The role of the energy prosumer

Enabling Net Zero Carbon through flexibility

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Luke Osborne

Member benefits

See even more member benefits: **www.eca.co.uk/journey**

Presentation Aims

- Describe the concept of:
  - Energy Prosumer
  - Prosumers Electrical Installation (P.E.I.)

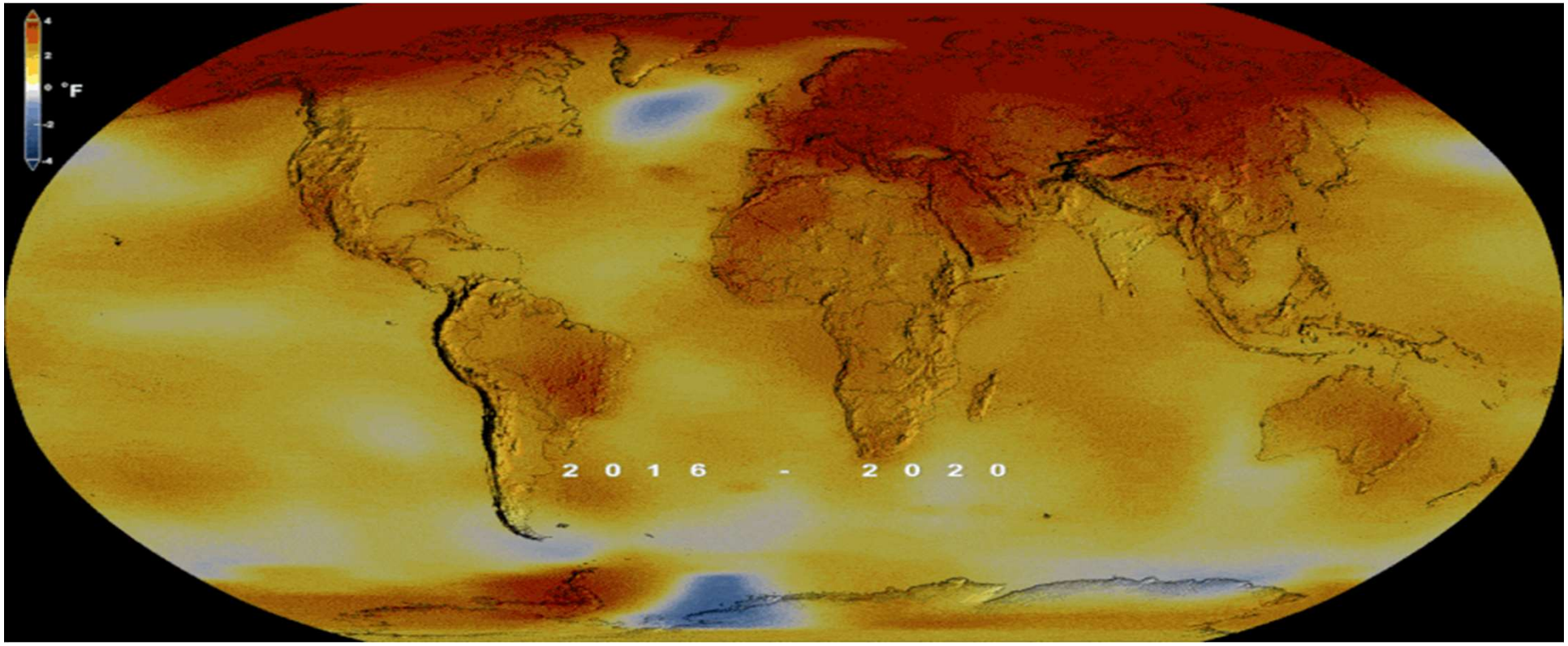
- Explain how the P.E.I. fits with our future energy network

Presentation Agenda

- Why change is required
- The concept of the Energy Prosumer and the Prosumers Electrical Installation
- Prosumer configurations and connections
- Prosumer use cases
- Notifications and considerations
- Conclusion
- Summary

Why change is required

Undeniable impact of climate change



Joining the race to Net Zero Carbon 2050

- Policy and direction
  - Governments legal commitment to Net Zero Carbon 2050
  - Increasing amounts of funding to aid adoption of measures
  - 2030 ICE sales ban
  - Focus on decarbonizing the built environment
  - 600,000 heatpumps to be installed every year by 2028
  - Move to low carbon electricity network
- **Electrotechnical contractors are key to delivering many of the solutions to help achieve our goals**

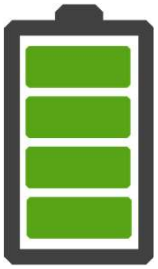
COP 26

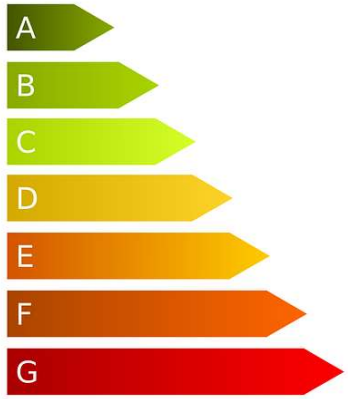
Low carbon electricity network

- Ever increasing amount of low carbon generation being added
  - On/off shore wind generation
  - Solar PV
  - Biomass plant and anerobic digestors
  - 43.1% in 2020 134.6 TWh
    - More than that generated by fossil fuels (117.8 TWh)
- Deployment will continue to increase
- So what's the downside?
  - **Variable output**

Low carbon electricity network

- So what's the solution?
  - Install greater amounts of renewable energy generation than is needed
    - To allow for reduction in output
  - Increase energy storage capabilities in the system
  - Maximise energy efficiencies and flexibility





Low carbon electricity network

- So what's the solution?
  - Install greater amounts of renewable energy generation than is needed
    - To allow for reduction in output
  - Increase energy storage capabilities in the system
  - Maximise energy efficiencies and flexibility

£30-£70bn savings

Department for Business, Energy & Industrial Strategy

ofgem Making a positive difference for energy consumers

Transitioning to a net zero energy system

Smart Systems and Flexibility Plan 2021

July 2021

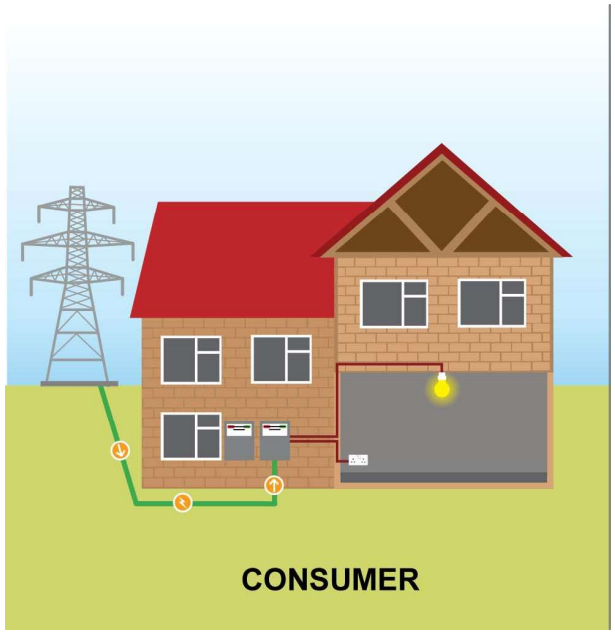
The Energy Prosumer & the Prosumers Electrical Installation (P.E.I.)

The ‘energy prosumer’ concept

- Originally published in IEC 60364-8-2
  - October 2018
  - IEC 60364- is the basis for *most* of our BS 7671 wiring regulations
- Introduced two new terms:
  - Energy prosumer
  - Prosumers Electrical Installation (P.E.I.)
- May possibly become a new chapter in Amendment 2 of BS 7671 The Wiring Regulations
  - (featured in the DPC but will have to wait until Spring 2022 to know if it has been included)

