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IPAG REVIEW OF THE
TRANSPower DEMAND
RESPONSE PROGRAMME

INNOVATION
AND
PARTICIPATION
ADVISORY
GROUP

Note: Content should not be interpreted as representing the views or policy of the Electricity Authority.

Contents

1. Introduction/context	2
2. Terminology is important	4
3. DERM must be carried out by flexibility traders (owners of DER portfolios) NOT network owners	0
4. Management of DER is not the same as Management of Flexibility	4
5. Transpower's DR programme over RCP2 was just a trial	6
6. Need to incentivise EDBs to invest in flexibility	8
7. Developing flexibility markets is an ongoing process	11
8. Flexibility needs to respond to the need	14
9. Recommendations	15
Thanks	17

1. Introduction/context

In March 2020, the Authority asked IPAG to review Transpower's Demand Response (DR) programme and assess the implications of the Transpower DR programme for flexibility markets in the New Zealand electricity industry more widely.

We note that this project started off as a review of Transpower's DR programme, but over time became much broader. The project challenged us to look at how flexibility services¹ should be used and procured in the New Zealand electricity industry and how best practice might be achieved. We consider that this project is an extension of IPAG's equal access project (completed in 2019) where we set out principles to maximise the benefits that distributed energy resources (DER) offer New Zealand in terms of the Authority's statutory objective.

The focus of this project is to maximise benefits to consumers. We want to ensure that consumers are able to take advantage of DER to meet their energy needs in new ways. Consumers should be able to decide how they want electricity to support their lifestyles – establishing pathways within which DER can complement grid electricity to deliver this. Intermediaries can then tailor services that minimise overall cost to the customer and their carbon footprint within these parameters. These services will fall into two broad categories:

- Continually optimising cost and minimising emissions for the consumer through automated control technology which is constrained by the consumer's lifestyle parameters (which they can continuously reframe) and
- Offering options to temporarily adjust these lifestyle parameters where DER is used actively both in advance, or near real-time, so the consumer can benefit by meeting high-value industry needs for flexibility services.

Transpower's DR programme pilot, while not perfect, has provided real clarity about how networks can use DER. As a direct result of their DR Programme trials, Transpower has clarified that it is more important for buyers of flexibility services to have access to competitive markets for flexibility services than it is for them to directly control DER. As a result, Transpower has made a commitment to not offer services in a way that creates competition issues. A competitive market will decrease costs which are then passed onto consumers. The changes Transpower has proposed for their DR programme build on the pilot and provide a clear template that distributors should follow to maximise long term benefits to consumers.

Maximising the benefits that DER can provide is key for meeting the Authority's statutory objective as it helps promote the efficient operation of the electricity industry. It also supports the strategic ambitions set out in the Authority's current Statement of Intent,² particularly the low-emissions energy, thriving competition, and innovation flourishing strategic ambitions. We draw specific attention to the Authority's low-emissions energy strategic ambition (emphasis added):

*Electrification is a key enabler in the transition to a low-emissions economy.
Unlocking the potential for more renewable generation is a focus for the Authority.*

¹ Broadly, 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

² The Authority's current Statement of Intent is for 1 July 2020 – 30 June 2024 and is available here: <https://www.ea.govt.nz/assets/dms-assets/27/27020Statement-of-Intent-2020-2024.pdf>.

We work hard maintaining, developing and implementing market rules that give investors confidence and signal where additional generation is required.

All forecasts for the energy sector's near future show the need to electrify New Zealand's heat and transport and increase low-carbon electricity generation.

Making more use of New Zealand's renewables advantage is essential in our transition to a low-emissions economy. The required level of investment in new generation will be significant.

We need to promote a stable investment environment with robust rules and clear price signals. This will ensure the transition is as efficient as possible while maintaining energy security, system adaptability and affordable electricity for consumers.

Most DER takes advantage of renewable generation (for example, a battery co-located with a solar panel can charge when the sun is shining and discharge during peak electricity demand) and allocating DER to its highest value use (or uses) will ensure the use of renewable generation can be maximised. Acting on the recommendations in this memo will help ensure that parties are willing to invest in DER and new technologies to support New Zealand's transition to a low-emissions energy economy.

The accompanying slide pack sets out the six questions the Authority asked IPAG to review and our responses to those questions. This memo summarises our general observations about the Transpower DR programme and recommendations.

2. Terminology is important

The name of Transpower’s DR programme reflects a transmission grid owner view of “demand” being “demand on the transmission system”. This means it includes distributed generation and storage on distribution networks as these are technically equivalent to a load reduction from a transmission perspective. However, this view of demand is not easily generalised to distribution networks where distributed generation and storage are “supply”.

Transpower’s DR programme is principally about the contribution of DER as a network input.

Distributed Energy Resources

Typically connected to roadside power lines, not the big power pylons, and increasingly consumer owned

Mostly electricity, but can include other energy, such as solar heating; hot water

Common examples are:

- Rooftop solar panels (photovoltaics PV)
- Storage (such as batteries)
- Electric vehicles
- Controllable demand (consumers turning appliances off and on either manually or pre-programmed, to suit the power system, for a payment)

Key difference between:

- *Uncontrollable DER (solar, “dumb” EV charging etc) and*
- *Controllable DER (batteries, “smart” EV charging etc)*

The impact of controllable DER is flexibility, which is the modifying of 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.

Transpower has introduced more precise terms for its “DR programme” during IPAG’s project, which we agree are more helpful. Transpower has referred to itself undertaking Distributed Energy Resources Management (DERM) using its DERM System (DERMS)—we further explain these terms below—and it has avoided referring to DR. We agree with Transpower that it is best to avoid using the term “DR” for anything other than consumers choosing not to use power because they do not want to pay for it. Specifically, IPAG has adopted the internationally understood concept of “flexibility” to describe the broader set of markets that Transpower’s DR programme addresses. OFGEM defines 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’³.

We also think the terms DERM and DERMS are useful, but note that these are only part of the flexibility markets we are interested in. We also have concerns with Transpower positioning itself in the DERM and DERMS part of the flexibility market, which we discuss more fully later.

³ <https://www.ofgem.gov.uk/electricity/retail-market/market-review-and-reform/electricity-system-flexibility>

We have used Transpower's terminology and introduced some further terms to expand on Transpower's thinking.

Terms that Transpower has used that we think are useful include:

- Distributed Energy Resources (DERs) – small-scale, distribution-connected assets that either reduce load or export more power – whether generation (like solar panels), storage (like batteries), or automated load management devices.
- Controllable DER – DER whose output or consumption can be turned up or down on demand – for example, diesel generation, batteries, and controllable EV chargers, but not intermittent renewable generation like wind or solar.⁴ The Impact of controllable DER is flexibility.
- DER Management (DERM) – the business process of selling, contracting with, operating and paying for controllable DER portfolios.
- DERM System (DERMS) – the software and digital information flows that enable DERM by controlling DER.

