Flexibility Program Design

Who are we
& what do we do?

enel X

enel Green Power

>38 GW of installed renewable capacity

ENERNOC
An Enel Group Company

>6 GW of dispatchable demand response

DEMAND energy
An Enel Group Company

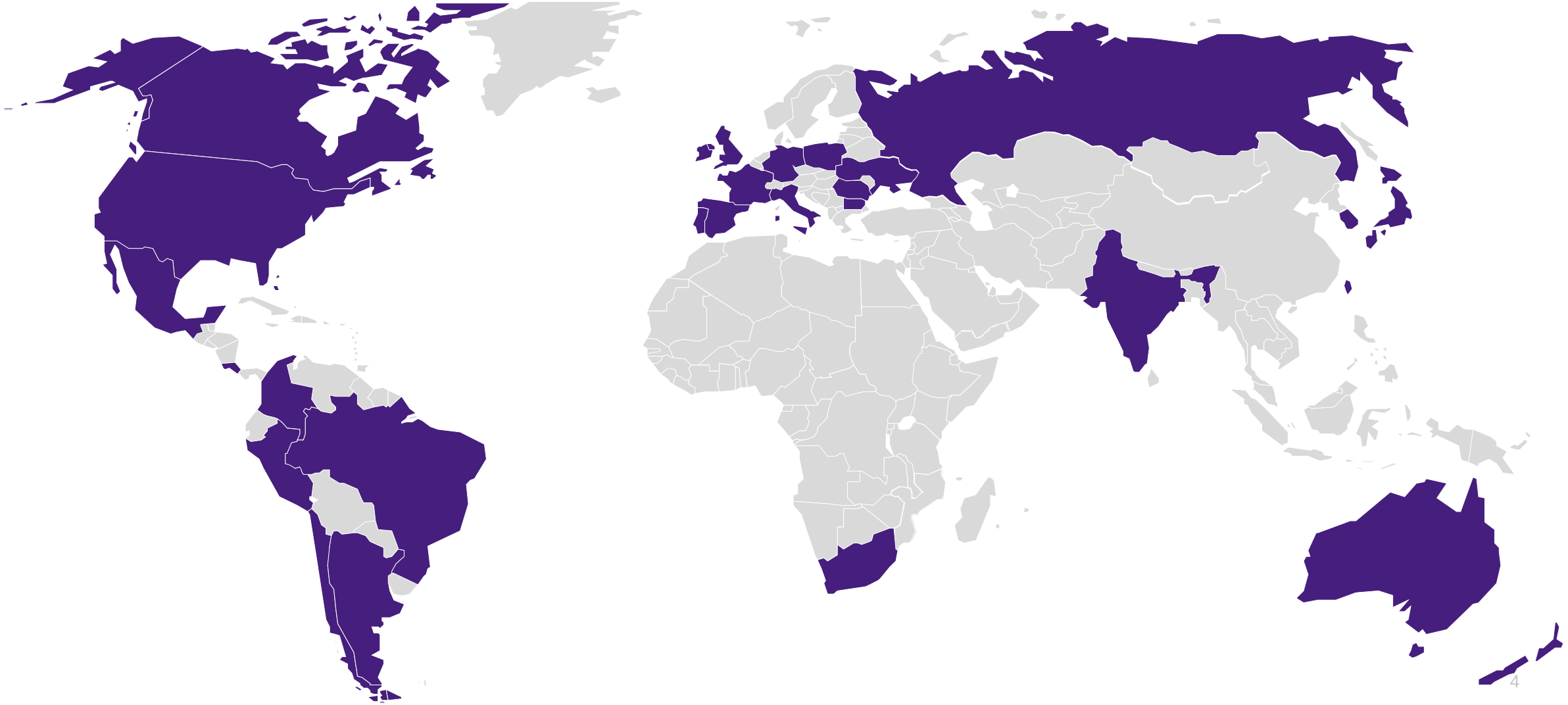
Behind-the-meter battery storage & optimisation