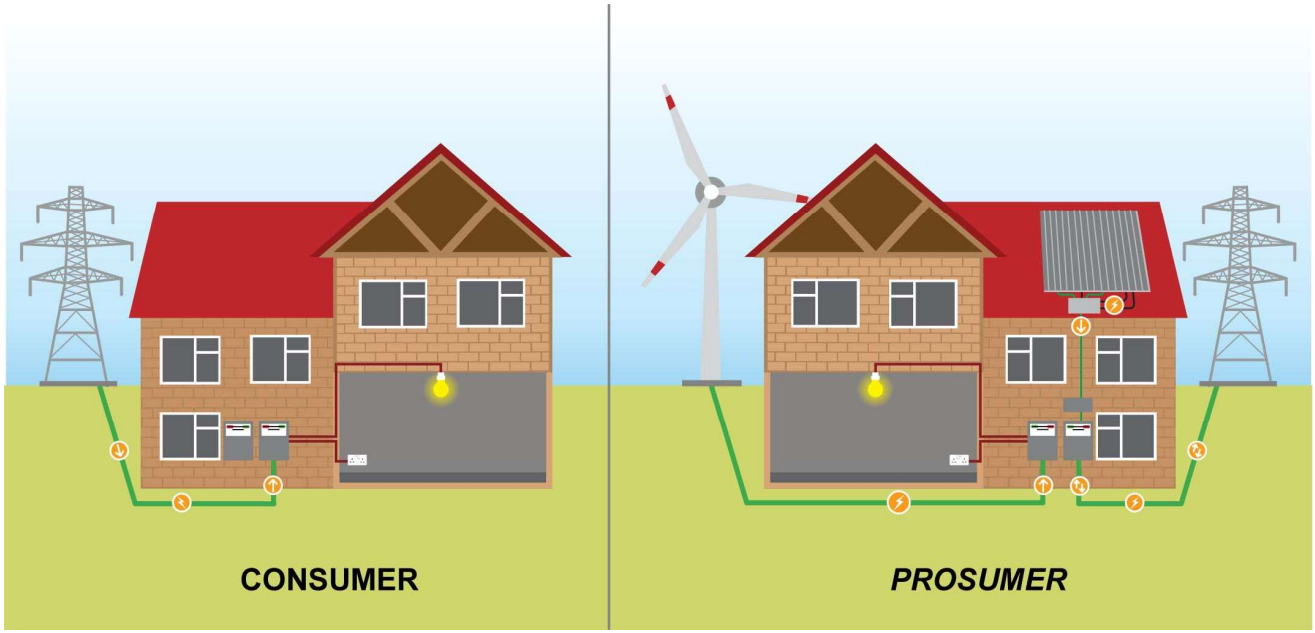
Prosumers Electrical Installations (PEI)

- Concept which ties in many technologies
- Aids in creating a building that is ‘active’ with the grid
- Moves from a uni-directional energy flow



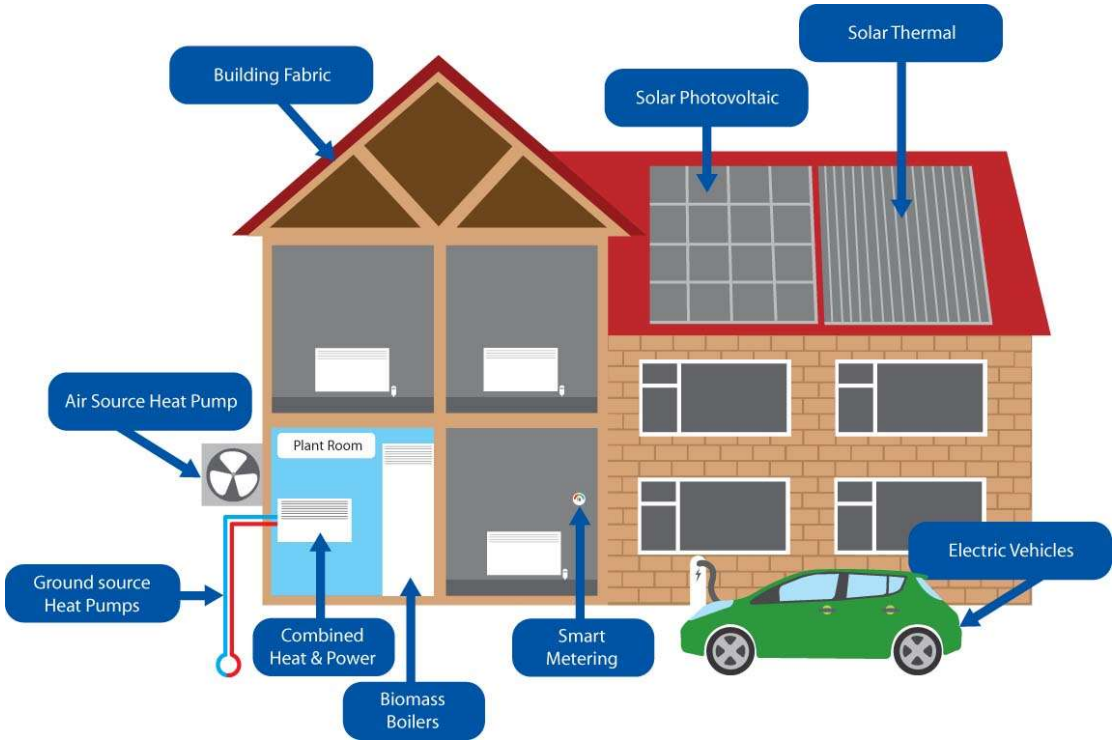
Prosumers Electrical Installations (PEI)

- Concept which ties in many technologies
- Aids in creating a building that is ‘active with the grid
- Moves from a uni-directional energy flow
- To that of a bi-directional energy flow

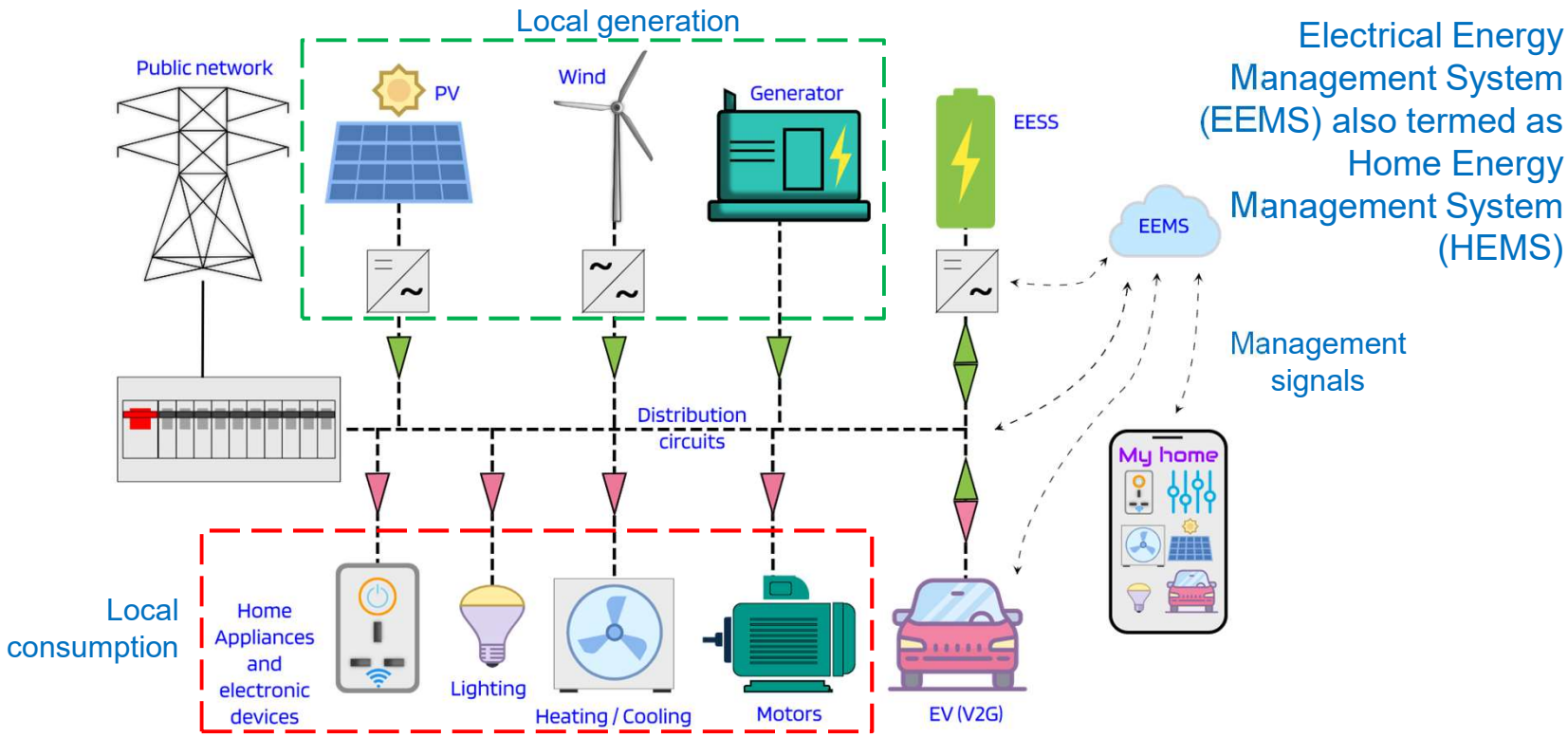


Prosumers Electrical Installations (PEI)

- Solar PV
- Electrical Energy Storage Systems (EESS)
  - Batteries!
- Heating (heat-pumps / smart storage)
- Electric Vehicles
- Domestic / commercial appliances and loads



