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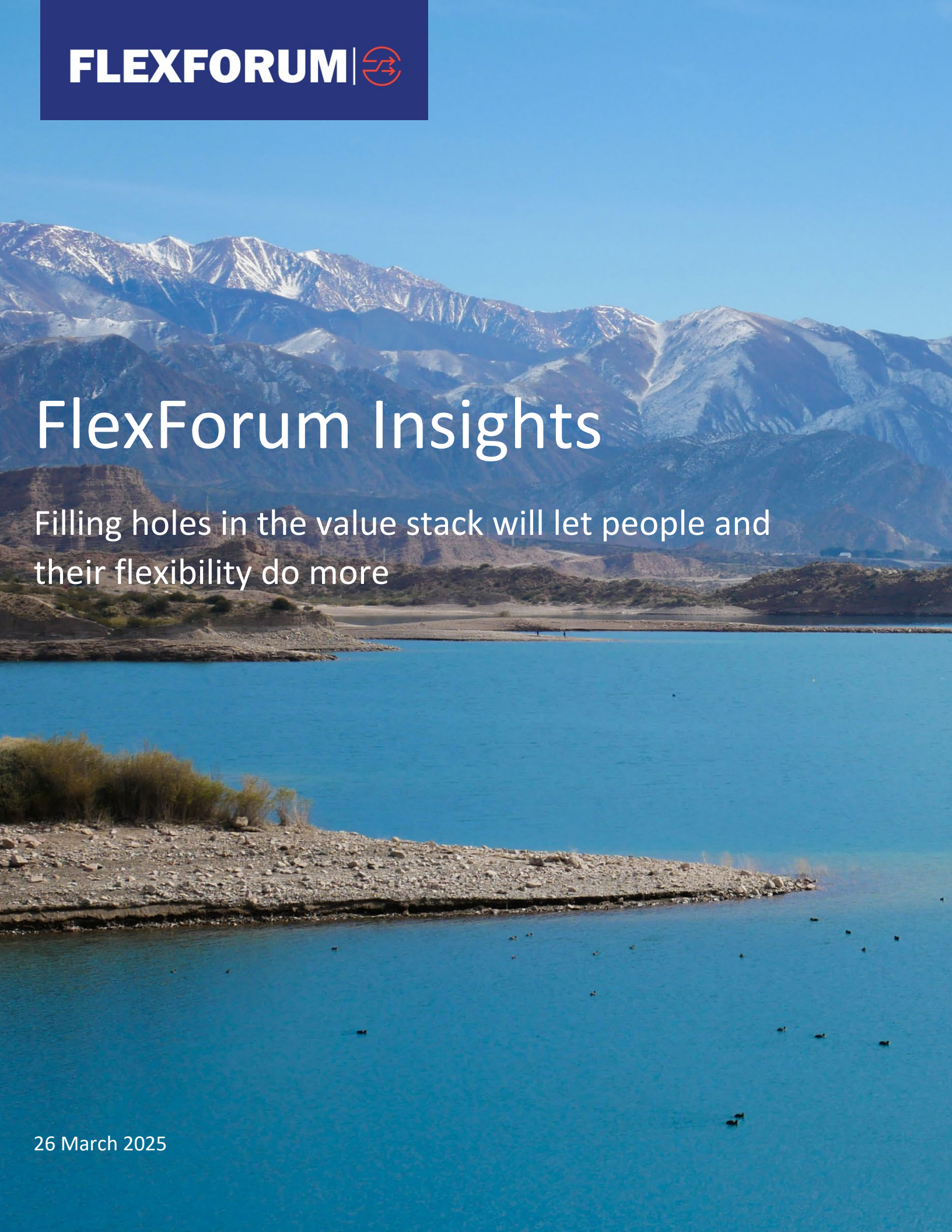

FlexForum Insights

Filling holes in the value stack will let people and their flexibility do more

26 March 2025

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This FlexForum Insights provides the FlexForum perspective on how to identify and fill holes in the value stack drawing on the experiences and views of FlexForum Members. Each Member may have their own perspectives and positions.

This FlexForum Insights is for people with a working knowledge of electricity pricing in Aotearoa New Zealand.

Contact info@flexforum.nz with questions or to find out more.

Executive Summary

FlexForum is an incorporated society with Members[1] from across the electricity ecosystem committed to working together to make it easy for households, businesses and communities to maximise the value of flexibility and electrification.

Flexibility[2] – from things like electric vehicles (EV), EV chargers, solar, battery storage, heating and cooling equipment and energy management systems – gives households and businesses greater agency and autonomy over their energy costs and outcomes and provides another tool to ensure a reliable, resilient, sustainable and affordable power system.[3]

Flexibility is our focus because it is central to affordable and reliable electrification and a key enabler of a truly consumer-centric electricity market and system.

FlexForum has discussed at length how to value and price flexibility since coming together in 2022. Fundamentally, everyone wants to be confident about what services flexibility can provide, what these services are worth, and what a flexibility buyer is willing to pay for them. This confidence does not currently exist due to the holes in the value stack we identified in June 2024.

These Insights provide the FlexForum view on how to find and fill holes in the value stack and provide the conditions to maximise the value of flexibility.

Flexibility is a significant financial and resilience opportunity for 'NZ Inc'

Things are becoming less predictable as the energy transition changes how and when people use electricity, whilst also changing the generation fleet from highly controllable fossil fuels to more variable sources such as wind and solar. The need for flexible responses that can be called on at relatively short notice is increasing.

Boston Consulting Group estimates that approximately 2 GW of flexible resources will be needed by 2030 and 5.8 GW by 2050 to enable more than $10 billion in savings available through avoiding expensive generation, demand curtailment, and deferring network investment.

Households, businesses and communities will also benefit from flexible resources. They could spend up to $150 Billion by 2050 on EVs, batteries and other electric assets as part of their efforts to decarbonise the economy and save money on increasingly expensive fossil fuels. Flexibility will make these investments more affordable.

Market and pricing mechanisms that provide fit-for-purpose cash signals are a critical way of maximising the savings potential and ensuring that households, businesses, and communities can be appropriately incentivized and motivated to invest in ways that not only support decarbonisation, but also increase the reliability, resilience and affordability of the electricity system.

But there are holes in our value 'bucket'

Just like a bucket with holes, our market mechanisms are currently retaining some of the benefits of these flexible resources, but a significant amount is being allowed to leak out. The approach we have as a country to integrating, incentivizing and motivating flexibility is outdated and resulting in an inefficient "value stack" – the term we use to describe the financial benefits available to flexible resources from responding to the external signals provided by market and pricing mechanisms to provide value across the electricity supply chain.

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[1] FlexForum Members are listed at https://flexforum.nz/about/. Members span the electricity ecosystem and include electricity generators, retailers, metering services providers, EV charger manufacturers, energy management software firms, Transpower, distributors, advisory services firms, industry associations universities, and individuals.

[2] For readers looking for a 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] The benefits of flexibility are flagged by a range of parties including Transpower, the Market development advisory group, and the BCG Climate change in New Zealand: the future is electric report.

Holes in the value stack are not surprising. Pricing mechanisms were designed for a world without any role for distributed flexibility, and, aside from pricing of transmission capacity, there has been no material change to pricing mechanisms and cash signals since the wholesale market was established in 1996. Pricing mechanisms continue to be designed around predictability.

But these holes in the value stack reduce the range of customer propositions and reduce the opportunities for people and the power system to maximise the value of their flexibility.

Retail products and customer propositions depend on the underlying cash signals provided by the pricing mechanisms which make up the electricity market. Our changing electricity system is demanding more than the pricing options predominantly available to customers today, which were designed for a system that had relatively high levels of predictability on the demand and the supply side. Even 'time of use' (TOU) pricing that have become more widespread recently are most suitable for routine and predictable use cases, like overnight charging.

The biggest holes are due to missing cash signals incentivising and motivating dependable flexibile responses to infrequent unpredictable system conditions and events.

For a variety of valid reasons, not all customers will want to make their flexibility resources available to the system at short notice, even if the premium is high. But, even for the customers who would be willing to contract for this service, there are very few options for them to do so available in the market today. Examples include the the Octopus Energy Saving Sessions, and a range of hot water automation retail products. However, these options are not routinely available across retailers or for all manner of flexible resources.

Filling these holes in the value stack will achieve key parts of the October 2024 Government Policy Statement on Electricity, particularly by making it possible that '*Household and business consumers can make meaningful choices between competing suppliers and technologies, and benefit from the opportunities available in the electricity system. This includes the benefits that consumers may gain from providing demand-side flexibility.*'

The key is fit-for-purpose cash signals are key and ensuring financial benefits reach the back pockets of households, businesses, and communities

Filling the holes in the value stack means strengthening the financial and non-financial incentives for retailers and network operators, collectively, to overcome the two types of barriers getting in the way of flexibility friendly customer propositions.

The electricity ecosystem – participants, regulators and partners – need to act to develop a smart system that harnesses the large and growing stock of latent flexibility in the hands of households, businesses and communities.

We have identified a package of solutions to enable the fit-for-purpose cash signals needed to underpin customer propositions which give people the option and motivation to provide a dependable flexible response to unpredictable events.

- More coordinated efforts and incentives to support development of flexibility experience and capability across the value chain, particularly focusing on multi-lateral interactions.
- A coordinated workplan to fast-track development of a digitalised electricity system with market infrastructure that integrates flexible resources into the system delivered jointly by regulators and electricity ecosystem.
- Strengthen financial and non-financial incentives for electricity retailers and network operators to develop capability and use flexibility when it is efficient.

Not taking action will continue to lock people out of the opportunity to realise the benefits of flexible resources and the opportunity to be a part of shaping our energy future.

Filling the holes in the value stack is a necessary condition for maximising the value of flexibility

Households, businesses and communities can use their flexible resources to get power that is more sustainable, reliable, resilient and affordable.

The value stack refers to the combined financial incentives from the electricity system and the benefits of responding to the range of pricing mechanisms and cash signals for the electricity market, transmission capacity, distribution capacity and ancillary services.

Today, the potential value and benefits of flexibility are compromised due to holes in the value stack.

A hole in the value stack occurs when an underlying cash signal or incentive either does not exist, or is not sending an efficient signal to owners of flexible resources (or their agents).

People and their flexibility could do more if they had options and opportunity

New Zealanders largely engage with the electricity sector and power via the customer propositions available to them through electricity retailers.

Retail products and customer propositions depend on the underlying cash signals provided by the pricing mechanisms which make up the electricity market, for example, the spot price signals electricity supply and demand, transmission and distribution pricing signal network capacity.