eMotorWerks
An Enel Group Company

EV charging with V2G capability

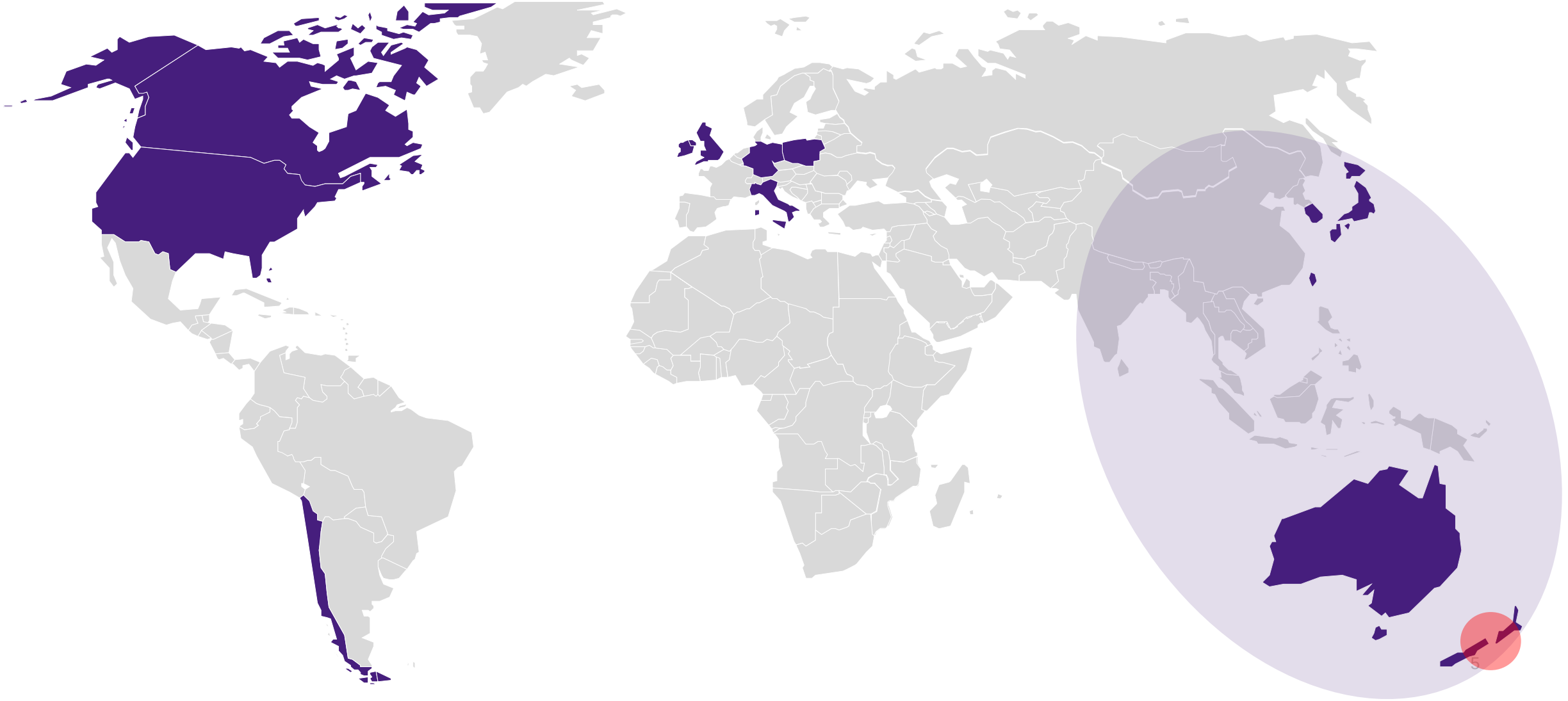
Enel X's presence

Where we are in the world

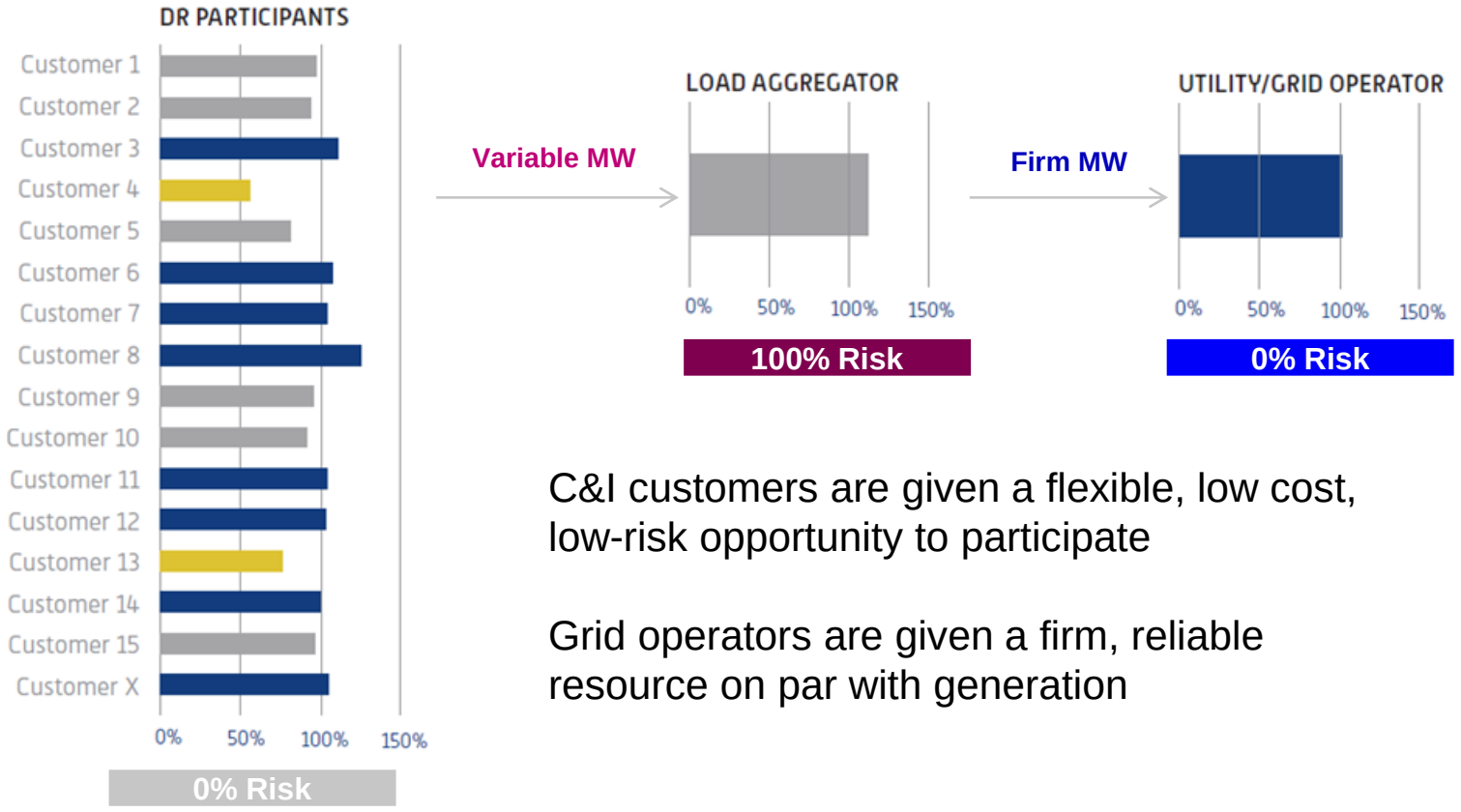


Enel X's demand response activities

>50 programmes in 12 countries



Aggregators are crucial to the success of demand response programmes



C&I customers are given a flexible, low cost, low-risk opportunity to participate

Grid operators are given a firm, reliable resource on par with generation

- Aggregators are specialists focused on doing DR well
- They find customers and persuade them to participate
- They make critical investments in technology and process
- They allow more customers to do DR (more MW)
- Their portfolio management delivers greater reliability
- In successful markets, 70%+ of DR is from aggregators

What makes demand-side flexibility valuable?

