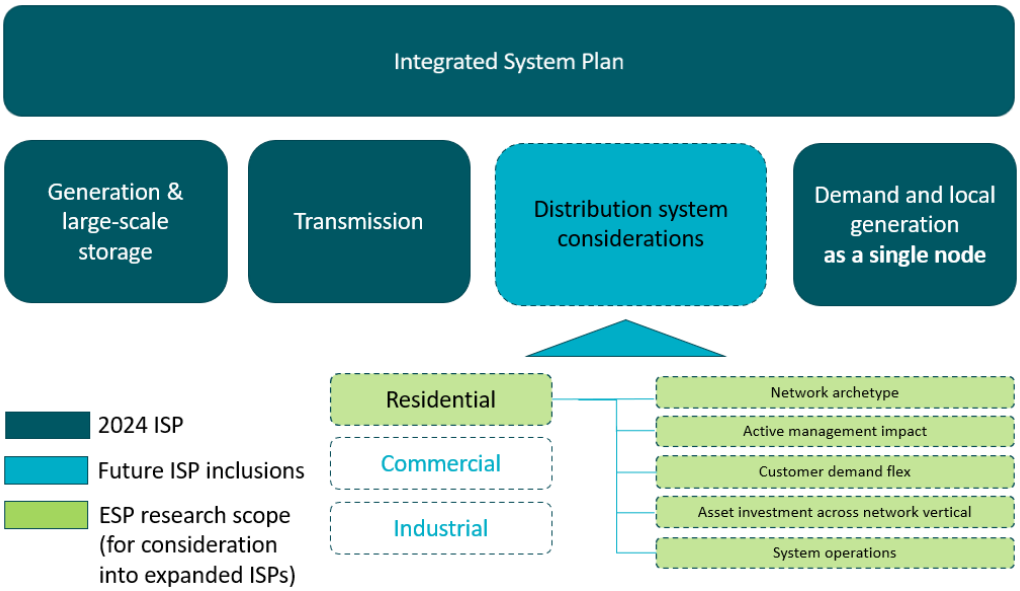
Appendix Two – Bigger picture integration with the ISP

Shift towards whole of system planning



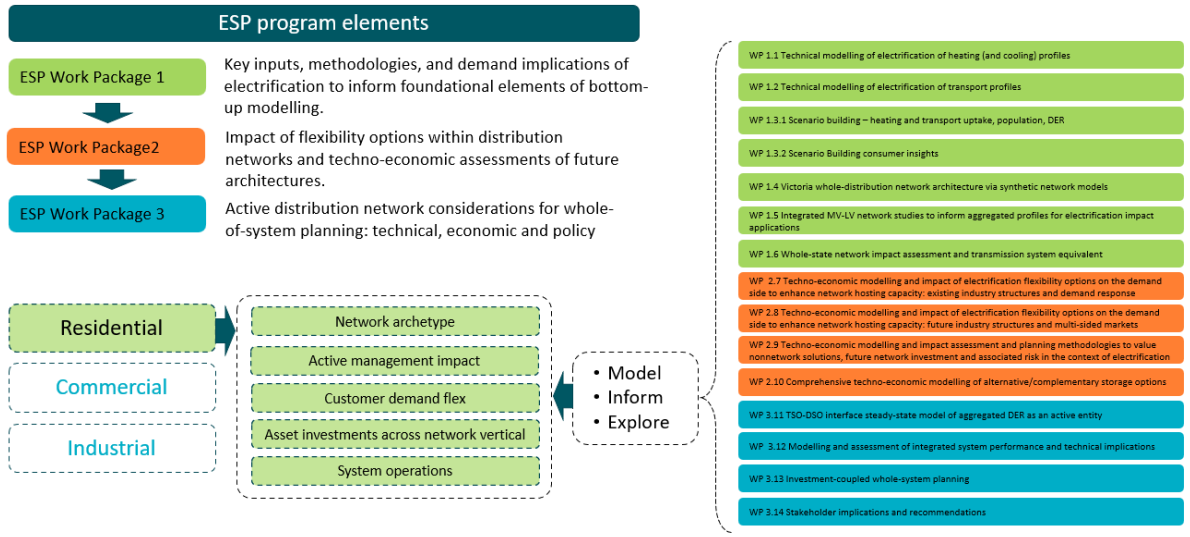
The Energy and Climate Change Ministerial Council (ECMC) accepted the recommendations of the review of the ISP which target transformation of the energy system as a whole, with particular reference to gas system planning, major industrial region planning and distribution systems.