Household propositions have provided options for flexible responses through time of use (TOU) pricing and pricing discounts for people with an electric hot water cylinder. Business propositions have provided options for flexible shape and shift responses through TOU pricing, plus demand-based pricing for network capacity, and spot-based pricing for electricity (mostly for large industrial users).

This is a simplified view of proposition options, the differing levels of responsiveness (of flexible resources) that they suit, and our desktop assessment of the availability of these propositions.

Proposition options	Less responsive	More responsive	Very responsive
Pricing	Flat rate fixed price variable volume pricing	TOU pricing FPVV or TOU price discounts for allowing a third party to manage the response	Very few options here
People	Probably most households and many businesses	Businesses and some households	Very few. Mostly businesses

Note: no public data is available about the popularity of different types of pricing options.

The key characteristic of most customer propositions today is they offer a predictable price – whether flat or TOU rates – for a predictable response. The reasons include individual preferences and capability to be flexible, simplicity of implementation from a retailer perspective, and care factor. But the overarching reason is the power system has been built and operated based on predictable use patterns.

Flexibility is less useful (and therefore less valuable) in a predictable environment. Network operators can plan and invest based on predictable network usage profiles. Retailers can calculate retail prices based on averaging electricity input costs and predictable electricity usage profiles.

The predictable environment means cash signals motivating a dependable flexible response to efficiently manage unpredictable system conditions have not been needed, and people have not been routinely offered propositions which incentivise and motivate flexibility.

But things are becoming less predictable because the energy transition changes how and when people use electricity. It also changes the generation fleet from highly controllable fossil fuels to more variable sources such as wind and solar. The need for more dynamic flexible responses is increasing.

This creates an opportunity to use some of the large and growing stock of latent flexibility in the hands of households and businesses to the benefit of system stability and people's bills. The key to this opportunity is to develop customer propositions which give people the option and motivation to provide a dependable flexible response to unpredictable events such as the energy shortage on 9-10 May 2024 and the transmission and distribution network failures caused by Cyclone Gabrielle.

Flexibility options and opportunities rely on cash signals

Customer propositions rely on the underlying cash signals. Prices are used across the power system to provide a cash signal and information[4] which assists with managing the supply and demand for transmission capacity, distribution capacity, ancillary services and electricity.

A cash signal that makes its way to the flexible resource owner (e.g., a customer) provides a direct financial benefit to the resource owner if they take an explicit action which provides system value. The benefit comes through either an explicit payment, a 'discount' on the price or price component, or through reduced or avoided electricity costs (e.g., from shifting use to times with lower prices).

However, the cash signal does not need to get through to people or be visible in the customer proposition. The cash signal only needs to be available to an agent who can trigger the flexible response – e.g., a retailer or a flexibility aggregator. But the *benefits* need to be experienced by the customer (through the customer proposition). If they aren't, people will not want to say yes to flex and will not provide valuable flexibility.

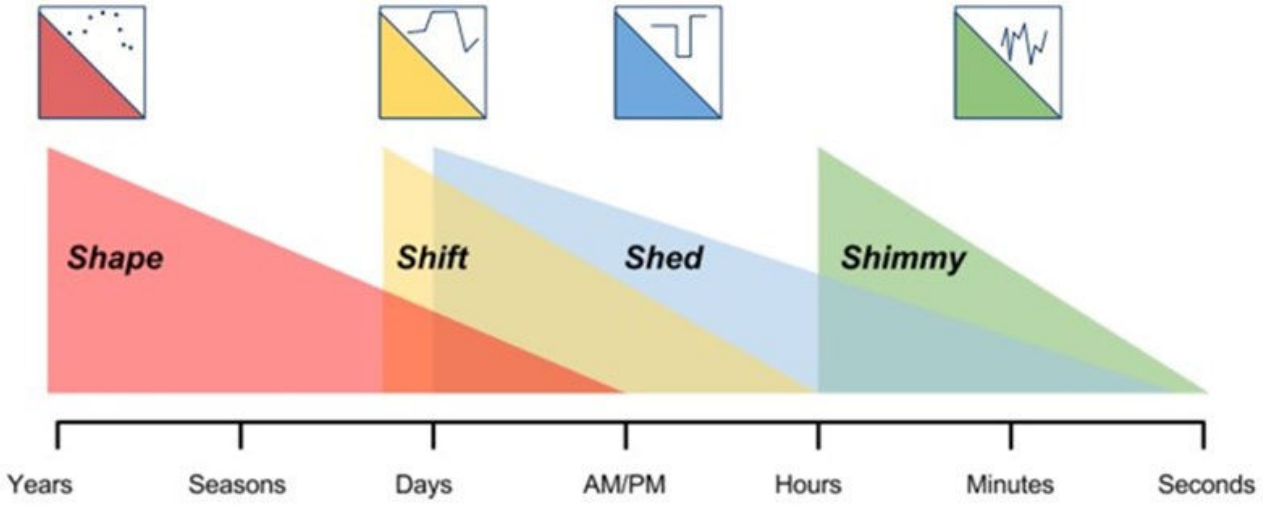
The four main electricity services each rely on various pricing mechanisms to provide a cash signal to motivate an efficient response and outcome. For example, a higher spot price provides a signal motivating more generation and less use.

These are the key pricing mechanisms used at the moment for the 4 main electricity services, plus the desired response.

Service	Pricing mechanism	Desired response
Electricity supply services involve generating, trading and using electricity	Spot price	Shift, Shed
	Forward contracts, futures	Shape
Ancillary services are used for power system operation	Contract payments	Shimmy
Transmission capacity management involves coordinating use of transmission network capacity	A connection charge ($/year), benefit-based charge ($/year) and residual charge ($/MW)	Shape
	Spot price	Shift, Shed
Distribution capacity management involves coordinating use of distribution network capacity	Variety of pricing structures with variable usage ($/kWh), demand ($/kW) and fixed ($/day) rate components	Shape, Shift

[4] "…in a system in which the knowledge of relevant facts is dispersed among many people, prices can act to coordinate the separate actions of different people…". Hayek, F.A. (1945) "The Use of Knowledge in Society." American Economic Review. Vol. 35, no. 4. pp. 519-30.

The shape, shift, shed and shimmy taxonomy is shorthand for the type of response required for an efficient outcome in given conditions.[5] The four response types represent the timescales – from years to seconds – for responding to a situation to achieve an efficient outcome.



Source: Lawrence Berkeley National Laboratory, 2025 California Demand Response Potential Study - Charting California's Demand Response Future: Final Report on Phase 2 Results, March 2017 and Race for2030, Opportunity Assessment Flexible demand and demand control Final report, October 2021.

Greater predictability of system events requires less responsiveness and makes flexibility less valuable. Less predictablility of events requires more responsiveness and makes flexibility more valuable.

The value of the response types to the flexibility buyer (network or retailer) is relative to the alternative. Shape is relatively less valuable because infrastructure is sized based on the predictable diversity of individual usage profiles over time.

Shift, shed and shimmy are more valuable when the flexibility buyer can depend on the response to manage infrequent, unpredictable events. Dependability and responsiveness are critical. For example:

- Network operators plan and invest to match supply and demand for capacity most of the time. A dependable flexible response at scale can avoid the lights going out in the event and efficiently defer the next (large) unit of infrastructure for a period. Without dependability, more poles and wires are the best option.
- Retailers buy physical and financial insurance to manage spot price risk and volatility to maintain a predictable cost to serve. A dependable flexible response can allow a retailer to reduce average input costs (wholesale purchases) and put downward pressure on spot prices in the long run, efficiently deferring investment in peaking generation.

Holes in the value stack are limiting flexibility options and opportunities

In the July 2024 FlexForum Insights where we first talked about holes in the value stack we pointed that: *'Each individual service or use case needed to operate the power system needs to be monetised through a cash signal. Ideally, this monetisation occurs through transparent prices which routinely signal the value of flexibility for an electricity service. These cash signals are critical to transforming*

[5] These response types were developed by Lawrence Berkely National Laboratory. See the 2025 California Demand Response Potential Study - Charting California's Demand Response Future: Final Report on Phase 2 Results, March 2017. The [flexible] demand responses are described in section 3.4. The framework has also been used by Racefor2030 in its October 2021 Flexible demand and demand control opportunity assessment.

the value of flexibility from a conceptual idea into a tangible benefit – either cold, hard cash or reduced costs (a benefit) for the resource owner.'

We have found several circumstances where potentially efficient responses are not rewarded through a cash signal. This is not surprising. Pricing mechanisms were designed for a world without any role for distributed flexibility, and, aside from pricing of transmission capacity, there has been no material change to pricing mechanisms and cash signals since the wholesale market was established in 1996.

FlexForum Members shared their perspectives of the experience and impacts of these holes in the value stack. The headline finding is people have little motivation and few incentives to provide dependable shift and shed responses to efficiently manage unpredictable system conditions.

There are two main reasons: cash signals are missing; and a lack of access to the benefits of existing cash signals. Both reasons reduce the range of customer propositions being offered and reduce the opportunities for people to maximise the value of their flexibility.

Missing cash signals

There are two key missing cash signals in the system right now that are needed to maximise the value and benefits of flexible resources.

First, the **transmission capacity management** service is missing a cash signal to routinely motivate shift or shed-type flexibility in response to transmission congestion. The spot price is meant to provide this signal, but does not accurately signal transmission constraints. For the spot price to accurately and routinely signal transmission constraints, the grid owner would need to delay upgrades until it was too late.[6]

Second, the **distribution capacity management** is missing a cash signal to complement demand-based pricing and hot water control discounts to routinely motivate shift or shed-type flexibility in response to network congestion.[7] Nor are cash signals routinely available for people to provide shimmy-type flexibility for distribution system operation services, ie, voltage regulation.[8]

Lack of access to benefits of existing cash signals

Another significant hole is the lack of access to benefits where cash signals do exist. Distributed flexible resources are not routinely used for **spot price risk management** (except through TOU pricing that only provides a shape response), despite the aggregate resource being sufficient to create big chunks of system value if the hedge product cash signals were on the table to motivate the flexible response.

Some retailers are monetising shift-type flexibility, e.g., the Octopus Energy Saving Sessions, and a range of hot water automation retail products. However, these are not routinely available across retailers or for all types of flexible resources.

More volatile spot prices strengthen incentives on retailers to harness flexibility resources, but the pace of product development will depend on the extent the products need common market infrastructure, such as mechanisms for transparent trading and pricing of risk management products, like the recently launched super peak product.

