

# Smart Energy

## An EnergyREV perspective



Parliamentary and Scientific Committee  
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[www.energyrev.org.uk](http://www.energyrev.org.uk)

@EnergyREV\_UK  
@RFordUK

The EnergyREV logo, featuring the word "Energy" in a white, sans-serif font, followed by "REV" in a larger, bold, white, sans-serif font. A red arc is positioned above the "E" in "Energy", and a blue arc is positioned below the "V" in "REV".

EnergyREV

# The EnergyREV consortium

Consortium of 32 co-investigators exploring challenges around smart local energy systems from an interdisciplinary and whole-systems viewpoint. Expertise and detailed knowledge in:

## Institutions

Policy, regulation, markets and governance issues around local energy systems

## End users and consumers

Social science understanding of end user research and engagement

## Business and finance

Local energy businesses practices and industry engagement

## Multi-vector "whole" systems

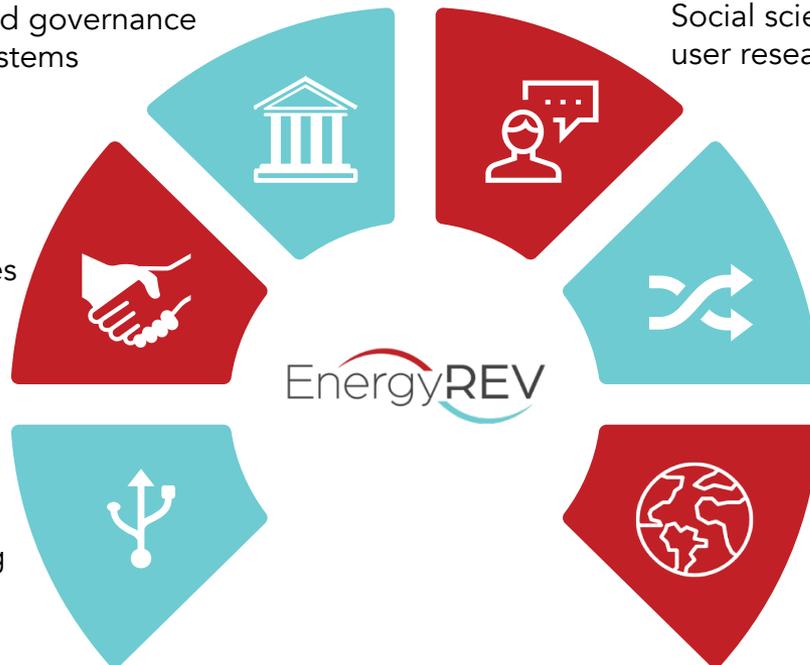
Electricity, heat and transport, and system integration

## Data and AI

Expertise across wide ranging cyber-physical issues

## Energy and environment

Interactions between energy and environmental systems



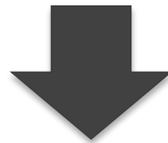
# Helping the UK Prosper From the Energy Revolution (PFER)



