Net zero levels of innovation: what is needed?

24 September 2019
What is Energy Systems Catapult?

**Mission:** Unleash innovation and open new markets to capture the clean growth opportunity

170

Innovation experts

Hubs in Birmingham and Derby

Established and overseen by Innovate UK. Independent from Government. Not for profit

Bridge the gap between stakeholders in the sector

**A place to develop and test new ideas**

- Supporting innovators
- Research
- Trials
- Systems engineering
- Digital
- Modelling and simulation
What is whole systems thinking?

Joining up the system from sources of energy to the consumer

- Generation
- Transmission
- Distribution
- Buildings
- Consumer

Breaking down silos between energy vectors

- Electricity
- Heat
- Transport

Joining up physical requirements of the system, with policy, market and digital arrangements

- Physical System
- Digital System
- Market System
- Policy

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Key messages

• 80% target was hard. Net Zero is very hard

• Modelling can get only you so far. Significant unknown is how consumers will respond to necessary changes
  • Heating, Transport

• Broad consensus on key technology options needed. Inc. CCS, biomass, nuclear, offshore wind, low-carbon heating (electrification, district heating, hydrogen), EVs. But inherent uncertainty about ‘right’ mix

• Net Zero very unlikely to happen without robust policy. An ecosystem of low carbon regulation, planning/co-ordination, markets, pricing, innovation required
  • Inc. need for more granular price signals (Rethinking Electricity Market Design)

• Understanding the opportunities and risks of digitalisation is essential
Context: Decarbonising heat is going to require significant changes to our economy.
The challenge

At the current rate of conversion, it would take...

1000 to 2000 years
How to decarbonise heat: our hypothesis

- Start with the consumer, not the technology
- Digitalisation offers significant potential (and some risk)
- Heat as a service could be a powerful proposition
- Understanding different local energy systems is essential
- Heat decarbonisation will require significant market changes/policy drivers
We created a Living Lab to test the potential of the future smart home.
Consumers discover the service they want through experience.
Heat Plans: a starter-for-ten energy service

- **Warm hours**: Hours any room is warm
- **Schedule**: Temperature of rooms at any time
- **Pence per warm hour**: Like “mpg” for heating
- **Extras**: Cost of warmth outside the schedule

**FixedTime**
- **65 Warm Hours**
- **£7.15 per Week**
  - **11p per Warm Hour**
- **Extra Warm Hours**
  - **25p per Hour**

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Offered households the chance to ‘buy’ Heat as a Service
Everyone enjoyed better control, but they used it very differently (e.g. temperature)

**Cool Conservers**
- Often adjust temperature to try and cut bills

**Hot and Cold Fluctuators**
- Often adjust temperature to get comfortable

**On-Demand Sizzlers**
- Some like it hotter or want to spend more than others in their home

**Steady and Savvy**
- Rarely adjust their heating as they are fine with 18-20°C

**On-off Switchers**
- Turn it on and off to try and make sure home is only warm when someone is in

**Toasty Cruisers**
- Love feeling cosy and prefer not to put clothes on if they’re cold
If energy services could guarantee people got the comfort they wanted, they might not care how it was delivered
Demonstrated the potential of richer consumer data to offer households better products and services, including tailored retrofits that prepare their homes for low carbon heat.

- Data about household and building
- Shows when cannot get comfort they want (e.g. lounge feels cold)
- Used to design retrofit that improves comfort and energy efficiency
- Prepares home for low carbon heating that suits that area

Supported by detailed local area energy plans.
Some of the toughest challenges for decarbonisation will likely require local and regional coordination and action

- How to decarbonise buildings and what combinations of fabric upgrades, heating systems and infrastructure in different local areas
- The future of the gas network (including the potential of hydrogen)
- How to minimise the costs of the transition for consumers, including integration of electric vehicles and low carbon heating
Developed a structured & repeatable framework

Understand local options and choices for heat in whole system context

Collaboratively develop a long term evidence based plan to decarbonise

Resulting in data and insight to target innovation and deployment projects
Local Perspective
Proportion of different heating solutions by 2050 in different local areas

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<th>NCC</th>
<th>BCBC</th>
<th>GM Bury</th>
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<td>Low Temp Heat Pump</td>
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<td>High Temp Heat Pump</td>
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<tr>
<td>Hybrid Heat Pump</td>
<td>12,500</td>
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* Numbers given are indicative only based on stakeholder inputs to Local Area Energy Planning engagement
The UK’s current economic framework for decarbonisation is uneven and incomplete.
Rethinking Decarbonisation Incentives recommendations:
market driver for low carbon heat is a crucial gap

1. Take opportunities to improve the current framework of policies by adjusting existing mechanisms to align incentives to reduce emissions across the economy.

