Sustainable Energy for a Sustainable Future

The role of Solar PV and Batteries in building a more resilient, clean, affordable, and reliable energy system to power New Zealand's low emissions economy.

Sustainable Energy
Association New Zealand

Sustainable Energy for a Sustainable Future

Our electricity network underpins our country's prosperity. In the coming years, as we transition to a carbon neutral economy, it will play an increasingly important role.

We must power not only our homes and businesses, but also our industry and transportation, and do so with 100% renewable energy.

Over the past 100 years, our centralised network has served us well, transporting energy from monolithic hydro dams and fossil fuel plants around the country on poles and wires. Once a symbol of strength and success, our expansive and ageing network, now leaves us exposed with an increasing frequency of severe storms. Security of supply is at risk, as is our ability to meet the increased demand that is forecast. Reliability has decreased in parts, while the costs have increased.

Business, as usual, does not offer solutions to our urgent energy challenges, nor does it deliver on our ambition of better living standards and wellbeing for all New Zealanders.

Distributed Energy Resources (DER), such as Solar PV, Batteries, and wind, embedded in mini and micro-grids, and connected by new business models can play a significant role in building a modern energy system by :

1. Powering New Zealand's low-carbon economy by,

a. **Getting us from 80% to 100%** renewable energy before 2035

b. **Supporting carbon neutrality** by 2050

c. **Meeting increased demand** to power our transport fleet

2. Improving system resilience and reliability by,

a. **Diversifying energy generation** to overcome risks associated with increasingly frequent hydro dry years

b. **Distributing generation** to improve resilience and lower the financial impacts of power outages due to increasingly frequent extreme weather events and from natural disasters

3. Improving fairness and equity, lowering energy costs, and reducing energy poverty through:

a. **Government policy** to ensure equal opportunity for all Kiwis regardless of socio-economic status

b. **Levelling and lowering the cost** of energy by producing it where it is needed

c. **Increasing competition** by creating a secondary market where kiwi households can buy and sell energy for a fair price with their friends and neighbours using the local distribution network

d. **Reducing and managing** peaks at peak demand times, therefore reducing the investment required in the distribution network

4. Providing additional benefits of:

a. **Job creation**

b. **Private Investment** offsetting and government or private generator investment

This brief from the Sustainable Energy Association of New Zealand (SEANZ) proposes an alternative approach to our electricity network and its generation, distribution, and retail component parts, which can operate concurrently with the existing network. Smart energy technologies and business models have created the opportunity to accelerate growth in our economy on the back of resilient, clean, affordable, and reliable energy in a way that benefits everyone.

Smart homes and businesses can be the cornerstone of our sustainable energy network, powering our lives with energy from the sun. We need the leadership to make it happen.

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Our Role

The Sustainable Energy Association of New Zealand (SEANZ) is the peak organisation driving our distributed sustainable energy future.

We establish, maintain, and engage on the platforms where smart energy technologies, stakeholders, legislation, policy, events, and standards operate.

SEANZ represents the interests of organisations, businesses and households embracing Solar PV, Batteries, energy management systems, Peer-to-Peer markets and the business models these technologies enable and represent. SEANZ is led by an industry appointed independent chairperson to ensure neutrality and objectivity.

SEANZ has overseen the safe and sustainable growth in the industry for the last decade. SEANZ membership ranges from technology manufacturers, importers, suppliers, system integrators, corporate electricity generators and retailers, and lines companies – all delivering smart energy solutions.

Solar PV and Batteies can play a significant role in building a more resilient, clean, affordable, and reliable energy system to power New Zealand's low emissions economy

Here's how:

1. Powering New Zealand's low-carbon economy

A. Getting us from 80% to 100% renewable energy before 2035

Burning coal and gas contributes around 20% of New Zealand's electricity and accounts for 10% of our carbon emissions[1]. In 2018, those emissions are even higher as fossil-fuel generation makes up the shortfall in hydropower.

To reach the Government's target of 100% renewable energy by 2035, we need to replace 20% of fossil fuels with renewable energy and meet 100% of the increased demand forecast for transport and industrial electrification. We need to be building new renewable generation ***now***.

One new Solar PV system is installed in New Zealand every 25 minutes. Every month, in excess of 1MWh of battery storage, is installed into people's homes, the equivalent of the Mercury Energy "grid scale" battery in Southdown is installed every 6 weeks.

