



TRANSPOWER

Te Kanapu

Fuelling growth by enabling a diverse mix of generation

Insights paper



Developing a
future grid
blueprint for
Aotearoa

About Te Kanapu

- Te Kanapu is developing a future grid blueprint to guide Transpower's strategic, least-regrets transmission investments that will support New Zealand's energy future, economic growth, and transition to net zero by 2050.
- We know there are many potential options for how New Zealand's energy system will evolve and we can use largely renewable electricity to meet future demand.
- Our role is to identify the option that enables the lowest cost yet highly reliable and low emissions power system for everyone in New Zealand – industry, business, communities and households.
- There are a range of options as well as transmission upgrades. We are committed to invest responsibly in the grid and only where there are clear benefits to everyone in New Zealand.
- It can take 7-10 years to consent and build new lines. That's why we have to start planning now.
- This insights paper has been completed as one part of the Te Kanapu programme.



Identifying the lowest cost pathway to a secure and sustainable future.

Overview

As part of our [Te Kanapu initiative](#) to develop a future grid blueprint, it is important we understand New Zealand's future and how our electricity system can support economic growth.

Changes in the generation mix and an increasing volume of distributed energy resources, such as solar and wind generation, will have a material impact on costs, reliability, emissions and our electricity networks – the infrastructure that carries electricity from where it is generated, to where it is used.

Our work is focused on identifying the pathway to the lowest cost, reliable and sustainable electricity system that enables New Zealand to leverage its renewable resources for growth.

We need to understand these changes and the impacts they have on the energy system. Only then can we identify the best approach to meeting an increasing demand for electricity at the lowest overall cost to everyone in New Zealand – industry, businesses, communities, households and individuals – while continuing to ensure a secure and sustainable electricity system.

In this insights paper, we've taken a deep dive into how New Zealand could meet increasing demand for electricity in a growing economy through different generation choices and what the impact of each choice might be on cost, reliability and sustainability.

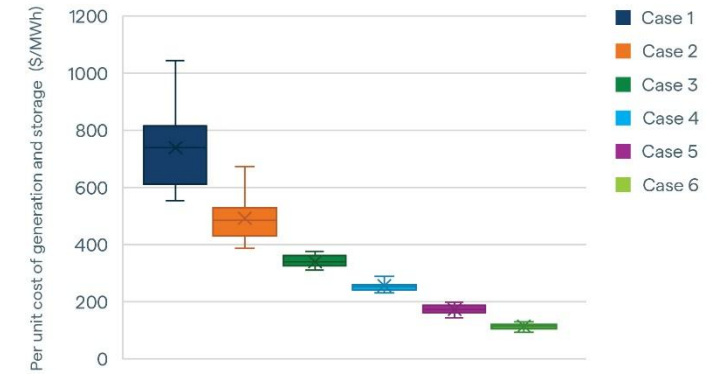
By identifying the lowest per-unit cost of generation and storage, we can begin to understand the generation and technology mix that will deliver the most affordable electricity, and enable new industries and the electrification of existing activities into the future.

To date, we have not explored in any detail how different generation choices may impact the existing or future electricity network, although, as the owner and operator of New Zealand's high-voltage transmission infrastructure, we will need to do so.

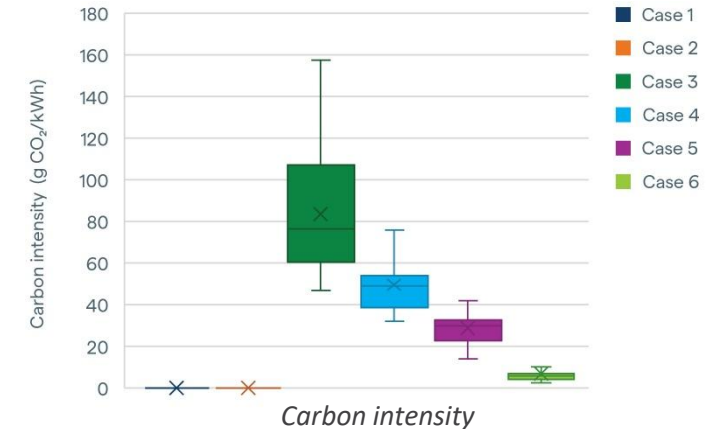
The role of networks is at the heart of our work on a Grid Blueprint for New Zealand to determine the overall lowest cost pathway to a secure and reliable power system. Over roughly the past 100 years, this infrastructure has served the country well. As our nation grows and more generation is needed to meet demand, we believe it is critical to also explore the future role of New Zealand's existing networks, along with what additional capacity may be needed, to answer the question around their ongoing role in enabling the lowest-cost pathway to Aotearoa's energy future.

What does the Insights Paper cover?

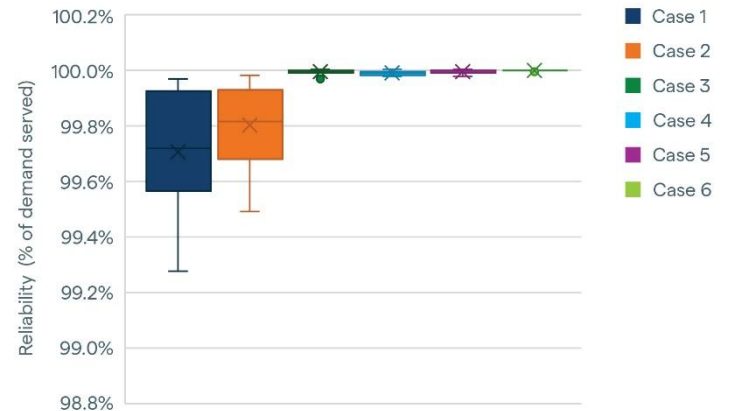
- We outline six possible ways New Zealand could meet increasing demand for electricity, through different combinations of new generation, and how each case delivers on the energy trilemma.
- We start just using local roof top solar and batteries then progressively introduce a wider range of generation sources.
- We found that, given various assumptions, a geographically and technologically diverse range of generation sources, including distributed resources, significantly reduces the cost of the new generation and storage.
- We also looked at the impact on electricity networks in each case.
- The lower generation cost with a diverse generation mix highlights the enabling role of electricity networks, both transmission and distribution, in New Zealand's future electricity system.
- However, the cost of network investment required to support this is not calculated. Our Grid Blueprint will identify the network costs and optimise this with different generation mixes across our five Te Kanapu scenarios to establish what combination gives the overall least "system cost".