Two basic situations, compared to conventional technologies

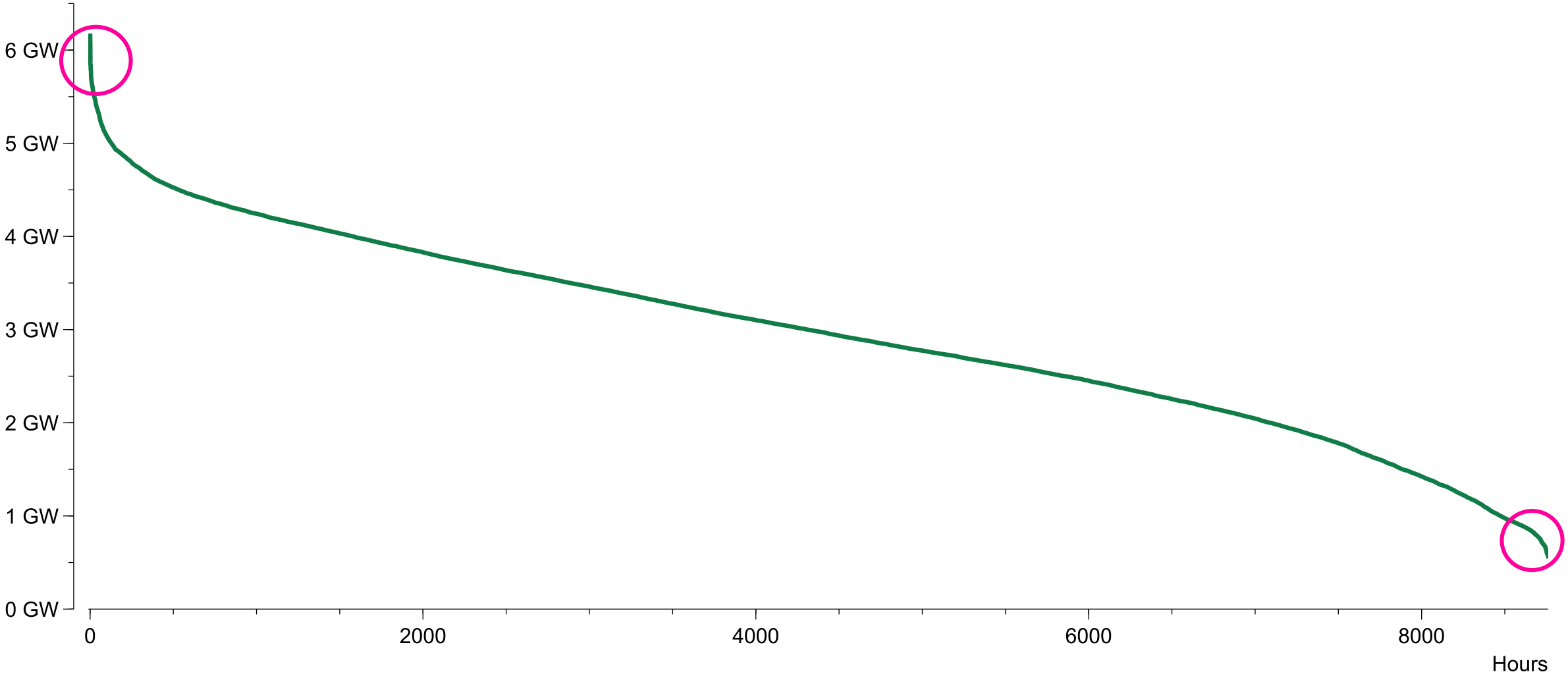
We provide the same service at lower cost

e.g.

- Emergency capacity

DR is best at providing capacity, not energy

Low capital investment but higher fixed operating cost + opportunity cost



What makes demand-side flexibility valuable?

Two basic situations, compared to conventional technologies

We provide the same service at lower cost

e.g.

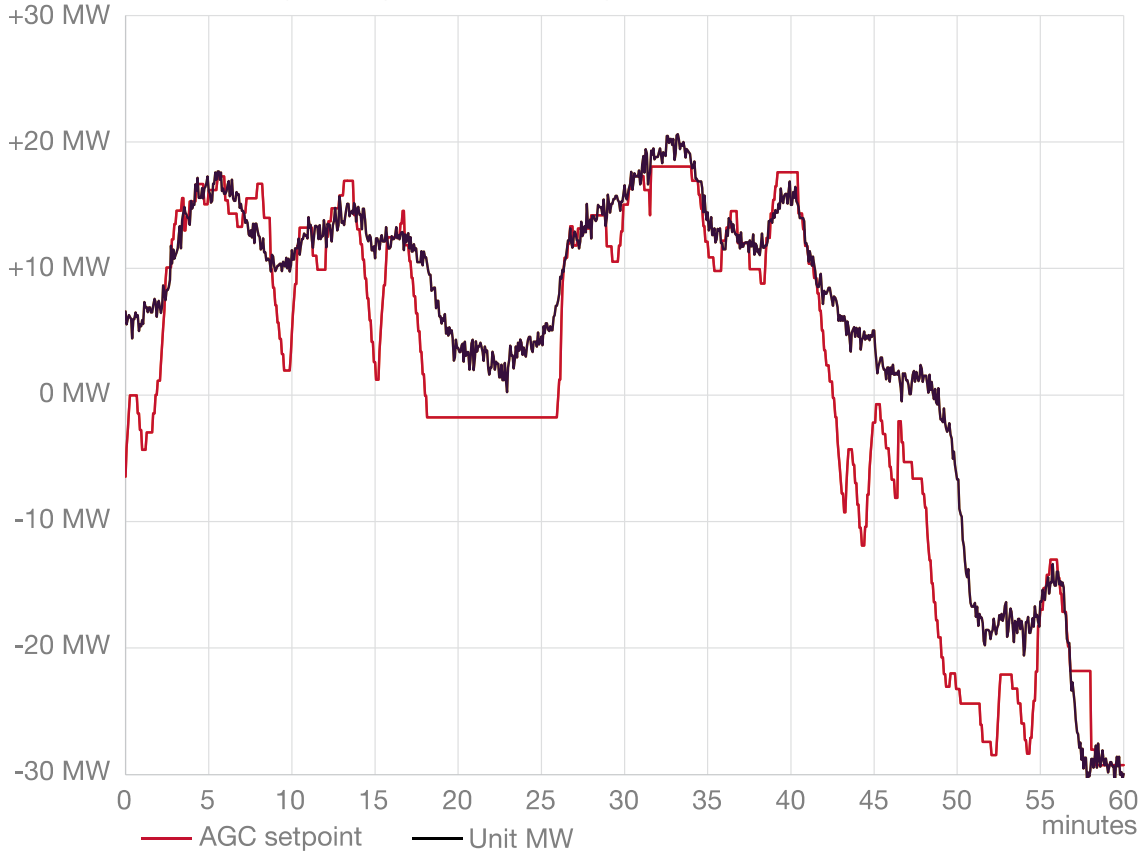
- Emergency capacity
- Balancing capacity

