TRANSPOWER

Distributed Energy Resource Management Briefing to IPAG #4

Richard Hobbs, Simon Murrow, Joel Cook, 24 February 2020

Agenda

1. **Introduction** (5 minutes)
2. How Transpower will use flexibility - RCP2 vs RCP3 (5 minutes)
3. How Transpower allocates DR programme costs (5 minutes)
4. Tendering for non-transmission solutions (30 minutes)
5. Tenders vs auctions (5 minutes)
6. Encouraging a competitive aggregator market (10 minutes)
7. Examples of potential applications in RCP3 (30 minutes)
8. Roles and functions in operating a flexibility market (30 minutes)
9. Discussion and next steps (15 minutes)

Transpower's proposals for DERM discussions with IPAG

22 July 2020	21 October	1 December	27 January 2021	February & March
• Introduction • Transpower's RCP2 DR programme • Transpower's DERMS platform	• RCP2 outcomes • Mechanics of our DERMS platform • Operationalising DERM: overview	• Value stack and pricing interactions • Operationalising Grid Owner DERM • DERM market development issues	• Procurement of NTS • MCP Process • Terminology	• Cost allocation • NTS tenders • Auctions vs Tenders • Aggregator competition

Transpower's intention is to lend our experience and analysis to the IPAG to assist you spark an effective DERM work plan with the Authority, and so facilitate:

- Competition in provision of DER aggregation, DERM and DERMS services
- Incentives for DER investment
- An efficient, least cost transition to electrification and decarbonisation

Some terminology

DER	Distributed Energy Resource	The object, e.g. a battery or EV charger
DERM	DER Management	The approach to managing a specific DER market, e.g. aggregating many DER
FMS	Flexibility management system	The software system that network companies use to select, dispatch and coordinate flexibility services
DERMS	DERM System	The software system central to that market, that performs e.g. registration, calling, verification and settlement

Flexibility market

- A very useful term, but…
- Perhaps best reserved as the generic term for not just a DERM market but also for:
  - demand response to price signals (nodal price, TPM, DPM)
  - demand participation in ancillary services directly rather than through a DERM market (current practice)

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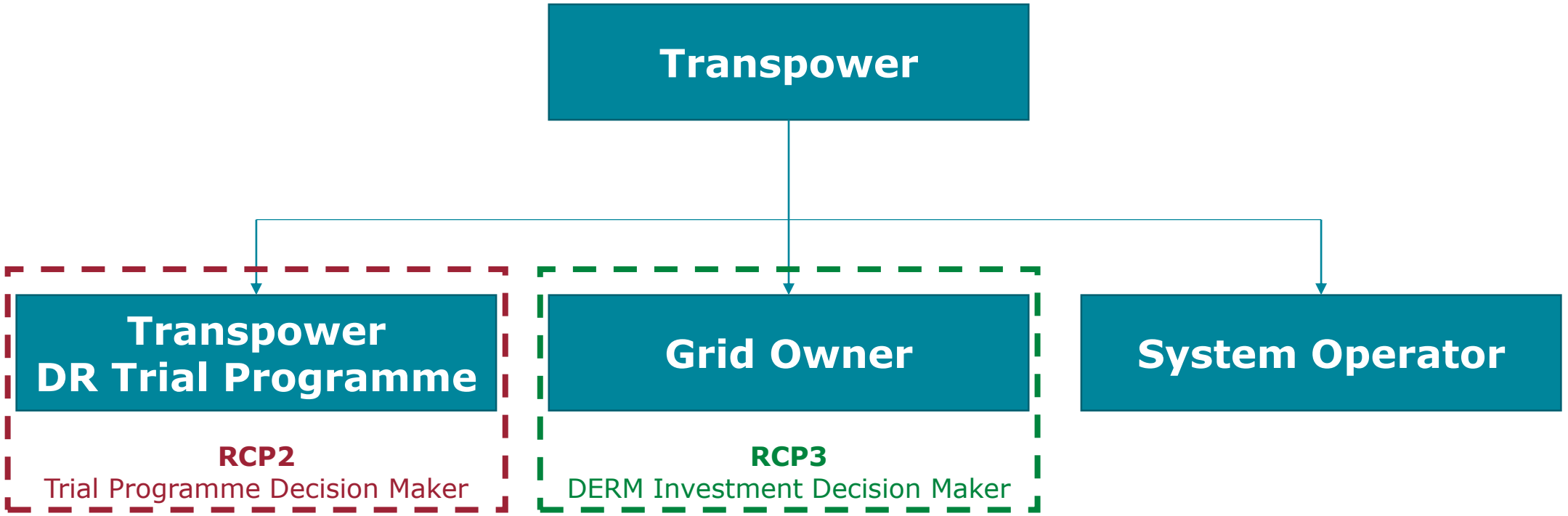
RCP2 was driven by the needs of the DR trial programme
RCP3 will be driven by the needs of the Grid Owner



RCP2: Investigate how demand response could offer transmission alternatives

	RCP2 – Trial Phase	RCP3 – Operational Deployment
Decision maker	Transpower DR trial programme	Grid Owner
Engagement	Direct consumer engagement Aggregator engagement	Aggregator or large single participant* engagement only
Procurement	Direct consumer contracts	Tender for Grid Support Contracts
Contract justification	Experimentation / learning	Most economic solution to a Grid Need
Call justification	Varied – Mostly trial calls	Grid trigger met (e.g. constraint)

* Threshold for 'large' TBC – provisional estimate 5MW+

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Action 5.1: Transpower to explain how it approaches cost allocation and related party requirements and present back to IPAG

- In RCP2 we used the Avoided Cost Allocation Methodology to allocate our Demand Response trial costs against the regulated funding that we received from the Commerce Commission.
- We already use an activities based allocation approach for costs related to our subsidiary companies EMSTradepoint Limited and Risk Reinsurance Limited. We have no reason to depart from that for our future activities such as DERMS.
- We are currently considering the business structure of our ongoing RCP3 DERMS activities but intend to further investigate employing an approach that is consistent with the EDB and GPB cost allocation IM

