TRANSPOWER

Distributed Energy Resource Management Briefing to IPAG #6

Stephen Jay, Murray Henderson, Richard Hobbs, Nicolas Vessiot, Simon Murrow – 28 September 2021

Agenda

1. Introduction
2. Market Participant compliance and assurance
3. EV Connect submission (continued)
4. The process for procuring flexibility services
5. Grid Support Contracts in practice
6. The contractual requirements of Grid Support Contracts
7. Discussion and Next Steps

Transpower's proposals for DERM discussions with IPAG

22 July 2020	21 October 2020	1 December 2020	27 January 2021	February & March 2021	August 2021	September 2021
• Introduction • Transpower's RCP2 DR programme • Transpower's flexibility platform	• RCP2 outcomes • Mechanics of our flexibility platform • Operationalising flexibility: overview	• Value stack and pricing interactions • Operationalising Grid Owner flexibility • Flexibility market development issues	• Procurement of NTS • MCP Process • Terminology	• Cost allocation • NTS tenders • Auctions vs Tenders • Aggregator competition	• Operationalising flexibility • International DSO examples	• Market participant compliance and assurance • International DSO Examples • Grid Support Contracts

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

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

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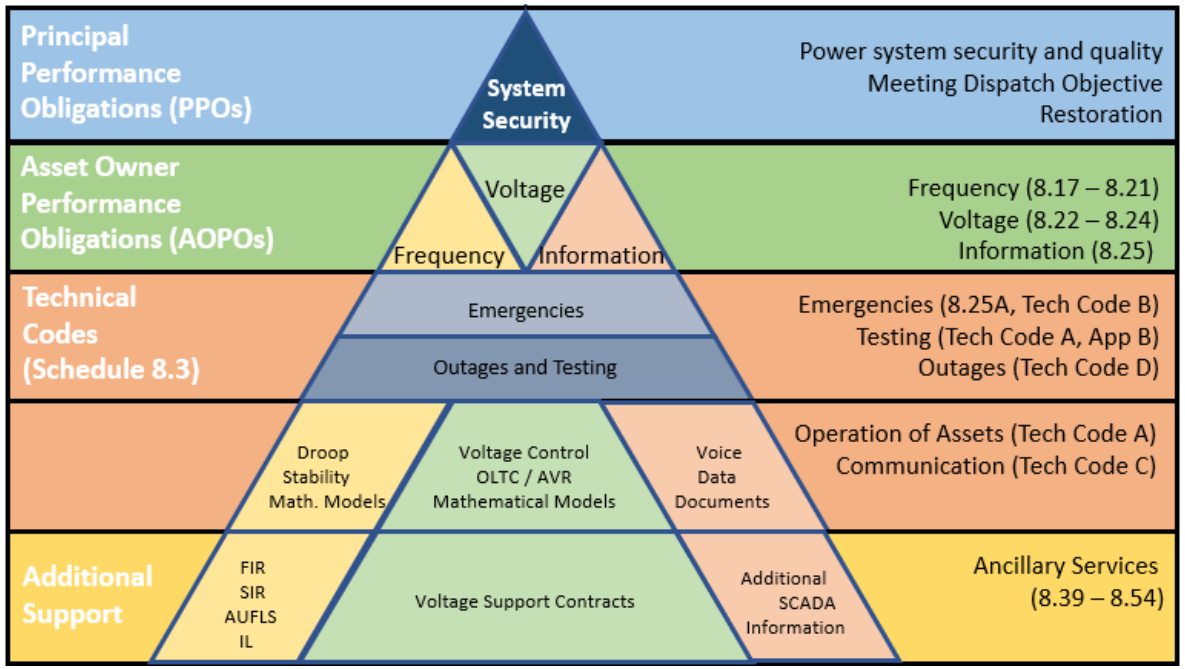
SO sources products that enable three key value streams

Value Stream	#	Accessible through[1]	Value Stream Enabler
Transmission deferral and congestion management	1	Grid Owner flexibility procurement	Grid Owner
	2	Nodal pricing	EA / System Operator
	3	Transmission pricing	EA / Grid Owner
Distribution deferral and congestion management	4	Distribution Network Owner flexibility procurement	Distribution Network Owner
	5	Distribution tariffs	EA / Distribution Network Owner
Ancillary services	6	Reserves market	EA / System Operator
	7	Frequency keeping market	EA / System Operator[2]
Energy services	8	Direct wholesale participation	EA / System Operator
	9	Indirect wholesale participation	EA / System Operator
	10	Self consumption	Retail Provider[3]

1,2,3: See notes in Appendix

System Operator needs to maintain System Security

- System Operator has Principal Performance Obligations (PPOs) under the Code to maintain System Security
- To assist the System Operator to achieve their PPOs:
  - Asset Owner Performance Obligations are placed on generators, connected parties, and the Grid Owner, and
  - A compliance framework exists within the Code which covers the accuracy of information provided to the System Operator and dispatch compliance



NB all layers are 'physical' attributes
SO compliance interactions are 'physical' not financial

Products and services the System Operator schedules

Category	Product or service	Provider(s)	How sourced	Payment
Energy services	Generation	Generators	Wholesale market	Market clearing - delivered
	Dispatchable Demand	Load	Wholesale market	N/A
Ancillary services	Frequency keeping	Generators	Frequency keeping market	Market clearing
	Instantaneous reserves	Generators and load	Reserves market	Market clearing- availability
	Over frequency reserves	Generators	Tender	Contract
	Black Start	Generators	Tender	Contract
	Voltage support	Generators and load	Tender	Contract

