

October 2025

Green Paper

Unlocking the potential of demand flexibility – a residential product perspective

A green paper seeking input on ways to
unlock the potential of demand flexibility
through residential end-use products



TE TARI TIAKI PŪNGAO
ENERGY EFFICIENCY & CONSERVATION AUTHORITY

Creative Commons license



This document is licensed under a [Creative Commons Attribution 4.0 New Zealand](https://creativecommons.org/licenses/by/4.0/) license. Inquiries about the license and any use of this document should be emailed to star@eeeca.govt.nz.

Citation

This document may be cited as: Energy Efficiency and Conservation Authority, (2025), *Unlocking the potential of demand flexibility – a residential product perspective*, Wellington, New Zealand, a consultation by the Energy Efficiency and Conservation Authority.

Acknowledgements

The Energy Efficiency and Conservation Authority would like to acknowledge the various stakeholders that provided input to inform this green paper, including the input of officials from the Ministry of Business, Innovation and Employment, the Electricity Authority, and the Department of Climate Change, Energy, the Environment, and Water in Australia.

Contents

Submission process	3
Official Information Act requirements	3
Purpose	4
Context	5
What is demand flexibility?	5
Benefits of demand flexibility	6
How demand flexibility aligns with EECA's purpose	9
EECA has been taking New Zealanders on a journey towards demand flexibility	10
Scope	11
Residential end-use products	11
Why focus on end-use products	11
Out of scope: cyber security	12
Out of scope: flexibility market settings	12
End-use product level components for demand flexible capability	15
Communication protocol	15
Product response	16
Operational information	17
Examples	17
Summary	18
Energy efficiency considerations	19
Home energy management systems	20
Next steps	21
Appendix One: Consultation questions	22
Appendix Two: What are power and energy?	24
Appendix Three: Three methods for identifying key end-use products for demand flexibility	25
Option one: Energy use in the residential sector	25
Option two: Peak demand in the residential sector	27
Option three: Theoretical maximum power use	29
Appendix Four: EECA has been taking New Zealanders on a journey towards demand flexibility	31

Table of figures

Figure 1: Demand response system diagram.....	6
Figure 2: Demand flexible system diagram.....	6
Figure 3: Proposed new electricity generation.....	8
Figure 4: EECA strategy.....	9
Figure 5: Illustration of charging load and efficiency.....	19
Figure 6: Difference between energy and power	24
Figure 7: Residential energy use 2023	25
Figure 8: Demand flexible and demand in-flexible products.....	26
Figure 9: Estimated power demand by time of day in the summer and weekday	27
Figure 10: Estimated power demand by time of day in the winter and weekday	27
Figure 11: Peak demand 4pm contribution on a weekday in summer	28

Table of tables

Table 1: Key end-use products	13
Table 2: Household products and power use	29

Submission process

The Energy Efficiency and Conservation Authority (EECA) seeks your feedback on the issues raised in this green paper. All relevant material made in submissions will be considered. You are welcome to provide additional information by directing feedback and enquiries to STAR@eeeca.govt.nz.

Submissions on this green paper close on 10th November 2025.

EECA may provide advice to the Minister of Energy following the consultation period. A summary of submissions and analysis will be posted on the EECA website.

Official Information Act requirements

Under the Official Information Act 1982 (OIA), information held by EECA is to be made available to requestors unless there are grounds for withholding it. The grounds for withholding information are outlined in the OIA.

If you are making a submission, you may wish to indicate any grounds for withholding information included in your submission. Reasons for withholding information could include information that is commercially sensitive or personal (such as names or contact details). An automatic confidentiality disclaimer from your IT system will not be considered as grounds for withholding information.

EECA will consider your preference when determining whether to release information. Any decision to withhold information requested under the OIA may be reviewed by the Ombudsman.

Purpose

This green paper seeks your views on how to unlock the potential of demand flexibility through residential end-use products. This will inform our ongoing thinking on the key issues and our role in addressing them.

Modern technology has the potential to improve energy outcomes in New Zealand. Harnessing demand flexible end-use products will mean lower electricity bills at the household level, and at a system level, the impact can be even more significant.

Flexibility services have a key role to play in the energy transition. It can help to manage intermittent renewable generation and manage peak demand (generation and line constraints), both of which are essential to the success of delivering energy security and affordability alongside decarbonisation.

Note that this green paper does not contain specific proposals – rather, it seeks further information from industry and other interested stakeholders about the key residential end-use products for demand flexibility.

Wider policy decisions and regulatory changes are being progressed across Government (including Ministry of Business Innovation and Employment [MBIE], the Electricity Authority and the Commerce Commission) to incentivise uptake of demand flexible technology and enable consumers and the wider electricity system to benefit.

Once feedback is received on the green paper EECA will publish a summary of submissions and confirm the actions to help support the uptake of demand flex capable end-use products and support the across government work on demand flexibility. Actions may include:

- Further education to homeowners on the benefit of demand flexibility, and the role of end-use products,
- Developing voluntary specifications for end-use products, and approved lists to support their uptake. This would be a similar approach to: [EV Smart Charger Approved List](#)
- Research to understand end-use product demand flexibility,
- Further engagement with stakeholders.

Context

What is demand flexibility?

Demand Flexibility is an emerging, complex topic globally, and has the potential to fundamentally change how the world uses electricity. It involves two-way communication between end-use products (e.g. an electric vehicle charger) and an external party, allowing flexible response to the electricity system's needs including peak demand and renewable generation. Importantly the consumer maintains control of how their product is controlled, and by whom.

The external party that is controlling the end-use product could be a flexibility provider that controls multiple end-use products across an area e.g. Wellington. It could also be an in-home controller (or virtual system) such as a Home Energy Management System (HEMS). It is possible that a flexibility provider and a HEMS could both work together to control end-use products, with the flexibility provider communicating with a HEMS, and the HEMS optimising the home's energy use, along with meeting the flexibility provider's request. In principle the external party providing flexibility must maximise the benefit to consumers.

Demand flexibility is not to be confused with demand response, which is one-way communication between an end-use product and the grid in response to peak demand constraints e.g. inadequate levels of electricity supply, or excess demand which the grid cannot support. A common example of demand response is ripple control of electric hot water cylinders to turn off at peak times via a signal from an electricity distribution business.

An example of demand flexibility is Electric Vehicle (EV) chargers that utilise the Open Charge Point Protocol (OCPP) to interact with charge point operators¹ (flexibility provider for EV chargers). These chargers can communicate and respond to external signals including providing information about the charger's operation (e.g. amount of electricity being consumed) and changing the charging rate (power draw). This ensures that the EV is charging at the optimum time for the electricity system, while also ensuring the consumer needs are met. Certain versions of OCPP also include vehicle to grid capability.

This two-way communication between end-use products and an external party is fundamental to efficient use of available generation and infrastructure. It also enables the optimisation of renewable generation and gives the consumer control of how their end-use products are used in a demand flexible system.

¹ Charge point operators can manage private and or public chargers, in this context it is focused on private.

Benefits of demand flexibility

Demand flexibility can be used to shift when and how energy is used, resulting in reduced peak demand on the electricity system, and is an important tool to optimise renewable energy use and reduce consumer costs.

Demand flexibility can occur in the residential, commercial, and industrial sectors, with each sector having unique demand flexibility mechanisms and opportunities. Demand flexibility can also be network/location dependent. Examples of end-use products that could operate in a demand flexible way and provide benefit in the residential sector include EV chargers, heat pumps for space heating and cooling, and electric storage water heaters (including heat pump water heaters). While in the industrial sector, processes can draw on stored hot water or steam to enable an electrode boiler to reduce load during a system peak.

Figure 1 below shows an example demand response system, while **Figure 2** shows a demand flexible system.

