

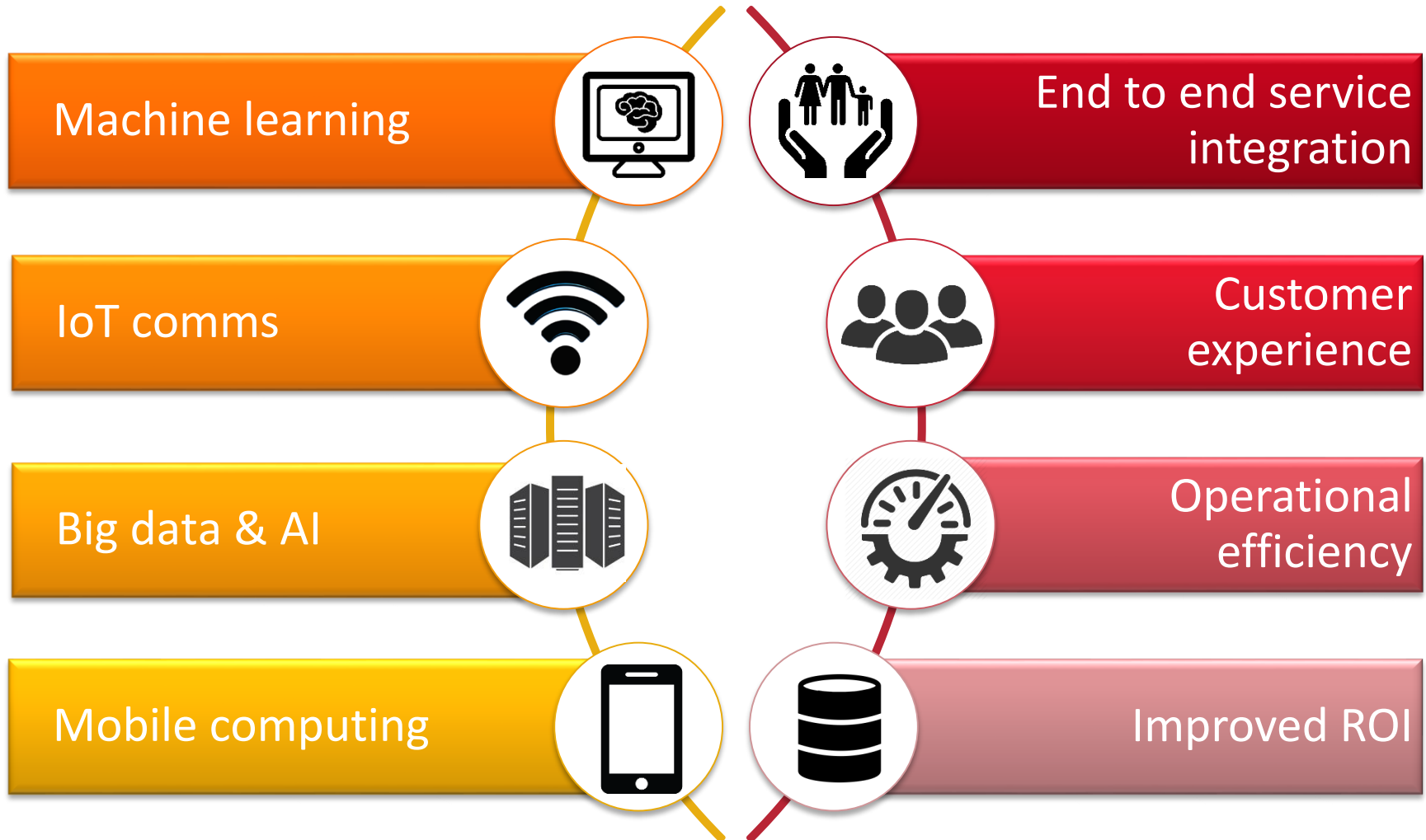
# Unlocking the value of consumer flexibility



Creating sustainable value from connecting homes

“How do consumers access energy system benefits without active engagement?”

