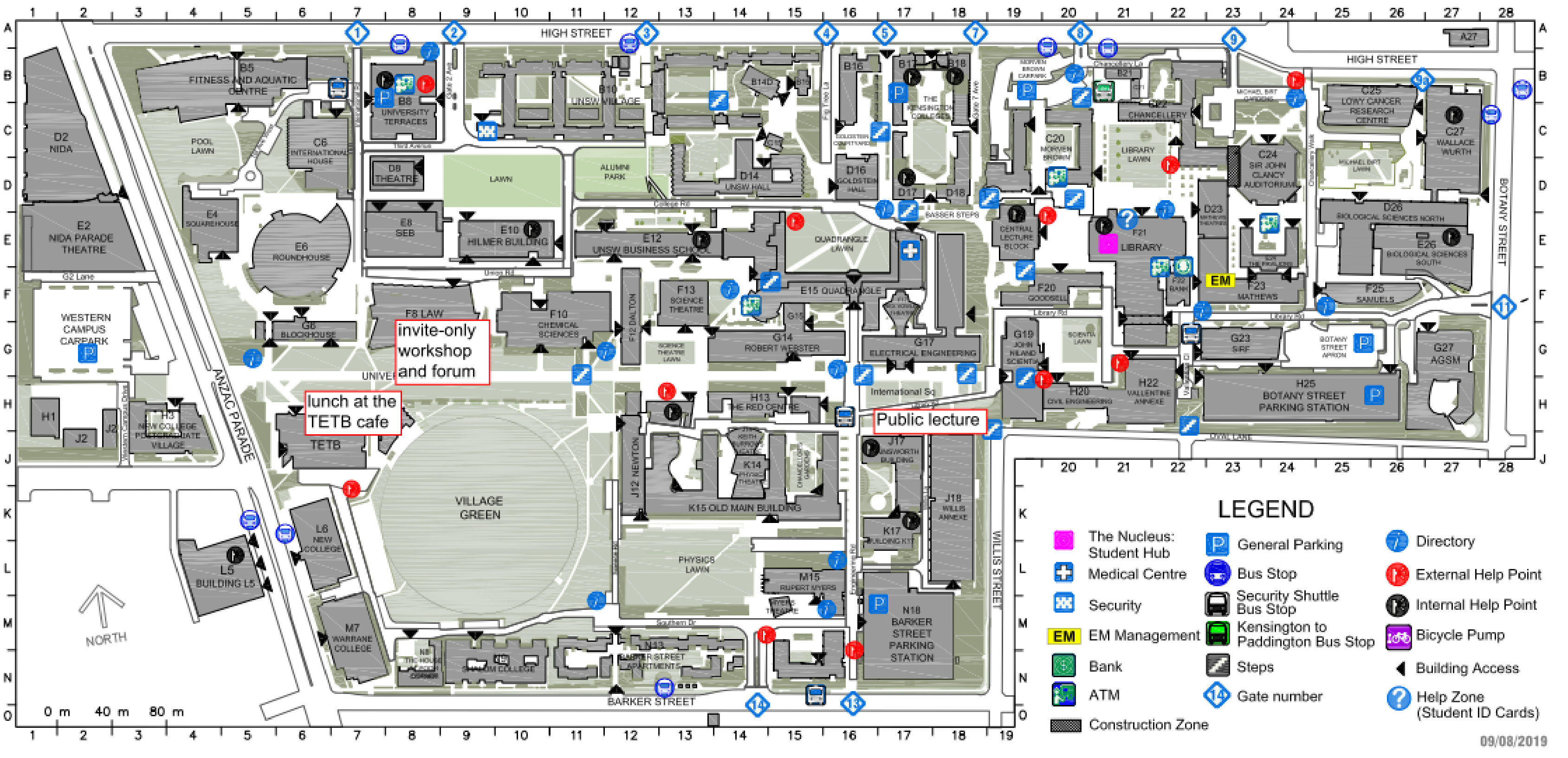
User-Centred Energy Systems

Social License to Automate Annex Launch Event

Morning session

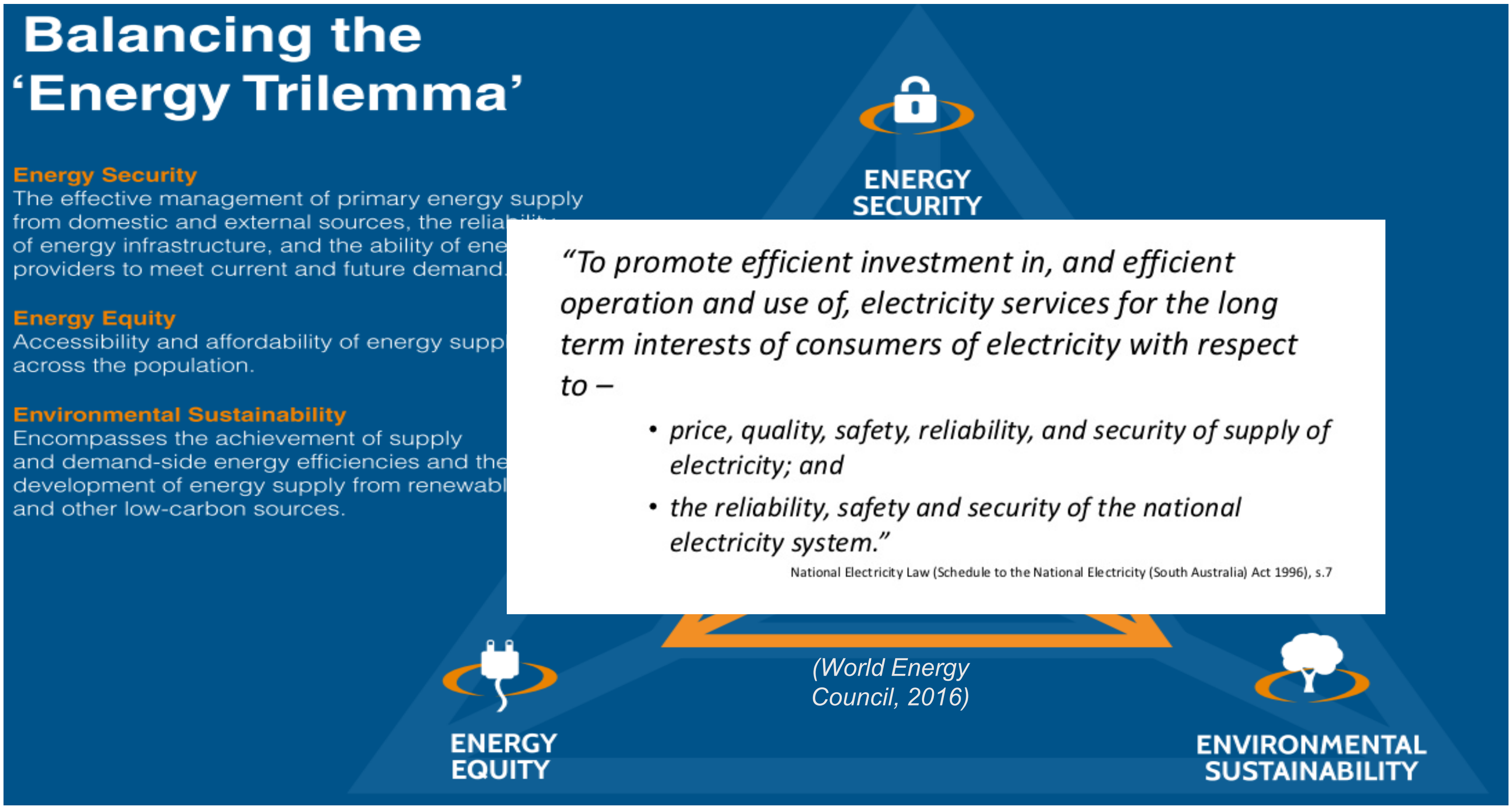
Welcome to the User Centred Energy Systems

Logistics



invite-only workshop and forum
lunch at the TETB cafe
Public lecture
HIGH STREET
BARKER STREET
ANZAC PARADE
BOTANY STREET
WILLIS STREET
VILLAGE GREEN
LEGEND
The Nucleus: Student Hub
Medical Centre
Security
EM Management
Bank
ATM
Construction Zone
General Parking
Bus Stop
Security Shuttle Bus Stop
Kensington to Paddington Bus Stop
Steps
Gate number
Directory
External Help Point
Internal Help Point
Bicycle Pump
Building Access
Help Zone (Student ID Cards)
NORTH
09/08/2019

Users apparently at the centre of the National Electricity Objective

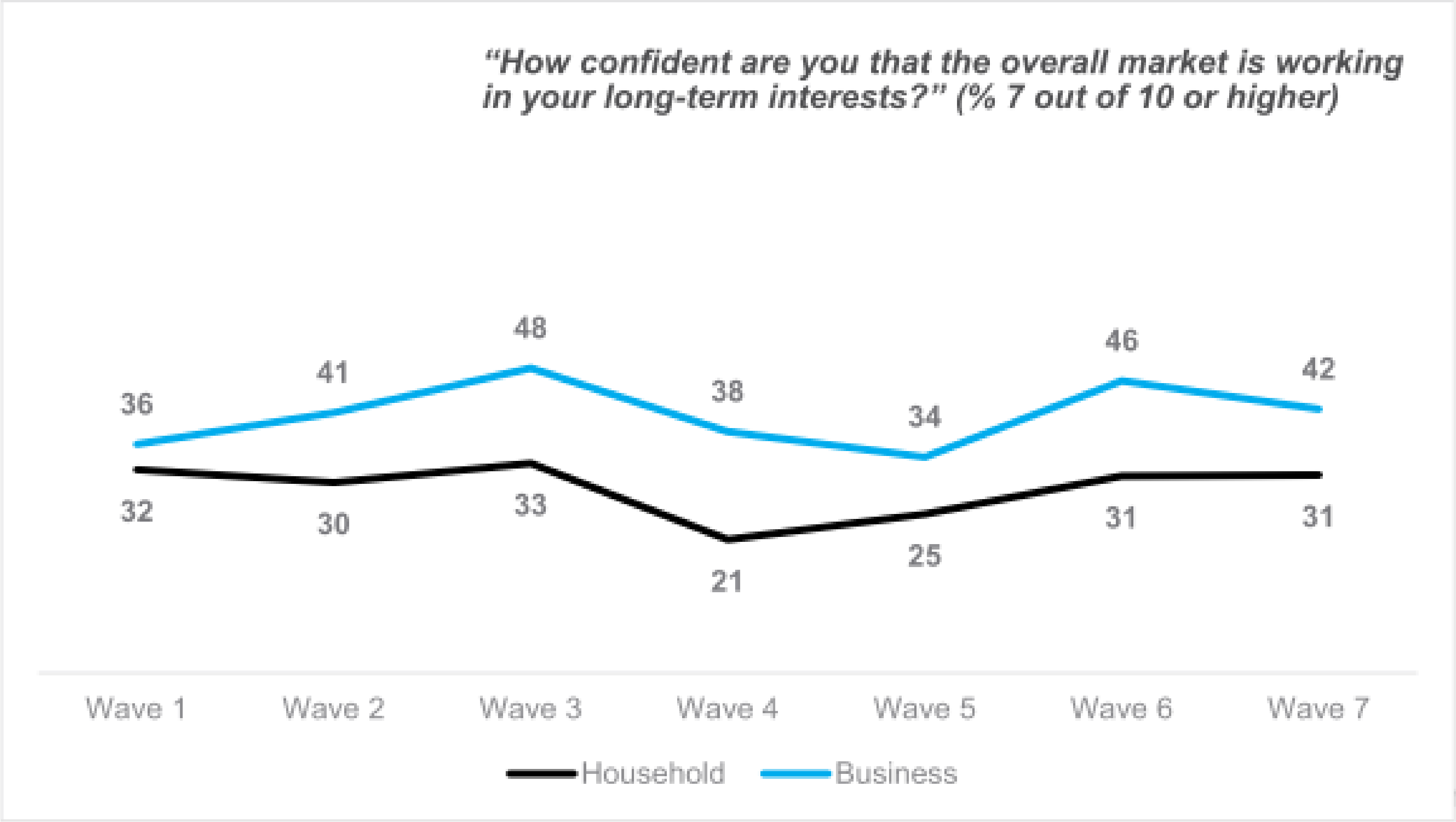


"To promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to –

- *price, quality, safety, reliability, and security of supply of electricity; and*
- *the reliability, safety and security of the national electricity system."*

National Electricity Law (Schedule to the National Electricity (South Australia) Act 1996), s.7

They aren't so sure

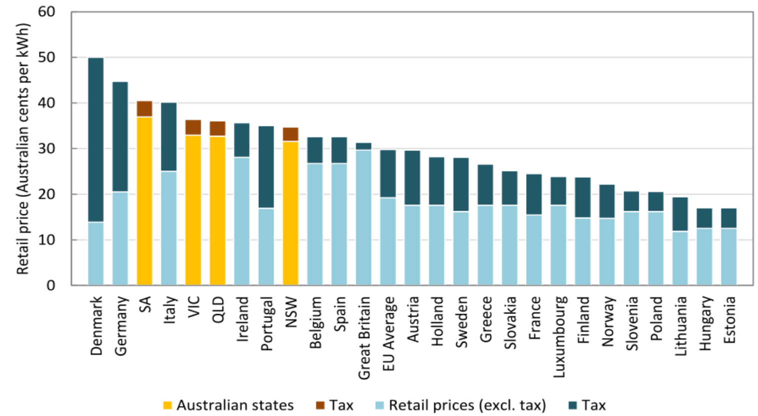


..with some reason

International retail electricity price comparison

(ACCC Retail Price Competition Inquiry, 2017)

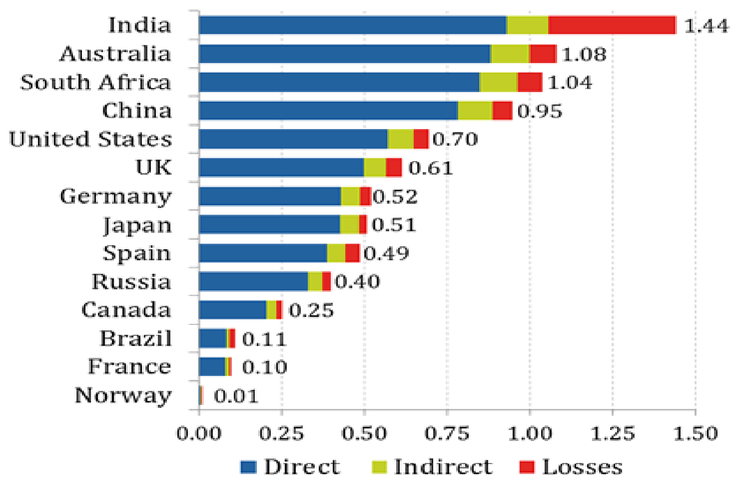
Figure 1.9: Comparison of residential electricity prices (before and after tax) (Australian cents per kWh) (May 2017 prices in Australia, 2015 prices in European countries)[62]



(ACCC, 2017)

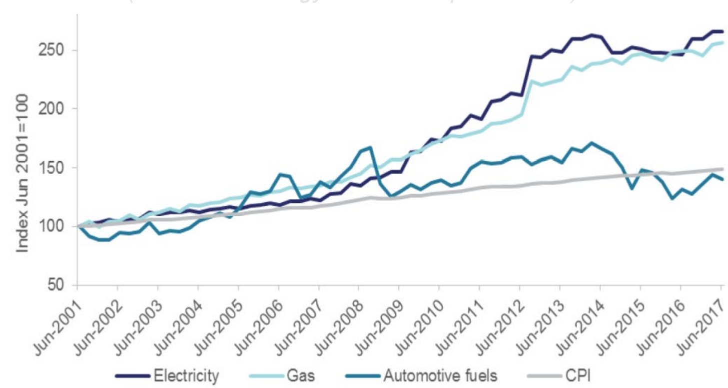
Electricity emissions intensity comparison

(shrink that footprint)



Australian residential energy prices index

(Australian Energy Statistics Update 2017)



Including growing security and reliability challenges

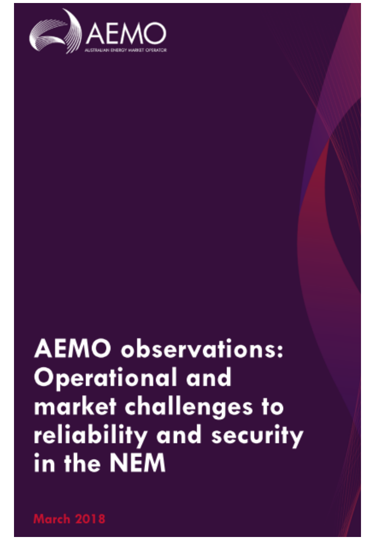


Table 1 Key system changes and operational challenges

Issue	What we are seeing	Operational implications	Potential avenues to address
Changing supply mix	• More variable renewable energy • Less dispatchable generation • Older resources	• Increased variability and uncertainty in the resource mix • Increased reliance on directions	• Forecasting improvements • Valuing flexible performance • Strategic reserves • Day-ahead markets • Integrated system planning
Changing electricity demand	• Higher ramps for peaks • Lower minimum demand • More active consumers • More distributed energy	• Increased variability and uncertainty in demand • Erosion of baseload • Increased ramping requirement	• Forecasting improvements • Use of DER • Valuing flexible performance • Strategic reserves
Changing impact of weather	• Temperature changes • Extremity of weather events	• Increased demand • Increased stress on system over prolonged heat periods • Increased risk of disruption • Increased uncertainty	• Planning operating standards • Use of DER • Optimising utilisation of demand side response – for reserves to manage uncertainty and support greater system resilience • Forecasting improvements