However, while Transpower has focussed on DERM, we consider that DERM is just one (reasonably major) part of electricity flexibility markets. Therefore, we further define the terms:

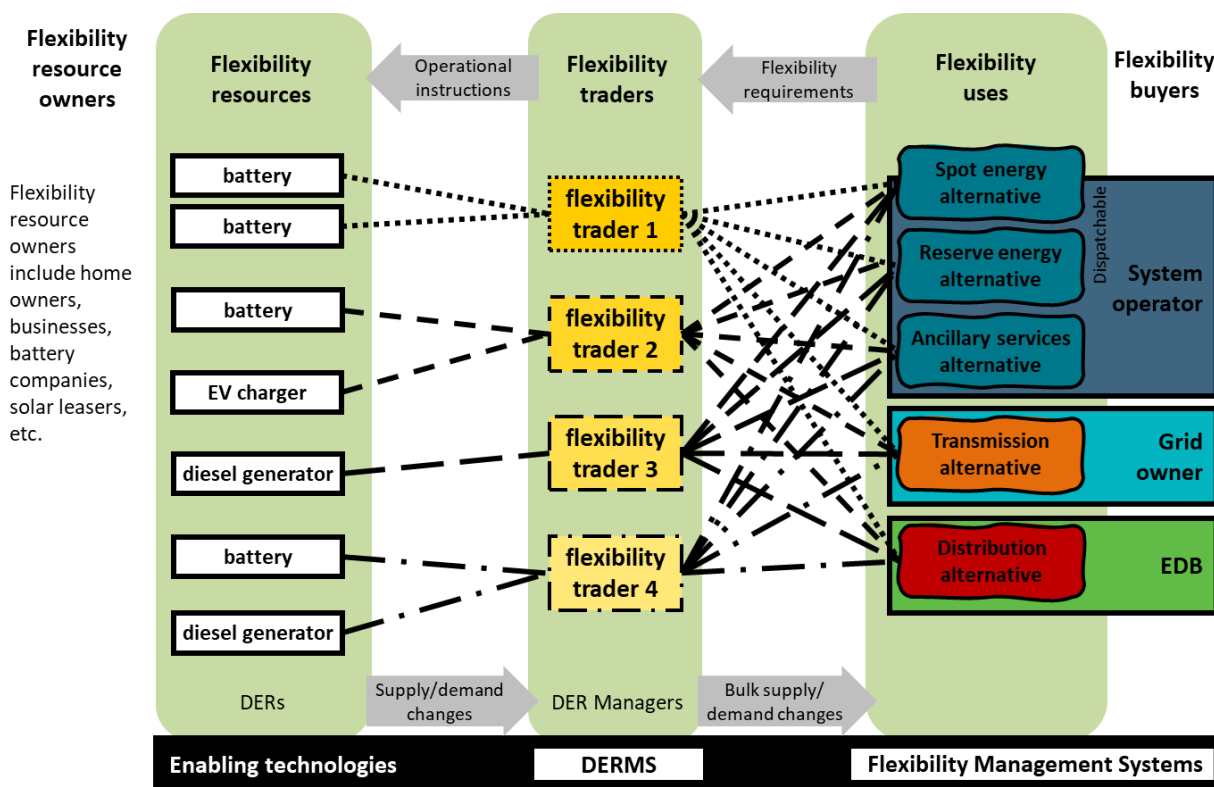
- Flexibility markets – mechanisms for matching and rewarding traders of controllable supply and/or demand on instruction or in response to prices.
- Flexibility resources – Flexibility resources are delivered through DER that is controllable. DER and larger resources like grid-connected generation or batteries that can provide flexibility services. Distributed solar without a battery is not a flexibility resource because it is not controllable.
- Flexibility resource owners – owners of resources that physically provide flexibility services.
- Flexibility traders – owners of DER portfolios who manage their DER portfolio to allocate it to its highest value uses. Flexibility traders interact with flexibility buyers (defined below) to provide the flexibility that they require. Importantly, flexibility traders maximise the value of DERs by allocating them to their highest value use (“value stacking”) rather than dedicating individual DERs to one use.
- Flexibility uses – what flexibility is used for – including energy, ancillary services, transmission investment deferral, distribution investment deferral, outage restoration, and construction risk management.
- Flexibility buyers – parties with flexibility needs that contract with flexibility traders to obtain flexibility (e.g. System operator, Grid owner, or an electricity distribution business (EDB)) – expressing an explicit need for flexibility and paying for it.
- Flexibility management – the business process of identifying need for, procuring, issuing operating instructions, and paying for flexibility services.

⁴ Although when combined with storage, intermittent renewable generation can provide controllable DER.

- Flexibility Management Systems (FMS) – the technology that allows the flexibility manager to forecast and respond to the need for, procure, manage, contract for, issue instructions to, check and reward flexibility providers.

Figure 1 illustrates the different players and flows in flexibility markets. The IPAG have focused on flexibility services because they have single buyers: the system operator, transmission network owners and distribution network owners. Other markets for DER exist but they have low barriers to entry and appear competitive. An example of such markets is self-supply by solar panels – which are not controllable but can be installed behind a customer’s meter and reduce daytime energy use.

Figure 1: Flexibility markets



As noted already, flexibility traders are owners of DER portfolios, who manage that DER to allocate it to its highest value uses. A flexibility trader may own some or all of the DER portfolio it manages (in which case it is also a flexibility resource owner) but may own none of the DER portfolio it manages (in which case it is not a flexibility resource owner).

We have avoided using the term “aggregator” here to emphasise that flexibility traders maximise the value of DER by:

- Offering flexibility from DER that may be owned by 3rd parties and
- Allocating that DER to its highest value use across all flexibility buyers.

IPAG used these principles in its April 2019 equal access report.⁵

We note that through the RCP2 DR trial, Transpower referred to distributors and solarZero as “aggregators” because they offered flexibility services by aggregating the actions of a fleet of distributed resources that they own. While this is true in a narrow sense, neither

⁵ Available here: <https://www.ea.govt.nz/assets/dms-assets/26/26594Equal-Access-IPAG.pdf>.

party meets the Authority's statutory objective requirement of competition and efficiency. To meet this would require those who offer flexibility services to build a portfolio of resources to meet the needs of flexibility buyers rather than simply offering the DER that they control to limited uses. Moreover, sourcing of services such as ancillary services, transmission, and distribution capacity support from DERs meets the reliability aspect of the Authority's objective.

We have used the terms “flexibility trader” and “flexibility resource owner” to make clear the role(s) each party plays.

Figure 1 is repeated below as Figure 2, but with examples of flexibility traders and flexibility resource owners. Note that the examples in Figure 2 are just examples and are not the only potential flexibility traders and flexibility resource owners in New Zealand.

