From subsidy to value-driven Local Energy Systems

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Background
A recently completed Delta-ee study evaluated examples of Local Energy Systems (LES) in various global contexts ranging from remote (off grid) systems to fully integrated, community-based systems which aimed to create value both by optimising local generation and demand, but also by delivering value added services to the wider energy system.

One of the most commonly asked questions arising from this study concerns how it may be possible to make money out of LES. The challenge in answering this question is that different individuals have widely differing definitions of what actually constitutes a LES.

Developing a typology for Local Energy Systems
We therefore begin by outlining a typology of LES. Our proposed classification is not only related to technical characteristics, but equally importantly, to ownership and business models.

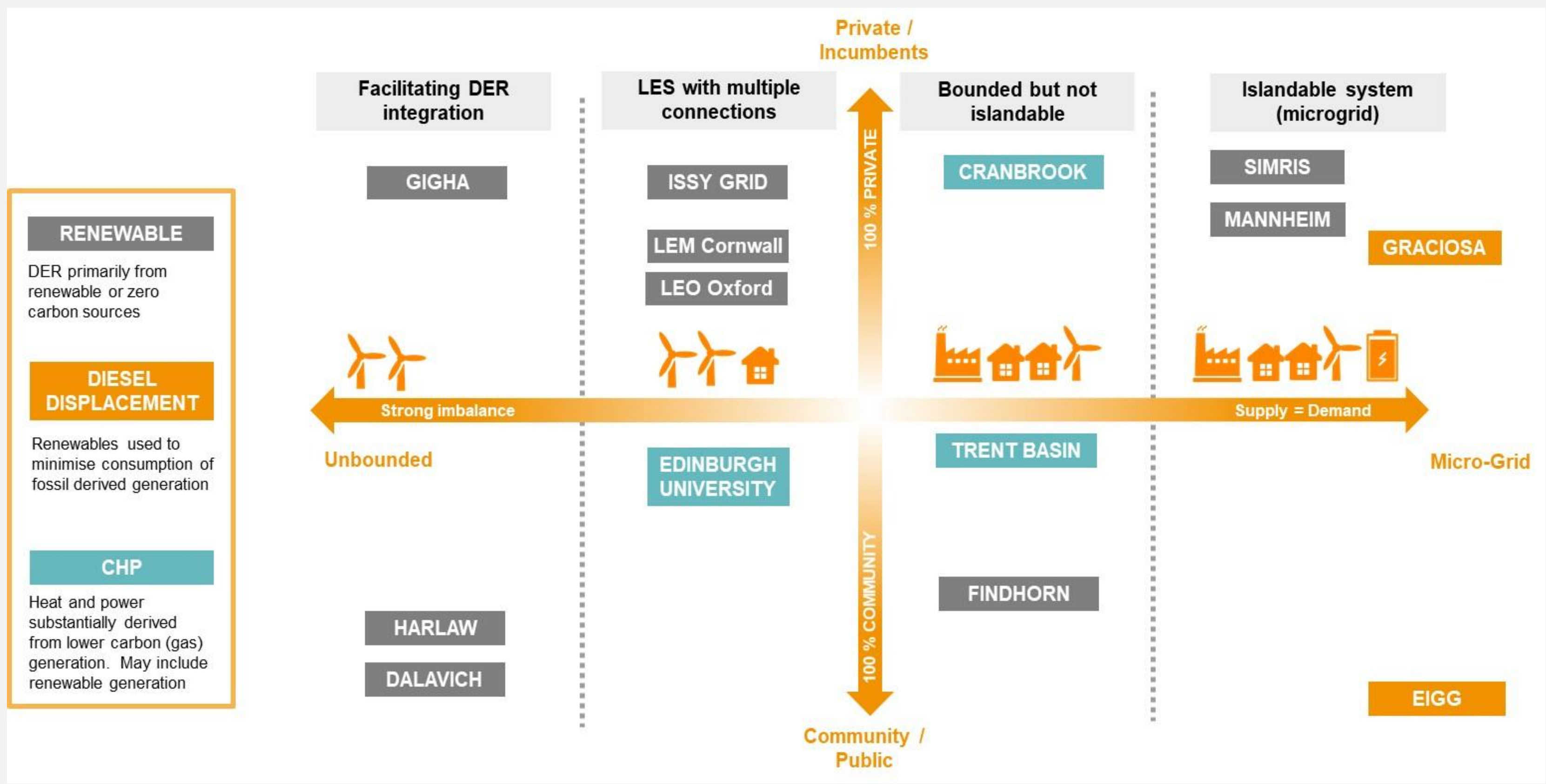
This approach enables us to classify use cases and their respective drivers and characteristics. We use this typology to evaluate selected projects to gain a better understanding of how it might be possible to replicate specific solutions in similar circumstances elsewhere.