Not just an electricity sector problem

1 in 2 Countries Have Lost Faith in the System

Percent of population who believe the system is not working

- Above global average
- Aligned with global average
- Below global average

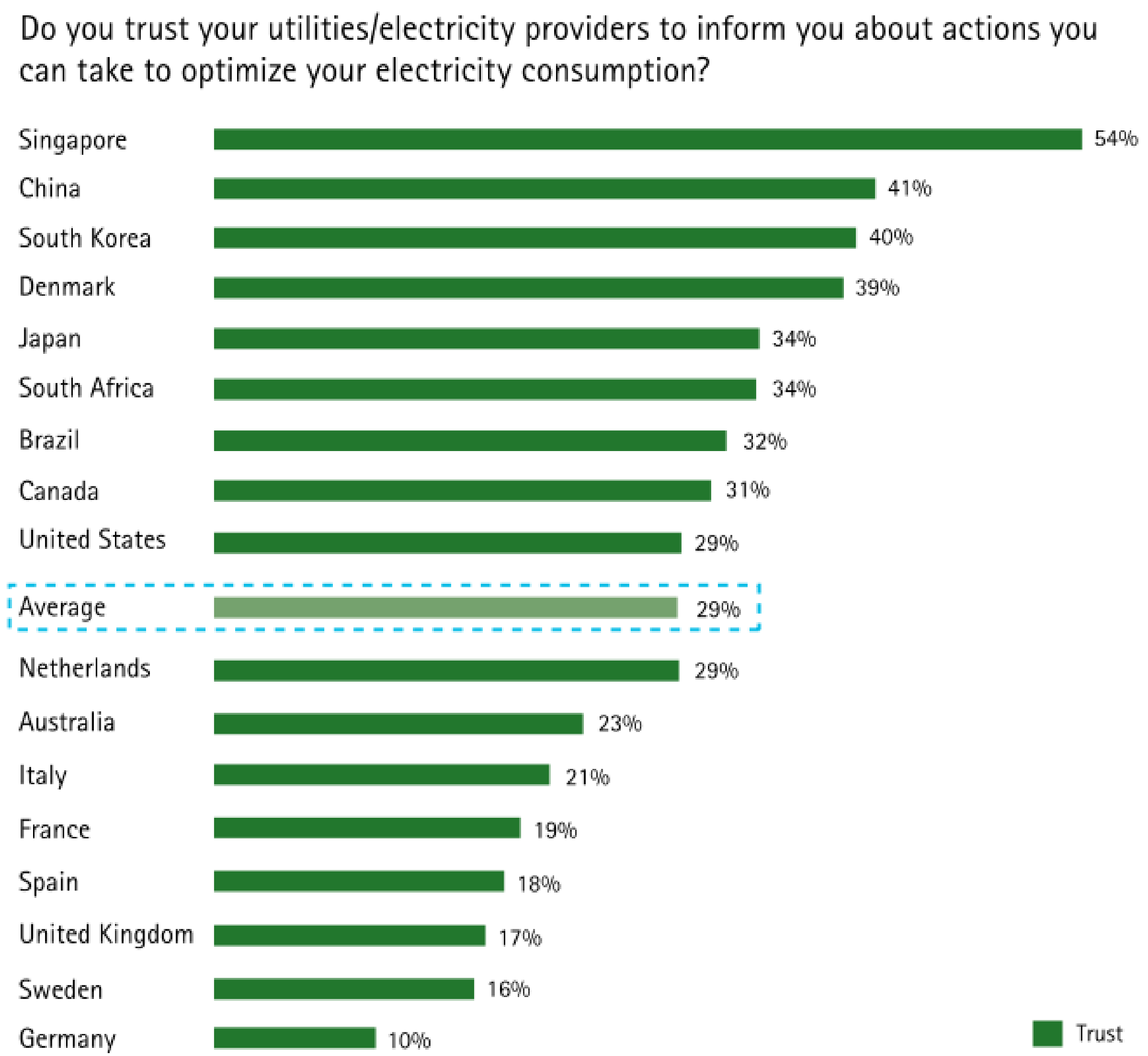
Systemic loss of faith restricted to Western-style democracies

In 14 countries, the percent of population that has lost faith is above the global average

	Global	France	Italy	Mexico	S. Africa	Spain	Poland	Brazil	Colombia	Germany	U.K.	Australia	Ireland	U.S.	Netherlands	Canada	Sweden	Argentina	Malaysia	Turkey	Russia	S. Korea	Indonesia	Japan	India	Hong Kong	Singapore	China	UAE
System failing	53	72	72	67	67	67	64	62	62	62	60	59	59	57	56	55	55	53	52	51	48	48	42	42	36	35	30	23	19
Uncertain	32	22	24	25	24	25	25	25	27	26	29	30	26	33	33	30	29	29	37	31	28	41	40	45	45	50	43	47	40

Source: 2017 Edelman Trust Barometer Q672-675, 678-680, 688-690.
For details on how the "system failing" measure was calculated, please refer to the Technical Appendix. The margin of error for the countries scores was added and subtracted from the global mean. Countries were considered above the global average if their score was higher than the global mean plus the margin of error. Countries were considered below the global average if their score was lower than the global mean minus the margin of error. All other scores were considered aligned.

And not just Australia



Virtual power plants, real pain … how the VPP puzzle has brought on a mild headache

14th October, 2019 | Australia, For Consumers, For Installers, Projects, Renewables, Solar, Solar, Solar Projects, Storage |

Virtual power plants made up of other people's batteries sound like a great idea but, gee, they're a headache to put together. Will they make it to the finish line or be overtaken by something better?

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Although the operational challenges in coordinating a varied orchestra of energy assets are pretty apparent there is plenty of confidence that VPPs can work, says Ryan Wavish, a principal consultant at Marchment Hill Consulting. The technology can perform the task, with batteries and control systems able to be integrated to follow centralised commands. But it's sometimes the finer details that present hurdles.

The Daily Telegraph

Anthony Roberts, Minister for Resources and Energy.

NSW

‘Smart’ energy meter move that bombed, lands in NSW

andrew clennell, The Daily Telegraph
October 27, 2014 2:48pm

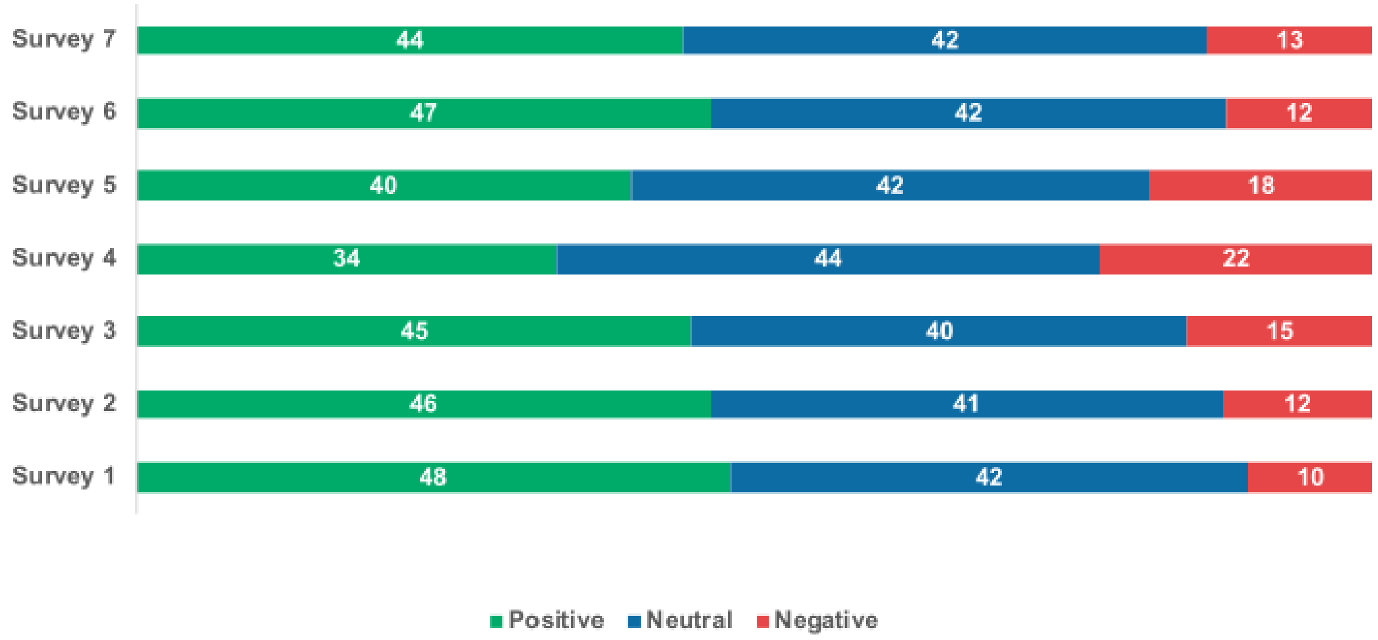
CONTROVERSIAL electricity smart meters — which resulted in a politicial disaster in Victoria when they were forced upon households in a mandatory rollout in 2009 — will be introduced in NSW under a government plan tied to deregulation of the electricity retail market.

But unlike their Victorian counterparts, NSW consumers will be given the choice to voluntary take up the meters.

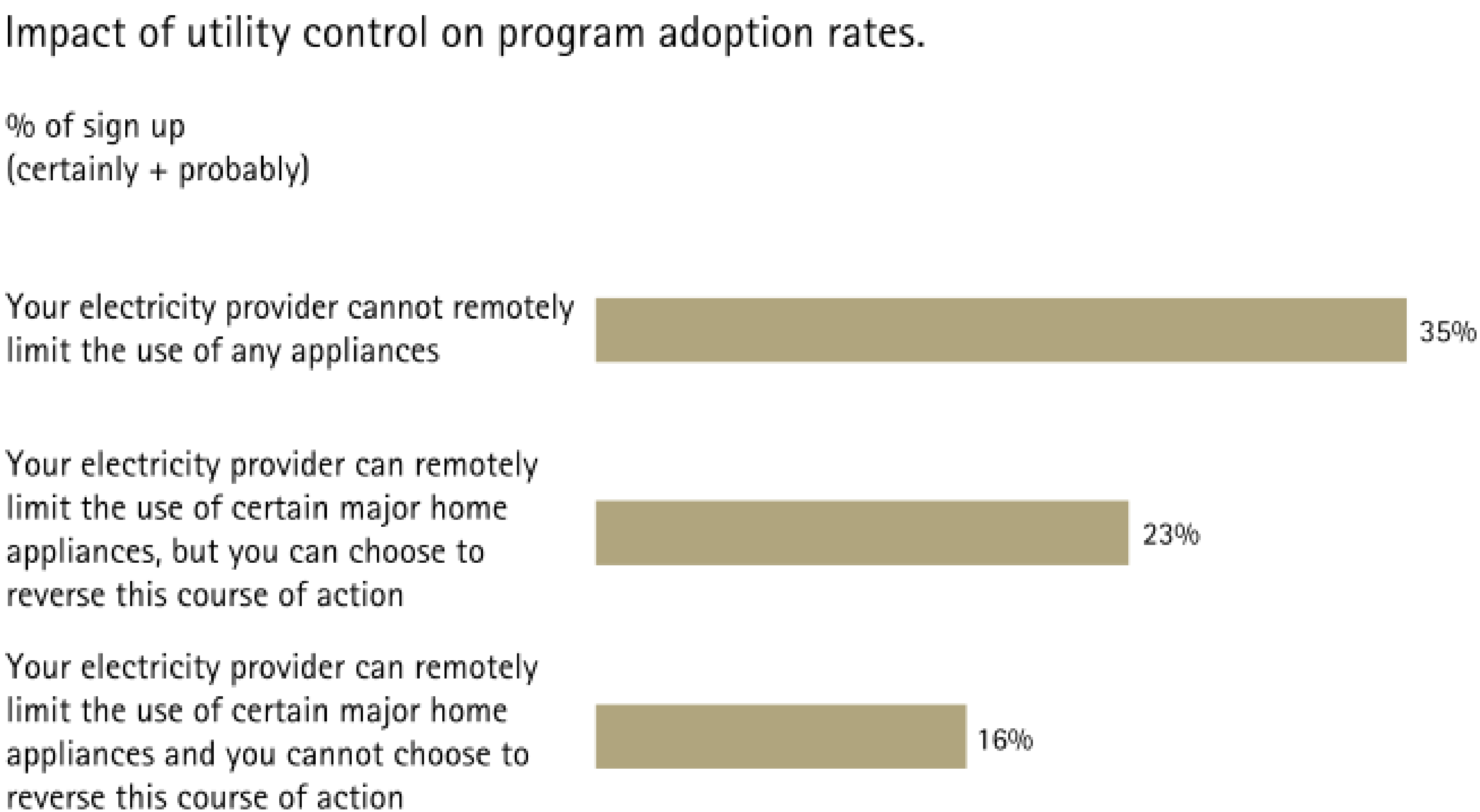
of the smart meters, but said he has learned a lesson from the unpopular compulsory Victorian rollout.

Not all bad news for tech

Figure 19 – Household's confidence in advances in technology

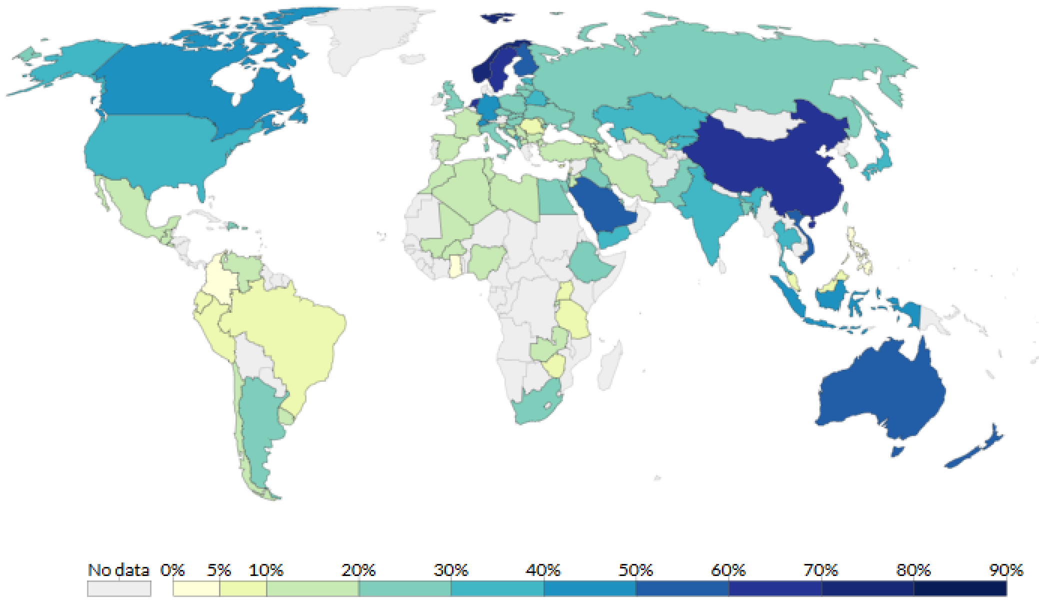


But certainly concerns…

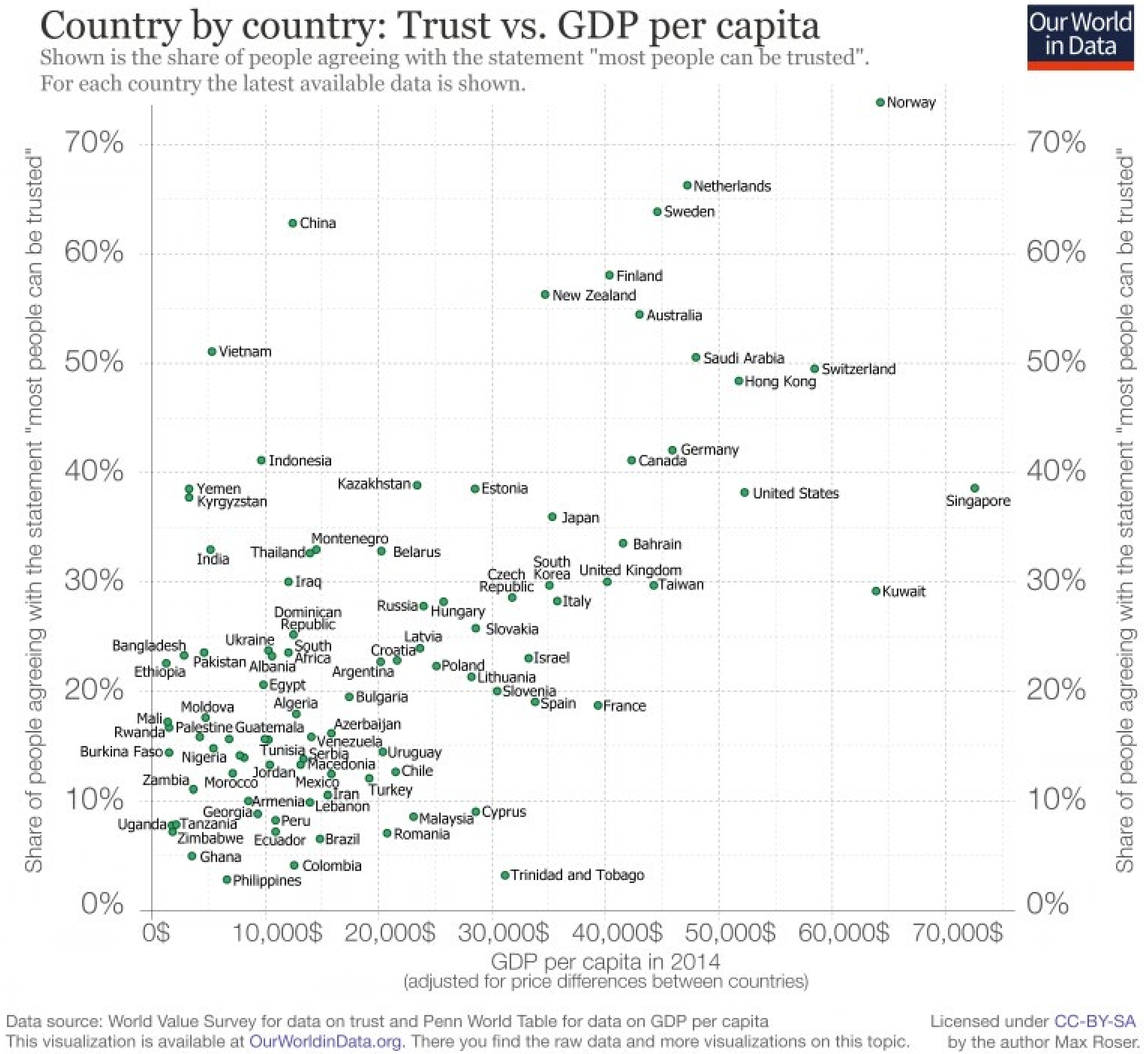


Interpersonal trust attitudes, 2014

Share of people agreeing with the statement "most people can be trusted" (World Value Survey).



Source: Trust (World Values Survey (2014))
Note: See source for further details regarding specific survey question.



Country by country: Trust vs. GDP per capita
Shown is the share of people agreeing with the statement "most people can be trusted".
For each country the latest available data is shown.
Our World in Data
Share of people agreeing with the statement "most people can be trusted"
0%
10%
20%
30%
40%
50%
60%
70%
GDP per capita in 2014
(adjusted for price differences between countries)
0$
10,000$
20,000$
30,000$
40,000$
50,000$
60,000$
70,000$
Norway
Netherlands
Sweden
China
Finland
New Zealand
Australia
Vietnam
Saudi Arabia
Switzerland
Hong Kong
Germany
Canada
Indonesia
Kazakhstan
Estonia
Yemen
Kyrgyzstan
United States
Singapore
Japan
Montenegro
Thailand
Belarus
Bahrain
India
South Korea
United Kingdom
Czech Republic
Taiwan
Iraq
Kuwait
Russia
Hungary
Italy
Dominican Republic
Slovakia
Latvia
Bangladesh
Ukraine
South Africa
Croatia
Israel
Pakistan
Albania
Poland
Ethiopia
Argentina
Lithuania
Egypt
Slovenia
Bulgaria
Spain
France
Moldova
Algeria
Mali
Palestine
Guatemala
Azerbaijan
Rwanda
Venezuela
Burkina Faso
Tunisia
Serbia
Uruguay
Nigeria
Macedonia
Chile
Jordan
Zambia
Morocco
Mexico
Turkey
Iran
Armenia
Lebanon
Georgia
Cyprus
Malaysia
Uganda
Tanzania
Peru
Romania
Zimbabwe
Ecuador
Brazil
Ghana
Colombia
Trinidad and Tobago
Philippines
Data source: World Value Survey for data on trust and Penn World Table for data on GDP per capita
This visualization is available at OurWorldinData.org. There you find the raw data and more visualizations on this topic.
Licensed under CC-BY-SA
by the author Max Roser.