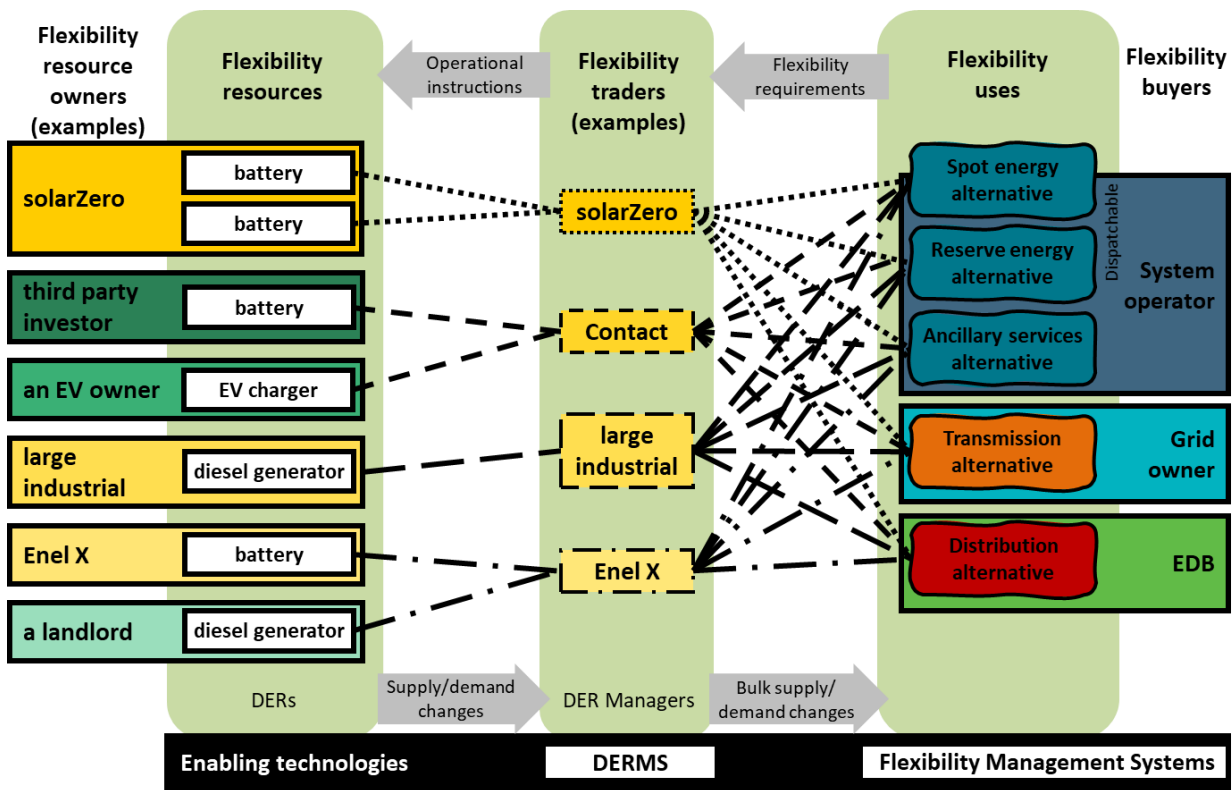
The examples of flexibility traders in Figure 2 are:

- solarZero – solarZero owns batteries installed at multiple households and businesses, which it manages to provide flexibility services. solarZero doesn't currently manage batteries owned by other parties. Therefore, solarZero is both the flexibility resource owner and the flexibility trader.
- Contact Energy – Contact has contracted with DER owners to reduce its exposure to Reserve costs but has also offered these resources into the Transpower DR programme when profitable. Contact doesn't own any of the DER portfolio it is managing, so they are the flexibility trader but not the flexibility resource owner.
- Large industrial – we have included the example of a large industrial that owns one DER that it manages to allocate it to its highest value uses. The large industrial is both the flexibility resource owner and the flexibility trader. The large industrial differs to solarZero as it is only managing one large DER rather than many (mostly small) DER.⁶
- Enel X – Enel X is the largest flexibility trader in the world and operates in New Zealand. Enel X's business is to build portfolios of flexibility resources (generally owned by others) in response to calls from flexibility buyers. Enel X has not participated in Transpower's DR programme (due to the specification of Transpower's DERM), but as flexibility markets open up in New Zealand, Enel X has potential to be a major flexibility trader. Enel X is a flexibility trader and in some cases may also be a flexibility resource owner.

To date, distribution businesses and Contact Energy have been flexibility traders “by accident” in terms of Transpower's DR programme – they own or operate resources in parts of the country where Transpower has called for “DR” but they have not yet developed flexibility portfolios specifically in order to meet Transpower's needs.

⁶ While it may be efficient for a large industrial who owns one large DER to be a flexibility trader (if it has the systems necessary to do so), it would not be efficient for an owner of one (or even a few) small DER (such as a household with an EV charger) to act as a flexibility trader. To be a flexibility trader a DER owner would have to enter into commercial arrangements with all flexibility buyers to maximise the value of their DER. This is likely to be too complicated and time consuming for an owner of one (or a few) small DER to do, but may be possible for a large industrial.

Figure 2: Flexibility markets in New Zealand



The IPAG recommend that the Authority update its “Demand Response Guiding Principles” to reflect IPAG’s suggested terminology so that they are “Guiding Principles for Flexibility Markets”.

3. DERM must be carried out by flexibility traders (owners of DER portfolios) NOT network owners

In Figure 1 and Figure 2 above, network owners (Grid Owner and EDBs) are shown as flexibility buyers, not flexibility traders. This is deliberate because we consider that DERM needs to be carried out by the flexibility traders who sell flexibility services. We distinguish between the tools that each role uses – Flexibility Management Systems (FMS) for flexibility buyers and DER Management Systems (DERMS) for flexibility traders.

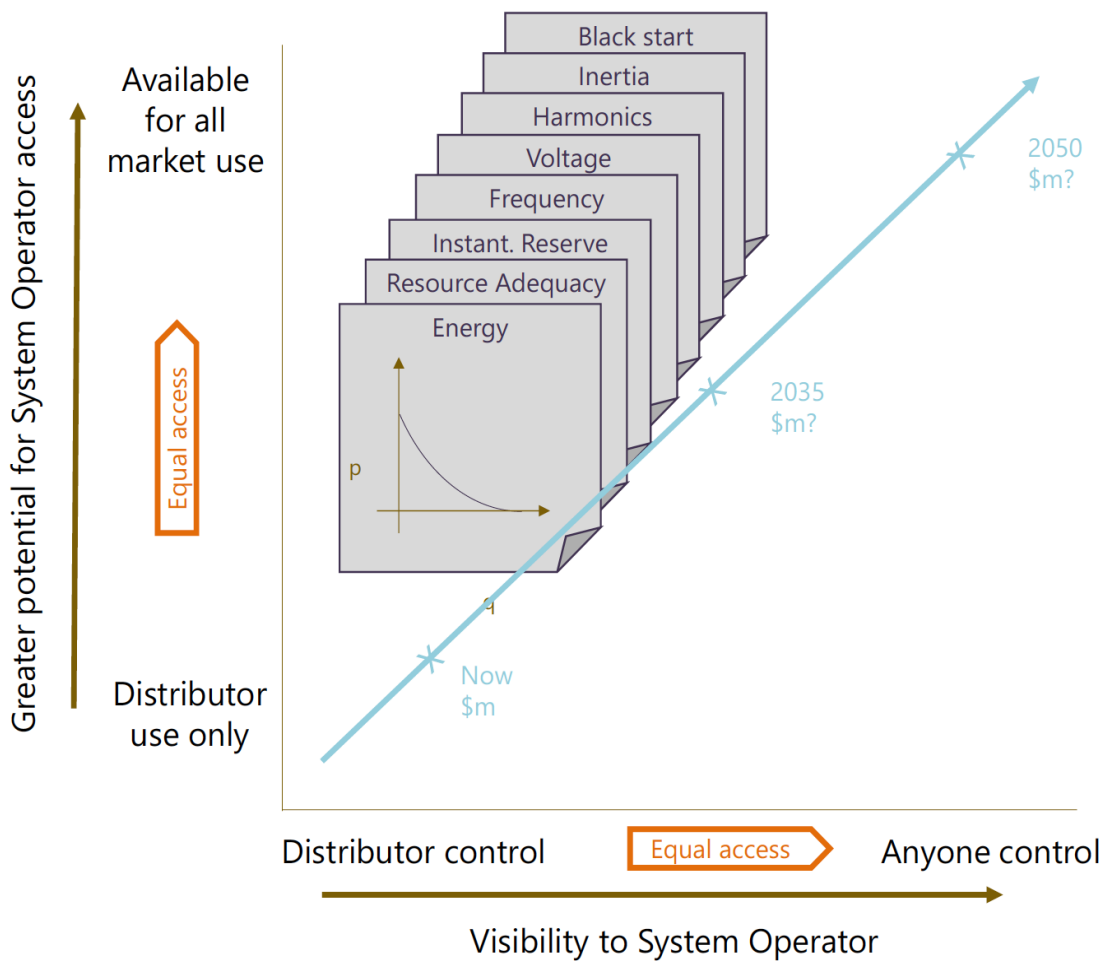
In IPAG's April 2019 advice to the Authority Board on creating equal access to electricity networks, we set out principles to maximise the benefits that DER offer New Zealand in terms of the Authority's statutory objective. In that report we noted that the 2019 Transpower DR pilot was not consistent with these principles. This is because if individual DER owners are required to deal directly with Transpower, then they would have to develop an understanding of, and enter into, commercial arrangements with all other flexibility buyers if they were to maximise the value of their DER. The transaction costs would be too high for most DER owners to do this and they would effectively limit the use of their flexibility to deferring and de-risking investment by the Grid Owner.⁷