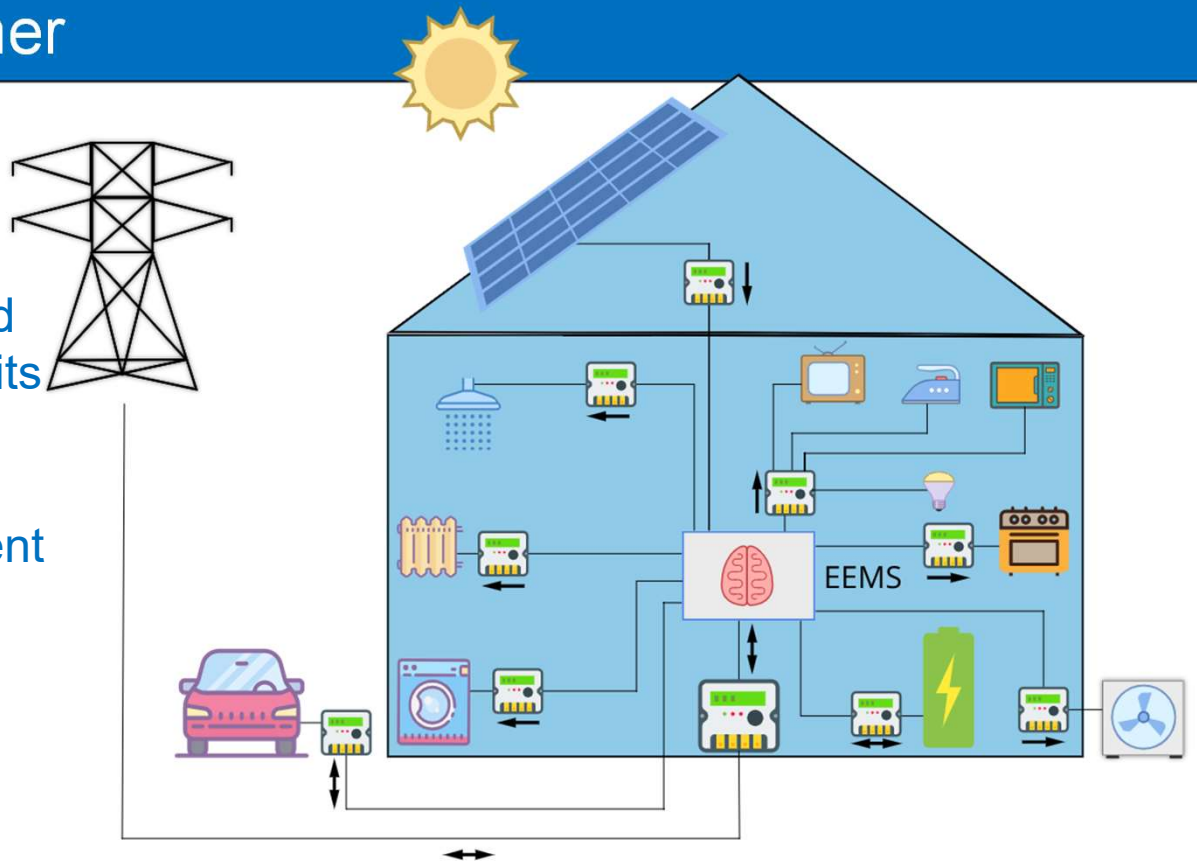
How does will prosumer idea work?



The Prosumer

Metering

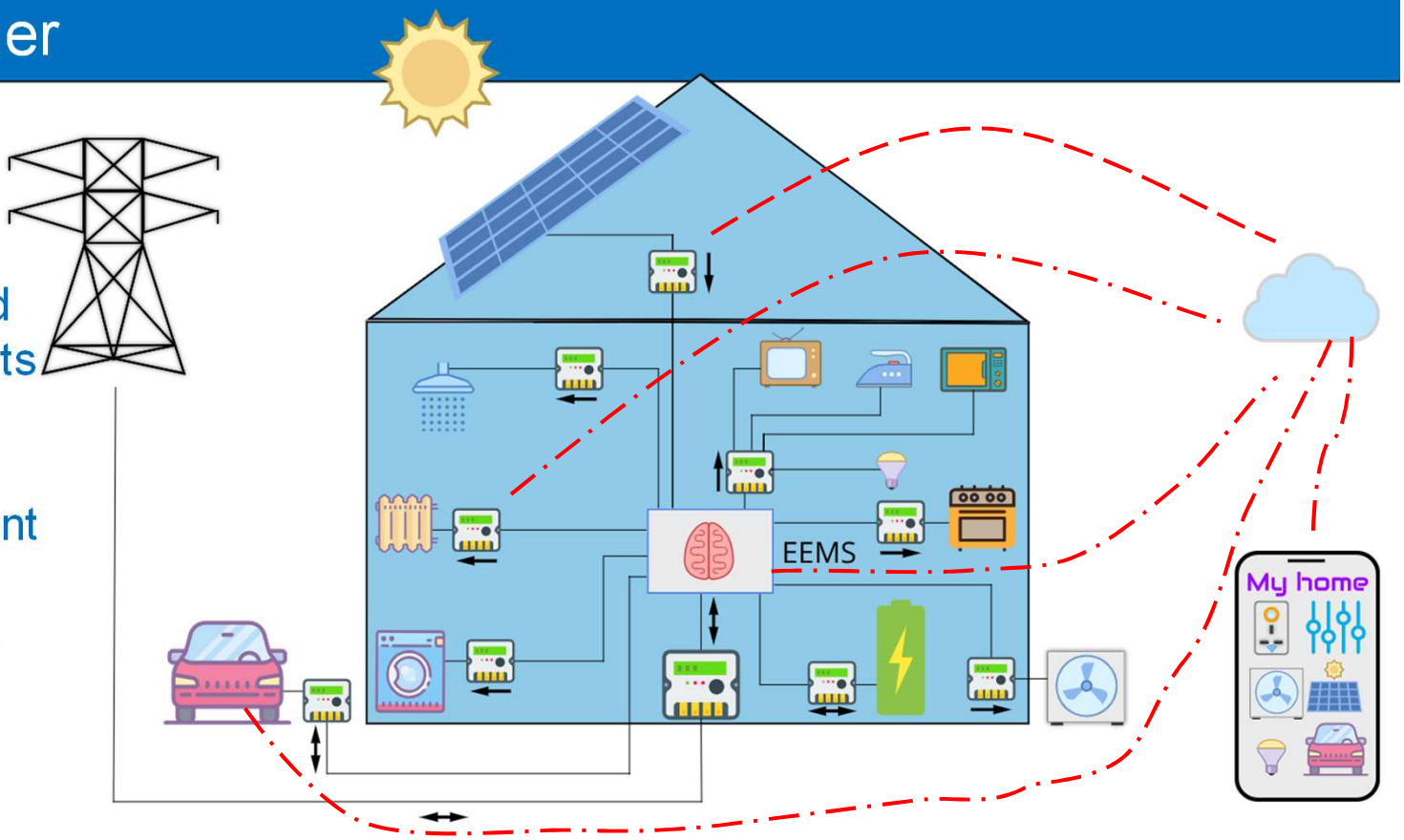
- Specific high- load devices and circuits
- General circuit monitoring
- Smart management through EEMS



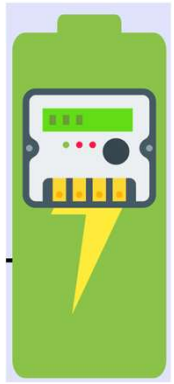
The Prosumer

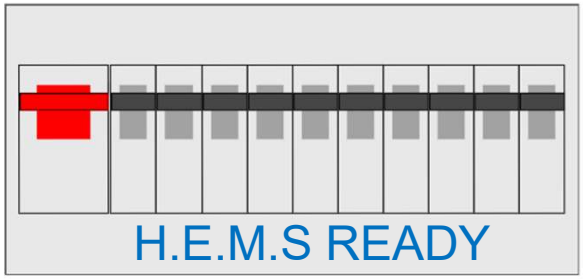
Metering

- Specific high- load devices and circuits
- General circuit monitoring
- Smart management through EEMS
- Cloud control and access