Products and services delivery assurance

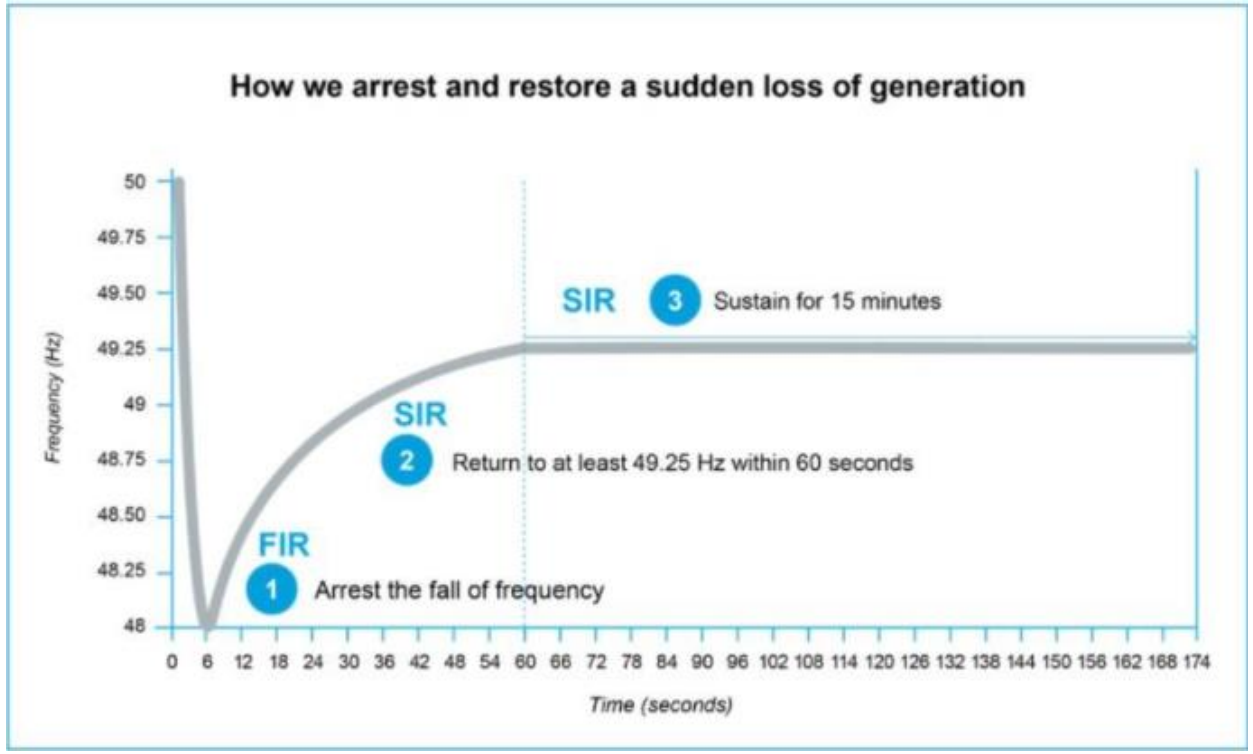
Category	Product or service	Pre-use assurance	Ongoing assurance
Energy services	Generation	Commissioning process	Visibility Compliance regime
	Dispatchable Demand	Approval process	Visibility Compliance regime
Ancillary services	Frequency keeping	Testing Approval process	Visibility Performance assessments Contractual
	Instantaneous reserves	Testing Approval process	Performance assessments Compliance regime Contractual
	Over frequency reserves	Testing Approval process	Testing Contractual
	Black Start	Testing Approval process	Testing Contractual
	Voltage support	Testing Approval process	Testing Contractual

Dispatchable demand – a brief dive

- No paid demand side energy product in NZ wholesale electricity market
- Eligible for constrained on and off payments
- No current participants
- RTP project changes – future focussed
  - Moving to real-time
  - Co-optimisation with interruptible load
  - Binary load optimisation
  - Look out for next RTP briefing

What compliance and assurance requirements are there for Instantaneous Reserve Market Participation?

- Covered by the Code, Procurement Plan and Testing Guidelines
- Reserve market is paid for availability
- Instantaneous reserve has a critical job to perform
  - FIR arrests frequency collapse
  - SIR restores frequency
- Underperformance has resulted in:
  - Reduction in allowable offer quantities
  - Clawback of availability payments



What compliance and assurance requirements are there for Instantaneous Reserve Market Participation?

- Covered by the Code, Procurement Plan and Testing Guidelines
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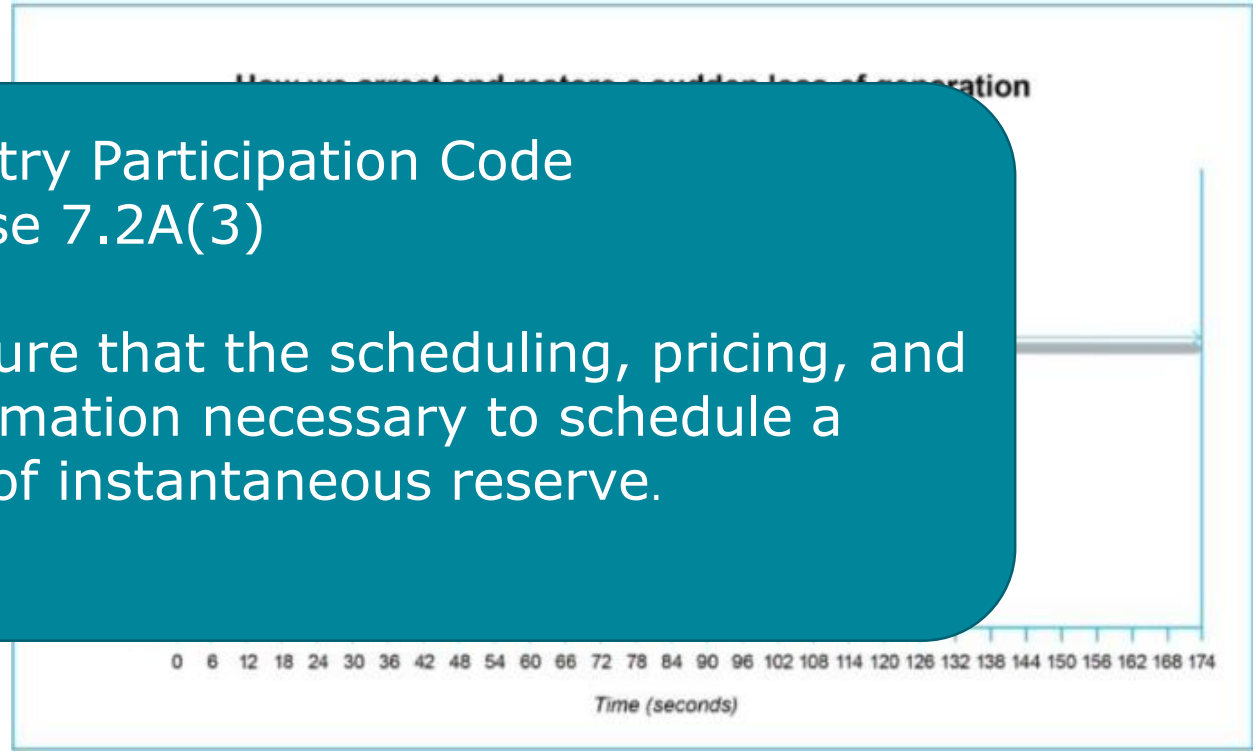
- Instanta
  to perfor
  - FIR ar
  - SIR re
- Underperf
  - Reduction in allowable offer quantities
  - Clawback of availability payments

Electricity Industry Participation Code
clause 7.2A(3)

The system operator must ensure that the scheduling, pricing, and dispatch tool has the information necessary to schedule a minimum quantity of instantaneous reserve.



