MDAG – Price Discovery in a 100% Renewables Wholesale Market

Enhancing wholesale market demand-side flexibility: Framework for Option Development

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Contents

1 Scope and framework

In our Issues Paper and its accompanying paper on demand side flexibility ('DSF')[1], we outlined:

- Why DSF is important
- Its primary sources
- The roles it can play in the wholesale market
- How the "market" for DSF works, in particular decision factors for providers (consumers) and DSF users (retailers and third parties), and
- Prospects for increasing DSF.

This previous work provided the platform for our distillation and analysis of the options in this paper.

We are grateful for the many submissions that were received on the Issues paper, which helped us refine our list of issues, as well as providing numerous suggestions that have informed our options framework.

Before examining the options, let's recap our scope and framework.

1.1 Role demand-side response as a competitive resource

We tend to overlook that, viewed from a wide lens, demand side response covers all decisions and activities by consumers to use electricity to meet their service requirements, whether in the short, medium or longer term. Indeed, it is the consumer's response to the value of electricity as a fuel that creates the need for the vast matrix of institutions, legislative and regulatory frameworks, markets and technologies that we call the electricity industry. Demand "response", in all its forms, is the reason that the supply side exists.

On a more dynamic level, the collective decisions made by consumers drive the response of supply side resources (across all time frames). If the decisions of consumers can be changed by an external influence (e.g., price, policy, technology, social norms) this will change the deployment of supply-side resources. This logic compels us to view this set of demand-side "responses" as a resource which, depending on the costs and benefits to the system, should be able to compete with the supply side in providing a reliable system at lowest cost. After all, electricity markets are designed to provide reliable electricity at least cost to consumers[2]. It follows that, if the marginal cost of reducing or shifting demand is less expensive than the cost of producing an additional unit of electricity from the

[1] Batstone (2022), "MDAG – Price Discovery with a 100% Renewables Wholesale Market Prospects for the uptake of demand-side flexibility in the New Zealand wholesale electricity market under 100% renewables", January 2022

[2] Peter Cramton, Electricity market design, Oxford Review of Economic Policy, Volume 33, Number 4, 2017, pp. 589–612

next cheapest source of generation, then the demand-reduction or demand-shifting option should prevail – it is best for the economy, the environment and consumers.

Put simply, wholesale market arrangements need to ensure that DSF can compete efficiently with supply-side resources (including transmission[3]) in the market's process of discovering the least cost solution for delivering reliability over the short, medium and longer terms. This then demands an inquiry of what the external triggers are, how they can be used, how effective they are, and whether the benefits to an individual consumer outweigh the costs. This only highlights the asymmetry between our understanding of the demand side and the supply side, where the former is absolutely dwarfed by the scale of modelling, data and understanding of the latter.

In the language of the supply side, demand-side resources:

- require investment to be enabled;
- have operational implications and costs;
- derive a (intrinsic and/or extrinsic) benefit stream; thus
- need to be explored and evaluated by resource owners in order to ascertain whether the benefits are likely to exceed the costs and, if so, how to bring the resources to market.

This perspective – that lower cost demand-side response resources should displace more expensive supply-side resources – is foundational to our consideration here.

1.2 Our focus is on demand side responses in the wholesale market – demand side flexibility (DSF)

Energy efficiency, fuel switching (e.g., the decision to purchase an electric vehicle), and embedded behaviours of conservation are extremely valuable demand-side responses, and they often have the long-term effect[4] of changing the shape of the load profile (usually reducing peaks) which has an obvious impact on dispatch. However, they are not our focus here. Rather, we focus on dynamic responses to the wholesale market price. We characterise this as "demand-side flexibility" (DSF), using OFGEM's definition of flexibility as "modifying generation and/or consumption patterns in reaction to an external signal (such as a change in price) to provide a service within the energy system."[5]

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[3] And, of course, distribution infrastructure. However, as explained below, network-related drivers of DSF, while very important to the value of DSF, are outside the purview of the wholesale market, which is our focus here.

[4] Long term elasticities are difficult to estimate empirically, but are central to the overall concept of dynamic efficiency. Recent analyses suggest long-term elasticities are many multiples of short-term elasticities. See Buchsbaum (2022), "Long-run price elasticities and mechanisms: Empirical evidence from residential electricity consumers", Working Paper, University of Chicago Energy and Environment Lab.

[5] OFGEM, as cited in "Draft IPAG review of the Transpower Demand Response Programme", 8 July 2021, which IPAG recommends

As a result of our external signal being derived from the wholesale market, this scope also excludes the significant potential for demand-side flexibility to be utilised for distribution network purposes[6]. We acknowledge that other workstreams are in progress considering options to develop DSF, especially in respect of network issues. Since MDAG commenced its work on 100% RE, we have engaged with and/or reviewed these workstreams, including the Future Security and Resilience project, the Innovation and Participation Advisory Group, Flex Forum and the South Island Distributors' group. These groups are making significant contributions to the understanding of, and planning for, a world with increased demand response. In some cases, their work is already progressing options that deal with issues raised in submissions to MDAG's paper. Later in this document, and in the MDAG Options Library, we flag particular issues where we endorse others' work.

Sources of DSF considered in this paper

The sources of DSF that fit within our primary field of focus are:

- Smart controls on home and business energy consuming devices (including water heating and EV charging) that allow users to actively manage consumption in response to an external signals that reflect wholesale market prices;
- Battery storage systems installed on a customer's premises;

These resources can be used to provide the following services to the wholesale market:

- Short-term shifting of consumption between time periods (utilising thermal inertia or chemical storage), and
- Increasing or decreasing of demand for a range of periods (minutes, days, weeks, months) when low or high wholesale prices persist.

1.3 Benefits of DSF to the wholesale market

There is a broad set of benefits[7] provided by the overall demand-side response "resource", which are widely acknowledged in the literature. The scope of DSF addressed in this paper offers the following

[6] Noting that a substantial component of transmission network needs will be signalled through locational marginal pricing in the current scope of the wholesale market. Should LMP be extended into the distribution network, this distinction would become less significant, as discussed later in this paper.