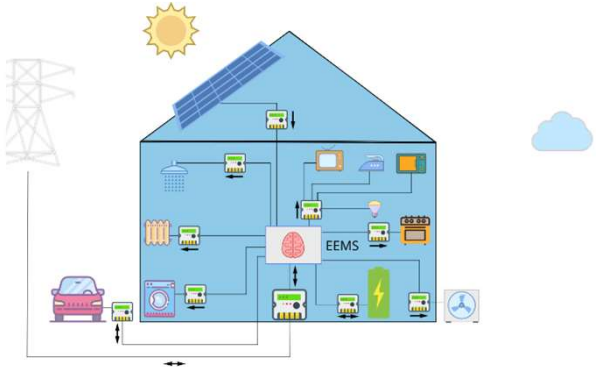


Communication control





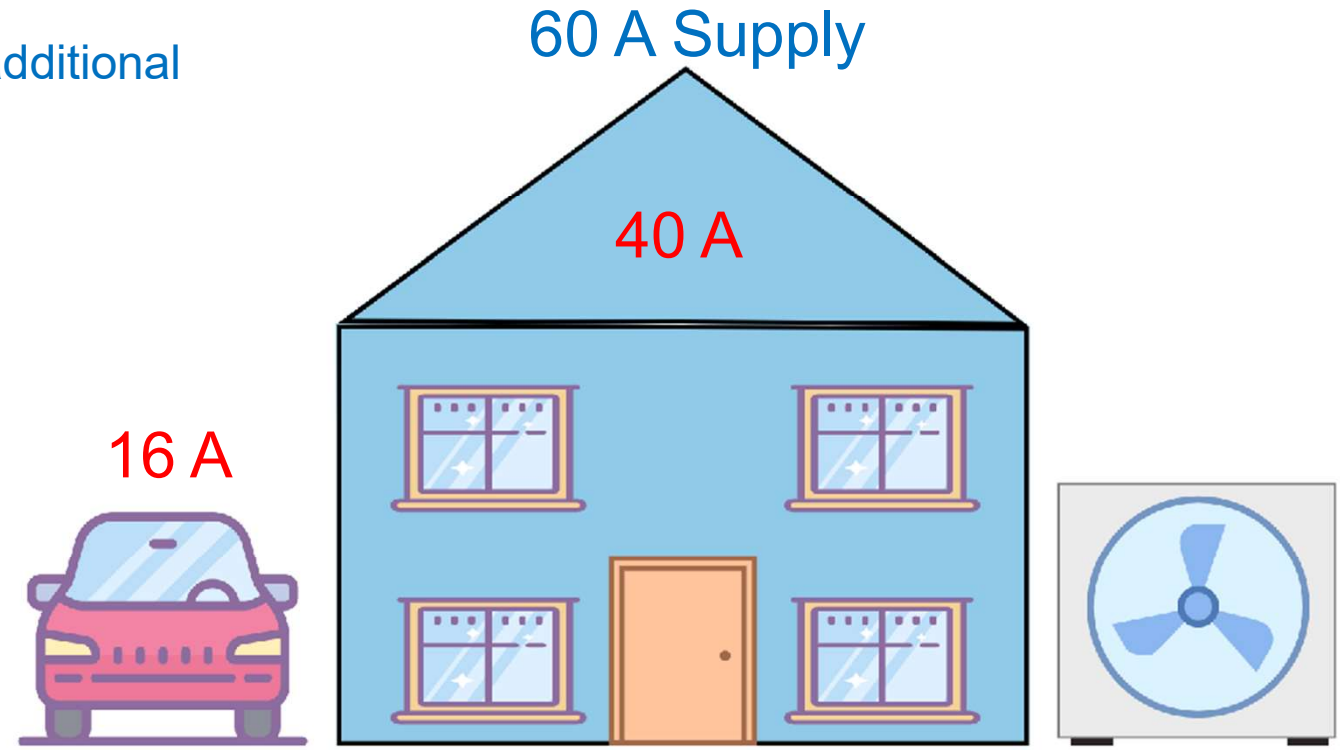
zigbee



Domestic scenario load control

Why do we need additional metering?

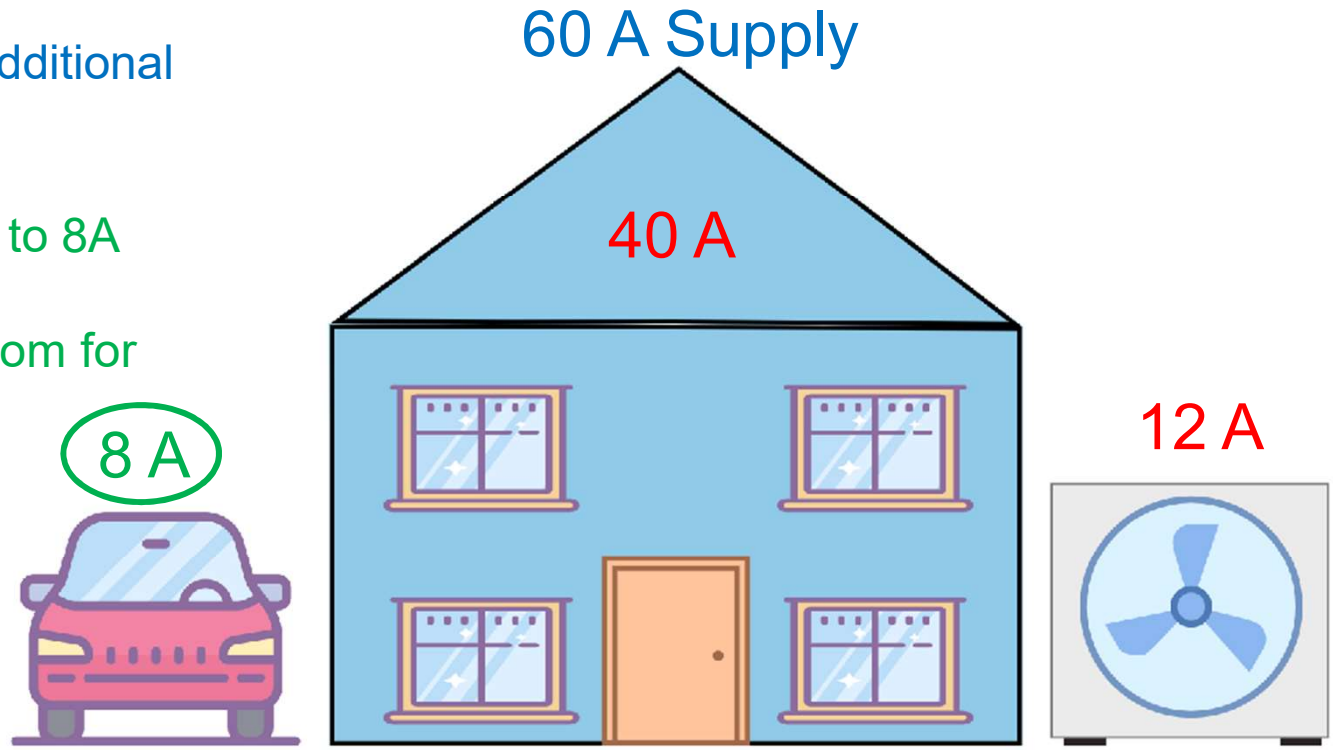
- Load control



Domestic scenario load control

Why do we need additional metering?

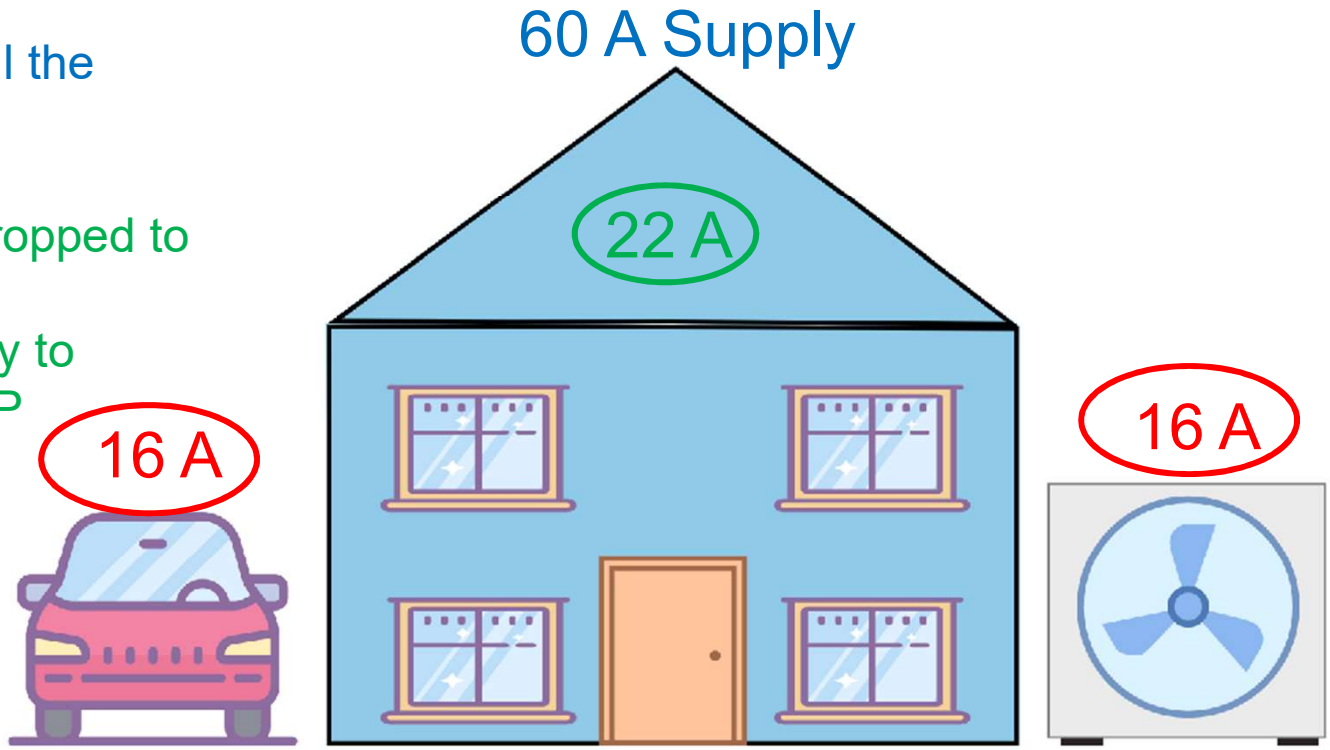
- Load control
- EVCP- dropped to 8A from 16A
- Allowing headroom for ASHP



Domestic scenario load control

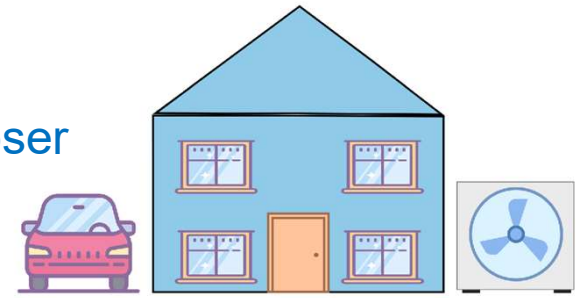
Why do we need all the metering?