The economic value of DER is substantially higher if it can be allocated to its highest value use across all flexibility markets rather than being dedicated to the sole purpose of deferring or de-risking investment in one network. This is shown in figure 3.

We note that this framework does require communication between different parties – the system operator will need to ensure it is communicating with other flexibility buyers (the grid owner and EDBs) to ensure it is accurately accounting for the procurement of flexibility services in its demand forecasts.

⁷ However, we note that Transpower's DR programme over RCP2 was just a trial and Transpower has indicated that how they procure flexibility services in the future will not necessarily reflect the structure of its DR programme in RCP2. We discuss this point further in Section 5 of this memo.

Figure 3: Allocation of flexibility resources⁸



Removing barriers to the efficient deployment of DER is worth \$1 billion annually to NZ by 2050

The improvements to Transpower’s “DR” programme that IPAG recommends, if applied to all flexibility markets in New Zealand, could save consumers in the order of \$10 billion over the years to 2050 as we decarbonize our electricity system and expand to remove fossil fuels from the economy.

The greatest potential contribution of DER is to resource adequacy. This is mainly due to avoiding investments in gas-fired generation, transmission and distribution infrastructure that would otherwise be required to support the increase in peak demand resulting from greater electrification of the New Zealand economy over the next decades.

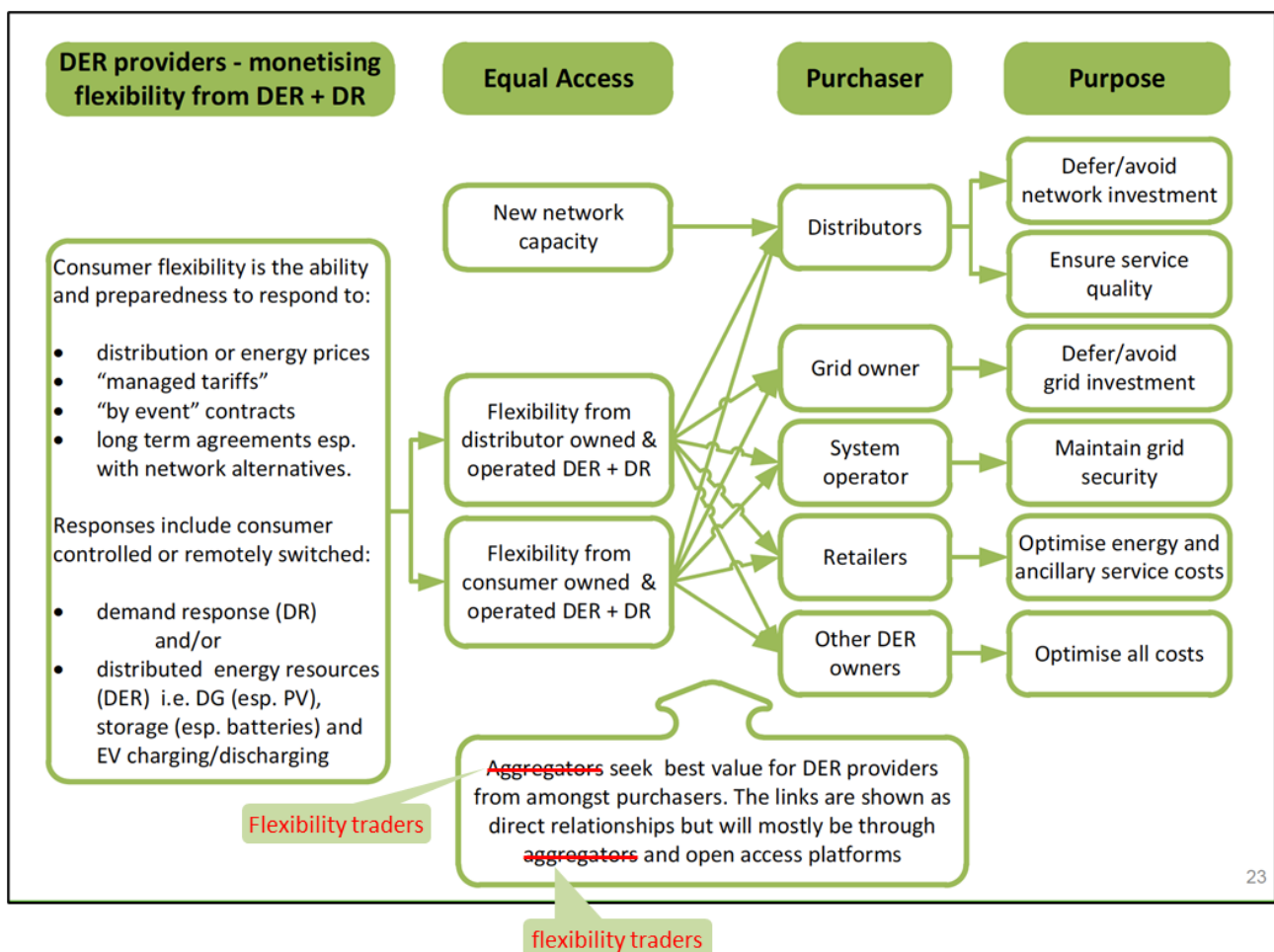
⁸ Distributed Energy Resources – Understanding the potential, Sapere for the System Operator, July 2020

Figure 4: Benefits from DER and DR⁹

Value stream (million)	2020	2035	2050	Additive
Energy Arbitrage (small-scale DER)	\$3	\$21	\$70	Yes
Resource Adequacy	\$24	\$588	\$861	Yes
Instantaneous Reserve	\$0	\$20	\$20	Yes
Frequency Keeping	\$0	\$1	\$0	Yes
Voltage	\$0	\$10	\$14	No
Harmonics	\$0	-\$1	-\$7	Yes
Simulated Inertia	\$0	\$21	\$85	Yes
Black Start	\$0	\$0	\$0	Yes
Total	\$27	\$650	\$1,029	

Figure 5 below (from IPAG’s equal access report) shows how an equal access regime works and role of flexibility traders in it.¹⁰

Figure 5: Equal access regime¹¹



⁹ *Distributed Energy Resources – Understanding the potential*, Sapere for the System Operator, July 2020

¹⁰ Note that in our equal access project we referred to “aggregators” rather than flexibility traders. However, our understanding of flexibility markets has improved since then and we now consider that “flexibility trader” is a more precise and less confusing term to use.

