Smart community energy schemes: A case study-based model

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Background

Smart community energy schemes can aid decarbonisation.
This work focuses on an existing model for community electricity supply, **the Energy Local model,** which:

- ❑ Makes use of electricity generated by local renewable sources within the community
- ❑ Provides flexibility to the wider grid
- ❑ Enhances community awareness of consumption, both amount and timing

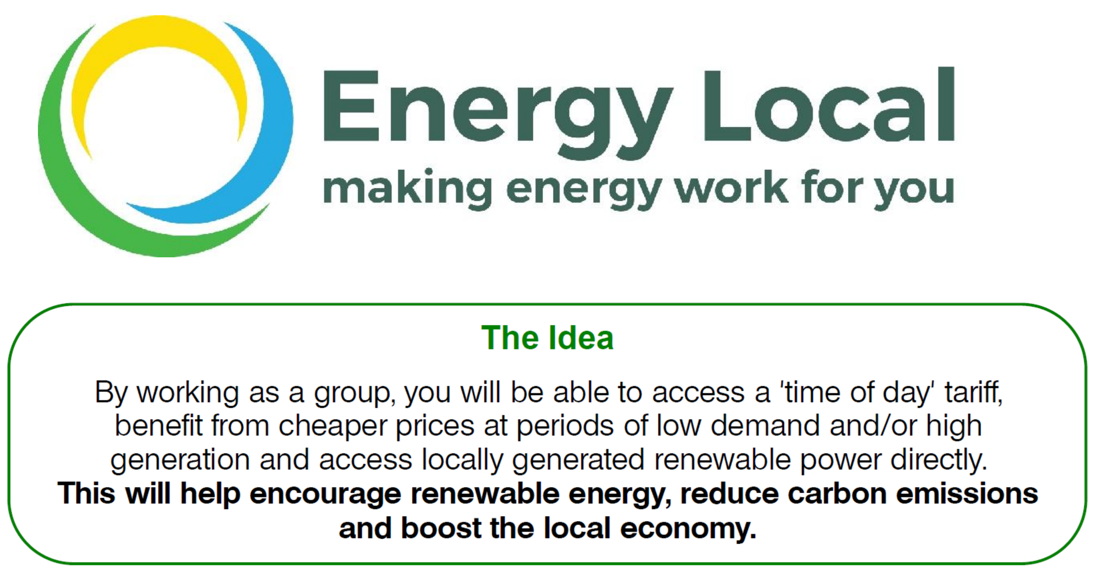

Fig. 1 Vison for Energy Local model source : Energy Local trial leaflet : http://www.energylocal.co.uk/project__swell/

Question

❑**Scaling up –** where and how can the community energy schemes reviewed be scaled up?
❑Strachan et al note the fact that community renewable schemes play a marginal part in energy delivery and set out to answer the question ***"how and in what contexts might community renewable energy pathways expand to influence wider systems of energy provision?"*** (Strachan et al., 2015**)** .

Case study description

50 household pilot in the UK
❑ Recently, Boait et al (2019) reported findings from a trial of a particular community energy model: the Energy Local model
❑ Primary aim: using distributed renewable generation locally;
❑ Secondarily saving the participants money and
❑ Reducing overall consumption.

1. a low price per unit for consumption of surplus local generation (£0.065/kWh), combined with a time of use tariff for demand not satisfied by local generation;
2. provision of information about the most desirable times of day to consume energy;
3. a significant community engagement effort led by project staff alongside local energy experts

Case study results

❑ From an economic point of view, the case study found that participants saved money over the year, an average of **£109/participant/year.**
❑ Significant amounts of local generation were shared within the community
❑Adding to community benefit, overall system may benefits via:

1. Increased predictability of aggregate demand across participants
2. Localised balancing reducing load on upstream assets
3. Decreased peak time consumption ("flatter" demand).
4. Flexibility – the community can potentially be asked to shape the aggregate demand towards a pattern to suit the supplier or system operator.

Developing scenarios for simulation modelling of scale-up simulations

❑**Agent Based Modelling (ABM)** provides a promising modelling paradigm to model the **heterogeneous agents (households) within a community.**
❑**Using an ABM model** allows different parameters of households to be tested without expensive field trials, transferring learnings from small scale real world trials to wider roll-out
❑Current work is developing scenarios for roll-out to parameterize the ABM. Scenarios developed are:

Use in off gas grid locations – particularly rural

❑In the UK, the largest energy load for a household is heating and a significant proportion (~13%; 3.5m households) of the UK remains unconnected to the main gas network,. The model scenario for simulating the Energy Local model in these communities involves parameterising the simulation with small communities (up to 50 scheme participants) and high penetration of Heat Pump ownership (50,70 and 80%). Building parameters are chosen to reflect the increased prevalence of solid wall properties in rural UK, with associated low poor insulation and relatively high energy loss rate. Household sensitivity to economic factors is set to be high to reflect the intersection between hard to insulate properties and households in fuel poverty With this agent population, three local generation scenarios will be tested: Community owned wind turbine; Rooftop PV; 3rd party (e.g. NGO) owned generation (e.g. mini-hydro)

Urban communities

❑A further area of interest is in urban communities, particularly within smart cities. The model scenario for this scenario will be parameterised with higher numbers of households per scheme (200) with very tight geographical co-location and community scale PV. Heating will be via electrical resistive heating (immersion for water and storage heating for space), with smart control.

Suburban community with high penetration of PV

❑This is pertinent in the UK where the Feed in Tariff supported a rapid increase in distributed domestic PV systems, with some 881,000 PV installations <=4kWp in the UK as of end 2018. The prevalence of local small-scale PV can pose challenges for the distribution network, in terms of local voltage management and power flows. A crucial output from this scenario will be the effect of the community scheme on variability of aggregated demand from the community.

Community with high penetration of Electric Vehicles

❑The recent trend in increasing EV ownership predicates this scenario, which will test whether the presence of multiple EVs (along with associated storage capacity) impacts the financial or technical benefit of the community energy scheme. This scenario is further divided into two cases with and without vehicle to grid storage capability for EVs.

Ongoing work

Work is ongoing to run model scenario and address the following questions using the model developed:

❑Can the scheme at scale still benefit the householder?
❑Can the scheme provide flexibility to the grid at scale?
❑Can the scheme provide enhanced flexibility in response to emergency requests to cut consumption
❑What policies are needed to incentivize scale up of community demand side flexibility schemes?

References

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2.Boait, P., Snape, J.R., Morris, R., Hamilton, J., Darby, S. (2019) The Practice and Potential of Renewable Energy Localisation: Results from a UK Field Trial. Sustainability. 11(1), 215.

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