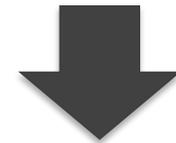
Synthesising knowledge



Delivering novel research



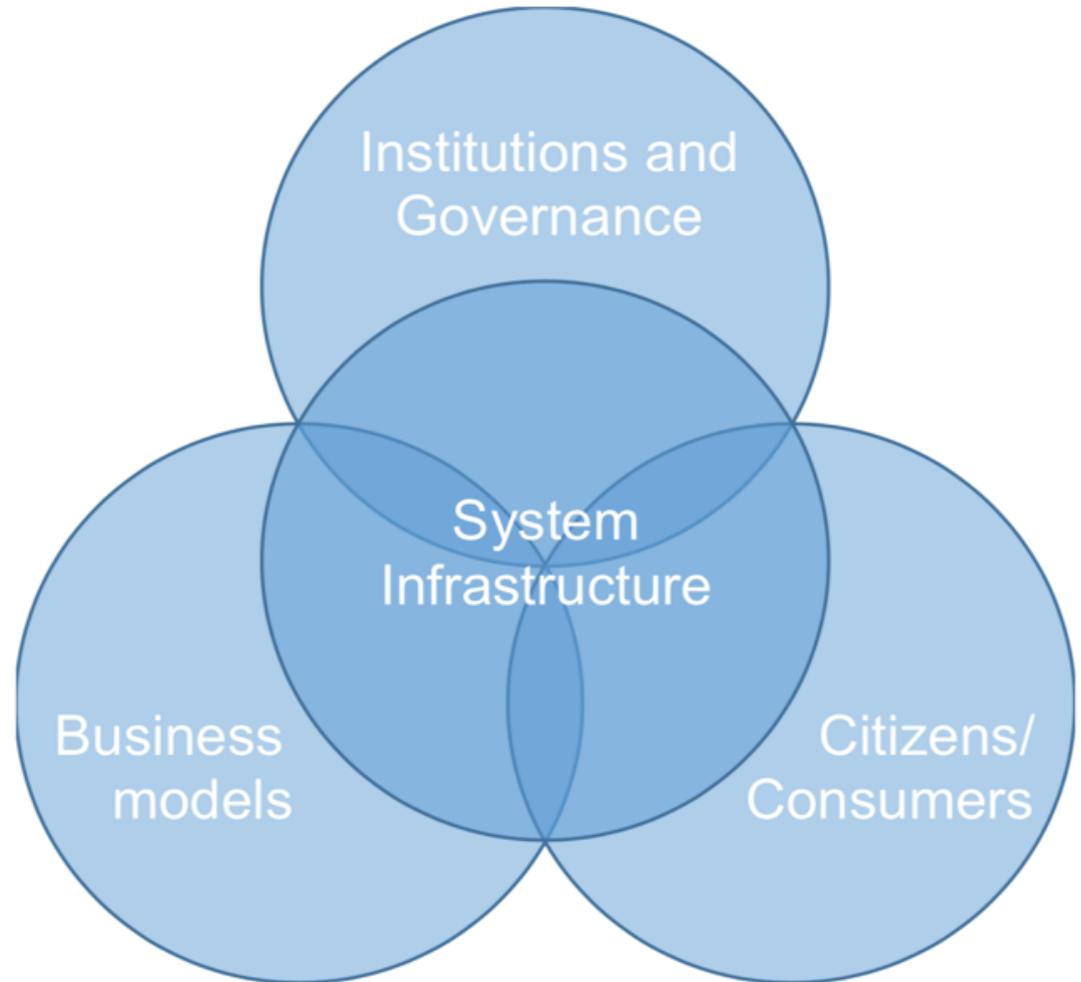
Exploring impact



1. Deliver whole systems research and innovation to inform local, investable, consumer-centred approaches
2. Develop robust principles, hypotheses, methodologies and a broad spectrum of analytical tools
3. Create a legacy of learning and understanding for global leadership in local smart energy systems
4. Create a hub to deliver integrated local energy systems knowledge

# Smart energy: focusing on systems

- Energy infrastructure: supply, networks, storage, demand.
- Multi-vector integration across all energy services (power, heat, mobility)
- Socio-economic elements: policy, regulation, markets, commercial arrangements, user engagement, community action.



Source: Eyre, N., Darby, S. J., Grünewald, P., McKenna, E., & Ford, R. (2018). Reaching a 1.5 C target: socio-technical challenges for a rapid transition to low-carbon electricity systems. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 376(2119), 20160462.

# Smart energy: many things to many people

Integration of information and communication technologies into energy systems, enabling data to be gathered and used in real time to optimise performance against key criteria.

Use data to support people implement more effective decision-making, planning, and governance processes.

Embedded machine learning / artificial intelligence enables the energy system to regulate itself in accordance with wider dynamics and user set preferences.

System responds to its environment, adjusting operation automatically to provide services in an optimal way.



*Ford, R., Maidment, C., Fell, M., Vigurs, C., and Morris, M. 2019. A framework for understanding and conceptualising smart local energy systems. EnergyREV, Strathclyde, UK. University of Strathclyde Publishing, UK. ISBN: 978-1-909522-57-2*

# Smart energy: many things to many people

Smart processes  Smart outcomes

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Human in the loop

Autonomous

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# Smart outcomes

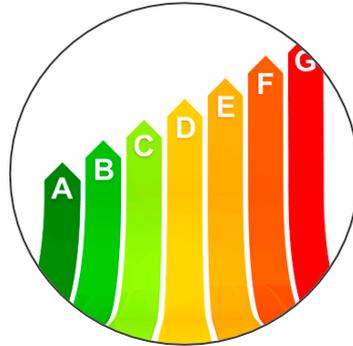


Focusing on what a smart energy system can deliver

# Smart in terms of outcomes



Deliver on net zero target



More effective and efficient



Environmental benefits



Social justice and energy equity



Flexibility across vectors



Resilience and coping with failure



Self sufficiency, independence



Context specific

Ford, R., Maidment, C., Fell, M., Vigurs, C., and Morris, M. 2019. A framework for understanding and conceptualising smart local energy systems. EnergyREV, Strathclyde, UK. University of Strathclyde Publishing, UK. ISBN: 978-1-909522-57-2