¹¹ Slide 23 of IPAG’s Equal Access Report, April 2019 (<https://www.ea.govt.nz/assets/dms-assets/26/26594Equal-Access-IPAG.pdf>). Slide has been amended to allow for use of the term “flexibility trader” rather than “aggregator”.

Importantly this is different from the legacy situation with the ripple control of hot water heating cylinders which was established in New Zealand in the 1950s. Ripple control has been a wonderful resource providing services for network peak management and other flexibility uses. Reflecting the limitations of the technology of the time, ripple control is centrally dispatched – affecting all customers on the same network spur when activated regardless of who they have chosen as their retailer.

Today, our ripple control infrastructure is used differently across the country. Some EDBs use it for distribution peak management, others use it to control transmission peaks, and yet others offer it into ancillary service markets. The technical limitations of ripple control make it incapable of maximising the economic benefit of the flexibility resource that it controls because individual hot water cylinder owners can neither choose when to reduce load nor choose the highest value use for load reduction. Consequently the ripple controlled hot water control resource is effectively constrained to the left-hand side of the chart in Figure 3.

As legacy ripple control infrastructure reaches the end of its life, the opportunity is to replace it with individually controllable hot water cylinders whose dispatch is determined by customers and their agents (flexibility traders) who will allocate it to its highest value use. Control of hot water heating is not a natural monopoly and exposing ripple control to competition could increase the value of this flexibility resource by an order of magnitude.

The shareholders of distribution and transmission networks could own unregulated subsidiaries who sell flexibility by aggregating DER. However, this would have to be at arm's length from the regulated network if it is to be consistent with the Authority's Statutory Objective. The network would only buy services from the subsidiary if it is selected in a fully competitive process on the same terms as any other potential flexibility provider. We have suggested that Transpower's DERM service be subject to the same rules about related party transactions that the Commerce Commission imposes on EDBs to ensure this is the case if it intends to continue to trade DERs.

Transpower has confirmed that they will not offer services in a way that creates competition issues. Transpower will not price services for FMS and DERMS in a way that impedes competition for these services or inhibits the development of a marketplace for flexibility managers and flexibility traders.

In the near-term, Transpower has said they would value the opportunity to work with the IPAG and the EA on the development of standard procurement methodologies for procuring flexibility across the industry.

IPAG recommends that the Authority monitor what progress Transpower makes on its commitment to not price services for FMS and DERMS in a way that impedes competition for these services or inhibits the development of a marketplace for flexibility managers and flexibility traders.

If the Authority believes that Transpower's "DR" programme is distorting markets for flexibility and flexibility management, then the Authority, with the Commerce Commission, could consider imposing on Transpower the same related party transaction rules that are already imposed on EDBs.

4. Management of DER is not the same as Management of Flexibility

Transpower has built a new technology platform to support their DR programme. As noted above, this platform is capable of managing individual DER as well as managing offers from flexibility traders. The platform is both a DERMS, supporting flexibility aggregation and an FMS, supporting the procurement of flexibility as a non-network solution. Similarly, Vector has engaged directly with DER owners through its mPrest platform which is described as a DERMS but appears also to be an FMS.

Conceptually the function of both types of system is similar as they both issue instructions, validate compliance and calculate payments for suppliers. FMSs do not control devices however; they are commercial tools that manage the procurement of a flexibility outcome (net MW reduced for a certain period of time) and are indifferent to how that outcome is achieved. Flexibility traders use DERMSs to meet the outcomes that the flexibility buyer's FMS sets.

In the short term, network owners FMSs could be very simple – manual processes, spreadsheets, even paper. DERMSs will need to be automated even during a trial as they issue realtime instructions to physical devices.

The market for DERMS, just as the market for flexibility aggregation, is not a natural monopoly. As with our concerns about a monopoly network owner carrying out flexibility aggregation in competition with independent 3rd party business service providers, we have concerns about monopolies offering DERMS in competition with 3rd party technology service providers. While we understand that distributors are currently just carrying out pilots, IPAG's concern is that consumers will not benefit if direct control of DER by distributors becomes part of their long term arrangements for flexibility management.

The Transpower DR platform has largely been paid for by the regulated Grid Owner. The incremental cost of using it to support other users would be very low and, other things being equal, would allow Transpower to offer competitive aggregation and DERMS services at short run marginal cost – always undercutting 3rd party service providers who would need to recover the cost of their capital investment and price at long run marginal cost.

The consequence of this would be crowding out of potential competitors for both flexibility trading and DERMS services.

Management of flexibility as a non-network input (rather than the DERs individually) is a monopoly function of a network owner. The Commerce Commission has explained how their regime creates incentives on EDBs and Transpower to minimise the cost of carrying out these functions, just as it does all other costs.

While we accept this, Flexibility Management System services are a competitive market, procured by network owners to allow them to manage flexibility. If a network owner builds their own solution and allocates the full cost of the solution to its regulated business, then, as with DERMS, it could price at incremental cost and crowd out 3rd party service providers.

In addition to our recommendation about related party transactions, we note that the Commerce Commission requires EDBs to allocate the costs of assets used for both regulated and unregulated purposes proportionately between those activities. Combined with the incentive to minimise costs for the regulated business, these rules simulate the

incentives that a competitive service provider would face if a network self-supplies services that could be procured competitively.

We asked Transpower whether it would adopt the cost allocation rules that EDBs are subject to. Transpower has said they are committed to ensuring that their FMS and DERMS business unit is appropriately structured to ensure that costs are allocated in ways that do not create competition concerns.

Transpower already applies activity-based cost allocation for FMS and DERMS activities. They are currently reviewing this method to ensure it is consistent with cost allocation methods required of other network businesses.

The solution proposed by Transpower addresses IPAG's concerns without needing regulatory intervention. This has been a particularly constructive response from Transpower which IPAG have appreciated. There may be scope for distributors to follow this example, but given the number of them and differences in their perspectives, it may be necessary to regulate to ensure that consumers are not disadvantaged if their EDB does not, or is late to, propose such a solution.

The IPAG recommends that the Authority monitor what progress Transpower makes on its commitment to ensure that costs are allocated in ways that do not create competition concerns.

If the Authority believes that TP's DR programme is distorting markets for flexibility and flexibility management, then the Authority, with the Commerce Commission, could consider imposing on Transpower the same cost allocation rules that are already imposed on EDBs.

The IPAG recommends that the Authority seeks assurances from EDBs that, like Transpower, they will not distort markets for flexibility and flexibility management. If EDBs do not provide such assurances, and do not demonstrate that they are not distorting markets, the Authority and Commerce Commission should regulate through ringfencing.

5. Transpower's DR programme over RCP2 was just a trial

When we started the project, we found many stakeholders had strong opinions about Transpower's DR programme, but it has become clear that few people outside Transpower and the Commerce Commission understood the terms of the Transpower DR programme in the Commission's RCP2 decision. The decision was explicit that the programme was a focused R&D exercise and neither a prototype of whatever DR programme Transpower might establish in future control periods nor intended to avoid any actual transmission expenditure during RCP2.

