Understanding the role of flexibility for the power system and people

How much flex is in the system now? How much could there be in 2030?

FlexForum exists to support knowledge sharing and collaborative action across the electricity ecosystem to enable households, businesses and communities to easily and routinely maximise the value of their flexible electricity resources.[1]

Flexibility[2] is all about how households, businesses and communities use electric things like electric vehicles (EVs), solar, battery storage, heating and cooling equipment and energy management systems.

People can use these flexible resources to become more sustainable, and have more reliable, resilient and affordable power.[3] Flexible resources also give the electricity ecosystem another tool for operating a reliable and efficient electricity system.

The power system is struggling to meet performance expectations

The power system has been built and operated based on predictable patterns of electricity use, the available generation fuels, and the resulting stock of generation and network infrastructure.

Performance – measured against reliability and resilience, sustainability and affordability outcomes – has not been perfect but has been broadly acceptable over the past two decades.

But there are growing doubts that the system is effectively delivering acceptable reliability, sustainability or affordability.[4] And these doubts come before we consider the impacts of the step change in demand and supply required to accommodate electrification of transport and process heat as an integral part of our decarbonisation goals.

The underlying challenge is that the way that we generate and use electricity is fundamentally changing. People are changing how, when and where they use electricity. The generation fuel mix

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[1] FlexForum is an incorporated society with 43 Members from across the electricity ecosystem. Members include: gentailers, retailers, metering services suppliers, electric vehicle charger manufacturers, energy management software firms, Transpower, distributors, solutions providers, universities, and some real people.

[2] For readers looking for a technical definition, we think flexibility is the modification of generation injection and consumption patterns, on an individual or aggregated level, often in reaction to an external signal, to provide a service to the owner or within the power system.

[3] FlexForum refers to 5 outcomes people can get using flexibility: Minimise energy-related ongoing costs; Minimise connection costs; Manage reliability and resilience; Reduce emissions; and monetise flexible resources. See the Flexibility Plan.

[4] The current government said in October 2025 that 'Reliable and affordable energy is the foundation of New Zealand's prosperity'. However, it acknowledges, 'that foundation is under strain'. Many commentators have expressed a similar view. See At a glance: New Zealand's Energy Package October 2025.

is changing to include more variable sources such as wind and solar. Electricity infrastructure is exposed to more frequent extreme weather events.

Each of these factors, and others, contribute to deteriorating power system performance, and lots of talk and effort is being directed at responding to ensure the power system continues to support economic activity and keeps the lights on by delivering a sustainable, resilient and reliable and affordable electricity supply.

Most recently, a set of energy sector initiatives was announced on 1 October responding to a Review of electricity market performance. We think the reactions to the review highlight diverging views held by a range of parties on what needs to happen for the power system to navigate the changes and have a well performing electricity system, and that there is no generally agreed set of facts and reasons for the current (poor, middling, okay, just fine?) performance of the electricity system.

Not up for debate is the lived experience of households and businesses with 'Energy costs are now households' second-highest concern after groceries…' and 'Several energy-intensive firms…have already closed or announced plans to curtail production'.

But the febrile environment means there is little agreement on much else, and we see that efforts are not always effectively directed, and progress is in some cases prevented as people pull in different directions.

Flex is expected to have a bigger role in the power system

Flexibility is expected to have a bigger role in the system and in everyday household and business activities as an extra tool to efficiently keep the lights and everything else on, and as a way for people to lower their emissions, improve their reliability and resilience and reduce their electricity costs.

Our Flexibility Plan lists 41 practical steps and tasks for the electricity ecosystem to develop capability, processes and practices which will make flexibility easy and routine for people and the power system.

The role of flex in the power system has been considered by a range of parties including Transpower, the Market development advisory group, and in the BCG Climate change in New Zealand: the future is electric report.

BCG said in 2022 that developing a smart, flexible, power system would save households, businesses and the economy billions of dollars, compared to other potential futures.

> *The smart electricity system of the future will need to be flexible, with an evolution in demand shifting and demand response from today's system.*

The BCG analysis indicated that this smart system requires 2GW of demand flexibility by 2030, with another 2GW in the 2030s and again in the 2040s for a total of around 6GW of flex by 2050. This flexibility was expected to come from electric vehicle chargers, heat pumps, hot water heaters all the way through to large industrial consumers flexing their processes.