We want to compete and be compensated with other technologies equitably

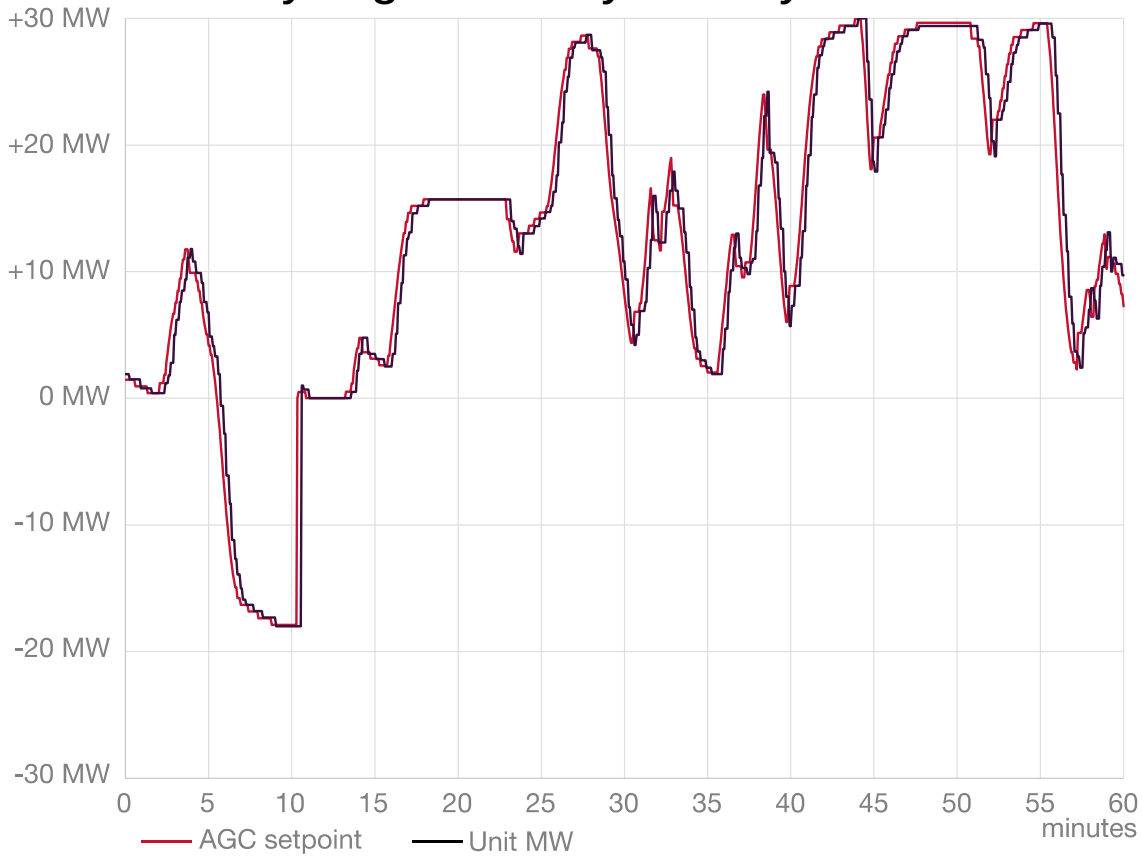
We provide a better quality service

Higher quality service

Primary regulation by steam turbine



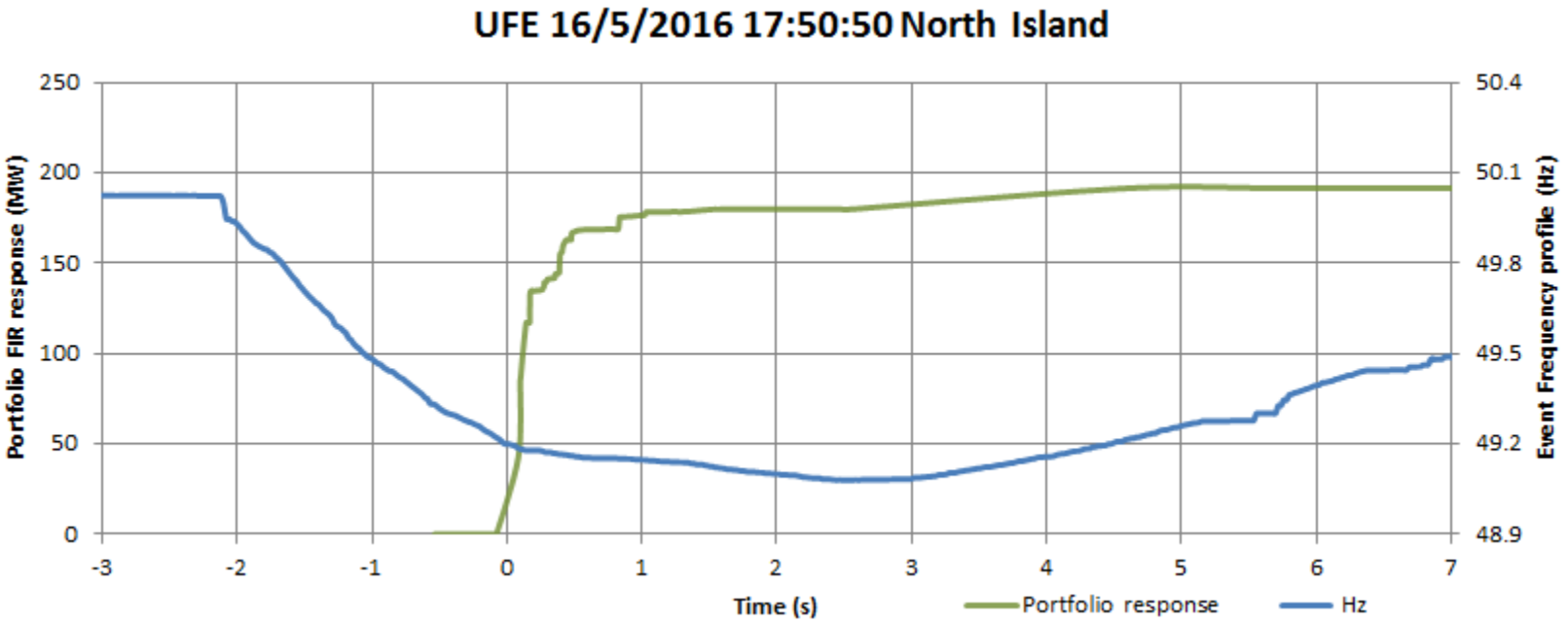
Primary regulation by battery



Figures 1 & 2 from AEMO, Initial operation of Hornsdale Power Reserve BEMS, April 2018.

Higher quality service, at lower cost

1-second frequency response in New Zealand



- Faster response than a generator can offer
- For a generator to be ready to provide a raise service, it incurs opportunity costs all the time
- Customers can be ready just by consuming normally

What makes demand-side flexibility valuable?

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We provide the same service at lower cost

e.g.

- Emergency capacity
- Balancing capacity

We want to compete and be compensated with other technologies equitably

We provide a better quality service

e.g.

