



(User-centric) UK Zero Carbon Energy Futures

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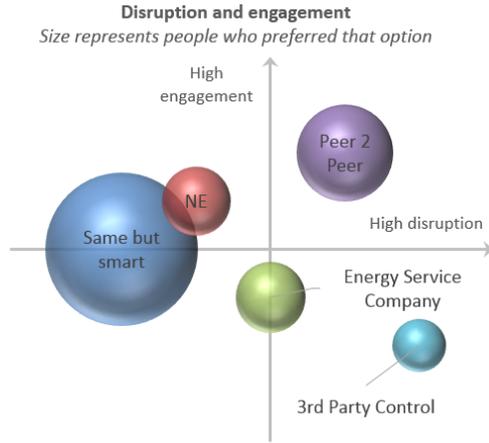
EnergyREV



About me

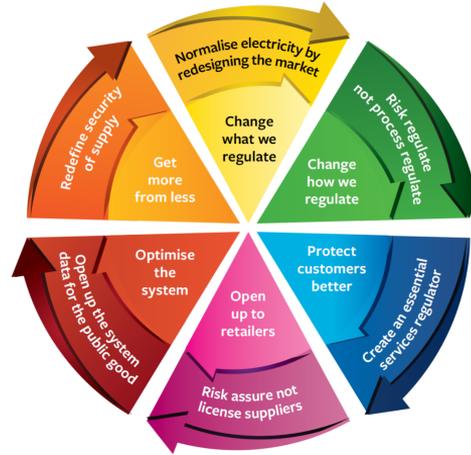
Current research interests

Future energy business models



Utility 2050

Energy policy and regulation



Redesigning Regulation

People and energy

Some issues need to be addressed to enable these businesses to succeed

<ul style="list-style-type: none"> Transnational data protection Multi-utility regulation Data ownership Clear service agreement 	<ul style="list-style-type: none"> Data and device interoperability Effective carbon regulation Models for rental sector Fairness for all customers 	<ul style="list-style-type: none"> Whole community opt-in Impact on national grid Shift to local balancing Fall-back options
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Key take homes

- Space to enable business model innovation
- Smart devices and data must be interoperable and secure
- Service standards must be better
- Solutions for all consumer situations required
- Targeted carbon regulation needed

Society led low-carbon transformation

Energy Revolution Research Consortium



UK net-zero journey

UK Climate Change Act

“It is the duty of the Secretary of State to ensure that the **net** UK carbon account for the year 2050 is **at least 100% lower** than the 1990 baseline.”



Climate Change Act 2008

Vital statistics

Now(ish)



2050(ish)



- Population 66 million
 - Energy per person = 0.025 GWh
 - % electricity from renewables = 33%
 - No vehicles per person = 0.58
 - Electric heating in homes = 8% (86% gas)
- Population ~ 77 million
 - Energy per person = ???GWh
 - % electricity from renewables = 80%
 - Vehicles per person = 0.51 (96.5% BEVs)
 - Electric heating in homes = 60%

Entwined policy & regulatory challenges



INDUSTRIAL STRATEGY

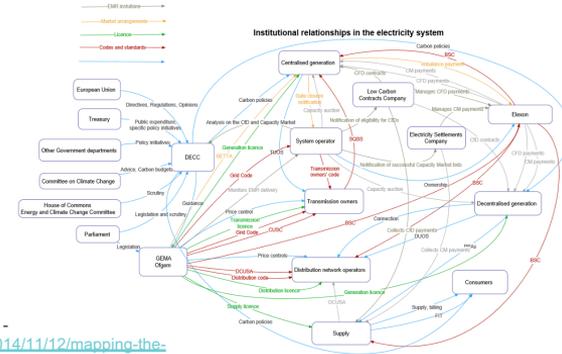


UK Research and Innovation

Objectives

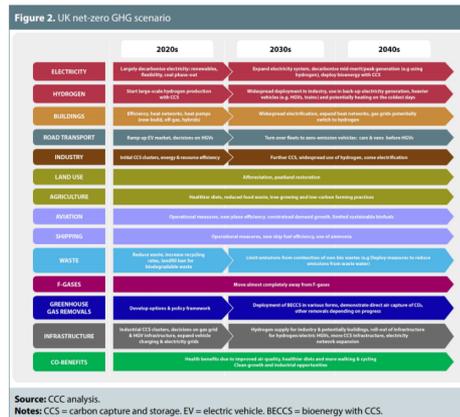
- Net zero
- Lowest (or reasonable) cost
- Security
- Competition
- Environment
- Equity & Fairness
- Better than today
- ...

Complexity



Credit: Exeter Energy Policy Group - <https://blogs.exeter.ac.uk/energy/2014/11/12/mapping-the-power-in-the-electricity-system/>