We want to get some agreed facts about the role of flex

This is the first of a series of thought pieces laying out a FlexForum view of the role of flex in the power system.

We want to get some agreed facts about the role of flex in the power system of tomorrow, next year and next decade, to provide a robust foundation for deciding where to direct our efforts and scarce resources.

Our starting point is: How much flex is in the system now? How much could there be?

Knowing what resources are on hand is a big step towards harnessing their potential for the benefit of the system, the economy and people.

For most of the power system – the generation and network infrastructure – there are a variety of formal (and often very detailed) records[5] of information on the capacity and capability of these resources.

Very few flexible resources are part of this formal record. There is no inventory of flex in the system.[6]

This means we do not have good information about how much flex is in the system today, what that flex can do, or what it is used for. More broadly, it means we do not have a good reference point for understanding how flex can improve power system performance.

It also means we had to develop our own estimates of flex in the system today.

There is somewhere between 590MW and 1,150MW of flex in the system today

Households, small businesses and large industrial energy users currently provide the system with somewhere between 590MW and 1,150MW of flex[7] for ancillary reserves (reserves), wholesale price risk management, and managing distribution network constraints.

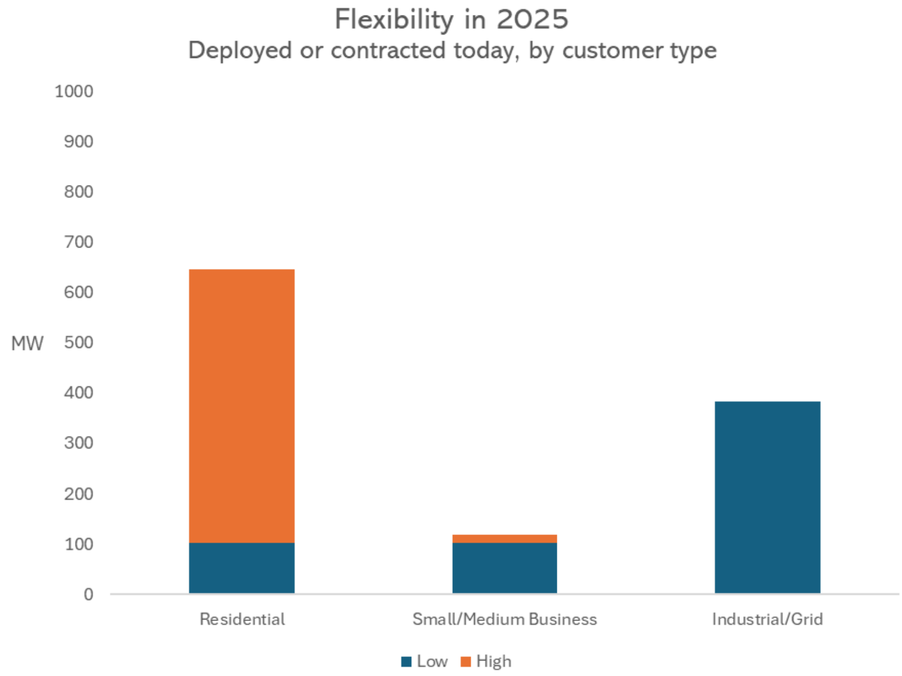
The estimates shown in Figure 1 draw on public and commercial data, and some estimates. We explain the method in the appendix.

[5] The Market operation service providers maintain records of generation and system-level infrastructure capability and capability, while individual distribution networks are responsible for maintaining records of the assets they manage. The record is not comprehensive or in a single place.

[6] A formal inventory and record of flex in the system was a recommendation of the November 2021 Hodgson report into the events of 9 August 2021. That report concluded, amongst other things, that operational awareness of flex (eg, hot water) in the system (irrespective of what it is being used for) was lacking and said 'We propose that in future the demand side's discretionary load be accorded attention equivalent to the supply side.'