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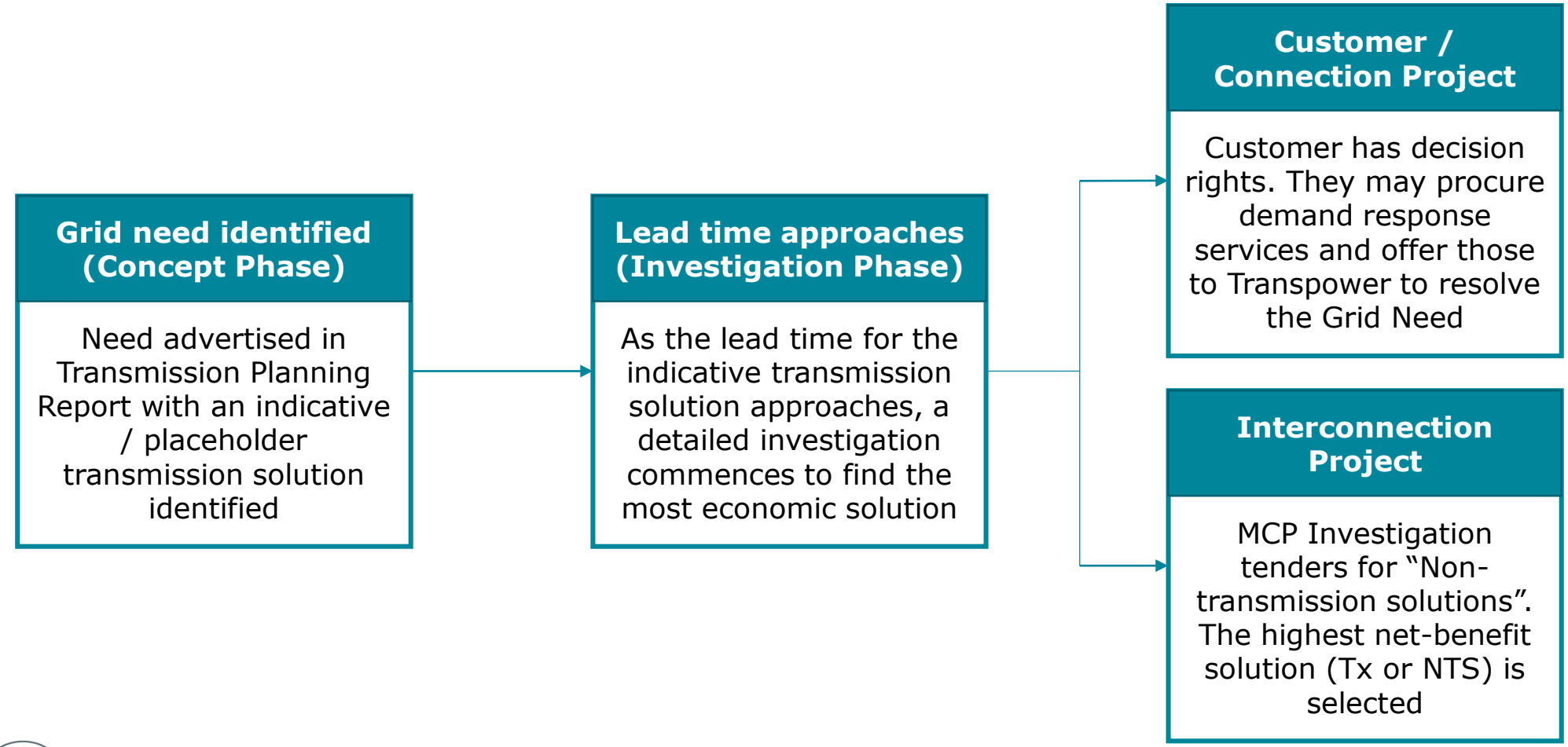
RCP3 – Transpower tenders for Non Transmission Solutions to discover price and feasibility – selects most economic option



RCP3 – Non Transmission Solution tenders use technology agnostic specifications

- Non-transmission solution performance criteria are technology agnostic
- The example to the left shows the frequency response that a non transmission solution must provide to meet the WUNI-VM need
- A number of technologies could be used to achieve the desired specification, including:
  - STATCOMs
  - SVCs
  - Synchronous condensers
  - Generator AVR action
  - Battery inverters
  - Demand management

The response characteristic is shown in **Figure 0-2**.

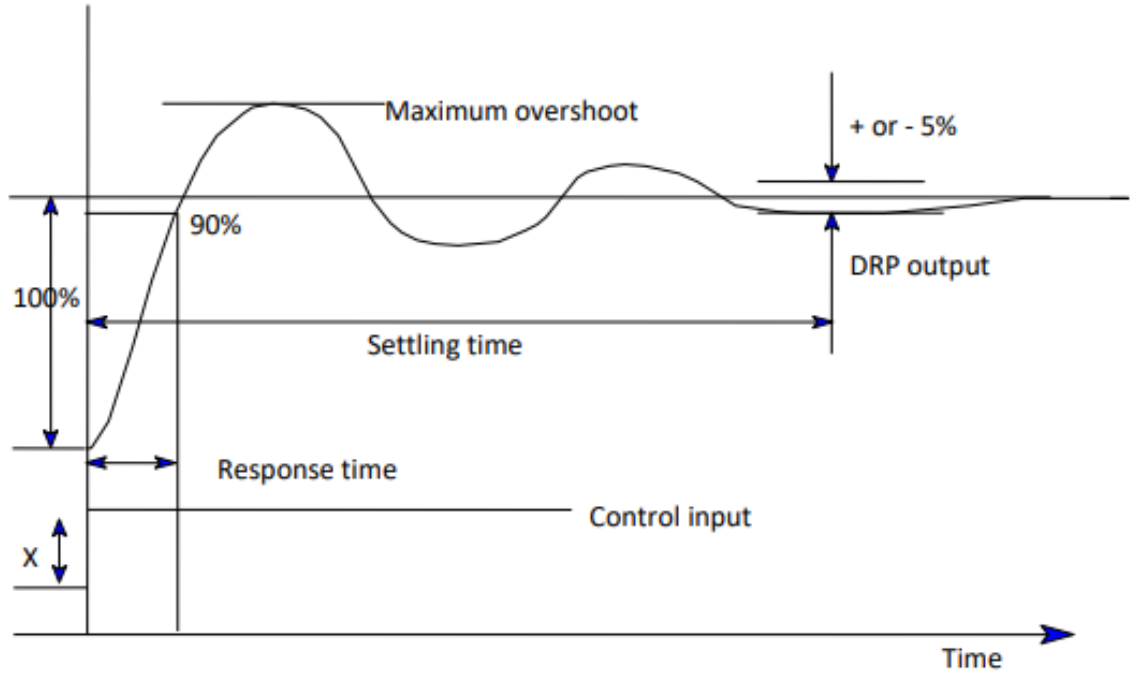


Figure 0-2: Response of the DRP

RCP3 – Non Transmission Solutions compete with each other and with Transmission Solutions to be most economic

Table 2: Short-listed investment options by commissioning year

Year	Investment Option 1 Non-transmission solution	Investment Option 2 N-G-1 with demand management	Investment Option 3 N-1 with demand management	Investment Option 4 N-G-1 without demand management	Investment Option 5 N-G-1 without series capacitors	Investment Option 6 N-G-1 with thyristor switched reactors
2022	Demand management scheme +/- 300 Mvar dynamic reactive support procured through grid support contracts on a 10-year contract*	Demand management scheme 150 Mvar SVC at Otahuhu 150 Mvar SVC at Hamilton	Demand management scheme 150 Mvar SVC at Otahuhu 150 Mvar SVC at Hamilton	150 Mvar SVC at Otahuhu 150 Mvar SVC at HAM110 Series capacitors (45% compensation) on Brownhill–Whakamaru 1&2	Demand management scheme 150 Mvar SVC at Otahuhu 150 Mvar SVC at Hamilton	Demand management scheme 150 Mvar TSR 2 × 75 Mvar TSR Series capacitors (45% compensation) on Brownhill–Whakamaru 1&2
2023						
2024				150 Mvar SVC		
2025	Series capacitors (45% compensation) on Brownhill–Whakamaru 1&2	Series capacitors (45% compensation) on Brownhill–Whakamaru 1&2			150 Mvar SVC	
2026				2 × 75 Mvar shunt capacitors		150 Mvar SVC

* Nominally 10 years; however, we are open to other contract lengths.