[7] These benefits include reducing spot price volatility; improving system security and reducing the risk of black-outs (for example, by emergency load shedding, ancillary service markets, voltage support, and limiting the consequences of network faults once they occur); reducing network congestion; delaying construction of additional generation, and/or grid and network upgrading; reducing greenhouse gas emissions; improving market efficiency by enhancing consumers' ability to respond to changing price, and lowering consumers' total electricity costs, with demand side resources competing effectively, displacing more expensive supply side investment – see "Electricity Demand-side Management", Treasury, October 2005. See also Batstone (January 2021) and MDAG Issues Paper (January 2021) at 7.90. Increased wholesale market participation from consumers was seen as important during the market design period in New Zealand (see Culy (1995)) and internationally (see e.g., Cramton, Ockenfels and Stoft (2013), Fraser (2001), Hunt (2002))

particular benefits, which (as explained later) are heightened in wholesale market of 100% renewable energy (or close to it):

- More competitive pressure on wholesale prices/costs, especially during times of higher prices when generation is scarce, mitigating market power concerns. As noted by Hogan (2016):

  Markets cannot function without the check of effective competition, with the latitude to form effective energy prices being a principal casualty. Ensuring competition is a non-negotiable prerequisite for the market in general, much less for proper energy price formation. And although the system 0perator's role as buyer/seller of last resort sets an upper limit on shortage pricing, full confidence in unfettered energy market prices is unlikely until demand has developed a more dynamic capacity to clear the market based on the range of values consumers actually place on continuous service, rather than at an administratively set average.[8]

- Bolstering the political sustainability of scarcity prices (Simshauser, 2018). In particular, if customers are able to reveal their true willingness to pay for electricity via bids into the wholesale market, the marginal price of electricity will reflect customers' valuation rather than an administered price (such as VOLL). Formal bidding of "willingness to pay" (WTP) demand bids into the wholesale market would therefore improve the social and political acceptability of prices, especially during periods of scarcity[9], and forestall the use of non-price demand rationing (and administrative pricing) in these situations;
- Broadening and deepening understanding of how electricity pricing works, and the arrangements that underpin it, which flows from having greater consumer engagement (directly or via intermediaries) in wholesale pricing process; and
- Reducing system costs as DSF can – at least partly – fulfil the role of a peaking plant or grid-scale storage schemes, potentially at lower cost to the system[10] and reducing greenhouse gas emissions from fossil fuelled plant. As reflected in Joskow (2019), demand side participation is not necessarily essential to the integration of very high levels of renewables, but, in many situations, will be a more beneficial approach in achieving high renewables than using only supply-side measures.

> Joskow (2019) shows that dynamic retail pricing yields a 2.4% - 4.6% reduction in electricity expenditures (in a fossil-fuel environment), but an 8.5% - 24.3% improvement in a system heavily dependent on renewable generation

- Stabilising wholesale spot prices (energy and ancillary services), especially when intermittent supply resources create volatility in the supply curve;

[8] Hogan, M., (2016), "*Hitting the mark on missing money*, downloaded from www.raponline.org.

[9] It is far preferable to maintain security of supply through price-based reductions in demand, rather than to have administratively set prices (usually referenced to an approximated value of lost load, or VoLL) or non-price rationed involuntary curtailment

[10] See later discussion on quantifying these benefits for NZ, using MDAG's simulations.

- If formally bid into the market, improved granularity and accuracy of the demand and supply curves the system operator optimises in finding the least-cost dispatch solution[11]; formal bidding also helps the discovery of "shape" in the demand curve, potentially replacing the contribution that thermal offers currently make to the supply curve.

MDAG's modelling has shown that, as we transition to a very high renewables system, flexibility becomes a highly valuable service to the system. This is because the removal of fossil-fuelled plant removes a significant source of flexibility that has been present in the electricity system (at scale) since the commissioning of Meremere in 1959. Our analysis also suggests that revealing more information on the "shape" of forward prices will be critical as we move into 100%RE. Hence many of the benefits listed above – while valuable in all scenarios – become increasingly valuable to a system moving towards 100% RE.

These benefits in combination – lowering overall system costs for consumers, mitigating market power concerns, lowering the need for forced demand curtailment in periods of scarcity, and more consumer engagement in the pricing process – promote the crucial overarching benefit of achieving reliability at least cost, while strengthening political-economy and public confidence in the market arrangements. We see this as a foundational for a well-functioning wholesale electricity market.

1.4 Costs of DSF

The cost of enabling and using DSF is often hard to measure, because the decisions are made by consumers for whom electricity consumption is just one of myriad factors they consider as relevant to their individual or corporate aims. While the entities that own and/or operate large supply-side electricity resources are typically *dedicated* to the production of electricity, very few consumers – if any – are focused exclusively on electricity consumption. Rather, their use of electricity is a demand derived from the pursuit of other aims (e.g., warmth, health, production of a good or service). Hence considering and enabling DSF requires resources, beyond the cash costs of any technology required to enable it (such as time and attention) which compete with other aims within the household or business[12]. The resources and attention that will be paid to enabling and operationalising DSF will likely be commensurate with the significance that energy consumption (and expenditure) makes up of the overall "budget".

By choosing to change a consumption decision in response to the wholesale price, DSF also requires the resource owner to sacrifice a degree of autonomy over their consumption, which implies an intangible "cost". As we outline below, today's technology offers far more sophisticated ways to minimise this cost. Other factors are important too, such as the values and preferences of consumers with respect to resource usage, environmental factors, and many other aspects of our "energy

[11] Consultation paper, Electricity Authority, March 2019, 3.53

[12] We note here the familiar social equity issue discussed in respect of electric vehicles and solar panels – the "entry" costs of DSF – whether it be the purchase of a small piece of automation equipment, an electric vehicle, or a solar/battery system – will not be affordable for a number of households. Which means the benefits derived from DSF will be difficult to access for most lower income households.

cultures"[13]. These values and preferences apply equally to the costs and benefits of DSF.

1.5 Reality of DSF to date, and what has hampered uptake

Since its inception, a key aim of the wholesale electricity market has been to unlock, over time, the considerable potential for the demand-side to offer competitive alternatives to supply side options. (Government policy positions on DSF since 1995 are noted in Appendix 4).

In reality, the most significant source of demand response has come from energy efficiency[14], rather than flexible and dynamic demand responses to wholesale prices[15]. Demand side participation in general, and DSF in particular, remain relatively undeveloped. Our Issues Paper sets out the key reasons.

To recap, historical inertia overall has been a material factor. Put simply, the inadequacy of the historical arrangements to enable and reward DSF, combined with the low "size of the prize" (for individual consumers) relative to the cost, led to a stasis in DSF beyond the small number of examples at industrial scale. This stands in stark contrast to the growth in supply-side resources; which, obviously, dominated growth necessitated by largely unresponsive demand. We outline below some of the key components of this asymmetry.

Asymmetry in benefits relative to household, business or organisational "focus"

As discussed above, electricity expenditure – let alone DSF - must compete inside a household or organisation with a range of other competing pressures. On the supply side, electricity revenue is almost exclusively the *raison detre* of the organisation.

As Treasury observed, our history of relatively low electricity prices is likely to have been a key driver of attitudinal barriers:

> "This is because low prices translate into electricity comprising a relatively small proportion of total operating/input costs. In most industries, electricity is therefore an essential but proportionally small input to the industrial process and is hence not a high priority for management. Apart from electricity-intensive industries, electricity typically accounts for less

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[13] Many of these behavioural factors are more comprehensively explored in the New Zealand context by the Energy Cultures work of the Otago Energy Research Centre. This work highlights how demand-side behaviours (including energy efficiency investments) are a result of "cultures" – a combination of norms, material culture and energy practices – that form in particular contexts (e.g., industries, households etc). See Stephenson, J., Barton, B., Carrington, G., Gnoth, D., Lawson, R., Thorsnes, P., 2010. Energy cultures: a framework for understanding energy behaviours. Energy Policy 38,6120–6129.