[7] These are rounded figures. We found between 524MW and 1,068MW is currently deployed, with a further 64 to 80MW contracted and expected to be available to the system soon, for a total ranging from 588MW to 1148MW.

Figure 1 Quantifying flexibility available today



We counted the flexibility currently available to the system from batteries, EV charging, hot water cylinders and other household devices, and commercial and industrial processes which is actively deployed to shift, shed or shimmy in response to external signals.[8]

The accounting is complicated by the absence of an official record. This means we cannot accurately quantify how much flex is in the system. Nor do we know what flex is used for or how often it is used.

We know for the low flex estimate that most flex comes from flexing of commercial and industrial usage (351 or 60%), then batteries (136MW or 23%) and then flexing of residential hot water systems (100 MW or 17%).

For the high flex estimate the ranking of flex sources changes, with most flex coming from flexing or residential hot water (644MW or 56%), then commercial and industrial flex (367MW or 32%) and finally batteries (136MW or 12%). The high flex estimate is 560MW (or 49%) higher because we do not have good data about the amount of flex available to the system from residential hot water.[9]

[8] FlexForum uses an adapted version of shape, shift, shed and shimmy taxonomy developed by Lawrence Berkeley National Laboratory to describe the various uses of flexibility. This count focused on resources able to provide shift, shed and shimmy flexibility for system uses requiring dependable responses over timescales of days to seconds. We exclude shape-based flexibility provided in response to time-of-use pricing signals. There is insufficient data on the amount of shape-based flexibility which dependably and routinely results from TOU pricing. See the FlexForum Insights Filling holes in the value stack for more discussion of the 4 types of flex.

[9] As an aside, the makeup of the aggregate flex resource has material implications for the jobs it can do, system costs, consumer welfare, economic productivity and GDP. We will dig into this topic in the next article.

Regardless, there is a material amount of flex in the system today. Even the low estimate of 590MW makes deployable flexibility amongst the largest power stations in New Zealand today and about equal to the combined capacity of the Contact Energy gas-fueled generation fleet.[10]

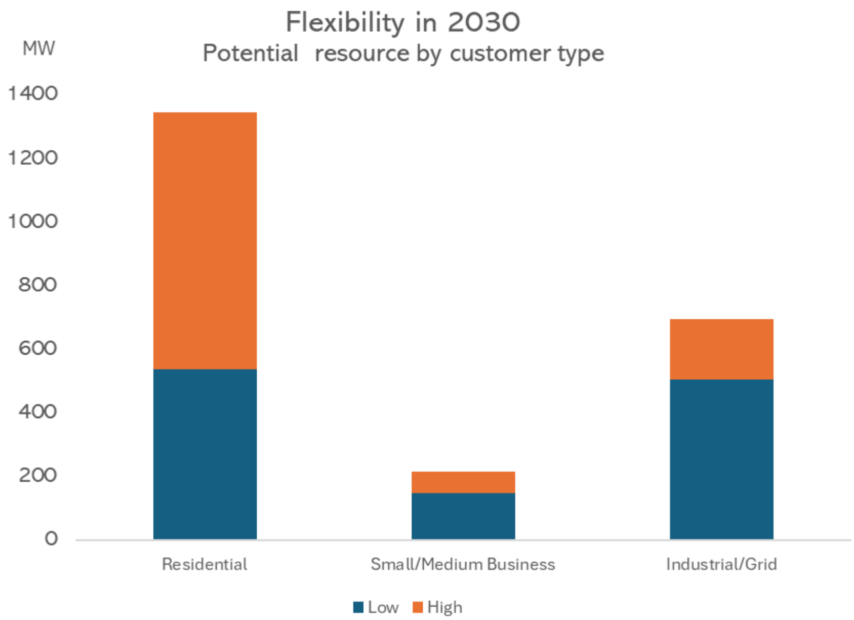
Taking steps to ensure this resource is used efficiently and deployed at the right times for the right reasons is nearly guaranteed to improve all facets of system performance.

An extra 1,160MW of flexibility could realistically be in the system by 2030

We went on to ask how much flex could realistically be in the system by 2030 to provide a reference point to understand the size of the flex resource and the amount of effort and priority to give to chasing the opportunity.

