



BRIEFING

Interim findings: Investigating the impact of high levels of rooftop solar and household batteries on wholesale markets and distribution network costs

Date:	2 October 2025	Priority:	Medium
Security classification:	In Confidence	Tracking number:	BRIEFING-REQ-0018640

Action sought		
	Action sought	Deadline
Hon Simon Watts Minister for Energy	Note the contents of this briefing	15 October 2025

Contact for telephone discussion (if required)			
Name	Position	Telephone	1st contact
Tamara Linnhoff	Manager, Electricity Markets Policy	Privacy of natural persons	✓
Mark Pickup	Principal Policy Advisor, Electricity Markets Policy	Privacy of natural persons	
Neeraj Dutt	Senior Policy Advisor	-	

The following departments/agencies have been consulted

Minister's office to complete:

☐ Approved

☐ Declined

☐ Noted

☐ Needs change

☐ Seen

☐ Overtaken by Events

☐ See Minister's Notes

☐ Withdrawn

Comments



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Purpose

You have requested advice on the potential impacts of high levels of rooftop solar and small-scale batteries on the electricity market, as well as advice on assertions made by Rewiring Aotearoa (**Rewiring**) on the potential benefits for New Zealand's security of supply and electricity prices.

This briefing outlines interim results of research into the potential impact of elevated levels of rooftop solar PV (including a proportion with batteries) on the wholesale electricity market and on costs related to network investment.

This modelling is complementary to your work programmes on reducing security of supply risk; and reducing barriers and incentivising uptake of rooftop solar and batteries by households and businesses. This briefing reports on modelling findings (to date) and notes how these compare to some Rewiring views: that high uptake of distributed energy resources (DER) such as small-scale solar and batteries can decrease system costs overall. It does not contain advice on optimising rooftop solar and small-scale batteries uptake.

Executive Summary

MBIE commissioned modelling to assess the impact of widespread rooftop solar and small-scale battery uptake across households, farms, and businesses. We have worked collaboratively with Rewiring to understand their calculations, and to scope this research.

The modelling contrasts a base case with a moderate and fast uptake rate to achieve Rewiring's more ambitious target of 28GW for rooftop solar and small-scale battery adoption by 2055. Rewiring's target is seven times higher than the base case. We engaged alongside Rewiring to agree the consultant's moderate and fast uptake pathways to achieve the 28GW target.

The research's interim key finding is that increasing solar and battery uptake to the level targeted by Rewiring may increase system costs overall: it could decrease average wholesale spot prices deterring investment in new generation; and could require additional network capital investment. This contrasts with Rewiring's message that DER will reduce system costs overall.

The modelling highlights that at a high uptake rate there may be impacts to manage:

- **Wholesale electricity market:**
 - High uptake could reduce the average annual spot price by \$10-15/MWh. But it could increase seasonal volatility in spot prices thus delay all new grid-scale renewable investments, and heighten the system's reliance on thermal generation for winter supply.

- **Network investment:**

- Using rooftop solar and batteries can help lower electricity demand during the evening peak, which means less need for expensive network upgrades. But if solar exports from homes aren't managed properly, the high uptake rate modelled could significantly increase the need for network investment - increasing network capex by around \$200 to \$300 per household (or installation control point (ICP)) each year.
- Higher network costs can be mitigated. The modelling shows that smart energy management—like limiting solar exports when demand is low, and using batteries, EV charging, and hot water systems wisely - can reduce these extra costs by more than 60%. That would bring down the cost increase to about \$100 per household per year. Your policy work programme already contains several measures aimed at enabling smarter energy use.

This modelling does not produce an optimised solar uptake pathway and so does not tell us if there is a 'sweet spot': an uptake rate where system benefits potentially offset higher network costs. Where this is will also depend on many variables, including electricity demand growth (households and industrials), fuel costs, hydrology, investment in renewables and firming generation, DER uptake rates and technological advances in grid-scale generation and in the efficiency levels of rooftop solar and household batteries. We are not aware of a model available in NZ that contains all these aspects of the energy system.

Work is underway to assess the potential effect on consumers' retail electricity bills, factoring in wholesale and network cost changes alongside household savings. Final results of this modelling are expected in late October 2025.