Figure 1: Demand response system diagram

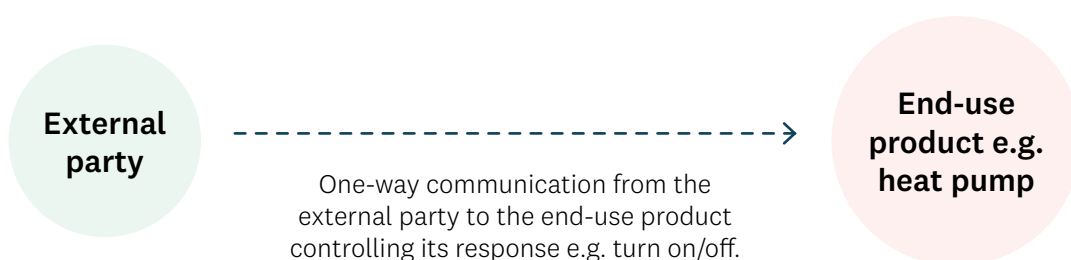
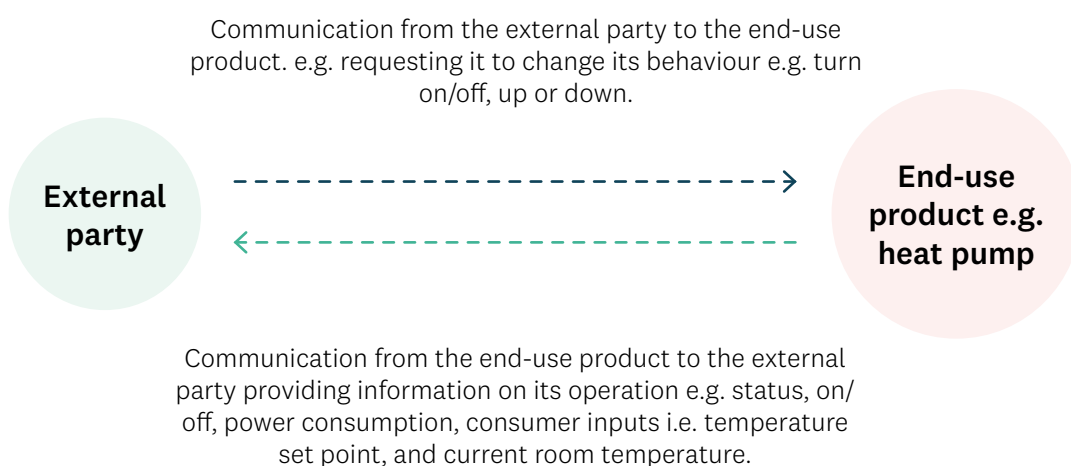


Figure 2: Demand flexible system diagram



As shown, demand response is simple one-way communication between an end-use product and an external party controlling its behaviour, while a demand flexible system involves two-way communication and decision-making. The two-way communication enables further benefit beyond a demand response-based system.

Demand flexibility has two main use cases:

- Reducing peak demand (by shifting to shoulder or off-peak periods) to manage either generation constraints, or line capacity constraints (limitations of electricity system),
- Optimising intermittent renewable energy use (including peak supply times).

Managing generation and line capacity constraints can avoid costly infrastructure expenditure e.g. building new generation or increasing line capacity (e.g. poles, wires, and distribution transformers). These infrastructure costs are passed to the consumer in lines fees and cost per kilowatt hour (kWh). Modelling from EECA estimates that uncontrolled EV chargers could cost New Zealand \$4 billion by 2050². This was also highlighted in the Electricity Government Policy Statement to the Electricity Authority, which outlined: “Market arrangements facilitate competition as an essential input to delivering electricity at lowest possible cost to consumers. This includes consumers receiving value from utilising distributed energy resources³ and demand-side flexibility”⁴.

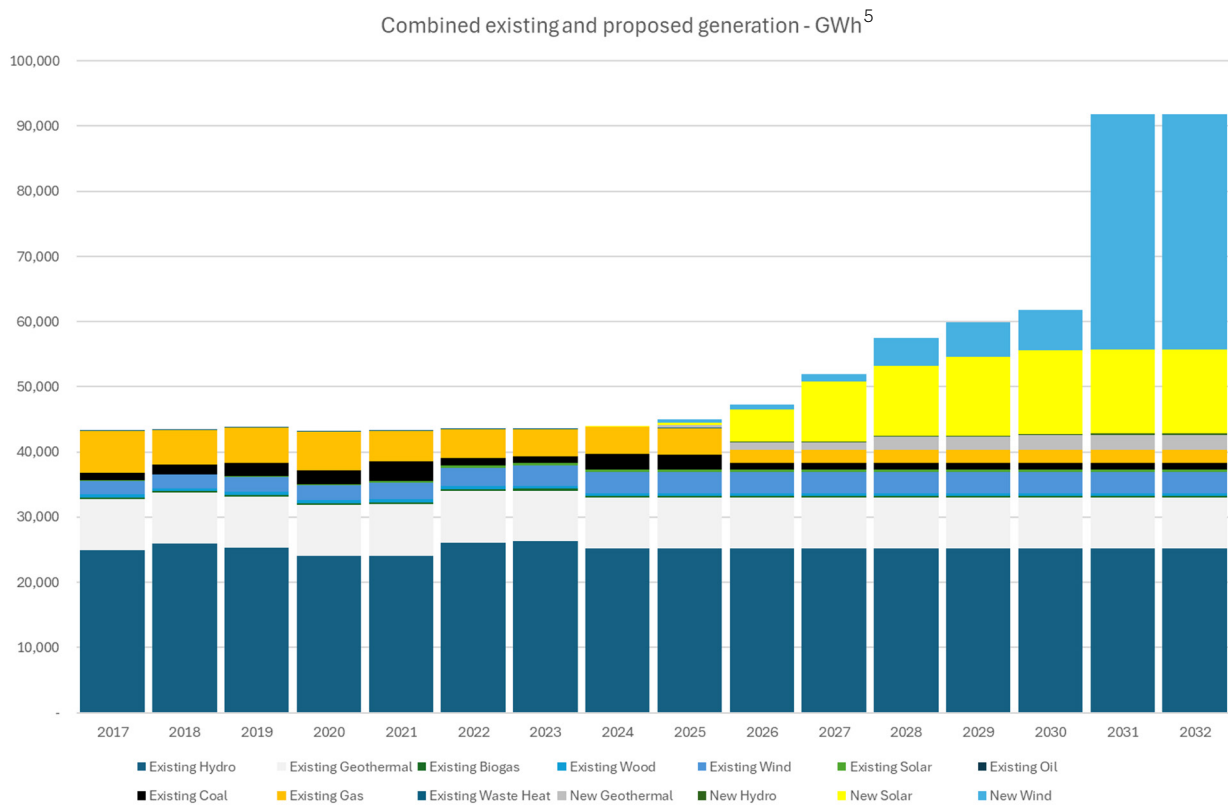
There is also an immediate energy affordability benefit from shifting demand out of peak times. Consumers save money on their bills in the short run through cheaper off-peak energy use (or innovative retail plans that reward them).

Optimising renewable energy consumption is less discussed in the demand flexibility context but is a large opportunity. New renewable energy (wind and solar) is expected to become a significant contributor to generation in the future, as shown in **Figure 3**.

² [Widespread use of smart EV chargers could save billions on grid infrastructure | EECA](#)

³ Examples distributed energy resource a home solar, and battery systems.

⁴ [New Zealand Government, 2024, Electricity Government Policy Statement](#)

Figure 3: Proposed new electricity generation

A demand flexible system can ensure that we are aligning our power consumption to times of renewable energy generation (peak supply), optimising our generation assets to favour cleaner, lower-cost renewables. This can accelerate New Zealand's goal of doubling renewable electricity by 2050 in support of the Net Zero 2050 target⁶.

⁵ EECA analysis of Electricity Authority generation pipeline survey in 2023.