Trust Index

Mass Population Left Behind

Average trust in institutions, Informed Public vs. Mass Population

Trusters (60-100)

Neutrals (50-59)

Distrusters (1-49)

Source: 2017 Edelman Trust Barometer.
The Trust Index is an average of a country's trust in the institutions of government, business, media and NGOs. Informed Public and Mass Population, 28-country global total.

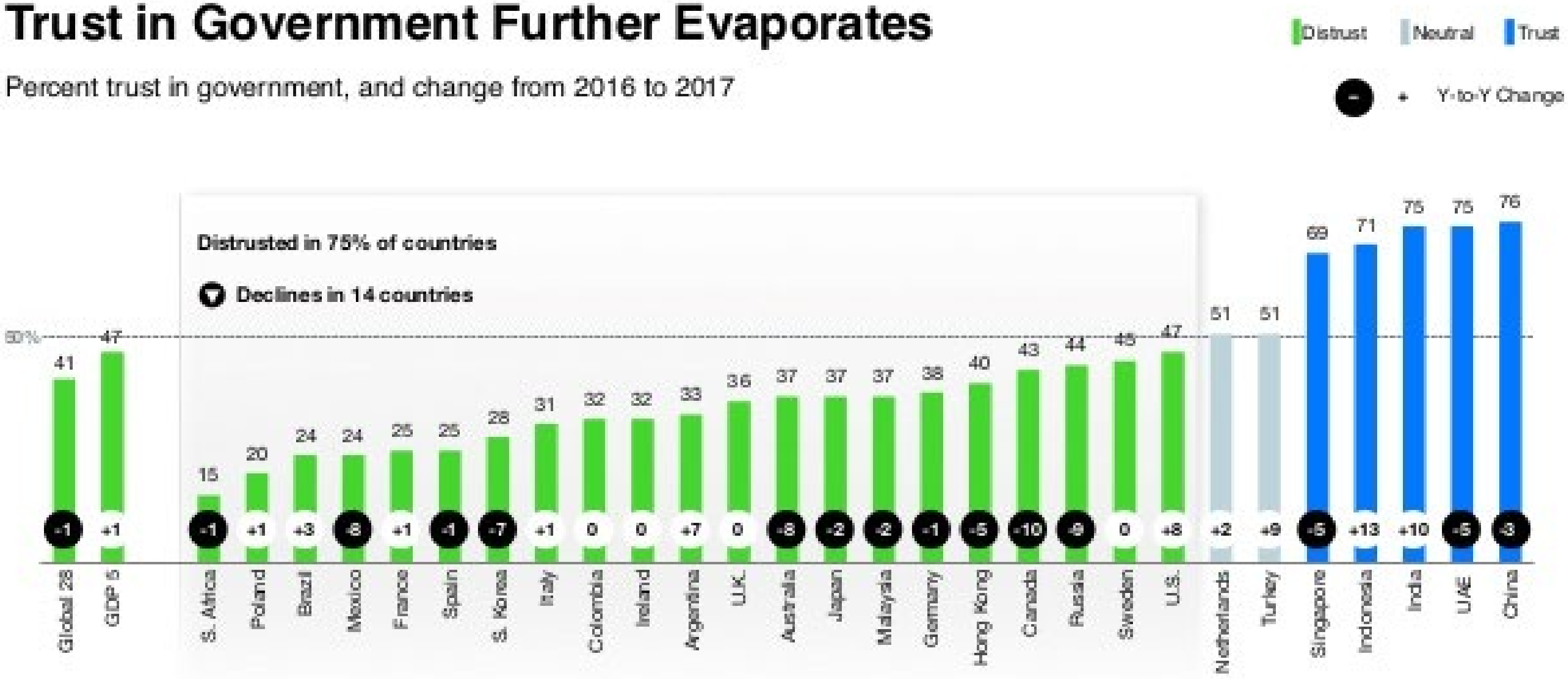
Informed Public	
60	**Global**
80	India
79	China
78	Indonesia
77	UAE
71	Singapore
68	U.S.
62	Canada
62	Netherlands
61	Italy
61	Mexico
57	Malaysia
57	Spain
56	France
56	U.K.
55	Colombia
54	Australia
54	Germany
53	Hong Kong
51	Argentina
51	Brazil
50	S. Korea
50	Turkey
49	Japan
49	S. Africa
47	Sweden
45	Russia
44	Ireland
43	Poland

Mass Population	
45	**Global**
70	India
67	Indonesia
62	China
59	Singapore
59	UAE
52	Netherlands
50	Colombia
50	Mexico
47	Brazil
47	Canada
47	Italy
47	Malaysia
47	U.S.
45	Argentina
42	Hong Kong
41	S. Africa
41	Spain
41	Turkey
40	Australia
39	Germany
38	France
37	U.K.
36	S. Korea
36	Sweden
35	Ireland
34	Japan
34	Poland
31	Russia

The Mass Population distrusts their institutions in 20 of 28 countries

Trust in Government Further Evaporates

Percent trust in government, and change from 2016 to 2017

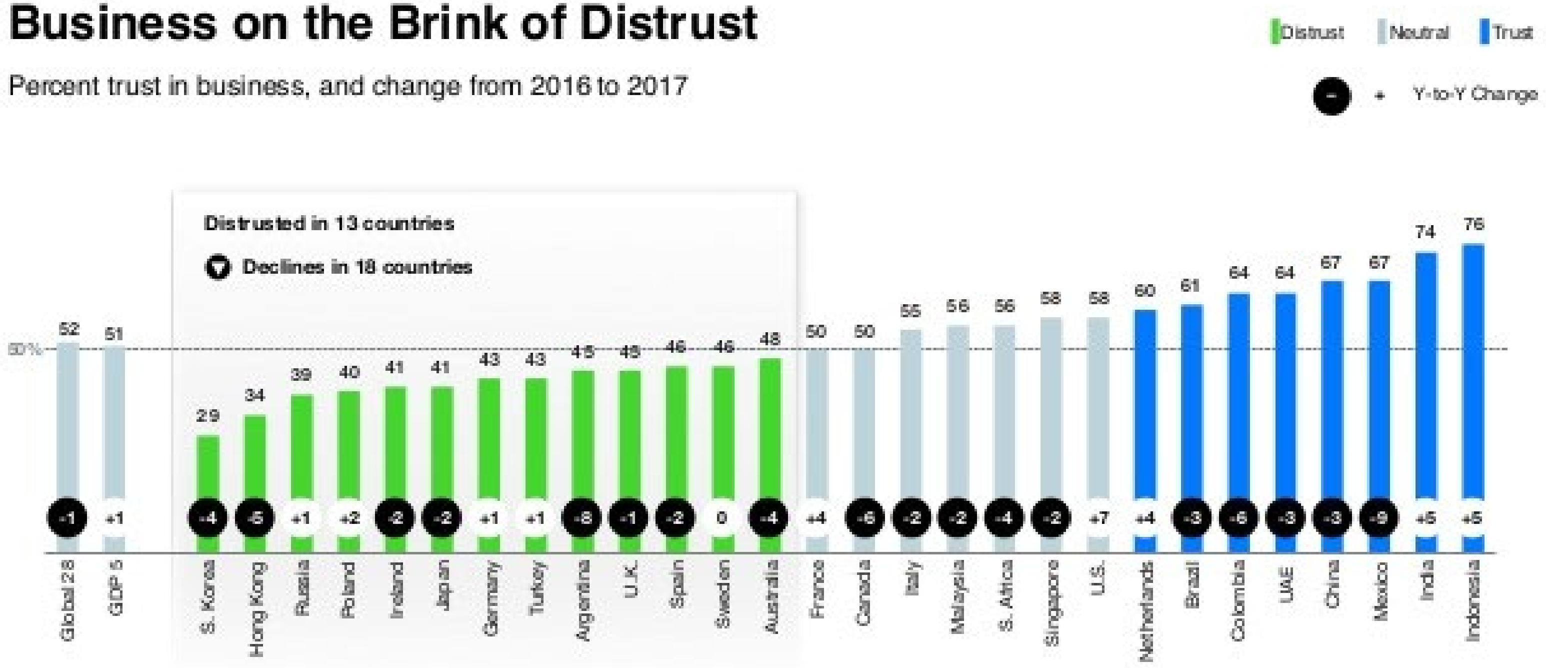


Source: 2017 Edelman Trust Barometer Q11-620. [TRACKING] [GOVERNMENT IN GENERAL] Below is a list of institutions. For each one, please indicate how much you trust that institution to do what is right using a nine-point scale where one means that you "do not trust them at all" and nine means that you "trust them a great deal." (Top 4 Box, Trust) General Population, 28-country global total.

GDP 5 = U.S., China, Japan, Germany, U.K.

Business on the Brink of Distrust

Percent trust in business, and change from 2016 to 2017



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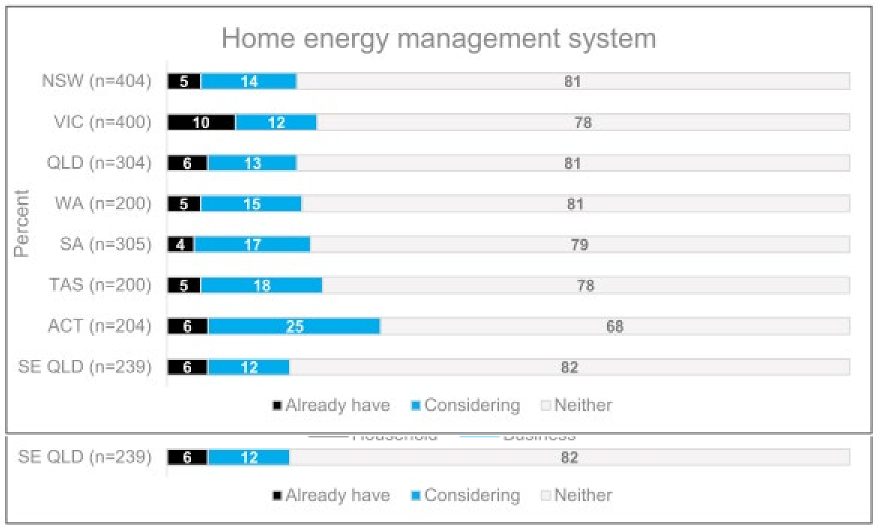
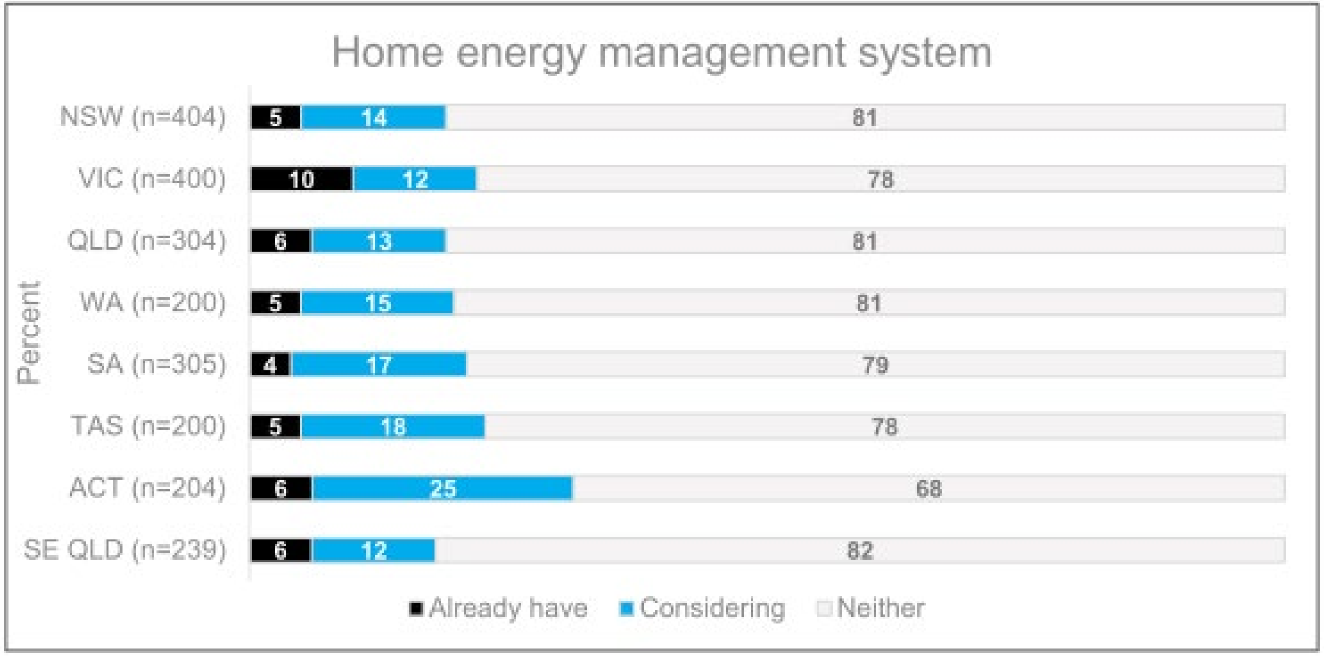

Home energy management system
Percent
NSW (n=404) 5 14 81
VIC (n=400) 10 12 78
QLD (n=304) 6 13 81
WA (n=200) 5 15 81
SA (n=305) 4 17 79
TAS (n=200) 5 18 78
ACT (n=204) 6 25 68
SE QLD (n=239) 6 12 82
Already have
Considering
Neither



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Percent
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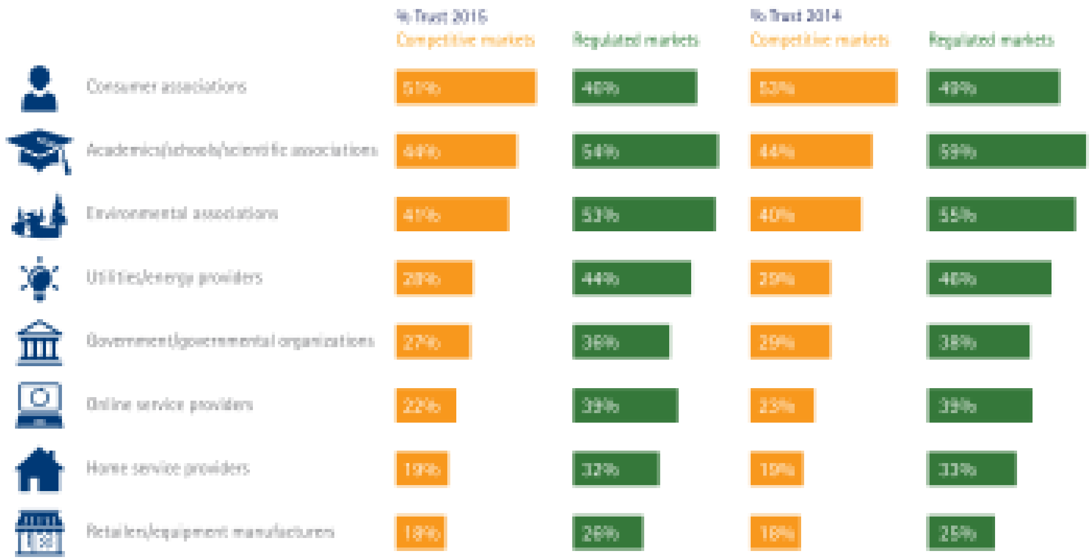
ACT (n=204)
SE QLD (n=239)
5 14 81
10 12 78
6 13 81
5 15 81
4 17 79
5 18 78
6 25 68
6 12 82
Already have
Considering
Neither

Figure 4. There is a marked difference in trust of utilities/energy providers across competitive and regulated markets.

What organizations do you trust to inform you about actions you can take to optimize your energy consumption?