[14] See Batstone, S., Reeve, D., "Trends in Residential Electricity Consumption", 5 August 2014 which describes the role of energy efficiency in the extended period of flat demand since 2007, which had profound impacts on the wholesale market, investment and decarbonisation.

[15] There is an extensive literature that debates reasons over the years – see Lund et al (2015), "Review of energy system flexibility measures to enable high levels of variable renewable electricity", Renewable and Sustainable Energy Reviews 45; Some of these barriers are captured in this paper as they remain relevant today;

> than 5% of total operating costs. End-users are likely to be more concerned with making large savings in significant cost areas, than achieving relatively small gains from low cost components…
>
> Another pricing problem occurs when electricity prices are based on average rather than marginal costs. This can distort decision-making, as it inhibits users' price-responsiveness and provides inadequate incentives to invest in [demand side management]. The structuring of tariffs (fixed rather than variable pricing) acts in a similar way."[16]

The relatively low level of historical prices, leading to electricity being a low proportion of overall expenditure means that the "size of the prize" for enabling DSF would have been small, relative to a supply side entity where the electricity price – albeit low – was a critical driver of revenue. Further, the dominance of highly flexible hydro in New Zealand kept short-term price volatility – a key driver of the value of DSF – lower than international peers. Hence the benefits of investing in DSF historically, even relative to the level of expenditure would have been low, even if consumers could have accessed these benefits.

Asymmetry of commercial arrangements

The reality is that, for much of history, few consumers could access the wholesale benefits of DSF.

The vast majority of flexible supply-side plant is grid-connected, and so – through the requirements of the Code – is by default and design fully exposed to a varying wholesale price. Generation resources can then elect to engage in a variety of hedging arrangements to smooth this volatility (while, in many cases, preserving their ability to benefit from responding to the wholesale price).

By contrast, except for the largest industrial consumers, the default arrangement for the demand side is a tariff which perhaps mimics a pattern of wholesale prices (such as TOU tariffs for larger consumers) or, for a large proportion of residential consumers, contains little[17] or no wholesale-related signal whatsoever that might stimulate DSF . Many consumers may prefer relatively stable retail prices over a more dynamic pricing. However, we have scant information about customer preferences in this respect, especially how – across the spectrum of consumers – some might be willing to provide a response to wholesale-reflective signals. Given the weak rewards contained in default tariffs, it should be no surprise that the costs of engagement and response have outweighed the benefits.

Asymmetry of scale and technology

Other key drivers for the asymmetry between supply and demand have been scale and technology. Grid-connected generators are large, and so have always been able to afford both advanced metering arrangements, as well as the focus, capabilities, resources and systems to drive wholesale-responsive

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[16] Treasury (2005)

[17] We acknowledge the recent emergence of a number of tariffs which offer limited hours of free electricity, and some peak/off peak tariffs, for domestic consumers.

decision making.   Historical demand-side metering arrangements only allowed – at least for residential consumers – measurement of consumption at a monthly resolution.

Further, the onus of enabling and activating the demand side response at the right time has been on the individual consumer or business, which – for all but the largest consumers – do not typically have the time or resources to undertake this task, as they must accommodate it within their needs to serve their customers or carry out their lives as individuals. Hence the cost of dynamic response has been relatively high.

From a DSF intermediary's perspective, the lack of automation and communications technology has made it costly to achieve scale. Due to the transaction costs involved with establishing DSF relationships with individual customers, achieving any meaningful scale in the mass market sector would have been very difficult. However, with advanced automation, these transaction costs should be significantly lower.

1.6 A counterpoint – ripple control of hot water

The most successful residential DSF arrangement in NZ – albeit not one currently focused on the wholesale market - is the ripple control arrangement used by many EDBs to manage loadings on their network.

The decision to implement demand control was built into the rollout of hot water cylinders: It was recognised that making hot water heating widely available would significantly increase demand for electricity, so the ability to control when it was on and off was included as a necessary part of mitigating the concomitant increase in peak demand. Demand side management was an integral part of the package. Today, it is estimated that over 900MW of hot water cylinders remain connected to ripple control systems; at peak times, the coincident usage of ripple control may reach over 600MW, more than the capacity of two Huntly Rankine units.

The nature of today's hot water tariffs is also insightful, and resemble the types of tariffs we expect will emerge for other forms of mass-market DSF. With hot water, the customer assigns control, within service parameters, to the EDB that executes the control of the consumer's hot water heating remotely. The customer never needs to dynamically engage. Further, the customer shares in the benefits to the EDB, receiving a lower electricity bill.

Whilst this form of DSF has almost invariably been used for network (not wholesale) purposes (incentivised by historical peak demand-driven transmission prices, which have now been removed), modern metering technology is allowing retailers to access this for wholesale purposes[18]. This is an

[18] Retailers have historically faced challenges in accessing ripple relays, although changes to the default distributor agreement made some headway here.   Even then, the old ripple control technology is not well suited to a landscape where retailers will want to control specific customers. However, we understand that with newer metering technology with the functionality to control ripple relays, some retailers are beginning to trial hot water control as a way of reducing customers' bills.

important development, given that hot water control at peak times may be as significant (in terms of quantity available) as electric vehicle charging[19].

1.7 Outlook for DSF now compared to 20 years ago

Ultimately, we believe the low level of historical uptake can be largely explained by the factors outlined above, which led to the tangible and intangible costs of enabling and using DSF outweighing the accessible benefits for the vast majority of consumers.

However, some of these impediments above are reducing, and we expect they will continue to change as we move towards 100% RE.

> "As it stands today, electricity demand can be increasingly flexible, but precious little has been done to access that flexibility. As new technologies come online at an ever-increasing pace, it's worth taking a closer look to see whether existing wholesale market structures are equipped to handle today's technology" [20]

Our modelling suggests wholesale benefits from flexibility will increase.

As outlined in MDAG's Issues Paper[21], the decline and, in due course, (near) absence of flexible, dispatchable fossil-fuelled plant (coal, gas) will considerably increase the value of flexible resources.

We expect there will be an increasing range of situations where the cost of reducing or shifting consumption will be lower than producing an additional unit of electricity from a supply-side resource. In these situations, allowing for whole-of-life costs and system security requirements, the demand-side option should displace the supply-side alternative and the wholesale market should reward the demand-side option appropriately. For this to occur, it is critical that the value of flexibility is signalled through the wholesale price, in a way that allows DSF and supply-side flexibility to compete on a level playing field.

We have been interested in sizing this for New Zealand at a quantitative level. To this end, we ran a range of assumptions in our simulation model, which we reported in our Issues Paper back in January 2022. Since then, we have both updated the model and prepared a selection of sample case studies.