Per-unit cost of generation and storage

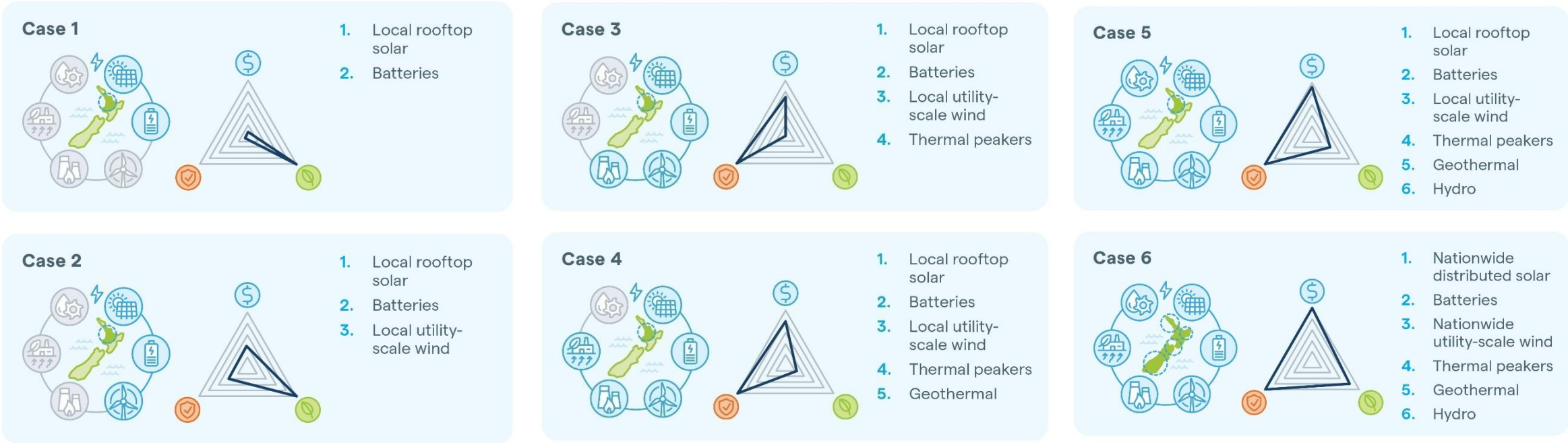


Carbon intensity



Reliability

A nationwide mix of wind, solar and batteries combined with geothermal, thermal, and our existing hydro fleet balances the energy trilemma and produces a strong outcome for NZ Inc



Increasing enabling role for electricity networks



Affordability



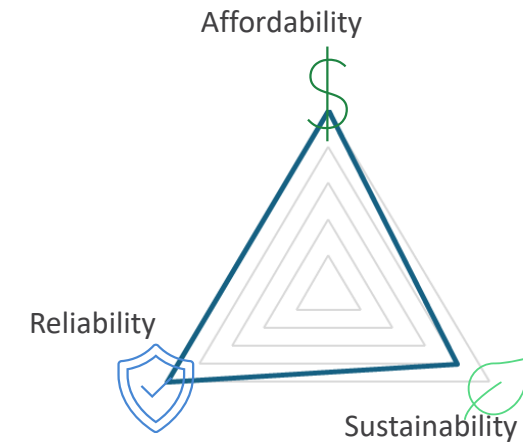
Sustainability



Reliability

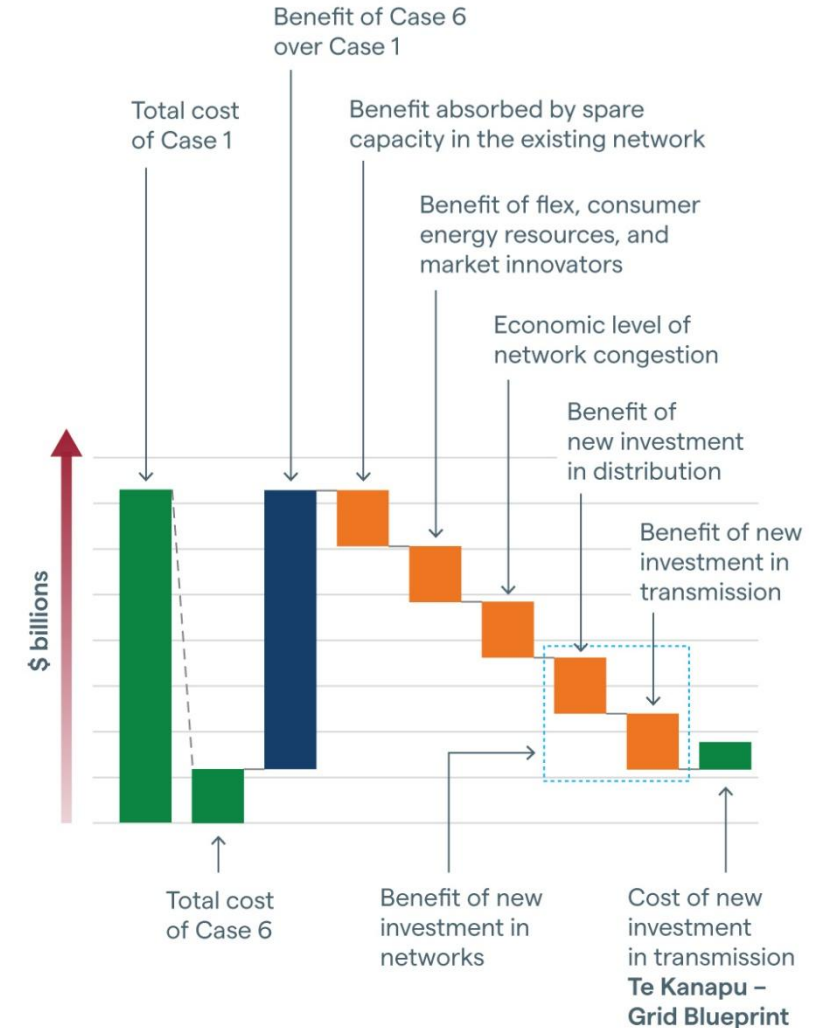
What does this mean?

- Our analysis indicates that a diversified mix of technologies supported by networks, is the better solution for delivering a lower cost, lower emissions, reliable system in a growing economy.
- That's reflected in what we are seeing – a strong grid connection pipeline of new largely renewable generation and storage projects as well as a greater uptake of distributed solar and batteries in distribution networks
- If consumers want to invest in rooftop solar and/or batteries because it works for them – go for it! It's all part of that diverse mix. However, it's a reminder that focusing on a single technology solution, will not be the best option for meeting future demand.
- This work helps to support our work to develop a Grid Blueprint for 2050.
- Our work underway to optimise the generation mix in each of the five potential Te Kanapu future scenarios, enabled by a range of network solutions, is important to achieving the lowest overall power system cost to reliably meet future growth.