Comparison of the real-time 'safety nets'

Safety nets	Energy services	Frequency keeping	Instantaneous reserves
	Frequency keeping	Frequency AOPOs	Frequency AOPOs
	Frequency AOPOs	Visibility	AUFLS
	Visibility	Re-dispatch	
	Re-dispatch	Instantaneous Reserves	
	Instantaneous Reserves	AUFLS	
	AUFLS		

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Unlocking the value stack – Providing DER with access to value

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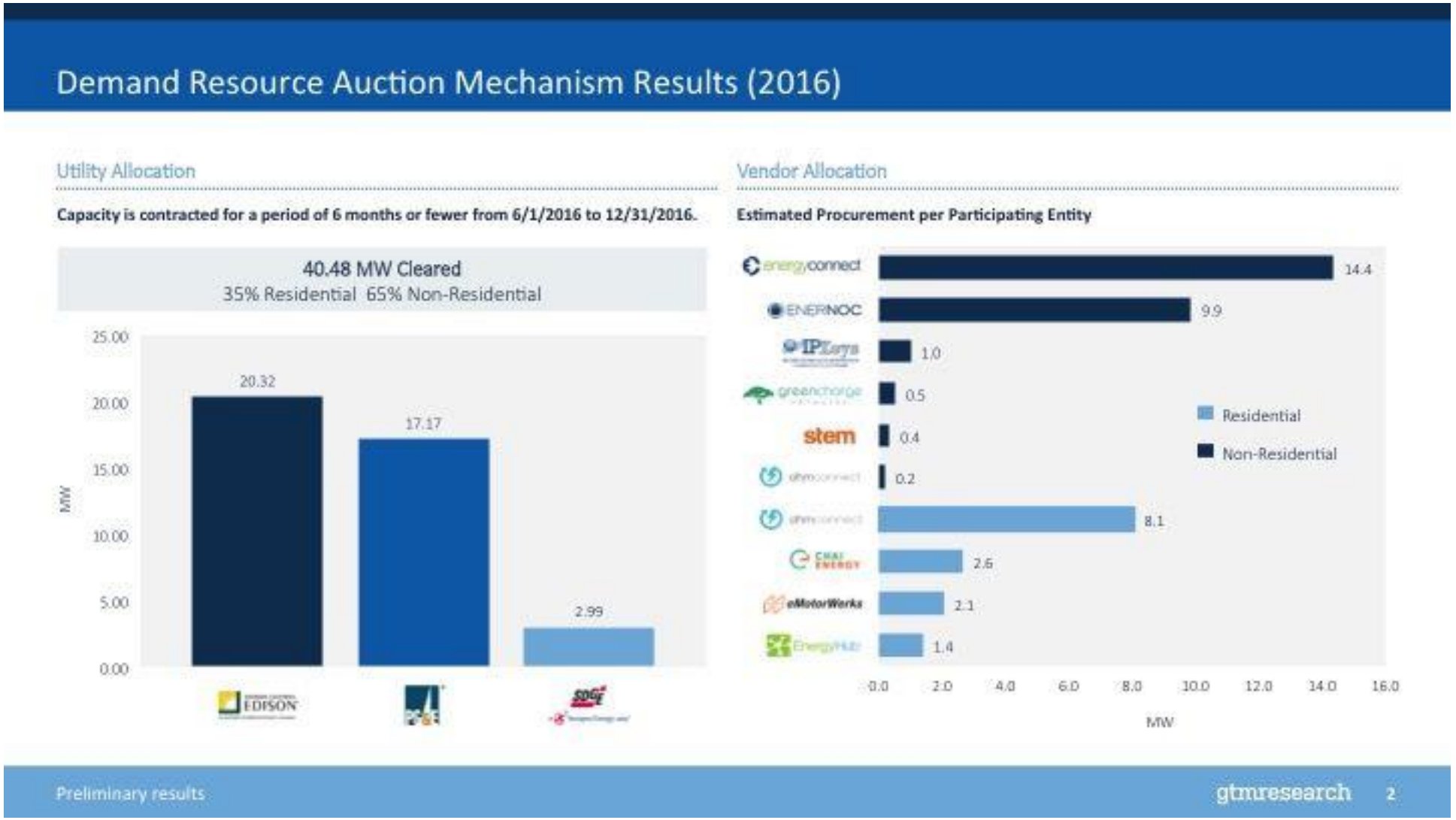
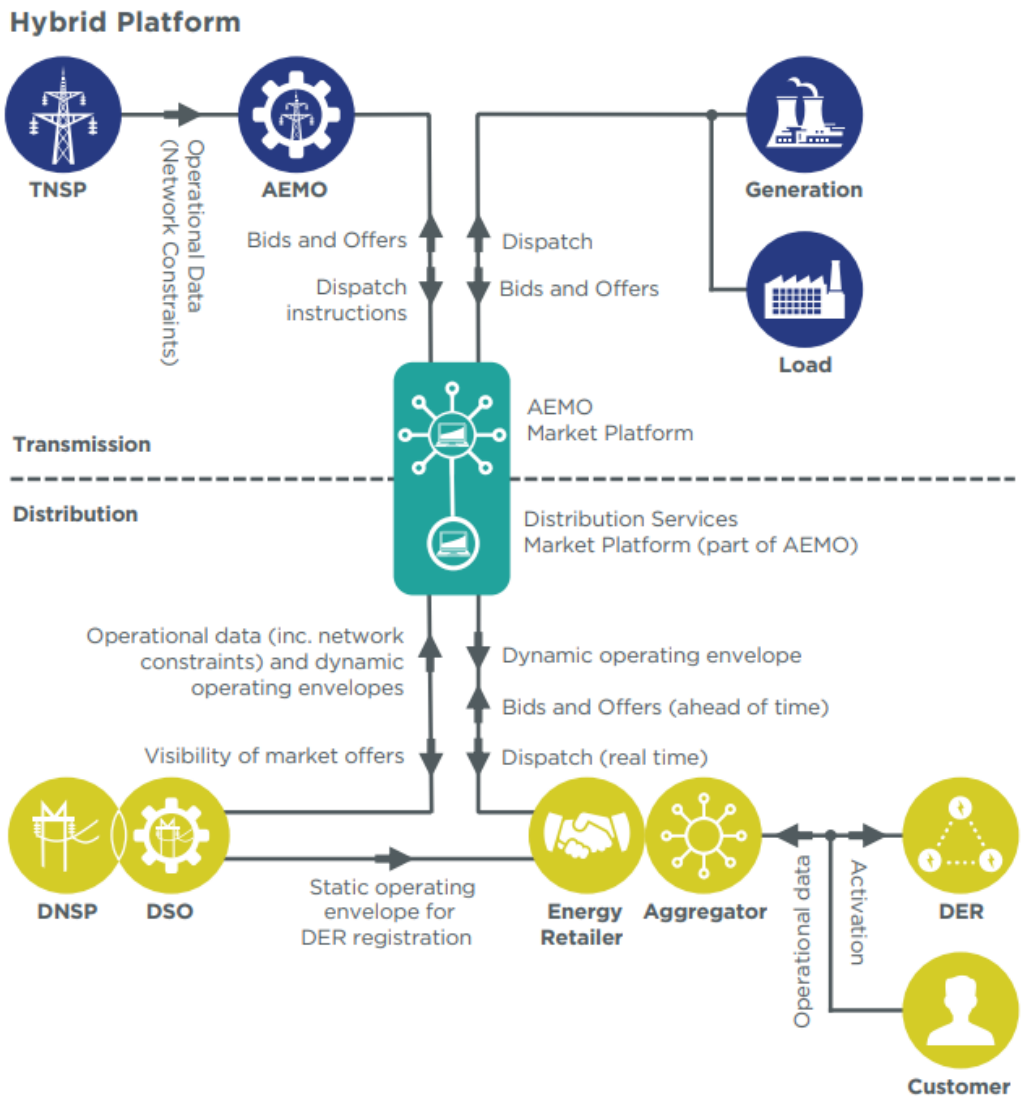
1,2,3: See notes in Appendix