Our revised modelling shows that adding 800MW of short-term wholesale-responsive DSF (equivalent to accessing 70% of the average charging requirements of a 1.7m fleet of EVs, plus 260,000 behind-

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[19] See Concept Consulting and Retyna (2001) "How New Zealand can accelerate the uptake of low emission vehicles Report 2: Consumer electricity supply arrangements". We also acknowledge solarZero's retail offering associated with batteries and solar panels installed on a customer's premises, which is a different form of commercial arrangement again, but effectively achieves a similar outcome.

[20] Sonia Aggarwal and Robbie Orvis "Wholesale Electricity Market Design For Rapid Decarbonization – Visions for the Future", JUNE 2019 - https://energyinnovation.org/wp-content/uploads/2019/07/Wholesale-Electricity-Market-Design-For-Rapid-Decarbonization.pdf

[21] MDAG (2022), "Price Discovery under 100% renewable electricity supply: Issues discussion paper".

the-meter batteries or wholesale-driven[22] hot water control) would reduce the need for supply-side resources by around $93M per annum. Adding a 400MW fully flexible demand – such as a flexible hydrogen electrolyser – would reduce supply side investment by between $77M - $91M.

Our case study of a stylised industrial consumer illustrates potential savings in electricity purchase costs of 8% if short term energy storage (e.g., hot water) was used to vary their consumption in response to wholesale market prices. A 16% saving on purchase costs could be achieved if they were able to provide longer-term, wholesale-responsive flexibility (e.g., through maintaining standby boilers with alternative fuel)[23].

The benefits we have quantified are based on three fundamental assumptions:

- That the benefits accruing to demand side resources (and their agents) are based on their response to a varying wholesale price; and
- That the "true" value of flexibility is reflected in wholesale prices signals.

Achieving the scenarios of DSF quantified in our modelling requires that these benefits (in addition to any network benefits that can be captured by the same resource) exceed the costs of enabling the demand side flexibility – including time, resources, hassle and the individual preferences of the flexibility owner[24].

These benefits are significant, and only represent the wholesale value of demand side flexibility. Of course, a key driver of the uptake of DSF will be the magnitude of the *total* benefit received by the potential DSF investor, and this will be a function of all its potential uses, not just wholesale market value streams: benefits accruing to network owners would likely increase these figures[25]. We see retailers being in the best position to optimise the use of DSF across network and wholesale benefit streams, on the assumption that network tariffs – as much as possible – reflect the majority of underlying network needs[26]. Retailers face network tariffs, and wholesale purchase costs, and hence have the best information to determine where DSF use is optimal. This may, of course, see retailers

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[22] As noted above, metering technology today allows retailers and flexibility traders to access what has traditionally been the domain of EDBs. We also note Concept (2021) who suggest that, on an average per-household contribution to peak demand basis (prior to use of demand management), hot water control may (by 2050, in an "All Electric" scenario) contribute nearly as much as an electric vehicle (~0.75kW each). This may understate the potential for uptake of heat-pump hot water cylinders, which Concept estimate at 15% of the total number of cylinders. Heat pumps today have a coefficient of performance of around 4, which means the instantaneous loading of a cylinder on the network would be ~1/4 of a traditional resistive cylinder.

[23] These case studies are described more fully in Appendix 2 (separate pdf)

[24] As discussed above, quantifying these costs is quite difficult, and likely only revealed through the decisions consumers make if presented with options. The case studies did consider the financial costs of the equipment required to enable the DSF evaluated, but did not extend to time, hassle etc.

[25] See BCG's 2022 report "The future is electric" which estimates $820m of network benefits in the 2020s, and $8.7b out to 2050, from a smarter demand side. These figures also echo Sapere (2021) "Cost-benefit analysis of distributed energy resources in New Zealand", which estimate $6.9b of benefits from DER out to 2050, 85% of which related to offsetting new lines and generation.

[26] See discussion in the MDAG Options Library on option C13 where we explore the degree to which network tariffs can feasibly reflect all the benefits that DSF can provide to network owners.

"outsource" the *execution* of flexibility management to expert third-party flexibility providers, rather than invest in the systems and capability themselves.

In addition to the economic efficiency benefits for the system, we reiterate the political economy benefits referred to above.

Recent technology evolution will enable DSF at lower cost than today.

Today's landscape is vastly different from that of even 20 years ago. New technology means that consumers who choose to receive a dynamic price signal should no longer have to dynamically (and often manually) determine their response. The recent evolution of sensors, automation, algorithms and smart devices has dramatically reduced this need for consumer engagement by determining and actioning the optimised response for the consumer, or their intermediary. A growing number of parties are emerging who are willing to manage this risk and monetise this opportunity on behalf of consumers.

Similarly, advanced communications and metering is increasing the potential for a range of consumption devices to be controlled remotely, similar to what ripple relays have provided for residential hot water controls over the last half century. We acknowledge that, for intermediaries, this increases the cost associated with the customer relationship, as communications protocols need to be established and a new set of customer preferences needs to be discovered. We believe that, as the market matures, these transaction costs will be outweighed by the benefits of DSF.

Another dimension of engagement cost is how the response would be indicated to the market – for large industrials, the transaction cost and compliance requirements of formally bidding a response under the current Code are onerous. However, the Authority's dispatch notification Code amendment, to be introduced in 2023, will lower this transaction cost.

Unlocking DSF potential in this new reality - commercial arrangements for DSF need to keep pace with increasing benefits and technology

The changes outlined above – increasing benefits and reducing costs are encouraging prospects for increased DSF uptake. But the potential for DSF – on a "true" cost and benefit basis – is relatively unknown because it has only been demonstrated and reported publicly in NZ in narrow contexts[27].

Direct participation in the wholesale market - and its reward to flexibility - will only be attractive (or even practical) – to limited set of customers. The remainder will require a commercial arrangement with an intermediary. For the vast majority of consumers, there are limited options today.

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[27] As outlined in more detail in Batstone (2021) - historical (Norske Skog Tasman) or current use of industrial DSF in NZ, Transpower's demand response trial (for transmission purposes), Flick Energy's spot tariff or the value of a range of trials conducted in the NZ context. See e.g., Lawson, Thorsnes and Williams (2011), "*Consumer Response to Time Varying Prices for Electricity"* University of Otago Economics Discussion Papers No. 1116.

The widespread rollout of 'smart' meters in New Zealand has removed a key technology barrier (though many customers are still on 'dumb' profiles) to tariffs that measure and reward customers who respond to wholesale signals. Further, metering technology being deployed today in New Zealand also has the capability to control hot water heating. This lays the platform for a range of commercial arrangements and tariffs through which market participants (including retailers and flexibility traders) can procure and reward DSF from resource owners (customers).