SEANZ surveys and analysis in 2018 show 30% of Solar PV installations now include battery storage, up from 24% in 2017 and 15% in 2016.

Solar is now the largest form of new generation being installed around the world. In 2018 nearly 100GW of Solar was installed globally, more than 10 times the entire generation capacity of New Zealand. Global investment in Solar was nearly 60% of all renewable generation investment, more than 1.5 times the global investment in new coal generation. In 2017 the world added more Solar capacity than gas, coal and nuclear combined[2].

Transpower, our national network operator, recently released a whitepaper, Te Mauri Hiko, predicting that 1.5 million houses will install Solar PV panels on their roofs by 2050[3], the equivalent of almost 40% of NZ's total current energy needs.

The financial case for Solar PV and Batteries is compelling and improving as costs continue to fall. SEANZ believes we are at a tipping point, where motivation meets economics, and that Solar PV and Batteries can make a significant contribution to getting New Zealand to 100% renewable energy.

[1]https://www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/publications/energy-in-new-zealand

[2]https://phys.org/news/2018-04-world-added-solar-fossil-fuel.html, based on a range of sources such as UNEP and Bloomberg New Energy Finance

[3]https://www.transpower.co.nz/sites/default/files/publications/resources/TP%20Energy%20Futures%20-%20Te%20Mauri%20Hiko%2011%20June%2718.pdf

Government Leadership

What would happen if a new standard was set for all new homes?

Example: Adding network connected solar power system to all Kiwibuild homes would:

- Reduce the annual power bill of an average home by at least 50%.
- Avoid 52,187.85 tonnes of carbon use
- Increase New Zealand's renewable energy portion by 1.05%
- Improve network-level resilience and reliability

Case study

How Kiwi homes help get us to 100% renewable energy

A. This Auckland family installed Solar PV and Batteries and cut their demand from the network to virtually nothing for 17 hours of the day.

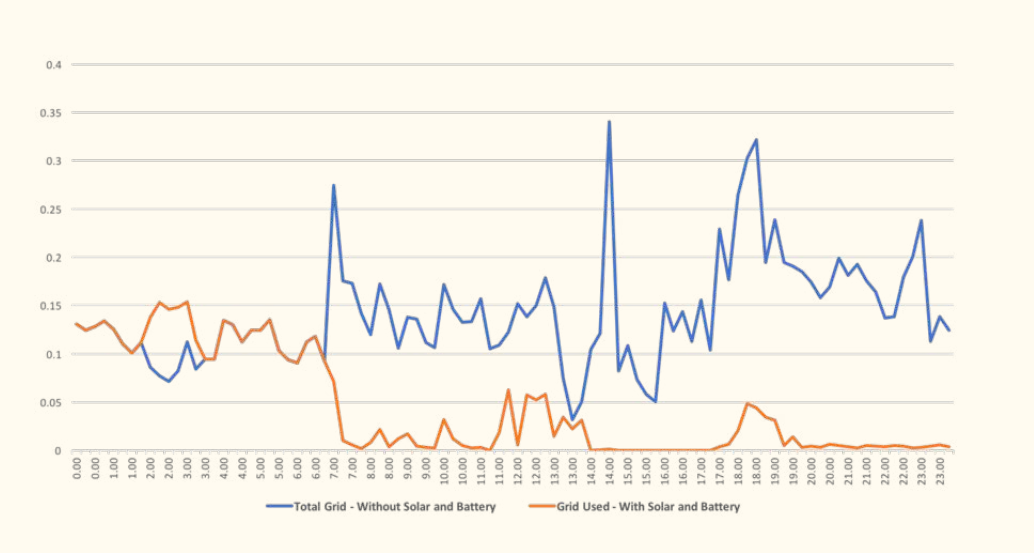
The battery charges from the network in the small hours of the morning when there is low demand across the network and the supply is largely renewable.

The battery discharges to support the home from 7am in the morning as its occupants wake and consume electricity as they prepare for the day. This is traditionally a time of high demand across the network, with higher fossil fuel supply and higher electricity prices, especially in winter.

Solar PV generation, supported by the Battery covers nearly all loads during the day and any excess solar generation is stored in the battery.

The battery discharges the stored solar energy in the evenings to meet the evening peak when the occupants heat the house, cook, and switch on lights and appliances.