We estimate the potential flex resource in 2030 could realistically be between 1,120MW to 2,130MW as shown in Figure 2 (broken down by consumer size). This is an extra 600MW to 1,160MW of flexibility in the system compared to today and, even using the low estimate, equivalent to adding another Manapouri or Huntly to the system.

Figure 2 Quantifying flexibility potential by consumer size



Our assumptions and method are described in the Appendix. Like all estimates, our figures will inevitably be wrong. But we think some very useful insights emerge.

Working out how to effectively ask households to say yes to flex is worth some effort. Households are likely to represent the largest source of potential flex growth with 700MW or 62% of the increase under the high estimate and would control 60% of the total flex resource. This growth is dominated by batteries.

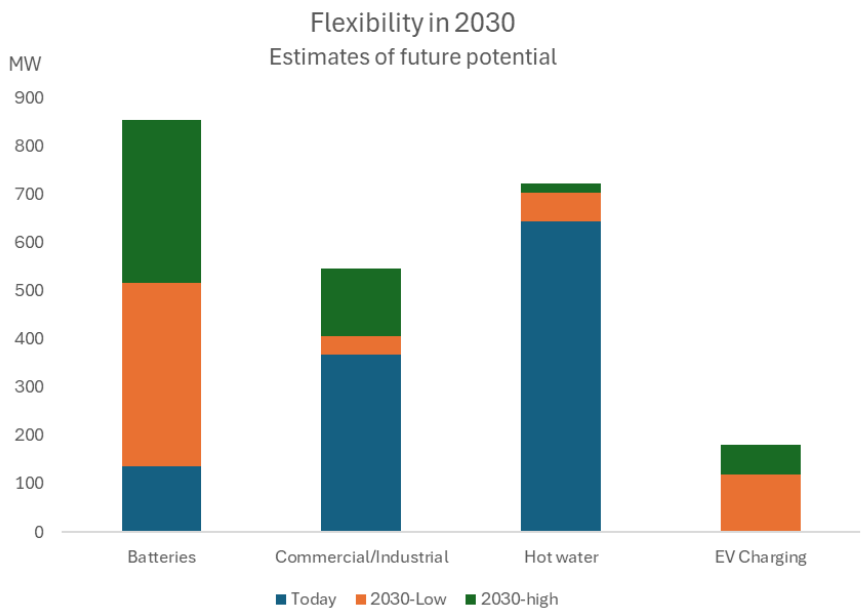
Industrial flex might be low-hanging fruit, but there is less to pick. Industrial flex could increase by 310MW or 28% under the high estimate to be 31% of the total flex resource.

[10] Total capacity of Contact's Taranaki Combined Cycle station (377MW) and Stratford station (200MW) is 577MW.

Flex from small and medium-sized business is estimated to grow the least – 10% of the total growth – and be the smallest source (10%) of flex.

In Figure 3 we show our understanding of where that future flex could come from. By definition, the estimate of future flexibility includes resources already in place (eg, EV chargers and batteries) but is not yet available to the system.

Figure 3 Quantifying flexibility potential by source



The hot water flex resource is mostly tapped. The growth prospects are EV charging and batteries; mostly owned by households.

We need to take steps to ensure these resources are available to the system to be deployed at the right times for the right reasons. If we do the ability for the system to perform and deliver the sustainability, reliability and resilience and system cost outcomes that people want (and expect?) will be materially improved.

Concluding points

Our estimates of flex in the system today, and what could be in the system in 2030, are a sophisticated back of the envelope calculation using imperfect data. Reality will be different than the estimates. Even so, the figures are a useful guide to the merits of unlocking the potential of our growing stock of flexible resources.

Useful insights from trying to understand how much flex is in the system today and potentially in 2030

1. The aggregate flex resource available to the system today is at least 590MW, and we could have up to 2.1GW of flex by 2030 if we play our cards right.
2. The existing and potential flex resources are enough, if used efficiently and deployed at the right times for the right reasons, to improve system performance in the face of system-wide

challenges like energy shortfalls and more localised transmission and distribution network capacity constraints.