Electricity consumers span a very broad spectrum, and we do not know the extent of consumer appetite to provide flexibility in their consumption to the wholesale market, or what arrangement they might prefer to do this under. There may be a portion that would like full spot exposure, cognisant of the risks that entails in prolonged periods of high prices, or even short periods of scarcity prices. Others may prefer a hybrid of relative price stability, assigning flexibility to a wholesale-exposed intermediary (i.e., retailer) or a flexibility trader[28], within particular limits, whilst sharing in the wholesale (and other) benefits. Other may prefer fixed price variable volume, as now.

> Richter and Pollitt (2018) provide an excellent analysis of the heterogeneity of preferences amongst consumers for enabling smart energy technology options, highlighting that an assumption that all DSF providers are the same is deeply flawed, and that the types of services they wish to provide, or be provided, is quite diverse.

Whilst not having any evidence, our belief is that the most fruitful avenues for DSF will occur through variations on the hybrid option above. Concept (2021) is even more emphatic regarding this form of tariff (which they term a "managed appliance tariff"):

"*Our evaluation is that by far the best long-term option for delivering flexibility from EVs and hot water are managed appliance tariffs. These grant the supplier the right to control an appliance to deliver flexibility – subject to meeting minimum service levels – in return for the consumer receiving a discount reflecting the value of such flexibility."* [29]

The key point is that consumer preferences in relation to DSF are relatively unknown and untested in general, because tariffs that provide for consumer choice across a spectrum of options are only starting to emerge. The best way to discover consumer preferences is to see them revealed through choices informed by the best information available regarding the costs and the benefits of doing so.

Tariffs need to keep pace with this new reality. While we are not advocating a future world where most customers are exposed to a half-hourly spot price by default[30], we are highlighting that there is

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[28] In order to generate the benefits from wholesale price response, a flexibility trader either needs to be purchase-exposed themselves (and hence effectively a retailer) or be providing the service to a retailer. However, we note that this does not apply to the use of DSF for ancillary services, where an underlying purchase exposure is not necessary.
[29] Concept Consulting and Retyna (2001) "How New Zealand can accelerate the uptake of low emission vehicles Report 2: Consumer electricity supply arrangements".
[30] Which is the case for over 60% of customers in Norway, and has been for a number of years. This included prior to the rollout of smart meters (where profiles were used). Discussions with representatives from the Norwegian regulator noted

some significant distance that consumer tariffs need to travel to capture the scale of benefits we have quantified above.

The reality is that these commercial arrangements and tariffs are, for the majority of consumers, a package of wholesale, transmission network and distribution network prices. The overall value of DSF to the consumer is determined by the extent to which demand response to reduce the cost of supply as determined by these collective "prices". The importance of the customer seeing these signals, in our view, is determined by who is controlling the response: if the customer is controlling the response, it is critical that they see prices that signal the overall supply chain costs at each point in time. However, if the response is being controlled by an intermediary, there is no need for the customer to see the underlying prices; it is only necessary that the intermediary does.

To be explicit, intermediary-controlled demand response removes the need for retailer pass-through of network charges for those customers. If network pricing efficiently signals network needs, and retailers are taking reasonable endeavours to minimise the combined cost of wholesale and network charges on behalf of the consumer, efficient DSF response options should eventuate. [31]

Make DSF integral to electrification investment decisions

While the transition to near 100% renewable supply is expected to take place over the coming decade, major decarbonisation and electrification decisions being made by consumers and investors today – for example, purchasing electric vehicles and chargers, or installing electrode boilers for large process heat consumers. For many of these decisions, the best time to enable flexibility is at the time of investment, rather than retrofitting later. As discussed earlier, again the example of hot water control is instructive.

It makes sense to apply this approach to introduction of EVs and the electrification of process heat, as contemplated recently (for the case of EVs) in EECA's green paper "*Improving the performance of electric vehicle chargers*"[32]. This may not necessarily include the "mandating" of DSF control mechanisms – today's technology landscape is moving much faster and enabling a wider variety of control systems that when hot water control was rolled out. However, if consumer choice is to be enabled, we believe there is a significant responsibility on the regulator, government agencies (e.g., EECA), the industry, and consumer groups to increase awareness and knowledge around the value of enabling flexibility when these decisions are made.

that strong encouragement of retailers to move from profiles to half-hourly data, once the smart meter rollout was complete, was still required.

[31] Of course, the degree of efficiency achieved depends on the extent to which network prices can reflect the true underlying value case for a network owner. See discussion in MDAG Options Library on Option C11

[32] Energy Efficiency and Conservation Authority, (2022), *Improving the performance of electric vehicle chargers,* Wellington, New Zealand, a green paper by the Energy Efficiency and Conservation Authority.

2 Key issues to be addressed

2.1 What is needed – at its essence

As noted earlier, wholesale market arrangements need to ensure that DSF can compete efficiently with supply-side resources in the market's process of discovering the least cost solution for delivering reliability over the short, medium and longer terms. For this to happen:

- Consumers need choice about, whether and how they provide demand flexibility, with arrangements available to suit different customer preferences about the level of automation, engagement, cost volatility, service level and control; and
- We need to ensure consumers have access to the information that will help them make the best decisions about providing DSF (benefits, costs, service impacts); and
- Tariff and technology innovation is needed to drive the development of these tariffs, and to lower the transaction costs of making demand-side flexibility available to the wholesale market; and
- DSF should have access to relevant value streams (sharing in the underlying benefits) where it has an economically efficient service to provide, and these arrangements should enable these value streams to be optimised.

We note that these requirements broadly align with Flex Forum's characterisation of a DER customer's journey: discover the menu of options, assess the options and decide, enable DER and operate in a way that maximises the value of the household or businesses DER[33].

2.2 Particular issues

The discussion in Section 1.7 described how a number of historical impediments to the uptake of wholesale DSF are disappearing, particularly through technology improvements and the expectation that wholesale volatility will increase, thus increasing the payoff to DSF.

However, it would be naïve to conclude that there is no action required in order to see DSF efficiently compete in the way contemplated above. In our Issues Paper, we distilled the factors that still today impair the requirements outlined above. Subsequent to this, we further developed these factors based on industry submissions on MDAG's issues paper. These are summarised as follows:

- Variable volume arrangements with either a fixed price, or a schedule of time-of-use fixed prices, are still the dominant tariff offered by retailers. These tariffs fully or partially anaesthetise the consumer from the underlying dynamic wholesale price which signals the value of flexibility;

[33] Flex Forum (2022), Flexibility Plan 1.0

- Where the value of response has been signalled through the tariff, the onus has been on the consumer to engage with their demand and determine the response, as opposed to intermediaries.
- Where consumers or their intermediaries have material quantities of flexibility to respond to wholesale, especially if we see the increase signalled above, the current Code does not provide practical ways for this flexibility to be included in the dispatch process and taking a role in price formation. Formal bidding carries high compliance requirements.
- There may also be current or potential future markets where DSF faces impediments that compromise the ability for customer for intermediaries to optimise DSF value. This includes the ability for intermediaries to integrate network and wholesale uses of DSF.
- It is difficult for consumers to ascertain the current or future underlying value of wholesale demand response, particularly at the point of making a significant electricity-related decision, and to discover and compare the effect of different tariffs on their ability to profit from demand response.