What's the takeaway?

- That the 'benefit' from relying on a more diverse mix of generation to meet future demand is significant.
- From our analysis, using the lowest and highest Te Kanapu growth scenarios, the difference in the total annual cost in today's dollars to generate the additional electricity in 2050, over that we use to day, is \$10b (lowest growth) to \$35b (highest growth scenario).
- The net present value of the accumulated 'benefit' across all years out to 2050 comparing Case 1 to Case 6 is \$42b in the lowest growth scenario and \$128b in the highest.
- This needs to be offset by the transmission and distribution network investment required. Our analysis is now underway

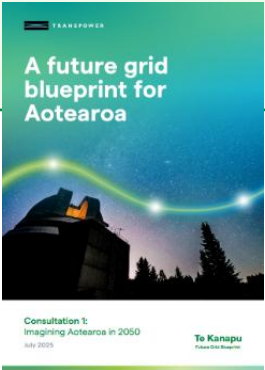
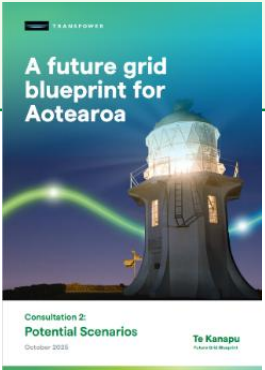
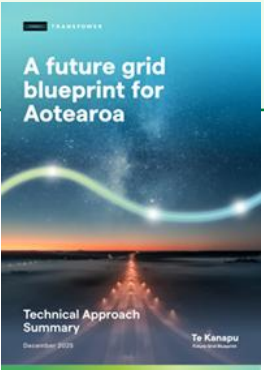
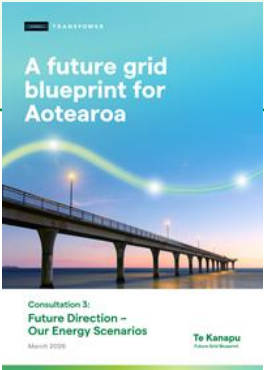


Schematic illustration of costs and benefits to achieve the lowest total system cost. Actual numbers and breakdown fractions are indicative only.

What's next?

- The results have given us some interesting insights. However, there is a lot more to do especially the required network investment.
- Over the years, New Zealand has invested in a vast electricity network that plays an important role in today's system.
- This network enables us to harness and use our wealth of renewable resources.
- Getting this right will ensure the lowest future cost of both electricity and energy, enabling growth and in the long term make it more affordable to live in New Zealand.
- We expect that maximising and potentially enhancing transmission and distribution networks, will help achieve this lowest-cost energy future.
- However, there are also new technologies to leverage and an increasing demand for distributed energy resources, all of which need to be factored into the discussion and our Te Kanapu work.
- It's not just new lines – network solutions could include spare capacity, upgrades of existing lines, greater use of flexibility, monitoring to improve utilisation, and new technologies.
- We hope you will join us in this discussion and work alongside us as we continue with Te Kanapu.
- We aim to publish our draft Grid Blueprint for consultation early next year.

Our timeline to develop the grid blueprint

1 Imagining Aotearoa in 2050	2 Potential scenarios	3 Technical approach	4 Future direction	5 Draft grid blueprint	6 Te Kanapu future grid blueprint
July 2025	October 2025	December 2025	March 2026	Early 2027	Mid 2027
Gathering views on the future of Aotearoa in 2050	Draft scenarios, load & generation	Draft methodology, potential investment options	Finalised scenarios, generation mix	Combining insights, research, inc. least-regrets investment	We'll publish our first grid blueprint
					

Thank you

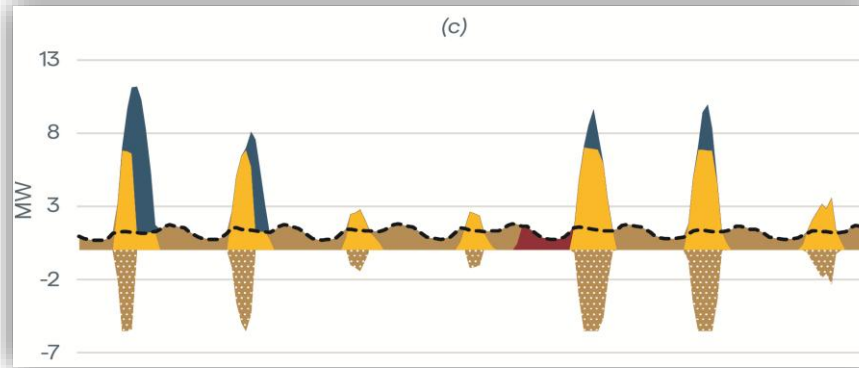
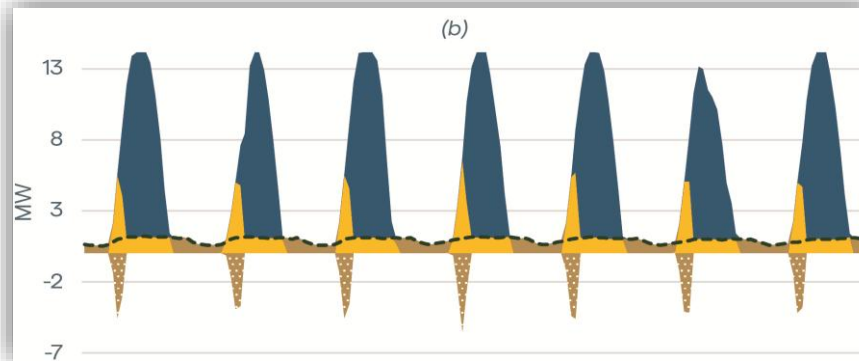
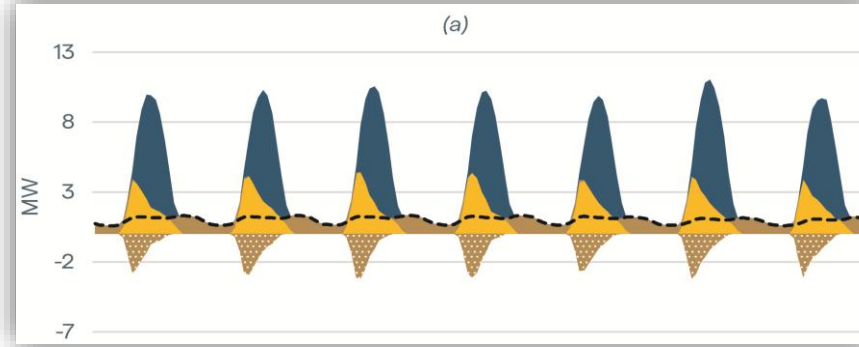