International examples demonstrate different potential models: California DRAM: Network deferral / congestion

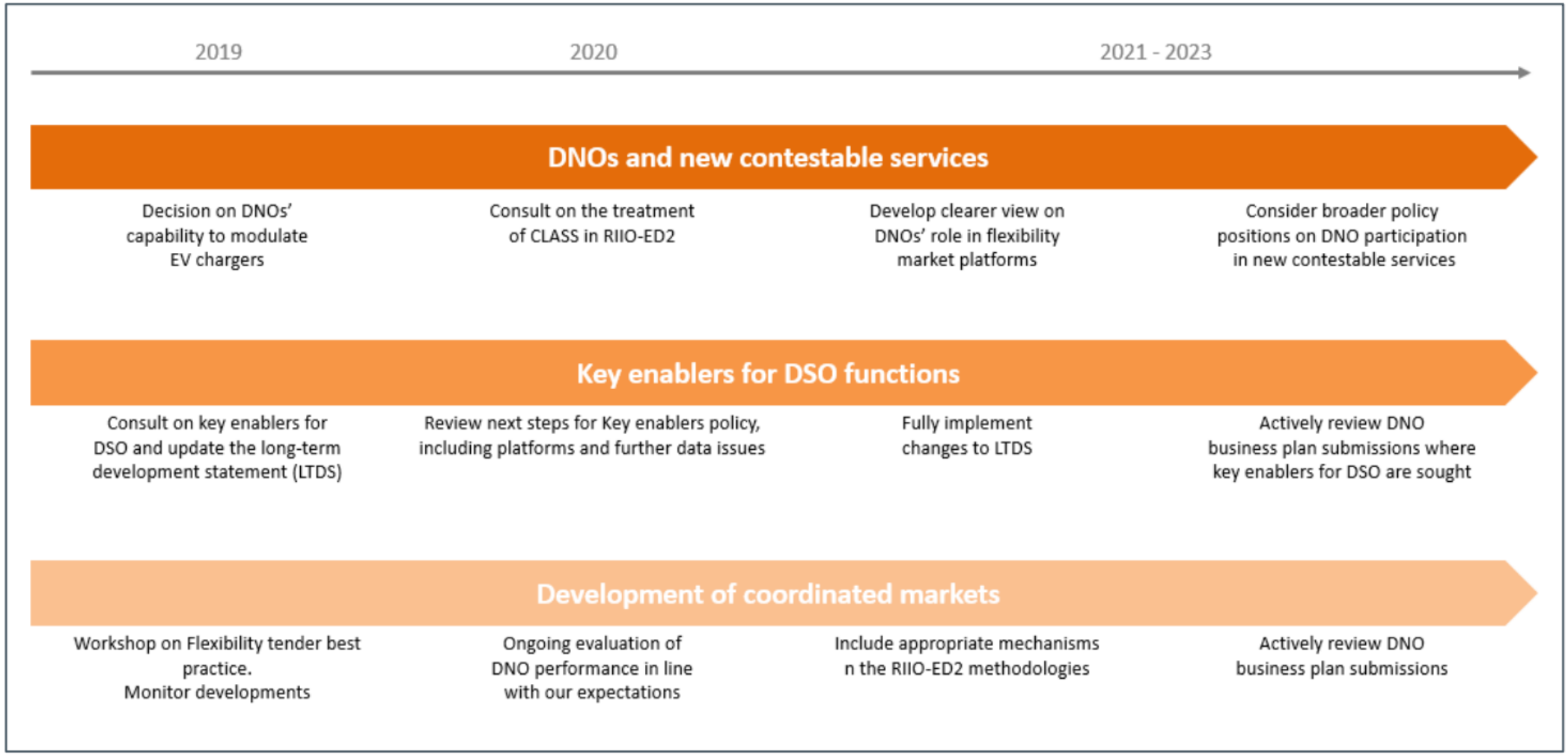


International examples demonstrate different potential models: Western Australia DERP: DER Integration and system stability



Key characteristics	
Market arrangments	» There is a two-sided market platform, comprised of wholesale and ancillary services that is organised and operated by AEMO » Market participants, including DER via aggregators/retailers, submit bids and offers for system services to the market platform which in turn makes them available to AEMO for whole system optimisation
AEMO	» AEMO organises the operates the market » AEMO assesses all bids and offers and optimises the dispatch of energy resources considering T-network and D-network constraints » AEMO sends out dispatch instructions to energy resources, including DER via their respective Aggregator/Retailer
DSO	» DSO provided DER with static operating envelopes based upon the technical capability forecast of the D-network to accommodate DER dispatch » The DSO assesses market bids and D-network constraints to generate dynamic operating envelopes for DER which respect distribution network constraints and inform their technical and commercial offering to the markets
Aggregator / Retailer	» Aggregator/Retailer combines different DER and offer their aggregated output as system services to the market platform

International examples demonstrate different potential models: UK Flexibility Markets: DER integration, system stability, and congestion management



https://www.ofgem.gov.uk/publications/ofgem-position-paper-distribution-system-operation-our-approach-and-regulatory-priorities

Industry collaboration is essential

- Alongside the market architecture and high level design considerations outlined in the international examples, there are also lessons in the need for information sharing, standards, and market settings that enable open access for DER owners
- The introduction of models to realise the value stack in other jurisdictions has required collaboration across industry and regulators
- Processes followed in both Australia and the United Kingdom provide examples of how an industry working group, comprised of regulators, the System Operator, transmission grid owner/s, and representatives of the distribution sector provides the perspectives and expertise that are required to successfully enable DER to realise its full potential
- In addition to these parties, inclusion of potential flexibility market participants in any working group could even further improve outcomes