⁶ [New Zealand Government, 2024, Electricity Government Policy Statement](#)

Demand flexibility can also improve our energy security, as we can better utilise the existing electricity system, which can:

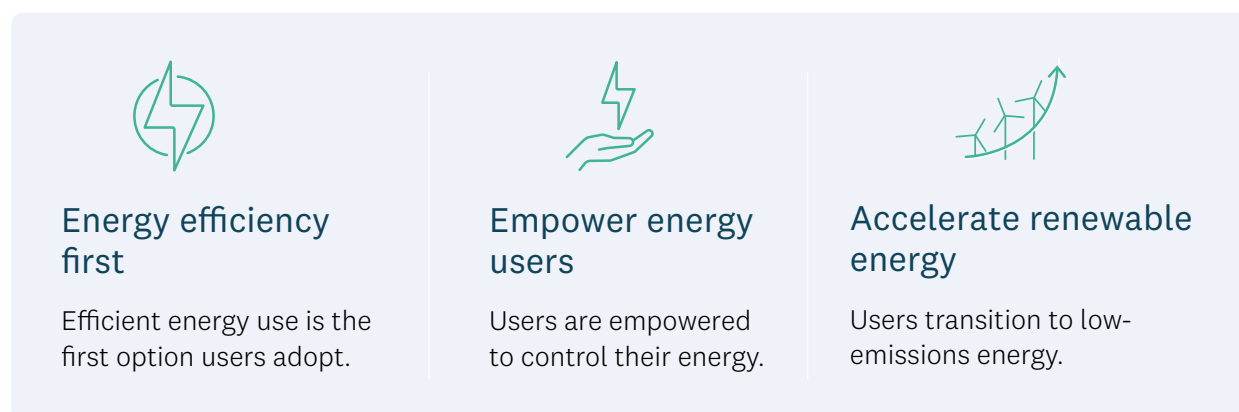
- reduce demand on flexible resources such as hydro and thermal generation, leading to less dependence on thermal and less impact from dry years/periods of low inflow,
- enable greater use of energy created locally in New Zealand, rather than being imported, and
- Enable greater network optimisation, and matching of generation and load.

How demand flexibility aligns with EECA's purpose

The Energy Efficiency and Conservation Act 2000 outlines EECA's purpose, which is to promote, in New Zealand, energy efficiency, energy conservation, and the use of renewable sources of energy.

In addition to this EECA has three strategic focus areas of energy efficiency first, empower energy users, and accelerate renewable energy (**Figure 4**).

Figure 4: EECA strategy



Supporting the development of demand flexibility and its uptake aligns with EECA's purpose and strategic focus areas as it will enable electricity to be used more efficiently, including the ability to more effectively utilise renewables, while ensuring that the consumer maintains control.

EECA has been taking New Zealanders on a journey towards demand flexibility

While demand flexibility is emerging in New Zealand, there have been a number of projects and initiatives building demand flexibility capability. A timeline of initiatives EECA has been involved in is provided in [Appendix Four](#): EECA has been taking New Zealanders on a journey towards demand flexibility, but key highlights include:

- Publicly Available Specifications covering:
 - [Electric vehicle chargers for residential use | EECA](#)
 - [Electric vehicle chargers for commercial use | EECA](#)
 - [Guidance for smart homes | EECA](#)
 - [Best practice guide - residential solar PV & battery storage | EECA](#)
- [EV Smart Charger Approved List | EECA](#)
- [Solar product technical specification for consultation | EECA](#)
- [FlexTalk 1.0](#)
- [Energy Efficiency and Conservation Act amendments](#)

Internationally, several countries are pursuing demand flexibility initiatives, including Great Britain and the Australian state of South Australia.

The Department of Energy and Mining in South Australia has introduced demand response requirements for EV chargers, heat pumps for space heating, and inverters (solar). These requirements must be met for a product to be connected to the grid. The requirements differ based on product, but at a high level:

- EV chargers must be OCPP compliant or have equivalent functionality⁷,
- Inverters must be IEEE 2030.5 compliant, respond as outlined in AS/NZS 4777.2, and provide information back including energy export etc.⁸

Great Britain has introduced requirements for EV chargers⁹ to help manage increased electricity demand from the transition to electric vehicles. They require that EV chargers meet demand flexible functionality requirements including interoperability.

⁷ [Electric Vehicle Supply Equipment \(EVSE\) standards | Energy & Mining](#)

⁸ [2022D066388-Technical-Regulator-Guidelines-Distributed-Energy-Resources-Version-1.5-1.pdf](#)

⁹ [Regulations: electric vehicle smart charge points - GOV.UK](#)

Scope

Residential end-use products

This paper focuses on residential end-use products, due to their standardised and widespread use.

Residential products have a relatively standardised nature (e.g. clothes washers, hot water systems), compared to often bespoke products used in the commercial¹⁰ and industrial sector. Further, residential products tend to be distributed across a larger area (and in large volumes: in 2024 there were 870,000 regulated appliances¹¹ sold across New Zealand). This combination means that they could be used to effectively reduce network peak issues in a localised area, or together to utilise the use of renewables.

Individual commercial and industrial products may offer a larger demand flexibility opportunity (due to their higher power and energy use), but their more bespoke nature means in many cases a customised solution is required.

The types of end-use products explored in this paper can be broadly separated into three categories:

- Products that consume power to provide an end service e.g. a clothes washer, a hot water system, or a heat pump for space heating,
- Products whose principal function is to provide power to another product or system e.g. inverter for a solar system, or an EV charger,
- Products that can both consume power to provide an end service, and can provide power to another product or system e.g. a two-way EV charger that can both charge an EV or provide power from the EV to a local electricity circuit (e.g. the home) or the electricity grid.

Why focus on end-use products

A critical part of a demand flexible system is the capability of end-use products, as well as their uptake and use by consumers. A lack of capability in the end-use products or low uptake by consumers would create a limiting factor in the system and market, by hindering flexibility providers from designing and offering demand flexibility services (or hindering the effective functioning of those services).

To date, the conversation on demand flexibility has taken a top-down approach, focusing on flexibility providers and market settings. In support of demand flexibility, we propose that EECA also pursues a ground-up approach by looking at demand flexibility from an end-use product level. EECA is ideally placed to do this, with over 23 years' experience taking a product approach through our work on regulating and encouraging the use of energy efficient appliances.

Future work will examine what demand flexibility each type of end-use product could have to maximise the benefits.

¹⁰ Light/small commercial can have similar products to large residential.

¹¹ This includes clothes washers, clothes dryers, dishwashers, fridges/freezers, and heat pumps for space heating.

Out of scope: cyber security

Cybersecurity of demand flexible systems (including end-use products) is an important aspect of energy security and consumer willingness to adopt the use of demand flexibility. This paper focuses on intrinsic product requirements including communication protocols, which to an extent will include cybersecurity. While Cybersecurity is important it is not further discussed in the paper as there is on-going discussion on who is best placed to determine and implement cyber security requirements.

Out of scope: flexibility market settings

Demand flexibility is in the early stages of being implemented in New Zealand. For widespread adoption, there are many aspects that would benefit from common understanding or standards, including market settings. This paper does not consider demand flexibility market settings, as they are overseen by the Electricity Authority, who have ongoing work in this space¹².

However, it is worth noting that the capability of key end-use products may influence electricity market settings, or market dynamics. An example of this is EV chargers and the extent to which they can be controlled, how they are controlled (communication protocol), and what information they can provide, could influence what market service offerings are possible.

Key end-use products

Identifying the priority end-use products for demand flexibility is dependent on several factors, including:

- The focus of demand flexibility:
 - Peak demand (generation and line capacity) constraints,
 - Optimising renewable energy use,
 - Optimising home energy use.
- The focus on energy consumption, or power consumption.

There are several ways to identify the key products in the residential sector, including:

- How much each end-use product contributes to annual energy use (key products including space conditioning, and water heating),
- Peak demand (key products including whiteware, space heating, and water heating),
- Theoretical maximum power use (key products including, EV chargers, and inverters [if charging batteries]).

These three options are discussed in detail in [Appendix Three: Options for power use in the residential sector](#).

¹² [Managing peak electricity demand | Our projects | Electricity Authority](#)

Some products contribute significantly to peak demand but cannot have their power use shifted e.g. cooking appliances.

What is clear is that the following are key end-use products for residential demand flexibility, based on their:

- High power use e.g. EV chargers, or the water heating component of clothes washers and dishwashers,
- Significant annual energy use e.g. space heating and hot water systems,
- Contribution to peak-demand e.g. space heating,
- Ability to participate in demand flexibility e.g. HEMS or defrost cycle of a fridge/freezer.

From an energy consumption perspective there is potential for 74% of residential energy use to be demand flexible to some extent (space conditioning, water heating, refrigeration, and whiteware), with space conditioning, and water heating accounting for majority of the demand flexibility opportunity.