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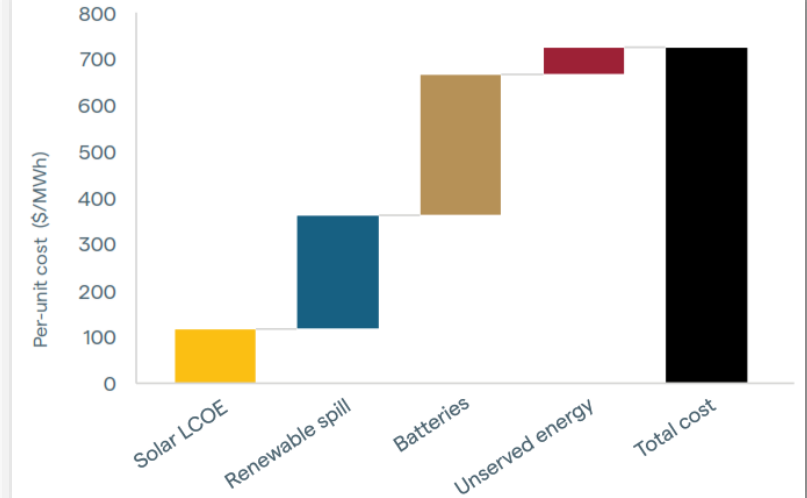
Case 1



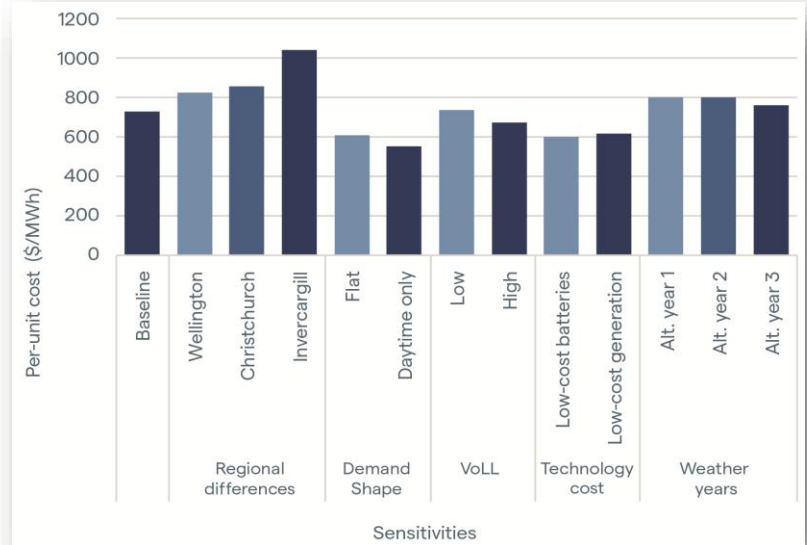
Weekly dispatch patterns
a) average b) high renewable spill c) high unserved demand



Per-unit cost of generation



Sensitivity assessment



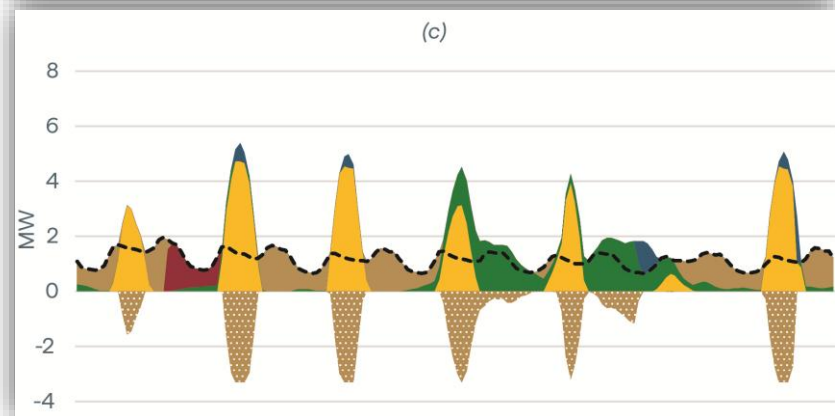
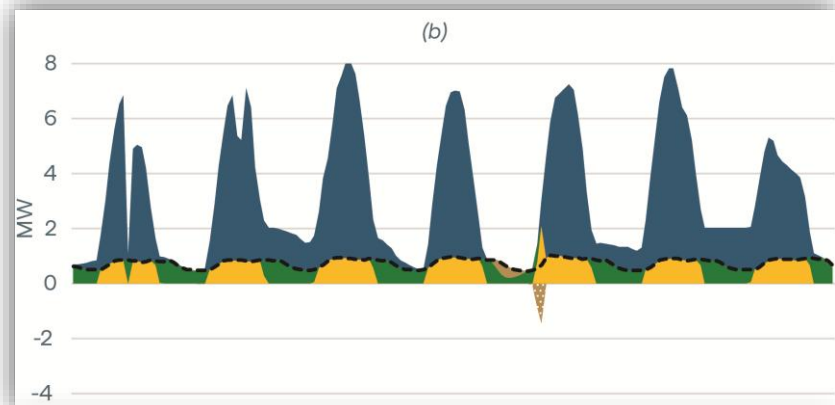
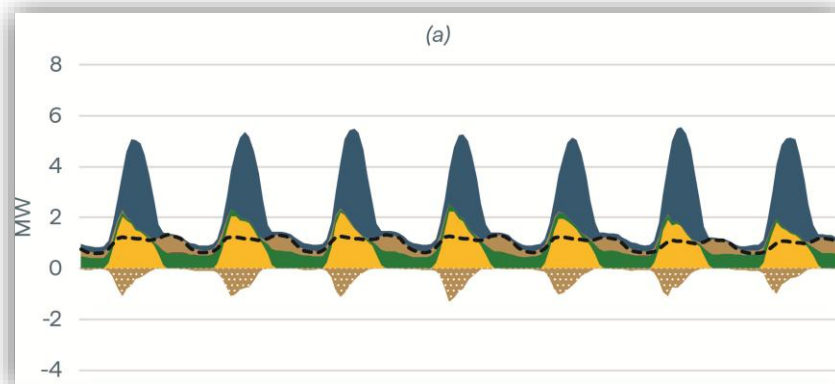
Sensitivities

Renewable spill (dark blue), Hydro (light blue), Battery (discharge) (yellow), Diesel Peaker (orange),
 Unserved Load (red), Wind (green), Solar (light yellow), Geothermal (dark grey),
 Hydro (virtual rain) (light blue), Battery (charge) (brown), Load (dashed line)