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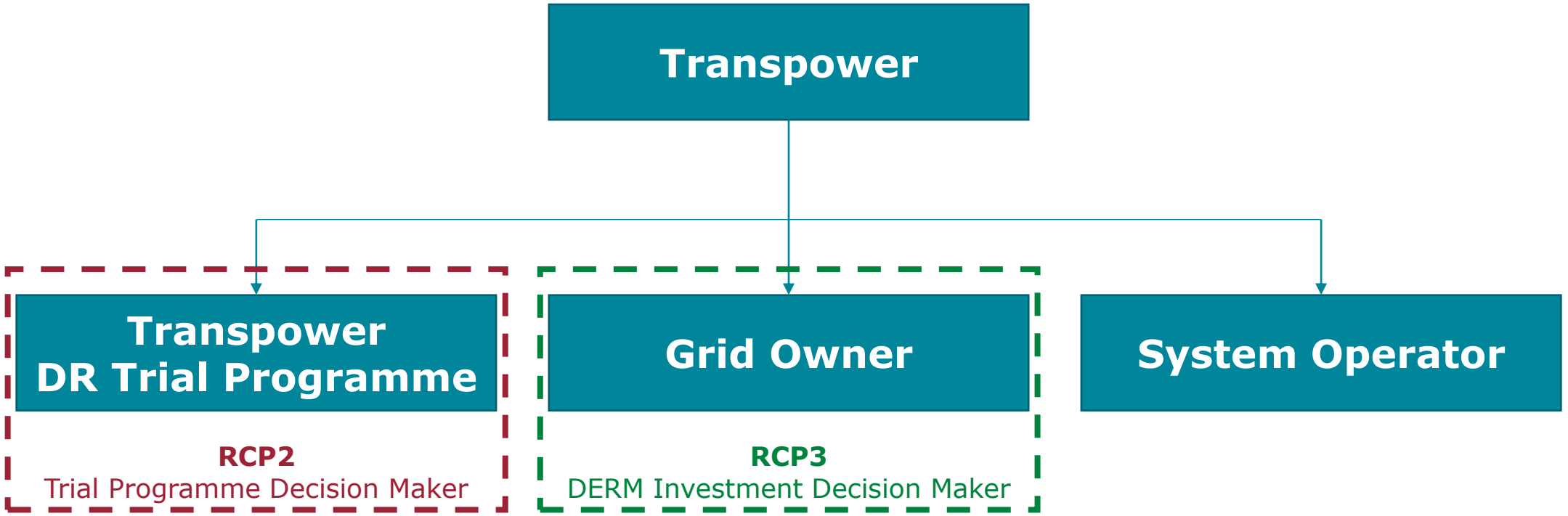
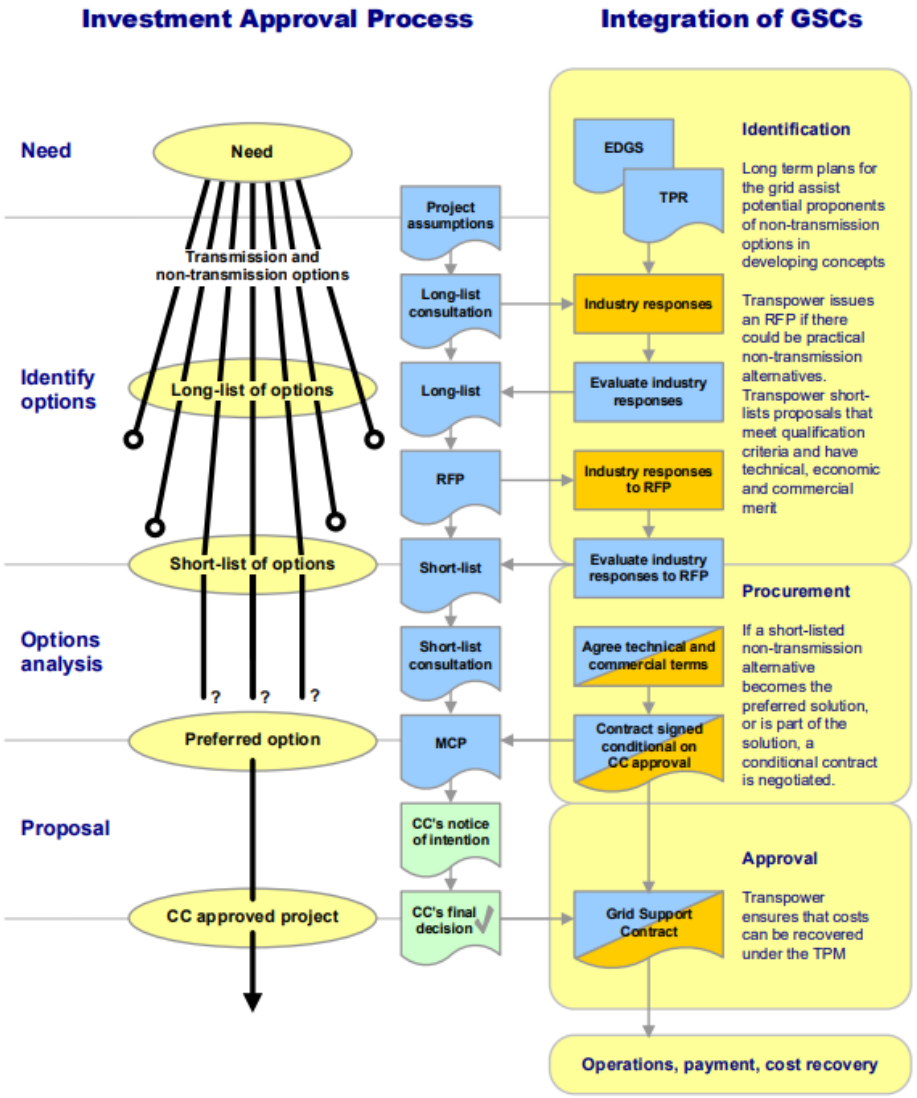
Flexibility services would be procured by the Grid Owner via Grid Support Contracts like any other non-transmission solution



Grid Support Contracts are considered as part of the investment approval process and compete against other options



Source - [Grid Support Contract Design Guidelines]

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Contact Energy: Otahuhu Synchronous Condensers (2010)