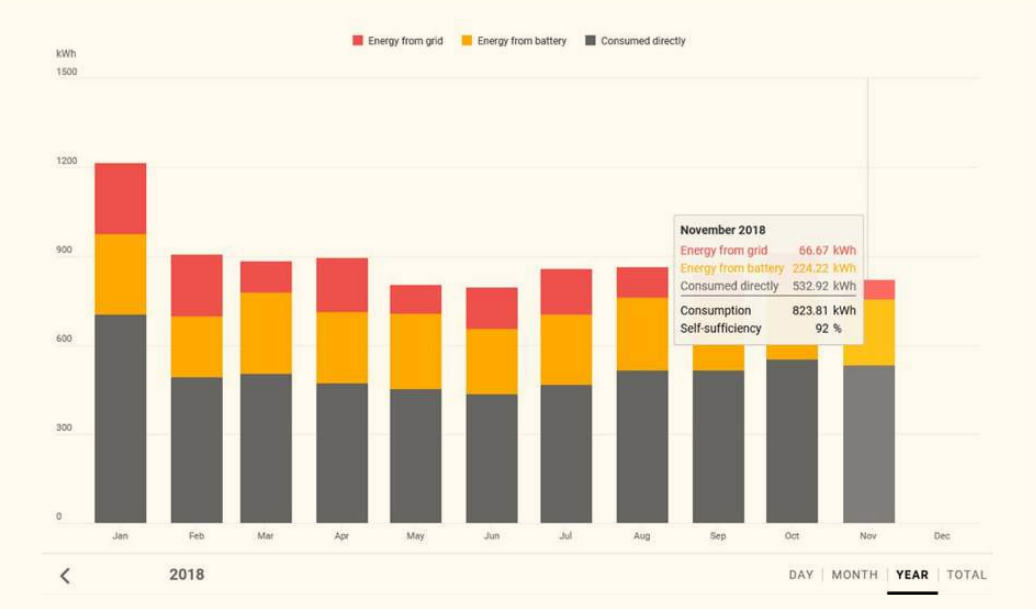
Solar PV charged Batteries reduce or eliminate the need for homes such as this to draw energy from the network in the evenings. Evening peaks are the time of highest demand across the network and are currently met by fossil fuels. If we reduce peak demand we can reduce our reliance on fossil fuels.



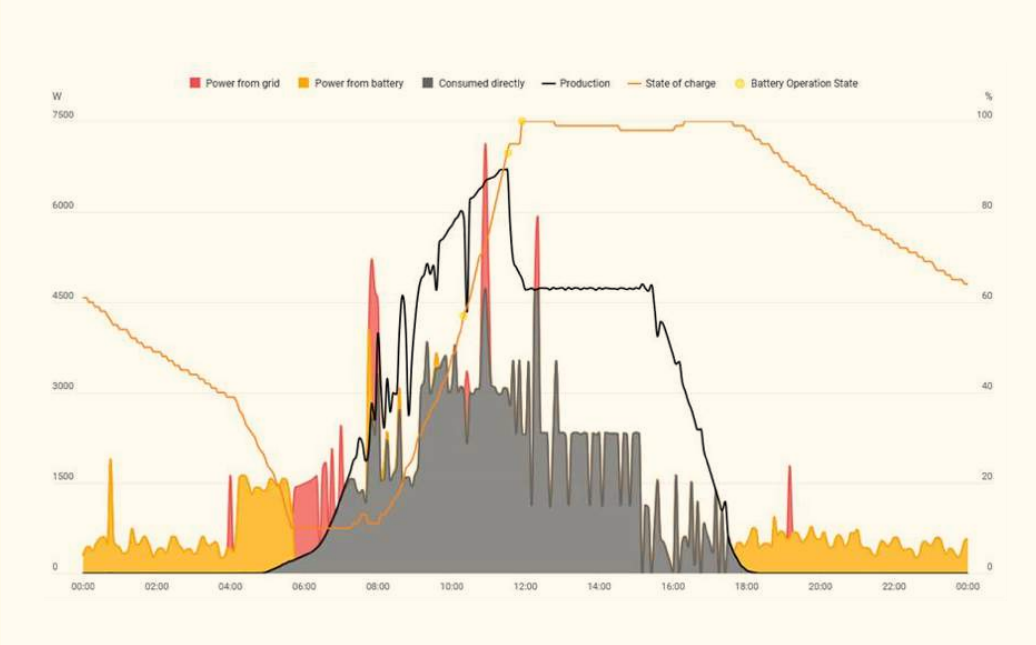
A1. Daily difference in the amount of energy supplied from the grid before and after this Auckland family installed Solar PV and Batteries

B. This Wellington family of four, installed Solar PV and Batteries and now meets ~90% of its electricity requirements from the sun.