Virtual power plants, real pain … how the VPP puzzle has brought on a mild headache

14th October, 2019 | Australia, For Consumers, For Installers, Projects, Renewables, Solar, Solar, Solar Projects, Storage | ★★★★★

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Figure 25 – Household's confidence in the market

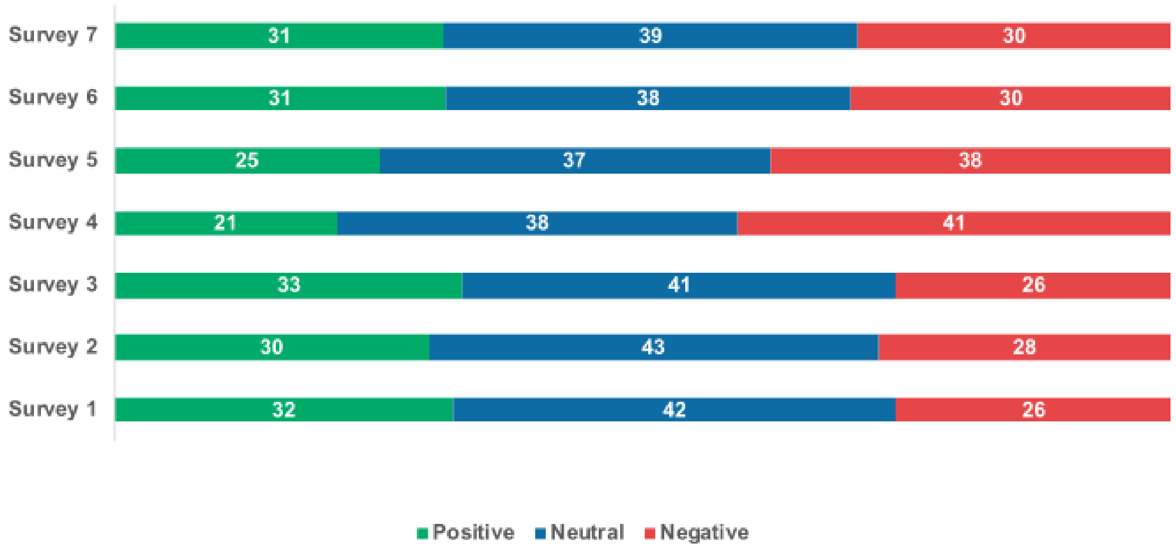
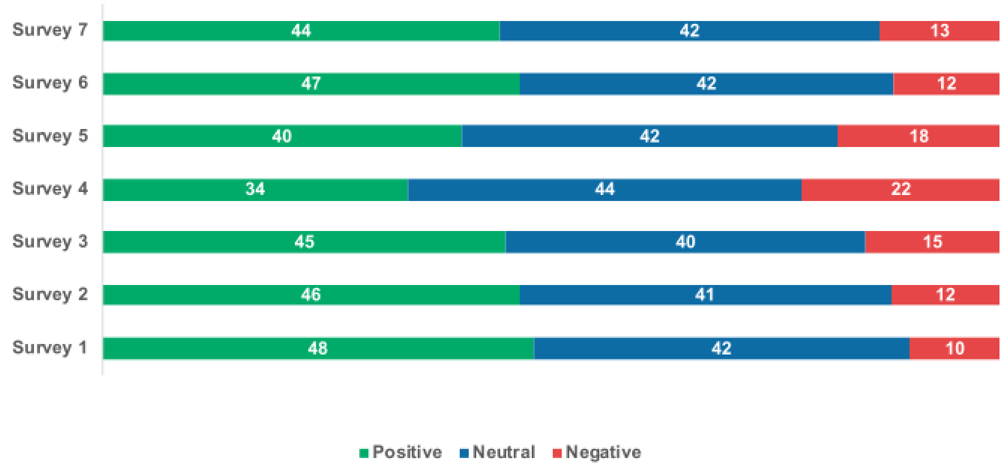
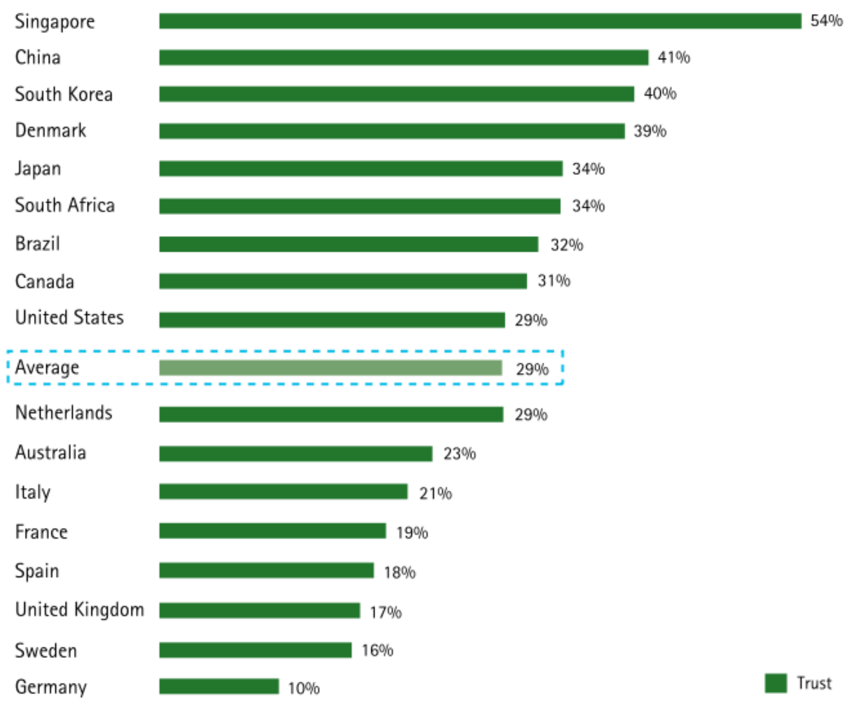


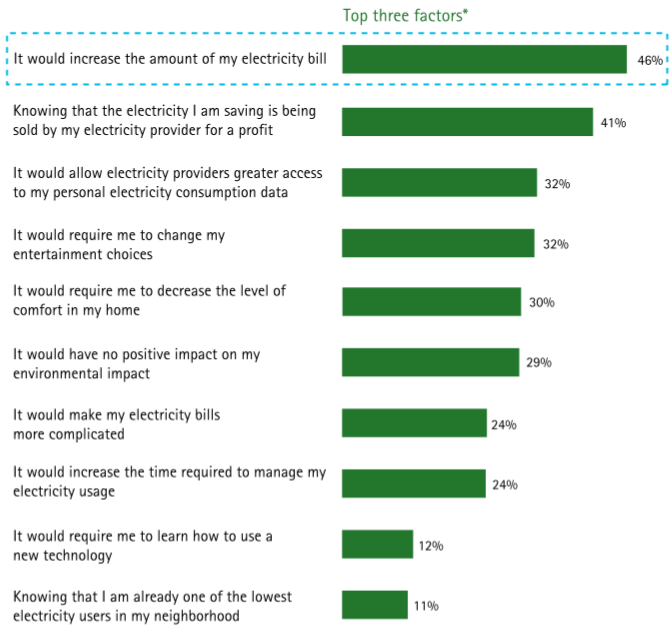
Figure 19 – Household's confidence in advances in technology



Do you trust your utilities/electricity providers to inform you about actions you can take to optimize your electricity consumption?



Which factors would most discourage you from using electricity management programs?



*All factors appeared among respondents' top three factors

Source: Understanding Consumer Preferences in Energy Efficiency
Base: All respondents

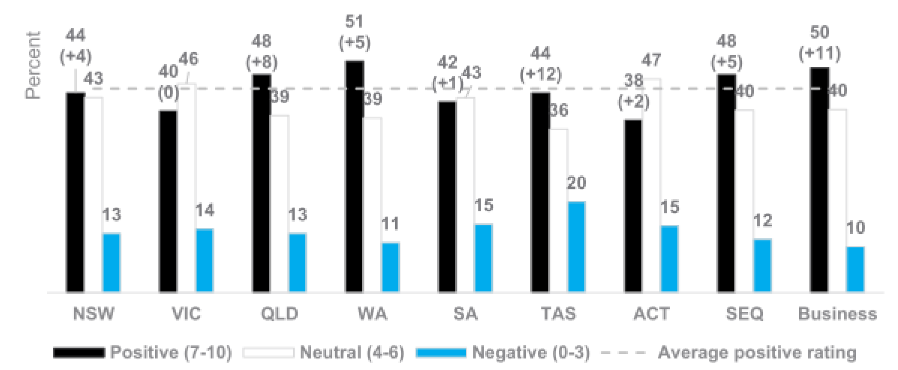
Confidence in future technology

The proportion of consumers expressing confidence that the market will deliver technological advances to manage energy costs has increased in most markets.

- Increases were largest in TAS (up 12% to 44%) and among small business consumers (up 11% to 50%).

Thinking about the overall market outcomes, how confident are you that the energy market will provide better outcomes for you in 5 years, in terms of technological advances to manage your energy supply and costs?

0-10 scale, 0='not at all confident', 10='very confident'



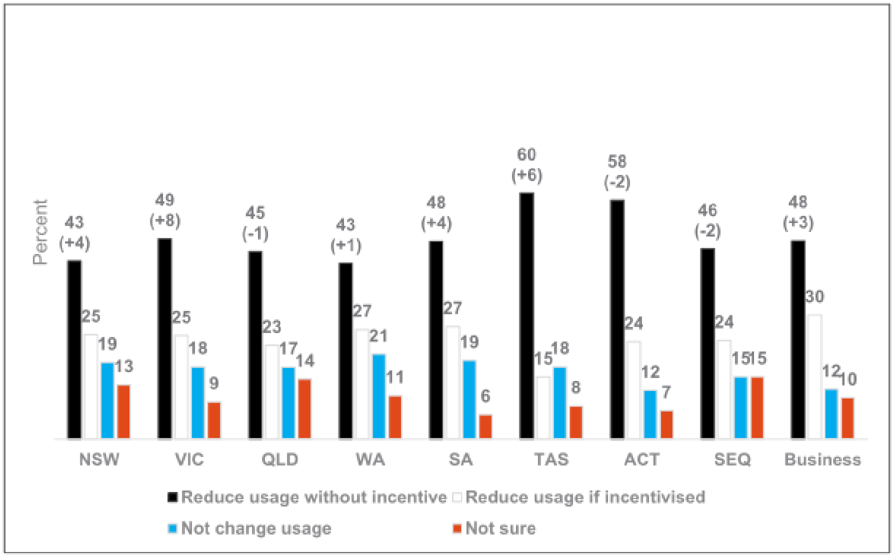
Energy use reduction campaigns
Energy use reduction campaigns

Energy use reduction campaigns

Most consumers are prepared to reduce energy use during periods of very high demand.

- Across all markets, a strong majority say that they would be willing to reduce their energy usage in periods of high demand and most of these say they would do so without requiring an incentive.
- About one in four household consumers would require an incentive to do so.

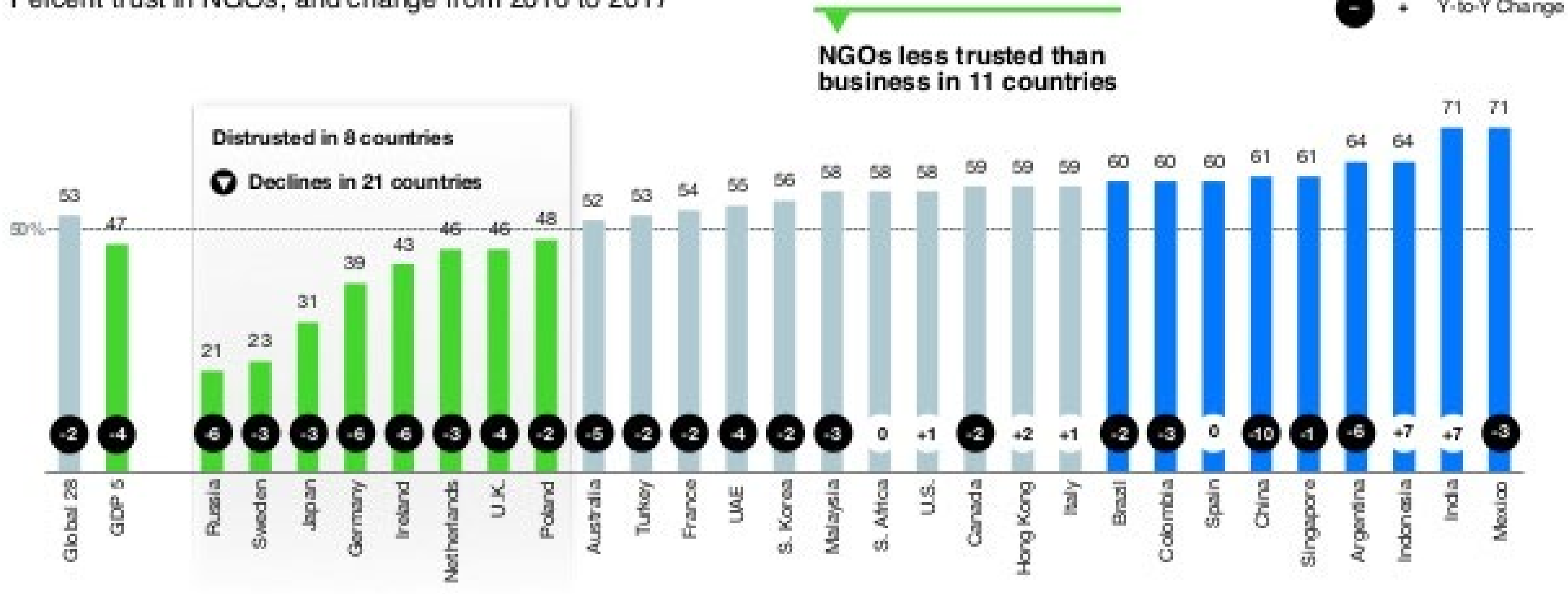
As you may be aware, sometimes there are campaigns asking people to reduce their energy use during periods of very high demand (e.g. when everyone is using their air conditioning during very hot periods). Such campaigns are often backed by government agencies or respected community groups. If there was such a campaign asking that people reduce their energy use during a very hot period, which of the following would you be most likely to do?



Base: Household consumers (n=2,037), Small business consumers (n=285).

Trust in NGOs Declines

Percent trust in NGOs, and change from 2016 to 2017



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GDP 5 = U.S., China, Japan, Germany, U.K.

Introducing Social License to Automate Task

Dr Declan Kuch and Dr Sophie Adams (UNSW)

Overview

Who are we?

What are we trying to do?

How are we going to do it?

What do we want to achieve today?

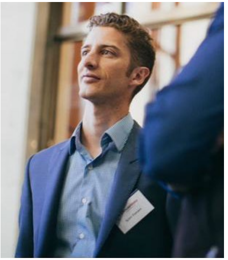
Who are we?

Our Research: Engineering

Dr Anna Bruce

A/Prof Iain MacGill

Dr Mike Roberts (UNSW)



Scott Ferraro (Monash)

Expertise in electricity market design and policy

Dr Bruce: renewable energy systems, development,

A/Prof MacGill: power systems engineering, market design, climate and energy policy

Dr. Roberts: residential energy, home energy systems

Scott Ferraro: Monash NetZero project

Australian Research Partners

UNIVERSITY of TASMANIA
AUSTRALIA

ENERGY CONSUMERS AUSTRALIA

renew.

MONASH University

energy efficiency COUNCIL

public interest ADVOCACY CENTRE

International Partners

Zürcher Hochschule für Angewandte Wissenschaften
zh aw School of Management and Law

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY

KTH VETENSKAP OCH KONST

TU Delft

UNIVERSITÉ DE GENÈVE

In discussions/ Pending:

ASU Arizona State University

NUS National University of Singapore

What are we trying to do?

Scope

Social License: ‘ongoing acceptance of a company’s operations’ often refers to project timeframes. Origins in mining industry.

Trust: verb, noun, ‘mood’?

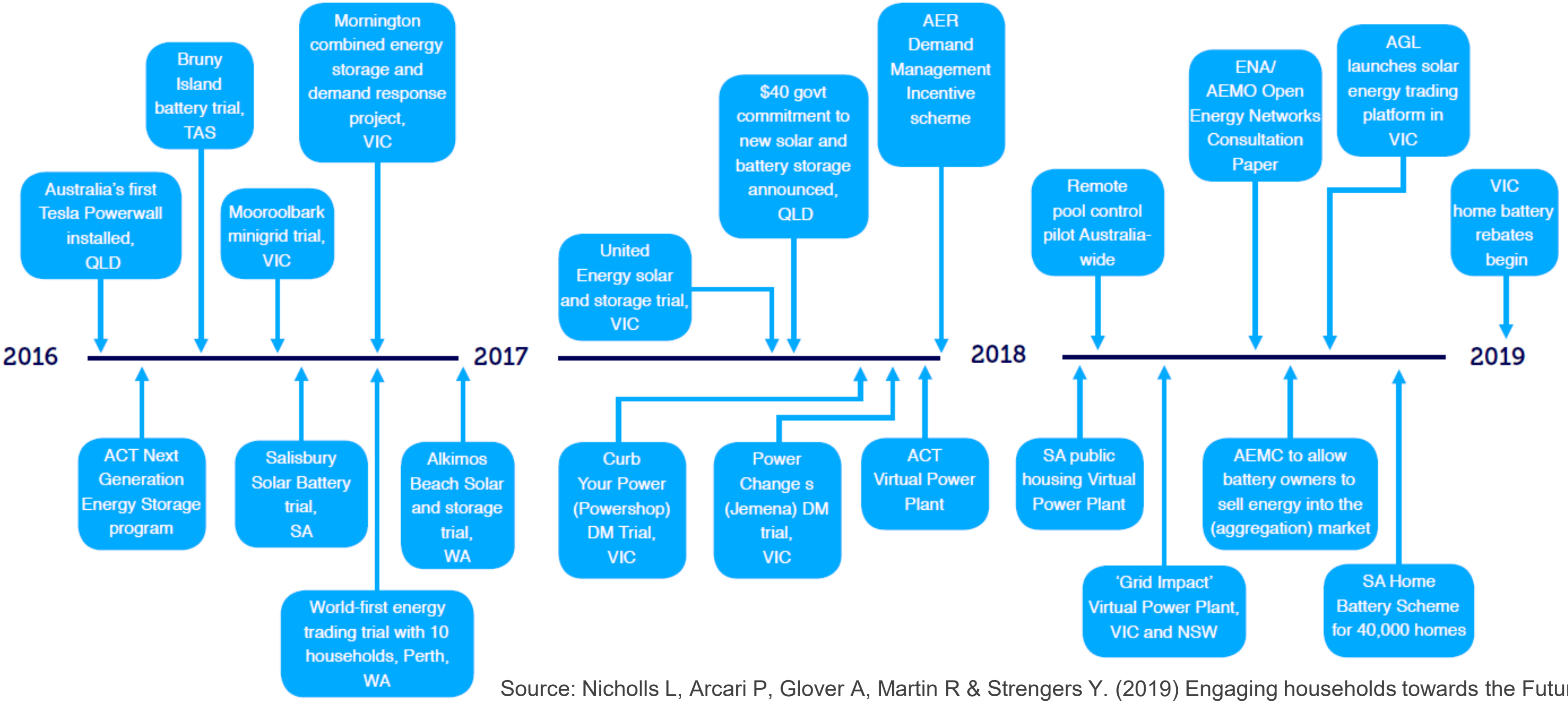
- to do what?
- a Trust (legal structure)

Automation

- Direct load control
- Demand Response
- load shifting technologies
- Virtual Power Plants

Case Studies: Automation/DSM

Figure 1. Sample of household solar and demand management initiatives and announcements in Australia 2016-2018



Source: Nicholls L, Arcari P, Glover A, Martin R & Strengers Y. (2019) Engaging households towards the Future Grid: experiences, expectations and emerging trends, Centre for Urban Research, RMIT University, Melbourne.

1. Context is critically important:

Users are open to some modes of engagement more than others, or only in specific conditions. A lack of receptiveness to automation can stem from resistance to the forms of engagement required of users (likely to be more important than from the principle of automation in itself).

2. Time frames matter:

Users accept automation to achieve load flexibility of only some energy consumption practices and within some time frames.

3. Preference for levels of ‘visibility’ will vary:

Direct load control may in fact be the preferred form of automation for some users where it can keep load shifting and shaving ‘invisible’ or imperceptible

Data Collection Hypotheses

4. Ability of users to retain **control** will impact receptiveness to automation
5. Fair **Compensation** through money or recognition will influences users' willingness to cede control
6. Why: **Transparency about the rationale** for automation in DSM, as well as about the ways in which **different actors may benefit from it**, can increase receptiveness to automation.
7. Ownership (in broadest sense) matters: **A sense of a stake in successful DSM**, and ownership over how it is undertaken, can increase receptiveness to automation.

Overview

How are we planning to get there?

Themes within the literature on automation for DSM	Observations	Relevant sources	Hypothesis	Possible approaches and cases for investigation
The load flexibility achieved through automation	As an alternative to behavioural change or manual response approaches in DSM, automation (both semi-automation and direct load control) is designed to achieve flexibility on behalf of the user, reducing the need for their active engagement. However, automation itself also necessitates new forms of user engagement, including managing automation technologies (e.g. programming smart appliances) and changing household practices to accommodate an automated flexible load. Studies of existing and prospective users have documented a variety of responses to what automation does or would require of them.	Some users have e.g. expressed 'fears about the time and energy required' to manage the automation technologies themselves (Paetz et al 2012). At least some of the householders participating in existing DSM programs have experienced the changes to their household practices associated with load shifting as inconvenient and disruptive (Pallesen and Jenle 2018; Christensen and Friis 2016), while focus group participants in studies exploring perspectives on the prospect of automation have raised concerns about possible disruption to important practices such as family mealtimes (Murtagh et al 2014; Paetz et al 2012).	Users are open to some modes of engagement more than others, or only in specific conditions. A lack of receptiveness to automation can stem from resistance to the forms of engagement required of users (perhaps more than from the principle of automation in itself).	

