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RELIABLE
AFFORDABLE
CLEAN
ENERGY

Catalysing a low-regret transition:

unlocking C&I flexible demand

Dani Alexander, RACE for Business Program Leader
Presentation to eceee 2021 Summer Study
9 June 2021

Agenda

1. Setting the scene: about RACE and flexible demand

2. The size of the prize (in Australia) today and tomorrow

3. Barriers to accessing untapped flexible demand

4. Overcoming barriers via Industry 4.0

5. Overcoming barriers via pricing/incentives

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About RACE for 2030

Overview

RACE aims to accelerate the transition to Reliable, Affordable, Clean Energy for 2030 through innovation focused on energy end users and the networks that supply them.

We are an industry led collaborative research center established in 2020 with $68.5M of Australian Government funding. The remainder of our resources come from our partners who cover the whole value chain from end user back to network, technology companies, governments, and many of Australia's leading energy researchers.
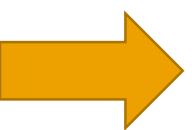
Programs

Our research is organised in four programs: RACE for Business, RACE for Homes, RACE for Networks and RACE for Everyone (covering cross-sectoral issues).

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RACE for BUSINESS

Boosting business energy productivity and cutting costs via flexibility, digitalisation, electrification and value chain transformation.

1. Theme B1: Transforming energy productivity through value chains
2. Theme B2: Industry 4.0 for energy productivity
3. Theme B3: Electrification and renewables to displace fossil fuel process heating
4. **Theme B4: Flexible demand and demand control technology and development**
5. Theme B5: Anaerobic digestion for generating power and displacing natural gas / diesel

For more information visit: www.racefor2030.com.au/race-for-business/

Why flexible demand and what is it?

Flexible demand helps to decarbonise the grid

- "Using" more renewable generation
- Maintaining reserves
- Ancillary services
- More benefits for customers

It's a win-win-win for businesses, the network, and for renewables

FD type	Description
Shape	modify load on a consistent or permanent basis e.g. TOU tariffs or behaviour change programs
Shift	changes that use surplus renewables or exploit fluctuations in market prices
Shed	more conventional load curtailment e.g. DR
Shimmy	the most dynamic, for power system stability and/or quality

Adapted from Lawrence Berkeley National Laboratory

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Then why is flexible demand underutilised?

In Australia, **only half of the technical potential** of basic demand response is realized

"Not all loads are created equal"

There are significant gaps in information in Australia re: costs and resource potential

Key:

Green: already present in Australia. Orange: emerging applications. Red: not currently applicable

FD source	Shift	Shed	Shimmy
Heating, Ventilation & Cooling	Orange	Green	Orange
Hot Water Systems	Green	Green	Orange
Pool Pumps	Orange	Green	Red
Other Domestic Appliances	Red	Green	Red
Electric Vehicles	Orange	Orange	Orange
Electrical Energy Storage	Green	Green	Green
Thermal Energy Storage	Orange	Orange	Red
Industrial Processes	Orange	Green	Red
Embedded Generation	Orange	Orange	Red
Material or Inventory Storage	Orange	Green	Red
Conservation Voltage Reduction (CVR)	Red	Green	Orange

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Where is the flexible demand potential?

The 'HUFF' matrix for industrial sectors: agriculture, manufacturing and water utilities

	Refrig-eration	Heat pumps	Irri-gation	Thermal storage	Processes	Material storage	Embedded generation	Electrical storage
Iron & Steel		56		56	70		70	63
Pulp & Paper		64		64	80	64	80	72
Cold stores	72	72		72			90	81
Water utilities		72		72	90	72	90	81
Agriculture	80	80	90	80	100		100	90
Mining		64		64	80		80	72
Chemicals	56	56		56	70		70	63
Cement		64		64	80	64	80	72
Manufacturing	80	80		80	100		100	90
Aluminium		56		56	70	56	70	63

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Where is the flexible demand potential?