# New technologies = New opportunities





- Every end point captures minute-by-minute temperature and power data
- Learning algorithms in each home generate a 24-hour ahead energy demand profile
- A flexibility value is attributed to each home based on learnt occupant and thermal dynamic behaviour
- In home controls act autonomously, protect consumer comfort and optimise energy demand and value by working in unison with a central Virtual Power Plant (VPP) or Energy Centre
- Demand is reshaped by the VPP to unlock value from the energy system



# Seamless Demand Response Pilot Project

## Heat Pump Control and Optimisation in Social Housing

Partner



Department  
of Energy &  
Climate Change

UCL ENERGY  
INSTITUTE

yarlington  
building communities

Westward  
Housing Group  
Incorporating Westcountry Housing and Tarka Housing

Size

2013-2015

£1.2m

### Energy Company



- ▶ System value derived from TOU tariffs
- ▶ Modelling consumer cost savings with Economy 7 and Economy 10 tariffs
- ▶ Measuring actual performance of controls in 100 homes with ASHP or GSHP

### Community



- ▶ Aggregated portfolio view and home control panel for social landlords
- ▶ Avoided home visits by remote analysis and settings configuration

### Energy Services



- ▶ Advanced control algorithms developed for ASHP and GSHP
- ▶ Load shifting based on TOU tariffs

### Consumer



- ▶ Surveys of usability of existing and new heating controls
- ▶ GUI design collaboration with RSL
- ▶ In-home tablet based controls

### Key messages

- ▶ First UK demonstration of heat pump load shifting using building mass as a thermal store
- ▶ Installed in social housing, typically rural, elderly, vulnerable tenants
- ▶ New user interface developed to aid tenant operation of the system
- ▶ Heating system efficiency improved by 10% through smart heat pump operation
- ▶ Demonstrated ability to derive further savings from load shifting with TOU tariffs

### PassivSystems' Role

- ▶ Project inception, design, and delivery responsibility
- ▶ Customer recruitment and community engagement
- ▶ In home heating controls
- ▶ Metering and monitoring
- ▶ Advanced control algorithm development using thermal mass of the building as a heat store
- ▶ User interface design and development, targeted elderly social tenant user group
- ▶ Social landlord dashboard view
- ▶ Customer support
- ▶ Data collection and analysis
- ▶ Project learnings dissemination

# NOTICE Project

## Network Optimisation Through Intelligent Control Execution

Partner



Department  
of Energy &  
Climate Change



WSP

PARSONS  
BRINCKERHOFF

e-on

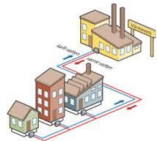
UK

Size

2014-2017

£690k

### Energy Company



- ▶ Modelling whole system benefits of domestic heat demand load flattening
- ▶ Measuring actual performance of controls in 30 homes
- ▶ Sigfox automated meter reading service

### Community



- ▶ Load shifting using different mathematical models for aggregated control
- ▶ Impact of different community load management parameters on customer comfort

### Energy Services



- ▶ Advanced control algorithms developed for Heat Interface Units
- ▶ Demand forecasting and load shifting
- ▶ Delta t optimisation using dynamic valve control to modulate flow temperatures

### Consumer



- ▶ Surveys of usability of existing and new heating controls
- ▶ Heat usage feedback and peer comparison

### Key messages

- ▶ First UK project to demonstrate active load control at the end points of a district heating network
- ▶ Demonstrated opex savings of 40% for heat network operator
- ▶ High levels of customer satisfaction with heating controls
- ▶ UK's first deployment of Sigfox IOT comms for heat meter AMR

### PassivSystems' Role

- ▶ Project inception, design, and delivery responsibility
- ▶ Customer recruitment and community engagement
- ▶ In home heating controls
- ▶ Sigfox AMR service creation, implementation and operation
- ▶ Installer support tool development
- ▶ Advanced control algorithm development
- ▶ Aggregation platform implementation
- ▶ Customer support
- ▶ Data collection and analysis
- ▶ Project learnings dissemination