3. Efficiently using the flex we have requires treating it like our existing electricity generation and network infrastructure resources: knowing where it is, what it can do, and providing effective pathways to participating in the system.

Flex is part of the solution to many of the challenges and changes confronting the power system and preventing a sustainable, resilient and reliable and efficient electricity supply.

We need to take steps to ensure flexible resources are available to the system to be deployed at the right times for the right reasons. If we do, the ability for the system to perform and deliver the sustainability, reliability and resilience and system cost outcomes that people want (and expect?) will be materially improved.

Importantly using flex efficiently will improve the productivity use and production and contribute to economic growth.

We think that the amount of flex in the system, and the opportunities it provides, is material enough to deserve a serious effort to ensure its value is maximised for people, the system and the economy.

But what are these so-called opportunities? What specific jobs can flex do? What is this value? Who pays? Who benefits?

These questions are the focus of our next article on the role of flex in the power system.

Appendix: Assumptions and method for estimating flex in the system today

The estimates of flex in the system today counted flex which is currently used or will shortly be used by being actively deployed to shift, shed or shimmy in response to external signals. That is, we tried to count flex which is dependably deployed to shift, shed or shimmy in response to a specific request.

Flex which comes from discretionary responses to external signals, such as time of use pricing, was not counted because there is insufficient data on the amount of this shape-based flexibility.

We acknowledge that the Electricity Authority conducted a survey of 'available' flexibility in 2024. However, the Authority asked respondents about what could be made available, not what was used in the system.

The quantity of flex was counted and estimated using various public and commercial sources by resource type.

- **Batteries**: Public information on solarZero Coromandel, WEL battery, Meridian's Ruakaka battery. Assumption that Aurora Upper Clutha trial was about the same quantity of flexibility as Coromandel.
- **Hot Water**: Low estimates from the July 2024 FlexForum insights on maximising the value of flexibility (100MW to 200MW) and a June 2024 Electricity Authority survey of demand-side flexibility (154MW). The high estimates from Concept Consulting Winter 2020 Capacity Margin Report (644MW).
- **Commercial/Industrial** demand response**:** commercial sources from conversations with market participants/industry sources.
- **Electric Vehicle charging**: No information available on deployable EV charging in the system today (other than TOU response or retailer trials).

Other flex resources such as **residential space heating and cooling** and **EV batteries** (V2G!) are not counted because there is no good data.

Appendix: Assumptions and method for estimating flex that could be in the system in 2030

The estimates of flex that could be in the system in 2030 counted flex from resources which could be dependably deployed to shift, shed or shimmy in response to external signals.

The estimates assume the resources and the power system have the capability, processes and practices necessary to deploy the associated flex. Resource types counted are: commercial and industrial demand response; residential hot water systems; and electric vehicles charging. EV V2G flex is not counted.

Estimates of commercial and industrial flexibility in 2030

The estimates of **commercial and industrial flexibility** are based on a Sense Partners assessment for the Electricity Authority (297MW) and adjusted for the Meridian-Tiwai flexibility contract. The high scenario includes 100MW due to process heat electrification. This is an additional 40-140MW of flexibility compared to today.

For commercial and industrial flex, reliable estimates can only really be formed based on a robust assessment of the underlying business process. A full national inventory of the supply chain implications for every C&I firm would be a major undertaking!

The Sense Partners work is based on a prior study (Williams and Bishop 2024[11]) and a significant degree of simplification and qualitative judgment was involved in forming these estimates. We have not tried to unpick all these judgments, but observe that Sense Partners conclude[12]:

- the "high confidence" technical DR potential for the C&I sector is 619MW
- the high confidence capability adjusted DR potential for the C&I sector is 297MW.

By "capability adjusted", we understand that Sense Partners applied a scaling factor that accounted for the capability of the sector (whether firms would have a significant enough electricity bill to warrant an energy manager) or the incentives for firms to offer demand response.[13]

The estimates are fundamentally based on the underlying electricity consumption of the various sectors inside the C&I category. Between now and 2030, these sectors could conceivably expand or contract. Rather than attempting to estimate industry growth rates, we assumed general consumption increases between now and 2030 are likely to be dominated by industrial heat pumps and electrode boiler conversions.[14] A high scenario assumed that 100MW of new electricity demand in the process heat sector will be available and flexible by 2030, in addition to Sense Partner's figure.