Source: WUNI-VM Short List Consultation

RCP3 – Grid Owner will contract any DER services under a Grid Support Contract – like any other non transmission solution

"A payment structure will be proposed as part of the RFP process, based on some or all of:

- Preparation payments
  - establishment payment to cover up-front costs of participation
- Operation payments
  - availability: payment for being available to call, per month, conditional on not failing to deliver against calls (including test calls)
  - delivery [call]: payment per MW delivered per hour up to the contracted amount

Transpower will consider variants on this mechanism or other payment structures, but will require that the payment structures for GSCs for DSP [DER participation] include financial incentives for performance"

Choice of DER payment mechanism will depend on the situation

- Transpower has trialled a variety of DER payment structures, with a focus to date on price discovery for targeted DER types
- Transpower has designed its DERMS system to be flexible enough to manage all these payment options

	Call payment	Availability payment	Pilots 2007 - 2020	Operational 2020+
			Focus on: • Price discovery • Targeted DER types • Refining end-to-end DERM process	Focus on: • Least cost reliability
A	Yes, as agreed through RFP (call price fixed* months beforehand)	May or may not be availability payment too	Yes: we called this our 'non-price responsive' programme	Most economic mix of DER types, payment structures and call conditions would be selected from RFP responses
B	Yes, as accepted through an offer window open prior to call notification (call price fixed* hours beforehand)		Yes: we called this our 'price responsive' programme	
C	None, maximum calls per month included in availability payment	Yes	Not trialled yet, but under consideration for our planned battery trial	
D	Yes, fixed price e.g. $200/kWh (set to elicit required volume, discovered through experience)	May or may not be availability payment too	Not trialled due to focus on price discovery	

** We used pay as bid for our call prices in our trials to minimise costs and because of low liquidity – operationally we could use marginal price*

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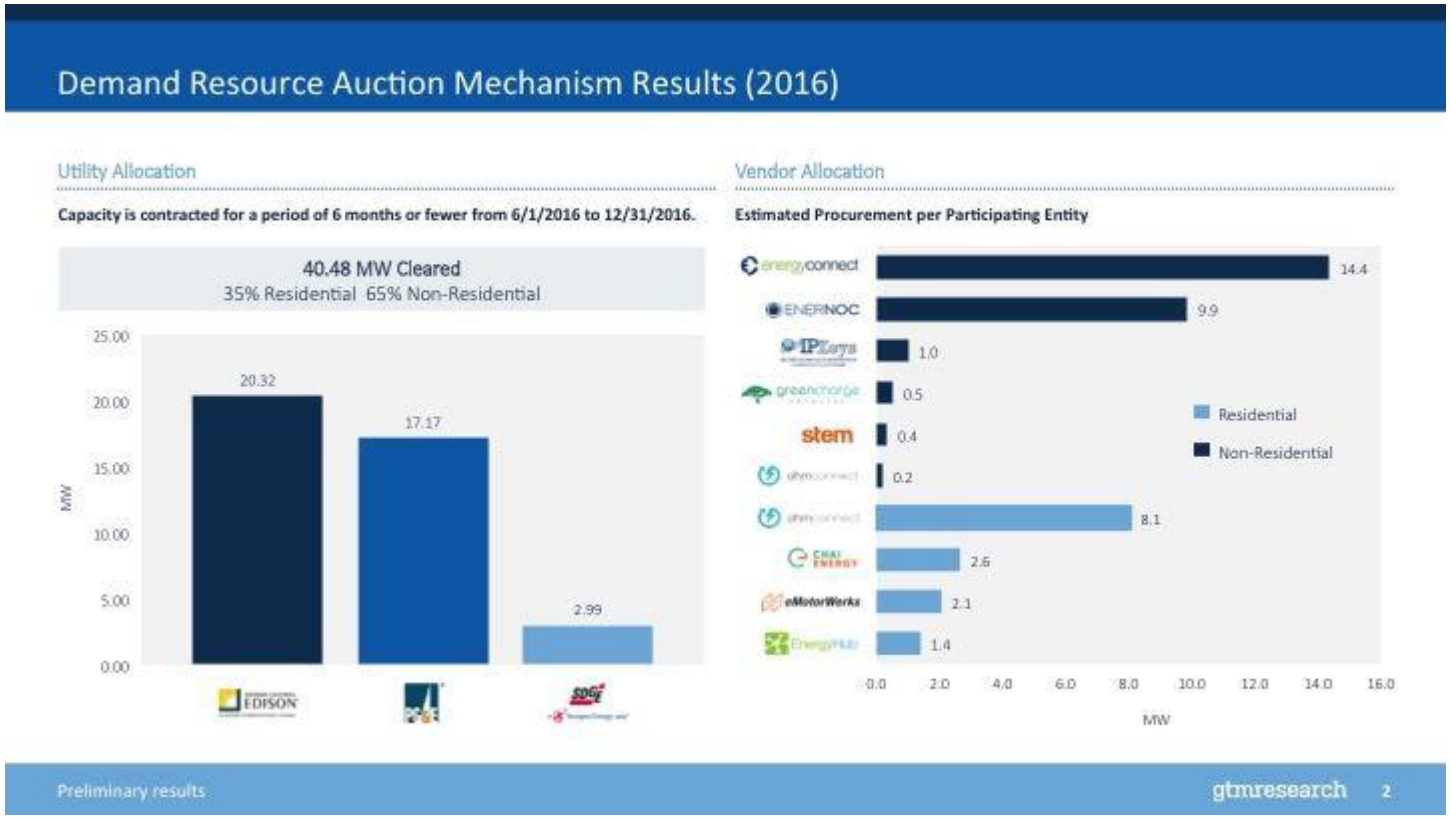
Model 1: Single party tenders offer certainty for both parties – useful in DER markets where there isn't sufficient existing resource

Aurora ENERGY	Need confidence that someone will invest in DER to defer upgrades to remedy the the forecast network need
SOLARZERO	Need confidence that they will make a return in order to establish a DER portfolio