Certainty



<https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf>

Acceptability



extinction rebellion

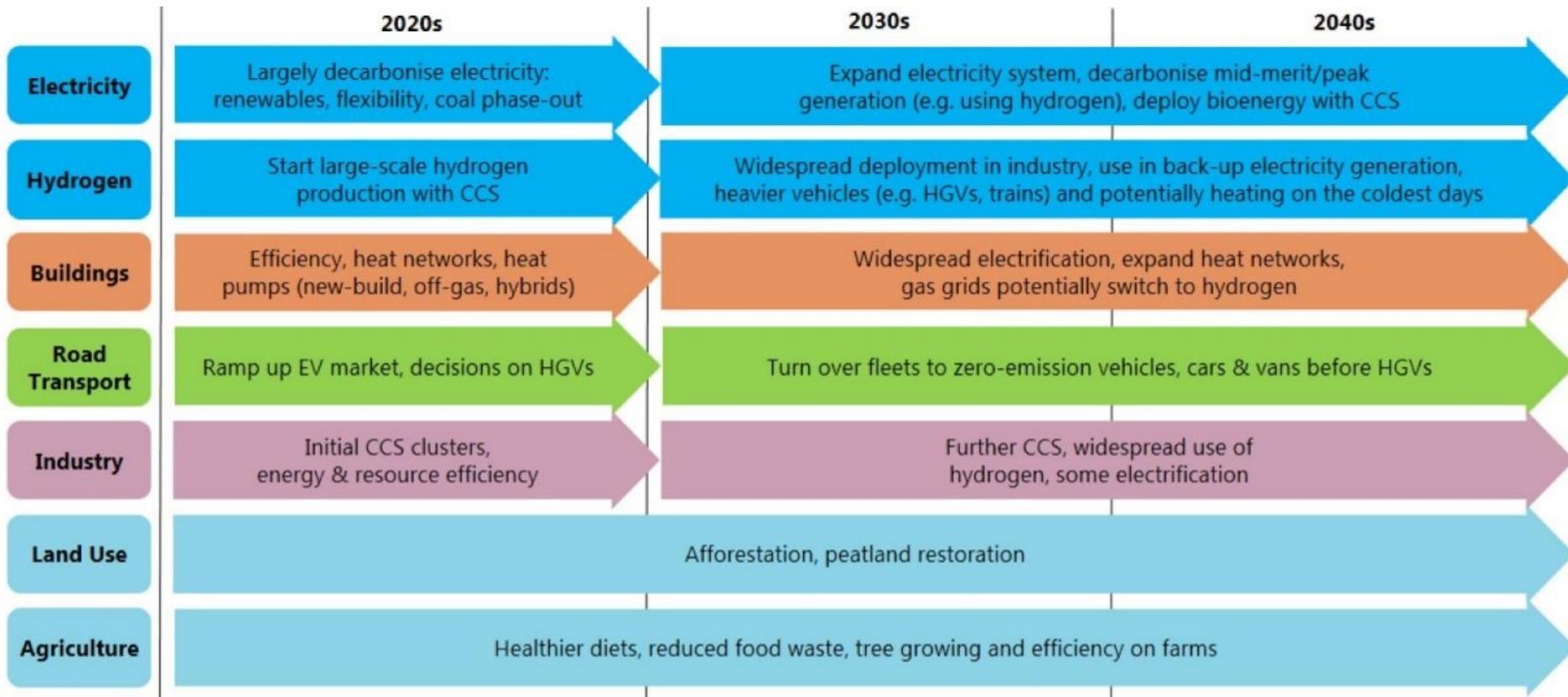
Net-zero means THIS and THIS and THIS...



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<https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-Chris-Stark-Presentation.pdf>

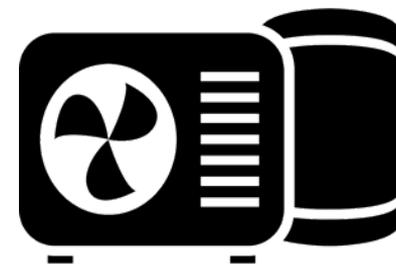
Thirty years of action required to meet UK net zero target



~3.6 (6.1*) GW/year
(300 x 12MW turbines/year)
(current 4GW/year)



~1.2 million BEVs/year
(136 per hour)
(current 331 vehicles/hour)



~600k installations/year
(68 per hour)
(current 182 boilers/hour)

*including CCS and electricity storage

Technology can't do everything

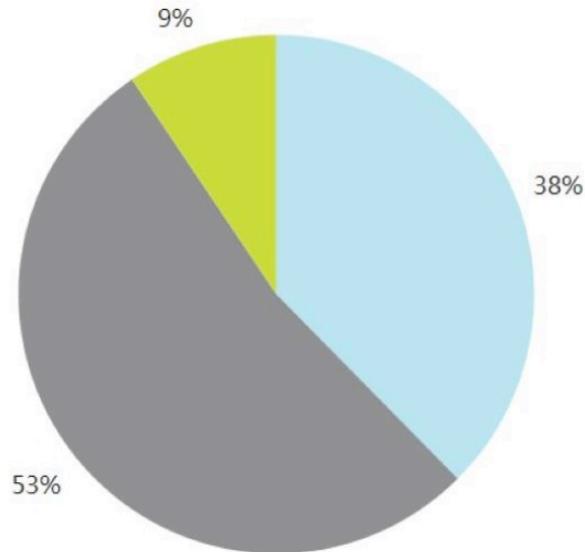


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Role of societal and behavioural changes



- Low-carbon technologies or fuels not societal / behavioural changes
- Measures with a combination of low-carbon technologies and societal / behavioural changes
- Largely societal or behavioural changes

Source: CCC analysis

Opportunity for consumer-centric business models

Implications for end-users...