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6 Transpower (grid owner) has made several requests for proposals for non-transmission solutions (including flexibility) for transmission capacity management, eg, in the upper South Island, which could have resulted in explicit payments, but no proposals had progressed at the time of writing.

7 Some distributors have requested for proposals for non-network solutions (including flexibility) for distribution capacity management (eg, Aurora, Mainpower, Network Tasman, Orion, Powerco, Vector). Aurora and Powerco have contracted with flexibility coordinators and are making explicit payments for flexibility, but no other proposals have progressed at the time of writing. Further, a small number of distributors provide "Congestion Period Demand" (CPD) signals to commercial and industrial customers to motivate a shift or shed response.

8 A cash signal is given to network users likely to create reactive power (ie, by using large electric motors), but no distributor currently gets voltage regulation as a service. Voltage management is done using non-financial incentives applied through technical connection standards. There is a possibility that using financial incentives for voltage regulation would lead to more efficient outcomes for network operation and distributed generation – we should find out.

People with do not have an efficient range of choices to maximise the benefits of their **electricity generation** resources by responding to the underlying cash signal (the spot price).[9] Some retailers[10] offer peak and off-peak export prices, however, the spot price (the efficient cash signal) is typically incorporated as a highly averaged flat rate as part of a bundled retail price (for use) and payment (for sale) package and people are prevented by regulatory settings from selecting the best prices for using and selling electricity.[11]

People are less able to access the benefit of providing **system ancillary services** because existing technical rules are written such that not all capable resources meet the qualification requirements. New technical rules and qualification requirements are needed.

Sources of the holes – and the basis for solutions

Back in July 2024, FlexForum described 13 reasons as to why holes in the value stack exist. Since then, FlexForum has gone deeper to identify the root causes for **buyers not being able to buy** flexibility (e.g., some ancillary services) or **not wanting to** (e.g., can get it for free) or **deciding not to, even when flexibility is the efficient option** (e.g., incentives to use flexibility are not strong enough).

The overarching problem is insufficient financial and non-financial incentives for retailers and network operators, collectively, to overcome the two types of barriers getting in the way of flexibility friendly customer propositions:

- Practical and capability-related barriers to investing in learning to build experience in procuring, deploying and using flexibility and to integrate flexible resources into the system.
- Financial and risk-related barriers to routinely buying flexibility at scale.

The root causes of these barriers provide the basis for potential solutions to fill the holes in the value stack.

Practical and capability-related barriers	Financial and risk-related barriers
Insufficient experience and know-how with practical use of distributed flexibility	Flexibility is not commercially attractive compared to other investment priorities even when it is the efficient solution
Integration of flexible resources into the system requires development of common market infrastructure such as communications pathways, contractual frameworks and cash signals	

Insufficient experience with using flexibility

Using flexibility to manage network congestion or other purposes requires a business case to commit to the investment and expenditure. The decision maker – executive or board – will want assurances the proposal stacks up and will do the job. This is a critical factor for network operators focused on maintaining network reliability.

Providing these assurances for flexibility is hard, particularly given they rely on robust evidence that sufficient flexibility will be available to dependably do the job when it is wanted. Today, this evidence does not exist in Aotearoa New Zealand, although a number of pilots and trials are underway to build this evidence base.

[9] Large generation businesses can choose between selling their power on the market (taking the spot price) and agreeing to sell to someone at a fixed price, or, typically both. Giving people the same range of choice would allow efficient resource allocation taking account of individual preferences. However this does not mean forcing people to deal with more complex retail pricing. Like any market, retail pricing/tariffs/contracts have to strike a balance between being tailored for an individual customer's needs, and minimise search costs.

[10] For example, Ecotricity and Octopus Energy.

[11] People are prevented from contracting with a retailer to purchase power and a separate retailer to sell their power because the market settings assume a one to one customer and retailer contractual relationship.

Key concerns for decision-makers include:

- **The difficulty with proving that sufficient flexibility will be available when it is wanted**. A lot of flexibility is latent[12] and is not integrated into the system. Most probably because there has been no financial incentive. This creates a chicken-and-egg situation with sellers wanting buyers to commit before investing in the integration, and buyers wanting sellers to show the resource is integrated before committing to buying
- **Uncertainty about the lifespan of a flexibility solution**. For example, a distributor would mainly use flexibility to defer reinforcement. At some point, the flexibility solution will be substituted for poles and wires and the cash signal will not be needed or efficient. A lack of experience with forecasting how long flexibility will be used has implications for the expected solution cost and the resulting cash signal with both over and under-estimates[13] have potential adverse consequences.

Like all good catch-22 situations, providing assurances that flexibility will do the job requires investment in learning to provide an evidence base. But investing in learning requires a leap of faith for resource constrained businesses with the ability and incentive (see root cause on commercial attractiveness) to opt for proven solutions.

Integrating flexible resources involves common costs

Flexible resources are most useful and valuable when integrated into the system. Integration means a resource is plugged in to open access communication pathways and counterparty relationships which are needed to enable the routine use of flexibility.

Household hot water cylinders provide an example of integration. A cylinder is visible to retailers through network pricing codes, can receive external signals through a communication pathway (ie, the ripple control system and, more recently, the metering communication system). The flexible response is exchanged subject to contractual arrangements between the distributor, retailer and resource owner setting out the cash signal and terms of use.

Individual buyers – network operators, retailers, flexibility coordinators – can and are investing to establish communications pathways, contractual arrangements and asking people to say yes to flex for other flexible resources such as EV chargers, batteries and space heating. However, these resources are only reliably integrated into the system if the owner can switch to another buyer. Some buyers are using proprietary communication pathways or contractual constraints to lock up the resource and protect their investment.

Open access integration requires interoperable communication pathways, standard contracts and counterparty relationships and for the resource to be visible to all potential buyers. These things require common market infrastructure and are necessary if owners are to be able to maximise the value of their resources by having the option to easily switch products and suppliers.

A critical part of the common market infrastructure is transparent, tradeable pricing of flexibility that potential buyers can build into their commercial assessments and potential sellers can use to attract capital and development funding. Without a reasonable estimate of the cost of flexibility, buyers are not able to decide whether flexibility is the most efficient option, let alone plan to use flexibility for future needs and embed this in business plans. And sellers are not able to decide whether investing in flexible resources is worth it.

Flexible solutions may be efficient but not commercially attractive

Financial incentives are not sufficient to consistently motivate network operators and retailers to buy flexibility when it is the most efficient option, or to invest in integration and developing experience with flexible resources.

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[12] FlexForum estimated between 280 to 420 megawatts of flexibility may be available at any one time from residential and commercial space heating and cooling equipment, hot water, EVs and EV chargers, and battery storage. Our estimates are supported by Electricity Authority survey findings indicating about 450MW of demand-side flexibility could be available now, including 160MW of reported hot water and ripple control, which may already be offered into the reserve market. Findings from the Orion and Wellington Electricity Resiflex project include the potential to harness 280MW of flexibility by creating a cash signal and customer proposition.

[13] Over-estimating the solution duration could mean committing to paying for unnecessary flexibility. Under-estimating the solution duration could adversely affect reliability.

- Network operators will continue to prefer capital expenditure and building more network (capex) over using flexibility (opex). Although the equal treatment of capex and opex (ie, totex) strengthens financial incentives to use flexibility, opex options will never be as commercially attractive while there is no way to earn a commercial return, or grow enterprise value, from opex. In this context, the motivation to invest in and use flexibility is the result of non-financial incentives arising from local factors such as adverse reliability impacts or not being able to build fast enough.

Historically, retailers with generation mostly had adequate tools for managing price risk, even if these tools did not represent the lowest operating cost solutions. Today, extra tools, including flexibility, are needed to manage increased spot price volatility[14], but investments by individual retailers to enable flexibility are in early stages and narrowly focused due to:

- Concerns about a first-mover penalty because investments in integration are rivalrous but non-excludable and someone else could reap the benefit without incurring your costs. Decision makers may want assurances that early-stage investments will deliver a guaranteed revenue stream.
- The relatively small scale of investments. With finite time, executives and boards prefer to prioritise, for example, a $100 million windfarm investment over a $10 million flexibility investment, particularly when the flexibility investment may not deliver guaranteed MW and holes in the value stack causes holes in the business case.

The ability to offer flexible customer propositions greatly relies on retailer's customer management and billing systems. Each retailer has a list of IT system investments to prioritise. Building capability to offer a proposition – such as a spot-based retail PPA – which might only initially be attractive to a small number of customers is unlikely to be prioritised without a clear incentive and motivation, e.g., from a regulatory expectation or from a sudden surge of interest from people in that type of product.

The economic impact of the problem

Holes in the value stack are bad for households, businesses, communities and the economy. The overarching economic impacts are:

- Less efficient operation of the power system. Resources (including flexible resources) are not efficiently allocated across the supply chain resulting in the use of resources that have higher operating costs.
- Less efficient use of electricity. People use more electricity when it is more expensive and use less electricity when it is cheaper. Both outcomes reduce economic productivity.
- Less efficient investment in new resources in the electricity system. Capital will not be allocated to flexibility resources that appear to provide poorer returns (due to holes in the value stack) than resources that can access the full value stack. This is likely to be the most significant economic problem through time.

The inefficient allocation of resources for operation, use and investment will manifest in the system as compromised resilience and reliability of supply, slower progress toward a sustainable zero-emission power system, and increased electricity costs, thereby reducing affordability.

What good might look like…

'Good' looks like households, businesses and communities having customer propositions available to them which give them the option and opportunity to maximise the value of their flexible resources across all of the ways that flexibility can benefit the system.

The propositions will give people the choice to be as flexible or inflexible as they like given system conditions, their circumstances and preferences. Good looks like all of the following.

- people unable or not wanting to be flexible can have an option of a flat rate retail product to enable a predictable power costs

[14] As reported by the Market Development Advisory Group, a higher renewables-based system will lead to more volatile spot prices, and potentially that some market participants will be 'short flexibility', even though they own significant generation assets. This will require new tools, including flexibility, to manage increased spot price volatility, which, until recently, have been provided by flexible supply-side resources such as gas peakers.

- people with some flexibility can have an option like a TOU rate retailer product, plus receive a benefit by selling the right to coordinate their flexible resource for specific agreed reasons (or something similar)
- people with lots of flexibility can have an option like a flat rate retail product, plus a spot-based retail PPA for their spare solar, plus receive a benefit from selling the right to coordinate their flexible resources for specific agreed reasons.

etc…

This is not possible without filling the holes in the value stack because having a wider range of flexible propositions relies on having extra cash signals designed to dependably motivate a shift and shed-type flexibility.