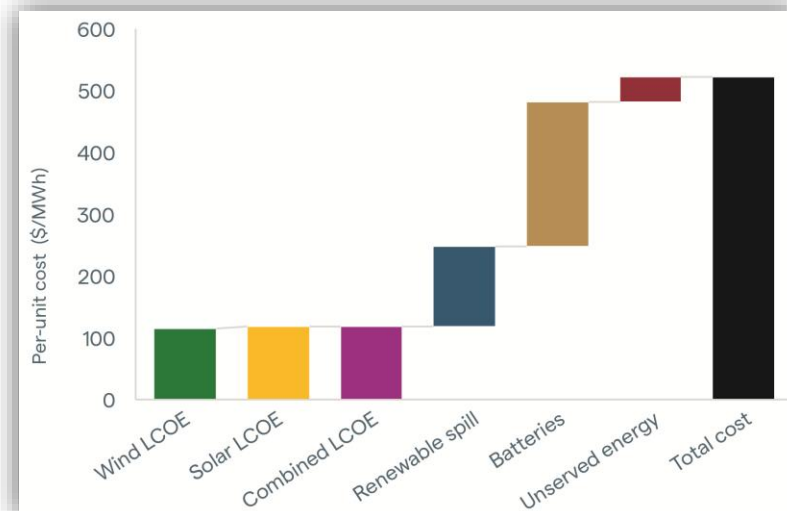
Case 2



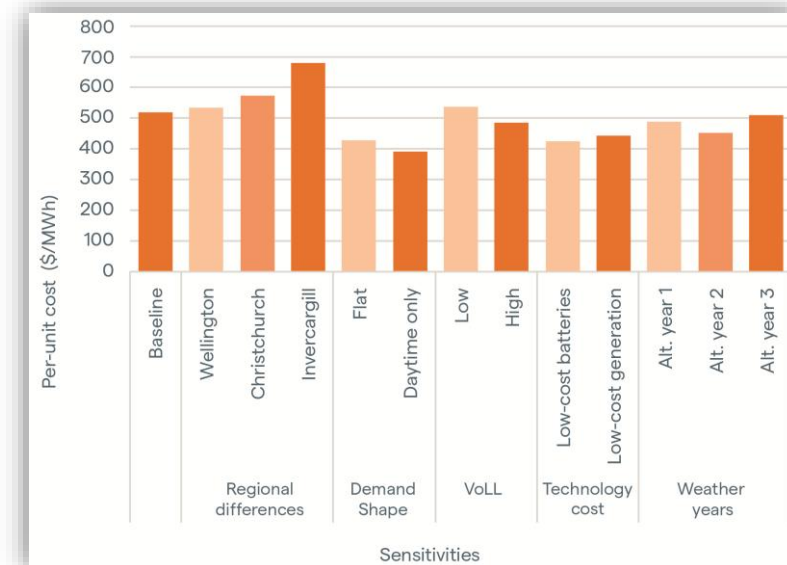
Weekly dispatch patterns
a) average b) high renewable spill c) high unserved demand



Per-unit cost of generation



Sensitivity assessment

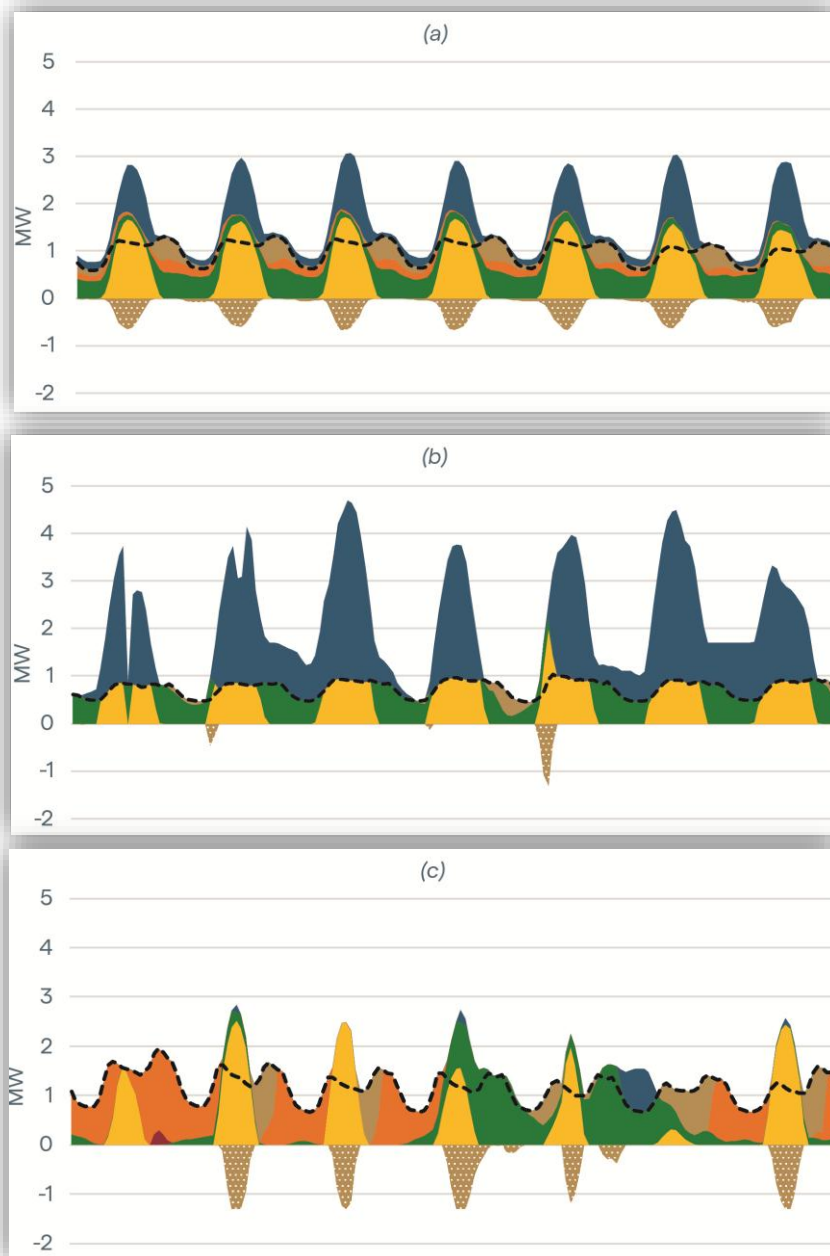


Renewable spill (dark blue), Unserved Load (red), Wind (green), Solar (yellow), Battery (discharge) (brown), Battery (charge) (dotted brown), Geothermal (dark grey), Load (dashed black line), Hydro (virtual rain) (blue), Hydro (blue), Diesel Peaker (orange)