Time of use pricing



New kit



Upfront costs

Massive opportunity for future UK utilities



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Plant efficiency
£75 – 1809 m



Service provision
£5 – 9 bn



Local LC generation
£42 – 4600 m



Large LC generation
£0.61 – 8 bn



Flexibility optimisation
£400 – 2000 m



CCS
£-0.14 – 1669 m

Up to £21bn
of new value
is available to
electricity
utilities per
year by 2050

Wegner, M.-S., Hall, S., Hardy, J., Workman, M., 2017. Valuing energy futures; a comparative analysis of value pools across UK energy system scenarios. Appl. Energy 206, 815–828. doi:10.1016/j.apenergy.2017.08.200

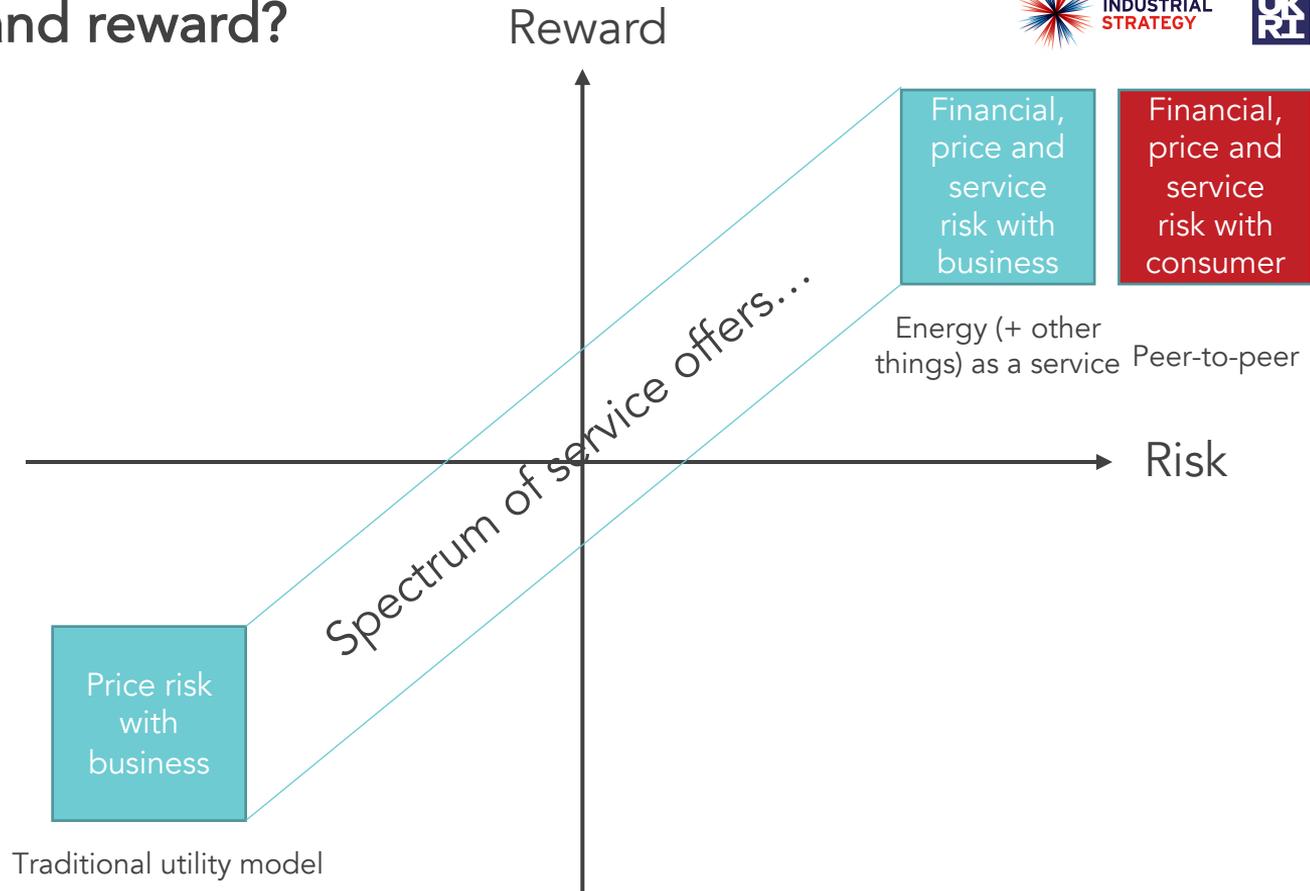
Greater risk and reward?



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Business model innovation is needed to capture value

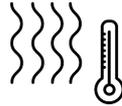


New electrifier



Traditional utility that is helping consumers switch to electric heat and mobility, including installing equipment and automating DSR

Energy as a Service



An ESCo delivers energy services to customers, such as comfort and illumination, rather than units of energy like a traditional supplier.

Peer-to-peer



P2P customers directly buy, sell or swap electricity with each other.

Lifestyle as a service



A third party, such as a price comparison website, takes decisions on consumers' behalf, like automatically switching energy supplier.

Everyone has an opinion on the energy business model of the future...



How could we buy energy in the smart future?