# FREEDOM Project

Flexible Residential Energy Efficiency and Demand Optimisation and Management

Partner  
s

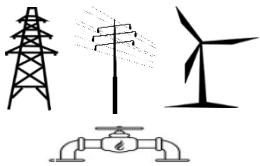


CITY UNIVERSITY  
LONDON

DELTA  
Energy & Environment

2016-2018  
Size  
£5.2m

## Energy Company



- ▶ Modelling whole system benefits of hybridisation of domestic heating
- ▶ Exploring business model impacts for gas and electricity network operators
- ▶ Measuring actual performance of devices in 75 homes

## Community



- ▶ USEF compliant aggregation model
- ▶ Aggregated portfolio optimisation against market price signals
- ▶ Frequency control, wholesale market, network constraint

## Energy Services



- ▶ Advanced control algorithms developed for different heat pumps and boiler combinations
- ▶ Demand forecasting and load shifting
- ▶ Demand response services that monitor and maintain customer comfort levels

## Consumer



- ▶ Cost optimised heat delivery
- ▶ New user interface design
- ▶ Advanced techniques to build consumer trust to support new service models
- ▶ Feedback on usage, cost and future budget

## Key messages

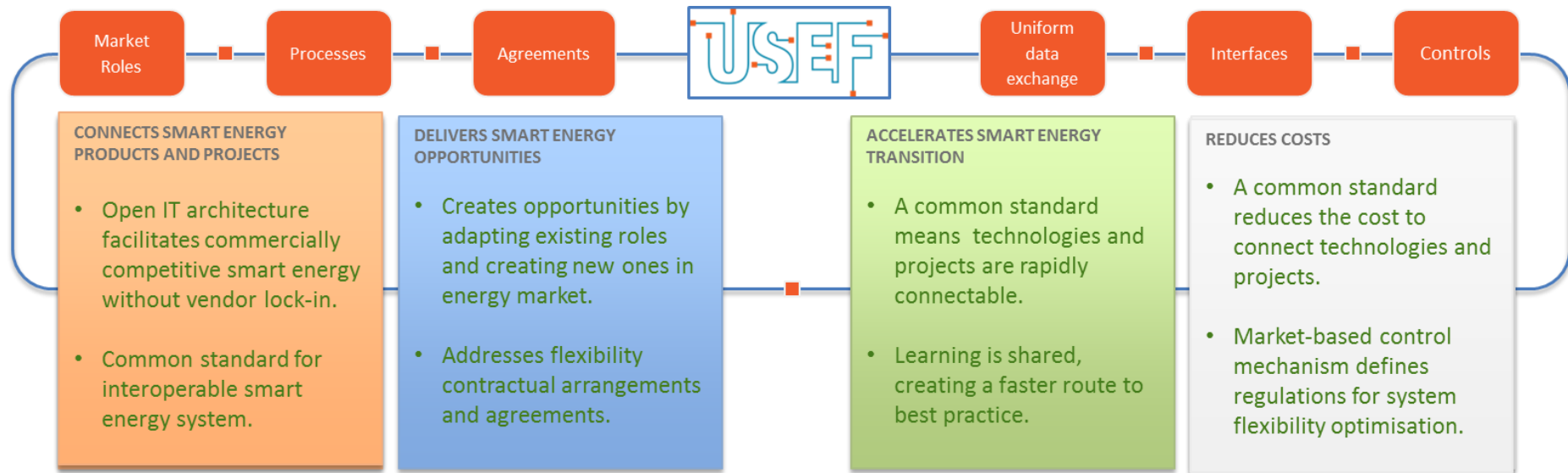
- ▶ First major UK project bringing together gas and electricity network operators
- ▶ Will demonstrate the most advanced load control of hybrid heating systems (gas boiler + air source heat pump) in UK
- ▶ Modelling UK system value of hybrid heating flexibility
- ▶ Outputs will help to inform UK policy makers on roadmap for heat decarbonisation
- ▶ Installations in a range of public and private housing types in Bridgend, South Wales