Recommendations

The Ministry of Business, Innovation and Employment (**MBIE**) recommends that you:

- a **Note** the contents of this briefing. *Noted*
- b **Note** MBIE will publish the results of this modelling exercise, once all three limbs are complete. This is likely to be in November or December 2025 *Noted*
- c **Note** Rewiring have agreed to hold modelling findings in confidence until you have been briefed *Noted*
- d **Note** Rewiring collaborated closely on 'network impacts' work and so have seen this report, and want to talk publicly about it at the Energy Resilience and Affordability Conference on 8 October 2025 *Noted*

- e **Note** that MBIE will ask Rewiring to talk only in general terms about the findings of the network study report on 8 October, for example at the level of detail in this briefing's executive summary. This is because the final critical stage of this work – assessing the effect on consumer retail electricity bills – remains underway.

Noted

Privacy of natural persons

pp. Tamara Linnhoff
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Building, Resources and Markets, MBIE

2 October 2025

Hon Simon Watts
Minister for Energy

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Research was instigated to examine the potential effects of greater adoption of rooftop solar and household batteries

1. MBIE commissioned research into the impact on the electricity market of increased adoption rates of rooftop solar and small-scale batteries by households, commercial premises and farms. The modelling work comprises three parts:
 - a) **Impact on wholesale electricity market outcomes** (on generation, security and prices).
 - b) **Impact on network capital expenditure** (on extra or reduced investment caused by large solar export and demand management).
 - c) **Effect on consumer electricity bills** (the potential flow through effect of wholesale and network cost impacts, plus household savings from solar and demand management).
2. This research provides valuable insight into the potential effects of widespread rooftop solar PV and small-scale battery uptake, as well as testing assertions made by Rewiring Aotearoa (**Rewiring**) about the benefits for New Zealand (see below). It does not aim to design or assess an optimised solar growth path for New Zealand.
3. We have worked collaboratively with Rewiring to understand their assumptions in order to scope this research and hear their feedback on interim results. The modelling was undertaken by expert modelling contractors independently of both MBIE and Rewiring.
4. This briefing focusses on modelling findings (to date) and notes how these compare to some Rewiring views: that high uptake of distributed energy resources (DER) such as small-scale solar and batteries can decrease system costs overall. It does not contain policy advice.

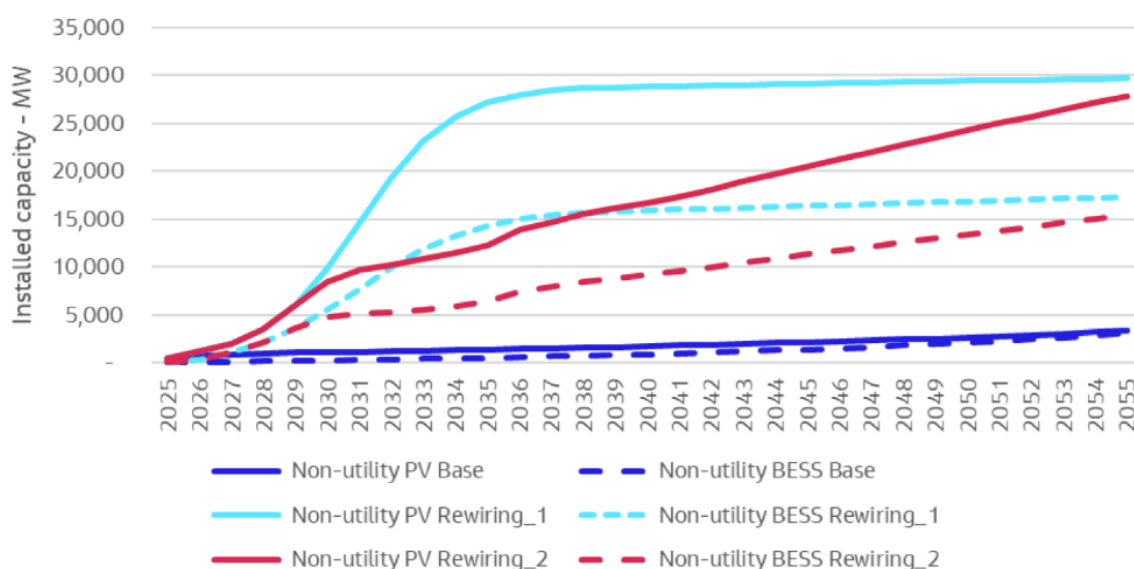
The modelling tested the impacts of different uptake rates to the same 2055 target