A consequence of this is that Transpower's focus during RCP2 has been on attracting participation by existing DER ("shaking the tree") rather than building flexibility portfolios of new and establishing DERs where they are needed – as Aurora's Upper Clutha programme (discussed below) will.

Transpower has shown real candour in explaining the limited opportunity that DER offers for deferring or avoiding transmission investment given that most NZ transmission assets are built to N-1 or higher levels of security – which means that all operating assets are duplicated or more than duplicated so that the system continues to supply load uninterrupted if a single asset fails. This duplication allows Transpower to operate Special Protection Schemes where the loading of circuits close to capacity are reduced by splitting flows across the duplicate assets – increasing the risk of non-supply for a proportion of the load but at low probability and for short periods of time which is almost always cheaper than buying transmission alternatives from flexibility portfolios based on DER or larger resources.

The Transpower DR programme in RCP2 has provided a useful confirmation of the opportunity for DER and other flexibility resources for network owners who don't have redundant or meshed network assets – parts of transmission and distribution networks built to N security or as spurs – and de-risking any network expansion that might not be complete before circuits become overloaded.

Transpower has noted that what Transpower's DERM will look like in the future will not necessarily reflect the structure of Transpower's DR programme in RCP2.

In November 2014, the Authority and Transpower signed a DR operational protocol that described how Transpower and the Authority would ensure that Transpower's development of DR would not adversely affect the wholesale electricity market (by depressing spot prices in an area for example). The IPAG considers that it would be timely for the Authority and Transpower to update the DR operational protocol because:

- Transpower's DR programme is moving out of the development phase
- The concerns that the Authority had with Transpower's DR programme in 2014 may have changed
- It should reflect the new flexibility terminology.

The IPAG has carried out a high-level review of the DR operational protocol and has suggested some possible changes. These changes are set out in Appendix 1 of our companion slides.

The IPAG recommend that the Authority and Transpower update the "Demand Response Operational Protocol" signed between the Authority and Transpower in

November 2014 to be a “Flexibility Management Operational Protocol”. The Operational Protocol should be updated to reflect new terminology and to reflect that Transpower is moving out of a development phase for its flexibility management.

6. Need to incentivise EDBs to invest in flexibility

In early 2020 the IPAG asked the Authority to contact all EDBs to ask for information on their current state of flexibility services. **All 29 EDBs replied to the information request.** There was a wide range of responses to this request. In summary the responses indicated that:

- Most EDBs use hot water ripple control for managing peaks in their own networks (as opposed to selling it as a service to other flexibility buyers)
- A few EDBs offer their hot water ripple control into Transpower's DR programme and ancillary service market
- Flexibility resources other than ripple are used but commercial arrangements are still in infancy and most flexibility resources are EDB owned
- Some larger EDBs are trialling flexibility services (mainly to investigate technical feasibility)
- Many EDBs consider there are several barriers to the adoption of flexibility services
- EDBs are concerned about grid constraints but aim to manage these with existing technology (such as hot water ripple control).

The IPAG considers that in general EDBs have made little progress on the investigation and development of flexibility services as a distribution alternative. Many EDBs (particularly the small consumer-owned EDBs) seem to consider that use of flexibility services is difficult and that traditional resources, in particular universal ripple-control, are adequate for network management. However, we do note progress has been made by some EDBs including Vector, Orion, and Wellington Electricity.

There was only one EDB that has actually awarded a contract to a flexibility trader as a network alternative. This is Aurora Energy's recently concluded RFP for non-network support in the Upper Clutha where a time and location-specific call for flexibility has resulted in a contract with solarZero as a flexibility trader to build a portfolio over which Aurora has priority call at network peaks. Unlike solarZero's participation in the Transpower DR programme to date, they will deliberately invest in batteries in the Upper Clutha to complement the controllable DER that already exists there.

The responses we received from the other 28 EDBs made it clear that they do not understand the value of flexibility as a network alternative or why they should explore it under the regulatory regime – or that they consider ripple control to be the optimal non-network solution. Our analysis is explicit that ripple control is not an optimal non-network solution: dedicated ripple control for network support provides less value to the consumer than individual hot water controls (DERs) that can be allocated to the highest value flexibility use by a flexibility trader.

The IPAG has considered the need to incentivise EDBs to invest in flexibility. Given the slow pick up to-date of flexibility services by EDBs, IPAG considers that incentives are needed to encourage (or even require) investment in flexibility by EDBs. However, IPAG considers that a lump sum allowance (as Transpower received during RCP2) would not be the most effective means of incentivising EDBs to invest in flexibility as a network alternative.

The IPAG has considered the pros and cons of different types of incentives. We consider that some soft incentives, such as nudging EDBs to act and providing education on the benefits of flexibility investment, are really important; but it may be necessary to provide a further push. This could include requiring EDBs to disclose what progress they have made in investigating or investing in flexibility services as network alternatives either in their Distribution Pricing reports to the Authority or Information Disclosure to the Commerce Commission. This requirement would need to include clear guidance on what constitutes a flexibility service—in particular, the guidance would need to note that EDBs need to consider how they can move away from using ripple control.

An even stronger incentive could be to link each EDB's regulated revenue to their progress on investing in flexibility, however this may be burdensome to the Commerce Commission, could result in perverse outcomes and would only be able to be applied to EDBs whose revenue is regulated (i.e., those that aren't owned by their consumers).

The Commission has explained to us its view that the incentives under Part 4 ensure that EDBs take advantage of non-network options where economic. In IPAG's Equal Access report, we noted (problem statement 7) that Part 4 incentives for using DER for regulated services and network alternatives may not be well understood noting that Part 4 incentives may be complex, or misunderstood. This may lead distributors to focus on in-house solutions, without using a contestable framework or not use DER as a network alternative at all.

Despite the Commission's repeated assurances that Part 4 incentives ensure the efficient use of flexibility, the evidence we have accumulated is that this is simply not the case. Not all DPP-regulated companies are profit maximisers and managers in many EDBs are cautious about the use of new technologies and techniques.

The DPP relies on revealed costs with a five-year reset lag. Given that only one company has actually contracted for flexibility as a network input, other companies will not be limited to the revealed costs of that solution until the next DPP reset. Most exempt companies shadow DPP-regulated EDBs in their work practices so integrating flexibility into their operations will take even longer.

The government has set a clear target that New Zealand's electricity system will be 100% renewable by 2030 and that the sector will be massively expanded by the electrification of the light vehicle fleet and process heat. Distributed renewable generation, demand management and storage are key enablers of this transition and, as Sapere's recently published investigation of the potential value of DER in a New Zealand context for the System Operator¹² establishes, many such projects are only economic if the flexibility value they offer to EDBs is monetised.

The IPAG recommends that the Authority and Commerce Commission develop processes to nudge EDBs to invest in flexibility and education for EDBs on how to invest in flexibility.

The IPAG recommends the Authority, with the Commerce Commission, consider whether EDB Directors should be required to warrant that they have fully explored flexibility as an alternative to all material (>\$5m) network investments and link each EDB's regulated revenue to their progress on investing in flexibility. The Authority and Commerce Commission would need to make clear to EDBs that this exploration

¹² <https://www.transpower.co.nz/resources/distributed-energy-resources-der-report>

should include considering how they can move away from sub-optimal use of ripple control.