Table 1: Key end-use products

End-use product	Annual residential energy use	Peak demand contribution (summer) ¹³	Theoretical maximum peak power consumption	Comment
EV chargers (including vehicle to load, home, or grid)	20% ¹⁴ (1500 to 2000 kWh average, comparable to space heating or hot water usage).	Low (due to uptake in time of use pricing and load shifting behaviour).	High, 7.4kW.	While has a low uptake, has significant power draw compared to other residential end-use products.
Hot water systems	30%.	17% (if not on ripple control).	2-3kW (electric storage water heater).	Large energy use and significant opportunity for demand flexibility for those with storage tanks.

¹³ The contribution to peak demand is heavily dependent on weekday vs weekend, and season, winter vs summer. It's expected that space heating will account for a larger percentage of peak demand in winter, which will reduce the contribution of other end-use products.

¹⁴ This percentage should not be added with the other percentages in the table, as it is based on it being additional to standard household energy use.

End-use product	Annual residential energy use	Peak demand contribution (summer)	Theoretical maximum peak power consumption	Comment
Space heating	33%.	20%.	2kW (6kW heat pump with COP of 3).	Large energy use and used at peak times, especially in winter.
Inverters	0% unless charging batteries from the grid.	0% unless charging batteries from the grid.	3-5kW, but can be larger e.g. 8kW.	Significant power draw compared to other residential end-use products, and integration with solar and battery is key for demand flexibility.
Whiteware (clothes dryers, clothes washers, dishwashers, and fridges/freezers)	12%.	10%.	Product dependent, but can be significant, up to 2.4kW.	Low energy use compared to other end-use products, but can be power intensive e.g. water heating, or defrost for a fridge.
HEMS	Low.	Low.	Low.	Key product as can integrate with end-use products to provide home energy optimisation.

End-use product level components for demand flexible capability

Three key components that are required to enable an end-use product to function in a demand flexible way are:

- How to communicate with the product (the communication protocols used),
- How the product can respond to that communication e.g. turn off/on, and
- The information the product provides externally about its past, current, or future operation.

These three aspects must work together to enable a demand flexible product, and a deficiency in any one of the three can be a limiting factor:

- If you cannot communicate with the product, its functionality and operational information cannot be used,
- If you can communicate with a product but it cannot respond then its power consumption cannot change,
- If the product cannot send operation information back then the product is limited to being a demand response product (one-way communication), and it will be unknown what impact there will be on the consumer if its operation is changed.

This rest of this section describes the three key components in detail and how they work together.

Communication protocol

The communication protocol used to communicate with the end-use product is fundamental to who can control the end-use product and how easy it is to control.

Communication protocols can be thought of as specifying the language that the end-use product can use to talk to external parties, e.g. a HEMS or flexibility provider. They do not need to specify what an end-use product or system does in response to the language used (but can for example turn off or provide information such as temperature).

Communication protocols are software based, and it is possible to equip existing end-use products with the communication protocol (in some cases), however the end-use product may not have the necessary capability (hardware) to respond to the request in a meaningful way, for example turn on.

There are also system level protocols, which are used to enable demand flexibility between multiple end-use products, market participants, and the wider electricity system. These protocols are important for the future of demand flexibility. However, this paper focuses on protocols to enable communication with end-use products directly.

Communication protocols can be freely accessible (and typically standardised e.g. IEEE 2030.5 and OpenADR) or proprietary, whose use is restricted by the developer of the protocol either to the developer's own products or commercially licensable by the developer to third parties.

Both approaches have their strengths and weaknesses. What is clear is that when there are multiple different communication protocols in use it can be inefficient to implement a demand flexible system that delivers benefit for all stakeholders, limiting market development. It can also create unintended consequences such as consumers being locked to specific suppliers and thereby limiting competition.

An example of this is domestic refrigeration, for which there are 30 different brands collectively supplying over 1,000 models of fridges, freezers, and fridge/freezers. If each brand were to use a different communication protocol for demand flexibility, it would be costly for an external party to design its service to integrate with all 30 protocols. This could encourage the external party to develop flexibility services compatible with only high-volume products. This would reduce the overall benefits of demand flexibility.

There is also a risk that if the operator of a proprietary protocol ceases operation, the end-use products' demand flexibility capability becomes unusable by the consumer and/or an external party.

There are several existing protocols to facilitate demand flexibility. Some examples of existing protocols are IEEE 2030.5 (IEEE Standard for Smart Energy Profile Application Protocol), and OpenADR (Open Automated Demand Response). These protocols aim to standardise the communication protocol between end-use products and external parties, but they do not specify how the end-use product should be able to respond, or the information it should send back. There are some product specific protocols, which do specify product response, and operational information that is sent from the device, such as Open Charge Point Protocol (OCPP) for EV chargers.

Product response

For an end-use product to operate in a demand flexible way, there are three basic responses (dependent on product type) to the information communicated between the end-use product and an external party.

- Turn on/off or start/stop,
- Increase power consumption/decrease power consumption,
- Increase power supply/decrease power supply.

It is important that end-use products have a range of responses to ensure that they can adequately respond to network constraints, generation constraints, and enable the optimisation of renewables.

There may be a need to specify a minimum set of product responses to enable the end-use products to adequately respond to the external party and consumer requirements. An example is a hot water system that can only turn on or off. If the electricity system needs the load of the hot water system to reduce, but the consumer also needs hot water, the product can only meet the requirements of the system or the consumer. If there was a third response which reduced the load of the hot water system (without turning it off), the requirements of the system could be met across a number of products, while ensuring the consumer has hot water.

Some examples of product response include:

- EV chargers: stop charging, start charging, turn down charging, turn up charging
- Whiteware: stop cycle, start cycle, pause cycle
- Heat pump for space heating: Stop heating/cooling, start heating/cooling, increase heating/cooling, decrease heating/cooling.

Operational information

The objective of operational information is to understand how an end-use product is operating, which can determine what its demand flexibility ability is at that moment or contribute to a demand forecast for that end-use product. It can also be used to ensure that the end-use product is not controlled in a way that impacts on the product's service delivery to a consumer.

Minimising the reduction in service of a product to a consumer is paramount to the development of a demand flexible system. Consumers should always need to opt into these demand flexible services, and if the reduction in service is not outweighed by the benefit to the consumer, they will opt out of demand flexible services.

Examples

Heat pump space heater

An example of important information for a heat pump space heater relates to the consumer's desired temperature and the current room temperature. These values can be used by the external party to determine the comfort impact of turning down (power consumption) or switching off the heat pump. Where the desired temperature of the heat pump is 20°C and the room temperature is only 15°C, turning down the heat pump (power consumption) will result in a reduced service that impacts the consumer's comfort.

However, if the room temperature were 19°C, turning the heat pump down (power consumption) will have negligible impact on the end consumer. Assuming in this scenario that the desired room temperature was 20°C, it would also be about to reduce its energy consumption (as the room was reaching the desired temperature). This is important information for an external party as it would be bidding for power or flexibility services based on forecast or available demand of the products under its control.

Another example is if the external party knows when the home will be occupied, and what the consumer's desired temperature is, they could preheat or precool the space utilising distributed energy resources (e.g. home solar with batteries).

Hot water system

For a hot water system, the external party would need to know the available useable hot water (how re-charged the storage tank is). From repeated information on the times and volumes of a household's hot water usage, the system could discern patterns (e.g. a large hot water draw in the morning) and control the product's electricity draw to optimally balance peak demand reduction, renewable energy optimisation, and maintain hot water service as required by the household.

Dishwasher

A dishwasher that has completed only its initial rinse cycle may be paused by the external party before commencement of energy-intensive water heating for the wash cycle and the cycle resumes later when electricity is cheaper. However, a dishwasher part-way through the wash cycle should not be paused as this would entail water reheating (unless the benefit was great enough).

Further, depending on what mode has been selected for the dishwasher e.g. eco 40°C, or hot wash 60°C, there may be a large difference in its energy and power consumption, so the operational information may include what cycle is being used or is typically used.

The information may also include when the consumer wants the dishes washed by. This would give the external party a window of time to wash the dishes, but run the cycle to optimise the cost without impacting the service to the household.