Estimates of residential hot water system flexibility in 2030

For **domestic hot water**, we used a combination of the Concept Consulting work (ie, underpinning the today estimates) and assumptions about the additional households that would be built and use electricity for hot water. This is an additional 60-80MW of flexibility compared to today.

Noting that what HWC is used for is evolving (with most retailers piloting or operationalising HWC for price risk management), the total flexibility potential for HWC will most likely grow at the rate of the increase in households. Using actual data and Statistics NZ estimates[15], there could be between 130,000 and 180,000 additional households by 2030.

How much these additional households yield in terms of hot water control depends on choices:

- Choices between gas and electric hot water; we assume that around 20% of new households use natural gas network or install LPG for hot water[16]

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[11] Williams B and D Bishop, 2024. "Flexible futures: the potential for electricity demand response in New Zealand". Energy Policy 195. https://doi.org/10.1016/j.enpol.2024.114387

[12] These figures are Sense Partners estimates for intra-day shifting at any time of year, rather than winter peaks (which is a lower number due to the absence of some primary production during winter)

[13] This used work by ClimateWorks Australia (2013) which looked at the degree of incentives required to entice an organisation into providing demand flex

[14] To obtain a reliable estimate for this, we await EECA's final Regional Energy Transition Accelerator report, due late 2025.

[15] Medium B scenario, which uses 2018 as a base (1.79M) and estimated a growth rate of around 26,000 households per year. However, the latest Statistics NZ figures estimates suggests the growth rate has actually been 40% higher at 35,000 households per year.

[16] See https://www.eeca.govt.nz/assets/EECA-Resources/Heat-pump-water-heater-project_Market-insights-report.pdf, which reports 24% of NZ households use gas for hot water. We are mindful of the fact that, over the past 2 years, the total number of gas

- Choices between resistive elements and hot water heat pumps (which are around 3 times as efficient).

Estimates of electric vehicle charging flexibility in 2030

For **electric vehicle charging**, we developed estimates based on recent surveys about the adoption of wall-mounted chargers with connectivity for domestic EV owners. This is an additional 120-180MW of flexibility. We made no assumptions about public EV charging, as there is not publicly available information on the utilisation of existing chargers.

Today, there are around 125,000 electric vehicles in NZ (BEV and PHEV). The Climate Change Commission's EB4 forecasts overstated the uptake of EVs by a factor of 2[17]; applying that factor to their 2030 forecasts suggests around 550,000 BEVs and PHEVs in the fleet in 2030.

The degree of EV-charging flexibility available to the system depends on both the choice of charging infrastructure by vehicle owners, and their desire to provide any flexibility in their charging requirements to the electricity system.

Like HWC, there is a paucity of information about the use of EV charging to provide flexibility to the system. Since we are focused on the reliable, dependable use of flexibility, our focus here is on smart (i.e., wall) chargers, rather than 3-pin plug chargers[18]. Available survey information includes:

- EECA's March 2023 EV charging research, which suggested that 32% of 712 respondents had access to a wall-mounted charger with connectivity (13% had access to a wall charger without connectivity); and
- EECA's 2024 Consumer survey, which suggested that 36% of respondents who had an EV (n=123) had a 'smart charger'. However, this survey did not distinguish between a smart charger with connectivity, or without connectivity.

As we look to 2030, the degree to which the rate at which new EV owners adopt smart charging is higher or lower than these current figures depend on a range of factors, and particularly how attractive customer propositions are for using their charging flexibility ("yes to flex").

If overall customer propositions are well designed, it is plausible that the current rate of around 32% could be maintained.

If these chargers are 7kW each, there could be 1.2GW of smart charging capacity (with connectivity) in NZ. However, like hot water, not all of these chargers will be available to the system at any point in time. The storage capacity of a modern EV is vastly greater than a hot water

connections (ICPs) has stalled and is actually declining (see Gas Registry Stats); new monthly gas ICPs is around 20% of what it was in 2023. We note that the number of houses built has also declined over that period, although nowhere near as significantly: Auckland Council's completion rate has dropped from around 1800 units per month to 800 units. Hence it is entirely plausible that the rate at which new houses have gas connections is falling.