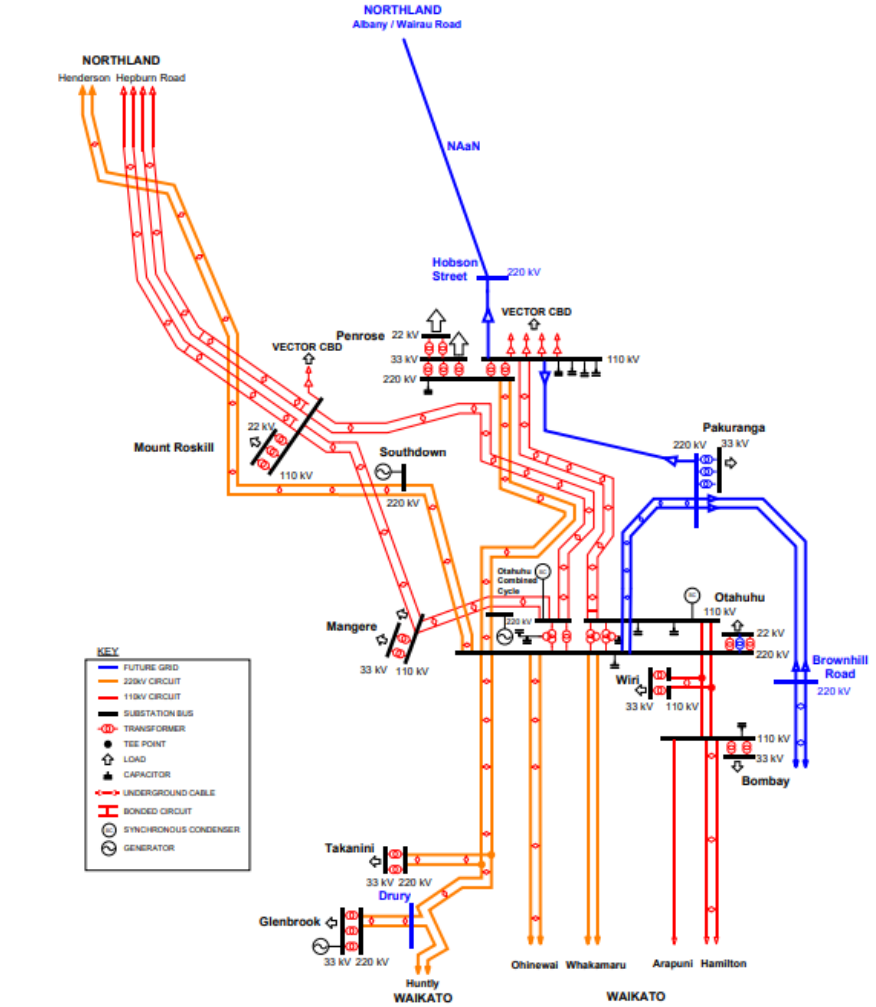


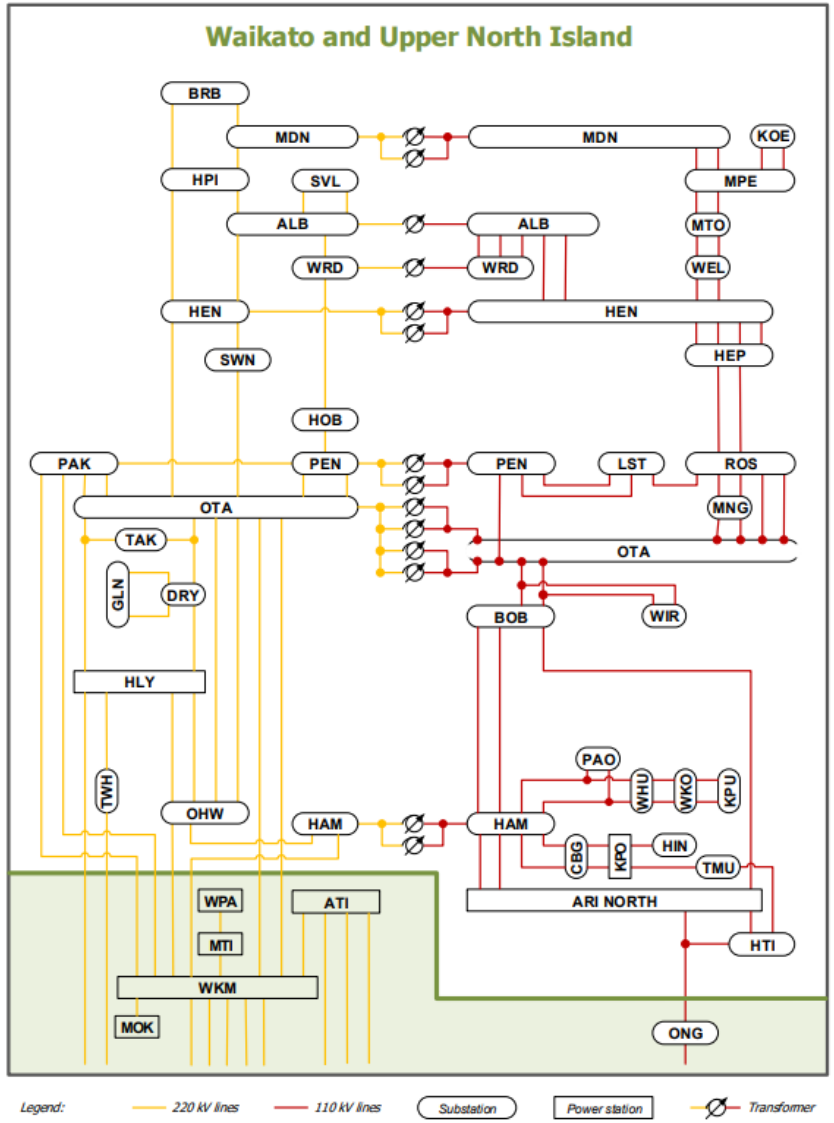
Figure 3: Auckland 220 kV and 110 kV schematic