5. For context, there are currently around 67,000 residential solar systems (or 3 percent of households) with a total of 360MW of generation capacity. The modelling examines scenarios of significantly higher uptake levels provided by Rewiring (covered below). The Rewiring target assumptions were for a point estimate (final outcome) so Rewiring, MBIE and the expert modeller agreed on rates of uptake from the present day until 2055 to enable modelling of impacts over time to be undertaken.
6. **Table 1** presents the modelling approach. **Figure 1** presents the non-utility solar and battery uptake assumptions in each of the modelled uptake pathways that reach the penetration level of 28GW provided by Rewiring.

Table 1: To assess impacts, the modelling contrasted, for rooftop solar and battery uptake

A base case: 3.5GW by 2055 This reflects the Climate Change Commission's electrification pathway but incorporates the modeller's projections of capital costs and grid-scale generation development. Dark blue line on Figure 1	<i>with</i> Rewiring's more optimistic final uptake level: 28GW of installed solar capacity by 2055 This reflects uptake by 80 percent of households and a majority of farms and commercial sites (around 7 times higher than base case). Two Rewiring uptake scenarios were modelled: 1. Rewiring fast: achieves around 75 per cent of the target 28GW by 2035. 2. Rewiring moderate: still achieves 28 GW, but at a more moderate uptake rate.¹ Light blue line on Figure 1 Red line on Figure 1
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Figure 1: Modelled uptake rate for solar PV and batteries by scenario (agreed with Rewiring)



The modelling considers Rewiring's claim that rooftop solar and battery use could allow for an additional 15 days of hydro

7. Rewiring considers rooftop solar a more efficient investment for New Zealand, and that fully electrifying New Zealand homes would significantly reduce costs to consumers over time, while significantly lowering emissions.
8. Rewiring has also made specific claims in the media, and in its recent 2025 Manifesto, on the extent of this benefit. Namely:

¹ Because of the differences in the rate of uptake in the two Rewiring scenarios, the volumes of solar don't completely align in 2055, so are referred to in the report as being around 28 GW. The actual value modelled for case 1 in 2055 was 29.723 GW with 27.830 GW for case 2. This compares to 3.467 GW in the Base case.

- *In an earlier paper on farming:* that 5,000 farms with mid-size solar systems could provide 30% more electricity to the grid, and an 11% increase in solar production during a dry year would allow for an additional 15 days of hydro storage.
 - *In their 2025 Manifesto:* if 9kW solar systems were installed on 50% of homes in Aotearoa NZ, there would be 225GWh of extra production in a dry year. The same extra production of electricity could also occur with 9kW systems on 25% of homes and 300kW systems on 15,000 farms.
9. In general terms, Rewiring considers that DER can assist New Zealand to decrease energy system costs, overall.

Interim key finding

10. **The research's interim key finding is that increasing solar and battery uptake to the level targeted by Rewiring may increase system costs overall:** it could decrease average wholesale spot prices deterring investment in new generation; and could require additional network capital investment. This contrasts with Rewiring's confidence that DER will reduce system costs overall.
11. The modelling highlights that at a high uptake rate there may be impacts to manage:
- **Wholesale market impacts:** Average spot prices may fall by \$10–15/MWh. But at the same time there would be increased seasonal volatility in spot prices. The first factor would delay grid based renewable investments, and second would heighten the system's reliance on thermal generation for winter supply.
 - **Network investment pressures:** Rooftop solar and batteries can reduce peak demand, but the high uptake rate modelled could increase the need for capex and drive costs of \$200–\$300/year per household (or installation control point) per year. The active demand management modelled mitigated the cost increases by 60%: bringing capex increases (per ICP) to an increase of about \$100 per ICP per year.
12. This modelling does not produce an optimised solar uptake pathway and so does not tell us if there is a 'sweet spot': an uptake rate where system benefits best offset higher network costs. Where this is will also depend on many variables, including electricity demand growth (households and industrials), fuel costs, hydrology, investment in renewables and firming generation, DER uptake rates and technological advances in grid-scale generation and in the efficiency levels of rooftop solar and household batteries. We are not aware of a model available in NZ that contains all these aspects of the energy system.
13. The next two sections explain these key findings in more detail.