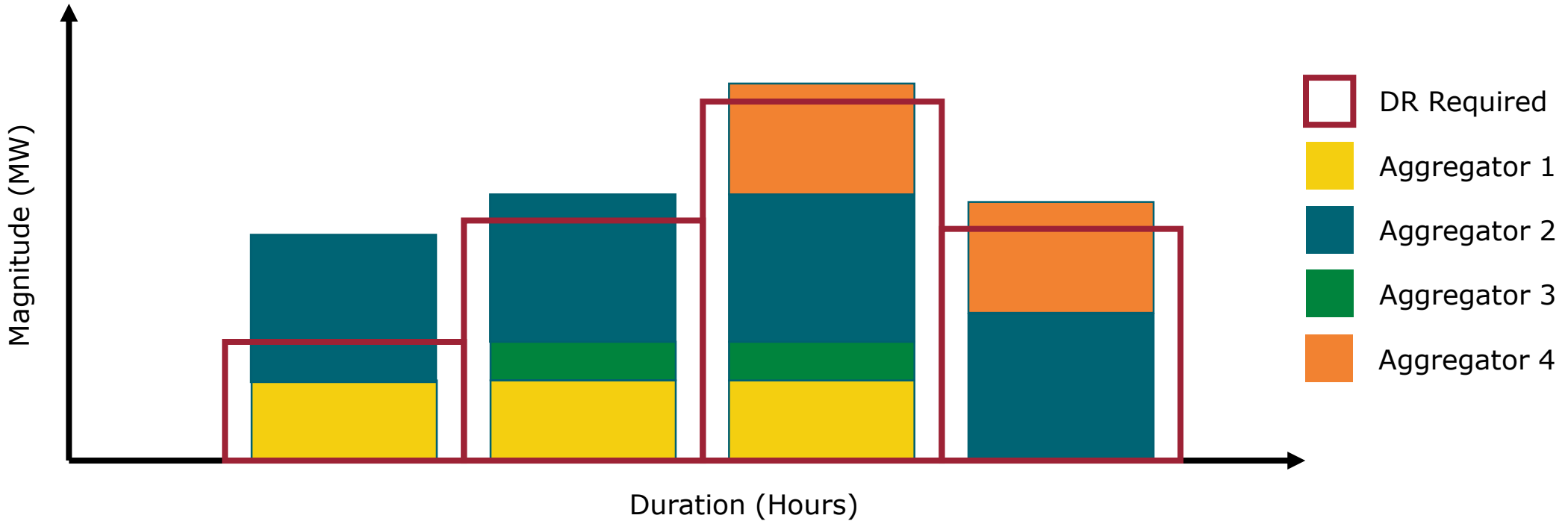
Model 2: Multi-Party tenders allow contracting for a portfolio of different resources

- Transpower's platform can operate a more sophisticated dispatch system
- Allows access to lower cost, more flexible portfolio of resources
- Weighs resources of different capacity, duration, and cycle rate capabilities
- Encourages competition between aggregators while providing some certainty

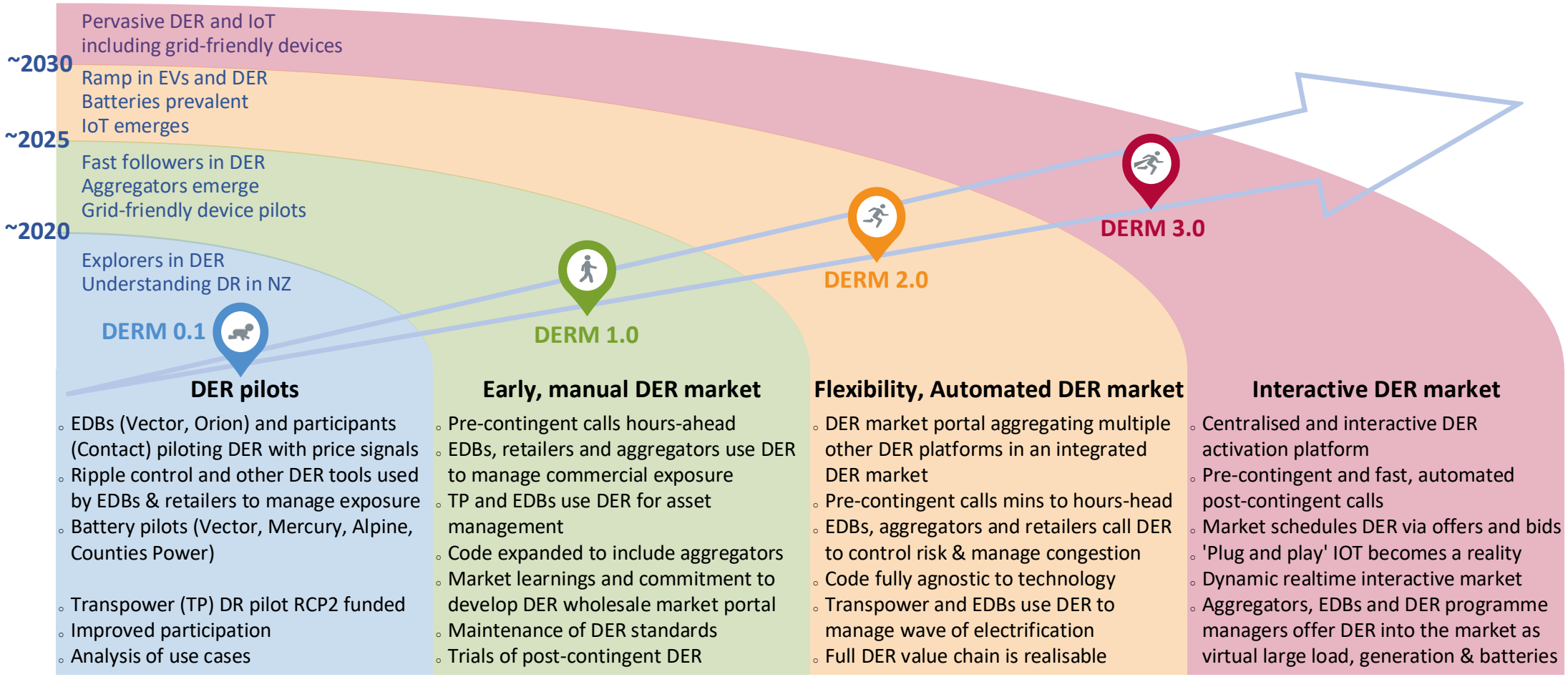
California's DRAM demonstrates multi-utility multi-vendor tendering



Model 3: Auctions allow for increased competition between aggregators and in markets with large amounts of existing DER



Different procurement methods are most appropriate at different levels of market maturity