# Challenges for delivering smart outcomes

## 1. Defining outcomes



Trade offs  
between  
outcomes

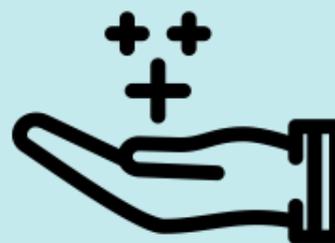


Conflicting  
stakeholder  
perspectives

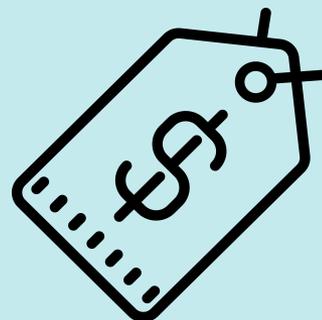


How and by who this is defined  
will drive impact, legitimacy, and  
acceptability.

## 2. Scales of impact



Which  
stakeholders  
benefit?



Which  
stakeholders  
pay?

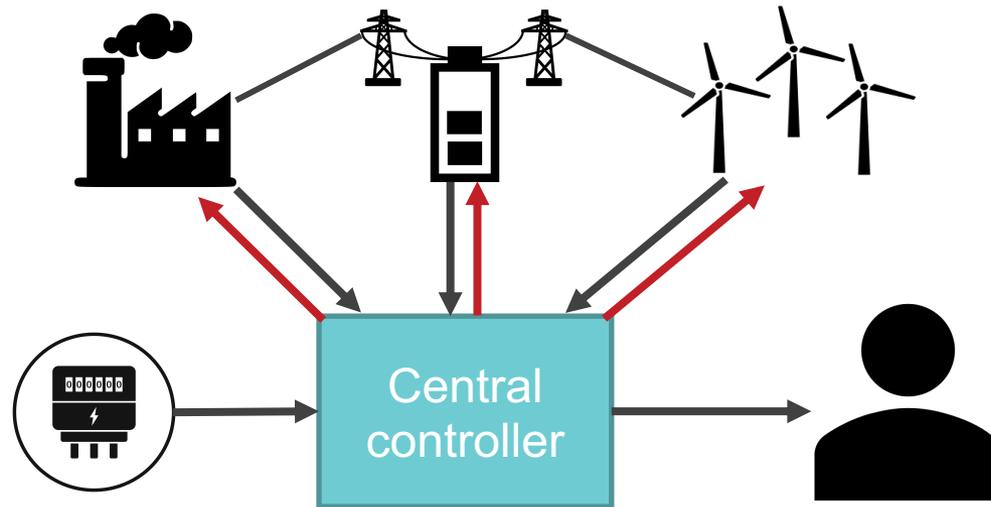
# Smart processes

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Focusing on how a smart energy system delivers optimal outcomes