This household could easily be 100% renewable if the network supplying their remaining 10% was fossil-fuel free. This household significantly contributes to reducing reliance on fossil fuels by using energy stored in their battery rather than purchasing power from the network during peak times (6.30 to 8am & 5 to 7.30pm), when excessive demand on the network is met by fossil fuels



B1. Yearly summary of energy supply source for this Wellington family that installed Solar PV and Batteries. Grey shows energy consumed as it is produced by the Solar PV system. Yellow shows solar energy stored in the battery and consumed after sundown.



B2. Daily energy supply for Wellington family of four.

B. Supporting carbon neutrality by 2050

New Zealand agreed to greenhouse gas emission reduction targets at the 2016 Paris Climate Accord. These targets are widely expected to increase in the future as the UN Intergovernmental Panel on Climate Change (IPCC) recently warned there are only 12 years left for warming to be kept below 1.5C. We must act decisively and swiftly.

Our global competitiveness is at risk without leadership to electrify the New Zealand economy. Transitioning to a low emissions economy is an opportunity to improve New Zealand's prosperity. Low-carbon, climate-resilient growth is obtainable, if built on the back of a resilient, clean, affordable, and reliable energy network.

C. Meeting increased demand to power our transport fleet

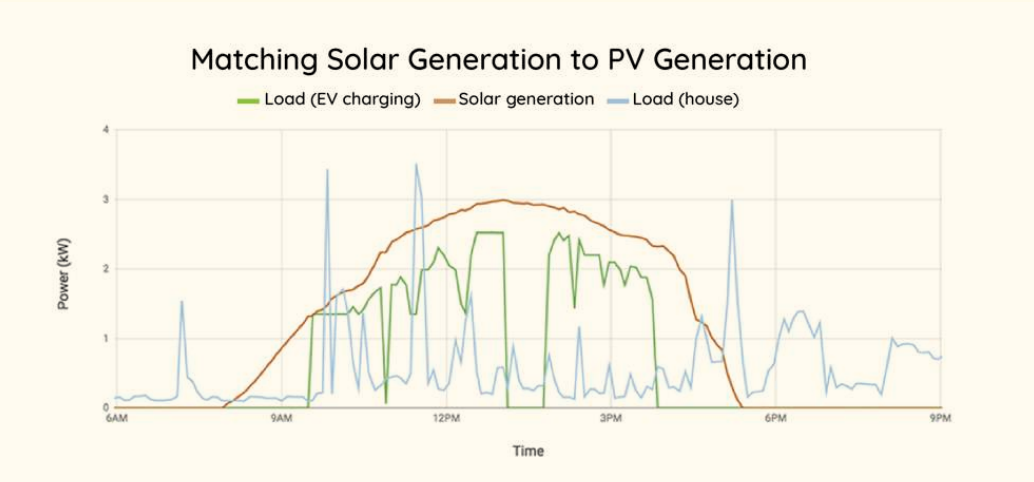
Electric vehicles offer a significant opportunity to lower our emissions, but one that can only be fully realised if we are prepared for where the energy to charge them comes from. Solar PV and Batteries installed in homes and businesses can literally have us driving on sunshine, significantly contributing to the increased demand required to electrify our transport fleet. Just as consumers are attracted to the independence of powering their homes from the sun, SEANZ and its members are seeing early adopters choosing to run their vehicles on solar energy. We expect these technologies to grow in tandem as businesses and households realise additional financial and environmental benefits of the complementary technologies.

Case study

How early adopters are driving on sunshine

A. This Auckland house is using an energy management system to charge an EV when surplus energy is available from the Solar PV system.

The EV is at home during the day and typically used for short hops to drop kids at school and local trips.