In essence, while we identified very few formal *barriers*[34] to the uptake of DSF, our assessment is that there is a significant evolution required in the commercial and market integration arrangements that allowed for DSF to compete and realise its full value. This results in a significant knowledge and information gap – not just for consumers who may provide DSF, but also for the many market players (e.g., intermediaries) who need to develop and provide the commercial arrangements and market integration functions. The absence of this information and knowledge elevates the risk associated with investment in DSF and DSF-enabling arrangements, slowing uptake.

2.3 Strategic issues

We grouped the various 'particular issues' around a common 'strategic issue'. Our options are the targeted to addressing each strategic issue, namely:

- Tariffs mute a signal for flexibility (yet to see widespread emergence of DSF-rewarding tariffs that enable DSF owners to make risk-value and engagement tradeoffs);
- The *market* is not able to achieve the highest aggregate value for DSF, therefore compromising benefits; and
- Consumer and intermediaries have low awareness or missing information regarding current or future DSF value.

The mapping of particular issues to strategic issues is provided in Table 1.

Table 1 – mapping of particular issues to strategic issues and consequences

[34] Here we mean barriers in a strict sense, i.e., factors that would lock DSF out of participation, as opposed to, for example, unnecessarily high costs of entry.

Issue	Strategic issue	Consequence
Dominant tariff offering is FPVV	Tariffs mute a signal for flexibility (yet to see widespread emergence of DSF-rewarding tariffs that enable DSF owners to make risk-value and engagement tradeoffs)	Inefficiently low provision of wholesale DSF, since costs exceed (understated) benefits for a number of consumers with potential DSF
Existing tariffs mute DSF signal		
Where signalled, DSF requires high consumer engagement		
High compliance cost to formally bidding DSF	Market is not able to achieve the highest aggregate value for DSF, and therefore compromising benefits.	Inefficiently low provision of wholesale DSF (and DSF overall[35]) since costs exceed realised benefits for a number of potential DSF investors (intermediaries and consumers)
Accessing DSF value limited by technical barriers or lack of market		
Potential co-ordination challenges between wholesale and network signals for DSF		
Consumer (and possibly intermediaries) have low awareness or missing information about current or future DSF value	[no change]	Inefficiently low provision of DSF, as investors (intermediaries and consumers) miss opportunities to enable DSF

Table 1 also briefly characterises the consequences if these issues remain unaddressed – essentially a prolonged period when DSF will be slow to develop. When considered alongside the fact, highlighted above, that consumers are making long-lived electrification decisions today, and we are already seeing the emergence of a higher volatility market (see Section 1.7), there is a compelling case to fund ways to accelerate the removal of those factors that impede DSF decisions being made. This has also been highlighted by the Flex Forum[36].

[35] Since we expect DSF to "value stack" across all potential uses, the inability to access any valid revenue stream will potentially lead to inefficiently low uptake – irrespective of whether the revenue stream is in the wholesale market, or in networks, it will be the "straw that breaks the camel's back".
[36] Flex Forum (2022), Flexibility Plan 1.0, p8

3 Options and proposals in summary

3.1 Approach to options

It is clear from our simulation and other analysis to date that DSF will become increasingly important for a renewables wholesale market to function efficiently.

Enabling the emergence of a dynamic market for DSF services driven by efficient wholesale price signals is therefore a critical part of transitioning to 100%RE.

Our objective is to identify and evaluate a range of options that could address the issues ('problems') outlined above. Our approach has three limbs:

- Removing significant impediments to a well-functioning (workably competitive) DSF market;
- Implementing better information gathering to monitor the market's progress in unlocking economically efficient DSF;
- Carefully 'nudging' the development of the DSF market, to overcome the historical tariff and technology inertia and knowledge gaps that may inefficiently slow the transition to a well-functioning DSF market.

To be clear, this paper outlines the options at a relatively high level. In the third and final stage in this project, we will go to the next level in specifying our preferred options and undertake a more thorough evaluation of costs and benefits, which will inform our final selection of options for our Recommendations Paper, which is due around May-June next year.

As observed earlier, other parallel workstreams and initiatives are already progressing options that deal with issues raised in submissions to MDAG's issues paper. Rather than replicate this work, we refer the reader to these initiatives, specifically noting:

- Flex Forum's work on commercial arrangements, closing of information gaps, service specification and access to consumer data. Flex Forum's advocacy for "learning by doing" trials also aligns strongly with our **Option C5**
- IPAG's recommendations on profiling (incorporated into **Option C2**)
- The Future Security and Resilience (FSR) project's roadmap, which addresses the visibility of distributed energy resources (including DSF) to the system operator, and removing barriers to DSF participating in ancillary services markets. Our **Option C8** endorses this work.

3.2 Options menu

Option name	Rationale	Status	Start	Put in place by
Options to address strategic issue 1: Tariffs mute a signal for flexibility: Yet to see widespread emergence of DSF-rewarding tariffs that enable DSF owners to make risk-value and engagement trade-offs				

Option name	Rationale	Status	Start	Put in place by
C1 - Monitor provision + uptake of DSF-rewarding tariffs	Provide reliable quantitative and time-series basis on which to assess retail market development and uptake of DSF tariffs	Preferred	2023	2024
C2 - Sunset profiling if smart meters in place	Continued use of profiles is impeding retailers' development of DSF tariffs	Preferred	2024	2025
C3 - Require retailers to offer DSF tariffs	Retailers are potentially slow to develop DSF-rewarding tariffs	*Backstop if C1 evidence shows need*	Mid 2024	2026
C4 – Develop standardised shape-related hedge products to reward DSF	Enable large consumers to smooth volatile revenues from DSF	Preferred	2024	Mid 2025
C5 – Provide significant funding for pilots/trials to remove common knowledge gaps	Help cut through complexities and risks in enabling use of DSF tariffs	Preferred	2024	Mid 2026
C6 – Use Customer Compensation Scheme to reward DSF		Not preferred	NA	
C7 - Negawatt scheme for wholesale market		Not preferred	NA	
Options to address strategic issue 2: Market is not able to achieve the highest aggregate value for DSF, therefore compromising benefits				
C8 - FSR – improve DSF visibility and remove Code barriers	Covered in FSR project	Preferred	2023	2025
C9 - FSR - accelerate new ancillary services for DSF uptake		Not preferred	NA	
C10 - Procurement process for high-scarcity DSF (RERT)	"Last resort" DSF should be formally contracted and paid for.	*Backup if little increase in bid DSF*	2025	2027
C11 – Ensure distribution pricing reflects network needs	Improve coordination and optimising the use of DSF across both network and wholesale market	Preferred	2023	2025