Work Plan: two streams

1. Country profiles documenting key cultural and policy factors shaping trust in automated load control and energy management.
Output: country profile reports
Responsibilities: National experts, with assistance from operating agents

2. Documentary and Case Study Subtasks
A) The user's sense of control over their energy use: Trusted infrastructures Fieldwork (primarily)

B) Socio-technical making of automation and load flexibility
Fieldwork (primarily)

C) Designing and Aligning Institutional Interests
Desktop analysis (primarily)

D) Policy and Regulatory Analysis
Desktop analysis (primarily)

Questions, comments, suggestions:

d.kuch@unsw.edu.au

User-Centred Energy Systems

Social License to Automate Annex Launch Event

Public lecture

User-Centred Energy Systems

Reshaping Energy – Reshaping society

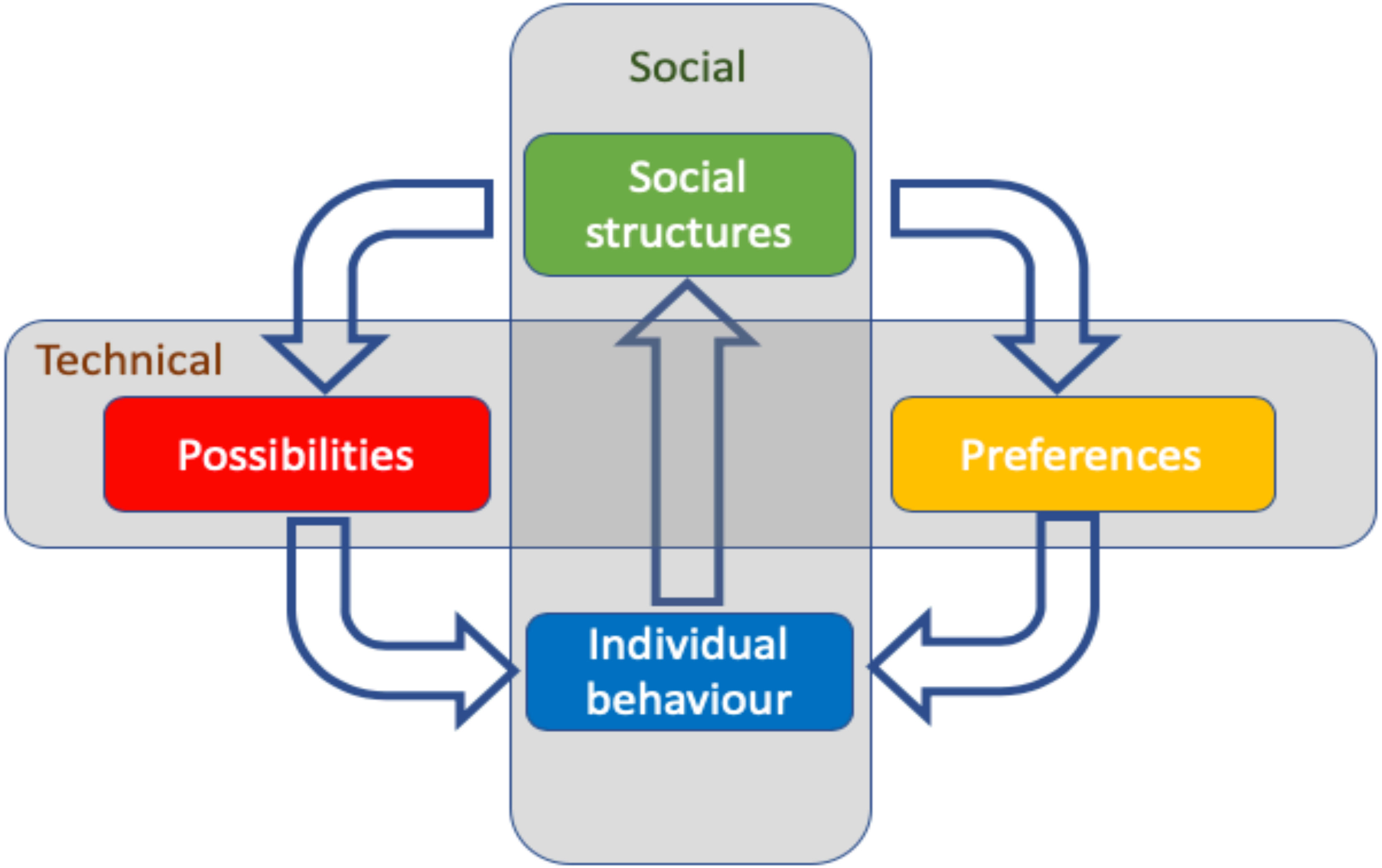
David Shipworth

UsersTCP

Systems tell people how to act. People tell systems how to change

Humans use energy through technologies to fulfil social functions. We shape, and are shaped by, the technologies we use.

All technologies, business models, energy policies and programmes contain a model of human behaviour.



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Energy is a socio-technical system

$$\text{National energy} \equiv \underbrace{\frac{\text{Energy Input}}{\text{Service Unit}}}_{\text{Energy Intensity}} \times \underbrace{\frac{\text{Service Demand}}{\text{Capita}}}_{\text{Consumption Intensity}} \times \underbrace{\text{Number of Citizens}}_{\text{Population Size}}$$

$$\frac{\text{Energy Input}}{\text{System Choice}} \times \frac{\text{System Choice}}{\text{Tech. Choice}} \times \frac{\text{Tech. Choice}}{\text{Design Eff.}} \times \frac{\text{Design Eff.}}{\text{Manu. Eff.}} \times \frac{\text{Manu. Eff.}}{\text{Assum. Behav.}} \times \frac{\text{Assum Behav}}{\text{Actual Behav.}} \times \frac{\text{Actual Behav}}{\text{Service Unit}}$$

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Energy is a socio-technical system

$$\text{National energy} \equiv \overbrace{\frac{\text{Energy Input}}{\text{Service Unit}}}^{\text{Energy Intensity}} \times \overbrace{\frac{\text{Service Demand}}{\text{Capita}}}^{\text{Consumption Intensity}} \times \overbrace{\text{Number of Citizens}}^{\text{Population Size}}$$

- Service demand depends how we structure society:
  - **Physical Infrastructures:** Cycling lanes; heat networks; etc
  - **Temporal structures:** Work times; School times; holidays; etc
  - **Social structures:** Social norms; cultural expectations; social practices;
  - **Psychological structures:** Habits and routines; role modelling; etc
  - **Legal structures:** speed limits; property ownership; collaborative economy; etc
  - **Economic structures:** taxes & charges; subsidies; etc
  - **Knowledge and skills:** Information campaigns; skills training; etc

Created by Pierre-Luc Auclair from Noun Project

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Reshaping energy: Major challenges

Socially regressive **Recruiting talent** **Socially progressive**

Industry: investment + recruitment and retention of talent

Centralised **Asset location, ownership & governance** **Distributed**

Regulators: Adoption of DERs

Cost minimisation **Consumer engagement** **Value maximisation**

Industry: attraction and retention of customers

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Recruitment and retention of talent

Socially regressive

Vs.

Socially progressive

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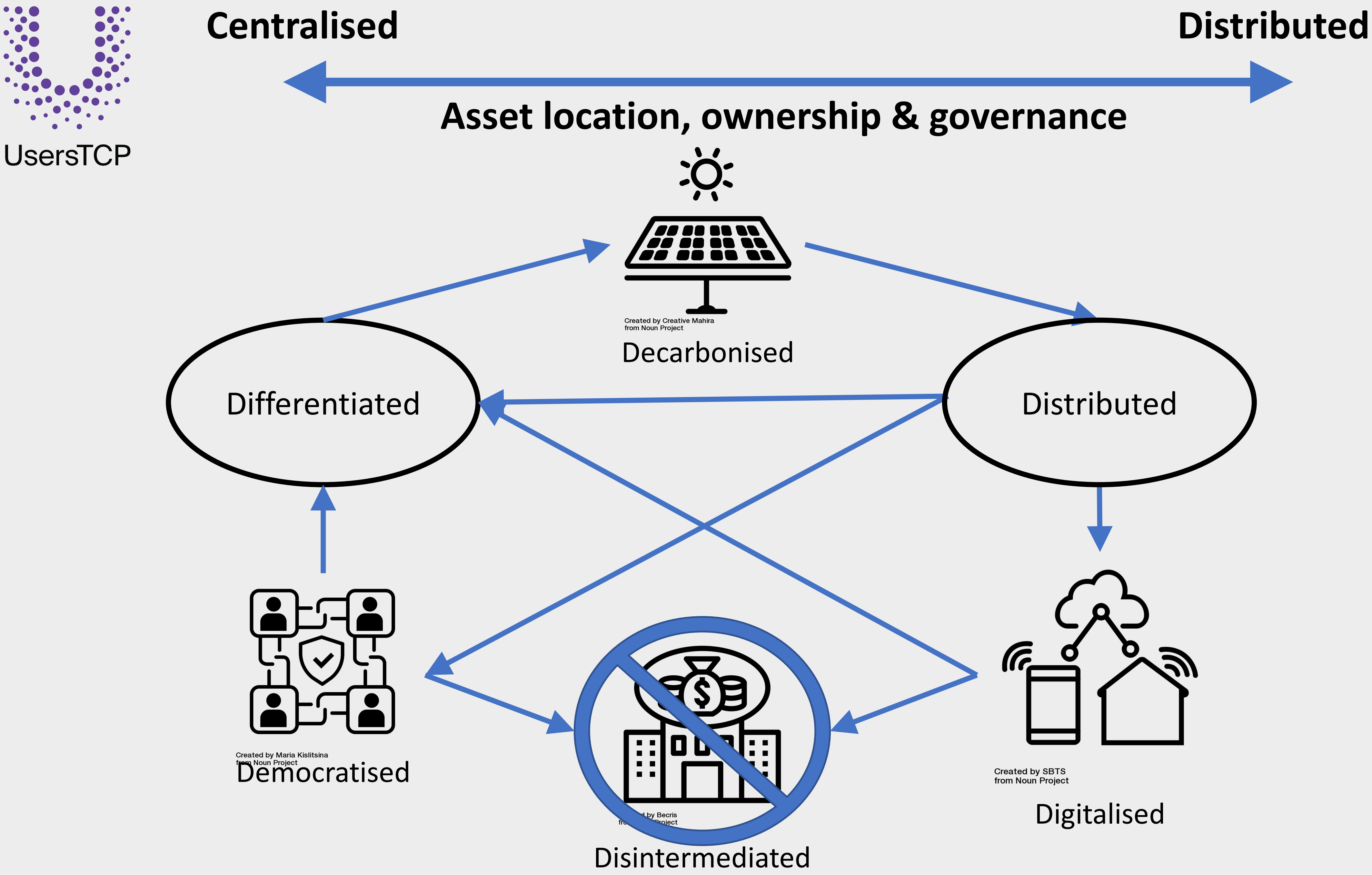
Distributed assets & governance

Centralised

Vs.

Distributed


UsersTCP
Centralised
Distributed
Asset location, ownership & governance
Created by Creative Mahira
from Noun Project
Decarbonised
Differentiated
Distributed
Created by Maria Kislitsina
Democratised
Disintermediated
Created by SBTS
from Noun Project
Digitalised

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Consumer engagement through value engineering

Cost minimisation

Vs.

Value maximisation

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Consumer engagement through value engineering

- Cost engineering
  - Approach of energy industry, regulators and planners
  - Energy planning based on whole energy system cost minimization
  - Energy is a homogenous good differentiated only by price
  - Energy suppliers have a temporal monopoly
- Value engineering
  - Approach of ICT & Fin.Tech sector + principles based regulation
  - Energy planning based on whole energy system value maximization
  - Reflects consumer expectations of constant value added services
  - Uses energy data to make differentiable goods that create consumer value

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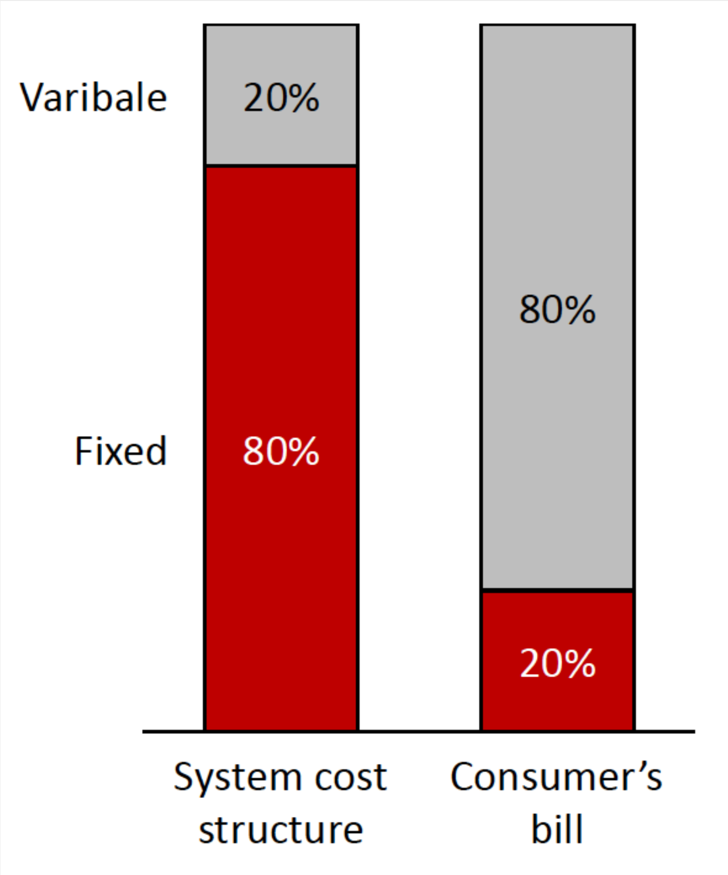
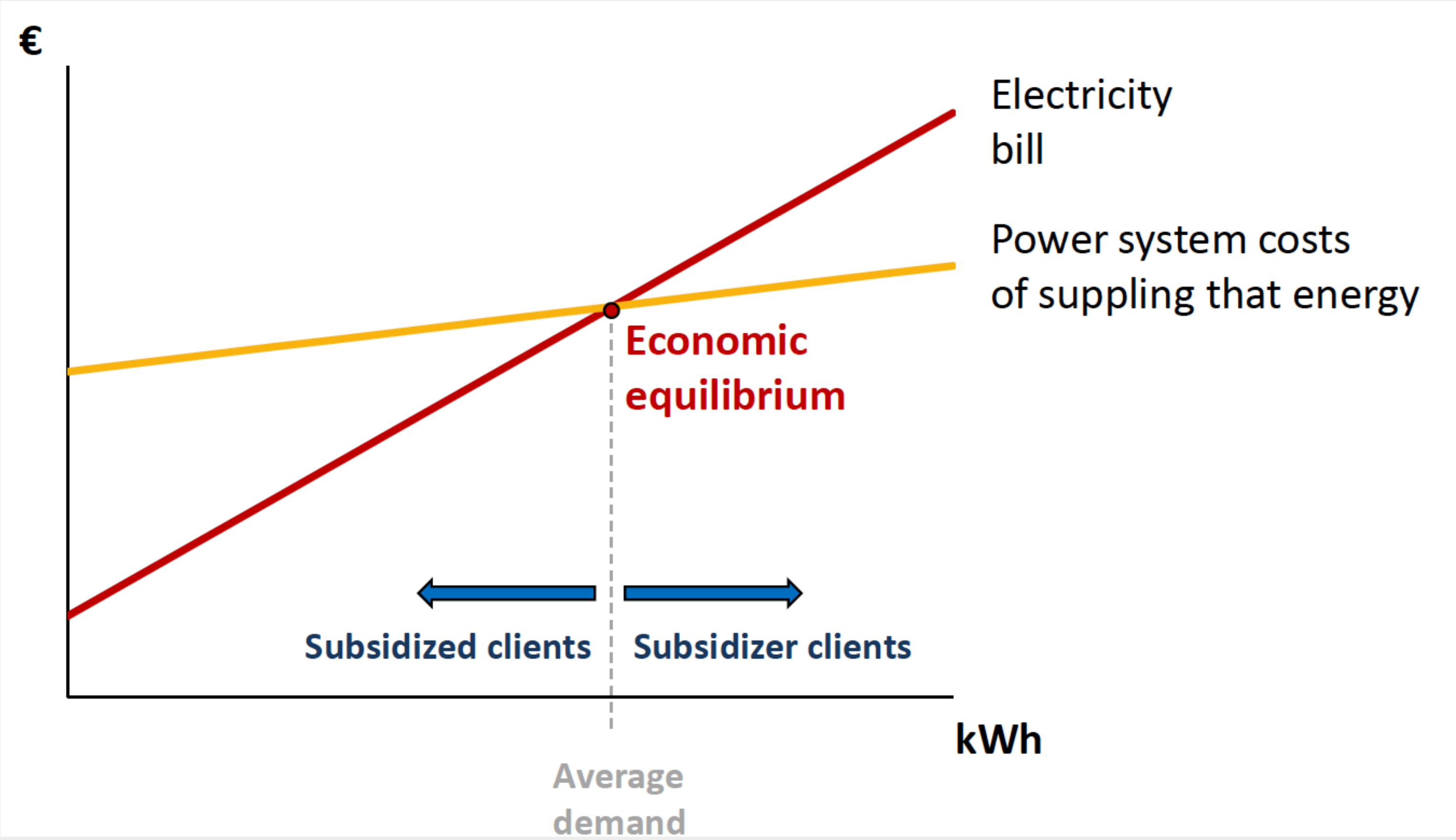
Consumer engagement through value engineering

- Maximising consumer engagement.
  - Identifying the social, psychological and financial value to consumers.
  - Design one platform that delivers multiple value streams (social, psychological and financial)
  - Designing intuitive interfaces with smart defaults and overrides that deliver value(s) to consumers.
  - Maximising the 'double-dividend' (saving + shifting) of self-consumption through increased engagement and salience.
- Minimising social costs
  - Working out how to equitably socialise the cost of a robust universal energy service.
  - Avoiding social marginalisation arising from product differentiation and 'energy gated' communities.