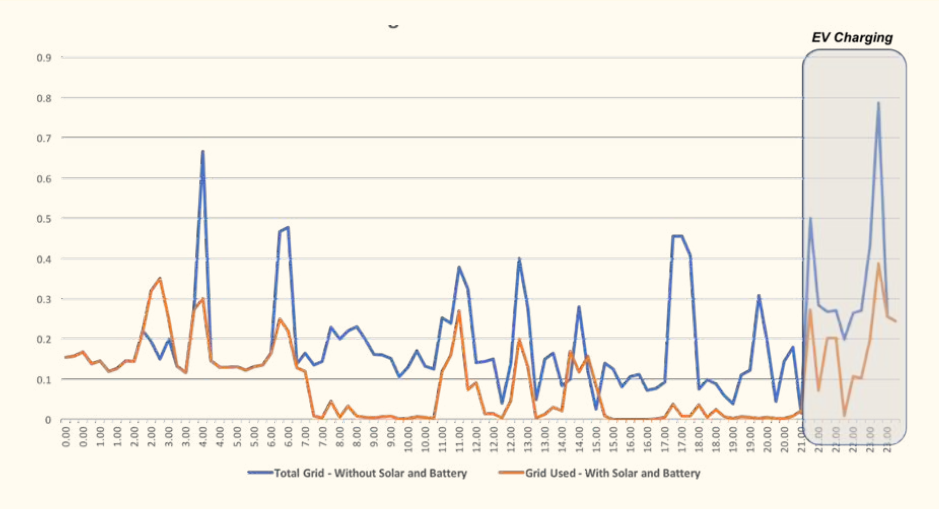


A.1. This Auckland home is charging it's EV and much of it's house entirely from the sun

B. This Wellington home uses Solar PV and Batteries to drop their demand at peak periods to almost zero.

After 9 pm the EV, which has been used to commute to work during the day, is charged by a combination of network electricity and Solar PV-charged Battery.

The battery recharges again overnight ready to meet the morning load.



B 1. Daily difference in the amount of energy supplied from the grid before and after this Auckland family, who have an EV, installed Solar PV and Batteries.

2. Improving system resilience and reliability

A. Diversifying energy generation to overcome the risks associated with increasingly frequent hydro dry years and lower the financial impacts of power outages due to increasingly frequent extreme weather events and natural disasters

New Zealand relies on hydropower for around 60% our generation[4]. Woodward Partners analyst, John Kidd, recently said that the falling hydro lake levels, combined with a gas supply shortage, posed an "immediate risk to NZ's economic performance across many key measures[5]". Limited by its storage, hydro is becoming increasingly unreliable as dry years become more frequent.

A high uptake of Solar PV and Batteries can lower risk across the network by providing alternative energy generation sources spread across the country.

New Zealand's reliance on large power stations connected by high voltage lines leaves us vulnerable to natural events that can cut supply and impact our economy. Storms and earthquakes have knocked out electricity frequently over recent years. In 2017 there were 170 power outages and more than 490,000 people were affected.

Greater resilience and reliability can be achieved by distributing Solar PV and Batteries across the network to reduce reliance on transmission and minimise the impact of electricity outages.

[4]https://www.stuff.co.nz/business/107891655/creaking-and-groaning-new-zealand-energy-system-poses-risk-to-econo-my

[5]https://www.stuff.co.nz/business/107891655/creaking-and-groaning-new-zealand-energy-system-poses-risk-to-econo-my

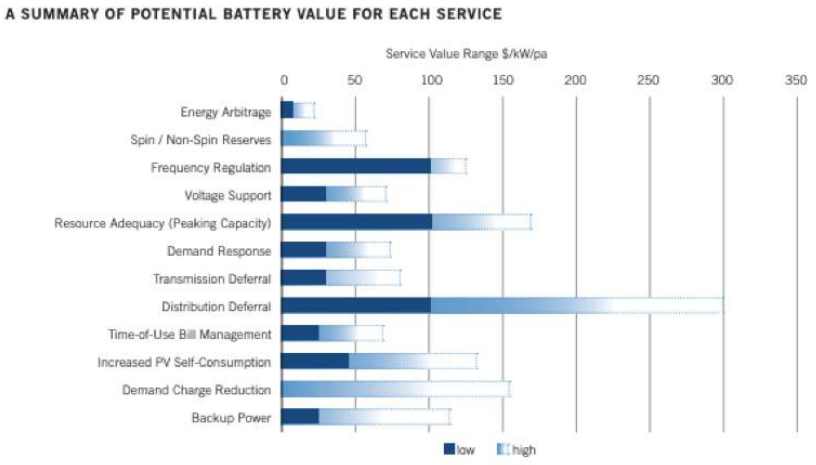
B. Distributing generation to improve resilience

Solar PV, combined with Batteries are increasingly being implemented in resilient power system designs. Although the benefit of having a resilient power system is clear when the electricity network goes down, putting a monetary value on additional resilience investments can be difficult. Each individual business or service provider may place a widely varying value resilience depending on the need for security of supply. A cold store may have a very different need than that of an office building. Historically, resilient electric power systems have been powered by diesel generators and other forms of fossil-fueled generation. Recent experiences, however, have highlighted some risks of relying on diesel as the only backup power option.

