Valuing the Infrastructure of Cities, Regions and Nations – University of Leeds

26th – 27th April

Valuing decentralised energy storage: business models for local authorities

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Presentation Overview

- Definition of a business model
- Examples of energy storage (electric and heat) in the UK
- Potential revenue streams in a decentralised energy system
- Non-traditional business models of energy storage
- Case studies
- Summary

Non-traditional business models of energy storage

"Disruptive technologies transform the way we live and work, enable new business models, and provide an opening for new players to upset the established order."
(McKinsey Global Institute, 2013: iii)

Energy storage is considered to be:

- One of eight "great technologies"

(Houses of Parliament, 2015)

- A real "game changer"

(World Energy Resources, 2016)

- The final piece of the puzzle?

(WSP/Parsons Brinckerhoff, 2016)

Definition of a business model

Lack of consistency on the definition in the energy storage literature.

Nonetheless, a business model must:

- **Create**
- **Deliver**
- **Capture**

Value for its stakeholders from existing or **non-traditional** marketplaces.

A blueprint, template or canvas containing several elements:

- **Customer segments, value propositions, ownership** and key partnerships, channels, customer relationships, revenue streams, key resources, key activities and cost structure**.**

For a business model to survive it ought to be validated on the basis of its economic value.

Energy storage: Electricity examples

DOMESTIC BATTERY

GRID-SCALE BATTERY

ELECTRIC VEHICLES

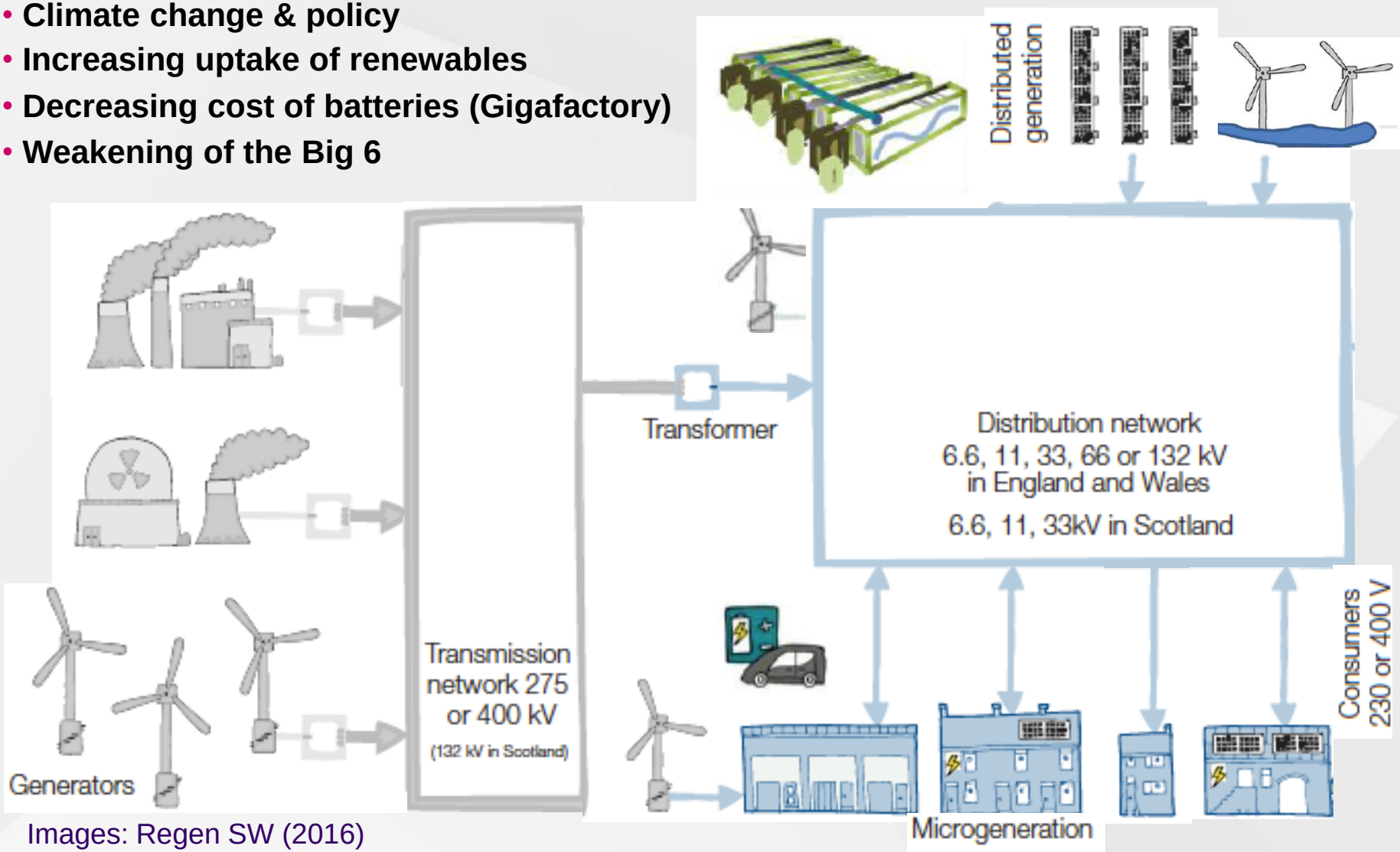
Energy storage: Heat examples

DOMESTIC STORAGE

DISTRICT STORAGE

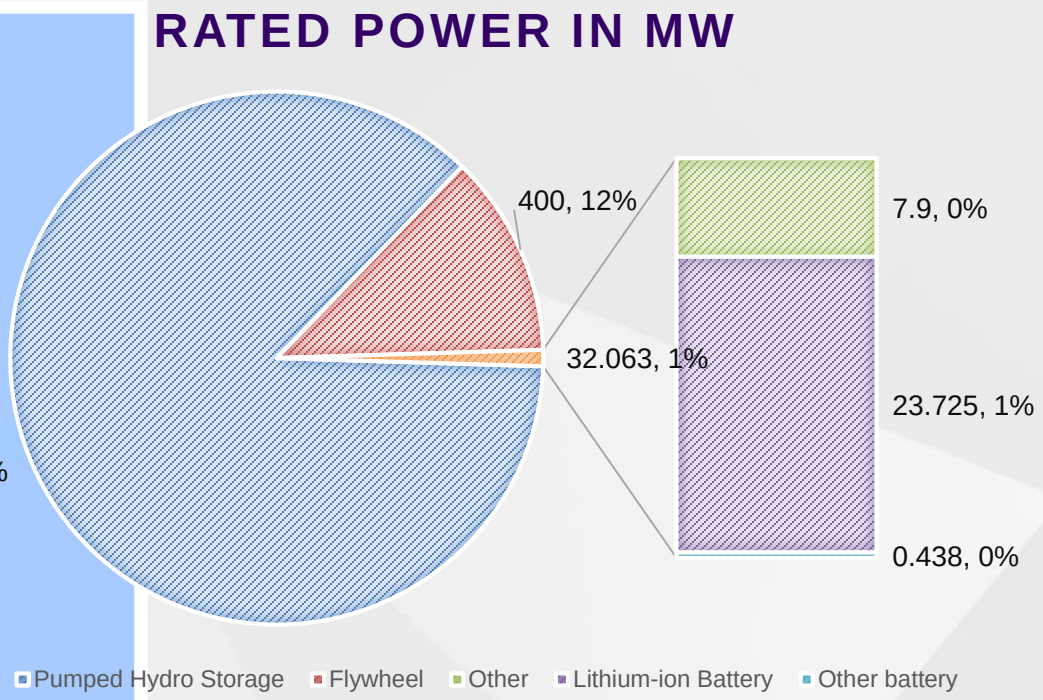
The non-traditional (decentralised) energy system

- Climate change & policy
- Increasing uptake of renewables
- Decreasing cost of batteries (Gigafactory)
- Weakening of the Big 6



Images: Regen SW (2016)

Energy storage: UK Deployment (Operational)