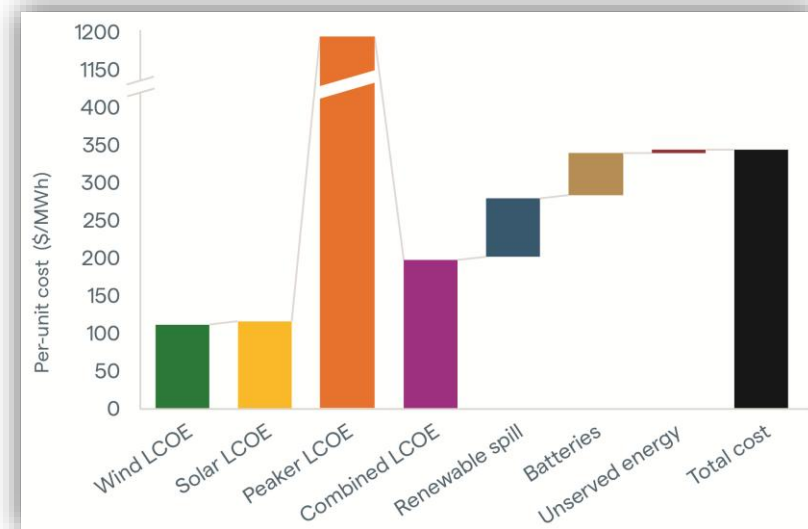
Case 3



Weekly dispatch patterns
a) average b) high renewable spill c) high unserved demand



Per-unit cost of generation



Sensitivity assessment

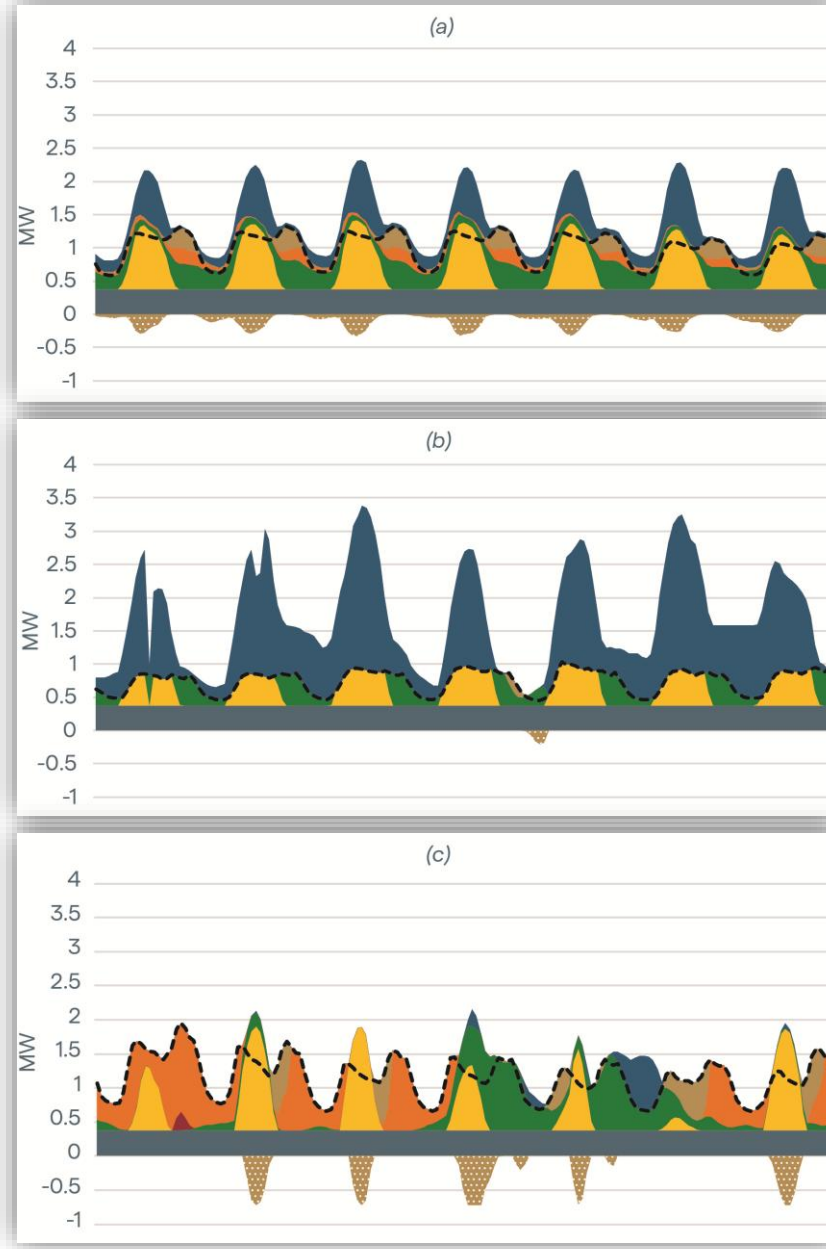


Renewable spill Hydro Battery (discharge) Diesel Peaker
 Unserved Load Wind Solar Geothermal
 Hydro (virtual rain) Battery (charge) Load