# Smart in terms of process: legacy energy systems

→ Data  
→ Control



Challenge: volume of data, speed of control required



Distributed generation



Distributed storage



Building energy management



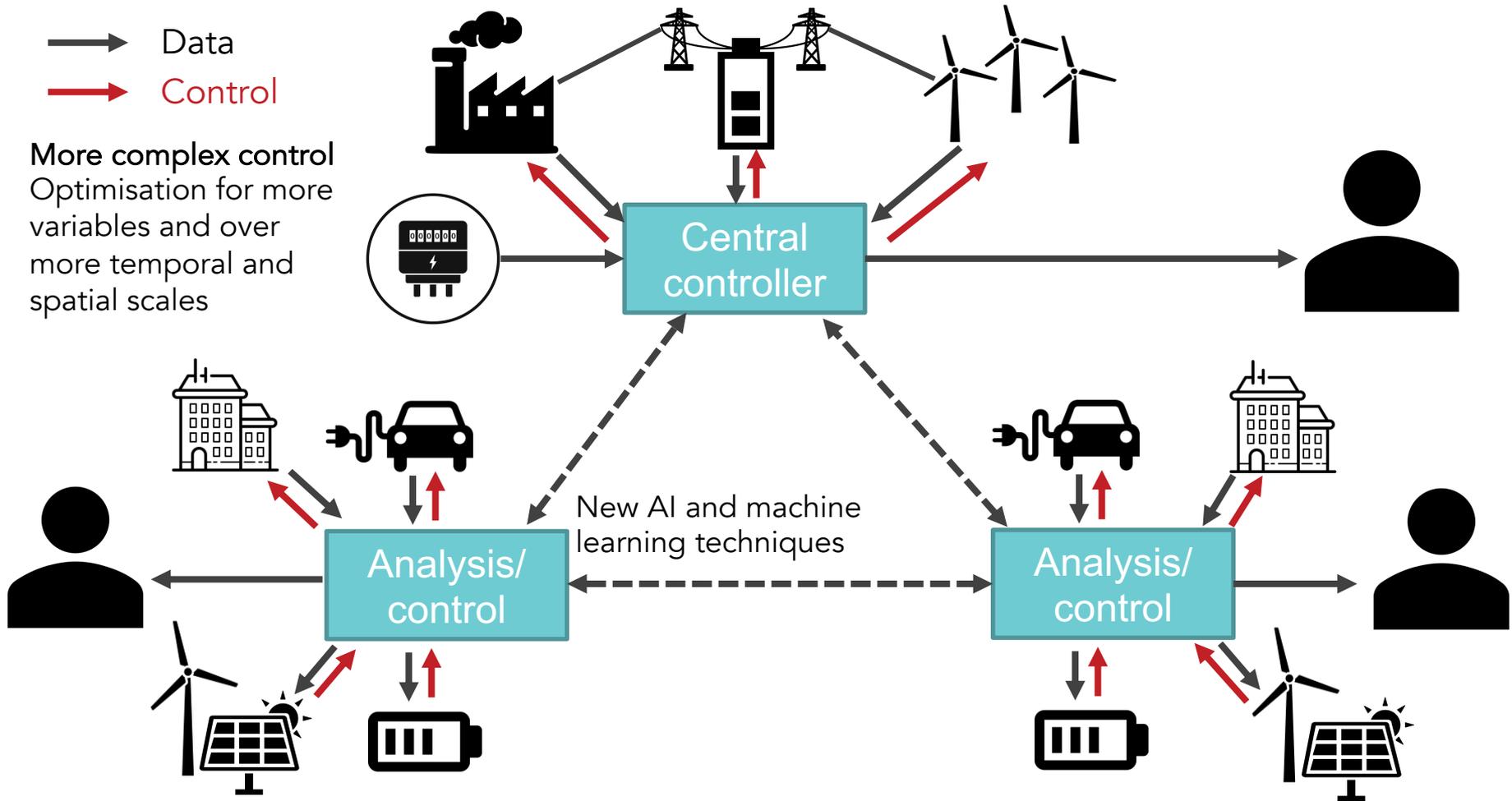
Electric vehicles

Based on Verba, N., Gaura, E., McArthur S., et al. "The Energy Revolution: Cyber Physical advances and opportunities for Smart Local Energy Systems". EnergyREV white paper.

# Smart in terms of process: future energy systems

→ Data  
→ Control

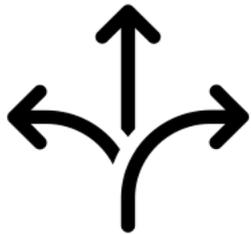
More complex control  
Optimisation for more variables and over more temporal and spatial scales



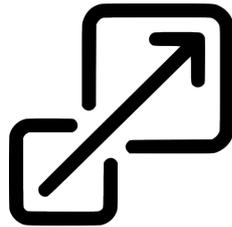
Based on Verba, N., Gaura, E., McArthur S., et al. "The Energy Revolution: Cyber Physical advances and opportunities for Smart Local Energy Systems". EnergyREV white paper.

## Challenges for smart processes

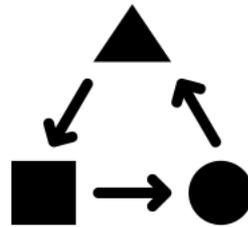
1. Ensuring that the system architecture is:



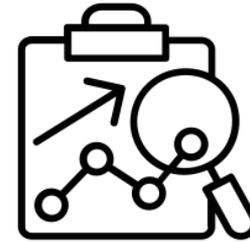
Flexible



Scalable



Interoperable



Predictive



Secure

2. Leveraging smart processes to deliver smart outcomes in context specific ways

3. Accounting for new forms of governance and accountability structures

4. Supporting emerging and “local” decision makers and information users

# Closing thoughts

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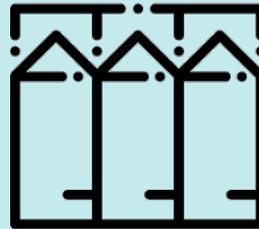
Insights from early findings from the EnergyREV programme

# How smart energy needs to be reframed

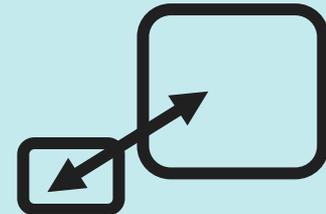
## Create connections



Between process and outcomes



Across policy and practice silos



Between local and national scales

## Allow agility



In how policies and regulations enable change



In how change is evaluated and progressed