Option name	Rationale	Status	Start	Put in place by
C12 - Investigate extending LMP into distribution networks	Static cost reflective tariffs may not provide the most efficient signal of dynamic network needs for flexibility, undervaluing the role that DSF can provide	*Backup if C11 doesn't provide signals*	Mid 2026	Mid 2029
Strategic issue 3: Consumers and intermediaries have low awareness of current or future DSF value				
C13 - Provide info to help large users with upcoming DSF investment decisions	Help large consumers to better quantify the value of DSF in electrification investment decisions	Preferred	2023	2024
C14 - Provide info to help domestic customers with DSF decisions	Help smaller consumers to better understand benefits of DSF tariffs	Preferred	Mid 2024	2026

These options are outlined in MDAG's paper - *Price discovery under 100% renewable electricity supply: Library of options.*

3.3 Preferred options and priorities – In a nutshell

Our preferred package of options reflects the underlying philosophy of providing consumers with the right information about the value of their flexibility, and a sufficient range of options to contract that flexibility, for them to choose from. We want to see these options and the information set, available as soon as possible.

To achieve this, we see a number of "early wins" that can help unblock DSF:

a) Understanding the pace at which development of commercial DSF arrangements is occurring requires better monitoring of the retail DSF market, especially tariff availability (**Option C1**). This should be implemented as soon as possible, since it underpins a range of future regulatory decisions.

b) Accelerating the development of DSF tariffs requires a rapid adoption, by retailers, of the high frequency metering data that will underpin these tariffs (**Option C2**).

c) For larger consumers, financial contracts need to be developed to underpin their investment in enabling DSF (**Option C4**).

d) To support the uptake of DSF tariffs, consumers need the best information available about their choices, and the potential rewards, as soon as possible (**Options C15, C16**).

The way the market can optimize the efficient use of DSF requires a number of existing or planned initiatives to proceed with a focus on understanding and enabling DSF (Options C8, C9, C20, C13).

Depending on the pace observed during the initial 1-2 years of monitoring (**Option C1**), further requirements on retailers to develop DSF-rewarding tariffs may be required (**Option C3**).

Consumers across the spectrum – from households to large industrial participants – are making electrification investment decisions today that would benefit from having flexibility being designed in at the outset. Providing these consumers with information about the current and future benefits of DSF – today - is vitally important to achieving efficient levels of DSF uptake (**Options C13** and **C14**).

Further, the DSF "market" is still very much in its infancy. We understand that developing new retail products, relying on new technology, new relationships with customers and other intermediaries (e.g flexibility traders), in a changing market environment is risky. There are a range of information and knowledge gaps about how DSF will work at scale which, combined with the historical inertia around DSF development, could see the development and uptake of DSF occurring slower than needed to play its important role as intermittent renewables increase[37].

Rather than embed significant changes in the market design to de-risk this process, we believe a well-funded and extended trial of new DSF-rewarding tariffs, technology, relationships and market integration (**Option C5**) can accelerate the closing of these common information and knowledge gaps, as well as "learning by doing"[38], that will lead to an accelerated and sustained increase in DSF in the New Zealand market. Such a trial should include how wholesale and network uses of DSF can be value stacked and integrated.

The level of government funding here should reflect the sizeable economic benefit to New Zealand from unlocking greater DSF. While the quantum of funding will be informed by how the trail is conducted, we note ARENA's demand response co-funding programme which saw 200MW of demand response realised through AUD36M of public co-funding[39].

We are cognisant of not wanting this trial to interfere with the natural competitive processes that will drive innovation. Rather, we see the trial solving a number of critical "common" problems so that the industry has a common framework of standards and protocols that will allow competition to thrive[40]. These are common problems - and the solutions then provide a platform for competition.

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[37] As noted by Flex Forum, "*Developing the capability, practices and processes cannot occur overnight. Electricity distributors in the United Kingdom have made considerable progress since announcing a flexibility commitment8 in December 2018, going from 116MW of flexibility contracted in 2018 to 1.6GW contracted in the first half of 2021.9 However, the UK's journey to use flexibility began in 2011.*" Flex Forum Flexibility Plan 1.0, p8.

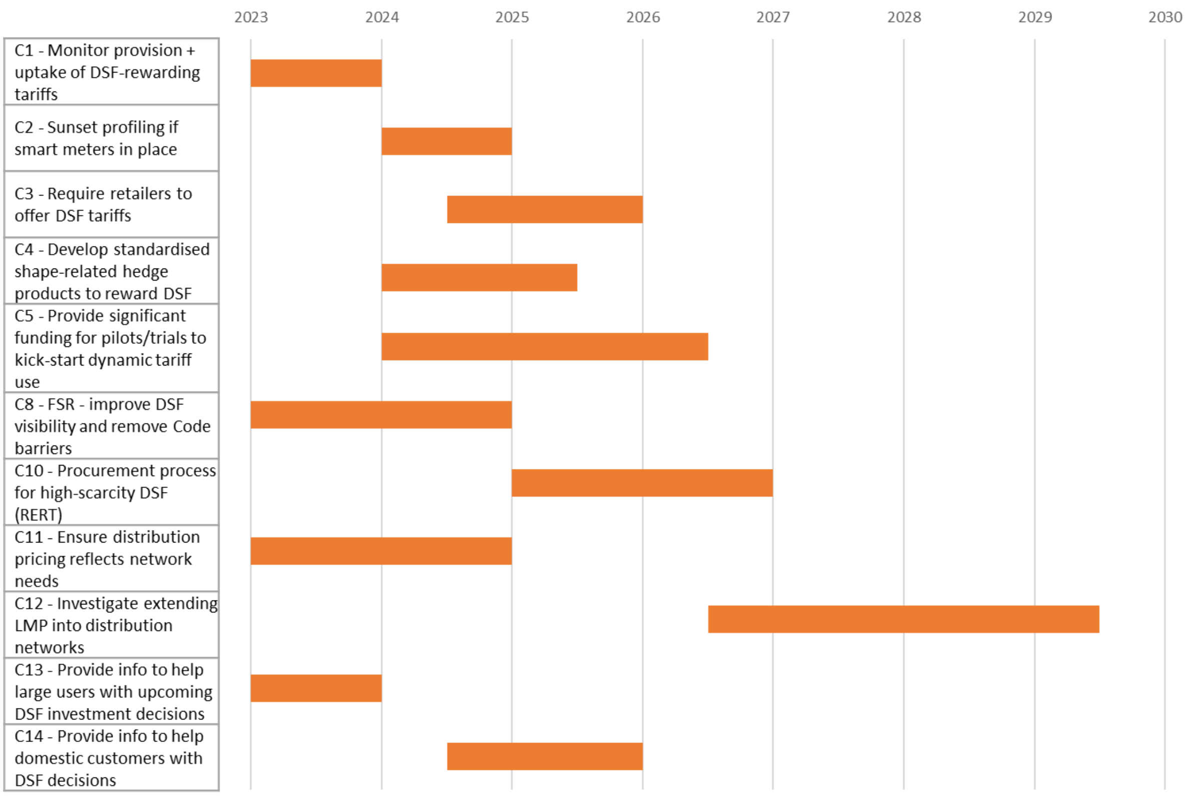
[38] Newbery (2018), "Evaluating the case for supporting renewable electricity". We note that the Flex Forum's Flexibility Plan 1.0 is also strongly supportive of "learning by doing" trials for DSF, as was IPAG in its review of Transpower's Demand Response Trial.