- Total Projects ~31, Total Power ~3260 MW

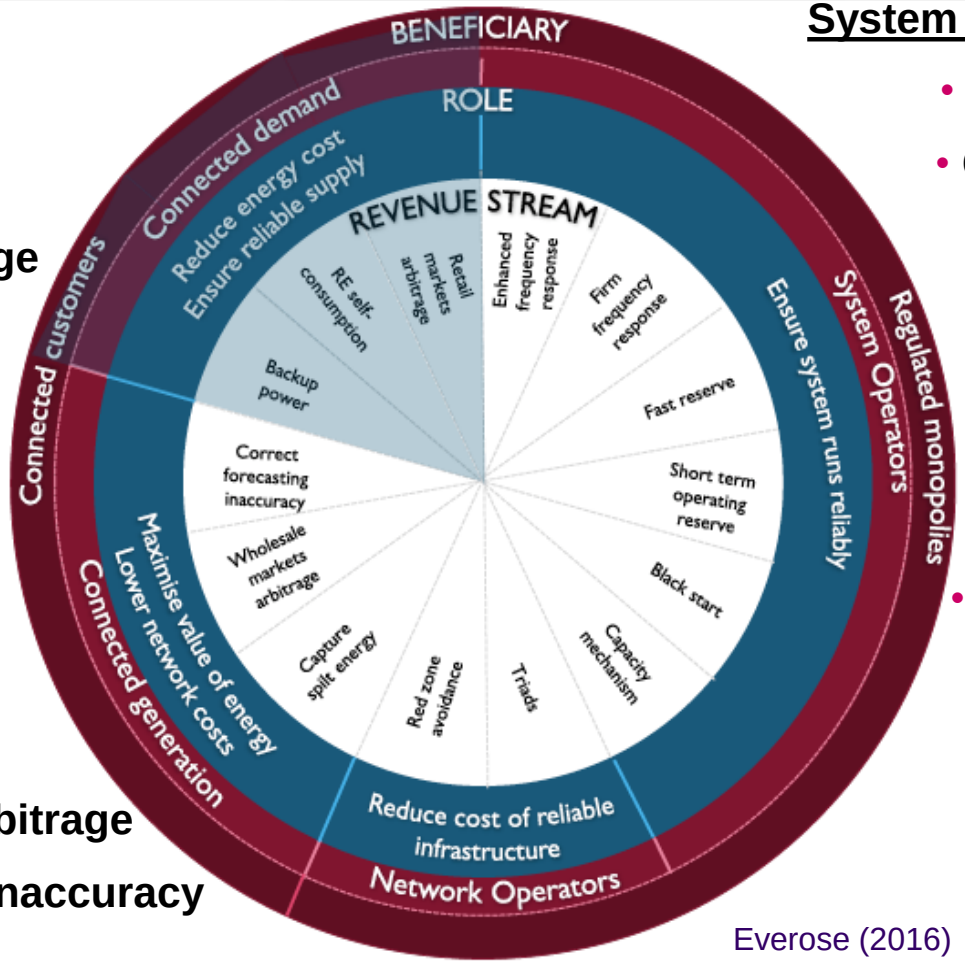
Utility (15), Community (10), 3rd Party (6)

- 2000 (12000) MW extra by 2020 (2030)
- EFR (500MW), Capacity Auction (200MW) and local storage (66MW)

Potential revenue streams in a decentralised energy system

Connected demand

- Backup power
- RE self consumption
- Retail market arbitrage



System & network operators

- ST operating service
- Capacity mechanism
- Black start
- Fast reserve
- FFR
- EFR
- Triads
- Red zone avoidance

Connected generation

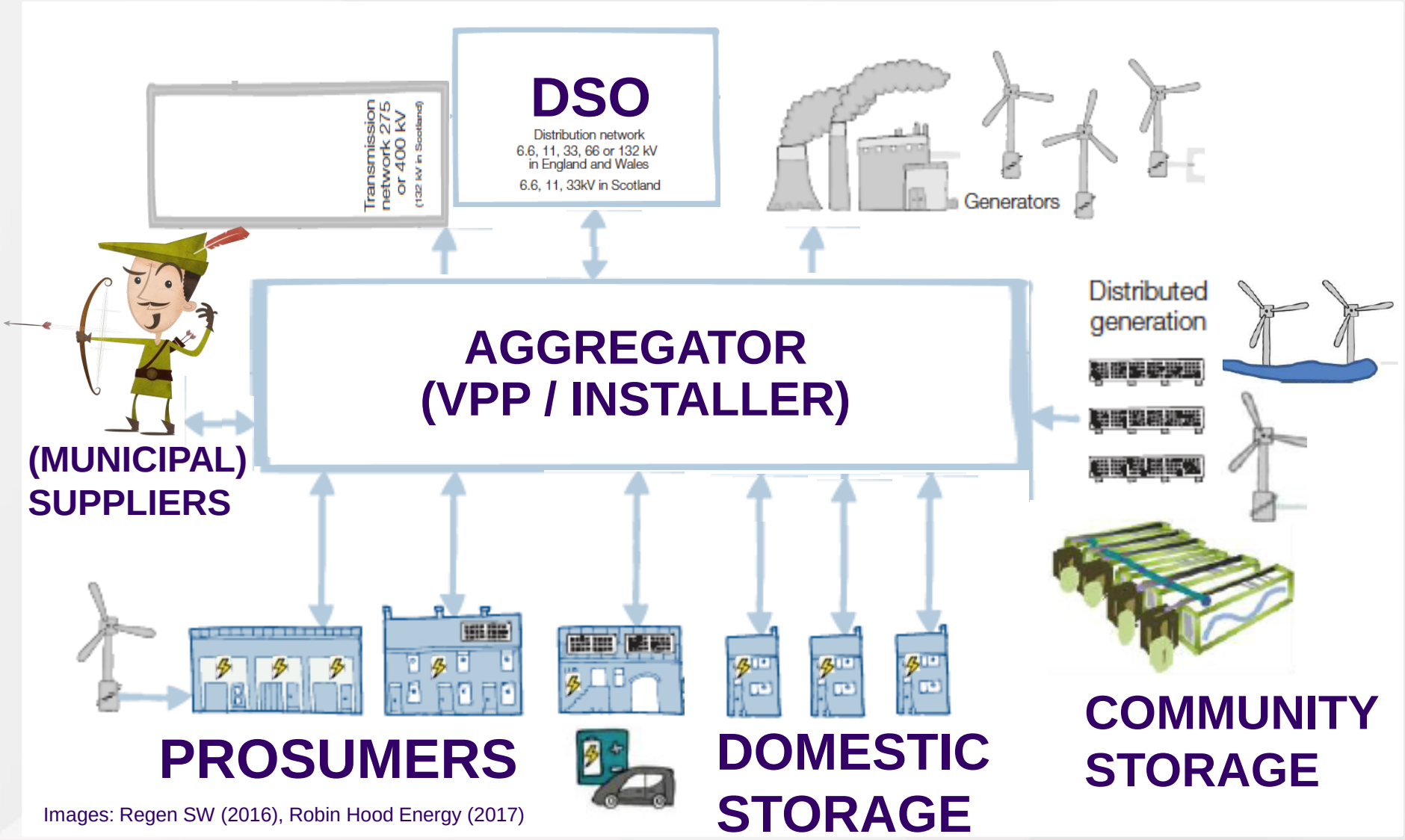
- Wholesale market arbitrage
- Correct forecasting inaccuracy
- Capture spilt energy