The 'HUFF' matrix for commercial sectors: apartments, public buildings and supermarkets

	HVAC	Heat pumps	Hot water	Thermal storage	EVs	Pool pumps	Embedded generation	Electrical storage	Refrig-eration
Retail	70	56	63	63	35		63	70	
Offices	80	64	72	72	40		72	80	
Warehouses	80	64		72	40		72	80	72
Apartments	90	72	81	81	45	72	81	90	81
Public buildings	90	72	81	81	45		81	90	81
Data centres				63			63	70	
Supermarkets	90	72	81	81	45		81	90	81
Aquatic centres		72	81	81	45	72	81	90	

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Where are the barriers to flexible demand?

The biggest **economic barrier** is lack of certainty

Regulatory and policy barriers affect energy market participants and customers in different ways

Market barriers are most keenly felt by the customer

A critical **behavioural and cultural barrier** in the electricity industry may be cultural bias in favour of centralised, capital intensive, and supply side solutions

Barrier	Regulators	Networks	Retailers	Aggregators	Industrial	Commercial
		Actor			*Customer*	
Technology Barriers						
Metering	yellow	red	red	red	yellow	red
Communication and control	green	red	yellow	yellow	yellow	red
Aggregation	yellow	red	yellow	yellow	green	yellow
Economic Barriers						
Certainty	red	red	red	red	red	red
Transparency	yellow	red	red	red	red	red
Engagement	green	yellow	red	yellow	yellow	yellow
Business case	yellow	yellow	yellow	red	red	red
Regulatory & Policy Barriers						
Policy priorities	red	red	red	red	yellow	yellow
Inertia	yellow	red	red	red	red	red
Level playing field	yellow	red	yellow	yellow	yellow	yellow
Competition	yellow	yellow	yellow	red	red	red
Market Barriers						
Incentives	yellow	yellow	yellow	red	red	red
Capacity	yellow	yellow	yellow	red	red	red
Capital	green	green	green	yellow	red	red
Pricing	green	green	yellow	yellow	red	red
Behavioural & Cultural Barriers						
Cultural biases	red	red	red	red	yellow	yellow
Behavioural factors	green	green	yellow	red	red	red
Risk to production	green	yellow	yellow	red	red	yellow
Government procurement	green	green	yellow	yellow	green	red

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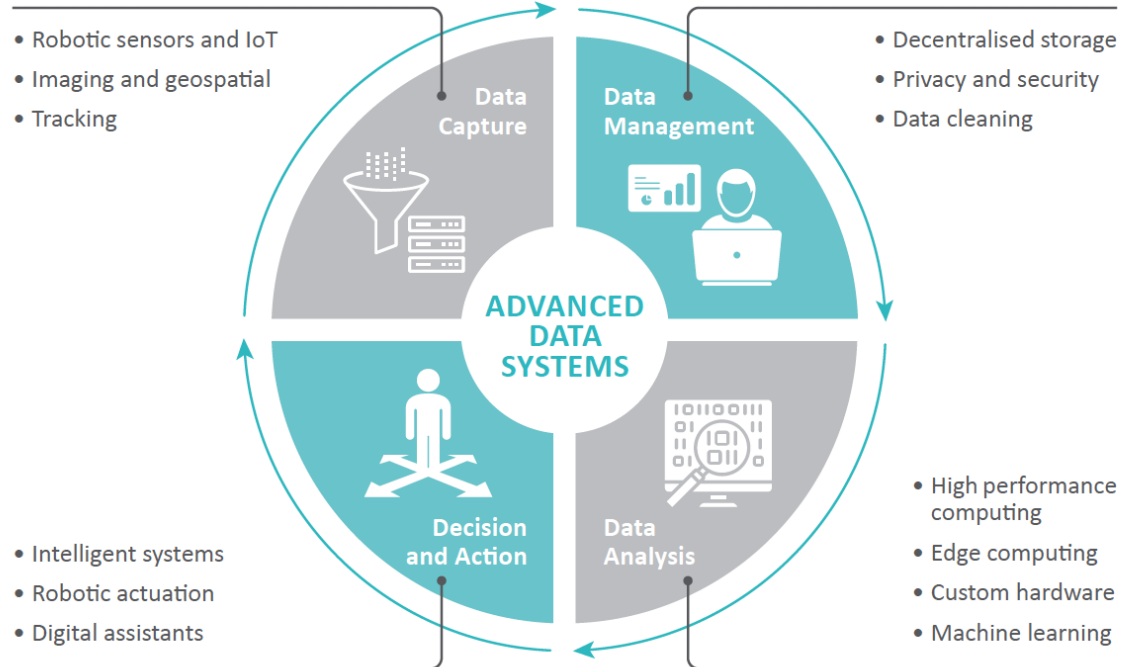# Addressing barriers with Industry 4.0