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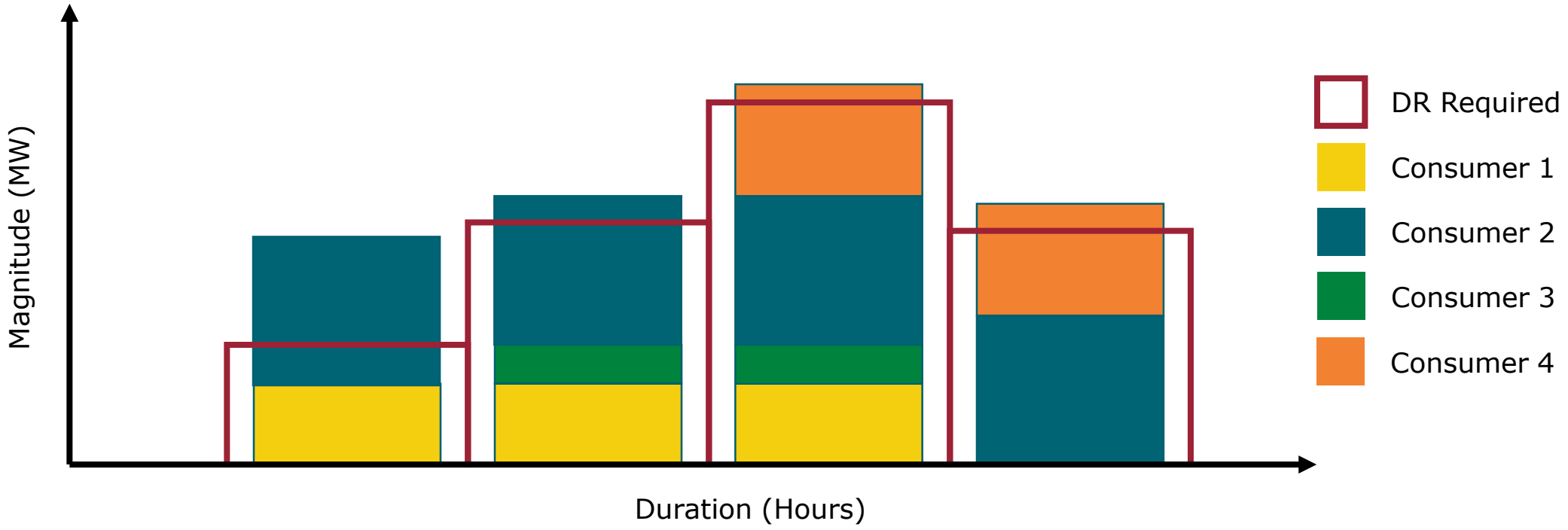
Action 5.3: Transpower to explain its approach to avoiding squeezing out commercial aggregators

- In RCP2 Transpower's demand response trial programme contracted directly with electricity consumers in order to investigate how demand response programmes could best be delivered.
- Investigations explored contracting arrangements, pricing structures, call obligations, behaviour base-lineing etc
- In RCP3 Transpower's Grid Owner will only contract for demand response where transmission deferral is the most economic option
- Transpower will procure all transmission deferral Non-Transmission Solutions through competitive processes

Action 5.3: Transpower to explain its approach to avoiding squeezing out commercial aggregators

- Aggregators and EDBs are free to use any software to run their programme so long as it uses industry standard communications protocols (ADR 2.0/DREDS) when communicating with Transpower's platform to participate in auctions
- However the platform that Transpower uses to select and dispatch aggregators could also be used by aggregators to select and dispatch resources
- Transpower intends to offer our software to EDBs so that they can run their own auctions, and to aggregators so that they can coordinate their respective resources
- By offering this software alongside the expertise that we have built during the trial, we will lower the barriers to entry for EDBs and Aggregators which will lead to more competitively priced non-transmission solutions

The software which Transpower uses to select and dispatch aggregators can also be used by aggregators to select and dispatch consumers



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Transmission deferral opportunities identified in the TPR

DR Opportunity	Grid Need	Need Date
Wiri supply supply capacity	Transformer overload	Customer Decision
Tauranga / Mount Maunganui regional supply	Line overload	2023-2025
Rotorua – Tarukenga transmission capacity	Line overload	Inv. Ongoing
Lower Waitaki transmission and supply capacity	Line and Transformer overload	Inv. Ongoing
Studholme supply security	Transformer overload	Customer Decision
Frankton transmission and supply capacity	Line and Transformer overload	Inv. Ongoing
Orari and Rangitata bussing	Voltage stability	2027-2030

Full list: https://www.transpower.co.nz/keeping-you-connected/industry/transmission-alternatives

Example: Wiri Transformer Overload

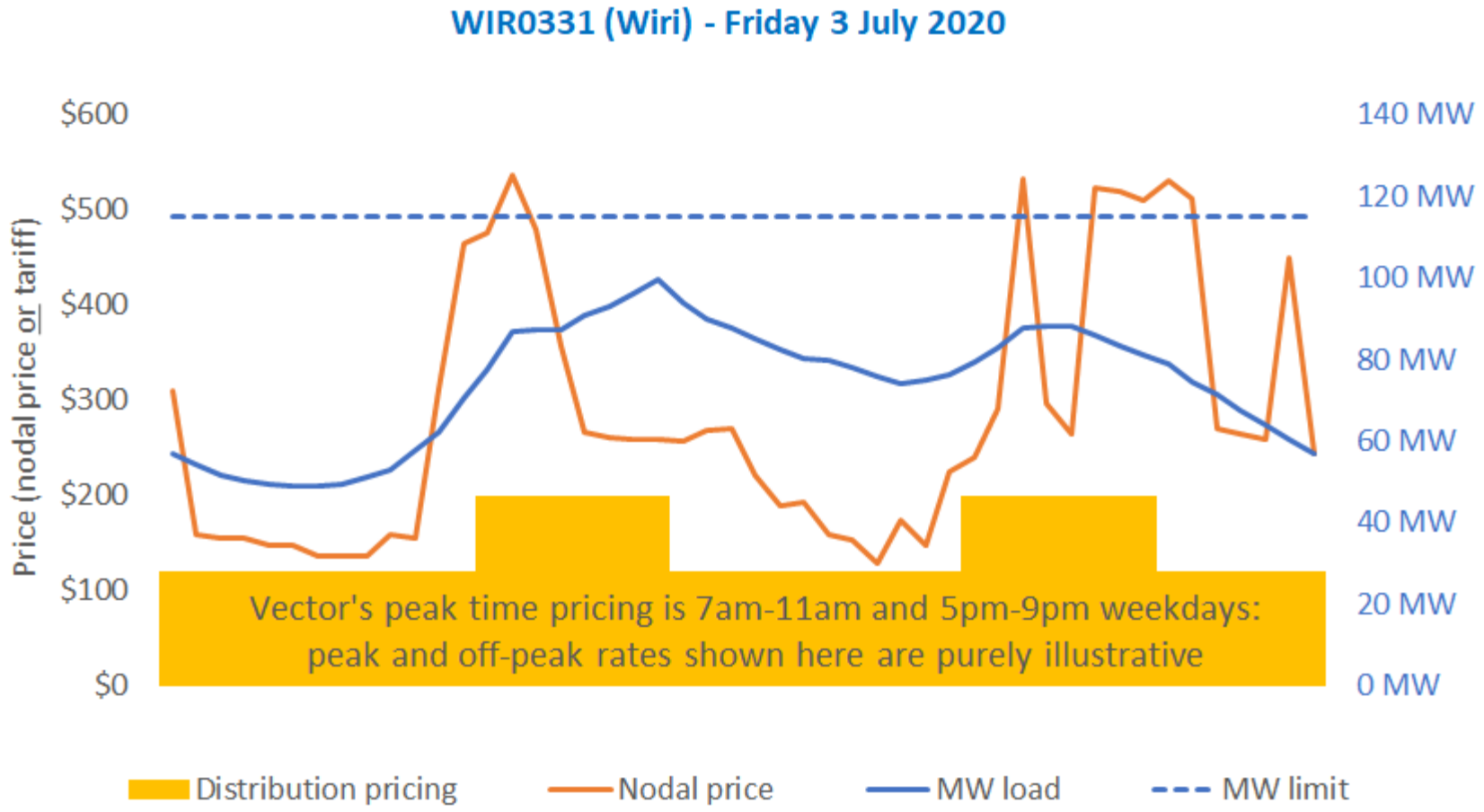
- Wiri, close to Otahuhu in South Auckland, is a GXP substation providing Vector with supply
- Wiri provides a good example of a potential DERM use case
- It has been identified in Transpower's Transmission Planning Report (TPR) 2020 as:
  - Peak load at Wiri will exceed the winter n-1 capacity of the transformers in 2022
  - Transpower is discussing medium to long term investment options to resolve the supply transformer capacity issue with Vector
  - In the medium-term, the supply capacity issue could be managed by installing an SPS or DERM
  - In the long-term, the possible option is replacing both supply transformer units with higher capacity units