2. Take immediate steps to progress a carbon policy driver for residential heat, including detailed design of an enduring framework of carbon standards.

3. Consolidate and streamline existing measurement, monitoring, and verification of all emissions and related incentives.

4. Develop a pathway towards a coherent set of interlocking sectoral instruments covering all emitting activities throughout the economy, with a linked market for greenhouse gas removals.

5. Integrate carbon reduction into the measurement of economic productivity, potentially through the Industrial Strategy Council.
With unmanaged charging, consumers charge at existing peak times (16:00-19:00)

- Without intervention, plug-in vehicles likely to accentuate existing peaks in electricity demand
- Could lead to issues in supply-demand balancing or local network capacity
Managed charging is effective at shifting demand away from peak times

- UMC shifted charging to later in the evening; SMC shifted charging into the overnight period
- UMC and SMC-type systems can be effective solutions for managing demand
Role of Demand Management

- Trial participants appear responsive to tariffs
- Significant ability to manage load
- Potential UMC ‘herding’ impacts
Today – digitalisation is starting to change energy market

CONSUMERS – 26 Million

APPLIANCES AND TECH - 000's

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But risks creating multiple bespoke solutions and “lock-in”
Open Interoperable & Competitive Market

Interoperability Framework

Consumers – 26 Million

Appliances and Tech - 000’s

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Future energy/heat system needs to be interoperable in different ways

**Consumer**
ensuring that provisions exist for consumers to switch between both different commercial offers and technology choices.

**Commercial**
to ensure that incentives are aligned across the energy system to ensure that value can flow where it needs to, driven by market forces.

**Data**
to ease the sharing and portability of data between different systems.

**Devices**
to ensure that devices are swappable, replaceable and exchangeable as needs change and technologies develop and to allow consumers to make informed choices between open and closed eco-systems.

**Physical**
to ensure that end-to-end systems function as changes happen to parts of the system.

**Vector**
to ensure that energy provision across gas, electricity, heat, transport fuels etc. are compatible with one-another and that coordination occurs in a timely fashion.
Need to learn from the success of the telecoms sector
Key technologies and innovations for net zero

- Broad consensus on key technologies These include CCS, biomass, nuclear, offshore wind, low-carbon heating (electrification, district heating, hydrogen) and low-carbon transport solutions (electrification)
  - Innovation is important in these areas, but increasing the availability and deployment of these technologies is critical and in some cases (e.g. CCS) significantly more valuable than innovation per se
- Innovation is likely to deliver most value in terms of reducing overall energy system transition costs:
  - Transport – specifically cost reduction in low carbon light vehicles (e.g. EVs and batteries specifically), HGVs
  - **Nuclear (in particular Small Modular Reactors)** – accelerating cost reduction, developing heat recovery systems to enable the provision of heat for district heating, etc
  - Offshore Wind – continued cost reduction, particular focus on floating offshore wind technology
  - **Low carbon heat solutions** – improvements in the quality, performance and cost of heat pumps, building fabric improvements, supply chain and technical innovations within new-build and retrofit markets, etc
  - Biomass – improving resource availability through more sustainable land management practices, yield improvements, etc
  - Hydrogen - whole value chain improvements in low carbon / low cost hydrogen production (primarily via biomass with CCS)

- **Some technologies that are likely to have been undervalued in ESC analysis** (e.g. technologies delivering system flexibility services, including some types of energy storage). Further analysis is needed.

- Understanding the risks and opportunities of **digitalisation** will be central to the transition
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Guy Newey, Director of Strategy and Performance

guy.newey@es.catapult.org.uk
@guynewey