New IoT options and digital twins for better data capture

Improved data analysis using AI:

- Improving the reliability of reinforcement learning approaches
- Hybrid approaches for multi-agent systems
- Extending ANN to two or more layers

Extending ADR and transactive control technology, particularly by better characterising baselines

DATA INNOVATION RELIES ON SPECIALISED SYSTEMS FOR DATA CAPTURE, MANAGEMENT, ANALYSIS, AND ACTION

- Robotic sensors and IoT
- Imaging and geospatial
- Tracking

Data Capture

Data Management

- Decentralised storage
- Privacy and security
- Data cleaning

ADVANCED DATA SYSTEMS

Decision and Action

Data Analysis

- Intelligent systems
- Robotic actuation
- Digital assistants

- High performance computing
- Edge computing
- Custom hardware
- Machine learning

CSIRO framework for Digital Innovation (AlphaBeta, 2018)

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Addressing barriers with pricing & incentives

Investigate **optimal ratios of availability and delivery** payments for FD resource in system stability programs

Improve registration transparency of wholesale market pricing programs to improve predictability of FD and overcome cultural biases

Experiment with **expanded incentive schemes** to address behavioural barriers to FD uptake.
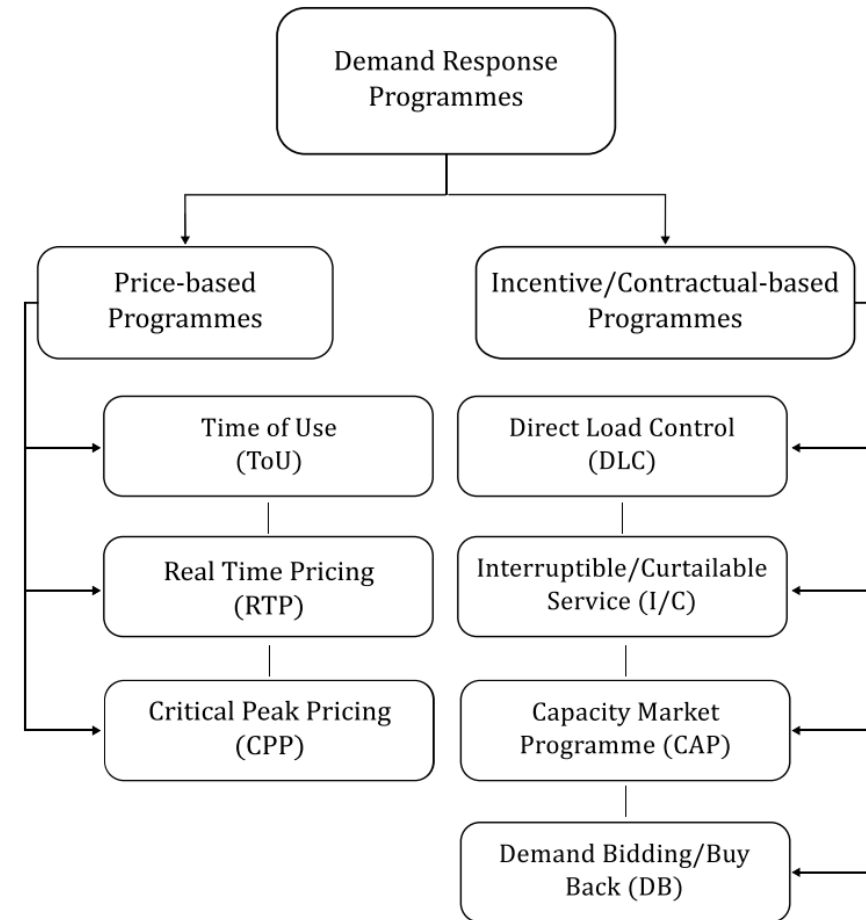
Categories of demand response programs (Antonopolous, 2020)

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Questions and contact details

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Thank you