Dr Jeffrey Hardy, Imperial College London

March 2017

Disruption and engagement

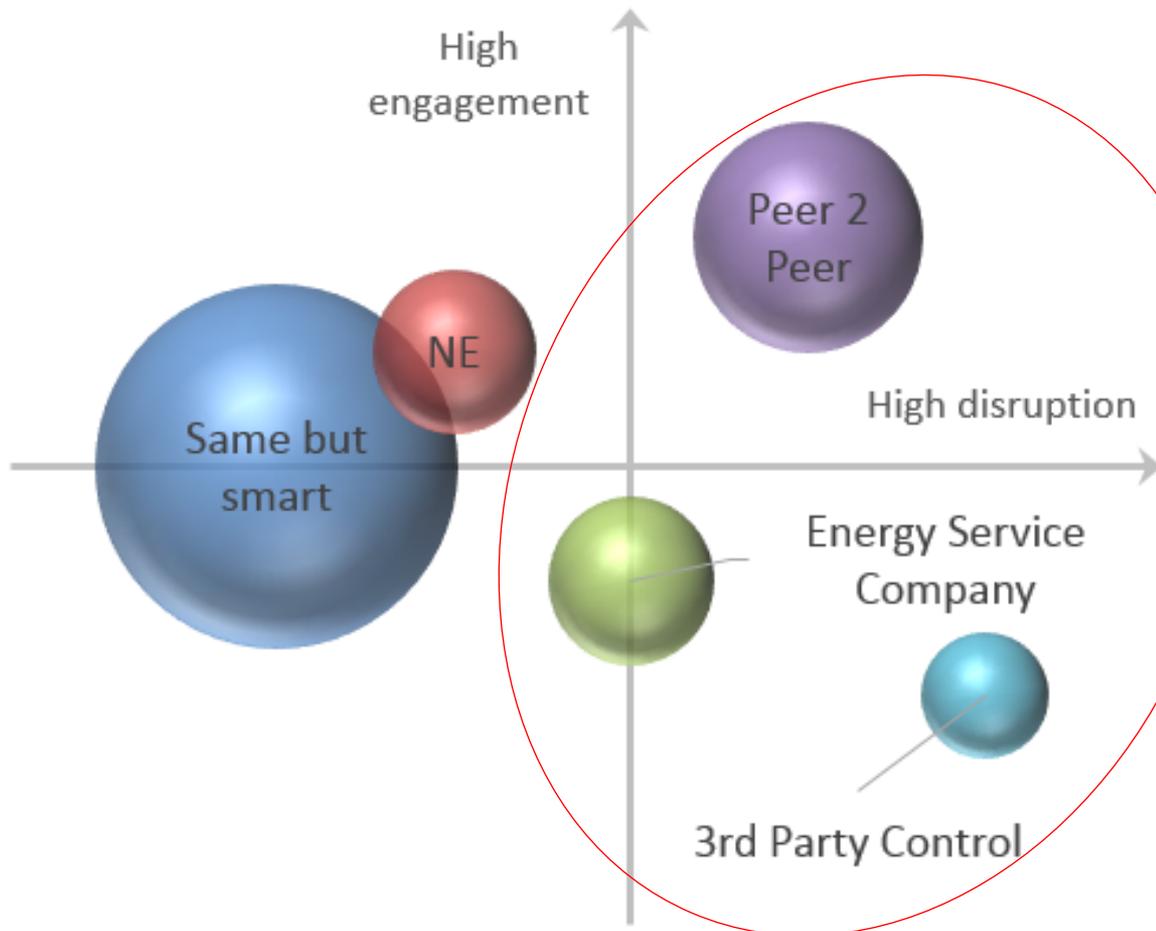
Size represents people who preferred that option



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Around 50% of domestic consumers