The IPAG recognises that it could be beneficial for EDBs to undertake trials to explore the use of flexibility services. However, to meet New Zealand's, and global, climate change objectives, the emphasis needs to be on genuine progress, rather than trials in the purest sense. The best form of trial is to progress flexibility service solutions in areas where a constraint is likely to arise in the medium term, thereby enabling trial solutions to be developed and refined in the short term to ensure that medium term risks can be managed. Trials should be avoided where they do not have potential to be useful as an enduring solution, either due to an unconstrained grid or network location or inadequate capability or scale potential. Trials should also involve learning from others' experience, developing best practice, and establishing standards. There may be a place for the Authority to coordinate EDB trials to ensure trials promote the long-term benefit of consumers.

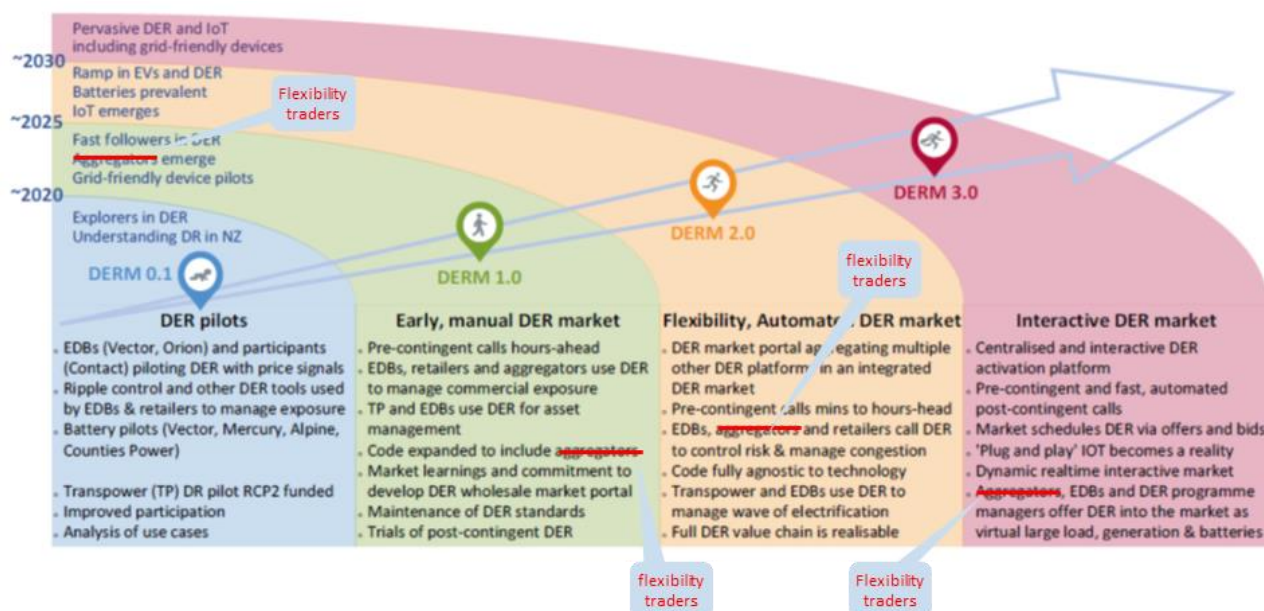
7. Developing flexibility markets is an ongoing process

The development of flexibility markets will take time, just as it has taken time for the development of the energy market and derivatives markets. Transpower has put considerable effort into exploring and understanding the role of flexibility through its DR programme pilot. EDBs and other flexibility users can (and should) use what Transpower has learnt as a resource for developing their own flexibility market systems.

Transpower has helpfully developed a “rainbow diagram” which sets out a possible pathway for use of DER for flexibility in New Zealand (see Figure 6 below). This pathway includes four phases:

- DERM 0.1 – DER pilots¹³
- DERM 1.0 – Early, manual DER market
- DERM 2.0 – Flexibility, automated DER market
- DERM 3.0 – Interactive DER market

Figure 6: Possible evolution of flexibility markets in New Zealand¹⁴



Transpower’s RCP2 DR programme was focused on “shaking the tree” by engaging existing DER in contrast to Aurora’s Upper Clutha RFP (referred to in section 6 above) which looks to develop a target volume of flexibility in a specific location for a specific period of time. Transpower’s programme relies on event-based payments but does not make payments that would underwrite location-specific new investment. For the supply-side of flexibility markets to develop it is essential that establishment or availability payments are available to flexibility traders:

- An *establishment payment* is paid by a flexibility buyer to a flexibility trader for developing the ability to provide flexibility to the flexibility buyer when needed.

¹³ We believe that we are still in this phase but are hopeful that Transpower and EDBs will move to the next phase soon.

¹⁴ Source: Transpower.

- An *availability payment* is paid by a flexibility buyer to a flexibility trader for having resource available to provide flexibility to the flexibility buyer when needed.

Establishment and availability payments will ensure the building of flexibility portfolios of new DER and establishing DER to provide flexibility services where they are needed rather than relying solely on existing DER. Transpower has indicated that the future of their DR programme would be awards of a (specific type of) Grid Support Contract which could accommodate establishment and/or availability payments.

Wellington Electricity has been establishing and developing processes and policies to support the development of dynamic connection agreements (DCA) for EV charging. DCA change the style of traditionally passive connection to the distribution network to allow variability required for DER.

Meanwhile, Aurora's Upper Clutha programme involves the flexibility trader (solarZero) entering into agreements with homeowners covering how the DER will be utilised, while Aurora contract with the flexibility trader to provide the flexibility services under the Upper Clutha Non-Network Electricity Capacity Support Agreement. The agreements between the retailer and Aurora and between the retailer and the homeowner remain the same. However, Aurora's programme differs from Wellington Electricity's because under Aurora's Upper Clutha programme the DER is owned by the flexibility trader, while Wellington Electricity's DCAs are, so far, for EVs where the EV is owned by the consumer/homeowner.

It is clear to us that some general form of commercial agreement needs to be developed so that a flexibility trader does not need to enter into a different type of agreement with each flexibility buyer.

Transpower has said that in the near-term, they would value the opportunity to work with the IPAG and the EA on the development of standard procurement methodologies for procuring flexibility across the industry.

The IPAG recommends the Authority require Transpower to work with Aurora and the EDBs more generally to agree a standard offer form for procuring flexibility as a "non-network" solution and enforce the use of this standard nationally for procuring non-network inputs through default agreements.

Long-term we would expect to see greater interaction of flexibility markets with the spot market.

A lot will change in the next few years: the next generation of transmission pricing will not include a peak demand charge. The spot market will move from determining prices after people use electricity to when they use electricity (i.e. in real time). As these changes work their way through, we expect to see more signalling of transmission scarcity through nodal spot prices – prices that signal the price of energy as well as the real-time cost of transporting that energy and any constraints in doing so. Consumer and business energy management devices would act in response to nodal spot prices to manage short-term demand, and thereby relieve constraints, through flexibility to prices. This would be through either the 'dispatch light' product, or autonomously in response to price – thus

Figures 1 & 2 show the spot energy market both inside the System Operator box (via dispatch light) and outside the System Operator box (via autonomous response to price).¹⁵

We see this as not only important in managing transmission scarcity in the future, but in also preparing for a future of increased renewable energy. In this future there may be increased volatility in spot prices as variable renewable resources increasingly provide our energy needs. At times of short-term (intraday timeframes) resource scarcity, having demand react to this based on price (the price consumers (via some automatic device) are willing to forgo consumption) will allow better matching of variable renewable supply and demand. This is seen as beneficial for a 100% renewable future and a way consumers can benefit in terms of managing the cost of a near fully renewable system.