Solutions to fill holes in the value stack

Here is a list summarising solutions to fill holes in the value stack by addressing the root causes of the current situation. Following the list are solutions to fill specific holes in the value stack.

Root causes	**Solutions**
Insufficient experience and know-how with practical use of distributed flexibility	**More coordinated efforts and incentives to support development of flexibility experience and capability across the value chain,** particularly focusing on multi-lateral interactions. Network operators need robust evidence that flexibility can be dependable before creating a cash signal. This requires building experience and capability with getting people saying yes to flex, working with flexibility coordinators, equipment manufacturers and other service providers. Financial incentives are not sufficient to motivate network operators, retailers or other parts of the ecosystem to sponsor the market development process at sufficient pace, scale or scope. The Energy Efficiency and Conservation Authority Scale demand flexibility demonstration pilot project is the exact type of initiative required to deliver this solution. Complementary initiatives are: • the Commerce Commission decisions in the 2025 DPP to provide an innovation and non-traditional solutions allowance (INTSA) and a low voltage data opex allowance • the Electricity Authority's Power Innovation Pathway.
Integration of flexible resources requires common market infrastructure	**A coordinated workplan to fast-track development of a digitalised electricity system with the market infrastructure to integrate flexible resources into the system** delivered jointly by regulators and electricity ecosystem. The workplan objective should be to reduce the risk and cost top participants of expanding the stock of flexible resources available to respond to market and network conditions, by developing common, open access communication pathways, contractual and counterparty relationships and a transparent, tradeable price of flexibility. The workplan can draw on the Flexibility Plan which lists most of the activities and tasks to deliver this objective. Initiatives such as FlexTalk and Resi-flex have shown the way through learning by doing. More similar projects may be needed to work out how to address practical challenges which will be confronted along the way. We expect this workplan to include most if not all the tasks required to develop a digitalised electricity system and enable a wider range of flexible customer propositions by identifying and implementing capability for flexibility buyers to create and send flexible cash signals and for people to easily and routinely pick the proposition which suits their flexibility and preferences.
Flexibility may be the efficient solution but not commercially	**Strengthen financial and non-financial incentives for electricity retailers** to develop capability and use flexibility when it is efficient.

Root causes	Solutions
attractive to the flexibility buyer	• **develop a suite of common risk management products focused on dependable flexibility** to create efficient cash signals for responding to unpredictable events such as high spot prices and network congestion. These cash signals will support development of a wider range of flexible customer propositions. • **retailers need to offer spot, shaped and fixed price variable volume retail power purchase agreements**. This solution will increase the range of flexibility options and opportunities, particularly by giving people a greater opportunity to maximise benefits of responding to the spot price cash signal. This is likely to encourage more people to make solar and battery investments sooner. • **fast-track development of a digitalised electricity system with the market infrastructure to integrate flexible resources into the system**. This solution is described above. It should also help to mitigate concerns about a first mover penalty and higher investment risks from a competitor eating my flexibility lunch.
	Strengthen the financial and non-financial incentives for network operators to develop capability and use flexibility when it is efficient. • **distribution and transmission network operators need to provide a cash signal(s) designed to dependably motivate a shift and shed-type flexibility** where it is needed as soon as practicable, either through the pricing structure or as a standalone contracted price. Practically speaking, the fastest way to provide transparent, tradeable pricing of dependable flexible responses is for network operators to offer a standalone contracted price via a flexibility exchange or platform. This approach would do the most to avoid inefficient cross-subsidies between network users. • **complement the financial and non-financial incentives provided through price-quality and information disclosure regulation** to strengthen incentives to use flexibility. An option is to introduce more granular, probabilistic and risk-informed quality standards from 2030. The current SAIDI/SAIFI measures discourage a more probabilistic, risk-informed approach to reliability investment and reduces the appetite for using lower cost options such as flexibility. Another option is to explicitly consider the impact of network pricing and cash signals on investment plans and allowed revenues.

Solutions for the transmission capacity management service

The transmission capacity management service is missing a cash signal to routinely motivate shift or shed-type flexibility in response to transmission congestion.

A practicable solution is to make non-network solution payments more routinely available. The process outlined in the Transpower Western Bay of Plenty Development Plan: Major Capex Proposal may provide a way for this to happen.

Success includes payments being accessible to any party with capable resources (directly or via an intermediary), rather than via a tender approach. The opportunity to provide a non-network solution has been up until now only available to flexibility coordinators securing a non-network solution contract through a tender process. Moving to a trading exchange or platform approach could provide greater visibility of qualified flexible resources, expand access to the benefits of the cash signal and assist to increase the stock of available flexible resources.

In parallel, a conversation is required about the potential for retailers and other network users to have and respond to robust forecasts of future scarcity prices at specific locations across the country at their locations. A forward looking locational spot price discovery mechanism could perhaps underpin a network price risk management (hedge) product motivating a shape response to deliver system value by deferring transmission investment.

Solutions for distribution capacity management

The distribution capacity management service is missing a cash signal to complement demand-based pricing and hot water control discounts to routinely motivate shift or shed-type flexibility in response to network congestion.

A practicable solution is to make non-network solution payments more routinely available. The effort and experience of distributors including Aurora, Orion, Powerco, and Vector mean we are on the way, but more learning is needed to develop experience in how to procure, deploy and use flexible resources so distributors can comfortably include flexibility as a business-as-usual tool in their asset management plans.

Payment-based cash signals are expected to be the fastest way to provide a transparent, tradeable price because including dynamic pricing methods in pricing structures requires significant new capability such as operational visibility across the network. Further, as dynamic pricing is untested, there is no evidence of how dependably people will respond.

Examples of customer propositions relying on payment-based cash signals are the 5c/kWh rebate available to Octopus customers in Wellington as part of the Resi-flex trial and the 51c/kWh available to Ecotricity customers in Lincoln on its for power put into the network during peak periods as part of the Orion Lincoln Flexibility Trial.

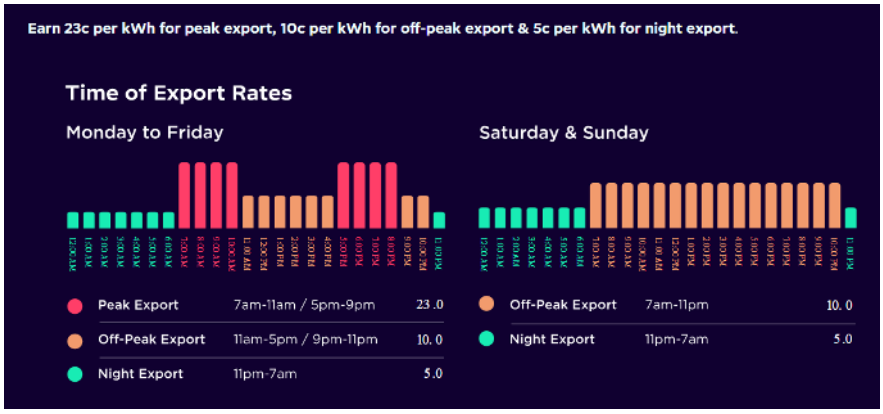
Payment-based cash signals are needed to complement cash signals from demand-based pricing and pricing discounts for hot water control for a range of reasons:

- the pricing discounts for hot water control comes with conditions that limit access to the benefits of the cash signal
- responding to demand-based pricing is discretionary and potentially not sufficiently dependable to defer or avoid network upgrades.

As with non-network solutions, providing the opportunity to respond to payment-based cash signals via a trading exchange or platform approach could provide greater visibility of qualified flexible resources, expand access to to the benefits of the cash signal and assist to increase the stock of available flexible resources.

Solutions for electricity supply services

Small scale flexible resources are not routinely used for spot price risk management. There are a few propositions based on the cash signals of hedge products or very high spot prices such as the Octopus Peaker Battery Plan which stacks the benefits of spot price risk management with the benefits of network TOU structures.



Source: Octopus Energy

More volatile spot prices strengthen incentives on retailers to harness flexibility resources, but the pace of proposition development will depend on the extent the products need common market infrastructure, such as mechanisms for transparent trading and pricing of risk management products, like the recently launched super peak product.

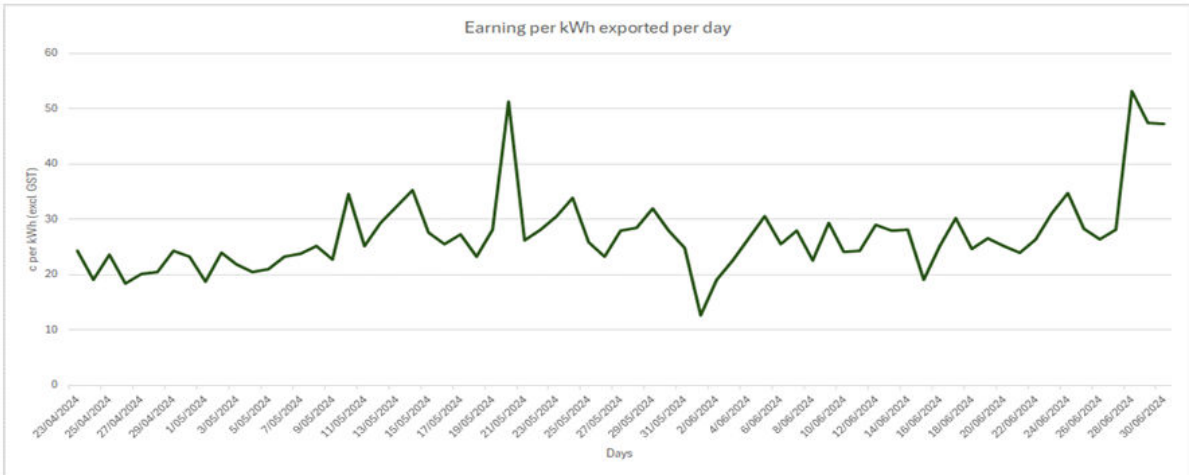
A way to speed up development of propositions which incentivise and motivate dependable flexible responses to unpredictable events, such as high spot prices and network congestion, is to developing a suite of common risk management products focused on shift and shed-type flexibility. If nothing else, having these products in the market will enhance price transparency and signal what 'the market' thinks flexibility is worth.

People have a small set of proposition types to choose from to sell their spare power, with most propositions offering a fixed price. A practicable solution is for retailers to offer people more choices: a PPA linked to the spot price, a shaped PPA or a FPVV PPA. Having this range of choices would put people on the same footing as a large generator which gets to offer some of its power at the spot price and some at a fixed price through the hedge market.