Key challenge: Socially equitable energy pricing





- Source: Ana Quelhas, EDP, Designing electricity retail tariffs to promote decarbonization
- Oxford Institute for Energy Studies Electricity Day, Oxford, November 7, 2018

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Constructing consumer value

- Consumer are disengaged with energy
  - It’s hard to get excited about a ubiquitous homogenous product
  - The current system is designed for consumer disengagement.
    - Like money, energy has no intrinsic value. The problems are very similar to those of banking. Like money, there is a lack of trust in market actors
- Lack of value(s)
  - Energy is an undifferentiated intermediary good that needs to be linked to non-energy values to engage customers
- Consumers want good energy-enabled services
  - People like appliances (for convenience and social signaling)
  - People like the services appliances and their ecosystems provide
  - People like the services energy data can provide

The great energy industry consumer disconnect

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- **Consumer organisations:** Minimum price for customers
- **Suppliers:** Minimum price for customers
- **Distribution Network Operators**: Power management
- **Transmission Network Operators:** Energy management
- **Government**: More renewables integration
- **Environmental organisations**: Carbon management
- **Market Makers:** Energy & Power management
- **New Entrants:** Energy management
- **Analysts/Academics**: Energy management

- **Consumers:** Comfort; convenience; health; social acceptability; risk; money; environment.

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The great energy industry consumer disconnect

- *'Welcome-home'*: have your home warm and ready when you arrive (currently available)
- *'Ghost-guard'*: maintaining energy & appliance use patterns (lights, radio, etc) while you are away.
- *'Think-ahead'*: Supermarkets' home delivery pre-chills your fridge/freezer.
- *'Benefit-bit'*: link your Fitbit to your AC unit to pre-emptively cool your home as activity level rises
- *'Movie-mood'*: download heat & light effects to accompany your favourite movies.
- *'Healthy-home'*: While on holiday, drive you home temperature and relative humidity levels to create conditions to kill mould & dust-mites.
- *'Fault-finder'*: Diagnose faulty appliances before they fail – avoid high price distress purchases
- *'Trade-checker'*: Run diagnostic tests on your building fabric and equipment to ensure tradesmen's work has been done correctly.

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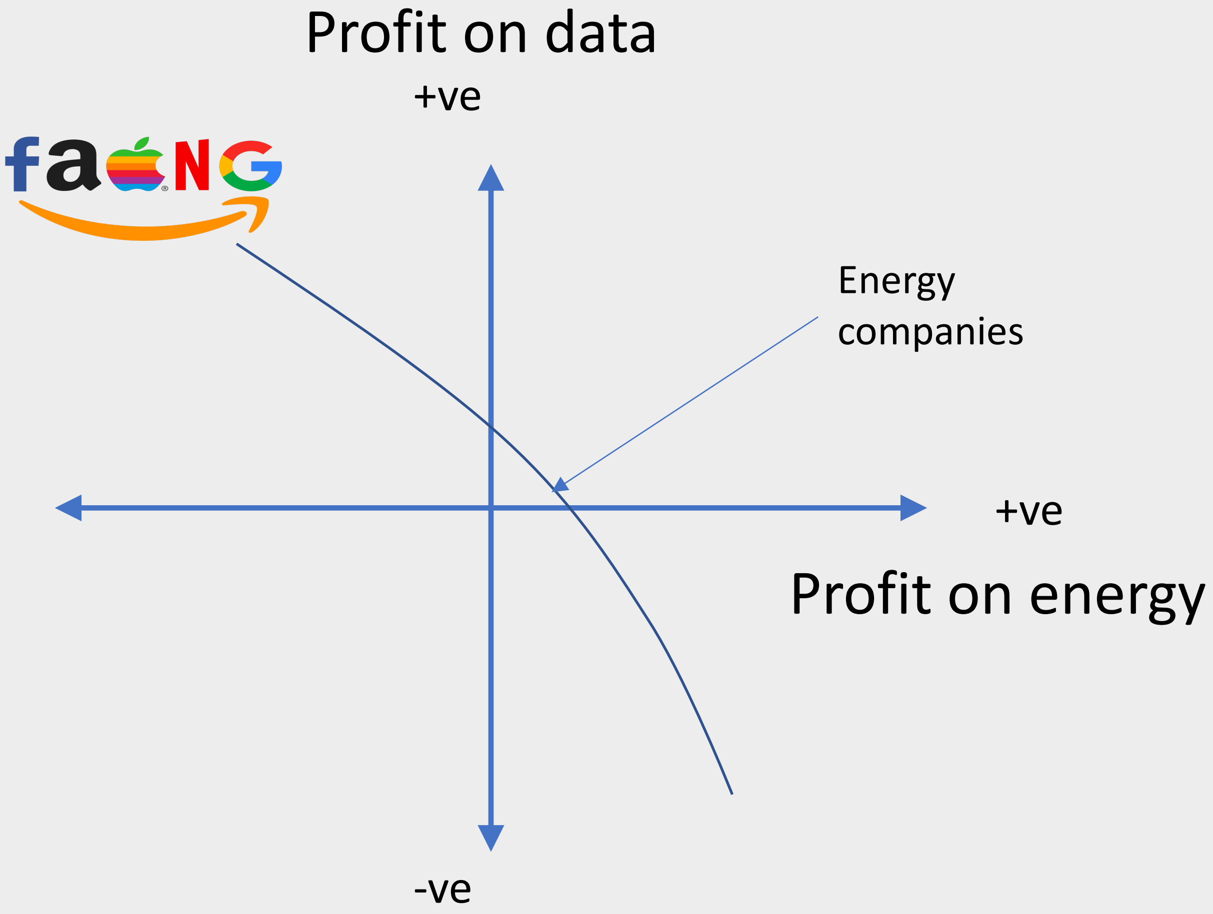
The value of electricity as a data vector

- Non-Intrusive Load Monitoring (NILM) can be used to virtually sub-meter appliances. This supports customer value through:
  - Disaggregated billing (low consumer interest)
  - Enhanced appliance-level feedback (low consumer interest)
  - Hazard reduction - e.g. fire risk appliances (interest to home insurers which pass lower premiums on to consumers)
  - Appliance use monitoring (interest for reminders appliance ecosystem product and service providers)
  - Appliance condition monitoring (more consumer and manufacturer interest)
- MIT have shown that high frequency electricity monitoring can be used to identify what TV channel you are likely to be watching or what website you are likely to be browsing.

What happens when the value of electricity as a data vector becomes significant?

- To what extent are the value of energy data, and the value of energy aligned?
- What does this graph look like? (I don't know – but I know it's -ve important)



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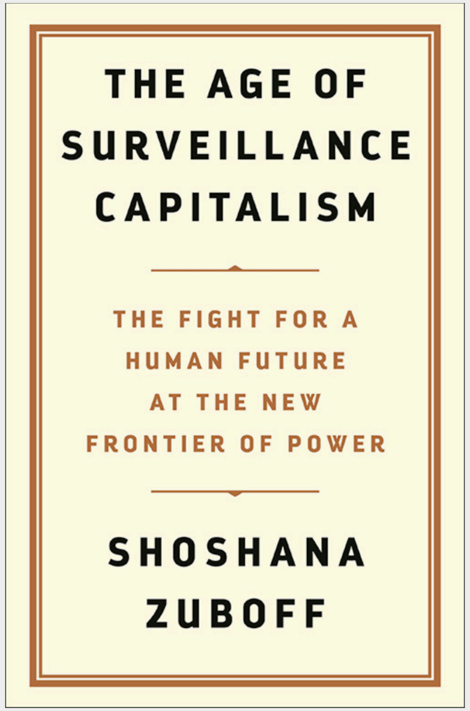
A Dystopian turn: Surveillance capitalism and behavioural prediction markets



Prof. Shoshana Zuboff – Harvard business school

- ’A new economic order that claims human experience as free raw material for hidden commercial practices of extraction, prediction and sales.’ (Zuboff 2019)
- ‘Behavioural prediction markets’ entail predicting or altering consumer behavior for targeted advertising.
- Google’s Nest thermostat entails over 1000 contracts and privacy agreements.
    - Queen Mary University Legal Studies Research Paper No. 219/2016
- Energy data can support targeted advertising inside the home delivering convenience and service to customers (at a price).

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A Utopian turn: Local energy for social value

- Supports communities through:
  - Local skills, education & training
  - Keeps money in community
  - Supports collaborative economy
  - Provides local energy resilience
- Supports CSR through profile matching:
  - Supermarkets buy from Schools during summer holidays
  - Homes donate to schools during term
  - Defense support local community
  - Etc
    - [Ref: http://communityenergyengland.org/wp-content/uploads/2015/10/Infographic_2015_Combined.pdf]
      [Ref: Community energy in the UK: A review of the evidence, Call for Evidence responses.]

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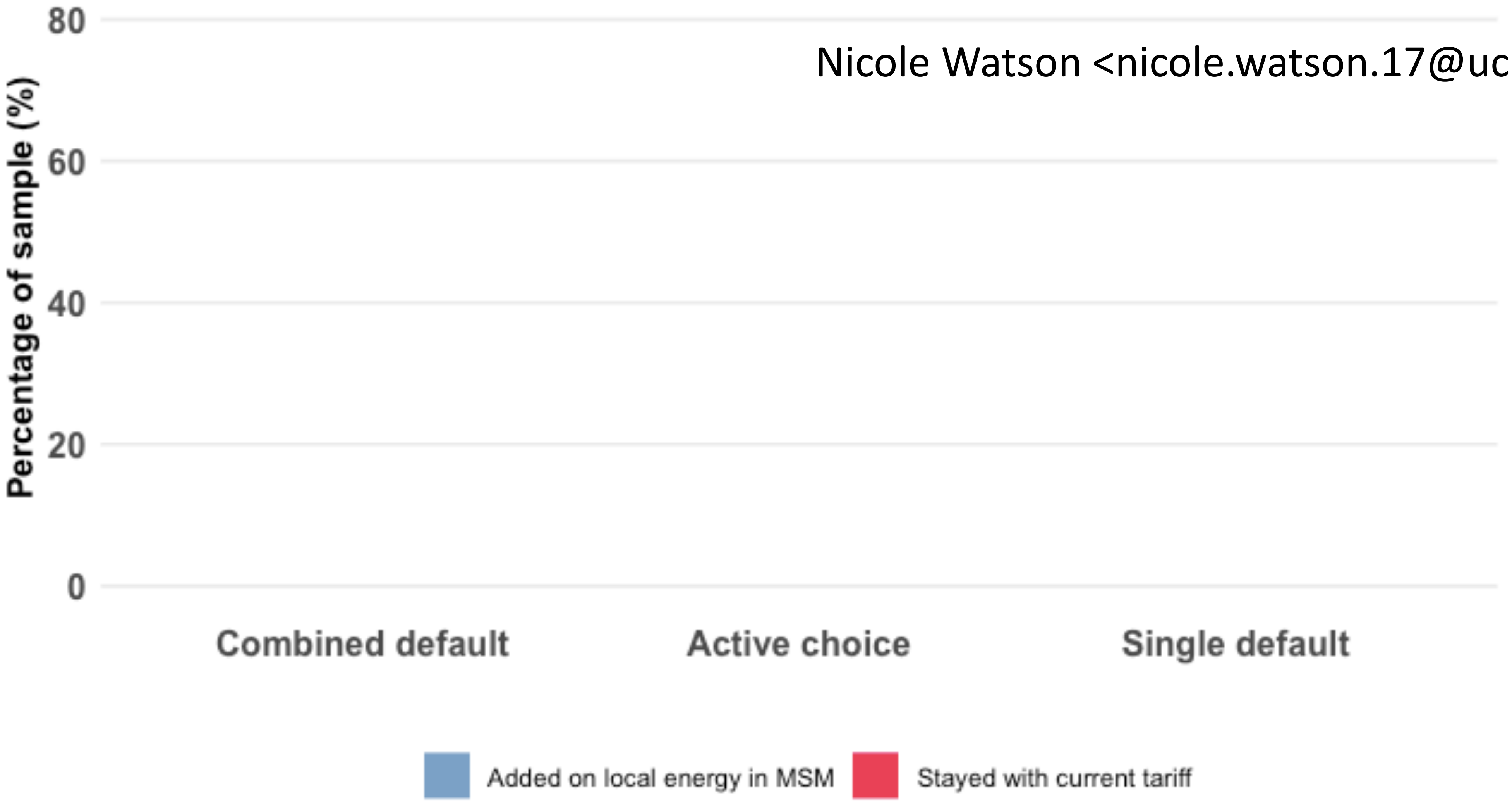
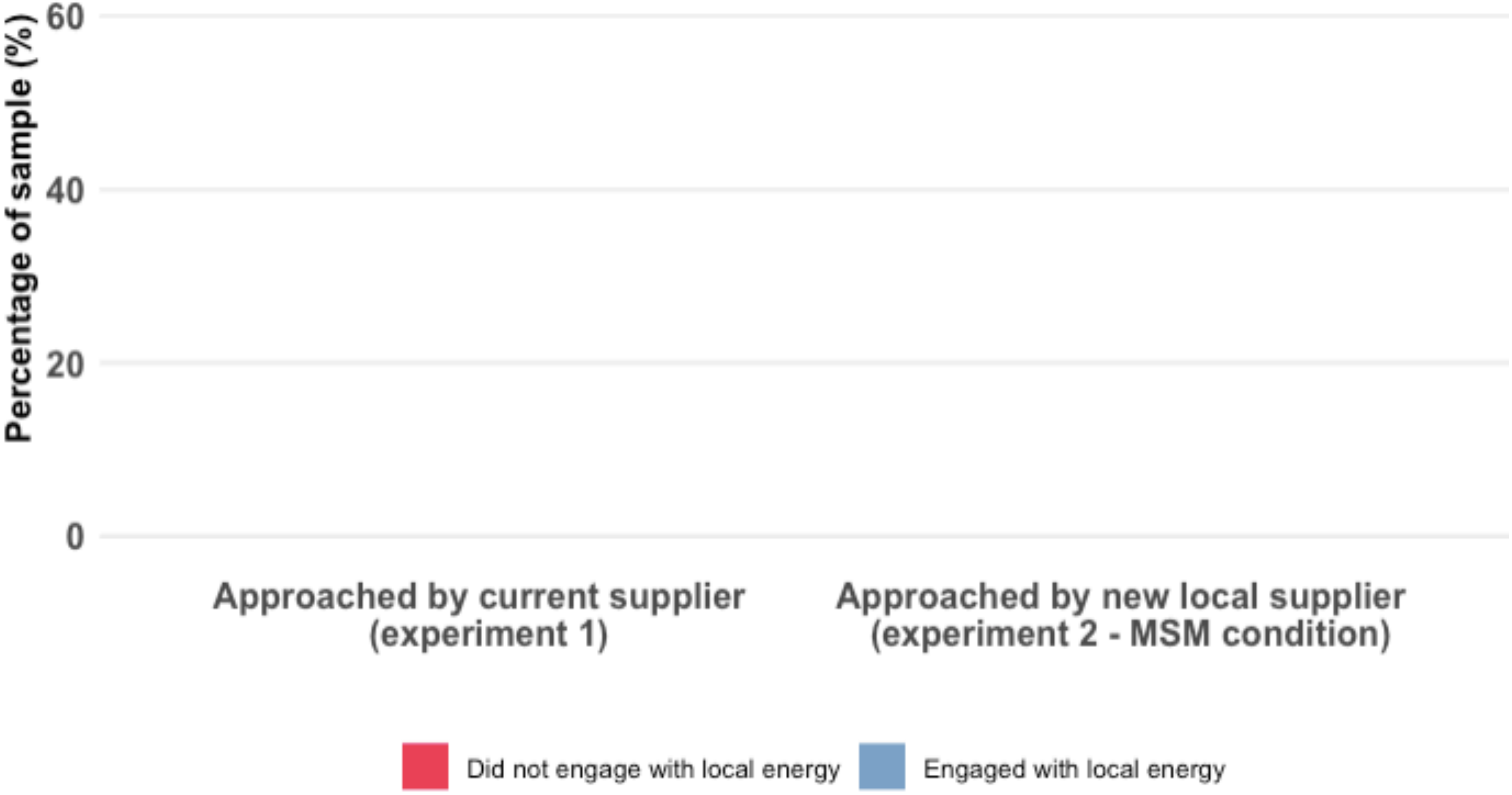
Consumer demand for local energy in an Multiple Supplier Models

Nicole Watson <nicole.watson.17@ucl.ac.uk>



Engagement with local energy in Multiple Supplier Model vs Supplier Hub Model

Nicole Watson <nicole.watson.17@ucl.ac.uk>



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CommUNITY – Brixton – London

- **Residents:** 62 apartments with pre-pay meters, gas central heating, electric immersion heaters. Paying ~14p/kWh
- **Generation:** 37kWp rooftop PV supplying landlord load (communal lighting + one lift). > 90% of power exported. Payed FITs ~4p/kWh.