In review: Nature Energy

Inertia and barriers to innovation

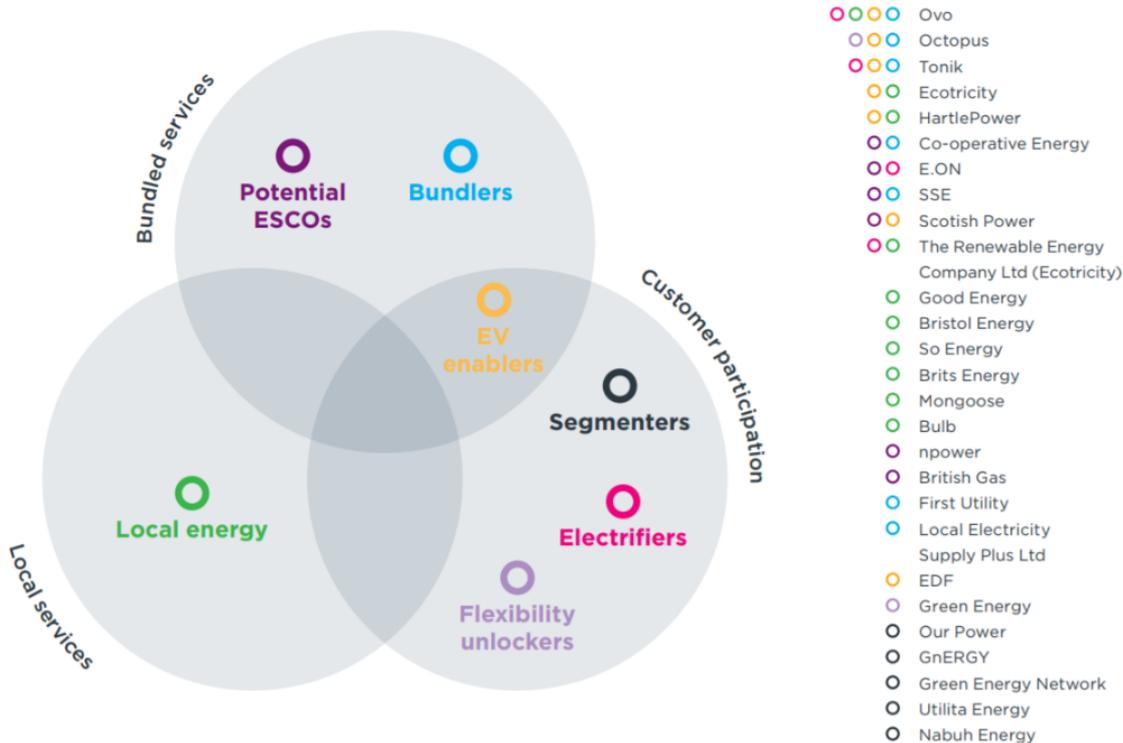
Innovation in UK energy suppliers



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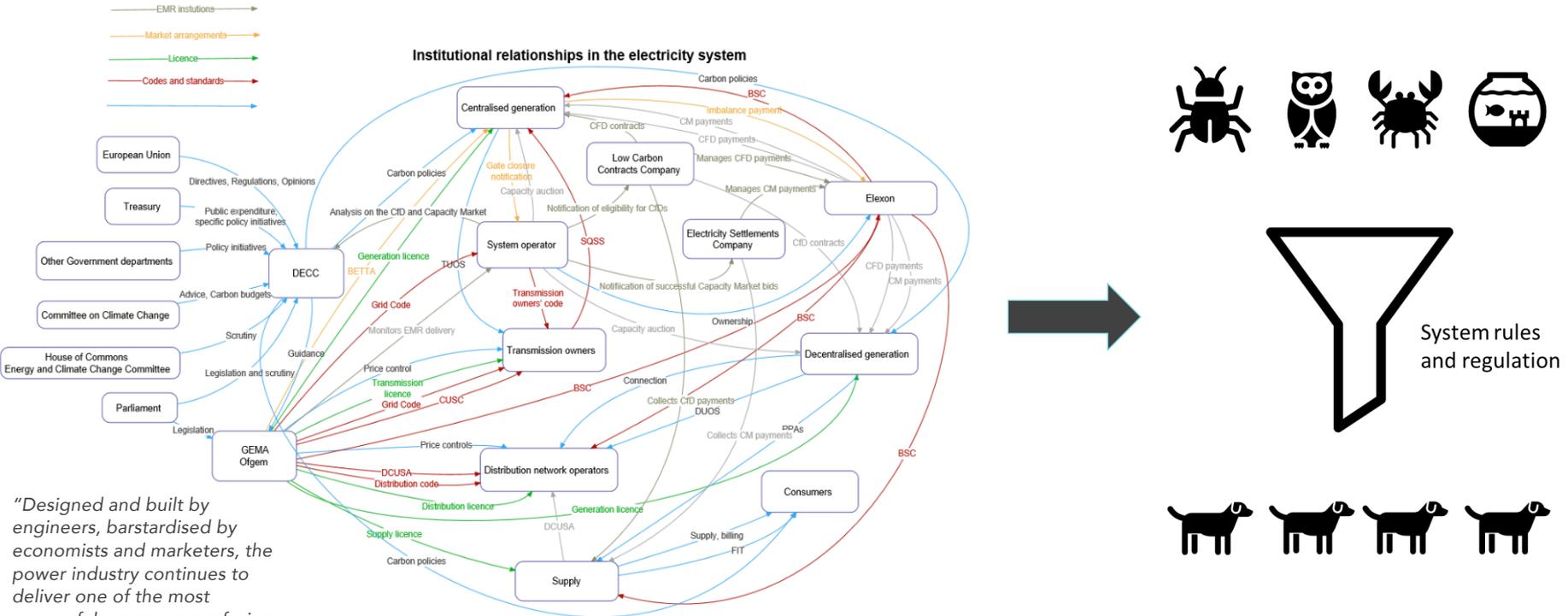


- **Lot's going on, particularly on local energy, electric vehicles, 'smart' electric homes and bundling products**
- **However, little innovation in the core traditional utility business model (selling units of electricity and gas)**

Credit: IGov - <http://projects.exeter.ac.uk/igov/wp-content/uploads/2019/01/IGov-BM-Analysis-report.pdf>

Figure 8: Emerging domestic electricity supplier value propositions compared to broad NTBM themes

Energy policy & regulation



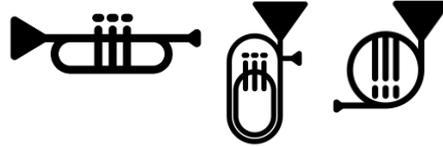
“Designed and built by engineers, barstardised by economists and marketers, the power industry continues to deliver one of the most successful consumer confusion programmes of all time” Ari Sargent

Credit: Exeter Energy Policy Group - <https://blogs.exeter.ac.uk/energy/2014/11/12/mapping-the-power-in-the-electricity-system/>

Who (or what) is conducting the energy system symphony?



Conductor



Individual sections / instruments



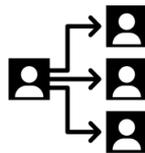
Instruments that play themselves (and create the music?)