Everose (2016)

Non-traditional business models of energy storage in the energy system at the city level

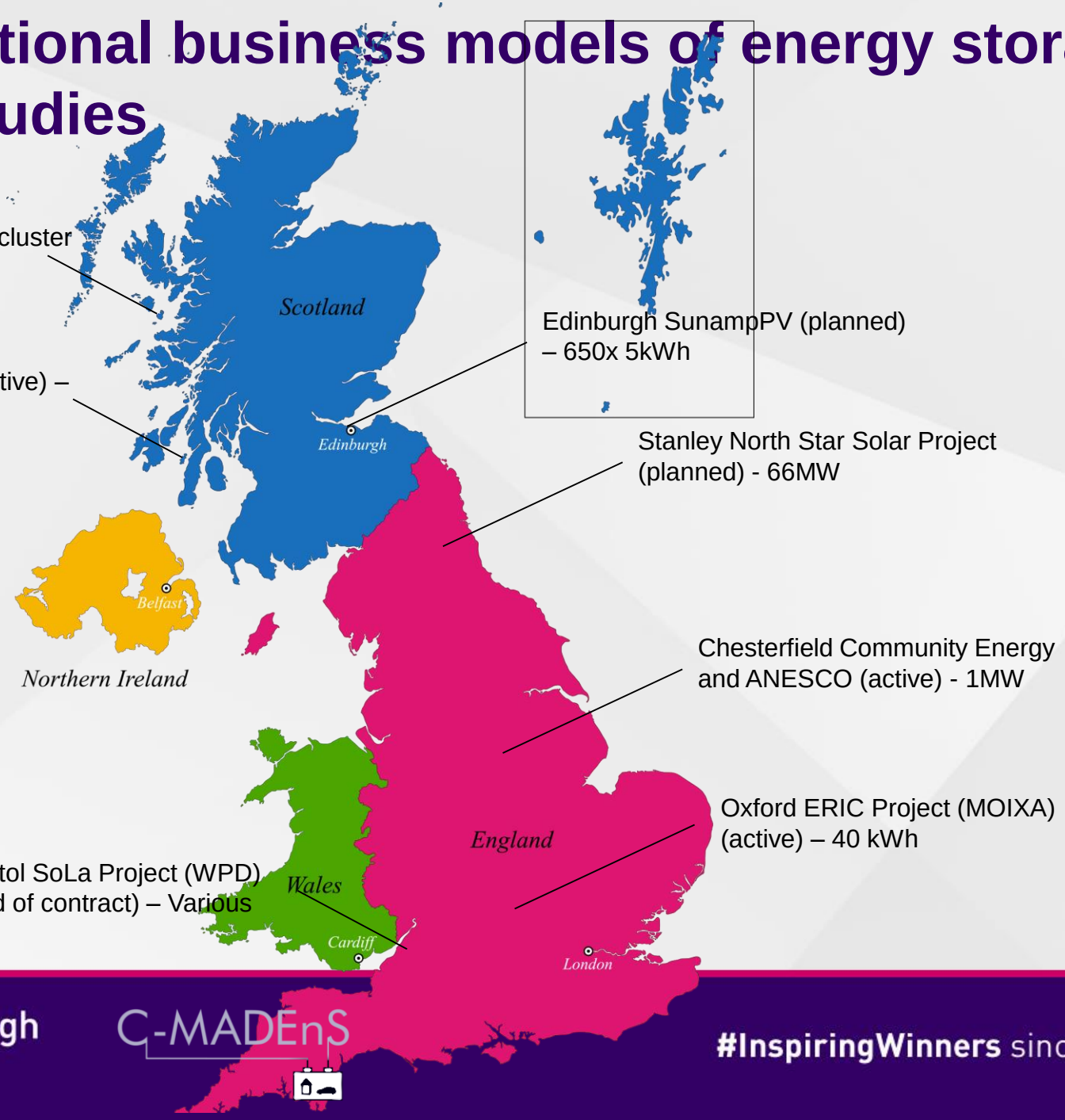
LAYER 1	Off Grid		On-Grid		Private wire	
LAYER 2	Prosumer	Aggregator +	Community storage	Municipal supplier	DSO	
LAYER 3	Licence lite / exempt	Multiple services	Peer-to-peer	Software developer	ESCo	White label