In the future we see consumer response to scarce nodal spot prices working in conjunction with Transpower's Transmission Planning Report and Grid Support Contracts (GSCs). These both signal forecast transmission constraints well ahead of time - and give the market (traders) an opportunity to prepare for them. The GSC is particularly useful, in that it gives the market an opportunity to respond to the GSC tender with a potential solution. For example, Transpower may call for a GSC at a particular location at a particular time in the future. The market (traders) may respond to that with a solution involving demand flexibility in response to nodal spot price, they may respond with a new generation proposal, or they may not respond at all. The key is that via the GSC Transpower identifies and communicates its grid support needs in terms of capacity, location and time.

We acknowledge that there will also be constraints in distribution networks – quite probably more, and very location specific. Clearly the real-time nodal spot price does not aid in managing those – and to move in this direction is a whole other level of complexity, something well in the future. Distributors will need to find other ways of managing these for now (a number forming part of the IPAG's Equal Access Advice). This note however sets the vision of a future where both transmission and distribution congestion might both be managed, to an extent, by demand flexibility. That flexibility will increase price elasticity of demand and thereby give the consumer more opportunity to manage their electricity purchase costs and contribute to a near fully renewable electricity system.

¹⁵ Autonomous action of consumer devices followed from two of the ENA's Network Transformation Roadmap scenarios (Set and Forget and Rise of the Prosumer), and led the 'Network Stability' action in the 'Network Operation, Monitoring, and Stability' programme of the ENA's Network Transformation Roadmap.

8. Flexibility needs to respond to the need

We believe that there are some misconceptions in the industry that any DER owner will be able to benefit from all uses of flexibility. However, this is not the case. Some (or most) needs for flexibility are only in certain areas – e.g., Transpower will only require flexibility as a transmission alternative on certain parts of the grid for certain periods of time (generally where a grid upgrade is imminent or under construction).

It is essential that owners of DER portfolios build their portfolios in response to need to ensure the value of DER is maximised. Aurora Energy's Upper Clutha flexibility pilot, where it asked for registration of interests before going out with a selected Request for Proposals to see what solutions were available to meet their need, is a good example of where an owner of DER portfolio has responded to need for flexibility in a certain area.

In some cases an owner of DER will be able to receive flexibility payments from multiple sources (i.e., value stack) if their DER is valuable to more than one flexibility buyer. For example, some DER may be able to be used as transmission alternative and distribution alternative. It may be the case that the payment from one flexibility buyer could tip DER over the edge from being uneconomic to being economic.

Again Aurora Energy's Upper Clutha flexibility pilot provides an example of this, where solarZero value stack flexibility benefits from Aurora Energy as well as energy arbitrage. I.e. they constantly charge their batteries at periods of low prices and/or from solar and discharge at periods of high prices. In addition, they add to this value stream availability payments from Aurora Energy to give Aurora Energy priority access to discharge their batteries on a few (0-10) occasions a year, when Aurora Energy anticipates peak load in the Upper Clutha area. The key point in this case is that Aurora Energy's availability payment was enough to tip the Upper Clutha area over the edge to being more economic than other areas for solarZero. Consequently solarZero launched a campaign to install its solarZero systems in the Upper Clutha area, benefiting consumers and Aurora Energy.

9. Recommendations

We have made several recommendations to the Authority to encourage efficient development of flexibility markets in New Zealand. While we think all the recommendations we have made are important, we consider that some recommendations are more urgent than others.

Key recommendations – important and urgent:

1. a). The IPAG recommends that the Authority monitor what progress Transpower makes on its commitment to not price services for FMS and DERMS in a way that impedes competition for these services or inhibits the development of a marketplace for flexibility managers and flexibility traders.
b). If the Authority believes that Transpower’s “DR” programme is distorting markets for flexibility and flexibility management, then the Authority, with the Commerce Commission, could consider imposing on Transpower the same related party transaction rules that are already imposed on EDBs.
2. a). The IPAG recommends that the Authority monitor what progress Transpower makes on its commitment to ensure that costs are allocated in ways that do not create competition concerns.
b). If the Authority believes that TP’s DR programme is distorting markets for flexibility and flexibility management, then the Authority, with the Commerce Commission, could consider imposing on Transpower the same cost allocation rules that are already imposed on EDBs.
3. The IPAG recommends that the Authority seeks assurances from EDBs that, like Transpower, they will not distort markets for flexibility and flexibility management. If EDBs do not provide such assurances, and do not demonstrate that they are not distorting markets, the Authority and the Commerce Commission should regulate through ringfencing.
4. The IPAG recommends that the Authority and Commerce Commission develop processes to nudge EDBs to invest in flexibility and education for EDBs on how to invest in flexibility.
5. The IPAG recommends the Authority and Commerce Commission consider whether EDBs should be required to report on their progress on investing in flexibility services in their information disclosure and/or link each EDB’s regulated revenue to their progress on investing in flexibility.
6. Rather than leaving the form of offer to GSCs open, the IPAG recommends the Authority require Transpower to work with Aurora and the EDBs more generally to agree a standard offer form for procuring flexibility as a “non-network” solution and enforce the use of this standard nationally for procuring non-network inputs through default agreements.

Secondary recommendations – important, but not urgent

7. The IPAG recommend that the Authority update its “Demand Response Guiding Principles” to reflect IPAG’s suggested terminology so that they are “Guiding Principles for Flexibility Markets”.
8. The IPAG recommend that the Authority and Transpower update the “Demand Response Operational Protocol” signed between the Authority and

Transpower in November 2014 to be a “Flexibility Management Operational Protocol”. The Operational Protocol should be updated to reflect new terminology and to reflect that Transpower is moving out of a development phase for its flexibility management.

Medium-term recommendations:

9. If nudging is not sufficient to trigger change in EDB behaviour, then the IPAG recommends the Authority, with the Commerce Commission, consider whether EDB Directors should be required to warrant that they have fully explored flexibility as an alternative to all material (>\$5m) network investments and link each EDB’s regulated revenue to their progress on investing in flexibility. The Authority and Commerce Commission would need to make clear to EDBs that this exploration should include considering how they can move away from sub-optimal use of ripple control.
10. When DER penetration is sufficient to compete directly with main frame generation, IPAG recommends the Authority review the Code to ensure there are no barriers to flexibility traders offering DER based service to any wholesale market value stream. In particular, we recommend the Authority:
 - look at introducing new types of participants (e.g., flexibility trader), which may have less strenuous requirements to meet.
 - look at Code changes to allow aggregation across retailers and multiple GXP.

Thanks

The IPAG would like to thank Transpower for their considerable and constructive engagement with us throughout this project. They have been open and receptive to our suggestions throughout and have developed many proposed changes to the DR programme as a direct response to our findings.

We have also dealt with many industry stakeholders – EDBs, flexibility buyers and traders. Everyone has been candid and generous with their time which has helped us enormously and we are grateful to all stakeholders for the time they have spent preparing for and interacting with us.

V10 12/7/21