Table 8-10: Wiri supply transformer overload forecast — **From TPR 2020**

Grid exit point	Transformer overload (MW)											
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035
Wiri	0	0	4	7	10	10	11	11	12	12	13	20

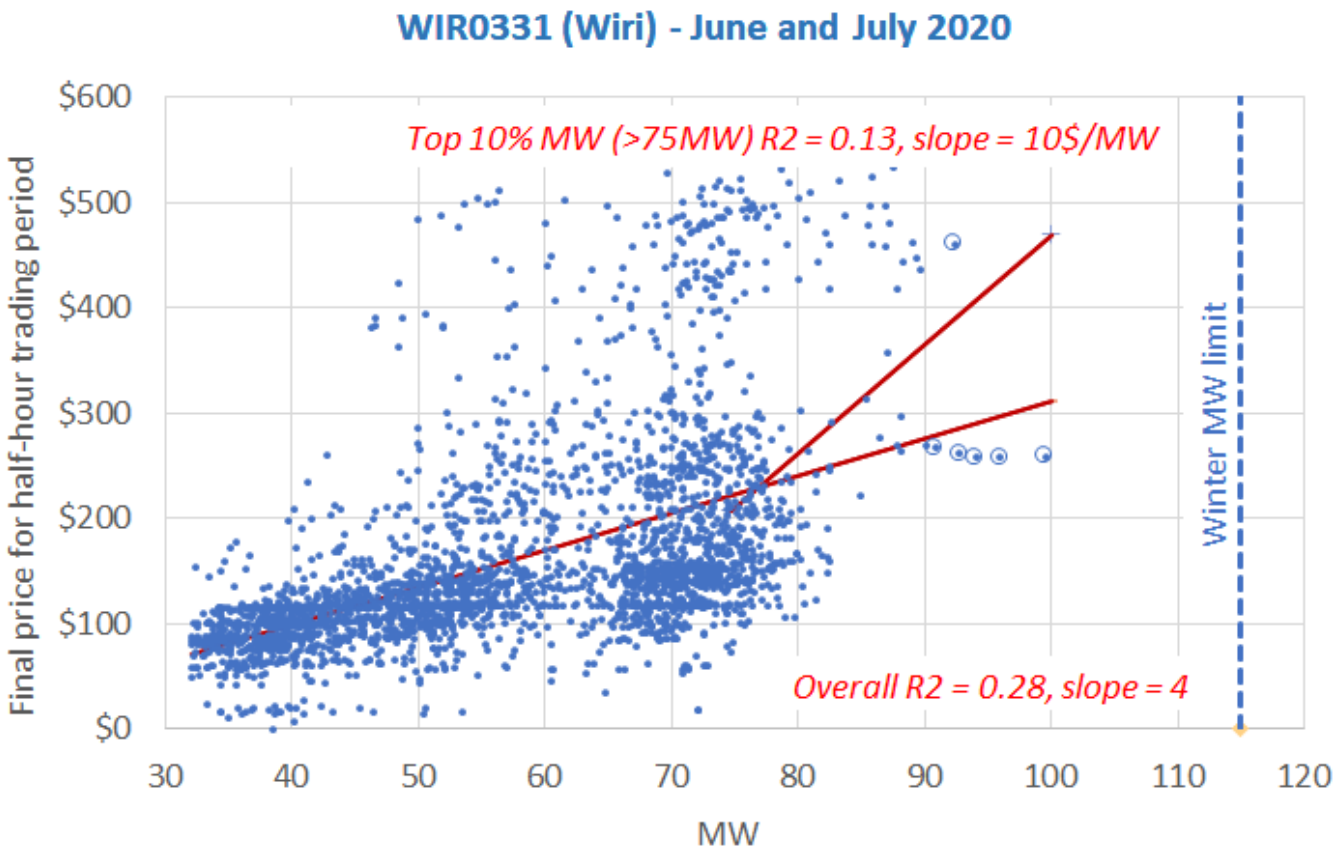
Nodal prices and TOU tariffs do most of the work

- In 2020, Wiri's maximum load during June and July load was on 3 July
- As illustrated here, both nodal prices and Vector's peak time pricing give signals to shift load off-peak
- Any role for DERM as load approaches the limit would be to 'top up' rather than replace those price signals



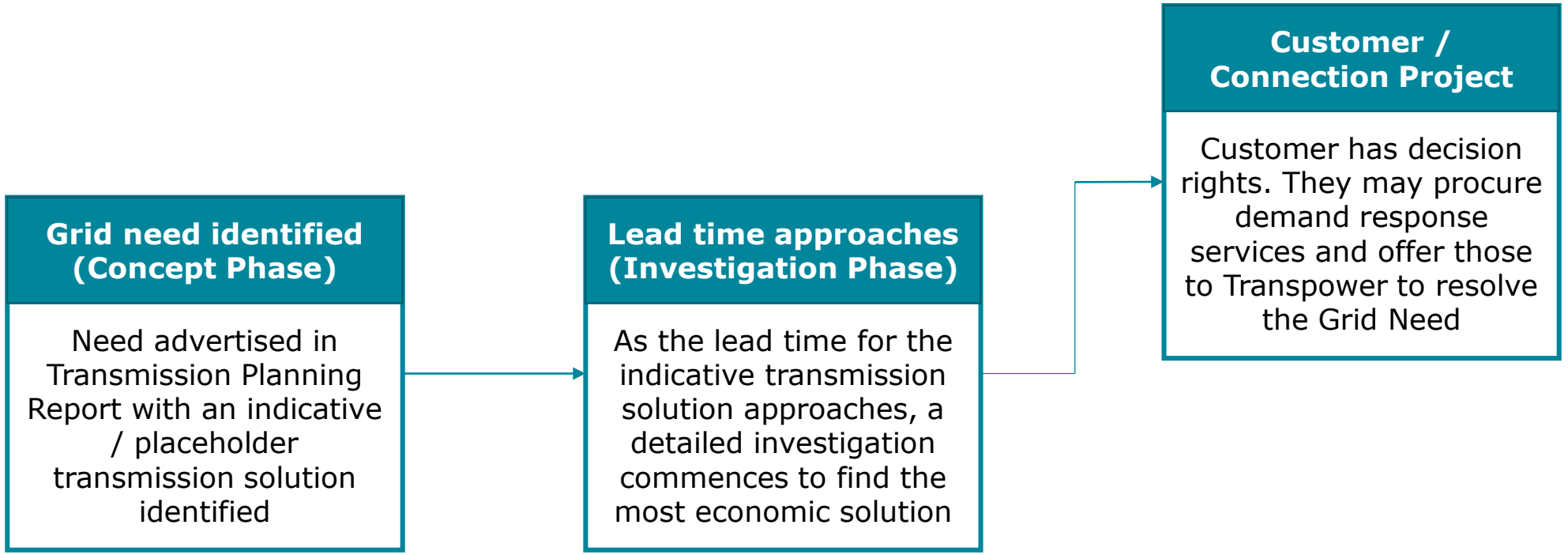
DERM can 'top up' nodal prices to help defer network investment