The core business models (Layer 2)



Images: Regen SW (2016), Robin Hood Energy (2017)

Non-traditional business models of energy storage – Case studies



The Ilse of Eigg (active) – cluster of 48V lead acid batteries

The Ilse of Gigha (active) – 1.68MWh

Edinburgh SunampPV (planned) – 650x 5kWh

Stanley North Star Solar Project (planned) - 66MW

Chesterfield Community Energy and ANESCO (active) - 1MW

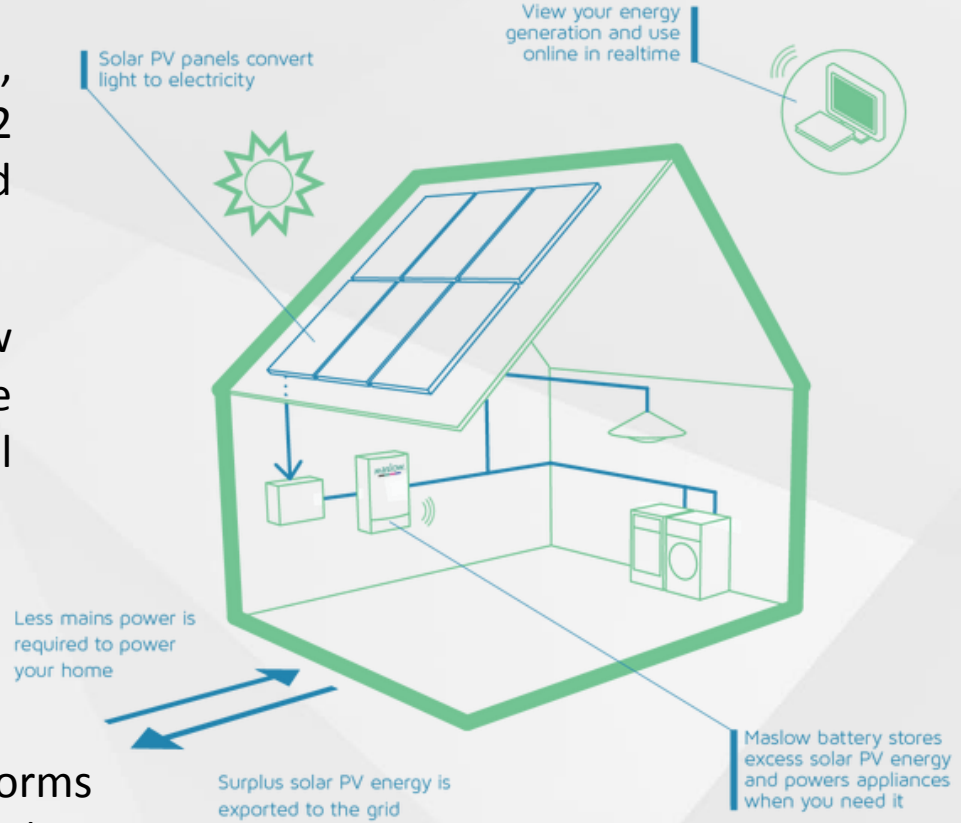
Oxford ERIC Project (MOIXA) (active) – 40 kWh

Bristol SoLa Project (WPD) (end of contract) – Various

The ERIC project (active) – Oxford City Council

Ownership & Financing: MOIXA, Bioregional, Oxford City Council and British Gas. £1.2 million investment over two years, part funded by the Innovate UK and crowdfunding scheme.