The solution could be accompanied by changes to enable multiple trading relationships to give people the ability to exert greater competitive pressure by selling their power to one retailer and buying from another and avoid inefficient tradeoffs between cash signals caused by a retailer bundling the retail PPA and the Retail product.

The initial results of the Kāinga Ora Wellington Multiple Trading Trial show that a spot price PPA resulted in an average buyback rate of 29c/kWh. Spot prices were high across this period due to supply shortfalls, but access to these high prices would enable people to make informed choices to maximise the value of their flexible resources, including creating system value by, in a small way, providing extra supply to meet demand.

The variability in the average price achieved per kWh exported per day is illustrated below.



Source: Kāinga Ora

A digitalised electricity system is needed for a wider range of flexible customer propositions

A digitalised electricity system is needed to maximise the value of flexibility.

Digitalisation means electricity sector data – there is heaps – is created and stored in a digital and computer-readable format to be processed, intermingled, stored, shared and transmitted efficiently and securely.

Digitalisation is needed to enable a wider range of flexible customer propositions.

- to create and provide the cash signals underpinning the flexible customer propositions
- for people to easily and routinely pick the proposition which suits their flexibility and preferences.

Cash signals must be created and sent

Cash signals to motivate a dependable flexible response to unpredictable conditions requires capabilities that are not yet widespread across the electricity ecosystem and depend on solutions to the practical and capability-related barriers to flexibility. Some of the most important capabilities to be developed are:

- operational visibility of network conditions at key locations, eg, substations, transformers, which provide the triggers for using flexibility (ie, the signal)
- forecasting future network conditions and power system analysis
- planning and investment practices routinely include planning to buy flexibility (via a cash signal)
- operational practices for network capacity management which accommodate and provide opportunities for flexible resources, eg, flexible connection agreements or dynamic operating envelopes
- procurement and contracting at scale
- communication flows between resources, sellers and buyers to send and respond to external signals
- dispatch practices for deploying flexibility when and where it is needed by sending, receiving and responding to a signal instructing a specified action, eg, raise generation.
- measurement, validation and settlement processes to calculate and pay for the flexibility response
- coordination across the system to manage potential conflicts from external signals pulling in different directions and adversely impacting a secure, reliable power supply that maximises benefits to system users.

People need to easily and routinely say yes to the more flexible propositions

There is a good chance most people are not on a suitable value maximising retail product and price due to the difficulty of getting good advice and information. This unsatisfactory and inefficient state of affairs will get worse as more complex propositions become available.

For the benefits of filling holes in the value stack to flow through to people, they and their advisers need better access to their own electricity information and to pricing information. People who can easily and routinely get prompt and personalised advice will be more able and more likely to make informed and confident choices to invest in flexible resources and sell the right to their flexibility.

Filling holes in the value stack achieves key parts of the Government Policy Statement on Electricity

Filling holes in the value stack achieves key parts of the October 2024 Government Policy Statement on Electricity.

The solutions outlined would help to **ensure accurate price signals that routinely and accurately monetise each source of system value.** Paraphrasing the GPS, this would support the objective of an efficient wholesale electricity market by providing ALL buyers and sellers of electricity (including those with flexible resources) with accurate price signals to discover lowest cost electricity supply and risk management solutions. As well as more affordable power, we could expect more efficient reliability and security of supply. Similarly, accurate network pricing would support efficient network operation by discovering lowest cost solutions, potentially including flexibility to avoid or defer network capacity augmentation.[15]

[15] The GPS says this about accurate price signals: 'This is best achieved by… An efficient wholesale electricity market with many different wholesale buyers and sellers of electricity, managing their own risks, responding to competitive pressures and accurate price signals…' [cl 3a], 'The Government's role is to ensure clear and consistent regulatory settings … that enable an efficient market anchored by accurate price signals…' [cl 8 and footnote 5], 'Efficient network pricing is essential… to find the lowest cost solution, which may include demand-side response and flexibility to avoid or defer the need for network capacity augmentation' [cl 14a], 'Clarity

The solutions outlined would help t**ensure resource owners or someone responding on their behalf can easily and routinely access the benefits of each cash signal**. This would support the objective in the GPS to make it easier for households, businesses and communities to invest in and benefit from flexible generation, storage and energy management technologies. Access to value promotes competition by enabling meaningful choices between suppliers, technologies and solutions and maximises the benefits of the using flexible resources in the electricity system.[16]

The solutions outlined would help to **ensure the cash signal is motivating efficient operation, security and reliability of supply**. This would support the objective in the GPS to ensure the growing value of flexible resources – demand side response, batteries, distributed generation – are used to efficiently manage energy and capacity shortfalls. Motivating efficient operating and behaviours will deliver benefits for people (lower bills) and for the system as a whole (more resilience).[17]

of incentives and accurate prices signals in the wholesale electricity market are critical to achieving efficient reliability and security of supply.' [cl 17], and 'The Electricity Authority has an important role in… Facilitating improved forward price discovery, particularly in relation to flexible supply…'.

[16] The GPS says this about enhancing competition and access to value: 'Technology advances are making it easier for new players (including households) to provide generation, energy storage or demand response services. It is important that our system promotes innovation across the system for the benefit of consumers.' [cl 6], '…If demand-side response is available in the market at a lower price, it should displace generation as the preferred source for meeting additional demand.' [cl 27], 'Market participants (existing and new, demand-side and supply-side) compete to find the solutions that are better than their competitors to meet the next increment of demand…' [cl 29c], and 'Household and business consumers can make meaningful choices between competing suppliers and technologies, and benefit from the opportunities available in the electricity system. This includes the benefits that consumers may gain from providing demand-side flexibility' [cl 29g].

[17] The GPS says this about the role flexibility can play in delivering expected outcomes: 'Demand-side response and other sources of flexible supply (such as batteries and thermal generation) will become more valuable, particularly in managing demand peaks and periods when short-term capacity is tight… [cl 10d and footnote 9], 'It is critical that this investment is economically efficient, which means (among other thing) that it reflects demand and optimises new capacity in a manner that avoids unnecessary cost increases for consumers, while ensuring network reliability.' [cl 13], 'Reliability requires enough investment in power stations, storage devices and demand side response capability to meet today's needs, as well as tomorrow's expected needs. [cl 16], and 'Efficient demand-side flexibility will deliver benefits for both consumers (lower bills) and for the system as a whole (more resilience).' [cl 28].

Our workings and how these insights were reached

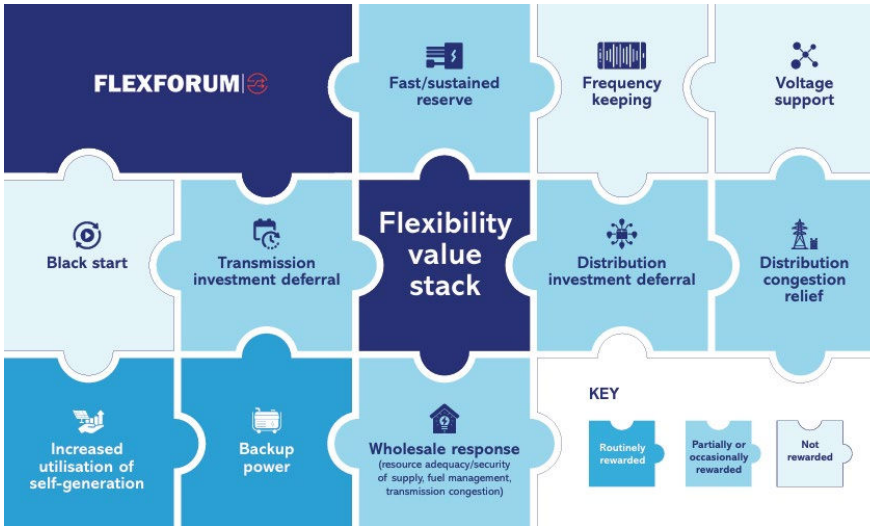
Below is our methodology for the development of these insights and solutions for finding and filling holes in the value stack.

FlexForum has discussed how to value and price flexibility at length since coming together in 2022. The insights were documented in July 2024, with the key insight being that there are holes in the value stack which prevent the value and benefits of flexible resources being maximised by the power system or by households, businesses and communities.

Our July 2024 ireport found cash signals were available routinely for 2 services, sometimes for 5 services, and not at all for 3 services.[18]

This FlexForum Insights documents the insights and conclusions of the 3 FlexForum workshops held from September to November 2024 looking at ways to find and fill holes in the value stack.[19]

The 1st and 2nd workshops were held to provide the Electricity Authority with expert advice on the flexibility-related solutions being considered by the Energy Competition Taskforce[20] and to develop a FlexForum view on practical options to fill the holes in the value stack and make it easy and routine for people to maximise the value and benefits of flexibility. The workshops covered 6[21] topics, asking:



Source: FlexForum.

- What is the underlying problem the solution is trying to address?
- What does success look like if the problem is addressed well?
- What outcomes would you expect to see from implementing the solution as specified?
- What is required to successfully implement the solution?,and
- What would you do differently or instead to solve the problem?.

The 3rd workshop focused on identifying a FlexForum view on solutions to fill holes in the value stack. The hunt for solutions was structured around insights from workshops 1 and 2 to understand the source of system value for specific activities (services), the cash signal or financial incentive for the service, the action required to produce that system value, and the flow of benefits.

[18] The 11 services were listed in our July 2024 insights and were adapted from a 2015 Rocky Mountain Institute assessment of services which can be provided using flexibility to align with the Aotearoa New Zealand lexicon. Not all of these services are referenced in this insights as the description of electricity services has been further refined since July 2024.

[19] The workshops were on 26 September (# attending), 3 October (#attending) and 19 November 2024 (31 attending).