Battery inverter system

For a battery inverter system (a possible component of residential solar installations), the external provider may require the battery's current charge status to understand how much power is available, or how much energy can be put into the battery. This could also similarly apply to electric vehicles operating with a vehicle to home or grid charger.

Summary

The degree of demand flexibility that an end-use product may accommodate is dependent on the external party's assessment of several types of operational information:

- Information relating to the physical or status of the product (power consumption possible, or available power),
- Physical information relevant to the product's efficiency e.g. outside temperature, mode selected,
- The impact to the end consumer of flexibility in the timing and quality of service provided by the product.

Energy efficiency considerations

We may need to manage trade-offs between energy efficiency and demand flexibility

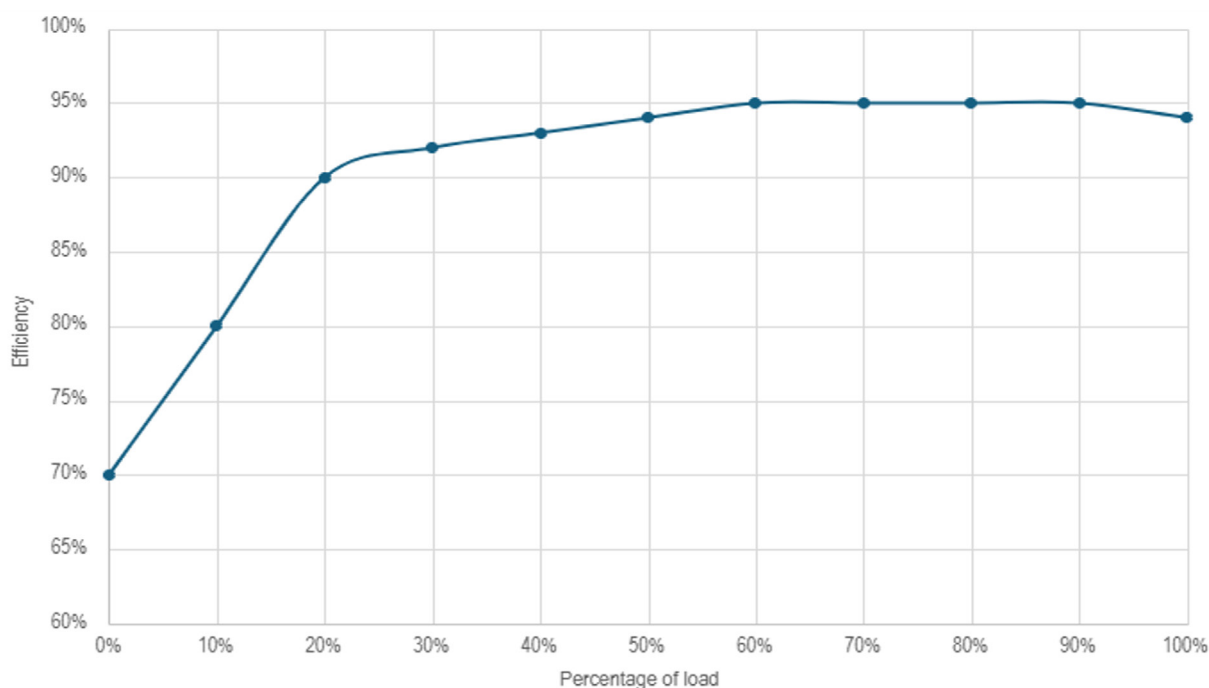
There are end-use products whose efficiency varies depending on how they are operated and operating them under demand flexibility can lead to adverse efficiency outcomes. Two examples are heat pump water heaters and EV chargers.

Heat pump water heaters use electrical energy to transfer heat energy from the outside air to water, which means their electrical efficiency can exceed 100%, typically 300% to 400%. Their efficiency is dependent on outside temperature and typically decreases with decreasing outside temperature. Their efficiency can also change depending on inlet water temperature¹⁵ and set point¹⁶.

A demand flexible heat pump water heater may be set to run between midnight and 6am (off-peak), when the outside temperature is lower resulting in a lower efficiency. By contrast, it may be set to run at lunch time, when the outside temperature is higher, at greater efficiency. Larger storage cylinders may give more flexibility on run times, but would also have comparatively higher standing heat losses.

EV charger efficiency is dependent on the load. At low loads their efficiency decreases as shown in **Figure 5**.

Figure 5: Illustration of charging load and efficiency



¹⁵ Inlet water temperature refers to the temperature of the water coming into the heat pump water heater from the water supply to the house.

¹⁶ Set point refers to the temperature setting of the product e.g. a set point 60 degrees would set the product to store the water at 60 degrees.

The trade-off between product efficiency, and energy cost (or flexibility cost benefit) will be product specific and further consideration is required. From an end-use product perspective, providing external parties who control demand flexible with end-use product level energy efficiency information may be an effective first step to ensuring it is considered.

Home energy management systems

HEMS could also play an important role

Home Energy Management Systems (HEMS) are a physical or digital system used to optimise home energy use while ensuring that a consumer's needs are met. A HEMS can provide automated orchestration of demand flexible products in a similar way to a flexibility provider, but may offer the consumer more control over their energy use, or other functionality. It is possible that a flexibility provider may communicate with a HEMS, and the HEMS controls the demand flexible products in a home. This would mean the communication from a flexibility provider could be broader e.g. provide 5kW of demand reduction, and the HEMS would determine the best way to operate the demand flexible products (based on consumer requirements). Use of HEMS could increase home energy efficiency.

The importance of batteries

Not all end-use products are capable of demand flexibility, as outlined in [Appendix Three](#): Three methods for identifying key end-use products for demand flexibility, these are end-use products where their usage cannot be shifted or altered. Examples include lighting, ovens, cook tops, and televisions. Cooking appliances can draw significant amounts of power, and their use can correspond with peak demand.

The use of battery storage can be used to overcome the challenges of demand flexibility for these products by charging the battery at times of high renewable energy generation, and low electricity use (off-peak). The end-use product can still be used when it needs to but its demand on the electricity system has been shifted.

Next steps

Once feedback is received on the green paper EECA will publish a summary of submissions and confirm the actions to help support the uptake of demand flex capable end-use products. Actions may include:

- Further education to homeowners on the benefit of demand flexibility, and the role of end-use products,
- Develop voluntary specifications for end-use products, and approved lists to support their uptake. This would be a similar approach to: [EV Smart Charger Approved List | EECA](#),
- Research to understand end-use product demand flexibility,
- Further engagement with stakeholders.

Appendix one: Consultation questions

Key end-use products and approach to commercial and industrial

- Q1. The main use cases for demand flexibility presented in this paper are: managing peak demand (generation and line capacity) constraints, optimising renewable energy use, and optimising home energy use.
- Do you think these are the main use cases?
 - What other use cases are there?
- Q2. In the residential sector, the following products have been identified as key end-use products for demand flexibility: EV chargers, heat pumps, electric hot water systems which use a storage tank, fridges/freezer, clothes washers, dishwashers, clothes dryers, inverters for solar and battery systems, and HEMS.
- Do you think these are the key demand flexible end-use products in the residential sector?
 - If not, what are the key products and why?
- Q3. Do you think a standardised end-use product/application-based approach is relevant for the commercial sector, or is a bespoke/customised approach needed?
- Q4. What do you think the key end-use products/applications are in the commercial sector?
- Q5. Do you think a standardised end-use product/application-based approach is relevant for the industrial sector, or is a bespoke/customised approach needed?
- Q6. What do you think the key end-use products/applications are in the industrial sector?
- Q7. What are the barriers to the uptake of demand flexible technology?

End-use product level components for demand flexible capability

- Q8. The paper describes the three main end-use product components for demand flexible capability as: communication protocol, product response, and operational information.
- Do you agree that these are the main components for demand flexible end-use products?
 - What other components or considerations are important for end-use products?

- Q9. Do you think to support the development and uptake of demand flexibility there is a need to create a minimum level of standardisation at an end-use product level (covering communication protocol, product response, and operational information)?