- Frequency regulation by battery
- Fast frequency response by load

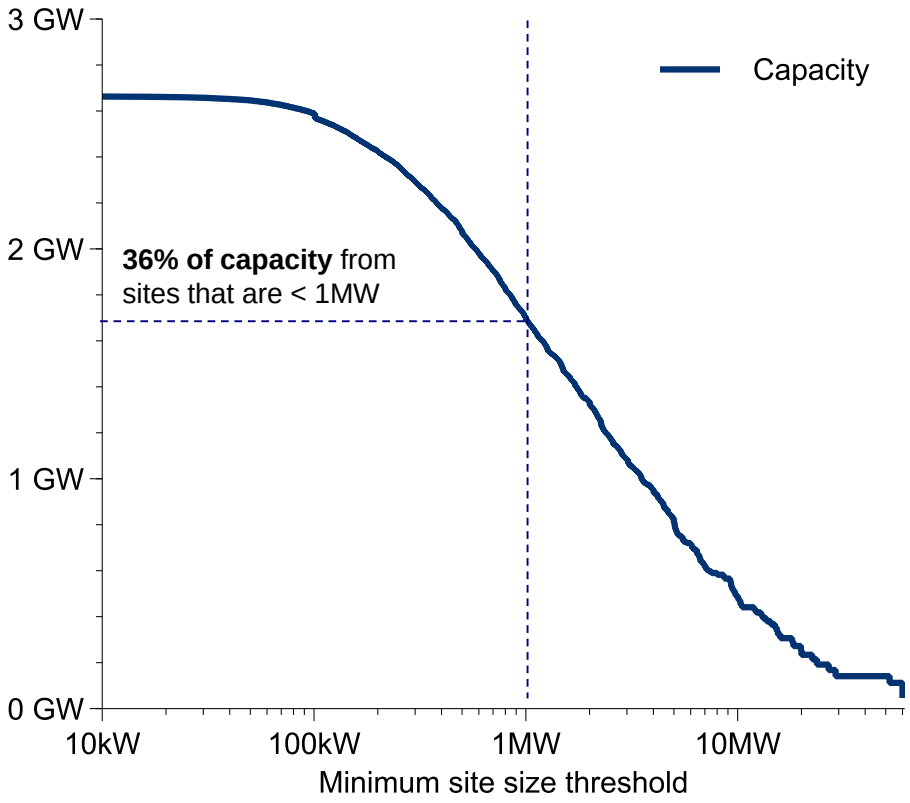
We want the buyer to equitably compensate the service provided to the system

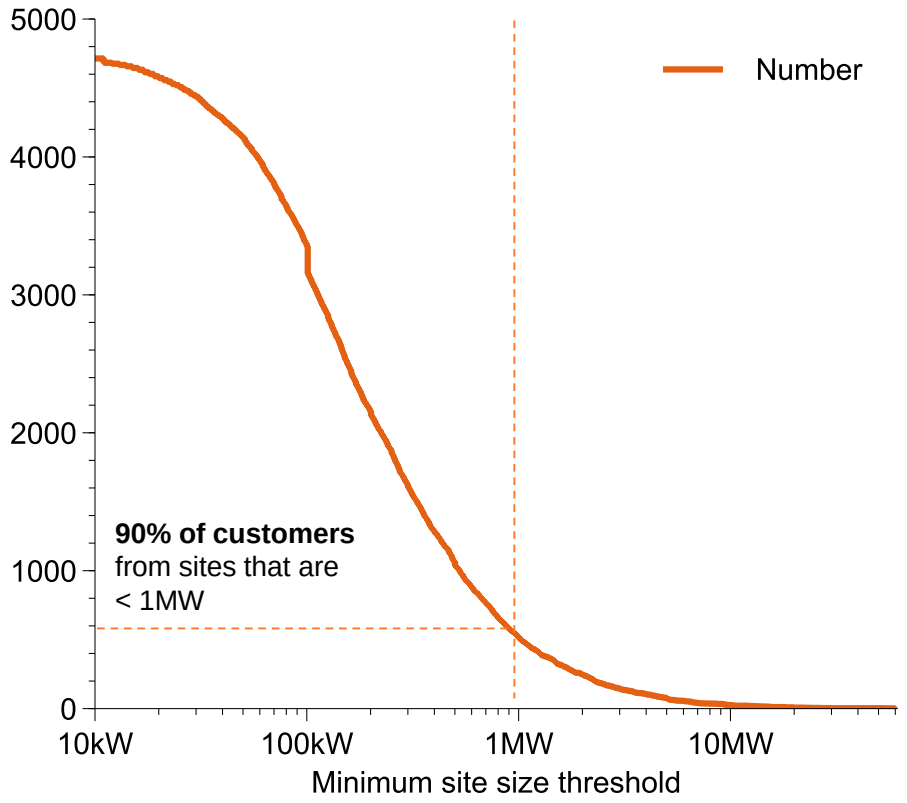
In both cases, we want to:

- Avoid requirements that are unnecessarily onerous
- Maximise the range of customers that can participate
- Minimise costs (especially per-site costs)

Per-site costs have a particular impact

Distribution of site sizes in EnerNOC's PJM portfolio





If a programme only works for huge customers, it'll remain a small programme.

What makes demand-side flexibility valuable?

Two basic situations, compared to conventional technologies

We provide the same service at lower cost

e.g.

- Emergency capacity
- Balancing capacity

We want to compete with other technologies, and be paid the same

We provide a better quality service

e.g.

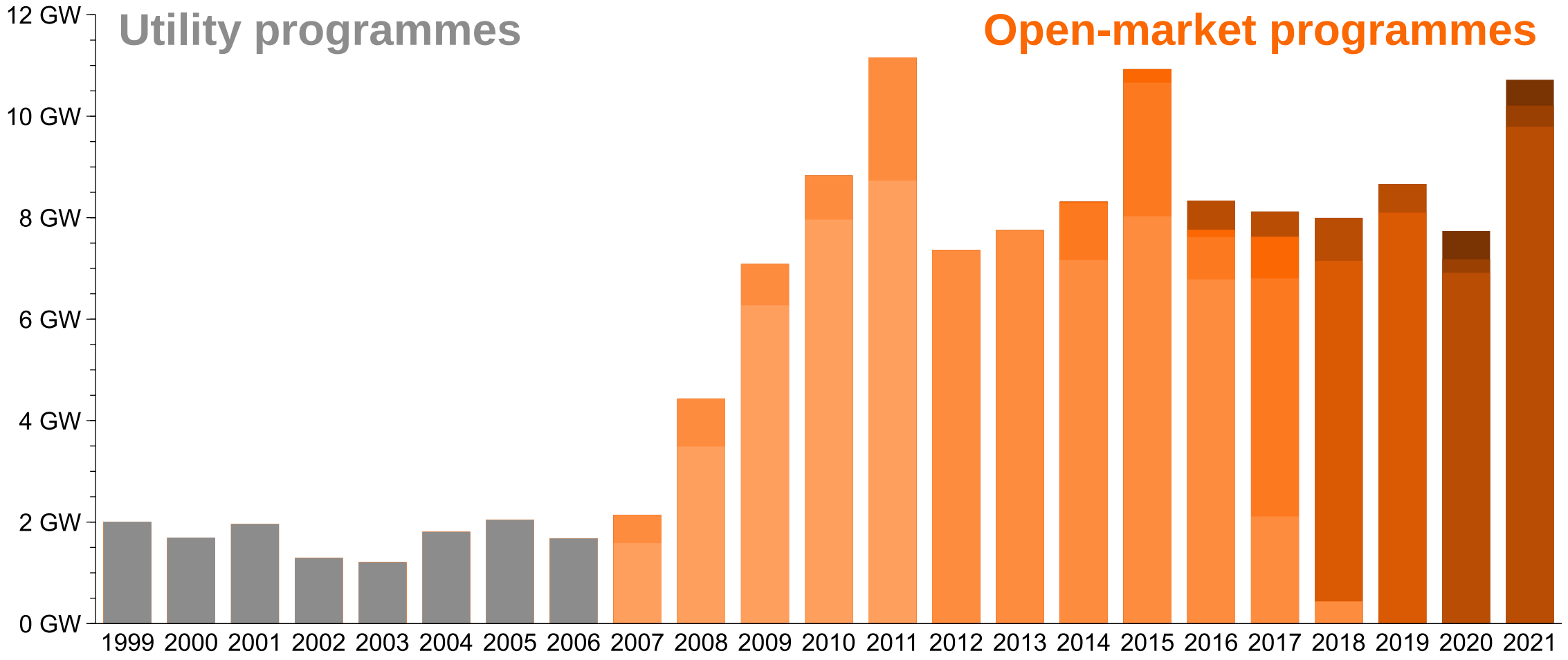
- Frequency regulation by battery
- Fast frequency response by load