Storage capacity: 90-100 x 2kWh Maslow storage units installed (over 180 kWh). The solar-storage package will be installed in a local school and community centre.



Potential benefits:

- Aggregation services
- Increased self-consumption of RE (100%)
- Innovative software and virtual energy platforms
- Ancillary network services (e.g. STOR and FFR)
- Time shifting services, peak load reduction
- Save households ~£150 p.a.
- 50 solar-storage packages saved 47,000 $kgCO_2$ within a year
- A local primary school saved over £11,000 in a year (100 panels)

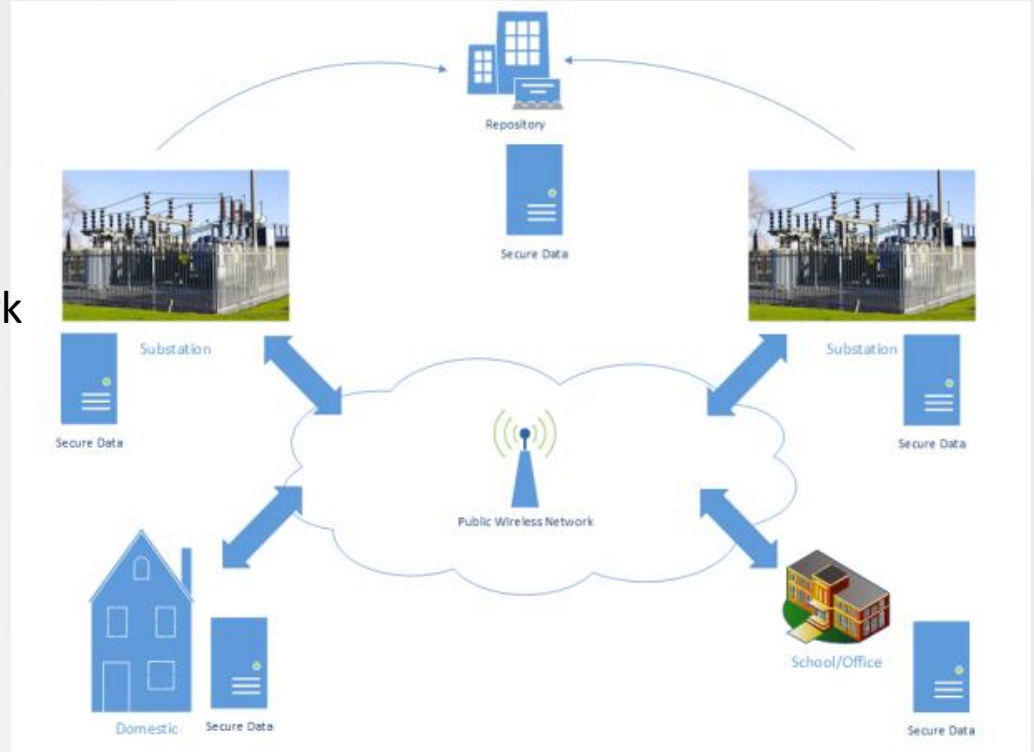
The SoLa project (completed) – Bristol Council

Ownership & Financing: WPD, MOIXA, Siemens, Bristol City Council and University of Bath. £2.8 million investment over 3 years from Ofgem LCNF.

Storage capacity: 26 x 4.8kWh Maslow storage units installed (~125kWh) and 18.4kWh in school.

Potential benefits:

- Aggregated batteries to provide network management services but network benefits from deferral is small
- Cost-effectiveness (evidence is limited) for consumers ~ £90 p.a. av.
- Consumer satisfaction is mixed



The 24/7 Solar project (planned) – Camden Council

Ownership & Financing: North Star Solar, London Borough of Camden, Lakehouse, Solgain and NEA (Technical Innovation Fund). Three local authorities (Camden, Islington and Waltham) will provide:

- enabling work
- project management
- home energy visits

Storage capacity: 41 storage units – MOIXA (32), Sonnen (6) and Growatt (3) various sizes (1.62kWp to 3.78kWp)

Potential benefits:

- Tackle fuel poverty
- Carbon reductions

North Star Solar – Stanley

Ownership & Financing: North Star Solar. Stanley council? Estimated cost around £140 million. Funding undisclosed.