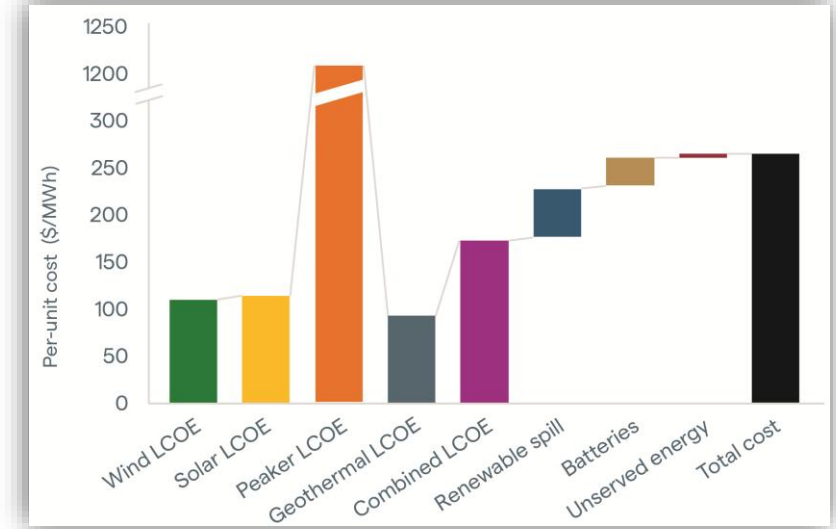
Case 4



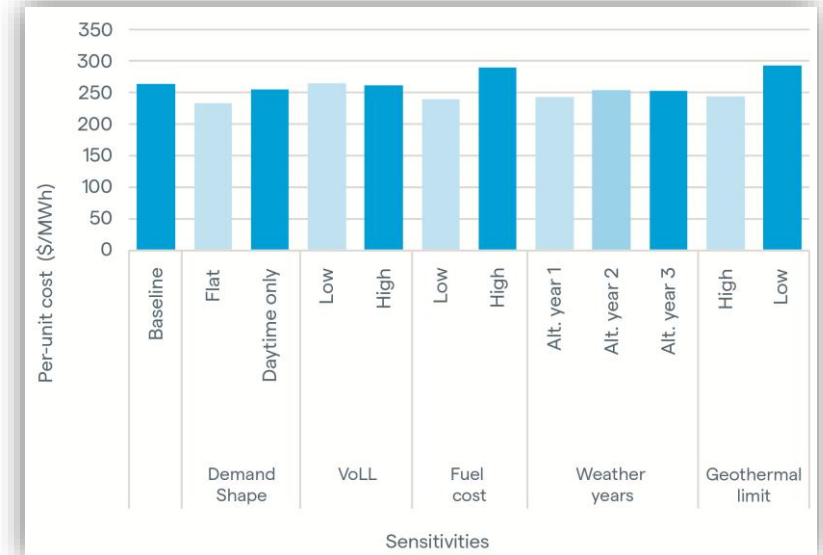
Weekly dispatch patterns
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Per-unit cost of generation