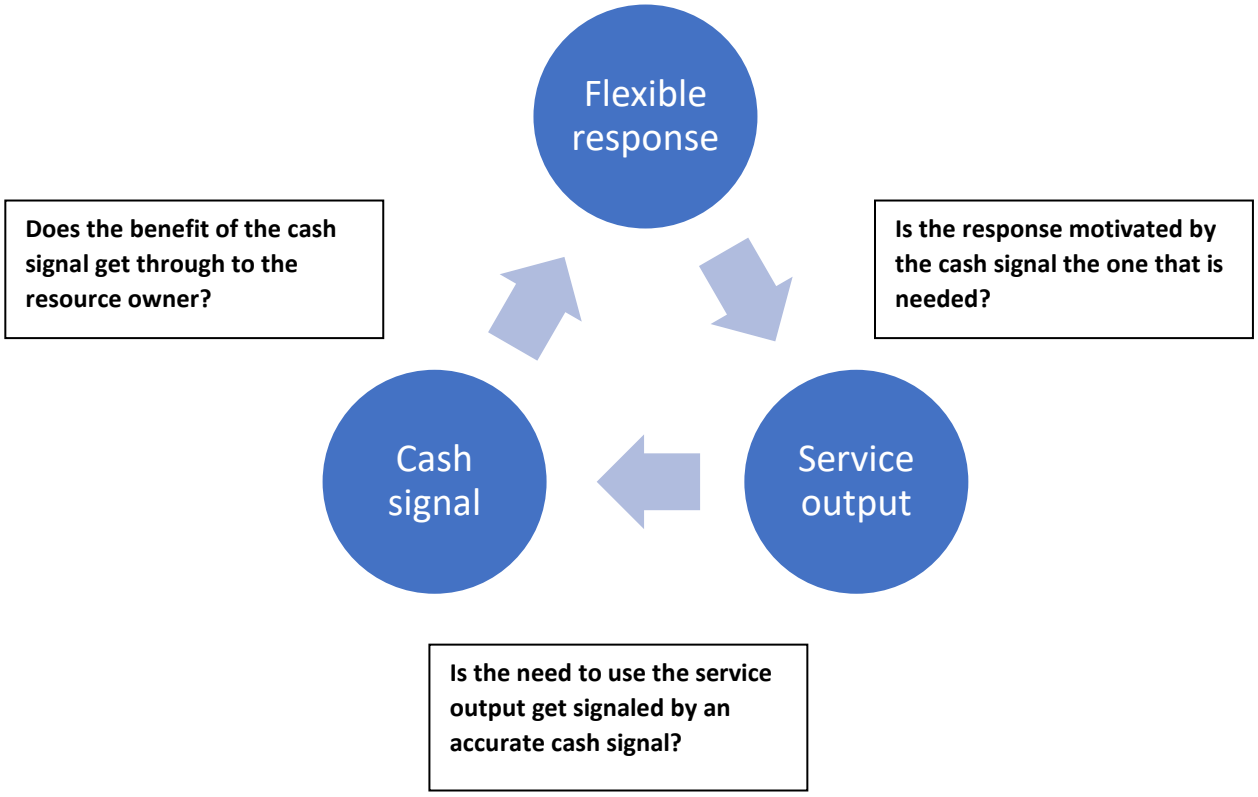
[20] FlexForum Members discussed the 6 flexibility-related solutions (of 8) proposed by the Taskforce to enable new generators and independent retailers to enter and better compete in the market (package 1) and to provide more options for end-users of electricity (package 2).

[21] The 6 topics were: requiring distributors to pay a rebate when consumers export electricity at peak times; requiring retailers to better reward consumers for supplying power; requiring retailers to offer a time-of-use plan; reward industrial customers for providing short-term demand flexibility; consider requiring gentailers to offer firming PPAs; and introduce standardised flexibility products.

A framework for finding and filling holes in the value stack

A hole in the value stack is where the cash signal or financial incentive for an activity providing an electricity service does not adequately monetise the value of the action and outcome.

This definition draws on discussion at a 19 November 2024 FlexForum workshop about 'where is the value' which highlighted the importance for buyers and sellers of converting value to actual cash (it is king), and is the basis for a framework to find and fill holes in the value stack without creating inefficient transfers of wealth and value.



For each electricity service or output, ask 3 questions.

1. **Does the need to use the service get signaled by an accurate cash signal?** We want to know whether the response is routinely and accurately signaled and monetised – irrespective of who sees this cash signal.[22] The cash signal should match as closely as possible the value and benefit of the response.

   For example, the electricity spot price is a marginal signal of the value of electricity at any point in time and location (in the transmission grid). Deploying a shift or shed service would reduce the use of electricity, in turn reducing wholesale purchase costs for whoever is the wholesale market agent for the customer, along with potentially helping to reduce traffic on the transmission grid and defer further upgrades.

[22] Some examples of routinely available and accurate: a retail TOU pricing structure provides a routine cash signal. A payment from bespoke flexibility procurement processes is not a routine signal. The spot price is an accurate cash signal. An LRMC-based price applying to a region is not an accurate cash signal.

2. **Does the benefit of the cash signal get through to the resource owner?** We want to know whether the benefits of the cash signal are accessible to the resource owner or their agent (someone who can respond on their behalf and pass through the benefit). For people to say yes to flex and respond to price signals, a big chunk[23] of the benefit from responding should get to the people providing the response, or who could provide the response – this will lead to efficient decisions to invest in, and enable, flexibility.
3. **Is the response motivated by the cash signal the response that is needed?** We want to know whether the response motivated by the cash signal is the type of response needed. This is important; different signals do different jobs. For example, a TOU signal is suited to motivating a shape-type response, but not shift or shed-type responses. Efficiency and value maximising outcomes are more likely from using the most appropriate cash signal.

A 'no' to any of these questions indicates a potential hole in the value stack.

The system uses 4 categories of electricity services

There are 4 categories of electricity services involved in keeping the lights on. Each service uses one or more pricing mechanisms to transparently signal and coordinate supply and demand for the service.

- **Electricity service**. This service involves generating, trading and using electricity.
- **System ancillary services**. This service involves managing power quality on the transmission network.
- **Transmission capacity management service**. This service involves coordinating the use of network capacity so capacity is greater than usage as often as possible.
- **Distribution capacity management**. This service involves coordinating the use of network capacity so capacity is greater than usage as often as possible.

Each service is provided efficiently when the outcome is realised through the most efficient set of inputs. For example, a distributor can provide the distribution capacity management service by managing the use of household hot water cylinders or by investing in more network infrastructure. Each action is an input for keeping network capacity greater than usage and, depending on the circumstances, one will be more efficient than the other.

Similarly, a household can get the electricity service by using a solar and battery system or by contracting with a retailer for grid supply. Each action is an input to keeping the lights on at that house and, depending on the circumstances, one may be more efficient than the other.

Well-defined electricity services and performance measures are a necessary condition for an efficient power system because this provides explicit performance criteria for the inputs and allows a comparison of options to do the job.

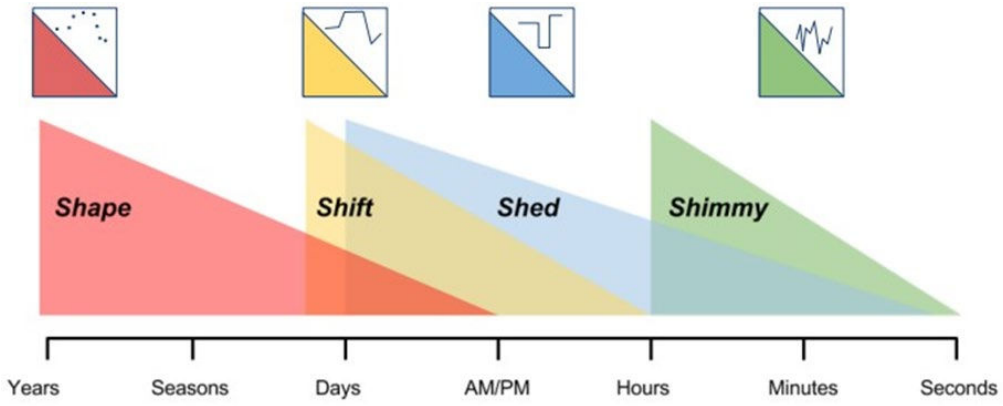
Not all electricity services are suited to being obtained as-a-service. Some outcomes are not suited to contestable mechanisms. We do not have a contestable supply of automatic under-frequency load shedding – the output is provided by households and businesses via distributors without an explicit cash signal. The presumption is that a non-financial incentive is appropriate when everyone benefits by avoiding a system failure. The black start service is perhaps in the same category, even if it is currently provided using financial incentives.

There are 4 types of flexible response

Flexibility – by modifying generation or use of electricity – can deliver system value through 4 types of response – shape, shift, shed and shimmy.

[23] Allowing for some postage and handling costs.

The response types represent the timescales – from years to seconds – required to do the job required to deliver the electricity service and use case. The timescales provide preformance criteria which influence the type of response, the nature of the cash signal, what flexible resources are suitable and how much convincing the people who own the flexible resources will need to say yes to flex.



Source: Lawrence Berkeley National Laboratory

The shape, shift, shed and shimmy taxonomy was developed to inform an estimate of demand flexibility potential in California.[24] FlexForum adapted the taxonomy to apply to flexibility from modifying both generation and use of electricity.

Here is a review of the use cases for each response type. Each response type is useful across the 4 service categories and all types of responses will be increasingly important as the system operation becomes less predictable due to changing use patterns and extreme weather events.

Response	Description	Suitability of response by service (High, Medium and Low)	
Shape	Modifying generation or use in an enduring way in response to an external signal without reference to system conditions at the time. • a consistent cash signal, eg, time-of-use pricing with higher rates at morning and evening 'peak' times, will motivate a consistent aggregate response even though individual households and businesses can respond differently day to day • obtained through pricing signals motivating a particular pattern of use, including 'shape as shift' by asking people in aggregate to regularly move use between time periods. This includes all TOU pricing products. • not a firm and deployable individual response as on any given day, the human has discretion to respond to reflect their preferences and opportunities to maximise value. May be a dependable response in aggregate due to diversity.	Electricity supply	High suitability for managing predictable and enduring wholesale market and network conditions, eg, the morning and evening increase in network use.
		Tx capacity management	High suitability for predictive and preventative capacity management in a region.
		System ancillary services	NA
		Dx capacity management	High suitability for predictive and preventative capacity management across the network or part of the network.

[24] These response types were developed by Lawrence Berkely National Laboratory. See the 2025 California Demand Response Potential Study - Charting California's Demand Response Future: Final Report on Phase 2 Results, March 2017. The [flexible] demand responses are described in section 3.4. The framework has also been used by Racefor2030 in its October 2021 Flexible demand and demand control opportunity assessment.