- Load control
- Building load- dropped to 22A from 40A
- Allows full supply to ASHP and EVCP



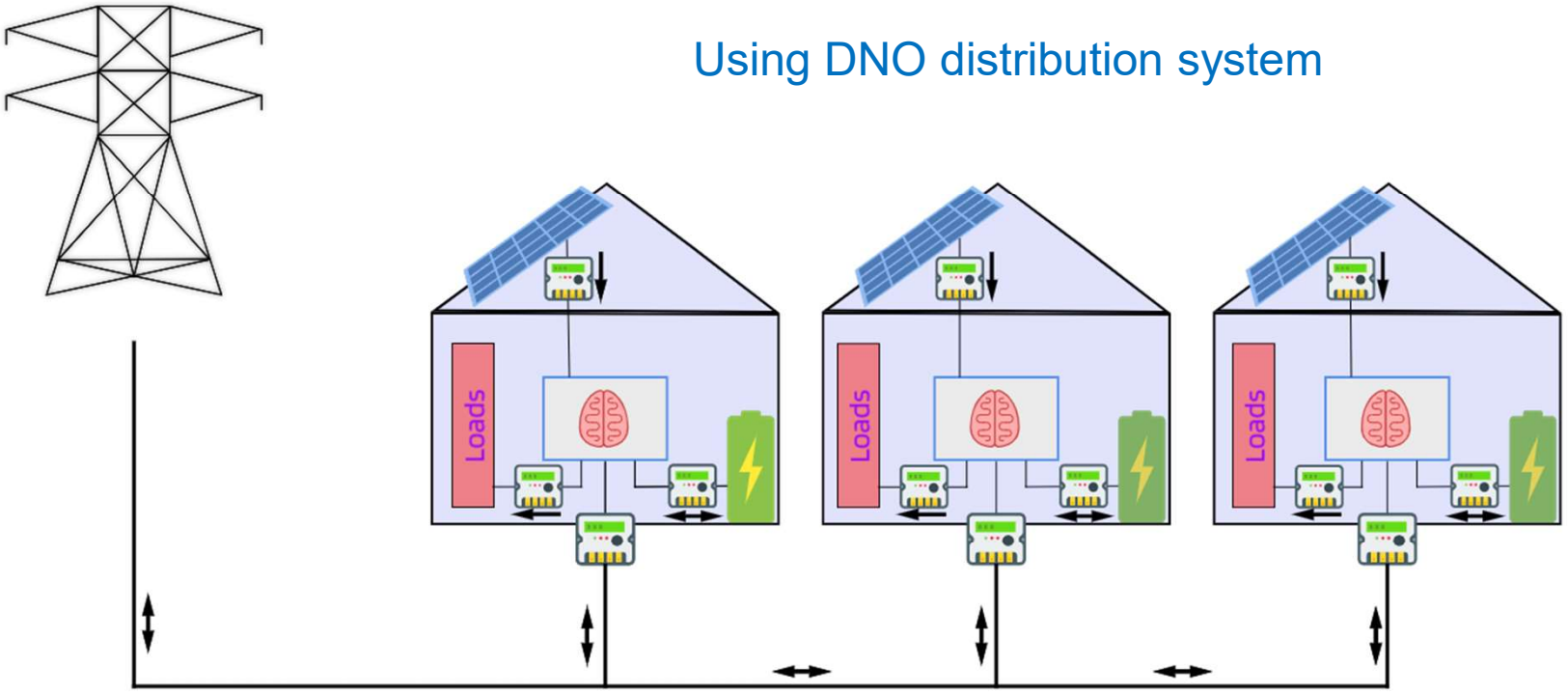
Prosumers Electrical Installations

- May look scary but most of this is with us already
- Smart homes:
  - Heating
  - Lighting
  - Geofencing
  - Programmable washing machines and dishwashers
  - These will just get smarter- and more integrated
    - Able to operate according to energy network signals
  - As we move to greater electrification- we need closer integration