Sensitivity assessment

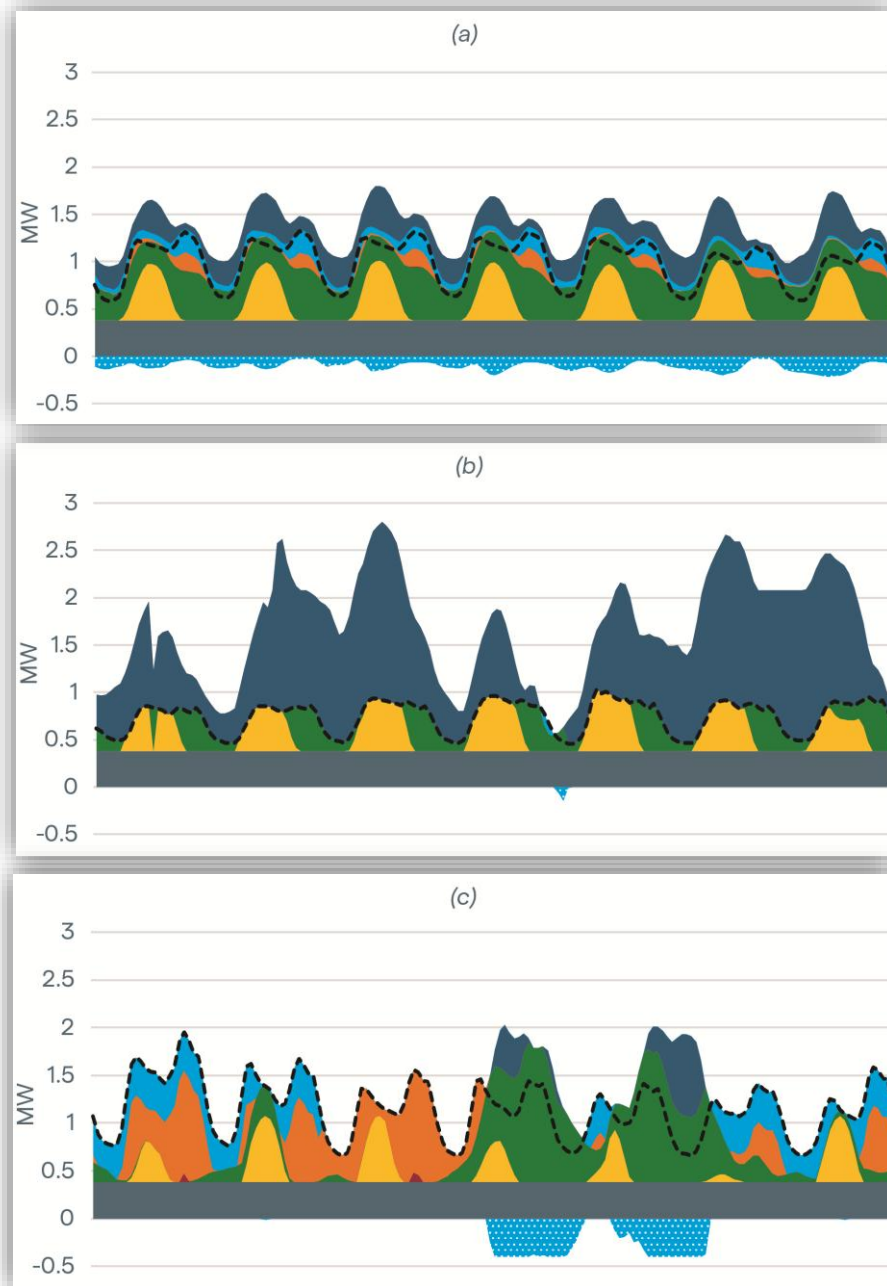


Sensitivities

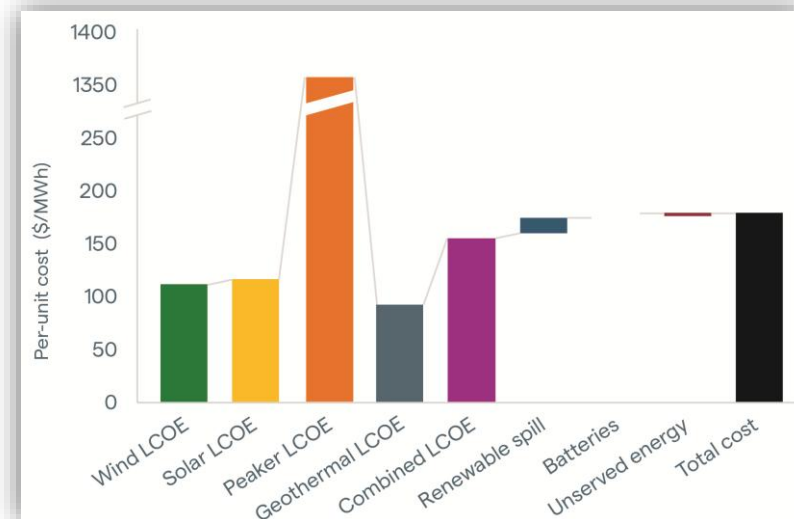
Case 5



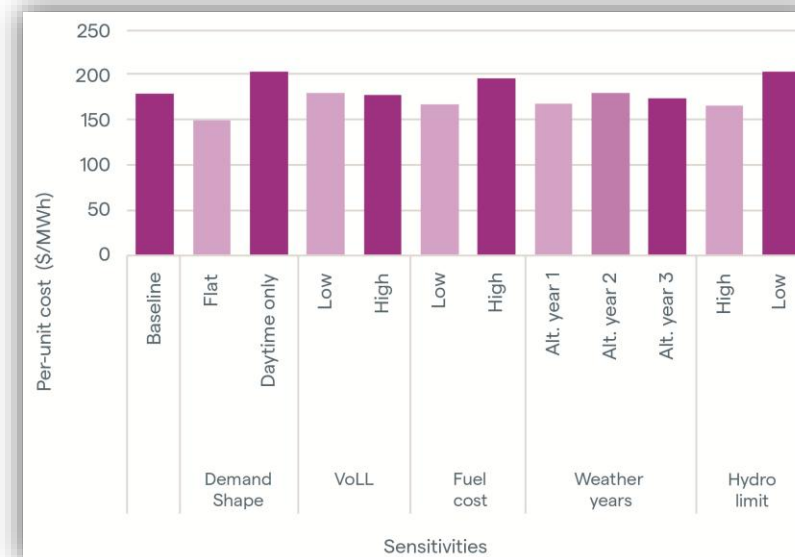
Weekly dispatch patterns
a) average b) high renewable spill c) high unserved demand



Per-unit cost of generation



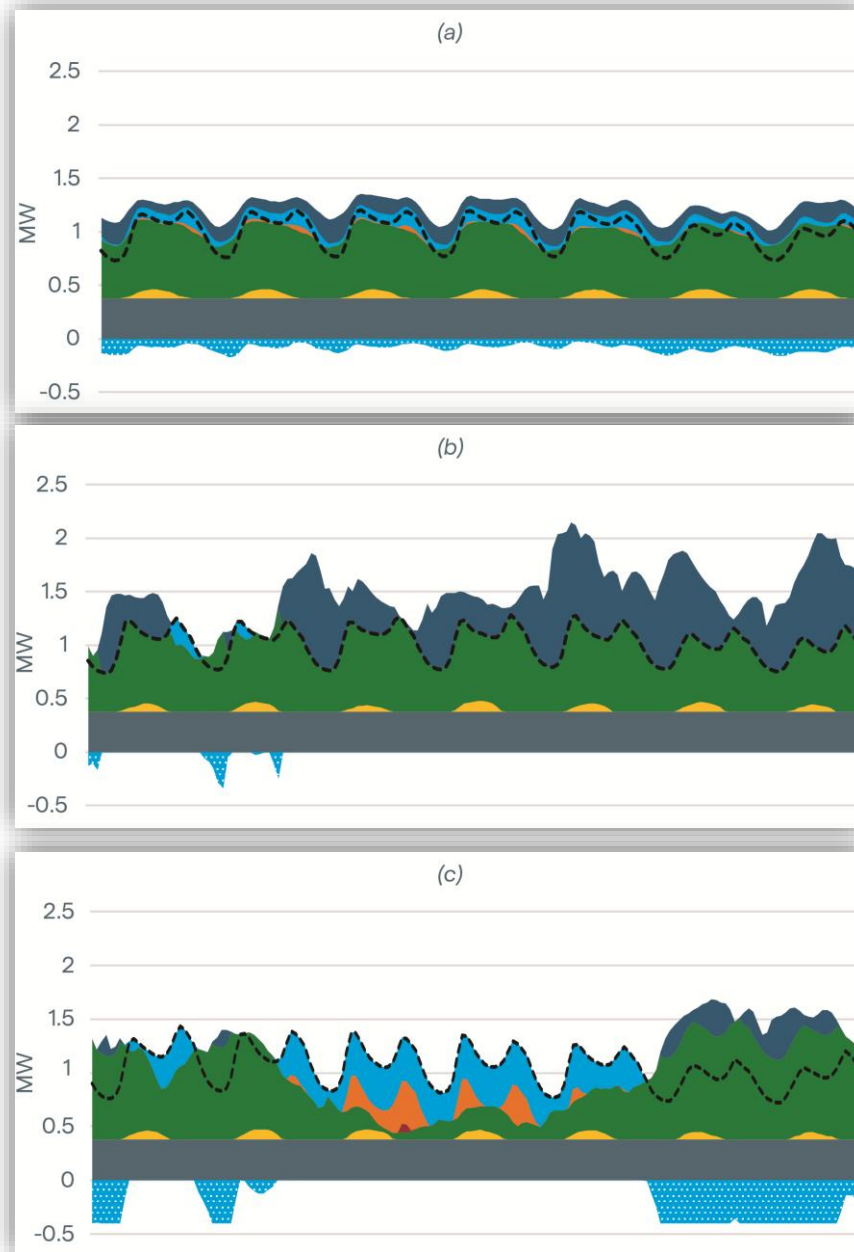
Sensitivity assessment



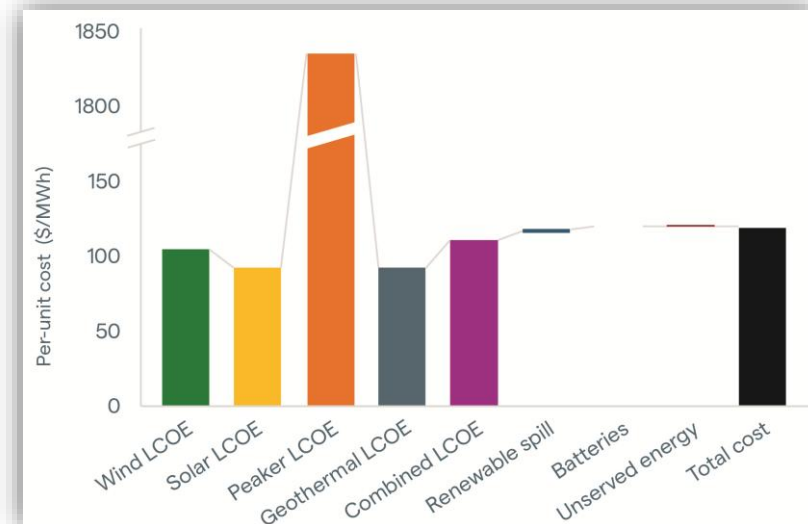
Case 6



Weekly dispatch patterns
a) average b) high renewable spill c) high unserved demand



Per-unit cost of generation



Sensitivity assessment



Sensitivities