- This graph shows the load to nodal price correlation at Wiri
- DERM can add value by capping demand on occasions where the nodal price is not high enough to (e.g. the five circled lower-right data points)
- As an illustration of the effect of RTP, as load grows and starts exceeding the limit, one can imagine that if load growth was such that the six circled data points exceeded the MW limit, then the Wiri price for them would jump to a scarcity price of $10,000*
- DERM could be used to keep load within limits, avoiding the scarcity price too



- *$10,000/MWh is the value for the first 5% tranche from the Authority's RTP consultation paper*
- Price, and the avoidance of scarcity pricing will not be a driver for Transpower DR calls – TP DR calls are only called for transmission deferral

RCP3 – Transpower tenders for Non Transmission Solutions to discover price and feasibility – selects most economic option



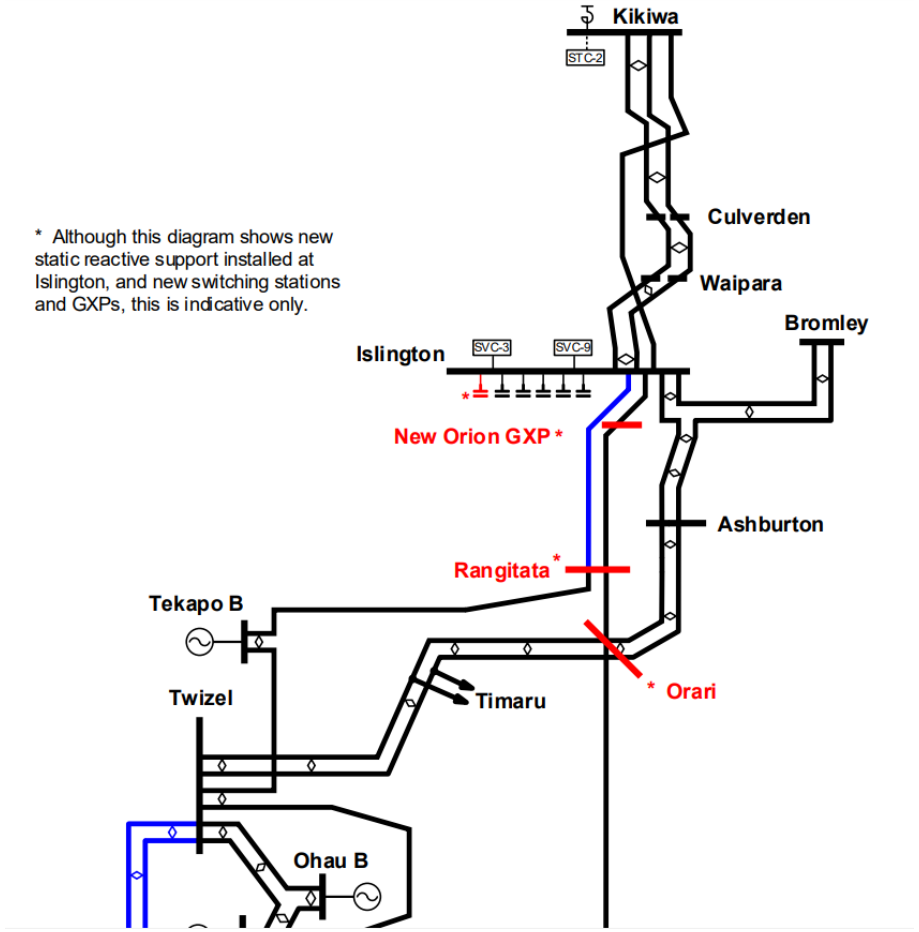
Has been recorded in TPR for as long as we've called it the TPR (at least since 2013)

Investigation ongoing

Decision rights sit with Vector

Example: Upper South Island Voltage Stability (Orari and Rangitata bussing project)

- There are few synchronous generators in the Upper South Island meaning that the region requires extensive reactive support
- Alongside static reactive support, Dynamic Reactive Plant at both Islington and Kikiwa help to manage voltage stability in the region
- As load grows, it becomes more difficult for this Dynamic Reactive Plant to maintain stability and could cause voltage stability issues at high load times
- The most economic transmission solution to this problem is to bus several lines together in South Canterbury to shorten the 'electrical distance' between generators and load centres
- The timing of this investment is driven by the aggregated peak demand of all load centres north of Tekapo



Example: Upper South Island Voltage Stability (Orari and Rangitata bussing project)

- While first forecast to breach the load limit in 2011, unexpected growth patterns in the USI mean that we expect the project will now be required between 2027 and 2030
- As the cut-off date for intervention approaches, we will tender for Non-Transmission Solutions to the issue
- There is a significant amount of load shedding capability in the Upper South Island which might be able to be incentivised to shave peaks for a lower cost than building a transmission solution
- If this is the case following the tender, then we would engage the aggregator of that demand under a Grid Support Contract to guarantee us deferral of the $82M project. At a WACC of 4.65%, a Transpower contribution of up to $3.7M per year would be economically efficient in that case

Major Capex investment

Project Name	Upper South Island voltage stability
Project description:	Build Orari and Rangitata switching stations, bussing 220 kV circuits from the Waitaki Valley. Uprate the Islington–Rangitata circuit.
Project's state of completion	Possible
OAA level completed:	AL 4p
Grid need date:	2027
Indicative cost [$ million]:	$82 ($72 million for the Orari and Rangitata switching stations and $10 million for uprating the Islington–Rangitata circuit uprating)
Part of the GEIR?	No

RCP3 – Transpower tenders for Non Transmission Solutions to discover price and feasibility – selects most economic option

Has been recorded in TPR for as long as we've called it the TPR (at least since 2013)

Grid need identified (Concept Phase)

Need advertised in Transmission Planning Report with an indicative / placeholder transmission solution identified

Investigation well developed, awaiting trigger

Lead time approaches (Investigation Phase)

As the lead time for the indicative transmission solution approaches, a detailed investigation commences to find the most economic solution

Decision based on outcome of Grid Investment Test, administered by Transpower and approved by the Commerce Commission

Interconnection Project

MCP Investigation tenders for "Non-transmission solutions". The highest net-benefit solution (Tx or NTS) is selected