Data



Rules



Roles



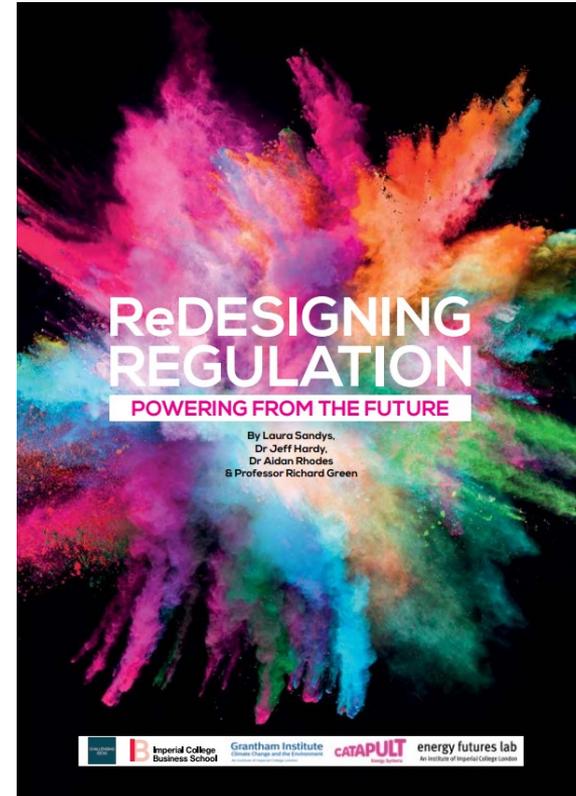
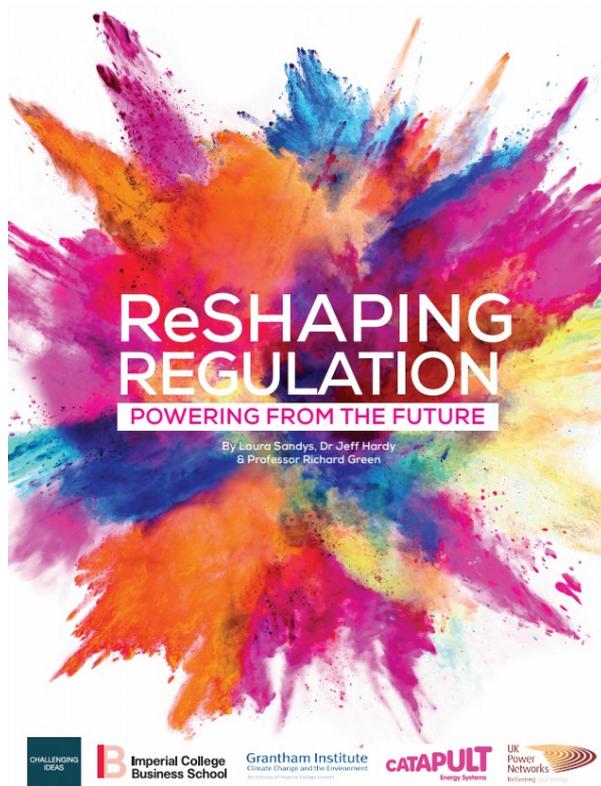
Transparency

Important

(or all the above simultaneously?)

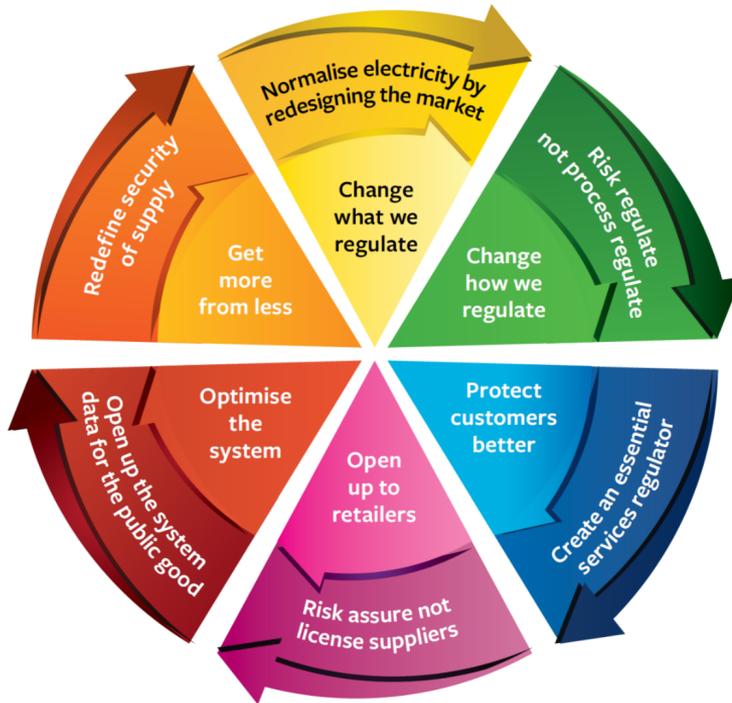
Redesign regulation?

Reshape and redesign regulation



http://www.challenging-ideas.com/wp-content/uploads/2017/10/Challenging-Ideas_single.pdf http://www.challenging-ideas.com/wp-content/uploads/2017/10/Challenging-Ideas_single.pdf

Redesigning regulation



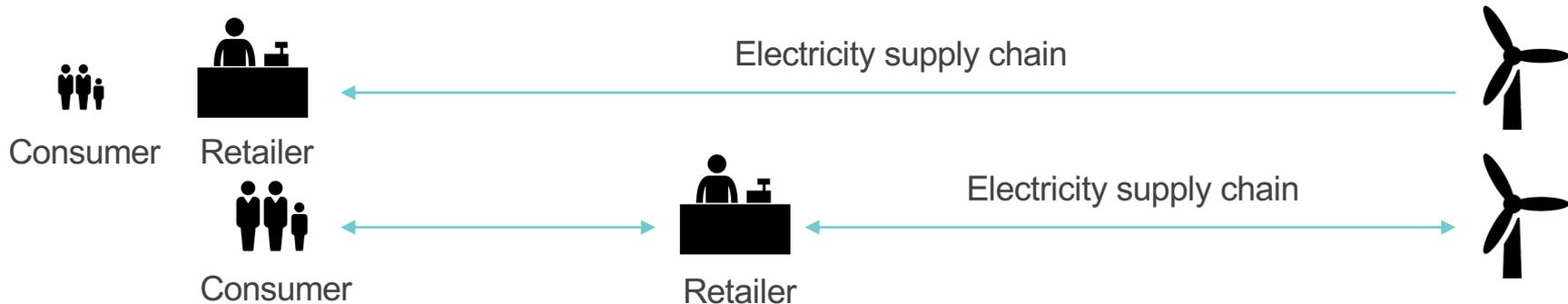
- **Change what we regulate:** normalise electricity through redesigning the market
- **Change how we regulate:** change from regulating process to regulating for risk
- **Protect and serve consumers better:** create one essential service consumer regulator
- **Open up to retailers:** risk assure retailers rather than license suppliers
- **Optimise the system:** opening up system data for the public good
- **Get more from less:** redefine and recalibrate security of supply