## PassivSystems' Role

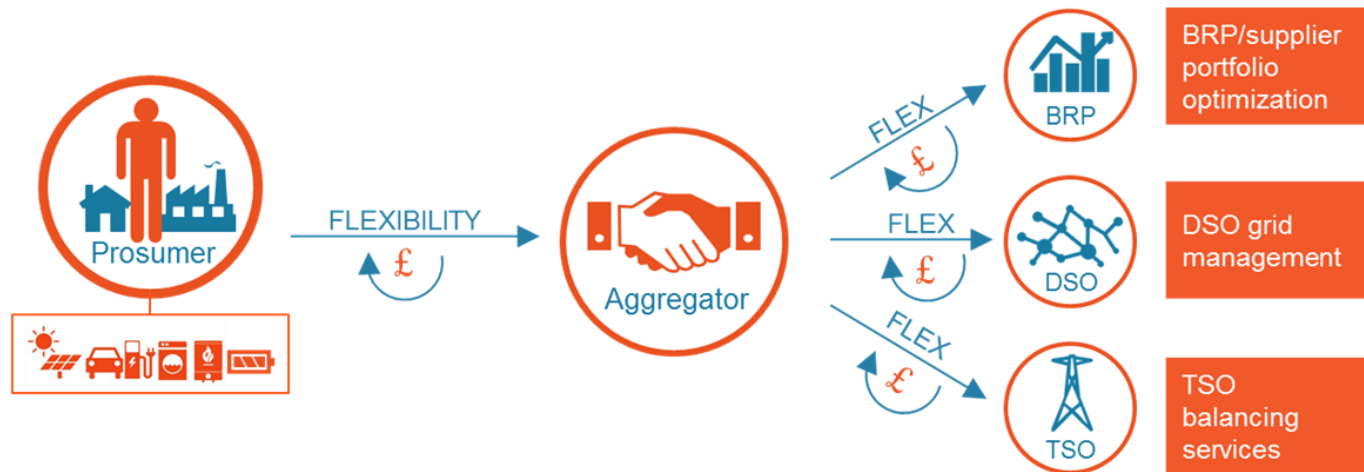
- |  |   |  |                                   |
|--|---|--|-----------------------------------|
| ▶ Project inception, design, and delivery responsibility | procurement, installation and commissioning | ▶ Advanced control algorithm development | ▶ Data collection and analysis    |
| ▶ Customer recruitment and community engagement          | ▶ In home heating controls                  | ▶ Aggregation platform implementation    | ▶ Project learnings dissemination |
| ▶ Hybrid heating system                                  | ▶ User interface design and implementation  | ▶ Customer support                       |                                   |

# Central Trading Desk

## Universal Smart Energy Framework (USEF)



- USEF provides the international common framework for a unified smart energy market.
- Flexibility made a tradable commodity;
- USEF delivers the market structure and tools required.