We want the buyer/market to reward the higher value we provide

In both cases, we want to:

- Avoid requirements that are unnecessarily onerous
- Maximise the range of customers that can participate
- Minimise costs (especially per-site costs)
- Utilise the benefit of aggregation to achieve economies of scale
- Ensure service standards are high

Volumes of demand response in PJM



Data: PJM, 2018 Load Response Monthly Activity Report, 12 June 2018.

What about NZ?

Pre purchase market opportunity due diligence

MARKET OVERVIEW

Bearish expectations both in terms of volumes and prices. High uncertainty on the medium-long term stability of DR revenues.

Liberalized electricity market	≈
Capacity Market (CM) or remuneration form	✓
Installed capacity (2016)	≈9GW
Flexible capacity (2016)	≈71%
Capacity remunerated (2016)	n.a.
Share of DR on remunerated capacity	n.a.
DR capacity price ($/MW/year)	n.a.

Intermittent RES share on capacity (%)	9%
Electricity demand (2016)	40 TWh
C&I share on electricity demand	70%

Legenda
○ Low ● High ✓ Yes ✗ No ≈ Partial

CURRENT MARKET STRUCTURE

Partially liberalized energy-only market with forward contracts for the provision of DR capacity on yearly basis. Limited potential for further DR deployment.

Liberalized electricity market	≈
Capacity remuneration form	✓
Capacity market maturity	n.a.
Energy Markets	
Concentration of demand	◑
Concentration of supply	◕
Capacity Market	
Concentration of generation capacity	n.a.
Concentration of DR	n.a.

Regulatory outlook

- Partially liberalized electricity market with 5 vertically integrated generation companies and a competitive retail sector.
- The Authority considers the energy-only design as suitable for New Zealand and its view the well-functioning hedge and futures markets provides parties with the means to enter into forward contracts without the prescription of a formal capacity mechanism.
- First DR trials started in 2007 and current mechanisms for DR remuneration are expected to be maintained in the future with limited potential for further DR development.
- Yearly, the TSO opens up a tender process to procure DR resources focusing on key geographical areas where a future transmission need has been identified. The program is pay-as-bid with offers being selected from the lower to the highest price until the TSO has satisfied its capacity needs.
- There are no information available on volumes and prices of past DR capacity allocated

Legenda
○ Low ● High ✓ Yes ✗ No ≈ Partial

1) Concentration rate reflects the number of participants and related obligation in the capacity/DR markets

Attributes that affect participation

Range of choices

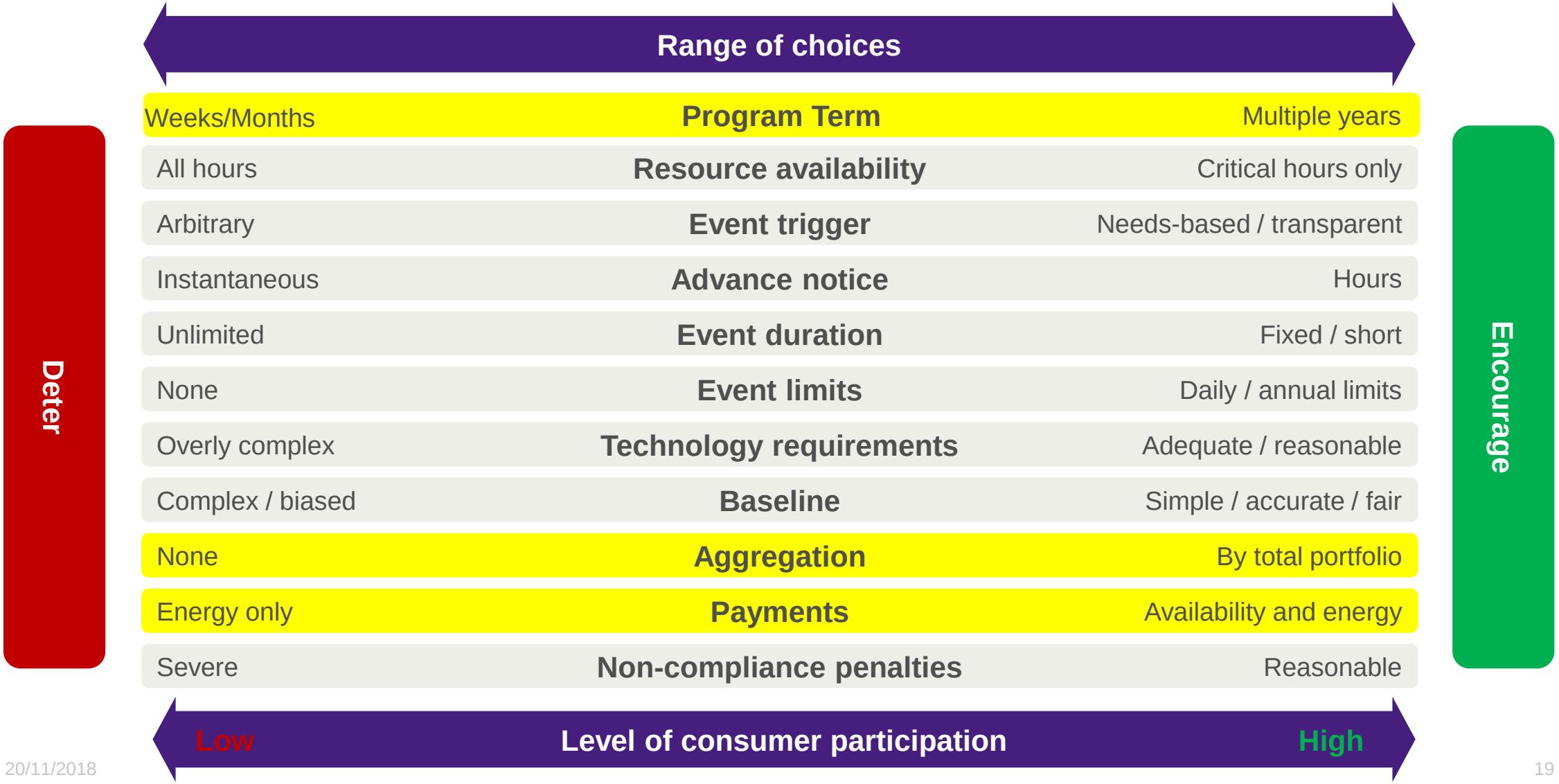
Weeks/Months	**Program Term**	Multiple years
All hours	**Resource availability**	Critical hours only
Arbitrary	**Event trigger**	Needs-based / transparent
Instantaneous	**Advance notice**	Hours
Unlimited	**Event duration**	Fixed / short
None	**Event limits**	Daily / annual limits
Overly complex	**Technology requirements**	Adequate / reasonable
Complex / biased	**Baseline**	Simple / accurate / fair
None	**Aggregation**	By total portfolio
Energy only	**Payments**	Availability and energy
Severe	**Non-compliance penalties**	Reasonable