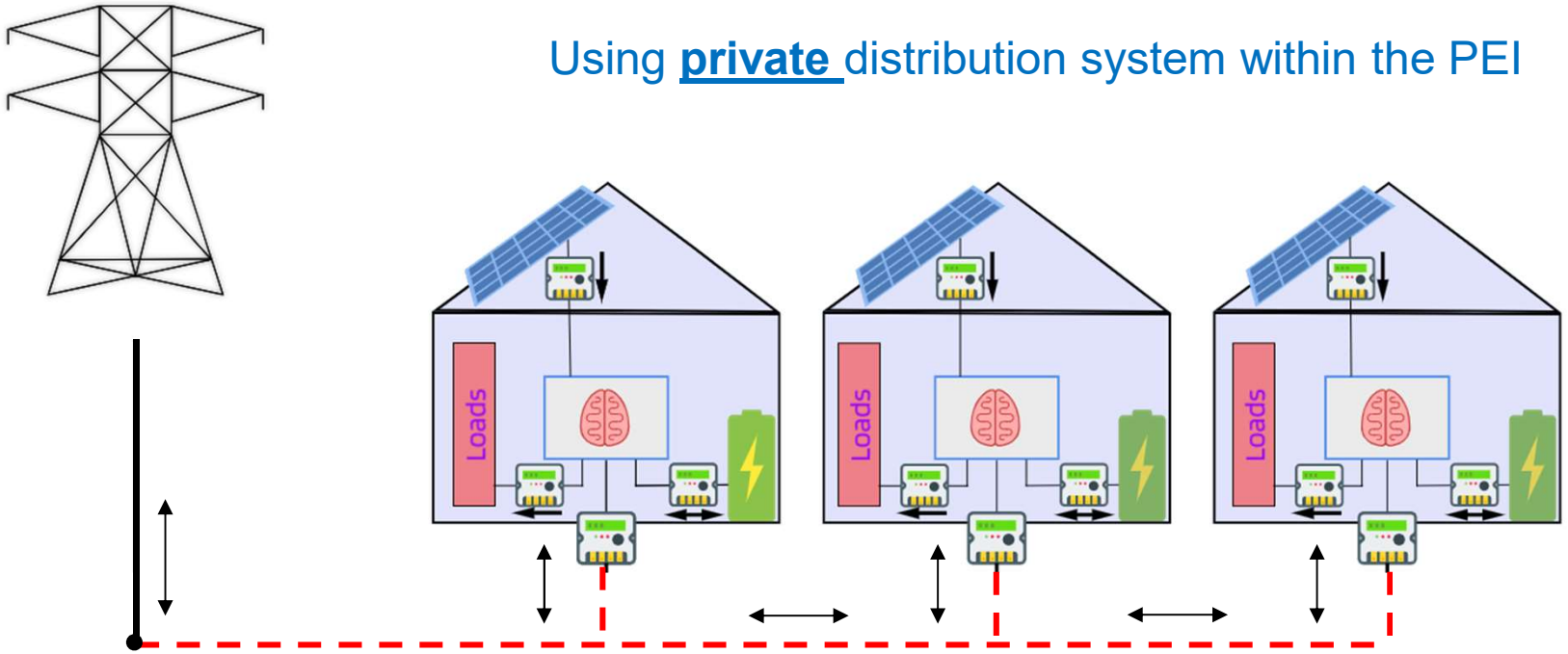
Prosumer configurations and connections

Prosumers Electrical Installations: Shared Assets

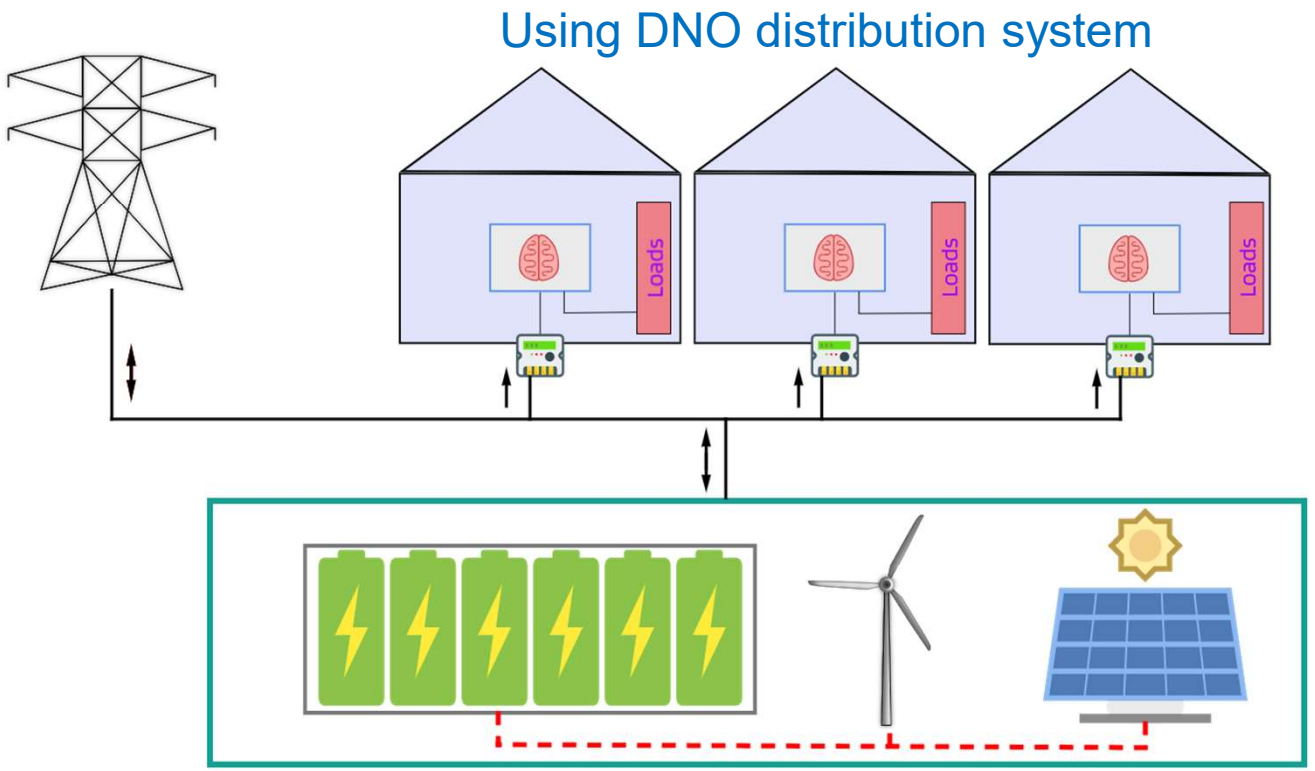


Prosumers Electrical Installations: Shared Assets

Using **private** distribution system within the PEI



Prosumers Electrical Installations: Collective Assets



Prosumers Electrical Installations: Collective Assets

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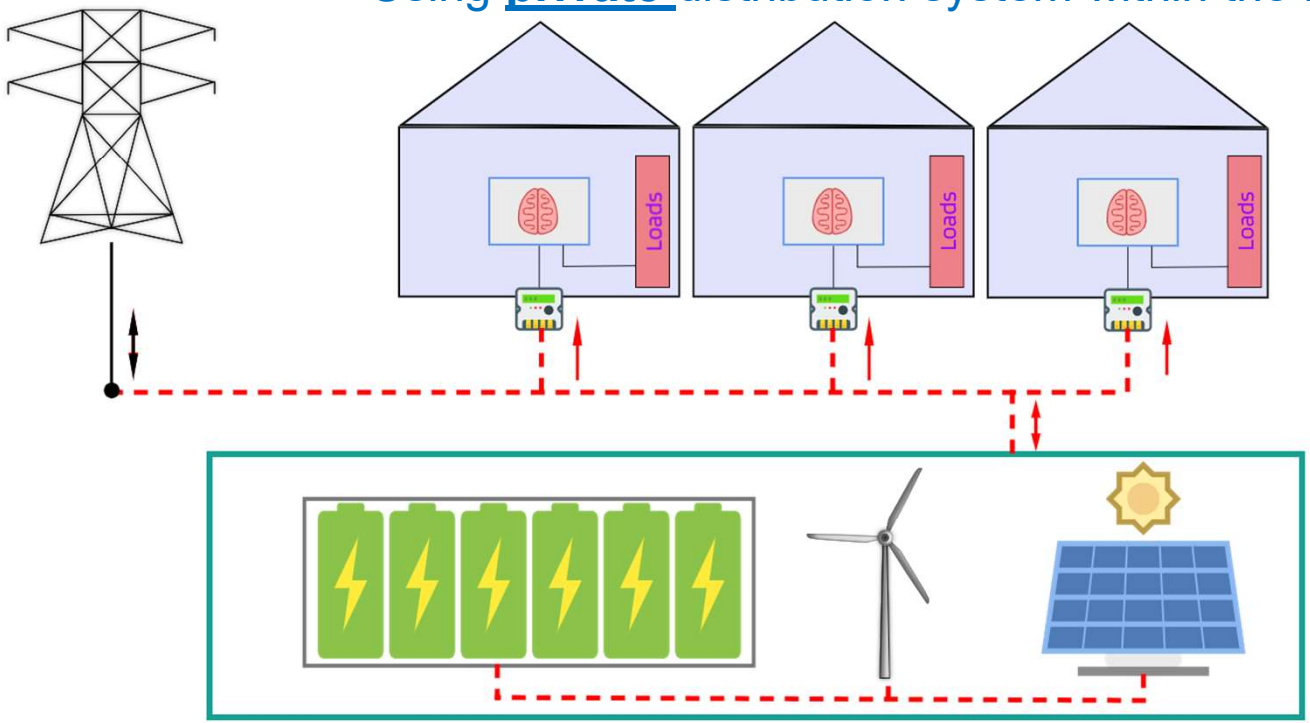
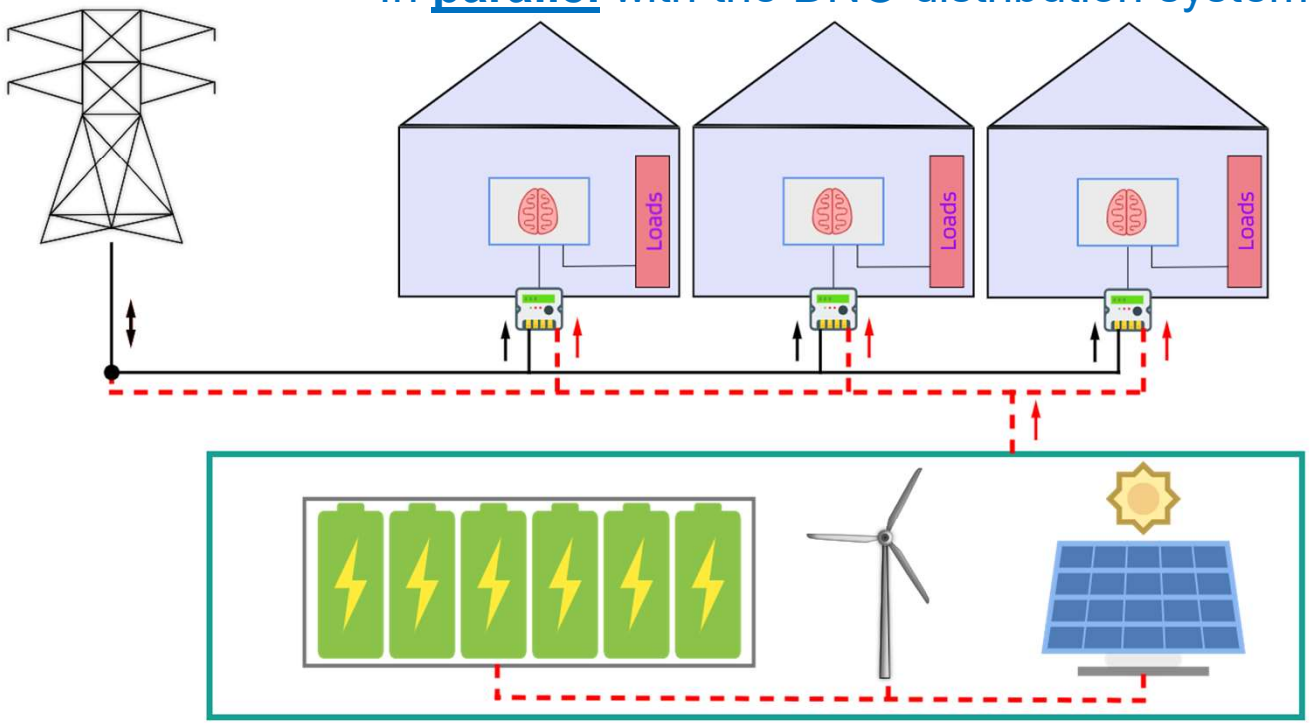


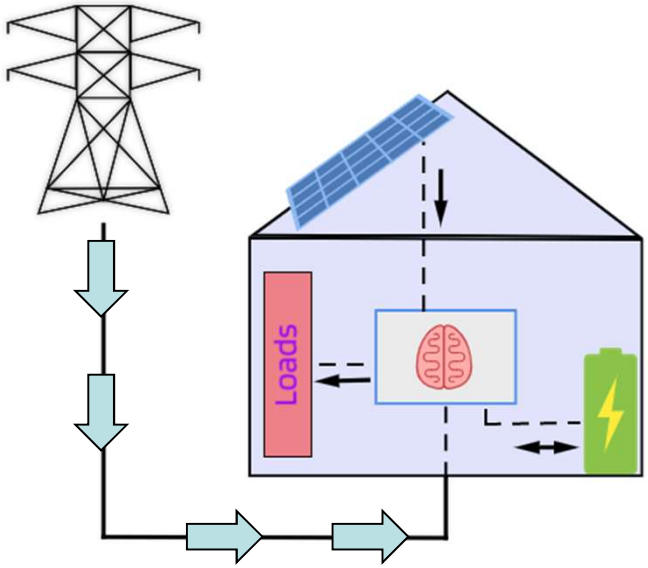
Prosumers Electrical Installations: Collective Assets