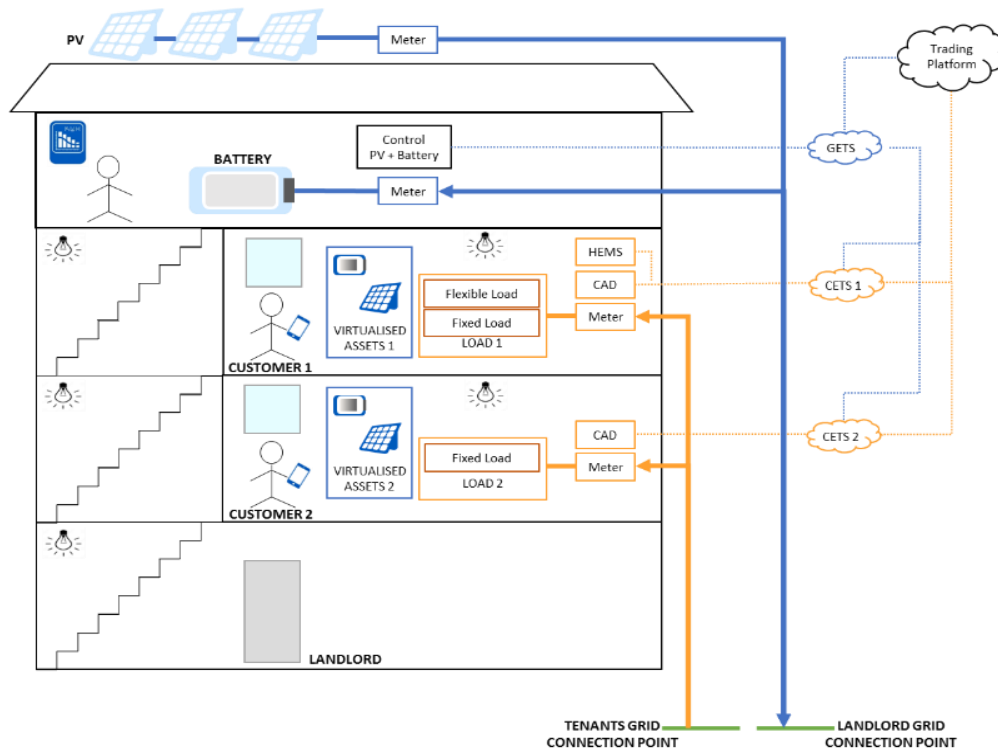


# Peer to Peer Trading

## Blockchain Enabled Energy Trading

Blockchain facilitates levels of trading interactions between large numbers of consumers that would otherwise be untenable.

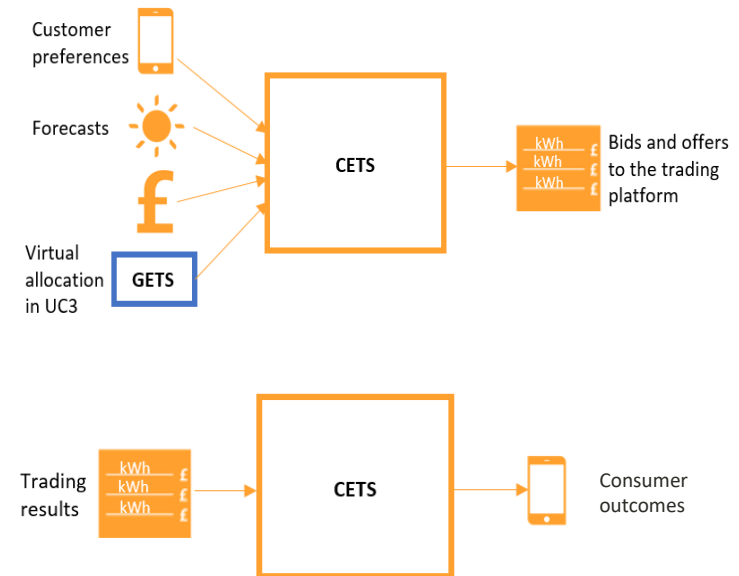
In this example, building occupants trade battery and demand flexibility and PV generation.