Response	Description	Suitability of response by service (High, Medium and Low)	
Shift	Modifying generation or use to shift activity between periods of a day in response to an external signal based on system conditions at the time. • a reduction in electricity use (or increase in generation) in one or more periods of a day paired with equivalent catchup use or reduced generation in a different period(s) of the same day • obtained through pricing signals, based on system conditions at the time, asking people to move use between time periods given specific conditions, eg, critical peak pricing, pricing discounts or explicit payments for an explicit response • must be a firm and deployable response.	Electricity supply	High suitability for arbitraging spot prices across a day
		Tx capacity management	High suitability for dynamically managing Tx capacity availability at a specific time and place
		System ancillary services	NA
		Dx capacity management	High suitability for dynamically managing Dx capacity availability at a specific time and place
Shed	Modifying generation or use to immediately lower or stop use or immediately raise generation in response to an external signal based on system conditions at the time. • an immediate reduction in use, potentially to 0, ie, lights out, with no catching up later on. Electricity use and the associated household or business activities are typically foregone. Not shifted. • typically an emergency response to network or system conditions in an area. All use is shed, typically at short notice, to avoid a network/system failure (blackout). Immediately raising local generation is a possible alternative to turning the lights off. • must be firm and deployable response.	Electricity supply	High suitability for matching demand to supply when there is a sudden supply shortfall, eg, generator tripping
		Tx capacity management	High suitability for emergency management, eg, Tx capacity shortfalls
		System ancillary services	Medium suitability for instantaneous reserves (FIR and SIR), and over-frequency reserve
		Dx capacity management	High suitability for Dx capacity emergency management, eg unforeseen network capacity shortfalls from rogue trees or car v pole events
Shimmy	Modifying generation or use over very short timescales routinely in response to an external signal based on system conditions at the time. • an immediate change in use or generation across a period (minutes, hours, days) to provide specific ancillary services to support the continuous balancing of power quality etc across the system. • must be a firm and deployable response.	Electricity supply	NA
		Tx capacity management	NA
		System ancillary services	High suitability for frequency keeping
		Dx capacity management	High suitability for Dx system operation, eg, voltage management

Source: FlexForum, Lawrence Berkeley National Laboratory, 2025 California Demand Response Potential Study - Charting California's Demand Response Future: Final Report on Phase 2 Results, March 2017 and Racefor2030, Opportunity Assessment Flexible demand and demand control Final report, October 2021.

The value stack relies on cash signals providing a financial incentive

In July 2024 our report noted that… *'Each individual service or use case needed to operate the power system needs to be monetised through a cash signal. Ideally, this monetisation occurs through transparent prices which routinely signal the value of flexibility for an electricity service. These cash signals are critical to transforming the value of flexibility from a conceptual idea into a tangible benefit – either cold, hard cash or reduced costs (a benefit) for the resource owner.'*

A cash signal provides a direct financial benefit to the resource owner if they take an explicit action which provides system value. The benefit comes through either an explicit payment, a 'discount' on the price or price component, or through reduced or avoided electricity costs (e.g., from shifting use to times with lower prices).

A cash signal is a financial incentive. Humans can be incentivised to take an action needed to create the system value through non-financial incentives, for example, technical standards, constraints on network access (a network operating envelope) or emotional appeals for people to conserve electricity.

Non-financial incentives have their place as not every service or activity across the electricity system will suit the use of financial incentives or a cash signal. Activities delivering a public or system good will be more suited to non-financial incentives. For example, the asset owner performance obligations on generators are non-financial incentives, though notionally the outcome could be achieved through financial incentives. Sometimes a 'no' to the question, 'Does the need to use the service output get signaled by an accurate cash signal?' is OK.

Applying the framework identifies holes in the value stack

We applied the framework to 10 pricing mechanisms used to provide cash signals across the 4 service categories to test whether the cash signal accurately reflects the efficient value and benefit of responding, is available, motivates the right type of response and the benefits are accessible to the resource owner. We found:

- 3 cash signals which do not **accurately** monetise the benefits of responding
- 8 cash signals which are not routinely **available** across the country
- 9 cash signals where the benefits cannot always be **accessed** by the resource owner
- 5 cash signals which do not motivate the most efficient **response**.

There is no real surprise that there are many opportunities to make it easier and more routine for people and the power system to realise the value and benefits of flexible resources – pricing mechanisms across the supply chain were designed for a world without lots of distributed flexible resources in the hands of households, businesses and communities. Filling the holes in the value stack is just a way of saying market and pricing mechanisms need upgrading to accommodate these flexible resources.

Hundreds of pages could be written on the purpose and operation of each pricing mechanism. We have not done that. Our assessment synthesises the expertise and experience of Forum Members for each pricing mechanism. The Appendix provides details of the method and explanations for the assessment of each of the pricing mechanisms considered.

Service	Outcome	Efficient response	Cash signal					Average score
			Mechanism	Accurate	Available	Access	Response	
Tx capacity management	Tx capacity > usage at all times	Shift or shed	Spot price					
			Payments					
Dx capacity management	Dx capacity > usage at all times	Shape	TOU pricing					
		Shift or shed	Demand pricing					
		Shift	Price discounts					
		Shift or shed	Payments					
	Power quality	Shape	kVar pricing					
Electricity	Supply = demand	Shift	Spot price					
	Spot price risk management	Shape, Shift	Hedge products					
System ancillary services	System strength	Shimmy	Spot price/ payments					

Source: FlexForum

Notes. Mechanisms listed are: spot pricing, TOU pricing ($/kWh), demand pricing ($/kW), kVar pricing ($/kVar), hedge products (typically a $/MWh payment), and payments (includes availability and volume payments).

The assessment showed where to focus efforts and points to likely solutions or solutions which should be avoided to fill holes in the value stack.

Key:

Not at all	Occasionally	Frequently	Always

Insights into the accuracy and availability of cash signals

We found 3 cash signals which do not accurately monetise the benefit of responding and 8 which are not routinely available across the country to the people potentially able to respond.

Using the spot price for transmission capacity management is the standout example of a cash signal which does not accurately monetise the benefit of responding. There is no direct connection between the benefit of responding to the spot price and the costs of transmission capacity constraints. At best, the impact on transmission costs is a second-round impact of spot price arbitrage, and the underlying benefit of deferring or avoiding transmission investment only becomes apparent when a solution is developed and costed by Transpower.

Two things need to happen for the spot price to accurately monetise the value of transmission capacity management:

- retailers need to forecast, expect to experience, and have sufficient incentives to respond to an increasing frequency of scarcity prices ($10,000+/MWh in the worst case) in each location
- the grid owner must hold back a transmission investment until scarcity prices are experienced.

Neither is plausible for reasons including:

- Scarcity prices are rare due to N-1(or higher) transmission reliability standards and the system operator and grid owner will not be doing their job if they occur often enough to be predictable;

- Retailers hedge against scarcity prices; responding will shift most use to another time, limiting the benefit to price arbitrage; and
- There is a free-rider problem if retailers think their competitors will get the benefits of their response without the costs.

Most cash signals for distribution capacity management are routinely available across the country, but are not accurate, either because they are based on accounting-based measures of the cost of capacity, or because they are based on highly averaged LRMC methods across a region or whole network, thereby approximating the value and benefit of responding. A more accurate alternative – direct payments for non-network solutions – is used by a handful of distributors but these are not routinely available.

Insights into the benefits being accessible to the resource owner

We found 9 cash signals where the benefits do not necessarily make it into the pocket of the households, businesses and communities which own the resources and provide the response. The resulting holes are mostly due to:

- The cash signals are accessed via select parties, thereby limiting opportunities for people with capable resources to access the signal because those parties do not offer products which pass on the benefits (or they need to be a customer of one of those parties). There are very few products based on the cash signals of hedge products or very high spot prices.
- The cash signals come with conditions which restrict which flexibility resources can access the value and benefits, eg, distribution price discounts, ancillary services and retail PPAs. For example, distribution pricing discounts (ie, controlled pricing) are typically limited to a specific resource (hot water) that is directly controlled by the distributor. Making the cash signal accessible to other capable resources would increase the size of the resource and the benefits.

Accessing the benefits of a cash signal can require a specific capability or risk appetite. For example, people could more easily get the benefits of the spot price (for electricity supply) and demand pricing (for distribution capacity management) if they have storage or autonomous response capabilities and the ability to decide how much price risk they want to accept.

People are less able to access the benefit of providing system ancillary services because existing technical rules are written such that not all capable resources meet the qualification requirements.

Insights into using the right cash signal for the job

We found 5 cash signals which do not necessarily motivate the flexibility response that is needed.

Selecting the most efficient signal requires distinguishing between input signals and customer-facing cash signals. Customer-facing cash signals mostly motivate a shape response to realise both electricity supply and network-related benefits, though a few retailers – eg, Ecotricity, Octopus[25] – offer products motivating shift (or shed) responses.

The limited range of customer-facing cash signals designed to motivate shift or shed responses is perhaps due to the limited range of corresponding input cash signals.

- Cash signals targeting shift or shed response for transmission or distribution capacity management are limited to distribution network pricing discounts for hot water control and demand-based pricing. This narrow range of cash signals leaves a bunch of capable flexible resources unmotivated.
- Flexible resources are not routinely used to back hedge products so the associated benefits are not on the table at the moment. We note that flexibility hedge contracts have only commenced trading on a common platform in 2025, but the Standardised Flexibility Product Co-design Group recommended further effort to develop new demand response products. This could address the problem that people currently have very few Retail products (usage) and Retail PPAs (supply) options which are linked to the spot price.

[25] The Ecotricity ecoWHOLESALE plan and ecoSolar plan and the Octopus Peaker Battery Plan provide various cash signals motivating people to shift their usage or generation between time periods providing electricity services to realise various sources of system value.

A further factor in the design in customer-facing cash signals is that people like retail products which provide price risk 'insurance' in the form of a more stable and predictable price.

Most people currently have Retail products which package the various input signals involving trade-offs to reflect the relative strength of the spot price (usually stronger) and network signals (usually weaker).

What people experienced due to The Lines Company demand-based pricing should be enough to warn off anyone contemplating dynamic pricing without ensuring people have tools and options to manage price risk.[26]

Dynamic responses are, and will become more valuable for managing capacity and spot price risk over the coming years. As such, along with making dynamic cash signals and the associated benefits more accessible, learning will be needed to understand how to maximise the value of flexible resources using Retail products (providing people with price risk management) AND cash signals motivating dynamic shift or shed-type responses.

Having a cash signal for a specific (flexible) response that provides a source of system value gives the human (or their agent) the ability to make decisions about providing or using their flexible resources and maximise their benefits and to the electricity system.

[26] Until 2018 The Lines Company used a demand-based pricing metholdogy. Network charges were based on usage during network constraints. It was not popular.

Appendix: detailed assessment of pricing mechanisms and cash signals

We assessed the cash signals used across the 4 service categories: transmission capacity management, distribution capacity management, electricity supply and system ancilliary services.

1. Does the need to use the service output get signaled by an accurate cash signal?
2. Does the benefit of the cash signal get through to the resource owner?
3. Is the response motivated by the cash signal the one that is needed?