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CommUNITY – Brixton – London

- Maximises self-consumption
- P2P market floats between import (~14p/kWh) and export (~4p/kWh).
- Local benefits:
    - Saves residents 10-20% on electricity
    - Pays more to community cooperative that owns PV
    - Provides local grid balancing services to DSO
- Wider benefits through demonstrating:
    1. Viability of P2P model for multi occupancy buildings
    2. Social value stacking for consumer engagement in local energy
    3. Financial value stacking for PV in urban area

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Transactive energy Colombia Project

- Community energy scheme in Comuna 13 – Medellin.
- Social strata 1 & 2
  - Semi-formal communities on mountains around Medellin.
  - Mostly low rise with roof space.
  - Pay ~median -20%/kWh
- Social strata 5 & 4
  - Wealthy communities in central Medellin.
  - Mostly high-rise flats with no roof space
  - Pay ~median +60%/kWh
- Generation and storage embedded in valued local community center

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Transactive energy Colombia Project

UsersTCP

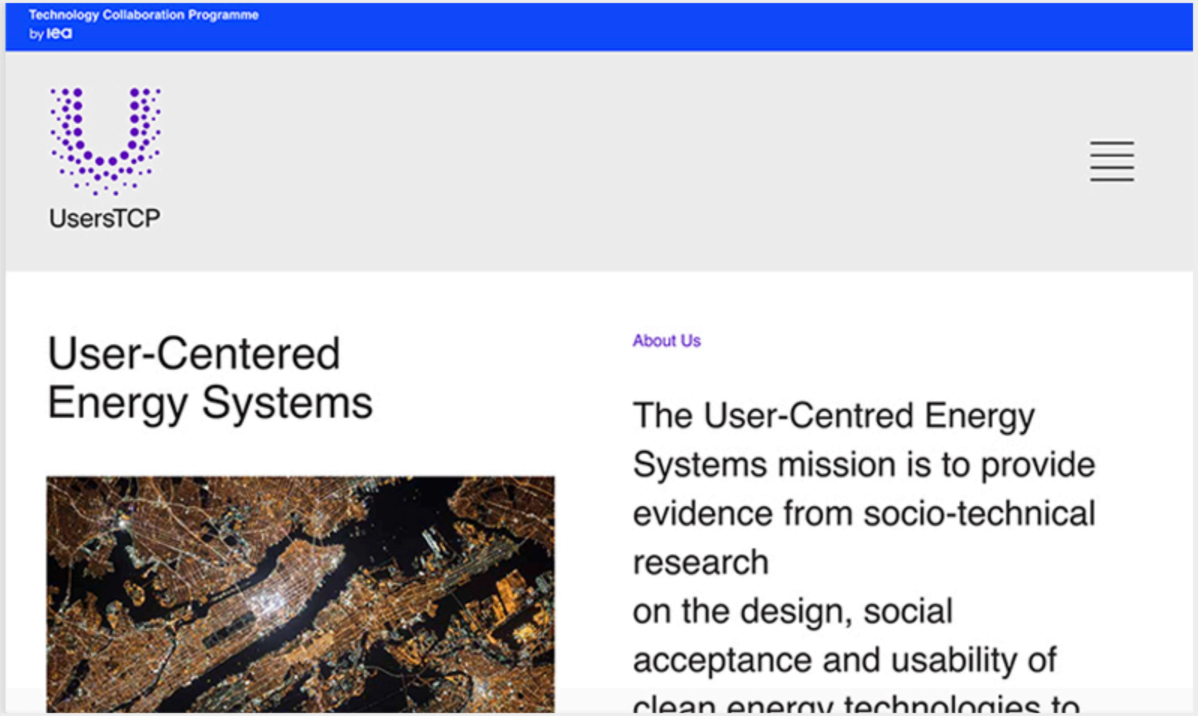
Users TCP: What we offer

A platform for research collaboration on socio-technical energy issues that is:

- Legally based in OECD agreements and mandates
- Designed to bridge industry, research and policy making communities
- Pre-competitive and technology neutral
- Policy and regulatory focused at national and international scales
- Geographically inclusive at the OECD level and beyond
- Offers rapid scalability of research outcomes and impacts

UsersTCP

userstcp.org



Webinars

User-Centred
Energy Systems
Academy

Annexes

UsersTCP | Business Models and Systems

UsersTCP | Hard-to-Reach Energy Users

UsersTCP | Peer-to-Peer Energy Trading

UsersTCP | Social License to Automate

User-Centred Energy Systems

Social License to Automate Annex Launch Event

Afternoon session

User attitudes to Smart HEMS and Automation

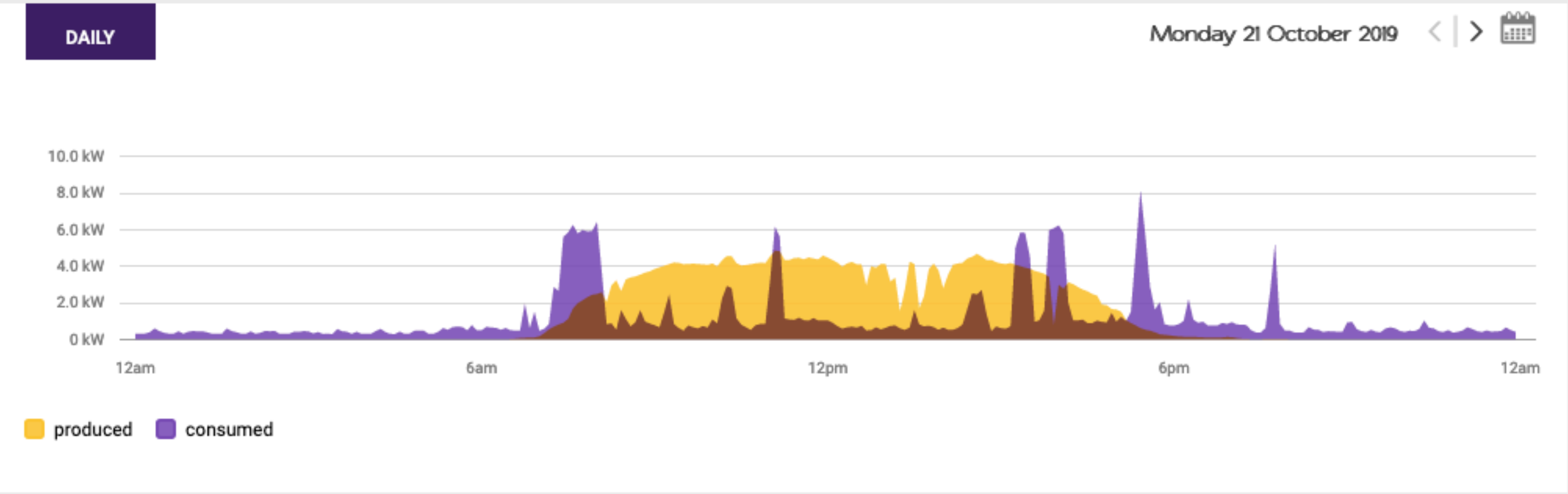
Oct 2019

Mike Roberts
School of Photovoltaic and Renewable Energy Engineering
Centre for Energy and Environmental Markets

CRCP

Smart Home Energy Management Systems

CRC-P Smart HEMS Project



1) Understand prosumer motivations, behaviours, attitudes and needs.

?) Help prosumers to shift loads to increase solar self-consumption

?) Enable user's DERs to respond to network signals

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solar analytics

Data

1) Online survey of Solar Analytics customers (120)
    - Highly energy-engaged solar prosumers - "Early majority" (Rogers, 2015)

2) Online survey - green tech social media (41)
    - Invited 'Smart HEMS Users' but many don't have Smart HEMS
    - Highly energy-engaged "innovators"

3) Semi-structured in-depth interviews (24)
    - Selected from above, categorised by motivation

Not representative of all energy users, highly self-selecting,

but there are insights to be gained:

- Innovators are an *exceptional stakeholder group* (Sovacool, 2018)
- Importance of early adopters as partners (Strengers et al., 2019)

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kickstand

solar analytics

Motivations for buying solar and batteries / for managing energy

- Bill saving is the most important motivation
- BUT multiple motivations combine in decision making e.g. solar / batteries (environmental / social / comfort / independence)
- Cost savings can be a proxy for carbon reduction (and visa-versa)
- Segmentation by motivation obscures complexity.

Need to address multiple (complementary and conflicting) motivations

e.g. articulate the broader benefits of managing the grid as well as market opportunity:

- carbon benefits (increased DER capacity)
- societal benefits
- broader financial benefits (avoided network augmentation)

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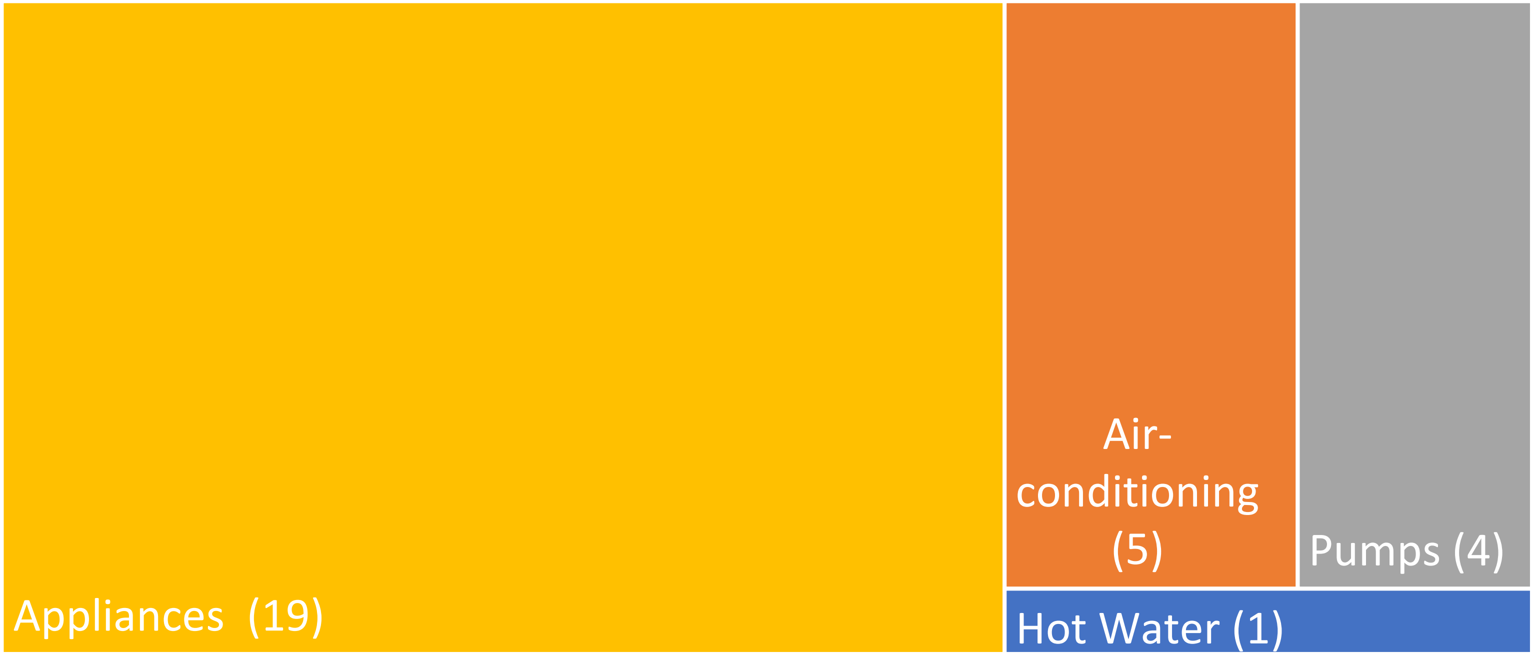
Existing load-shifting behaviour?



Shifting loads to increase self consumption / reduce bills / reduce carbon

...but the effects (kWh, \$, kgCO_2) are (almost) never quantified.

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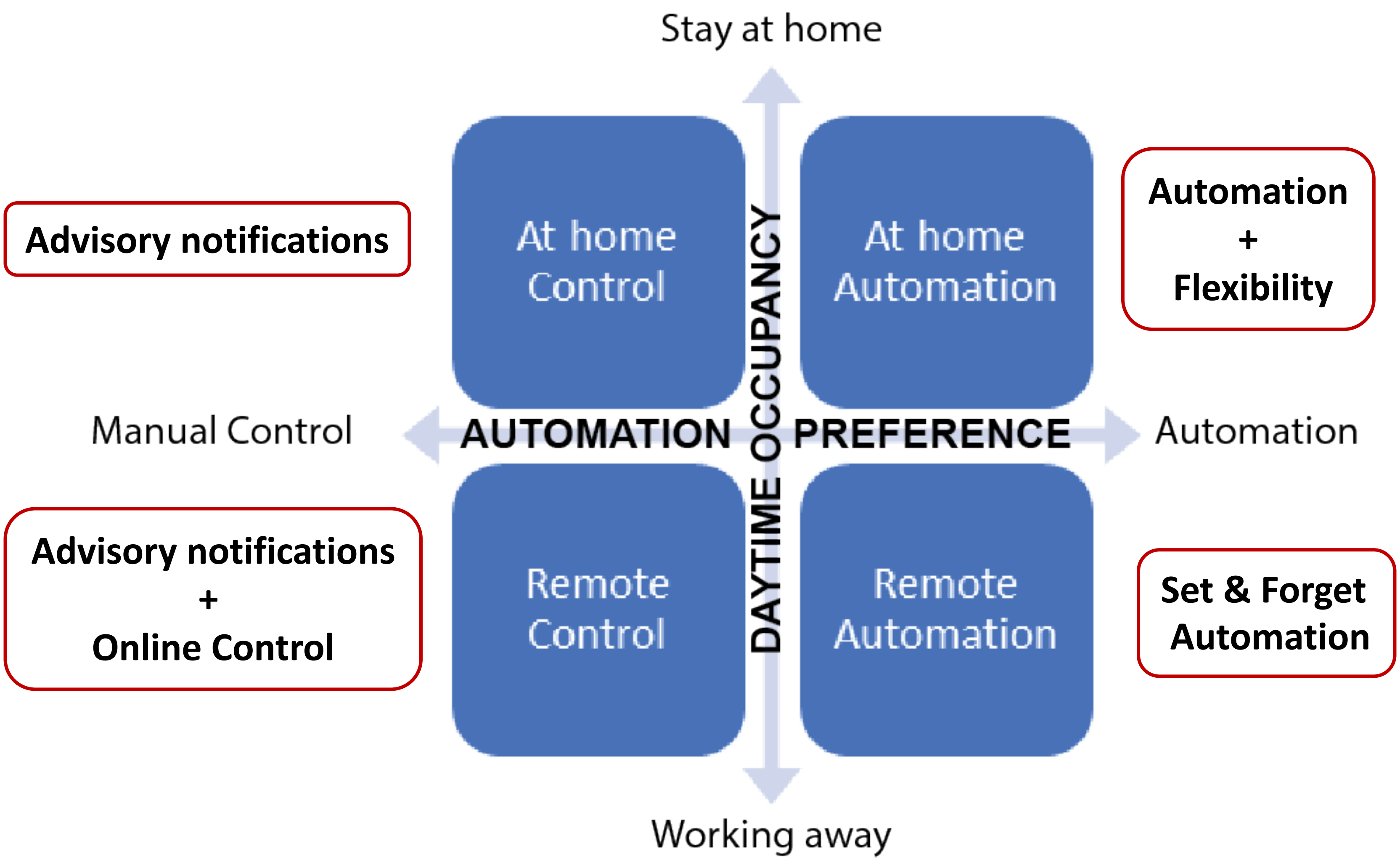
User Needs Segmentation?



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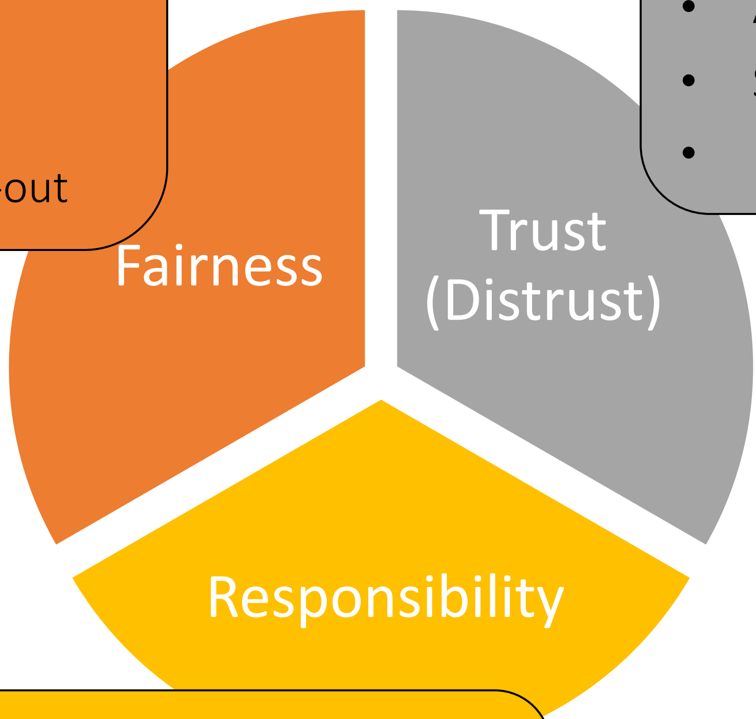
Licence

- PV connection / curtailment
- Load control
- Geographic / Social
- Transparency
- Compensation
- Health exclusions / Opt-out



- Energy companies
- Automation
- Algorithm
- Service Provider
- Data

- Ensure Fairness / Regulation
- Maintain Grid
- Lead Transition
- Educate

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solar analytics

Smart Home Energy Management Systems

wattwatchers DIGITAL ENERGY

Apricus AUSTRALIA

ERGON ENERGY NETWORK

SA Power Networks

m.roberts@unsw.edu.au

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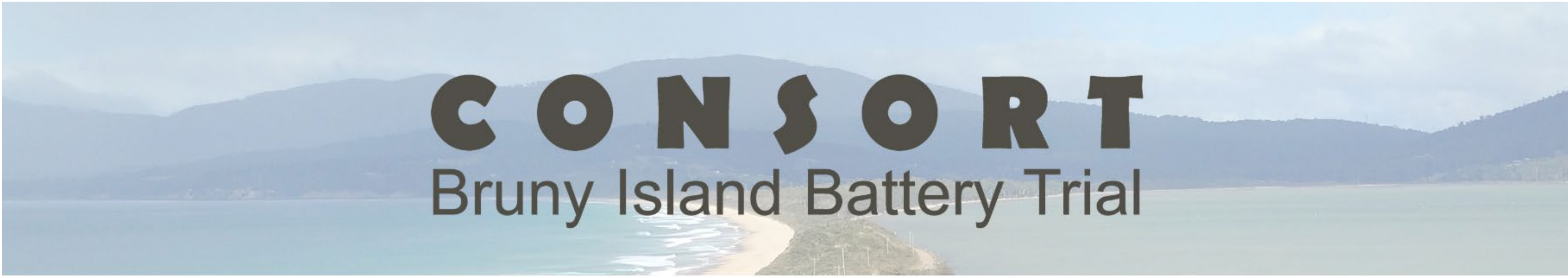
Does it spark joy?

Householder responses to network aware coordination on Bruny Island

Hedda Ransan-Cooper

Battery Storage and Grid Integration Program (BSGIP)



Social Research Team:

Professor Heather Lovell (Team Lead) University of Tasmania
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Veryan Hann University of Tasmania
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Australian National University

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ARENA
Australian Government
Australian Renewable Energy Agency

reposit

TasNetworks
Delivering your power

Bruny Island, Tasmania

Salient findings

1. Multiple components raise questions about accountability

Nobody seems to be really on top of knowing. I don't think from beginning to end there's been enough actual information of how it all works and how it all happens. And that's I think there should have been a lot more information. It shouldn't just have come from the installer. It should have come from the program itself. They needed to write the idiots guide, basically. BT 112

Well, look, in summary, I would say it's a problem for us that we can't get consistent information. Sometimes, we don't even feel that we can get answers. …Sometimes, we feel we get them but they're conflicting, not consistent. BT113

Salient findings

2. Cautious response to automation

I would like to be able to say, "Charge it up now," because I know, as opposed to the software, that tonight's going to, you know, whatever. We're going to have lots of people round or we're going to be cooking big meals or, I don't know, whatever it happens to be. But we currently don't have that facility. BT132

Salient findings

3. When householders are overwhelmed, tendency to get stronger emotional/gut feel responses – trust becomes even more important

… as does the tech providing other values e.g. backup.