In **parallel** with the DNO distribution system

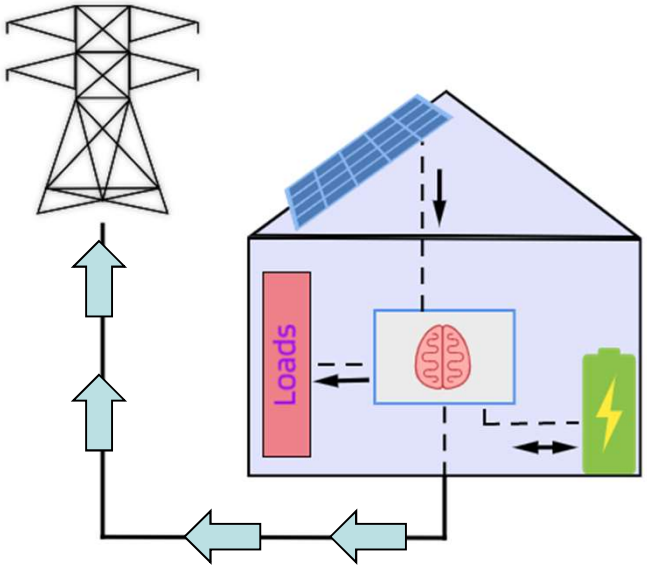


Operating modes

Prosumers Electrical Installations:

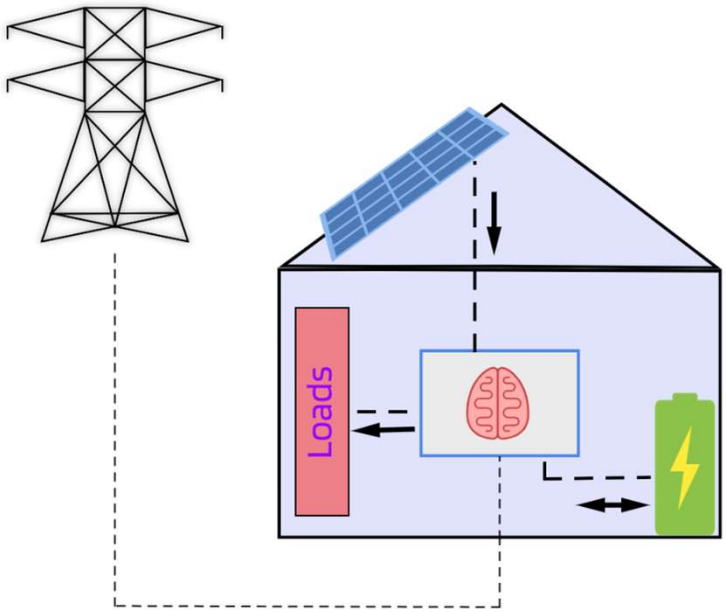


Direct Feeding Mode



Reverse Feeding Mode

Prosumers Electrical Installations:



Island Mode

- PEI disconnected from public network
- Current using equipment supplied by either onsite generation or EESS
- EESS either charging via on-site generation or supplying current using equipment
- Load shedding may be recommended to aid in duration of islanded operation
- Specific earthing conditions apply

Considerations: Local Earthing - ‘Can I run off grid?’

- **Island Mode**
- When running a building from an alternative energy source- the earthing arrangements from the DNO cannot be **relied** upon for protection by automatic disconnection of supply (551.4.3.2.1)
- Additional earthing arrangements need to be provided
  - Earth electrodes, earth mat or foundation earthing
  - To protect against an instance of open-PEN
    - (a combined neutral and earthing conductor feeding the property)
  - All live conductors must be disconnected from the DNO supply
  - The earthing from the DNO **doesn’t need to be disconnected** but the additional earthing is required.

Considerations: Ensuring capacity for loads

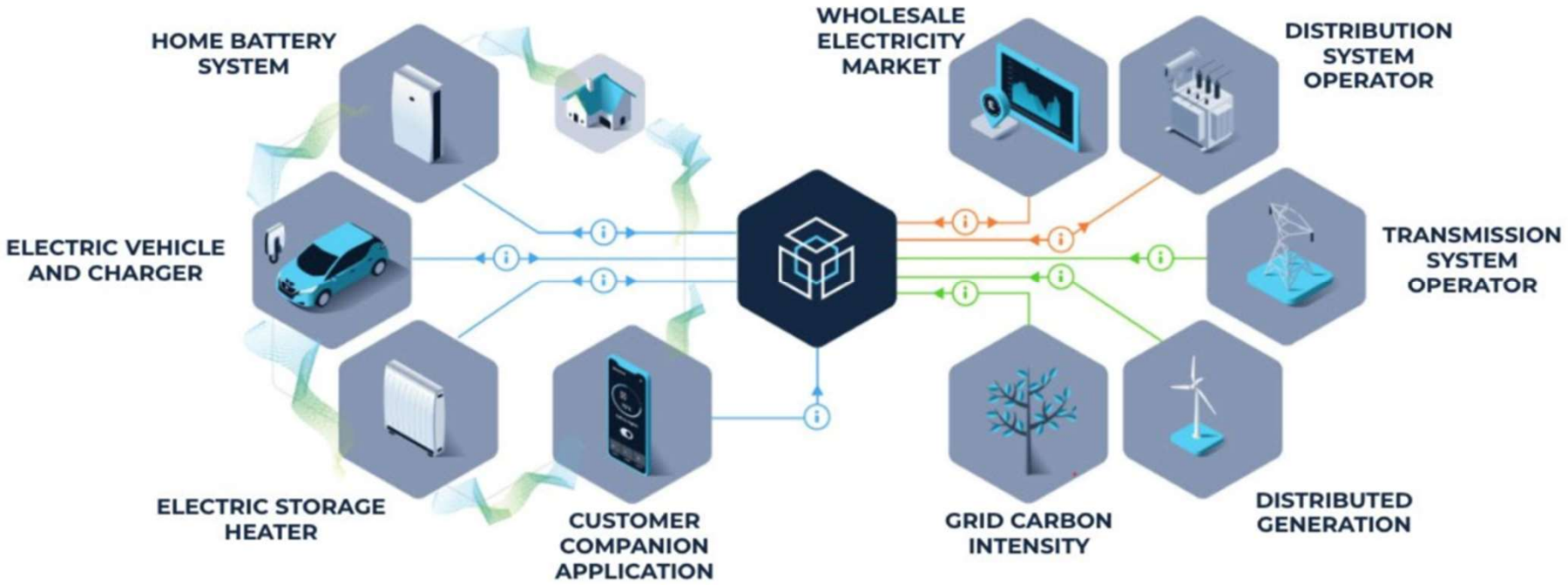
Island Mode

- Regulation 551.2.3:

  Means shall be provided to automatically disconnect such parts of the installation as may be necessary if the capacity of the generating set is exceeded

- Employment of **load control** would suffice or **dedicated 'priority circuits'** which will not exceed the generation / storage capacity.

Importance of digitised energy systems



(image courtesy of BEIS 'Digitising our energy system for net zero- Strategy and action plan 2021)

Notifications

Importance of notifications

- Success of the system relies on connectivity and transparency
- Heatpumps, EVCP, On-site generation and EESS must be notified to DNOs
  - G98, G99/G100 for generation or storage
  - ENA or DNO specific portal for EVCP and HP
    - If total demand is <13.8 kVA per phase- install and notify within 28 days
    - If total demand is >13.8 kVA per phase- must apply to connect
      - (also if there are concerns with the supply equipment)
- Possibility of auto registration when devices are connected is likely in the future

PEI- Generation and Storage

Use Cases

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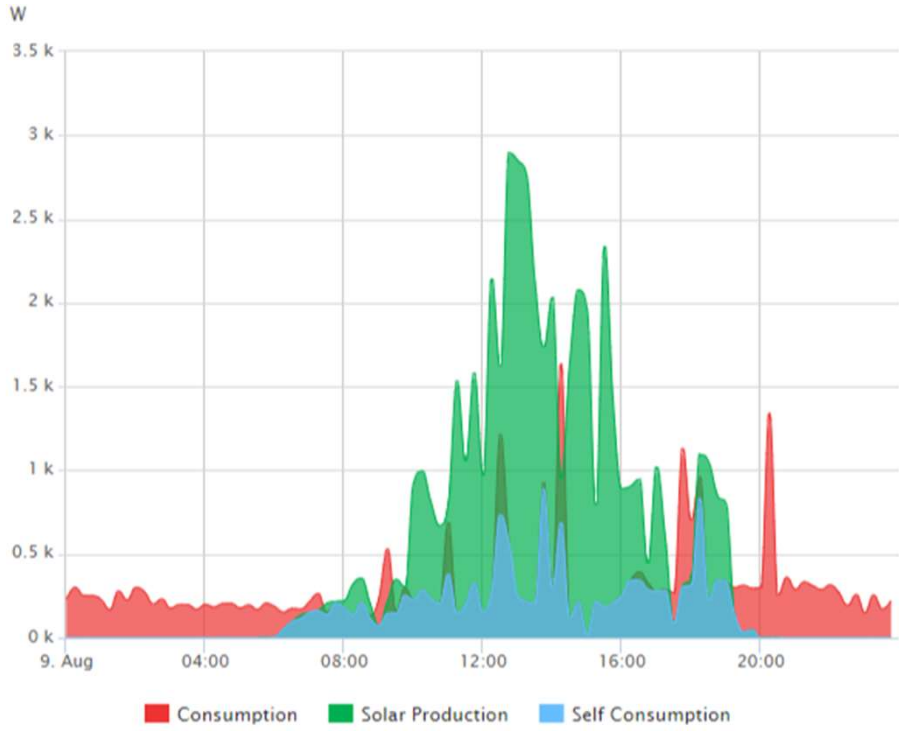
EESS use case: Light usage home with 4kW PV