Storage capacity: 22,000 solar-storage-LED packages (around 66MW).

Potential benefits:

- Zero upfront or maintenance costs for the consumer (paid using savings from energy bills for 23 years)
- Tackle fuel poverty and 20% energy savings
- Reduced carbon emissions

SunAmpPV– Edinburgh

Ownership & Financing: Part funded by the Scottish Government and anonymous Chinese investor. Local Energy Challenge Award (£3.2 million).

Storage capacity: 650 solar powered phase change thermal batteries (5kWh).

Potential benefits:

- Estimated savings of £270 per year
- Tackle fuel poverty
- Plan to install 3000 solar PV
- Reduced carbon emissions

Smart Energy Islands

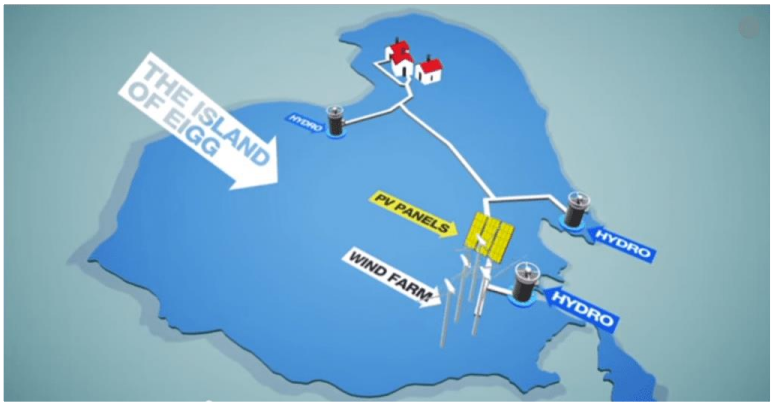
ISLE OF GIGHA

Renewable Energy | + Add to myFT

Battery that could revolutionise renewables on trial in Scotland

Government-funded test run hopes to show that the redox flow device is commercially viable

ISLAND OF EIGG



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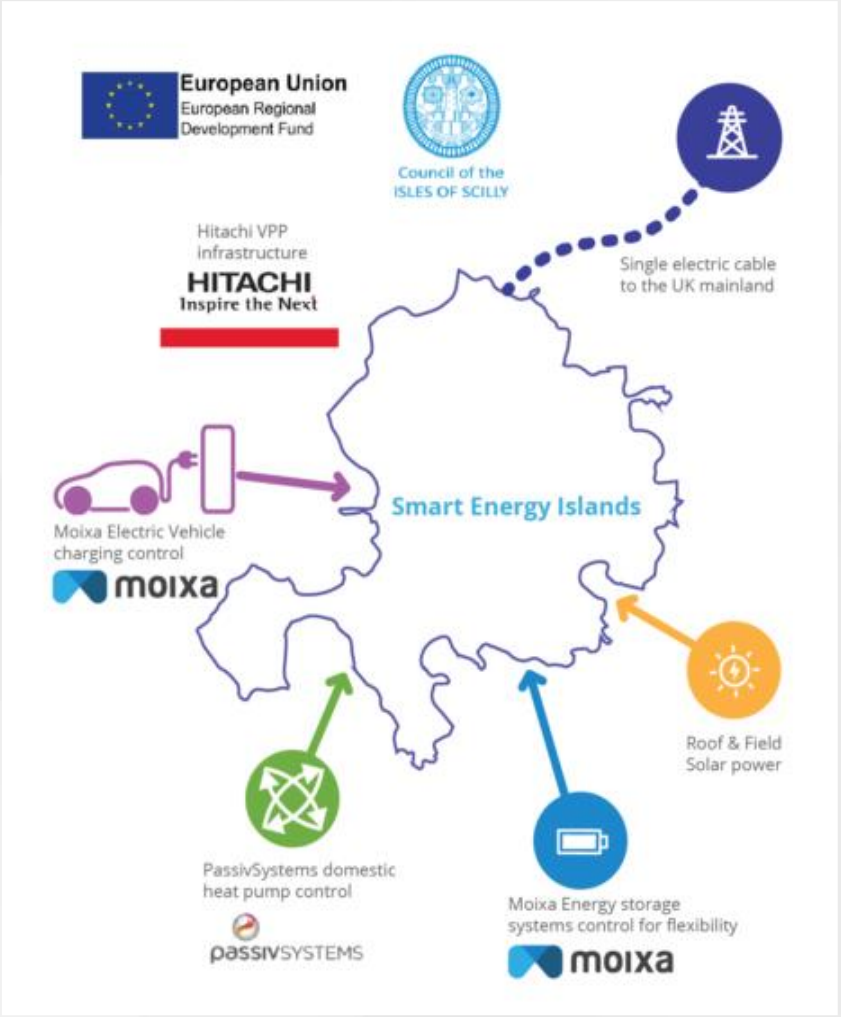

Is there a role for distributed storage?