Development of demand flexible end-use products

- Q10. Would you support EECA creating a voluntary approved list of residential demand flexible end-use products, similar to [EV Smart Charger Approved List](#)
- Q11. Would you participate in working groups on the key end-use products to develop voluntary demand flexibility requirements (covering communication protocol, product response, and operational information)?
- If so, what product based working groups would you like to be part of?
- Q12. If you are an end-use product supplier, would you manufacture/import/supply end-use products that meet the voluntary specification?

Appendix two: What are power and energy?

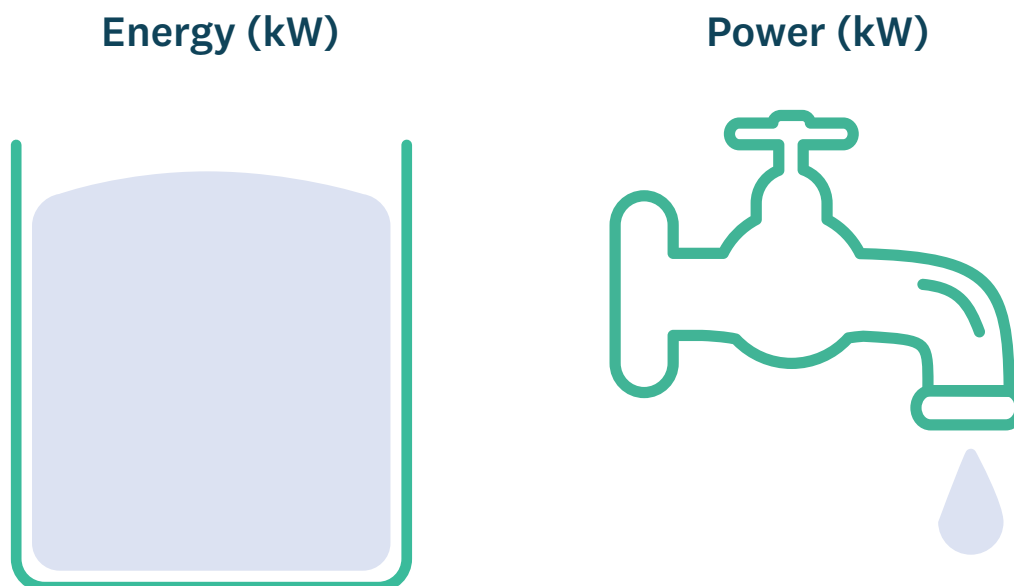
Two important concepts for understanding the benefit of demand flexibility are power and energy.

In this paper, power is the rate of transfer of electrical energy. In this context power can be thought of as an instantaneous value e.g. an electric storage water heater draws 2000 joules per second (2000W). Energy can be thought of as the amount of power over a defined time, for example: Take two electric storage water heaters. Product one has a 500W element, and product two has a 2000W element. To heat the water to the same temperature, they both need to use the same amount of energy (5000 Watt hour [Wh]), but product one will take 10 hours, while product two will take 2.5 hours.

The difference between power and energy is important as a product that has a high-power draw for a short time (product two) may consume the same energy as a lower power draw product that is on for a long time (product one).

For demand flexibility, when energy is used is just as important as how much energy is used.

Figure 6: Difference between energy and power



Appendix three: Three methods for identifying key end-use products for demand flexibility

There are several ways to identify which end-use products are key opportunities for demand flexibility and the best approach (and priority) is dependent on what issue is trying to be solved with demand flexible end-use products, i.e.

- Reducing peak demand to manage either power generation constraints, or line capacity constraints (limitations of electricity system),
- Optimising renewable energy use.

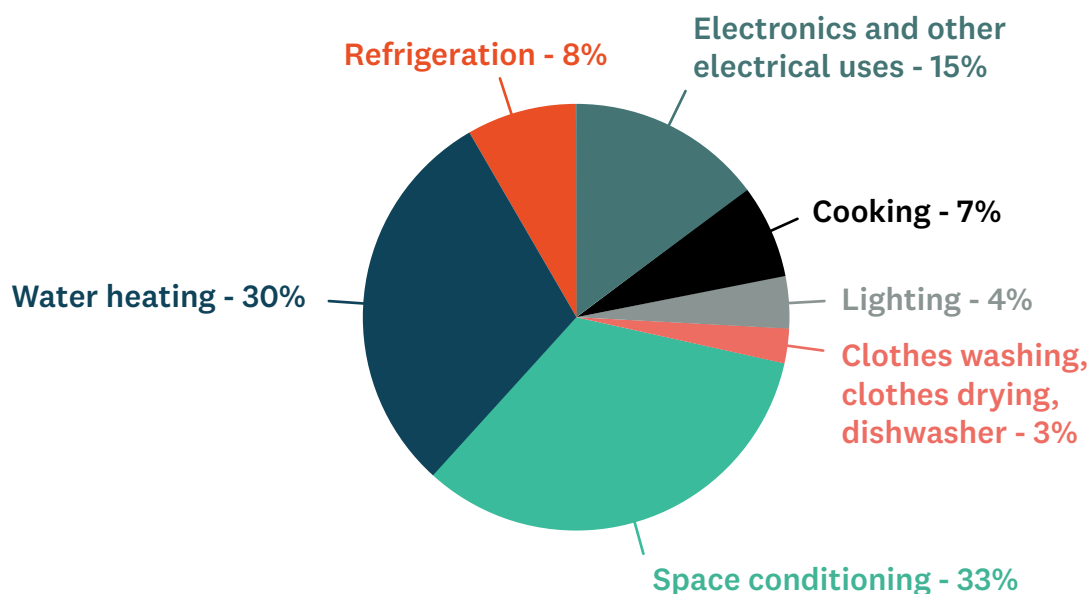
This paper presents three ways to identify key products (residential energy use, peak demand, and power use). See Appendix Two: What are power and energy for information on the difference between power and energy.

Option one: Energy use in the residential sector

One approach to identifying the most impactful opportunities for demand flexibility in the residential sector at an end-use product level is identifying those that have the greatest contribution to annual residential energy use.

In 2023 the residential sector consumed 66,256 Tera Joules TJ¹⁷ (23% of total energy use in New Zealand), with 72% of this being electricity. Figure 6 shows how energy was used in the residential sector¹⁸. Space conditioning accounts for 33% of residential energy use, followed by hot water (30%).

Figure 7: Residential energy use 2023



¹⁷ This excludes motive power, which is offroad, and transport.

¹⁸ [Energy End Use Database | EECA](#)

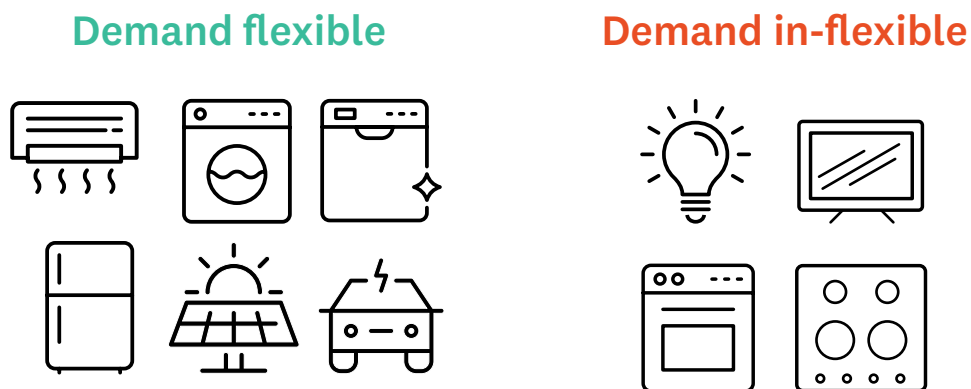
From an energy consumption perspective there is potential for 74% of residential energy use to be demand flexible to some extent (space conditioning, water heating, refrigeration, and whiteware), with space conditioning, and water heating accounting for majority of the demand flexibility opportunity.

Transport (light vehicle) is also a large opportunity accounting for 129,339 TJ of total energy used in 2023 (almost twice the amount of energy used in the residential sector). As the light vehicle fleet is electrified the total energy used by light vehicles will decrease and the charging of vehicles can be demand flexible. There are currently 3,647,252 light passenger vehicles (30/06/2025), with 3.3% (119,458) being plugin electric¹⁹.