Generation Energy Trading System

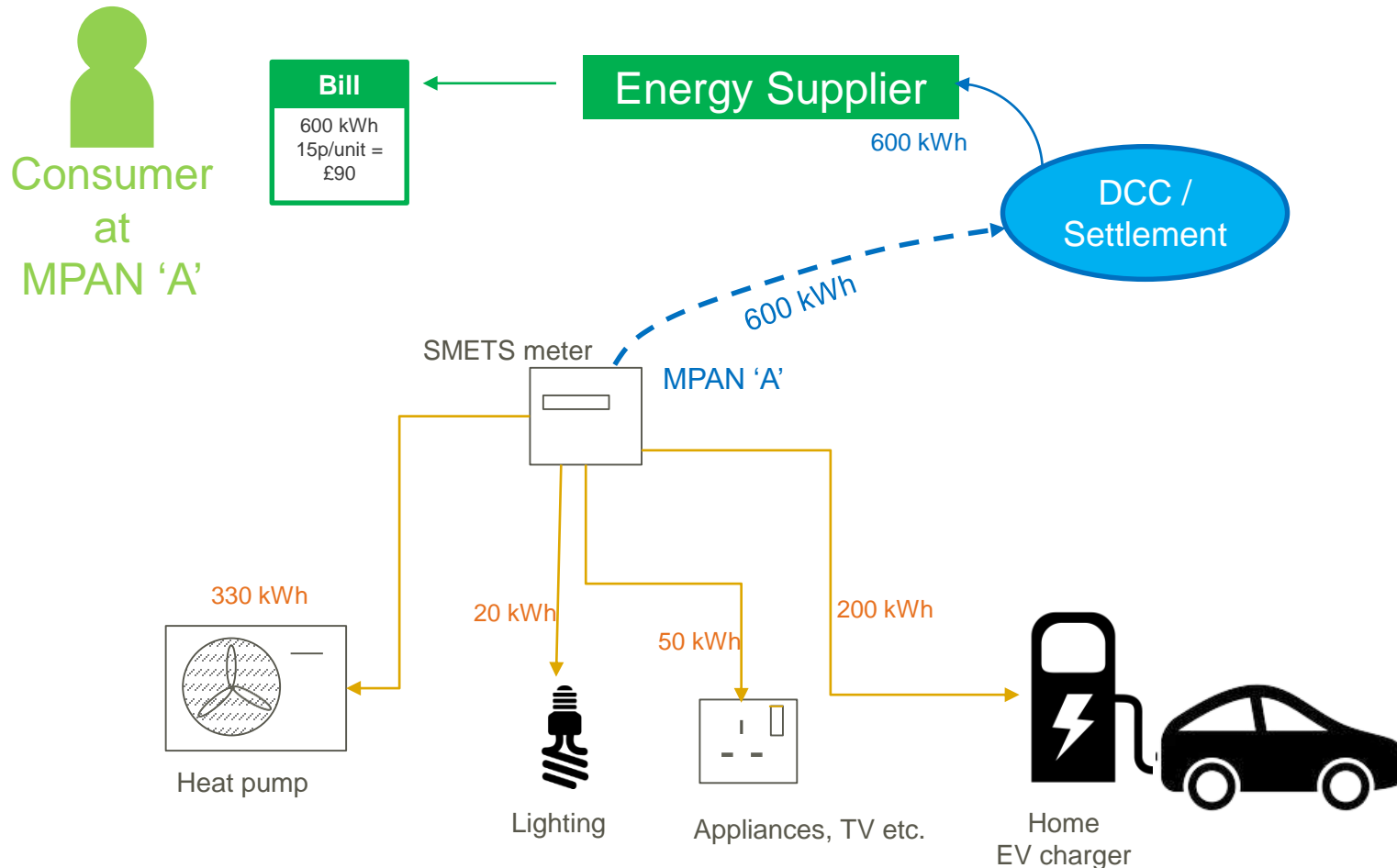


Consumer Energy Trading System

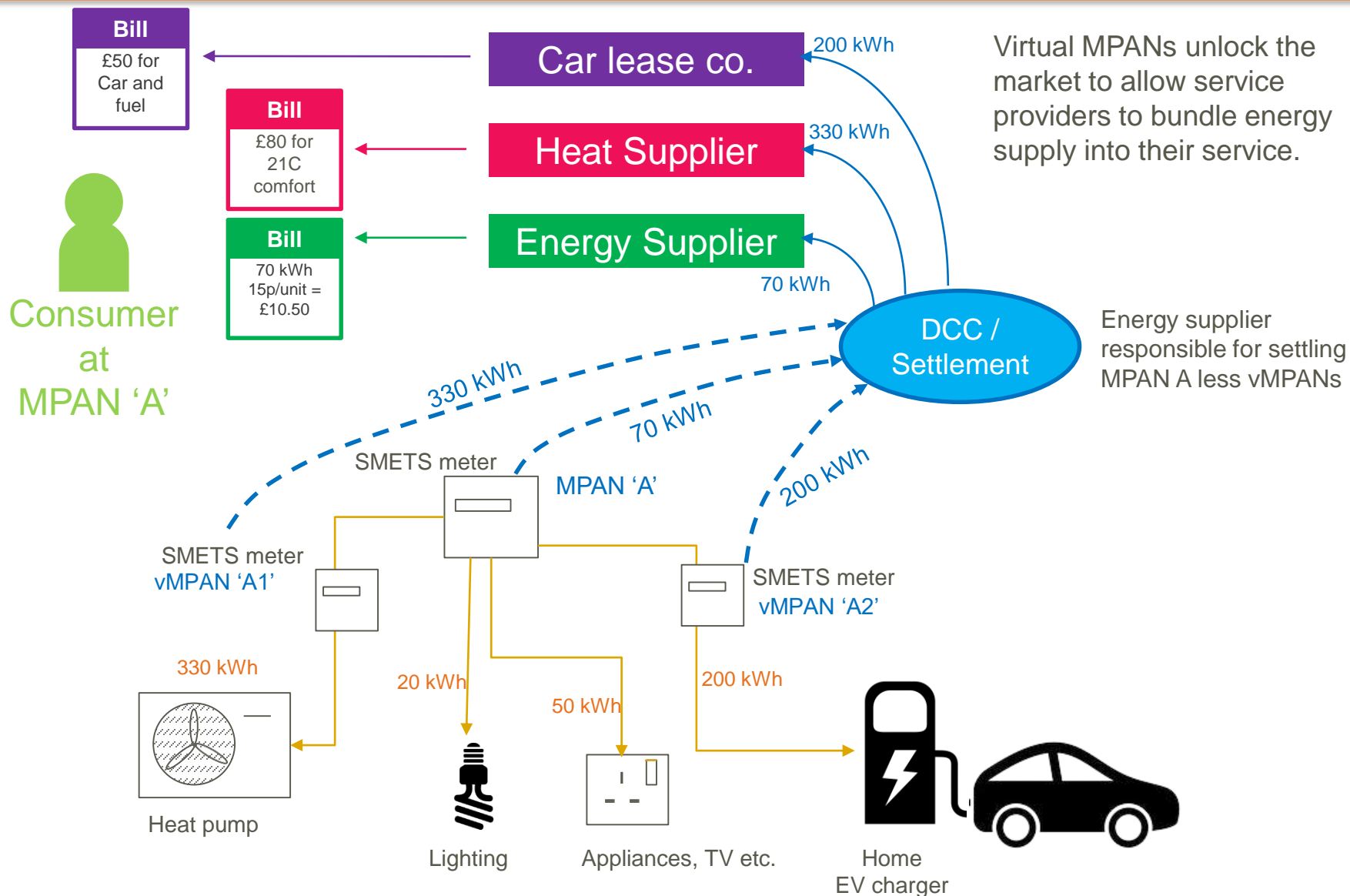


# Current monthly energy billing

Currently consumers are constrained to purchasing all electricity consumed from a single energy supplier. One supplier to each MPAN.



# Future monthly service billing



PassivEnergy has been developed to deliver mass market consumer propositions without the need for consumers to actively engage with the energy system

There is a lot of work to be done before the industry will be ready to engage with consumers in the way they expect

Large scale trials of consumer propositions that provide statistically robust evidence on different decarbonisation of heat use cases and deployment of EVs are urgently needed





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