Incentives could be offered to provide network support such as frequency regulation and demand response at peak times.

The value of Solar PV and Batteries to the network have yet to be realised in New Zealand, however, there is a significant opportunity to provide valuable network services if such behaviour were incentivised.

Incentives could be offered to provide network support such as frequency regulation and demand response at peak times. These programmes could smooth peaks and troughs in supply resulting in more predictable loads and lead to a cost reduction for all consumers, as the need for peak charging is reduced, and energy may be sold into the system at reduced prices.



The value of each service an battery can offer in New Zealand

3. Improving fairness and equity, lowering energy costs, and reducing energy poverty

A. Government policy to ensure equal opportunity for all Kiwis regardless of socio-economic status

Since 1980 there has been a 79% increase in power prices for households[7] and Statistics NZ recently found that almost 30% of households reported energy hardship during the 2015/16 year[8]. Solar PV and Batteries provide low cost electricity and can put an end to energy hardship.

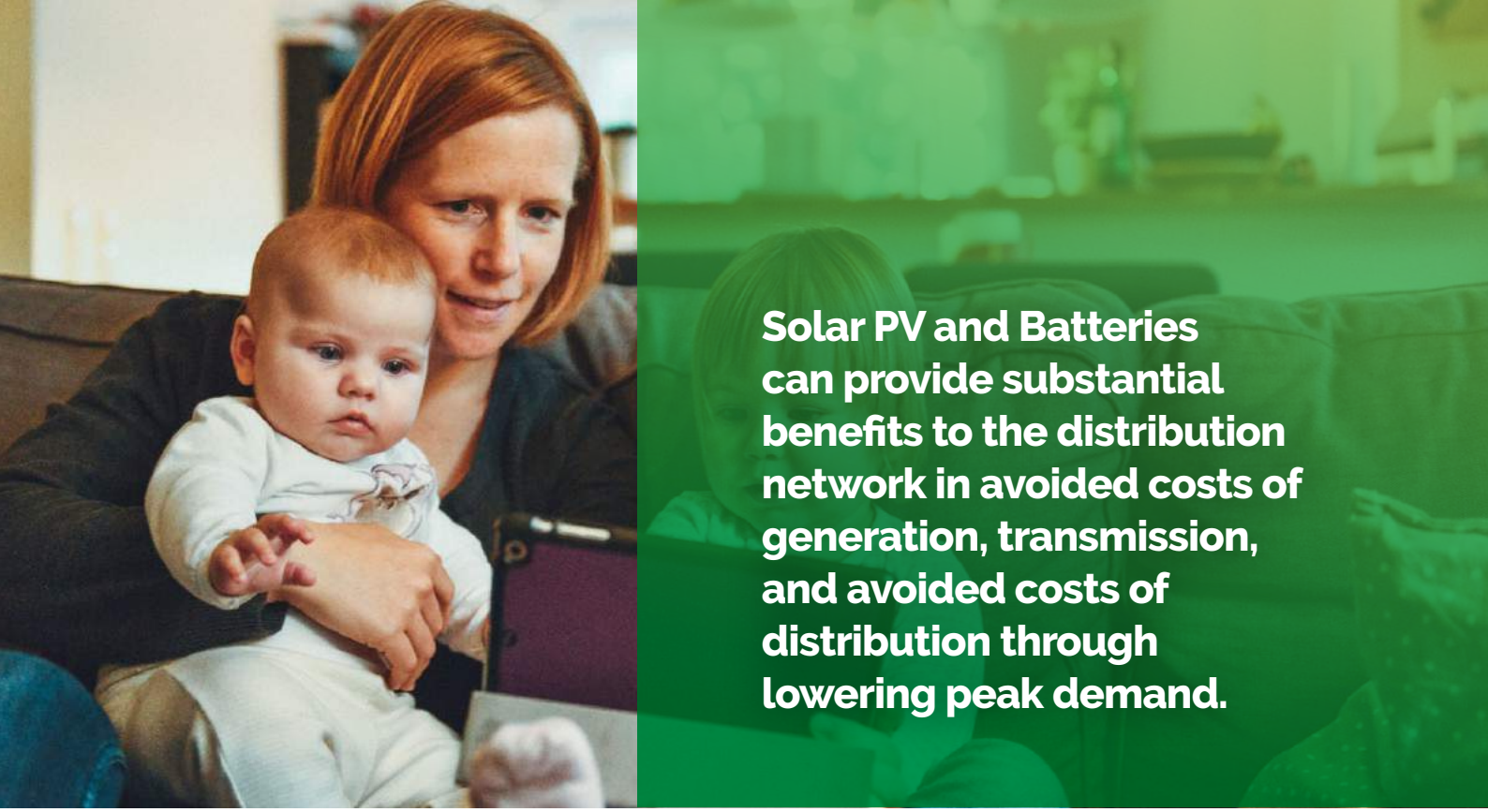
Government Leadership

What would happen if we chose to address energy poverty at the source?

Example: Adding a network connected Solar PV and Battery storage system on all state-owned
social housing

- Reduce homes annual power bill by ~80%.
- 30,734.31 Tonne of carbon avoided
- Increases New Zealand's Renewable Energy Portion by ~0.72%
- Reduces the need for a winter energy payment could save the Government $444.29 to $690.94 per household per annum
- Improves network-level resilience and reliability

[6]https://www.transpower.co.nz/sites/default/files/publications/resources/Battery%20Storage%20in%20New%20Zealand.pdf
[7]https://www.mbie.govt.nz/info-services/sectors-industries/energy/electricity-price-review/consultation/first-report.pdf
[8]http://archive.stats.govt.nz/browse_for_stats/people_and_communities/Households/energy-hardship-report.aspx



Solar PV and Batteries can provide substantial benefits to the distribution network in avoided costs of generation, transmission, and avoided costs of distribution through lowering peak demand.

B. Levelling and lowering the cost of energy by producing it where it is needed

An extremely useful description and summary of the Solar PV and Battery sector in the United States that describes impacts and the value of behind the meter batteries to the network – avoided costs of generation, transmission, distribution, spin reserve and balancing the network[9].