The different residential products have varying demand flexibility opportunities. Importantly, not all products will be suitable for demand flexibility. Examples of this are ovens and cook tops where the timing of their power consumption cannot be separated from the timing of food preparation (breakfast, lunch, and dinner). In the future these products may change to enable them to participate in demand flexibility e.g. with battery integration. However, in the short term for these products it may be more effective for overall peak demand reduction to focus on the efficiency of these products.

Figure 8 shows end-use products which could be demand flex capable and end-use products which cannot be demand flex capable (without further development e.g. battery integration).

Figure 8: Demand flexible and demand in-flexible products



¹⁹ [Fleet statistics | Ministry of Transport](#). Electric vehicle is battery electric and PHEV

Option two: Peak demand in the residential sector

Another approach is to identify the contribution of residential end-use products to peak electricity power use. To assess the value of this second opportunity, the Residential Baseline Study²⁰ can inform how each residential product contributes to peak demand across seasons and day of the week (**with a number of assumptions**). **Figure 9** and **Figure 10** show the estimated power demand by end-use and time of day across summer and winter²¹.

Figure 9: Estimated power demand by time of day in the summer and weekday

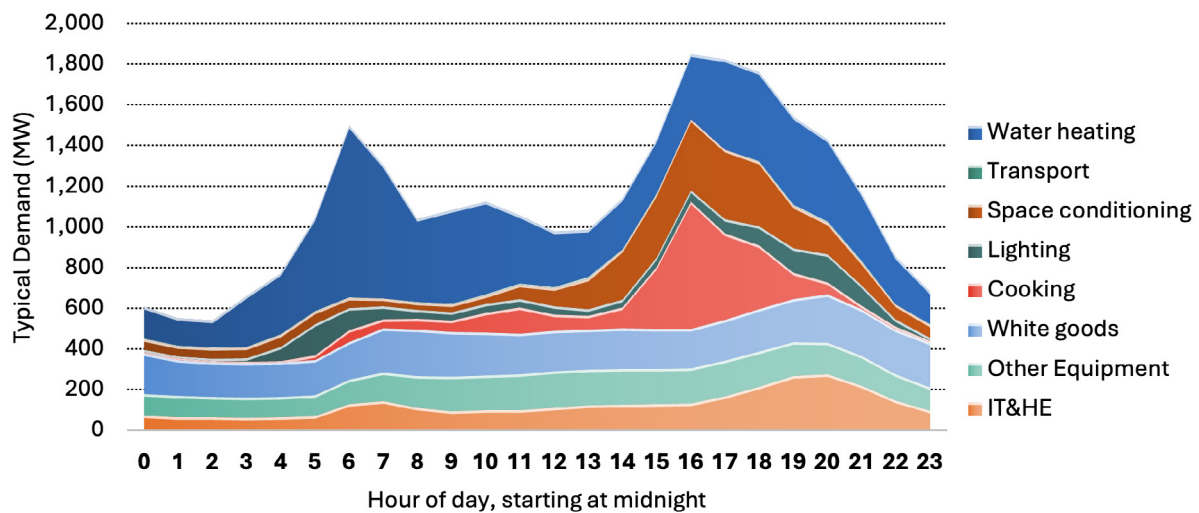
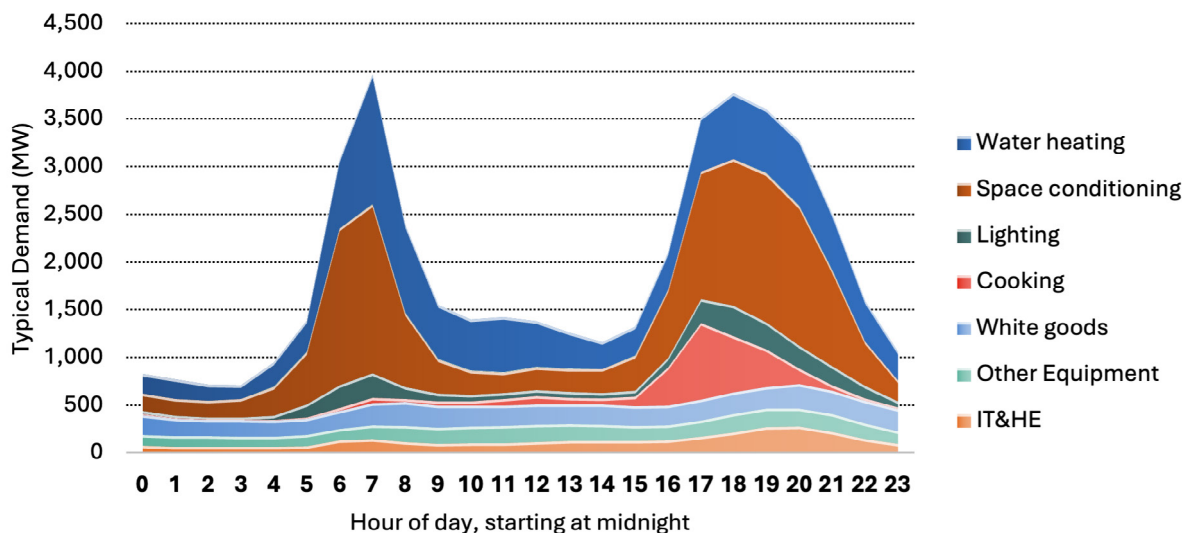


Figure 10: Estimated power demand by time of day in the winter and weekday



²⁰ 2021 Residential Baseline Study for Australia and New Zealand for 2000 to 2040 | Energy Rating

²¹ Transport is not featured, due to relatively low uptake of electric vehicles

It is clear that the season can significantly impact the size of the peak and the combination of appliances that contribute to it. In general, the winter peak is twice the size of the summer peak (4000 MW), mainly due to space heating. Water heating, space heating, and cooking are significant contributors to peak demand, while whiteware, other equipment, and IT & Home entertainment are more constant loads.

These graphs show two daily peaks, at around 6am and 4pm in summer and 7am and 6pm in winter. These peaks are out of phase with peak solar production, which occurs around noon.

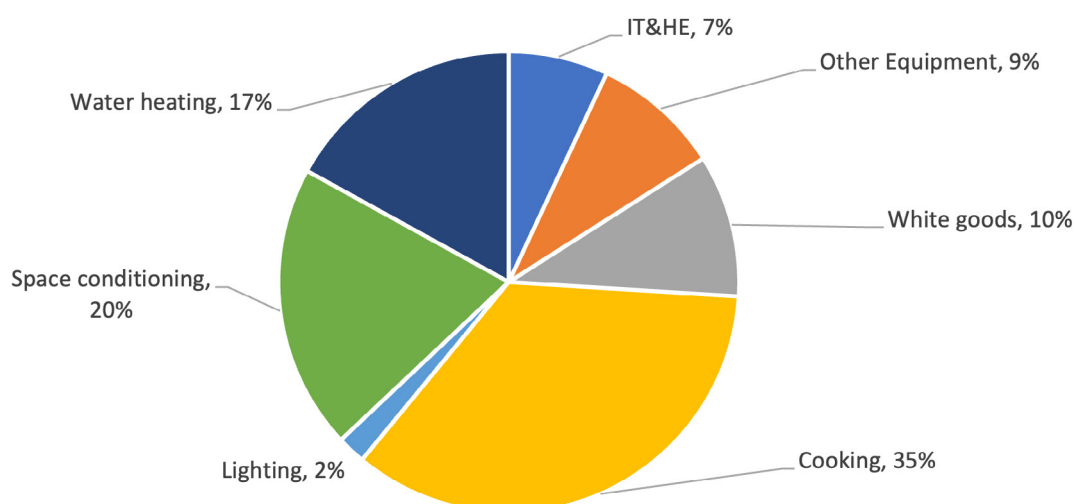
These graphs are based on the current use of products. However, this will likely change over time as the energy system evolves, for example, in response to the widespread adoption of electric vehicles or greater electrification of other products e.g. hot water and space heating systems. Use of these products could create new peaks and change the electricity demand profile considerably. In general, there appears to be a shift towards electrified space heating and hot water systems. This can be seen with the sale of gas water heaters which peaked in 2020 with 56,020 sold and has seen a decrease each year to 39,639 in 2023²².