Distribution system components of whole of system planning



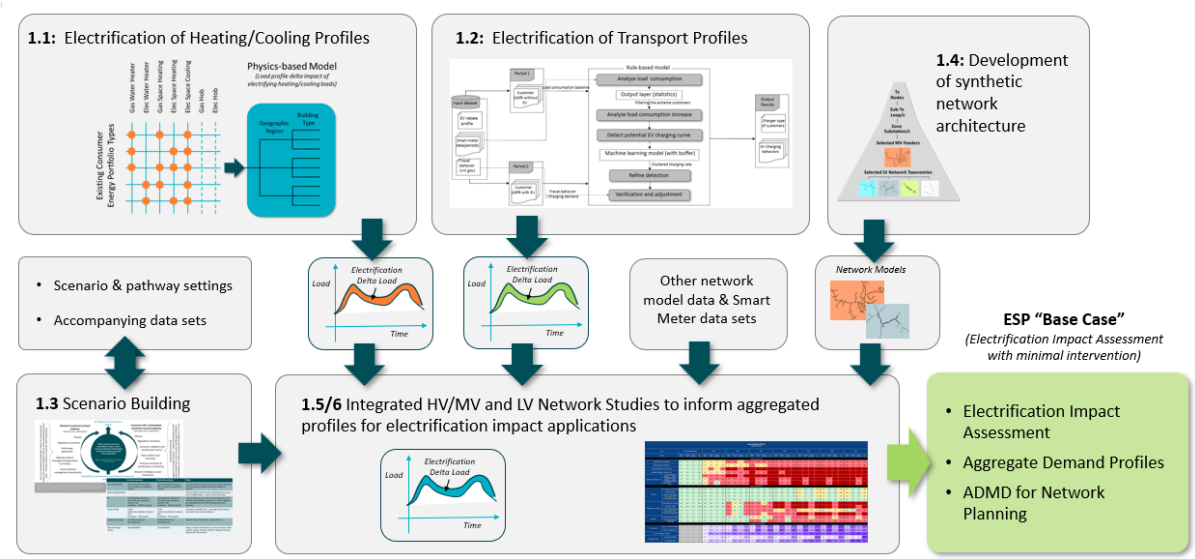
The ESP was scoped to be deliverable with the resources and time at hand to inform feasibility of broader application. It focussed on the more complex areas around residential and low voltage assets of the distribution system, with an application across Victorian networks with methodologies applicable to any region in the NEM.