WORLD UK COMPANIES MARKETS OPINION WORK & CAREERS LIFE & ARTS

National Grid + Add to myFT

National Grid may pay power plants to reduce output

Proliferation of solar panels has created problem of keeping system stable

The number of solar panels on the roofs of homes and businesses around the UK has grown rap
© iStock

Coal

British power generation achieves first ever coal-free day

National Grid hails milestone as other sources like gas, nuclear, wind and solar allow UK to keep lights on with all coal-fired powerplants offline

42k 1,017

Georgia Brown

Saturday 22 April 2017
03.44 BST

In summary…

- Storage market growing – final piece of the puzzle?
- Stacking revenues is crucial for profitability
- Identified core business models of energy storage (prosumers, aggregators, community storage, municipal suppliers, DSO) that aim to create, deliver and capture value
- Case studies suggest that these business models interact (at least in the trail stages) – **local authorities/councils** either take a central or hands-off role
- **Benefits:** increased self consumption (PV), backup power, reduced energy bills, reduce local emissions, defer local network investment, job creation, community fund (local charities), consumer/community empowerment

Thank You

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Non-traditional business models in the energy system at the city level - Overview

Layer 2			
Model	Value Proposition	Consumer	Ownership
Prosumers	• Consumers produce/consume their own energy • Standalone battery used to purchase energy when price is low (e.g. Economy 7/10) • Retrofit residential PV/Solar with storage (i.e. lower bills, increase self-consumption and utilise arbitrage)	*Primary:* • Domestic sector • Private sector • Public sector	• Technology bought and owned by *individual* consumers

Source: Everose (2016)

Non-traditional business models in the energy system at the city level - Aggregators

Layer 2			
Model	Value Proposition	Consumer	Ownership
Aggregators	• 3rd party aggregates storage devices and accesses ancillary (upstream) services (e.g. frequency response) • Revenues shared between 3rd party and storage owners (reflecting costs and risk) • Reduce energy bills, increase self-consumption • Opportunities: FiT, ToU tariffs, time shifting and peak reduction	*Primary:* • Domestic sector • Private sector • Public sector *Ancillary:* • National grid • Network operators • Generators	• Consumer owns storage technology • 3rd party intermediary owns a contracted amount of energy stored by participants / or sell energy one day ahead • PPA

Source: Delta Energy and Environment (2016); Ofgem (2015)

Non-traditional business models in the energy system at the city level – Aggregators +

Layer 2			
Model	Value Proposition	Consumer	Ownership
Aggregators +	• Install solar and storage at zero upfront or O&M costs (which are recovered from energy bill savings) • Consumers *possibly* misses-out on aggregation/ancillary revenue • Reduce energy bills, increase self-consumption • Opportunities: FiT, ToU tariffs, time shifting and peak reduction	*Primary:* • Domestic sector • Private sector • Public sector *Ancillary:* • National grid • Network operators • Generators	• Consumer owns storage technology at end of contract (=payback period) • 3rd party intermediary owns a contracted amount of energy stored by participants / *possibly* sell one day ahead • PPA

Source: North Star Solar (2016)

Non-traditional business models in the energy industry at the city level – Community storage

Layer 2			
Model	Value Proposition	Consumer	Ownership
Community storage	• Deploy and aggregate energy storage locally • Reduce energy bills, increase self-consumption • Opportunities: FiT, ToU tariffs, time shifting and peak reduction • Provide extra capacity and defer local network investment • Fund local charities, social and nature projects (community fund) • Free electricity (supply > demand) • Create current/reserve account	*Primary:* • Domestic sector • Private sector • Public sector *Ancillary:* • National grid • Network operators • Generators	• Behind the meter storage owned by the consumer • Aggregated energy possibly owned by a 3rd party • 'Bulk' storage systems owned by community investors (e.g. bond and shareholders, crowdfunding, social enterprises etc.) • Joint ventures: commercial energy organisations or manufacturers

Source: Delta Energy and Environment (2016); Ofgem (2015a); Moixa (2015)