From discussion with electricity distribution businesses there is already a new peak emerging at 9pm due to time of use pricing for electric vehicle charging.

Figure 9 shows the peak demand breakdown at 4pm on a weekday in summer. It can be seen that cooking (35%) is responsible for the largest power use. This is followed by space conditioning 20%, water heating 17%.

Importantly, an end-use with a low annual energy use (e.g. cooking, 7%), is not correlated with low peak demand (35%). Both the energy use of an end-use and the power use of an end-use needs to be considered when determining priority products.

Figure 11: Peak demand 4pm contribution on a weekday in summer



²² [Sales & efficiency data | EECA](#)

Option three: Theoretical maximum power use

A third way of identifying the most impactful ways of using demand flexibility in the residential sector is to examine the maximum power draw of end-use products in a home. This can show the theoretical maximum peak power consumption per household. **Table 2** shows the maximum peak power consumption of common household appliances.

Table 2: Household products and power use²³

Product	Maximum peak power consumption
EV charger	7.4kW
Electric storage water heater	2-3kW
Oven and stove top (each) ²⁴	2.4kW
Lighting (LED) (multiple)	0.25kW
Heat pump (6kW heat pump with COP of 3)	2kW
Refrigeration (defrost)	0.3kW
Clothes washer, dishwasher (water heating)	1-2.4kW
Clothes dryer (heating)	1.5kW-2.4kW
Other (electronics e.g. Television)	0.2kW
Inverter for battery system	3-5kW
Total	20-25kW

EV chargers have the largest maximum peak power consumption of residential end-use products, which is twice as large as the next largest power consuming end-use products (electric storage water heaters, and ovens and stove tops, followed by heat pumps).

The maximum connection capacity at a home level is 15 kW (230V and 63A), which is significantly more than the grid can provide in a localised area. While homes may have a connection capacity of 15kW, the planned total power draw of all homes in a localised area is less than this, with typical after-diversity maximum demand of between 2.5kW and 5kW²⁵.

While clothes washers, clothes dryers, and dishwashers use a comparatively small amount of annual energy use (as shown above), they have significant power draw of 1kW to 2.4kW, which may make them an opportunity for demand flexibility.

Refrigeration accounts for 8% of annual energy use and has relatively low power consumption (0.3kW), however the defrost cycle of these appliances tends to be the most power intensive mode, and there would be benefit from being able to control them in a demand flexible way.

²³ EECA research

²⁴ Induction stove tops can be higher than 2.4kW, can be as high as 7.4kW.

²⁵ [Code amendment omnibus three: May 2024](#)

Inverters (solar and battery) have not been discussed in the above as they are seen as generation end-use products rather than consumption end-use products, but offer a large demand flex opportunity. Uncontrolled inverters feeding into the grid can create several issues including power quality and overloading, putting the electricity system at risk. Globally there are examples of uncontrolled solar and the issues it can create, e.g. Australia where the Australian Energy Market Operator has outlined the growing challenges with uncontrolled solar inverters to maintain a safe and resilient electricity system²⁶.

²⁶ [V03 - Fact Sheet: Operating electricity grids with high rooftop solar](#)

Appendix Four: EECA has been taking New Zealanders on a journey towards demand flexibility

A timeline of initiatives EECA has been involved in is provided below:

2021-2023:

- **Electric vehicle chargers for residential use²⁷ – Publicly Available Specification published 2023 (first published 2021)**
 - This Publicly Available Specification (PAS) published by Standards New Zealand describes the types of EV chargers suitable for use in residential homes. It provides an overview of things a buyer of an EV charger needs to know and questions to ask sellers of electric vehicles and EV chargers. It also includes a technical specification for energy efficient, safe, and smart residential chargers that will perform well for many years.
- **Electric vehicle chargers for commercial use²⁸ - Publicly Available Specification published 2023 (first published 2021)**
 - This PAS describes EV chargers designed for use in commercial settings, such as private parking facilities for EV fleets and EV charging stations for public or customer use. It includes an overview of what a business procuring these sorts of chargers needs to know and questions to ask of key parties involved in the installation. It also provides a technical specification for energy efficient, safe, and ‘smart’ commercial chargers that are able to be controlled remotely to minimise charging costs without reducing service levels.
- **Smart Home Guidelines²⁹ – Publicly Available Specification published 2022**
 - This PAS has been developed to help New Zealanders improve the way they consume energy. Smart home networks preferentially shift household energy demand to periods of least-cost electricity. Adoption of this approach to home electricity use will bring direct benefits to the adopters but also to New Zealand’s energy system and New Zealanders more generally.
 - The guidance aims to help electricity consumers, appliance retailers, and suppliers of smart home equipment and services to align to best practice. It is designed to contain key smart home advice and point readers to more detailed information.

²⁷ [Electric vehicle chargers for residential use | EECA](#)

²⁸ [Electric vehicle chargers for commercial use | EECA](#)

²⁹ [Guidance for smart homes | EECA](#)

2024:

- **Approved EV charger list³⁰**
 - In 2023 EECA consulted on an approved EV charger specification that covers both smartness and efficiency. The list was published in 2024 and has grown to have over 50 approved chargers.
 - The development of a test method for the efficiency and connectivity of electrical vehicle chargers with the Electric Power Engineering Centre (EPECentre) at Canterbury University.
- **FlexTalk 1.0³¹**
 - EECA worked alongside industry on the FlexTalk 1.0 pilot, which installed demand flexible EV charging functionality on NZ electricity networks. We are now implementing a second stage of this programme.

2025 and ongoing:

- **FlexTalk 2.0**
 - Will add more consumer technologies onto the two-way communication platform created under FlexTalk 1.0 – e.g. electric hot water heating, space heating (heat pumps), solar photovoltaic, home energy management systems, etc.
 - Focuses on retrofitting ‘smartness’ to existing/installed appliances in NZ homes (100 of them) to rapidly show network optimisation and consumer cost reduction benefits. This is a key project to build confidence in smart technology and its potential to help solve security of supply issues.
- **Scaled residential pilot**
 - This suburb-level pilot is designed to evidence demand flexibility as a viable alternative to poles and wires supply upgrades (i.e. asset management planning). EECA is currently selecting a partner for this project.
 - There will be five pilots in total.
- **Scaled industrial pilot**
 - This is planned to assess demand flexibility potential at industrial sites/parks using various approaches (e.g. battery energy storage systems, thermal storage, and hybrid fuel supply). This is also at the project partner selection stage.
 - EECA is conducting research to quantify demand-side flexibility. This research will use analysis and econometric modelling to understand peak demand at regional, national and sector levels, and the potential for demand flexibility.

³⁰ [EV Smart Charger Approved List | EECA](#)

³¹ [The EEA leads FlexTalk in partnership with the Energy Efficiency and Conservation Authority and industry. Read reports from the initial trial.](#)

- **Energy Efficiency and Conservation Act amendment**

- In August 2024, Cabinet approved a package of amendments to the Energy Efficiency and Conservation Act (2000). A Bill is currently being developed.
- This package includes amendments that will enable New Zealand to require 'smartness' of products (i.e. demand flexibility), such as EV chargers.
- We are working alongside MBIE on an approach to regulating EV chargers to introduce minimum demand flexibility requirements, including recommendations on technical details. MBIE has consulted on options to improve the uptake of smart electric vehicle chargers in New Zealand³².
- This work will enable the introduction of regulations and rules once the Bill is enacted.

- **Residential solar photovoltaics (PV) and battery storage systems guideline³³ - Publicly Available Specification published 2025**

- This PAS has been developed to provide good practice advice, information and guidance on solar photovoltaic (PV) and battery storage systems. The guideline provides valuable advice to homeowners' on choosing an appropriate solar and/or battery-storage system aligned with their specific needs.

- **Solar product technical specification for consultation³⁴**

- In September 2025 EECA released a consultation paper on a technical specification to encourage the uptake of efficient and demand flexible solar.
- The specification covered photovoltaic panels, inverters, and batteries.

³³ [Best practice guide - residential solar PV & battery storage | EECA](#)

³⁴ [Solar product technical specification for consultation | EECA](#)