Deter

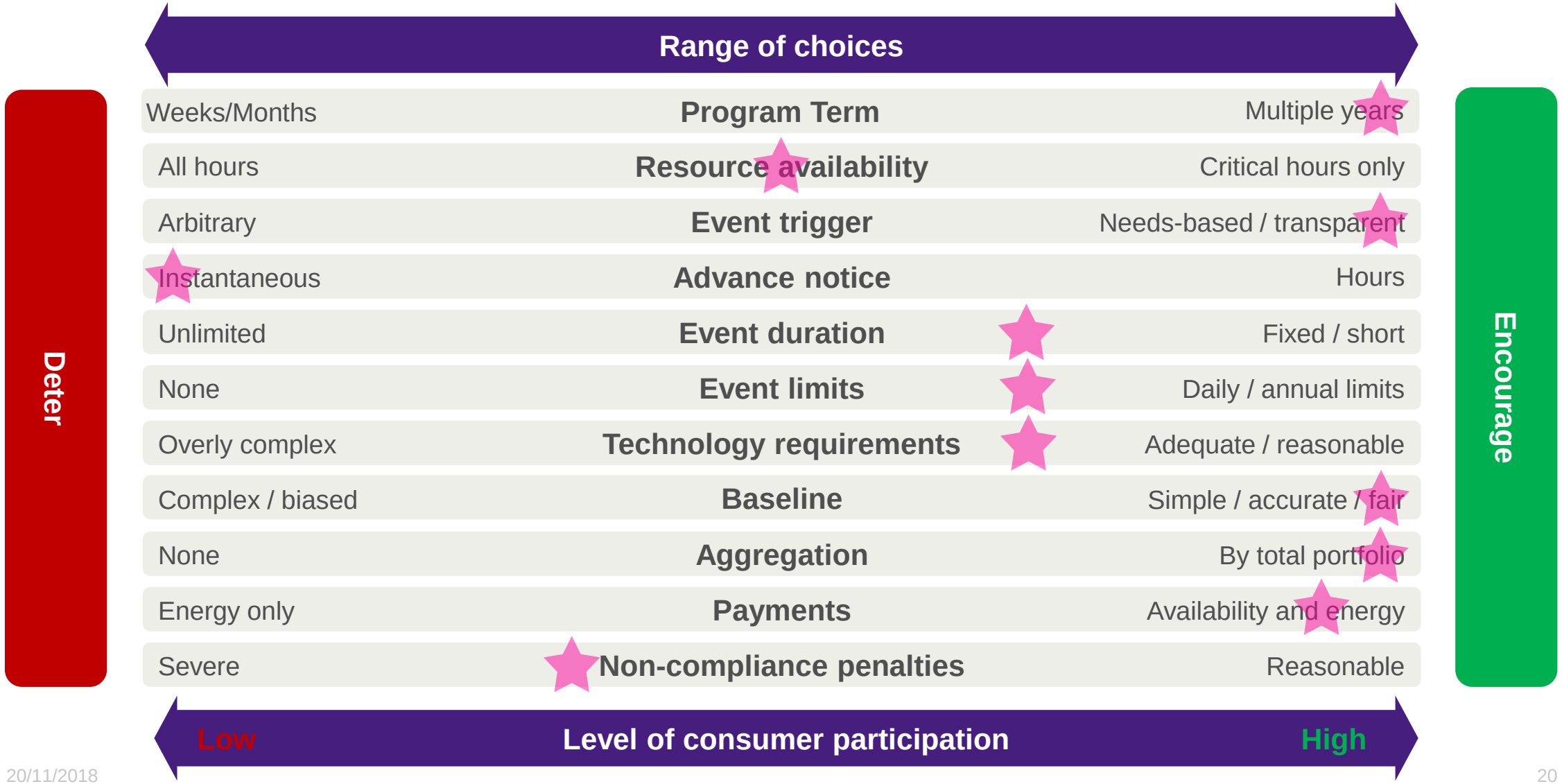
Encourage

Low — **Level of consumer participation** — High

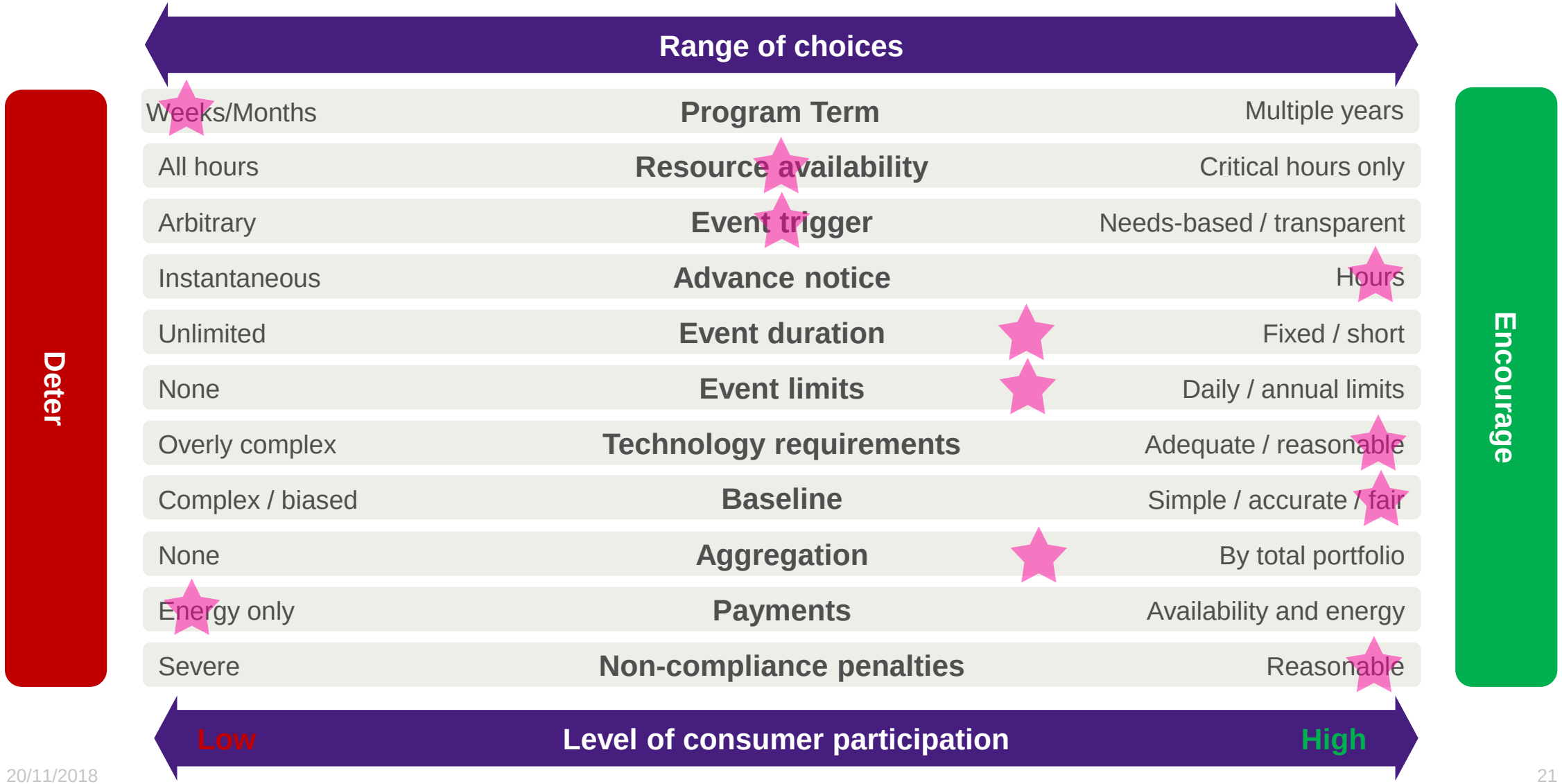
Attributes that affect participation



New Zealand's instantaneous reserves - 220MW



Transpower Demand Response – 150MW



Transpower DR Program

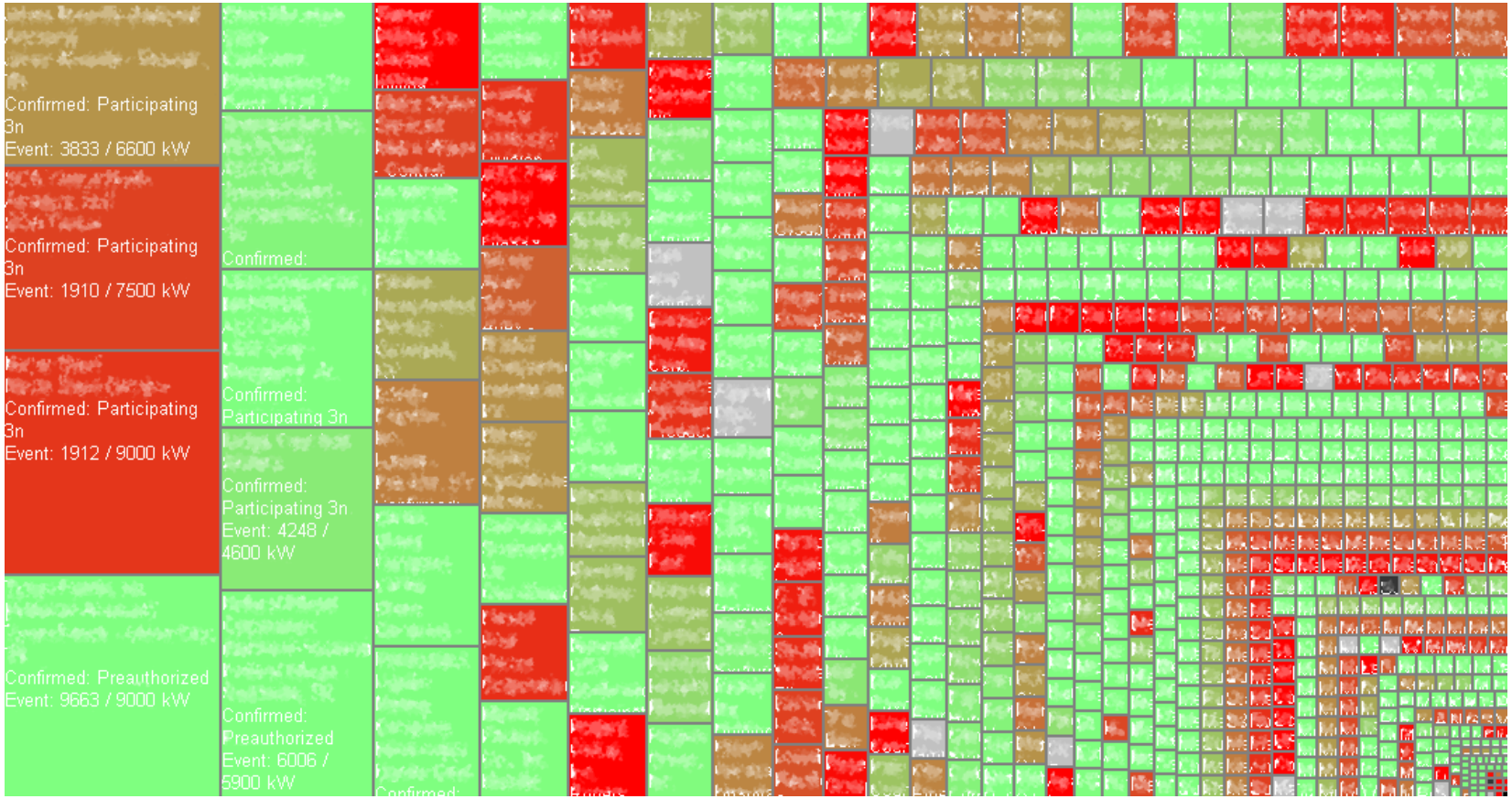
In principal were all for it, but:

We strongly discourage the sole buyer of DR as a transmission alternative also becoming a competing supplier of that DR. This tends to make commercial suppliers of DR wary of investing in the sector, leading to reduction in both competition and innovation.

To avoid impeding the development of a competitive market for DR as a transmission alternative. We strongly encourage:

1. The purchaser of transmission alternative DR refraining from using regulated funding to engage directly in retail consumer acquisition for DR (though it is reasonable for it to deal with direct grid-connected entities which approach it).
2. The development of standardized transmission alternative DR capacity products, with clear performance obligations and penalties and sensible contract durations.
3. Define all program requirements in line with these standardized products, and allow parties to compete to supply them.

Large-scale demand response is resilient



- 734 sites had to deliver 223 MW
- Mix of load & decentralised generation
- Things went very badly
- 3 of the largest sites substantially underperformed
- But we still delivered 90% of our obligation