Impact on wholesale electricity market outcomes

14. In more detail, the modelling finds:
- *Spot prices drop but become more volatile:* From 2030 to 2045, average spot prices may drop by \$10–15/MWh, but prices could swing more between seasons—very low in summer and very high in winter.

- *Renewable investment delays:* New large-scale renewable projects may be put on hold from 2028, restarting in the mid-2030s or 2040s depending on uptake speed.
 - *More thermal generation needed:* With fewer new renewables and low solar output in winter, the system may rely more on thermal generation to keep supply secure.
 - *Less use of existing grid-scale generation:* Distributed solar reduces how much existing power stations are used, especially in summer. This could affect their financial viability and may require government policy to manage.
 - *Higher system costs:* Overall generation costs rise due to the higher cost of rooftop solar and batteries, plus high winter prices and lower hydro storage.
 - *Winter supply risk remains:* While solar helps keep lake levels higher before winter, low solar output in winter means more hydro is used then - leading to lower lake levels by July/August and greater risk to supply. We do not find the same '15 days extra storage' as Rewiring earlier claimed.
15. Many of these effects mirror those found in other markets, where high solar penetration has led to zero and even negative spot prices during periods of excess solar generation, such as Spain and Australia. One major difference between New Zealand and these countries is that we have a winter peaking load which may accentuate this effect as peak solar generation will occur here in summer when demand is lowest.

Impact on network capital expenditure

16. In more detail, the modelling finds:
- *Managing solar exports and smart energy use* can help reduce network upgrade costs.
 - *Without changes, network costs could be much higher* than otherwise because midday solar generation puts pressure on the system, and current networks aren't built to handle it.
 - *These costs could be cut by at least 60% - or even more - by smartly managing* hot water systems, EV charging times, and limiting solar exports when demand is low.
 - *Using batteries to reduce peak demand could lower the upwards cost impact even further*, possibly to just tens of dollars per household each year.
17. Smart energy management could help cut costs - but it depends on consumer choices. The model assumes a very high level of control over how people use electricity, but it's unclear how much control consumers are willing to hand over to others (like retailers), or how much effort they'll put into managing their own energy use. Encouraging people to use tools like home energy systems, or giving them incentives to shift when they use electricity, could avoid higher network costs from occurring - especially by reducing the level of solar exports to the grid during low-demand times.
18. There is significant wider work underway to support active management of demand – including recent Electricity Authority decisions requiring time-of-use pricing, updates to Electricity Safety Regulations, progressing smart charging regulations and other consumer information and technology pilots run by EECA.

19. This study didn't look at possible savings in transmission costs - but there could be some. The focus was on low-voltage network costs, so it didn't explore whether rooftop solar could reduce Transpower's transmission costs. There might be similar savings in higher-voltage networks by managing peak demand, but these are likely to be small over the long term. That's because transmission investments are planned far in advance, and the modelling shows that large-scale generation will still grow - just more slowly due to high levels of rooftop solar.

Work underway: estimating the effect on retail electricity bills

20. Work is underway to model the flow on effects of the modelled wholesale and network impacts (of the Rewiring Cases) on retail consumer electricity bills. This work is being undertaken by contractors in liaison with both Rewiring and EECA and is expected to be completed in late October 2025.
21. This work will provide a specialist modelling tool that parties like EECA and Rewiring will be able to use to study factors that affect consumer bills. The model is not intended for general public release due to its specialised nature. Instead, MBIE has asked the consultant to prepare a short report that can be published on its findings.

Next steps: a final briefing then publication of this research

22. Once complete, we will brief you on the full suite of modelling results, with a focus on the estimated impact of different solar PV and battery uptake rates on retail customer electricity bills.
23. This programme of research was developed in conjunction with Rewiring to evaluate how its solar and battery scenarios could affect the electricity market - and for MBIE to test its public claims about benefits for New Zealand. While the study is based on modelling a possible future, the results will offer useful insights for electricity networks and help shape future policy.
24. MBIE plans to publish the full results once all parts of the study are complete - likely in November or December 2025, after the final report on consumer bill impacts is reviewed and approved by MBIE and EECA.

Rewiring has requested to be able to publicly discuss the interim findings

25. Rewiring wants to speak publicly about the network cost modelling at a conference on 8 October.
26. Free and frank opinions
27. MBIE plans to share all three completed studies with Rewiring at least one week before publication.