Positive experiences

- Empowerment through energy monitoring
- Tech in line with local environmental and community values
- Back up
- Personal growth through learning about new tech

The Impact of Artificial Intelligence on the Energy Revolution

Dr Penelope Crossley
Sydney Law School

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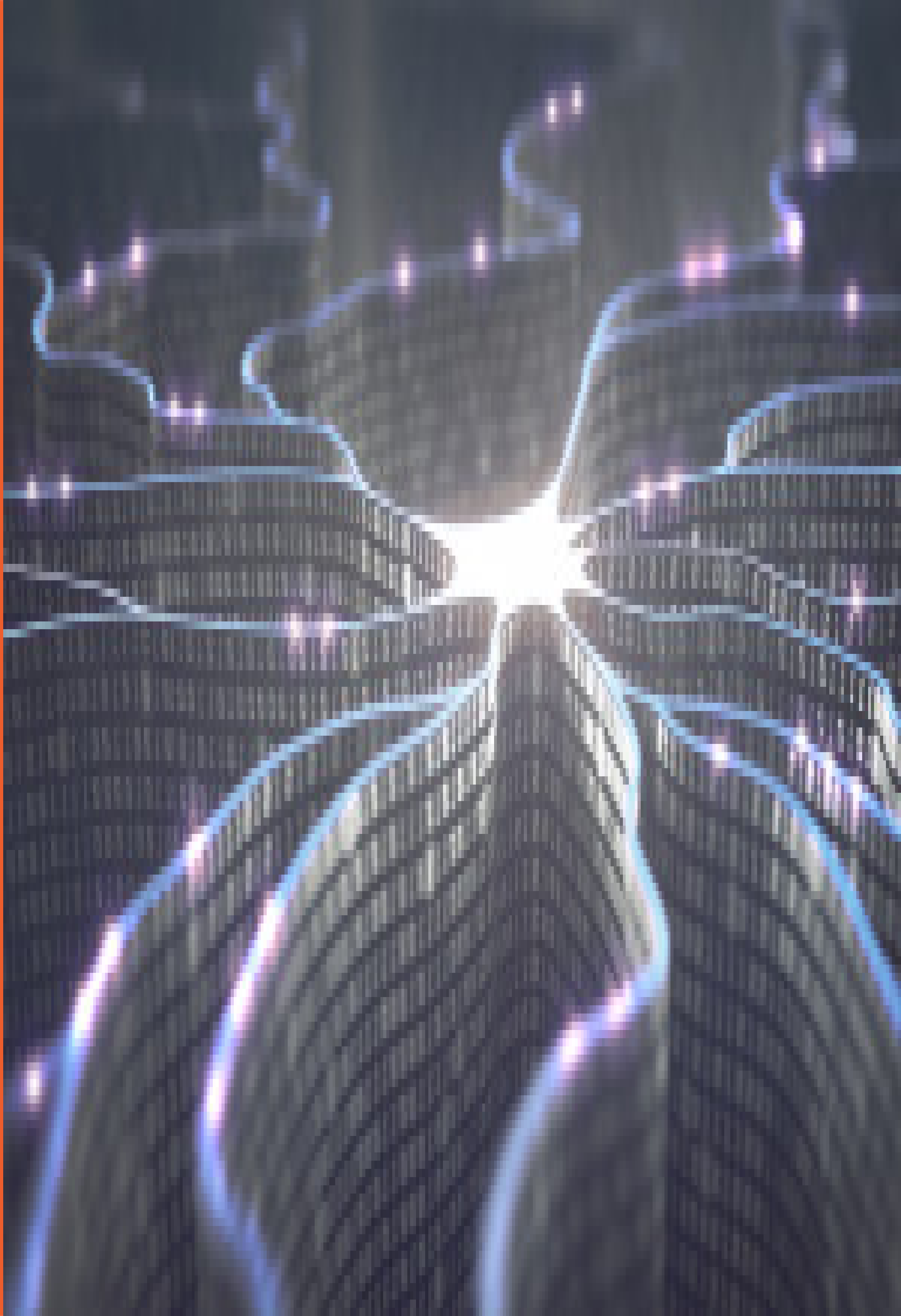
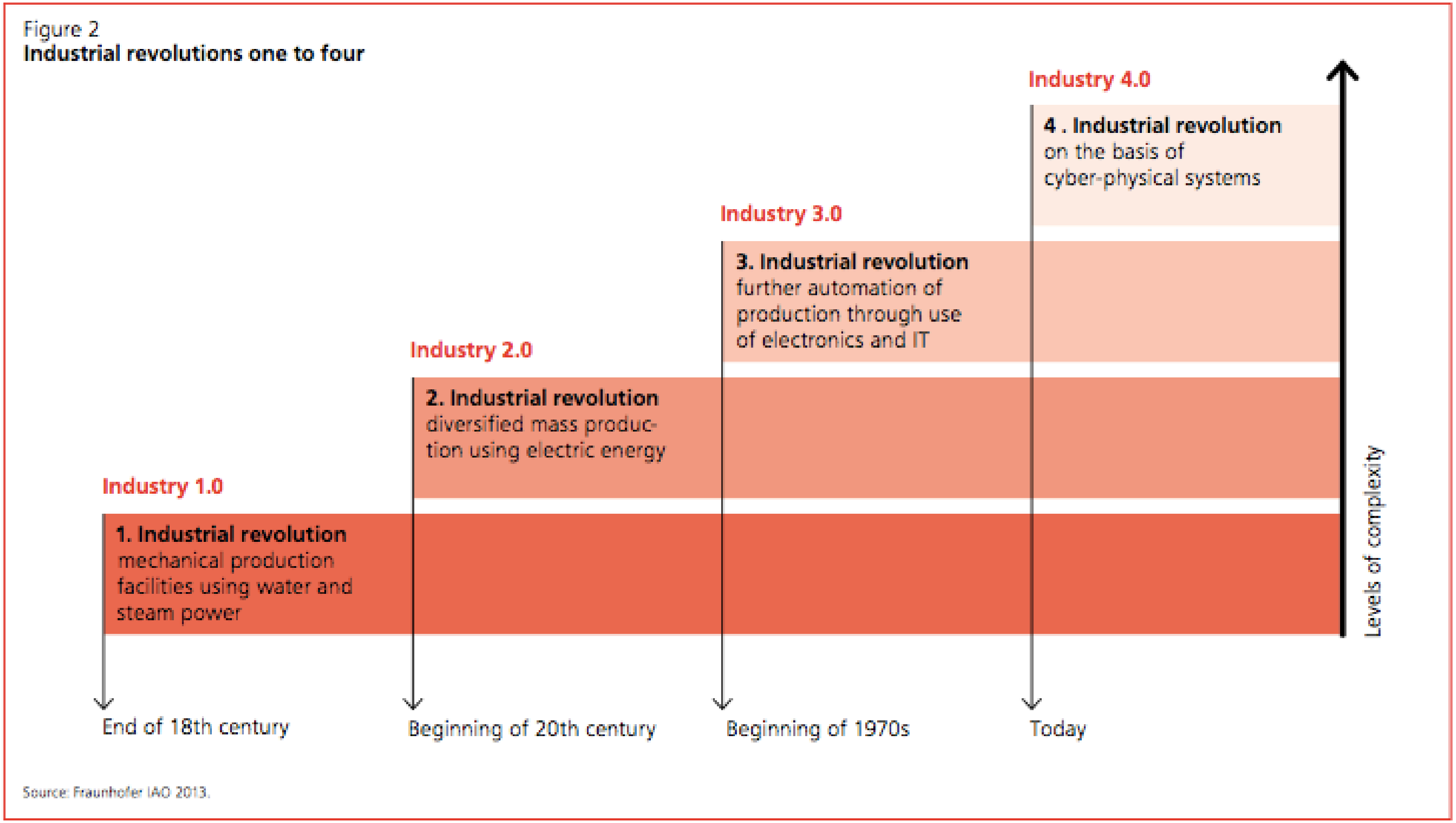
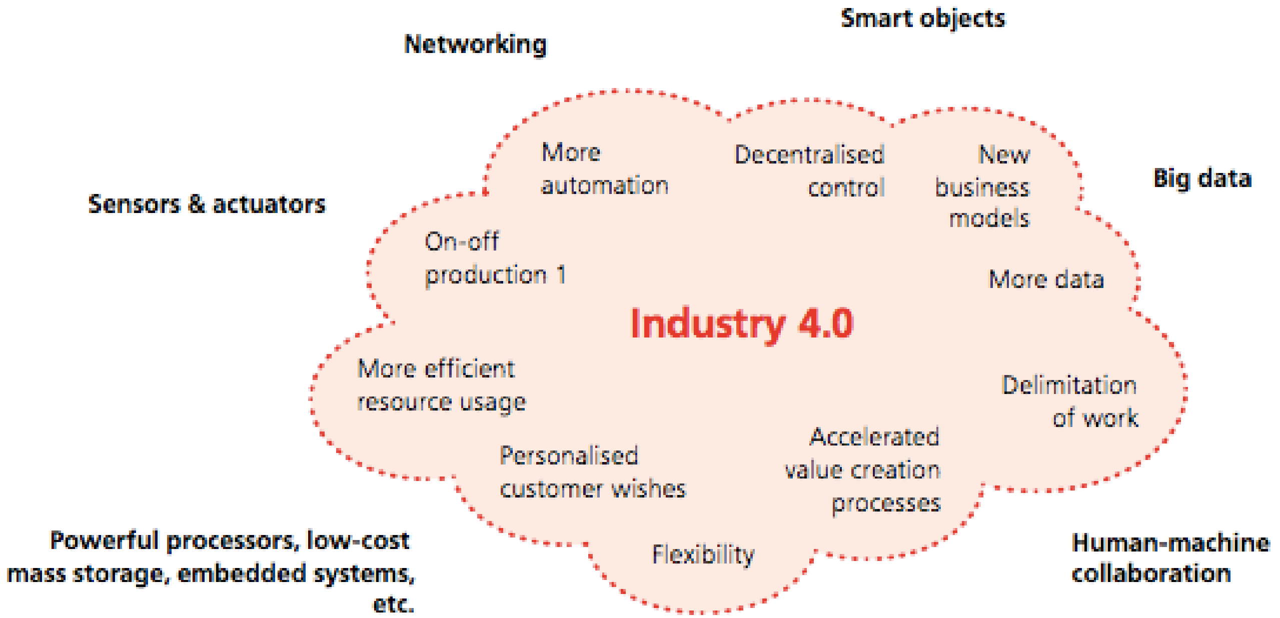


The 4th Industrial Revolution



Industry 4.0

Figure 3
Industry 4.0 drivers and their consequences



Source: Forschungsunion/Acatech 2013: 105 et seq.

Recent developments within the Australian energy sector

- Widespread deployment of renewable energy
- Increasing deployment of storage
- The development of more decentralised networks, greater distributed generation and more embedded generation and networks.
- New business models such as peer-to-peer energy trading which are "smart," based on artificial intelligence and mass digitisation within every aspect of the energy market.

So what does a future energy market look like?

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Digital technologies like big data, analytics and machine learning, blockchain, distributed energy resource management, and cloud computing, can help overcome some of the key challenges in the energy sector—most notably intermittency, aging grids, balancing distribution-connected generation, managing consumer self-generation, and coping with increasing system complexity.

— Digitalization and Energy, International Energy Agency, 2017,11

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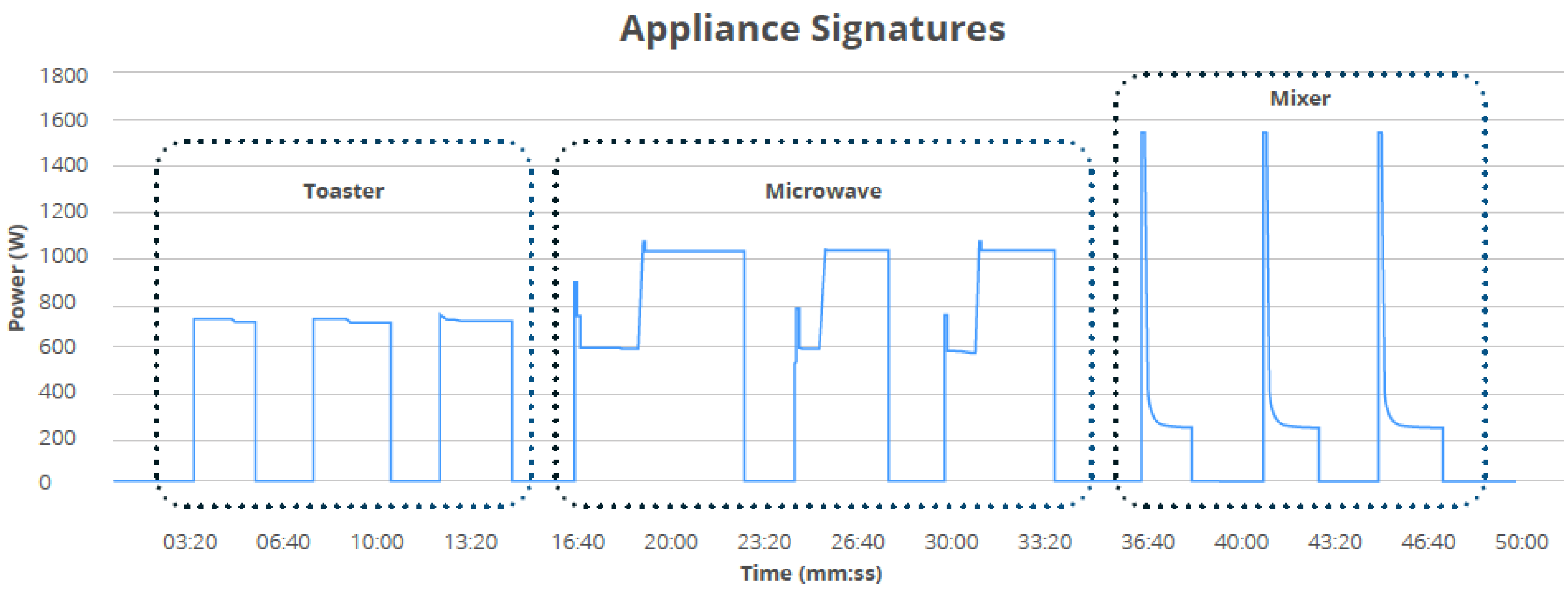
The future energy market?

- Digitisation and the use of artificial intelligence accelerates and new prosumer models emerge

- Blockchain technology
- Digital ledgers
- The advent of smart contracts

Medium term power contracts → Transactive contracts

The biggest shift: the use of disaggregated energy data generated by AI



Uses of artificial intelligence in the energy sector:

1. Predictive maintenance (using algorithms to keep key machinery functioning more efficiently by avoiding machine failure, optimising maintenance activities and minimising downtime).

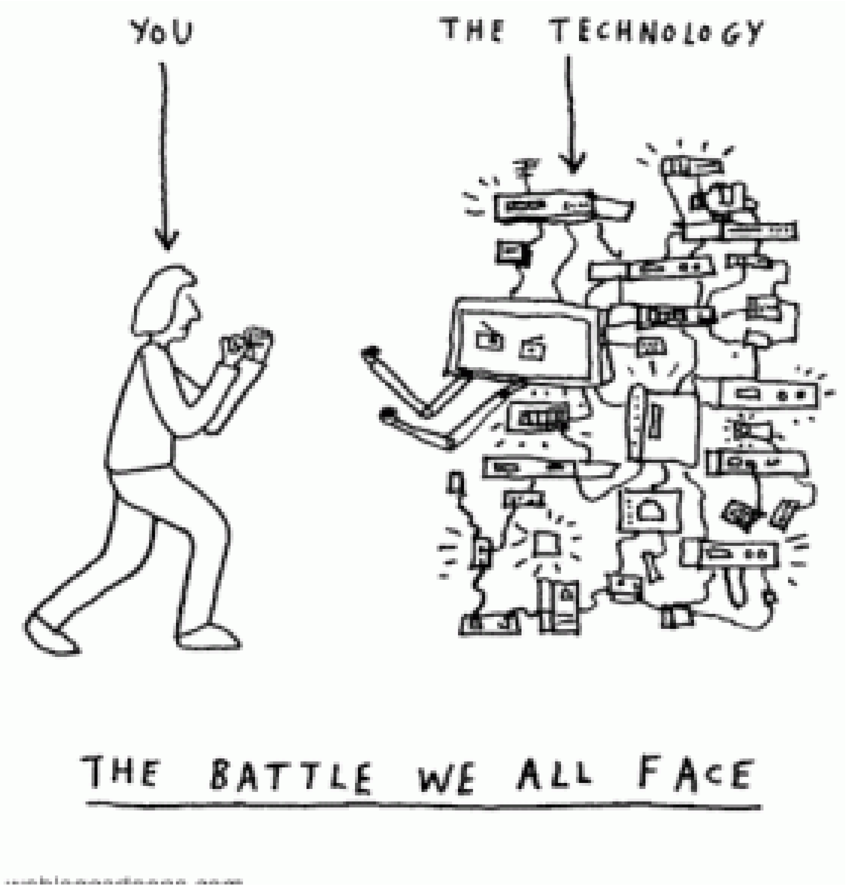
2. Provide consumers with data (using nudge behavioural economic theory) to help them improve their energy consumption patterns to improve efficiency and lower their energy costs.

3. Improve grid stability and system balancing associated with growing amounts of renewable energy on the grid.

Other uses

- Provide detailed insights as to how individual data subjects spend their private lives

- Enable better marketing of products and services



By 2040, 1 billion households and 11 billion smart appliances could actively participate in interconnected electricity systems.

— Digitalization and Energy, International Energy Agency, 2017

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This poses new risks for consumers and market participants

New risks? New rewards?

– This transformation will increase complexity within the sector and pose new risks for consumers and market participants.

– This transformation of the energy sector offers potentially huge rewards for market participants, with US$718 billion invested in the electricity sector worldwide in 2016 alone.

What type of risks?

5 key types of risks can be identified:

1. Risks arising from the use of big data
2. Risks arising from increased complexity
3. Risks arising from the changing market structure
4. Risks arising in respect of consumer protection and changing legal standards
5. Risks emerging from a breach of “smart contracts”

What does this mean for regulators?

– Regulation has not kept pace with the speed of technical developments and their applications.

– However, reforming policies that unintentionally block or deter entry by disruptive firms can be a challenging task because those policies usually serve other, legitimate objectives.

What does this mean for energy regulators?

– At the moment, the delayed action by regulators has led to concerns about regulatory uncertainty.

– Energy regulators need to be more agile and communicate more openly with a broader array of other regulators and stakeholders.

– The Finnish Model: Using artificial intelligence and big data to engage in long-term planning and coordinated action.

What roles might we expect regulators to play in the era of Energy 4.0?

– Consumer protection (esp. of vulnerable consumers) and safety.
– Emergency, resiliency and system security.
– Privacy
– Providing data or mandating the provision of information suitable for cost comparison.
– Incentives provided to optimise the system as a whole
– Competition

A further challenge: regulating "state-remote" networks

Many of the artificial intelligence and mass digitisation technologies that the energy sector is seeking to adopt, were conceived of as "state-remote networks, ie networks entirely self-governed on the basis of consensus amongst their users."

However, if there is widescale adoption of these technologies, regulation will inevitably be required.

Conclusions

- Artificial intelligence and mass digitisation is going to profoundly revolutionise the energy sector.
- This provides new opportunities but also presents very real challenges around the use of big data, the complexity of the systems, consumer protection and smart contracts.
- The current governance model used in the energy sector lacks transparency and is arguably, not in the democratic interests of citizens who participate in the market
- Need a coordinated approach that supports the optimal use of technology and supports flexibility within the market.
- The Finnish Model as a solution?

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