[17] 223,000 BEVs and PHEVs in 2025

[18] This is not to diminish the importance of vehicle owners' behavioural response to time-of-use pricing signals, which EECA research shows are highly prevalent amongst EV owners today. Our challenge is lack of publicly available data on the reliable reduction in peak period demand that results from these pricing signals; this involves both an estimate of what peak period demand would have been had no TOU signal existed, and the observed peak period demand.

cylinder; at an average driving distance of 40km/day, a modern EV could plausibly go many days without needing charging[19].

Conservatively, we estimate that 10-15% of residential smart chargers can be available to the system at any point in time[20]. This leads to the potential that, at any point in time, there may be 120MW-180MW of smart charging capability in 2030.

In addition, there are currently 1,349 public charging points in NZ, with an estimated charging capacity of over 120MW[21]. If the Government's target of 10,000 public EV chargers is met by 2030, this could increase significantly; a naive estimate would result in nearly 900MW of charging *capacity* in 2030.

However, the critical factor in determining the flexibility that could be provided by these chargers is their utilisation. There is no public information about public charger utilisation.

Estimates of battery flexibility in 2030

For **batteries**, we took announced grid-scale projects (100MW committed, plus an allowance for another 140MW[22] "actively pursued" for our high scenario) plus an estimate of increasing distributed battery adoption (an additional 280MW-480MW by 2030). This is an additional 380-720MW of available flexibility compared to today.

Today, according to EMI data, there are around 11,000 distributed batteries in New Zealand, providing around 80MW of capacity. This number is likely to underestimate the true battery capacity.[23] That said, we note that EECA's 2024 consumer survey suggests that 18% of households that have solar also have a battery, which would also suggest around 11,000 distributed batteries.

According to the same dataset, the current average capacity (which we assume is the instantaneous capacity of the battery in kW, rather than the storage capacity in kWh) is around 7kW (although growing).

At the current install rate (40MW per year), batteries will reach around 280MW of capacity by 2030. This would make Kiwi households and businesses (collectively) the 9th largest power station in New Zealand.

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[19] Despite this, many EV owners may, out of habit, routinely connect their EV to their charger and top up the battery most nights.

[20] This is half the rate used by Concept Consulting to estimate the proportion of hot water cylinders that are heating at peak times. We note that the evolution of vehicle-to-grid charging would fundamentally change this; this would mean that any vehicle connected to a smart V2G charger could provide flexibility to the system, if allowed by the owner.

[21] See https://www.eeca.govt.nz/insights/data-tools/public-ev-charger-dashboard/; we use the mid-point kW rating of the distribution of charger size to calculate the total capacity. We note that scaling up to 10,000 charging points by 2030 may see a tendency to deploy more lower capacity AC charging units, compared to the dominance of high capacity charging units.

[22] The Electricity Authority's generation pipeline lists 100MW committed and 277MW of 'actively pursued'; we have allowed for 50% of the actively pursued category to come to pass before 2030. 'Actively pursued' means where a final investment decision hasn't been made, but other significant milestones have been reached (a location being secured, consent application submitted, or contracts to finance the project executed) then the project is 'actively pursued'

[23] See EMI Installed distributed generation trends (solar with battery). We understand that this may understate the true capacity, for two reasons. Firstly, EDBs were not required to grandfather existing installations into their information provision to the Authority, at the point that the information requirements were introduced in late 2022. Second, we understand from the EA that it is not clear what the kW capacity figure reported by EDBs **represents**: the inverter capacity, or the battery discharge capacity. The inverter capacity could potentially understand the ability of the battery to reduce demand (its discharge capacity), as the inverter capacity may focus on *export* capacity (ie, after demand is deducted from battery discharge).

Of course, with battery prices decreasing, and the prospect of broader finance products becoming available, there is every chance the installation rate will increase. Our high scenario for distributed batteries doubles the installation rate from 40MW per year to 80MW per year, leading to 480MW of distributed batteries in 2030