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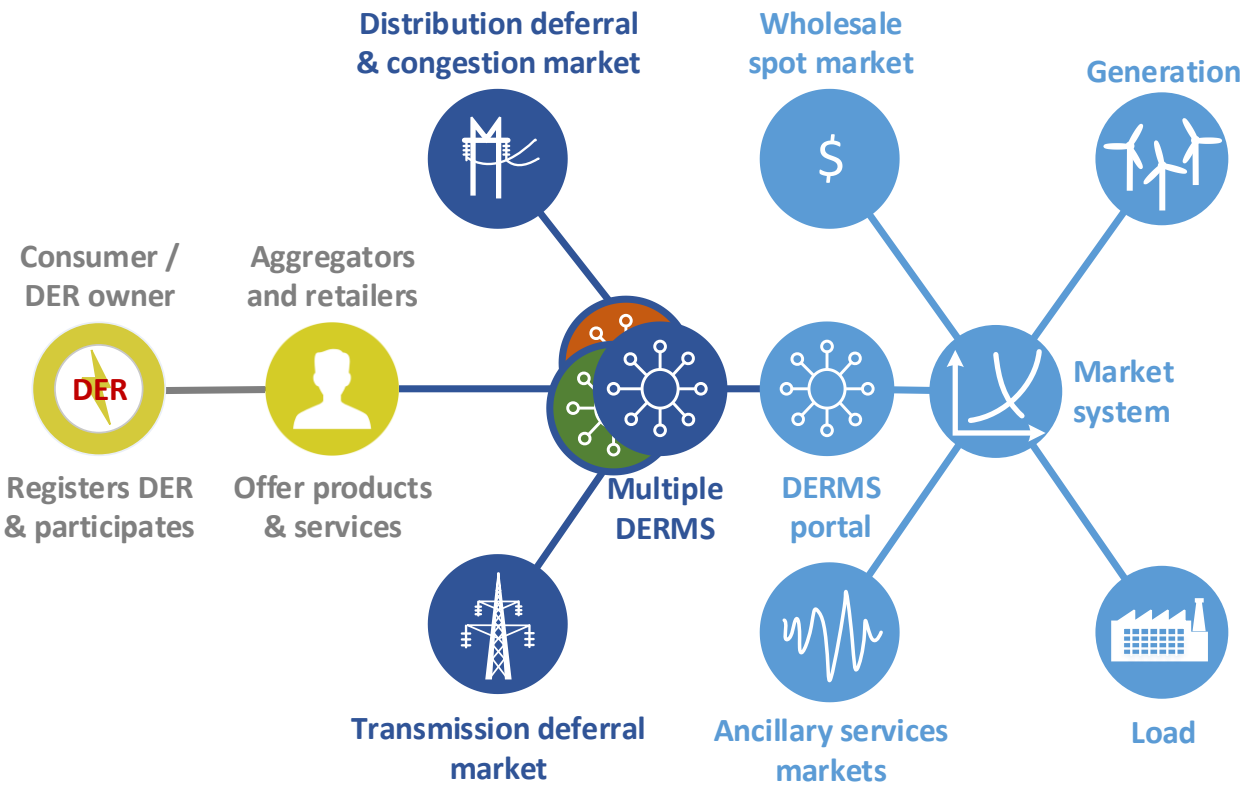
Action 5.4: Transpower to unpack the functionality necessary for each of the components of the multiple DERMS model

- The market could develop in different ways in future to enable value stacking
- Another model would be that of a single 'wholesale' DERMS portal or gateway for DER to access the spot and ancillary service markets through the market system, providing equal access to multiple other 'retail' DERMS
- It would have the functionality of a fully DER-capable market system, but be simpler (and probably significantly cheaper) to build, as a simple extension of existing DERMS technology and market rules

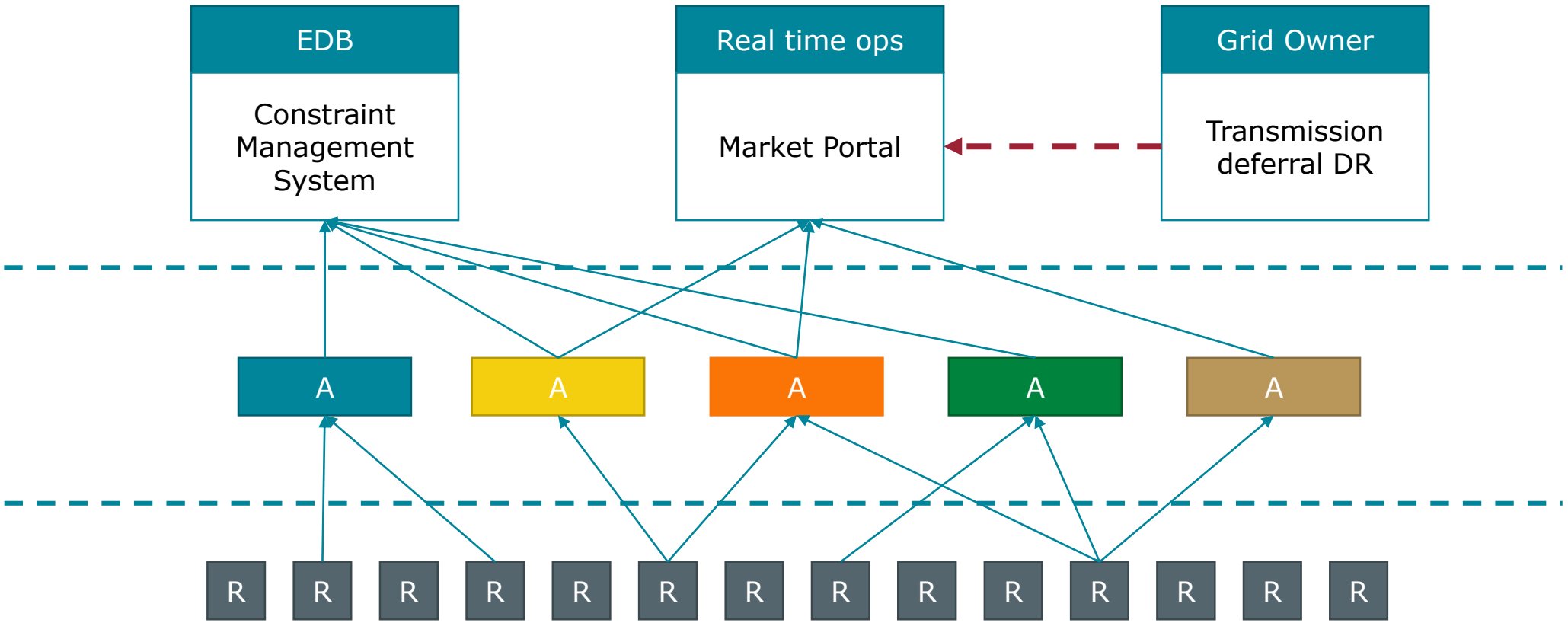


Action 5.4: Transpower to unpack the functionality necessary for each of the components of the multiple DERMS model

Networks
Need flexibility management system

Aggregators
Need Distributed Energy Resource Management System

Resources



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