Redesigning regulation – December 2018

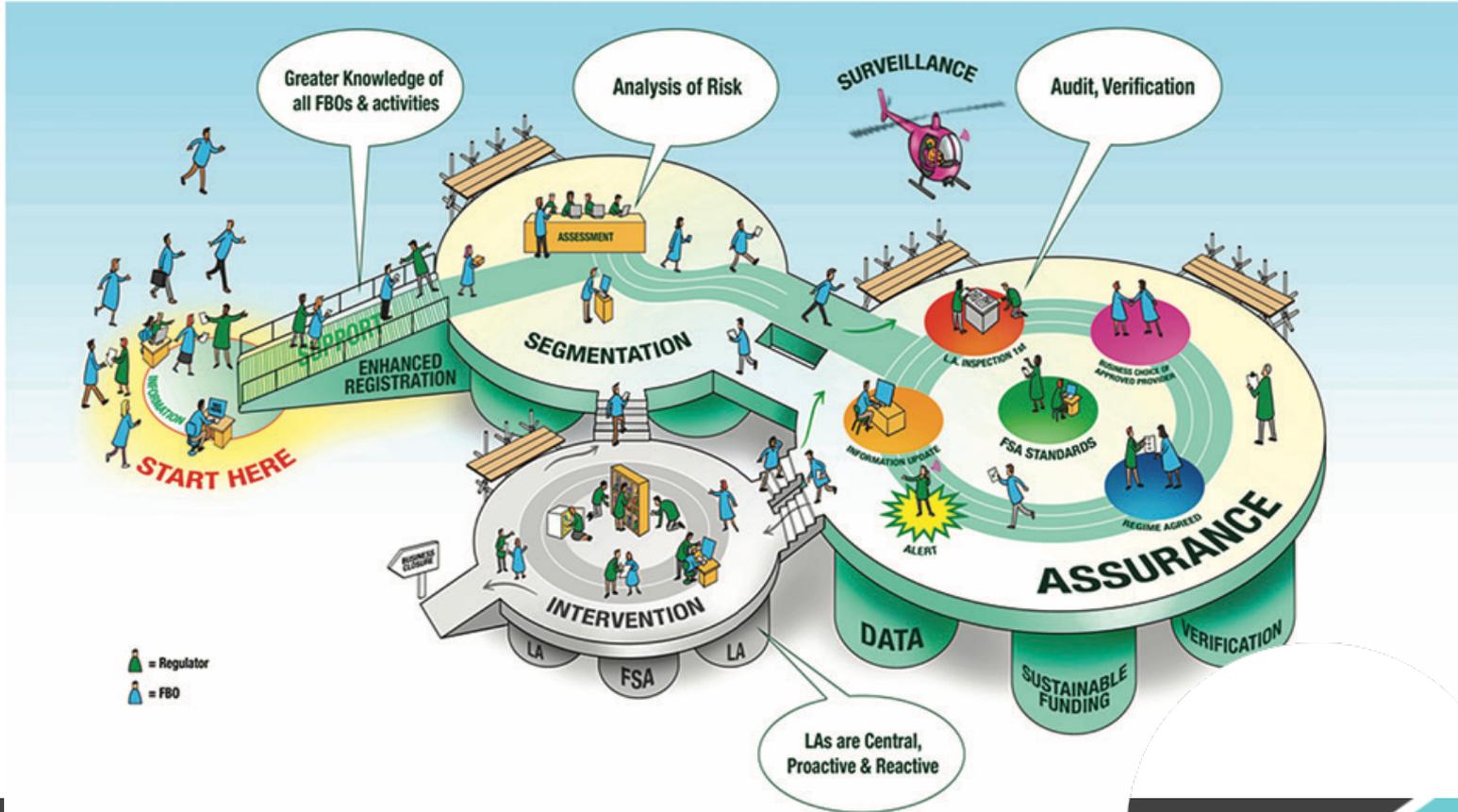
<https://www.imperial.ac.uk/grantham/publications/redesigning-regulation-powering-from-the-future.php>

Change what we regulate

“The energy sector should be open to same benefits, opportunities, pressures, risk and expectations that consumers’ benefit from in other products and services.”