Options Analysis

Table 1-1: N-1 Development plans

Development Plan Reference	Description
DP1	STATCOMs are built at UNI GXPs as needed
DP2	The Penrose 33kV bus is split and additional and/or replacement 220/33kV transformers are installed at Penrose. STATCOMs are built as needed.
DP3	Four of the Otahuhu synchronous condensers are contracted until the end of 2015. The remaining Otahuhu synchronous condenser is retained as back up for the other four. STATCOMs are built at UNI GXPs as needed.
DP4	Four of the Otahuhu Synchronous condensers are contracted until the end of 2012, the remaining condenser is retained as back up for the other four. From the start of 2013 to the end of 2015 two Otahuhu condensers are contracted, a third condenser is retained for back up. STATCOMs are built at UNI GXPs as needed.
DP5	Marsden condenser is contracted on a 15 year grid support contract. The Marsden exciter is upgraded with a new static exciter. STATCOMs are built at UNI GXPs as needed.
DP5a	Marsden condenser is contracted on a 5 year grid support contract. The existing Marsden exciter is employed. STATCOMs are built at UNI GXPs as needed.
DP5b	Marsden condenser is contracted on a 5 year grid support contract. Marsden exciter is upgraded. STATCOMs are built at UNI GXPs as needed.
DP6	Marsden condenser is contracted on a 15 year grid support contract. Four of the Otahuhu synchronous condensers are contracted until the end of 2015. The remaining OTA condenser is retained as back up for the other four. STATCOMs are built at UNI GXPs as needed.
DP6c	Marsden condenser is contracted on a 5 year grid support contract. The existing Marsden exciter is employed. Four of the OTA condensers are contracted until the end of 2015. The remaining OTA condenser is retained as back up for the other four. STATCOMs are built at UNI GXPs as needed
DP6d	Marsden condenser is contracted on a 5 year grid support contract. The Marsden exciter is upgraded. Four of the OTA condensers are contracted until the end of 2015. The remaining OTA condenser is retained as back up for the other four. STATCOMs are built at UNI GXPs as needed.
DP7	SVCs and STATCOMs are built at UNI GXPs as needed.
DP8	Northland wind farm is built in 2015, and STATCOMs are built at UNI GXPs as needed.
DP9a	Rodney generation is built in 2017, and STATCOMs are built at UNI GXPs as needed.
DP15	Rodney generation is built in 2017, OTA condensers are contracted from 2013 to 2015, and STATCOMs are built at UNI GXPs as needed.
DP16	Otahuhu generation is built in 2015, two OTA condensers (with a third as backup) are contracted from 2013 to 2015, and STATCOMs are built at UNI GXPs as needed.
DP17	Otahuhu generation is built in 2015, and STATCOMs are built at UNI GXPs as needed.
DP10	Distribution network STATCOMs are built in the UNI in 2014 and STATCOMs are built at UNI GXPs as needed.
DP12	Series capacitors are built in 2015, STATCOMs are built at UNI GXPs as needed.

Waikato and Upper North Island Non-Transmission Solution tender



- Tender closed
- Sought dynamic voltage support in the WUNI region
- Recent RFI received 9 responses incl:
  - Demand management
  - Large batteries
  - Distributed batteries
  - Solar + battery
  - Others

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The Grid Support Contract design guidelines provide a framework for use-case specific contracts

Use of GSCs

Transpower has identified two situations where GSCs could be offered – first as a risk management tool, and second, to allow the deferral of a transmission investment.

In either use, GSCs will act as a security product. Their reliable operation when, where and as required is essential.

Key parameters

Key parameters of Transpower's GSC product design include:

- GSCs will be specific to transmission capacity problems and offered only for specific regions and periods when these are occurring or are forecast to occur. GSCs will not be offered to address national generation capacity adequacy problems.
- Transpower will identify a need, request potential providers to propose commercial solutions to the need, and once received, Transpower will decide whether or not to offer a GSC for those proposals.
- To encourage innovation in non-transmission solutions, GSCs will be open to all non-transmission solutions, but with clear qualification and evaluation criteria to ensure their reliability of delivery.
- To encourage competition in procurement, GSCs will be offered to successful tenderers following an invitation for information (in the long-list consultation) and request for proposal (RFP) process in which qualification and evaluation criteria will be applied.
- GSCs are contracts for services, not for Transpower ownership.
- Transpower will offer GSCs in its role as grid owner.
- GSCs will be offered as part of a reliability investment proposal only for assets on the interconnected grid – they will not be offered for connection asset issues or for economic investments that do not have an underlying reliability purpose.
- GSCs will be entered into only if approved for the purposes of cost recovery through the transmission pricing methodology (TPM).

Connection GSCs could be contracted by the EDB, or new form of contract could remove these design features

https://www.transpower.co.nz/sites/default/files/plain-page/attachments/design-features-for-grid-support-contracts_0.pdf

Grid Support Contract design features

#	GSC design feature
1	GSCs will be specific to transmission capacity problems for which transmission investment is under consideration, and hence offered only for specific regions and periods when these are occurring, or are forecast to occur
2	GSCs will be considered to facilitate the management of outages that are driving transmission investment timing, to achieve more optimal transmission investment, or are necessary to implementing an investment GSCs will not be considered as mechanisms to manage other and routine outage management issues for which transmission investment is not under consideration
3	Any GSCs entered into will be relied on operationally to ensure continuous delivery of electricity to end users: Transpower will operate the grid on the assumption that any GSCs entered into will deliver the contracted services
4	GSCs will be designed to complement existing market arrangements and to: • minimise distortions in electricity generation investment • avoid Transpower becoming relied on for energy as well as transmission capacity provision
5	GSCs will not be offered if they would compromise other security products, including ancillary services and extended reserves, or the markets for these products GSCs will require that there is no physical 'double dipping' between GSC operation and operation of the GSC resources in an ancillary service market
6	GSCs for DSP and market generation are likely to be viable for short-term measures only, perhaps for say 1 or 2, or maybe 3 years The increasing impact with time will be assessed on a case-by-case basis
7	Before entering into a GSC, Transpower will seek technical as well as commercial assurance that the service providers under the GSC will be available and operate as required
8	All forms of pre-contingent and post-contingent GSC options will be considered
9	Transpower will take the impact of expected forecasting errors into account in evaluating the reliability and cost of entering into GSCs (at the time of evaluating GSC proposals), and in calling GSCs
10	Transpower offers three types of GSCs: • risk management GSCs • transmission deferral GSCs ('deferral GSCs') • voltage support GSCs
11	Transpower will offer deferral GSCs to defer investment in interconnection assets only

#	GSC design feature
12	GSCs will be contracts for grid support services Transpower will not use GSCs to take ownership of any assets
13	Transpower will only offer GSCs where it has approval to recover their costs through the TPM • as part of an approved MCP (or existing GUP) • as part of Transpower's opex
14	Transpower will only offer GSCs where they can assist in meeting the grid reliability standards
15	Transpower will implement a competitive procurement approach for GSCs, including: • preparatory information provision • invitation for information (as part of the long-list consultation) • request for proposals (RFP) • tender evaluation and selection
16	Transpower will in its long-list consultation document define the need for transmission and/or non-transmission solutions, including providing as much information as possible on the possible range of: • capacity shortfalls versus time • size, shape and frequency of capacity shortfalls
17	Transpower will issue an RFP where the long-listing process has identified that there are expected to be appropriate, reliable and economic non-transmission solutions to meet the need The RFP will: • specify the need (possibly refined from that in the long-listing process, consequent on information received and further analysis) • invite proponents to make a commercial proposal to provide grid support services through a GSC that would meet some or all of the need
18	Qualification criteria will specify the minimum requirements for a particular GSC
19	Evaluation criteria will be used to specify how GSC proposals will be evaluated against each other and against transmission solutions
20	Transpower will evaluate GSC proposals in two: • Firstly, individually evaluate each GSC proposal • Secondly, assess the GSC proposals as a group to develop a portfolio of GSCs that best meets the full range of reasonably foreseeable requirements
21	Transpower will in its long-listing and RFP processes specify the possible locations of resources for the supply of GSC services and, where relevant and practical, indicate the relative merits of resources at different locations
22	Transpower will endeavour to provide adequate notice of future need, but recognises that especially for risk management GSCs need can occur at relatively short notice