- Typical summers day
- Most of the energy generated is exported
- **Definite** benefit in having an EESS for maximising self usage of generated energy

Imported energy

Exported energy

Self consumed energy



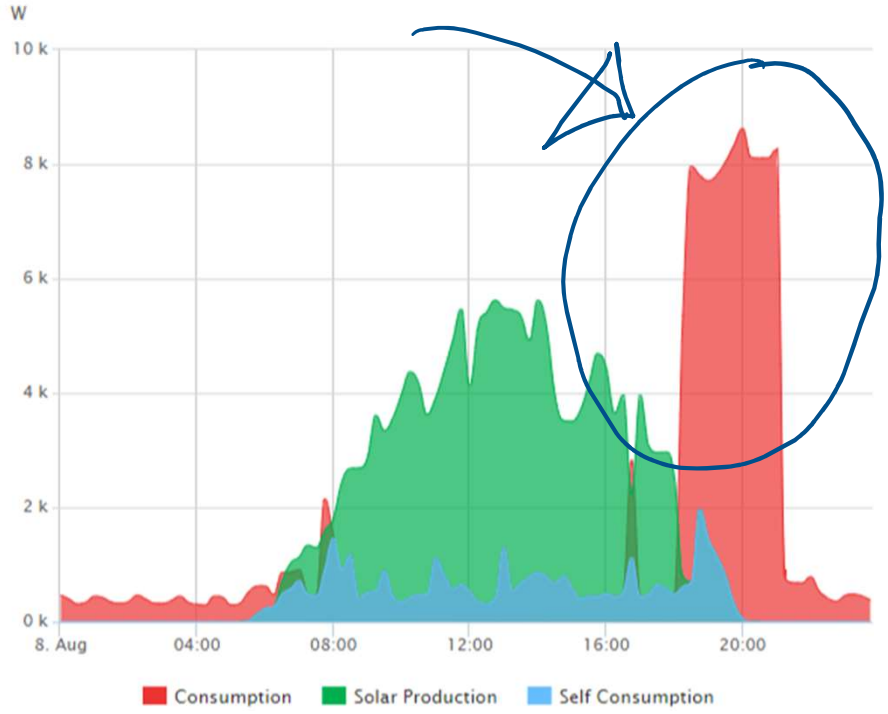
EESS use case: Domestic with 5kW PV & EV

- Typical summers day
- Most of the energy generated is exported
- **Definite** benefit in having an EESS to offset imported energy for EV charging

Imported energy

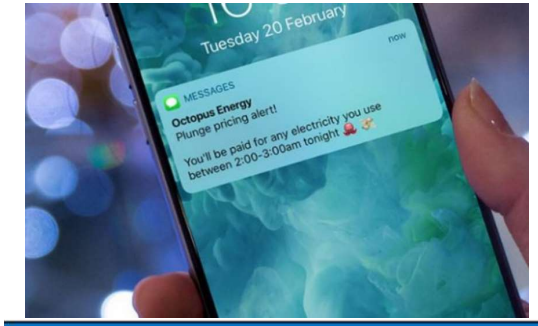
Exported energy

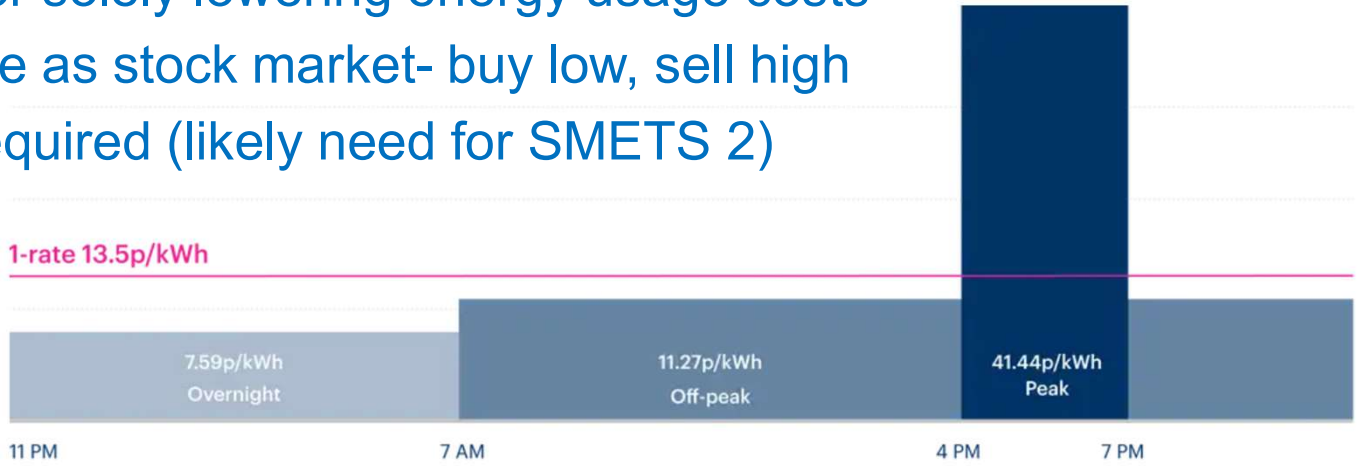
Self consumed energy



EESS financial benefits: ToU and Arbitrage

- Nascent ideas- big potential
- Limited tariff offerings at the moment but will expand
- Can be used for solely lowering energy usage costs
- Arbitrage- same as stock market- buy low, sell high
- Smart meter required (likely need for SMETS 2)





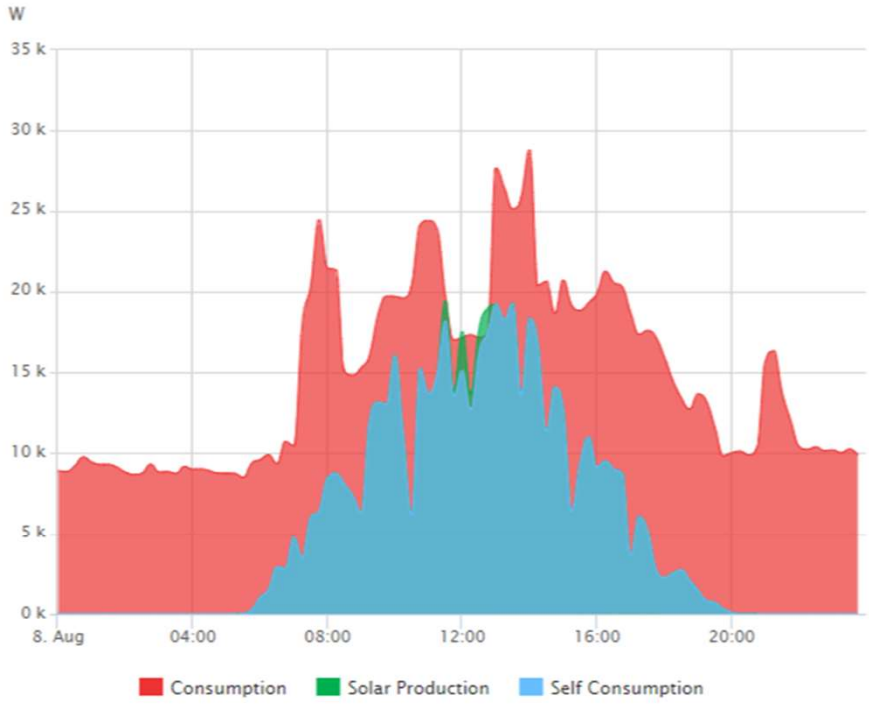
EESS use case: Occupied office with 30 kWp PV

- Typical summers day
- Almost all energy generated is consumed
- **No** benefit of EESS- for self-consumption
- **BIG benefit for utilising ToU tariffs**

Imported energy

Exported energy

Self consumed energy



Considerations

On-site Generation and ECP Open-PEN devices

- O-PEN devices operate (disconnect) when supply is outside of 207 V- 253 V
  - BS 7671 722.411.4.1 (iv)
- Overvoltage tripping when there is localised generation and storage
- Invertors and EESS can raise the voltage to ‘push back’ electricity onto the network

Summary

- A stable low-carbon energy system requires flexibility
- The Energy Prosumer and the Prosumers Electrical Installation affords flexibility to the energy network by providing:
  - Additional generation
  - Energy storage
  - Load shifting, load control
- Various potential configurations exist
- Technologies, products and tariffs will continue to evolve
- Considerations need to be made for operating ‘off-grid’
- **<u>Co-ordination is key</u>**

Questions?

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