Change how we regulate

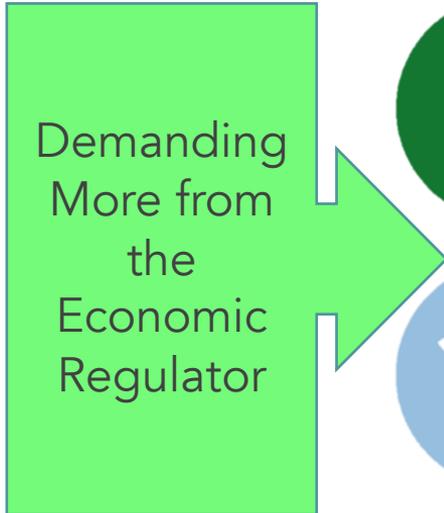


From Tesco to the local café all registered under the same registration process with clear triage process giving the FSA & LAs total visibility and risk management tools

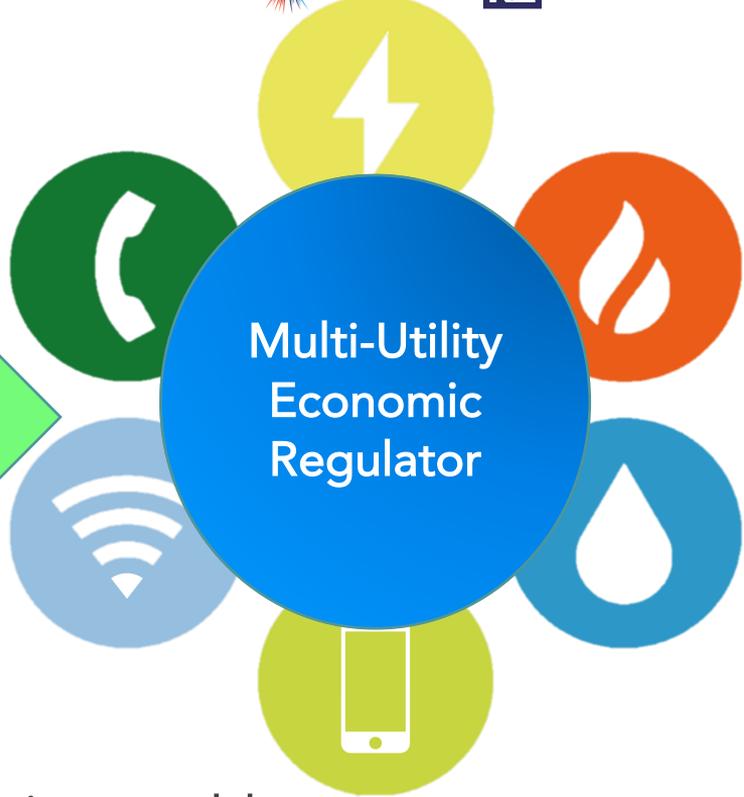
Protect and serve consumers better



An Essential
Service
Consumer
Regulator



Demanding
More from
the
Economic
Regulator



Multi-Utility
Economic
Regulator

Protecting consumers across new business models
Building holistic programmes to support 'vulnerable' consumers

“Give the Consumer the power to make, shape and break how they are provided with energy”



More Complexity
More Transparency



More Choice
More Consumer Power



More Freedoms
More Penalties



More Services
More Redress

Optimise the system

Data Visibility: Understanding the data that exists, the data that is missing, which datasets are important, and making it easier to access and understand data.

Infrastructure and Asset Visibility: Revealing system assets and infrastructure, where they are located and their capabilities, to inform system planning and management.

Operational Optimisation: Enabling operational data to be layered across the assets to support system optimisation and facilitating multiple actors to participate at all levels across the system.

Open Markets: Achieving much better price discovery, through unlocking new markets, informed by time, location and service value data.

Agile Regulation: Enabling regulators to adopt a much more agile and risk reflective approach to regulation of the sector, by giving them access to more and better data

A strategy for a Modern Digitalised Energy System

Energy Data
Taskforce report

Chaired by
Laura Sandys

“Recalibrate security of supply to reflect the new nature and ‘anatomy’ of the sector delivering appropriate risk profile for the security of the system”

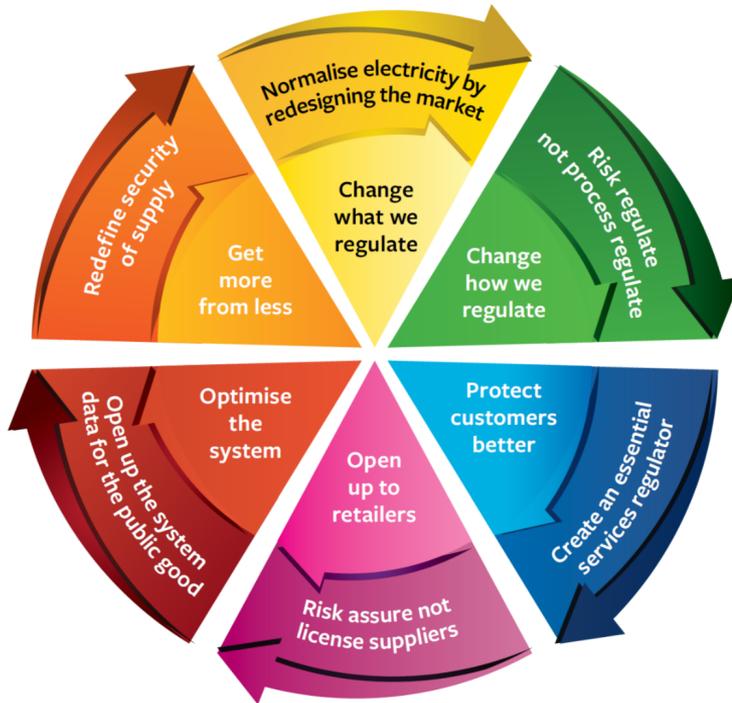


No Build: Less Build



**Better Build and Fully
Costed Procurement**

Redesigning regulation



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