Grid Support Contract design features

#	GSC design feature
23	Transpower will have two approval approaches for GSCs in MCPs, both as part (or all) of a reliability investment proposal: • specific GSC approval, for approval of specific GSC contracts • generic GSC approval, for approval of a future GSC procurement process Both approaches may be combined in one reliability investment proposal, and will be accompanied by an appropriate physical and financial scope of the approval
24	Transpower offers three forms of GSC: • demand-side participation (DSP) including non-market generation • voltage support • market generation
25	GSC proponents and providers do not need to be participants under the Code
26	GSC contracts will include requirements for testing Transpower will reserve the right to make calls to test operational readiness
27	Transpower may accept an emergent technology that has not as yet demonstrated appropriate reliability as part of a solution mix so long as overall solution reliability can be achieved
	For GSCs for DSP including non-market generation only
28	GSCs for DSP will allow for blocks comprising one of: • a single load resource • a single non-market generation resource • an aggregation of multiple load and/or non-market generation resources
29	Transpower will require GSCs for DSP to deliver reliable: • load reduction, where the service is to reduce net load by an agreed amount, or a • load cap, where the service is to limit net load at a certain location to an agreed amount
30	GSCs for DSP will either be: • called by Transpower as required ahead of real time • operated automatically post-contingency (for operational contingencies) • called by Transpower post-contingency (for planning-only contingencies)
31	Transpower will, where reasonably practical and meaningful, provide historical load data and non-binding probabilistic estimates of how often and under what conditions (e.g. call durations, timings and sequencing) DSP might be called. These will be for information only and will not affect operational calls
32	Transpower may define in its RFP a minimum block size in order to keep the number of blocks manageable by the System Operator

#	GSC design feature
33	Transpower expects aggregators to contract for resources of total capacity significantly greater than the contracted block capacity, to allow for the risk of resource non-availability or failure Transpower expects aggregators to manage blocks through adding or substituting resources if and when necessary to maintain block reliability and capability over time

34	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: 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 include financial incentives for performance

35	Providers will be required to meet specified communications requirements to for example accept and acknowledge calls Aggregators will be required to have reliable call and acknowledgement processes between themselves and all of their resources
36	Transpower will enter into GSCs for DSP only with resources that offer DSP additional to what would be expected to occur otherwise
37	GSCs for DSP within distribution networks will require each source, the aggregator or Transpower to notify its: • retailer • local distribution network
38	Providers will be required to verify the delivery for each called resource for each call as the basis for payment. Verification must: • for a load reduction service, demonstrate additionality to that which would otherwise have occurred in that call period • for a load cap service, demonstrate that load was no greater than the cap throughout the call period • demonstrate that load did not rebound beyond any contracted limits for the recovery period For aggregators: • verification for each called resource must cover the full call period and any call recovery period specified • while verification will be at the resource level, delivery relative to the contracted amount will be at block level across all called resources for the full call period and any call recovery period specified Transpower will require some standardisation of verification methods and reporting formats

Grid Support Contract design features

#	GSC design feature
39	Providers will be required to ensure that resources are adequately metered to enable accurate and prompt verification of delivery For resources that could inject into the local distribution network, metering capability must be two way (separately for import and export)
40	Non-market generators may be required to demonstrate their ability to: • ride through frequency excursions within defined limits • return to operation within defined timeframes from failing to ride through larger frequency excursions
41	Transpower will allow for the potential risks of DSP resource fatigue: • in evaluating individual or sets of GSC proposals • in developing its call strategy
	Design features for GSCs for voltage support only
42	Transpower as grid owner may offer GSCs to ensure that adequate voltage support services are available to be called by the System Operator when required
43	Voltage support GSCs will not be offered to market generation when injecting MW Voltage support GSCs will be offered only for dynamic or static Mvars from participants where those Mvars are additional to any obligation to provide Mvars under the Code Measurement of Mvar performance will be at one or more defined GIPs or GXPs
	Design features for GSCs for market generation only
44	The design and operation of GSCs for market generation will assume that the market will ensure that market generation capacity is available at times of demand peak except in the case of forced (unplanned) generation outages (or generation outages that had to be planned at short notice)
45	GSC payments for market generators will be in the form of a preparation payment The preparation payment will be in the form of a fixed payment path, set at the start of the project, but conditional on: • Key deliverables being met • Demonstrated availability of capacity at times of demand peak except in the case of forced outages (or generation outages that had to be planned at short notice) • GSC terms being transferred in case of any change in ownership The only operation payments available for GSCs for market generation is for post-contingent run-up or run-back schemes, for which availability, call and delivery payments are allowed
46	GSCs could be offered to market generators to modify their plans to meet Transpower's need for capacity, reliability, timing and location
47	For market generator preparation payments the GSC will fund up to (but not exceeding) the actual, incremental cost of the modification

#	GSC design feature
48	For market generation that is not yet commissioned, GSCs will be offered only for generation plant that is committed, in accordance with the criteria of the CapexIM GSCs that include investments will be required to provide progress reports and maintain schedules
49	Market generation GSCs will not be offered to intermittent generators • with no fuel storage (e.g. wind or solar) • with limited fuel storage (e.g. some run-of-river hydro) Limited fuel storage means not reasonably likely to have sufficient fuel storage to enable offering generation at demand peaks under all reasonably foreseeable conditions, e.g. including dry years
50	Risk management GSCs may be offered to market generation to hold fuel capacity in reserve in case of an asset failure

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Notes accompanying slides 5 and 13

- Value streams can be accessed via different markets through direct participation or via a flexibility trader who can value stack on the consumers' behalf.
- Indirect wholesale participation can occur when a DER is used for either demand response or generation but is not bid into the market. This can be achieved via a flexibility trader who can value stack on the consumers' behalf. The EA and the System Operator still enable the value stream as it is the wholesale market price signal that is being responded to.
- Where a consumer uses self-consumption, it is often to avoid retail charges. The Retail provider is considered the value stream enabler due to their tariff acting as the price signal which a direct participant or flexibility trader would respond to on the consumers' behalf. When this occurs, it can lead to access to components of the value stack beyond energy services (i.e. avoiding volumetric network charges).