[39] See https://arena.gov.au/assets/2019/03/demand-response-rert-trial-year-1-report.pdf

[40] For example, how DSF will interact with the system operator's forecasts (Option C8), how DSF can value stack wholesale and network drivers (Option C11), and how better information can be provided to consumers who may wish to enable DSF

3.4 Next steps

Our current view of priority and sequencing is as follows. Other than the current programming of existing initiatives (Options C8 and C11), our sequencing reflects the need to commence monitoring of the retail market through a DSF lens as soon as possible (Option C1). This information will support any future decisions about changes to the market design. We see a similar level of urgency in providing large consumers with information regarding the current and future benefits of enabling DSF as they make electrification decisions (Option C13).



As noted earlier, we have outlined the options at a relatively high level. In the third and final stage in this project, we will go to the next level in specifying our preferred options and undertake a more thorough evaluation of costs and benefits, which will inform our final selection of options for our Recommendations Paper, which is due around May-June next year.

(options C13 and C14). Flex Forum's Flexibility Plan 1.0 has a comprehensive list of the information gaps that exist today, many of which need to be solved for DSF to be efficiently deployed.

Appendix 1 – Summary of submissions

The balance of these impediments will be different for residential, commercial and industrial consumers, because awareness, tariffs, the nature of response and access to technology is different across these customer groups.

Submitters generally agreed with our characterisation of the issues, but added context and information:

- Vector noted that retailers appeared to be slow in moving away from profiling despite the high penetration of advanced metering. This is a topic we have obtained data on and comment on further below.
- A number of submitters specifically agreed with the muting effect of FPVV on consumer signals, but suggested the move to more innovative tariffs that reward demand response may need to be "de-risked", incentivised or kick-started, due to the behaviour changes required.
- Transpower and Meridian both reinforced the need to consider how demand response (potentially above a certain threshold) needs to be indicated to the System Operator in order to maintain the efficiency of dispatch and price discovery.
- A number of submitters reinforced the need for greater consumer awareness about the increasing value of demand response as we transition to 100% RE. Electricity Ashburton provided a compelling case for greater provision of information about the world MDAG had modelled, so that organisations considering electrification of process heat could optimise how to embed demand response potential in those investments.

Additional issues worthy of consideration were also introduced through the submission process:

i. A number of submitters drew our attention to the potential technical barriers in the Code. MDAG's analysis for the Issues Paper[41] had highlighted the recent Code amendments to allow batteries to participate in instantaneous reserve markets. However, in further consultation with these submitters, we are aware of further examples of technical barriers. We understand these will be addressed through the Future Security and Resilience process, but will include them as an additional issue here;
ii. Transpower noted the question (raised through the Stage 1 FSR report) as to whether the development of *new* ancillary services, needed for a high renewables future, should be accelerated to provide an early revenue stream for DSF providers;
iii. These submitters also noted that last-resort demand response (forced curtailment, including hot water control) is not paid for in New Zealand, which may be masking an opportunity for organisations to provide demand curtailment in these very infrequent situations, if they were paid;

[41] Batstone (2021)

iv. A range of submitters also highlighted the extensive demand response development underway in distribution networks, and questioned how DSF deployed for network purposes would be coordinated (and “value stacked”) with wholesale-driven DSF. This issue has a range of potential consequences; the primary consequence we consider here is that DSF may not be deployed for its highest-value use, thus reducing the potential benefit to consumers.

We consider (i), (ii) and (iii) relate to a general issue of barriers to DSF accessing markets and value – either because there are Code barriers to existing markets (i.e., (i) above), or that the “market” doesn’t yet exist ((ii) and (iii) above). We include this as an additional issue.

We also include issue (iv) as an additional issue.

Appendix 2 – Case Studies of DSF

Separate pdf available on MDAG website

Appendix 3 – Description of the NEM's Wholesale Demand Response Mechanism

Separate pdf available on MDAG website

Appendix 4 – Government policy positions on DSF since 1995

MDAG's review of the last 25 years in New Zealand highlights how governments and regulators have consistently appealed for improvements to market rules and regulations with the objective is unlocking demand side response.

1995 Government Policy Statement

Government has concluded that the objectives and outcomes set out above would be best achieved by workable or effective competition, in particular….Vigorous competition from private sector generation and demand-side management to meet new electricity demand"

1998 MOU – Reform package

Demand side management was a key objective (as above)

2001 – Post-winter review

The market would have worked better if the reforms specified in the Government Policy Statement (refer 55) had been fully implemented (such as improved information disclosure, **demand-side participation in the market**, and mechanisms to invest in the grid to relieve transmission constraints)

2004 - Government Policy Statement

It set out the priorities of the Commission including "Improving hedge market transparency and liquidity, and **demand-side participation.**"

2006 - Government Review

Effective demand-side management (DSM) which includes:

"35. Spot prices send efficient signals to **reduce demand when supply is tight and to shift load from peak to off-peak times**. However, **residential customers and business customers on fixed price contracts do not have incentives to reduce demand, which, in combination with exposure of some larger businesses to spot prices, has led to pressure for emergency conservation campaigns**. The response to campaigns in 2001 and 2003 was good and the EC is now empowered to run and fund campaigns when required.

36 Overall, however, my review concluded that initiatives relating to **demand-side management and energy efficiency, including tariffs which incentivise savings in dry periods and smart meters, remain limited**. The EC has a work programme to investigate and improve DSM activities."

2008: Review of electricity market design by Electricity Commission

An options paper released in July 2008 examined in detail five key areas of concern to stakeholders, and developed a range of options to address them. The five areas included **demand-side participation.**

2009 Government review

"39. Recommendation 19 to allow demand response to be dispatched in the same way as generation is also likely to assist with improved management of dry year situations. It effectively makes redundant the need to tender for demand-side responses as a reserve energy mechanism."

“Provide for **increased demand-side participation** in the wholesale market: Demand-side participation in the wholesale market is not well developed in the New Zealand market, with the exception of load reductions by some major users when spot prices are high for sustained periods in a drought situation. “

“145. The way our spot market currently operates does not maximise the opportunity for **demand-side participation**.

146. Reforms in these areas have been held up for a range or reasons, including Transpower’s introduction of new market systems, but it is important they now be progressed as quickly as possible.”