C. Increasing competition by creating a secondary market where Kiwi households can buy and sell energy for a fair price with their neighbours

A network that allows consumers to engage in the sharing economy, buying, selling, or gifting energy amongst their community would provide an added value proposition for consumers and incentivise greater uptake and investment in renewable energy. With a high penetration of Solar PV and Batteries, our electricity network can become an ***electron common***, with bi-directional flows of energy and millions of active prosumers.

D. Reducing and managing peak demand, and therefore reducing the investment required in the distribution network

Solar PV and Batteries can provide substantial benefits to the distribution network in avoided costs of generation, transmission, and avoided costs of distribution through lowering peak demand. This value should be recognised and used to incentivise uptake.

[9] https://ilsr.org/wp-content/uploads/2018/07/Reversing-the-Power-Flow-ILSR-July-2018.pdf

4. Additional benefits

A. Job creation

The Solar PV and Battery industry has the potential to create a significant number of jobs in New Zealand. In the United States, the Solar industry now employs more people than Google, Facebook and Apple combined[10]. Many analyses in the US have revealed that investment in Solar PV and Batteries generates more jobs per MW capacity than any other energy technologies, amounting to 7.45 to 10.5 jobs per MW of installed Solar PV. We can expect more than 2000 new clean tech jobs could be created in New Zealand.

B. Private Investment offsetting any Government or generator capital investment

Currently the main electricity generators are not investing or willing to invest in new renewable generation until there is an increase in electricity demand, resulting from electrification of the economy – transport, process heat and other commercial factors. However, consumers continue to build power stations on their roofs and properties and feed that energy into batteries. This private investment continues day by day, week by week, month by month at the rate of $21,600 per working hour.

Private investment may total $6.5 Billion by 2050 to achieve the delivery of Solar PV supplied electricity predicated in Transpower's report – Te Mauri Hiko.

The increase in private distributed generation capacity will have a bearing on any additional centralised generation capacity and may inhibit, delay or even negate the need for additional investment.

The avoided cost for generators and any associated costs for Government are evident.

[10]https://thinkprogress.org/soaring-demand-for-global-solar-53f11bcaa89e/

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