Answering the questions involved:

- Identifying the **type of response needed** to deliver an efficient outcome.
- Identifying the **pricing mechanism used** to provide the cash signal(s) and rating its **accuracy**, **availability**, **access to benefits** and **appropriateness of response motivated** using a 4 point rating: not at all (0); occasionally (1); frequently (2); and always (3).
    - **Accuracy**: how accurately the cash signal reflects the value and benefit of responding. For example, a cash signal accurately reflecting the value of a response to manage transmission capacity would be be based on the deferral value of avoided capex. Accuracy does not mean perfect precision. Cash signals will rarely be precisely accurate. The obvious example is distribution prices which must balance cost recovery with forward signalling, sometimes based on the estimated long-run-marginal cost (LRMC) of forecast network investment. Converting the LRMC of forecast network investment ($/kw-year) into, for example, a peak price for a TOU contract (that is available to the customer every peak period) is difficult.
    - **Availability**: is the cash signal created and available across the country. The spot price is created at transmission nodes across the country. Prices for network support are not created or available across the country.
    - **Access to benefits**: whether the resource owner can easily access the benefits of responding to the cash signal, whether directly or via an intermediary. For example, the benefits of hedge market cash signals are not easily accessible because distributed flexible resources are not routinely used to provide a relevant physical response.
    - **Appropriateness of response**: each cash signal will motivate a type of response. Efficient outcomes require the cash signal to motivate the right type of response. For example, TOU pricing signals motivate a shape response, but not the shift or shed responses needed to manage unpredictable events.

Ratings have not been weighted. This probably makes things look better than they are. A cash signal that is routinely available, frequently accessible and motivating the needed response, but is not accurate (eg, relying on the spot price for transmission capacity management), can cause as much or more harm as a signal which is accurate but not accessible (eg, payments for managing distribution capacity). Both scenarios cause inefficient outcomes.

Service category: transmission capacity management

Service	Source of value	Response wanted	Cash signal					Explanation
			Mechanism	Accurate	Available	Access	Response	
Tx capacity management	Tx capacity > usage at all times	Shift is the highest value response to be deployed with confidence to manage Tx capacity in specific conditions Shed has value as a safety net response if shift cannot keep usage < Tx capacity Shape has some value as a consistent long term response not linked to specific conditions	Spot price	0	3	1	1	The spot price is not an accurate cash signal for Tx capacity management. The benefit is from electricity arbitrage and not connected to the benefit of monestising avoided Tx costs. The signal is routinely available with prices discovered every 5 minutes. The signal is not easily accessible. Few people directly experience the spot price. Some benefits may be passed on through TOU rates or discounts for offering automated hot water control but are stacked with electricity and Dx-related cash signals The signal motivates a shape as shift response as part of the retail price, but not the more valuable shift or shed responses. Note: TOU retail rates and control discounts motivate shape as shift.
			Payments	3	1	1	3	Direct payments via grid support / non-network solution contracts would accurately monetise the system value. No contracts are live, but we know payments will be calculated based on avoided capex. Payments are not routinely available. No contracts operating, though RFPs have been sought Payments are not routinely accessible. The RFP method would require resource owners to contract with successful tenderers. Payments would achieve the desired response (shift or shed) because that would be a contract requirement.

Service category: distribution capacity management

Service	Source of value	Response types desired	Cash signal					Explanation
			Mechanism	Accurate	Available	Access	Response	
Dx capacity management	Dx capacity > usage at all times	Shift is the highest value response to be deployed with confidence to manage Dx capacity in specific conditions	TOU pricing ($/kWh)	1	2	2	2	TOU pricing is less accurate. TOU rates signal forecast long-run capacity costs which are averaged region or network. TOU pricing is frequently available. Prices are published annually, but not all distributors offer TOU. TOU pricing is frequently accessible. TOU retail prices are offered by most retailers and pass through TOU benefits but

Service	Source of value	Response types desired	Cash signal					Explanation
			Mechanism	Accurate	Available	Access	Response	
		Shed has value as a safety net response if shift cannot keep usage < Dx capacity Shape has some value as a consistent long term response not linked to specific conditions						stacked with the more dominant electricity (spot and risk) cash signals. The signal motivates a shape as shift response as part of the retail price but is not suited to motivating the more valuable shift or shed responses.
			Demand pricing ($/kW)	2	3	2	3	Demand pricing is mostly accurate. Demand rates signal forecast long-run capacity costs, but more accurately reflect costs than TOU rates by basing the price on the average of 100 peaks or on the more dynamic critical peak demand (CPD) in the month/year. Rates are not usually set to reflect localised network conditions so responses impose unnecessary costs on the customer without providing system value. Demand prices are frequently available and mostly accessible to target (business) customers. Typically offered by distributors to business customers requiring large connections via a direct contractual relationship. Has not worked well with households in the past. Motivates a shift response, but requires the customer to have the capability to respond.
			Price discounts ($/kWh) for load control	1	2	1	2	Price discounts in return for load control are less accurate. Discounts have not historically been set to reflect avoided costs or use case benefits (eg, reserves) Mostly available automatically for households with eligible load via retail price, but the benefits are less accessible. Benefit is not accessible as a standalone signal for capable flexible resources, and eligibility restricted to resources connected to the ripple system/direct control by the distributor. Direct control autonomously delivers a shift response, but there is little transparency about what source of system value the response is delivering, or the associated benefits.
			Payments	3	1	1	3	Direct payments via non-network solution contracts are accurate with payments based on avoided capex Not routinely available. A handful of distributors are using contracted flexibility. Not routinely accessible. Benefits accessible only in specific areas and via specific intermediaries Delivers the desired response (shift or shed) because that is a contract requirement.
	Power quality (reactive power) within limits	Shape (reactive power)	KVar pricing ($/kVar)	3	3	3	3	Kvar pricing accurately monetises the benefit of avoiding reactive power. The signal reflects the costs of managing reactive power

Service	Source of value	Response types desired	Cash signal					Explanation
			Mechanism	Accurate	Available	Access	Response	
								Routinely available (mandated) for target customers who create reactive power, eg, irrigators Routinely accessible for target customers via a direct contractual relationship with the distributor Delivers the desired response (shape) by motivating investment in devices/equipment which manage/do not create reactive power.
	Power quality (voltage) within limits	Shimmy (voltage)	No cash signal	0	0	0	0	There is no cash signal for voltage management. Non-financial incentives have been preferred.

Service category: electricity supply

Service	Source of value	Response wanted	Cash signal					Explanation
			Mechanism	Accurate	Available	Access	Response	
Electricity supply	Spot price arbitrage to deliver lowest cost supply = demand all the time	Shift, shed	Spot price	3	3	2	1	The spot price is calculated every 5 minutes using bids and offers to accurately and routinely monetise the benefits of providing shift and shed responses from both generation and load. Routinely available. Prices are discovered every 5 minutes Mostly accessible. Few people directly experience the spot price, but retailers have incentives to reduce input costs using financial (eg, hedge) and physical (eg, flexibility) risk management tools. Incentives to realise and pass on the benefits of flexible responses appear to be strengthening due to increased frequency of high price events People directly experiencing the spot price are motivated to provide shift and shed. Otherwise the signal contributes to a shape as shift response as part of the retail price, but not the more valuable shift or shed responses.
	Spot price risk management	Shape, shift	Hedge products 1. futures and options exchange (ASX) 2. over the counter hedges	3	2	1	0	Spot price risk management is via various financial products which are typically backed by a physical ability to provide a relevant response. Each product provides an accurate cash signal reflecting future spot prices (to buy or sell) in different scenarios, eg, superpeak or baseload. The system value comes from managing the cost of electricity by avoiding high prices and low prices, thereby helping physical supply to equal demand in the future.

Service	Source of value	Response wanted	Cash signal					Explanation
			Mechanism	Accurate	Available	Access	Response	
			3. financial transmission rights					The cash signal is routinely available to parties approved to buy/sell hedge products, but the benefits are only accessible to resource owners if parties which sell hedge products elect to use distributed flexible resources to provide the relevant physcial response. This is not currently routine. The cash signals do not motivate a response relevant to the source of system value because the benefits are not directly accessible or routinely passed on.
	Input price risk management	Shape and/or shift, shed depending on individual risk appetite	Retail pricing products	3	2	2	2	Retail pricing products can take many forms based on the outcomes many people want, but all products package the input costs and provide spot and network price risk insurance. The cash signal accurately monetises system value to the extent it reflects the input costs and insurance level desired by the customer. The most common structure is fixed price, variable volume (flat rate or TOU). The TOU variant motivates a shape response aligned with network TOU signals FPVV and spot-based retail pricing options are routinely available, but pricing options which realise benefits of shift and shed responses are not routinely available The benefits of responding align with purpose of the cash signal, eg, the benefit of a flat rate FPVV structure is risk management Retail pricing products get the response they are designed to provide the customer. In a world where distributed flexible resources are not easily or routinely used to realise system value, the most common products motivate no specific response, or a shape response. Forcing people to expose themselves to cash signals they are unable or unwilling to respond to removes customer choice and agency.
	Spot price arbitrage to deliver lowest cost supply = demand all the time	Shift	Retail PPA	1	2	1	1	Retail power purchase agreements are a better term form buyback rate for spare solar, or other flavour of power, put into the system. The cash signal is typically a fixed price variable volume structure which averages the spot price. Accuracy is further impacted by regulatory settings forcing the bundling of retail pricing products and retail PPAs – both signals are potentially distorted A PPA is available from most retailers alongside a retail pricing product. Access to the relevant system value as signaled by the spot price is not routine. A couple of PPA products providing time of export signals exist, but these are not common

Service	Source of value	Response wanted	Cash signal					Explanation
			Mechanism	Accurate	Available	Access	Response	
								The commonly available cash signal does not motivate shift type response needed to realise the system value.

Service category: system ancillary services

Service	Source of value	Response wanted	Cash signal					Explanation
			Mechanism	Accurate	Available	Access	Response	
System ancillary services	System operates within technical limits 4. frequency 5. Reserves 6. Black start 7. Voltage support	Shimmy	Spot price (frequency and reserves) Contract payments (voltage, black start)	3	2	2	3	System ancillary services are obtained to deliver a specific source of system value The various cash signals accurately monetise the specific source of system value, eg, maintaining frequency The cash signals are routinely available to people with resources that meet technical qualification requirements The qualification requirements are written such that not everyone with capable resources can qualify, meaning the benefits are not easily accessible The cash signal delivers the desired response because that is a contract requirement.