ESP alignment with distribution system components of whole of system planning



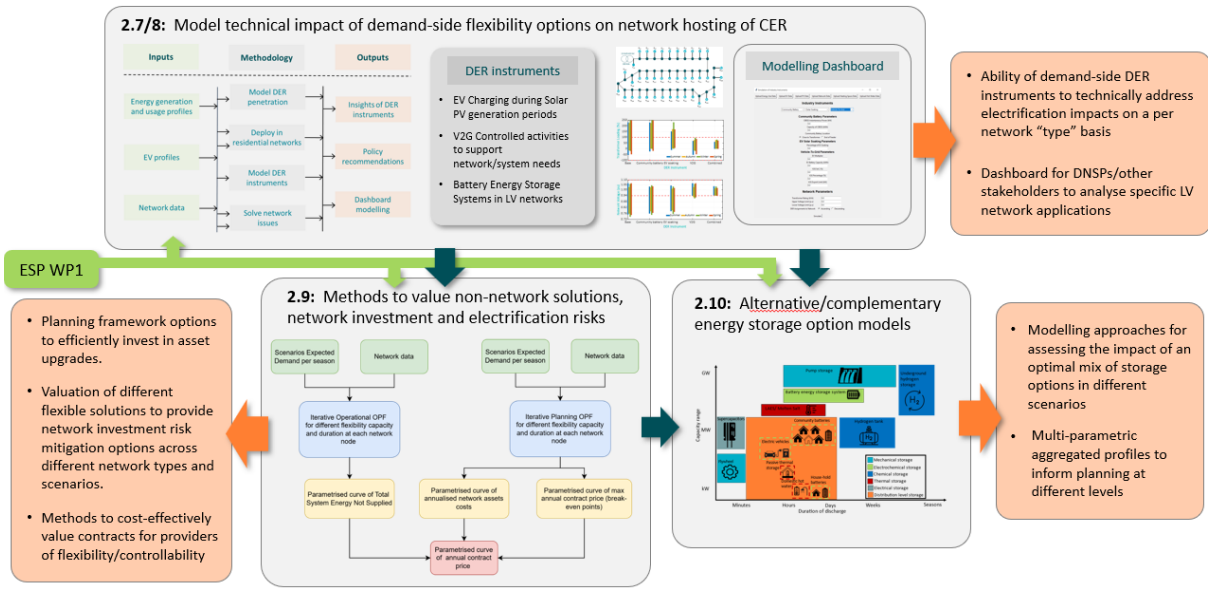
The 'base case' for residential electrification impact assessment, the flex options and relativity to other investment options

(ESP Work Package 1)



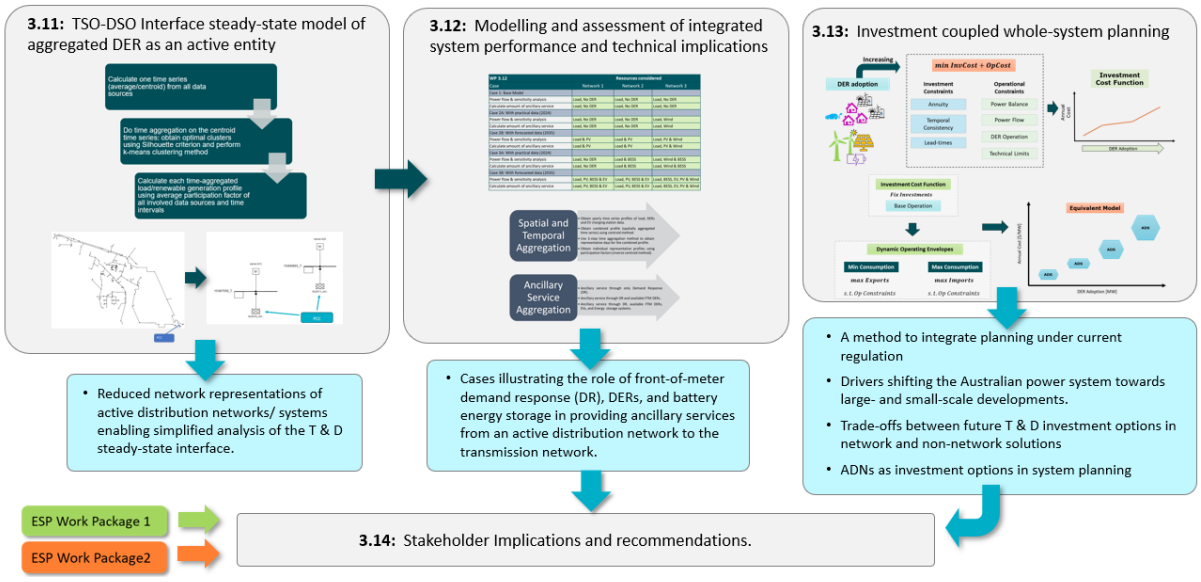
Impact of flexibility options within distribution networks

(ESP Work Package 2)



Active distribution network considerations for whole-of-system planning

(ESP Work Package 3)



C4NET

Appendix Three – ESP project and research partners