The need for value-driven business models
In the early days of LES development, schemes were often characterised by niche requirements such as the lack of a conventional electricity supply. In this case, the cost of providing an electricity supply was secondary to the availability of a reliable supply.

Other, grid connected LES were typically dependent on subsidies either in the form of grants or on an ongoing basis with Feed-in-Tariffs. As these subsidies are being withdrawn or reduced, there is now a need to identify alternative, sustainable, value-driven business models.

Emerging profitable business models
Within the UK context, a number of potentially viable business models have emerged. In some instances, it is already possible for a LES to compete with LCOE of grid supply, particularly in the case of innovative ownership models which leverage the availability of low-cost capital. Further enhancements to the business case are possible through capturing additional revenue streams.

A combination of lower costs and higher values can result in significant economic benefits whilst simultaneously delivering decarbonisation and democratisation of the energy system.



Local Energy System Typology

The illustration is intended to provide a context for the wide variety of concepts broadly referred to as Local Energy Systems.

The horizontal axis indicates the physical configuration of the system under consideration; at the far left, the LES is often little more than some "smart" mechanism to integrate additional renewables or to overcome technical network constraints. Examples include the Dalavich micro hydro scheme which employs a dynamic output control to exploit surplus network capacity of another, nearby hydro scheme, or the Gigha project which uses in-line electricity storage to buffer excess wind generation and increase line load factor.

On the right, we find fully functional microgrids, balancing local generation and demand and able to seamlessly transition between grid-connected and islanded operation; further right we come to islanded systems which never connect to the grid.

The vertical axis is used to illustrate the ownership models which can be used to describe how value is shared in the LES. This may range from incumbent owned assets at the top, to fully community owned systems at the bottom.

Given these two fundamental characteristics, it should be possible to identify LES models suitable for replication in other locations. However, it is important to understand the context in which these models have been implemented as, in many cases, the original scheme may, for example, have been heavily dependent on some form of subsidy which is no longer available.

Local Energy System based on renewable generation
The economic viability of a Local Energy System is determined both by the cost of building and maintaining the system on the one hand, and on the other by the potential revenue streams available to recover the investment.

It is almost invariably the case that, for any energy system based primarily on renewable generation, economic viability is determined from the outset by the initial cost of the system. Once the investment has been made, the ongoing marginal cost, comprising only administration and maintenance, represents a relatively small percentage of the overall LCOE.

There are two aspects of this, the CAPEX itself and the cost of capital. With regard to CAPEX, a trend of reducing system cost can be observed resulting from learning curve cost reductions for wind, solar PV and energy storage technologies. In addition, innovative investment approaches using second-life technologies such as ex-automotive batteries, can lead to step-change cost reductions.

However, of equal importance is the cost of accessing the necessary capital. Typical costs of capital for private sector investments are often around 10%, whilst significantly cheaper capital can sometimes be obtained from the public sector and from individuals who today might be content with rates as low as 2-3%. This factor alone makes a significant, even game-changing impact on the viability of the project as can be seen from the graphs below illustrating the LCOE for electricity produced from a system funded at 10% and 3% respectively.

On the other side of the equation, the potential income from the system can be enhanced by a number of factors. Firstly, the ever-increasing performance of DER technologies which both reduces the specific cost of energy production and reduces the cost of other components of the energy system required to balance supply and demand. For example, the increased load factor for wind from a typical 25% in older systems, is being replaced with modern turbines with load factors in excess of 60%, considerably reducing the need for back-up power.

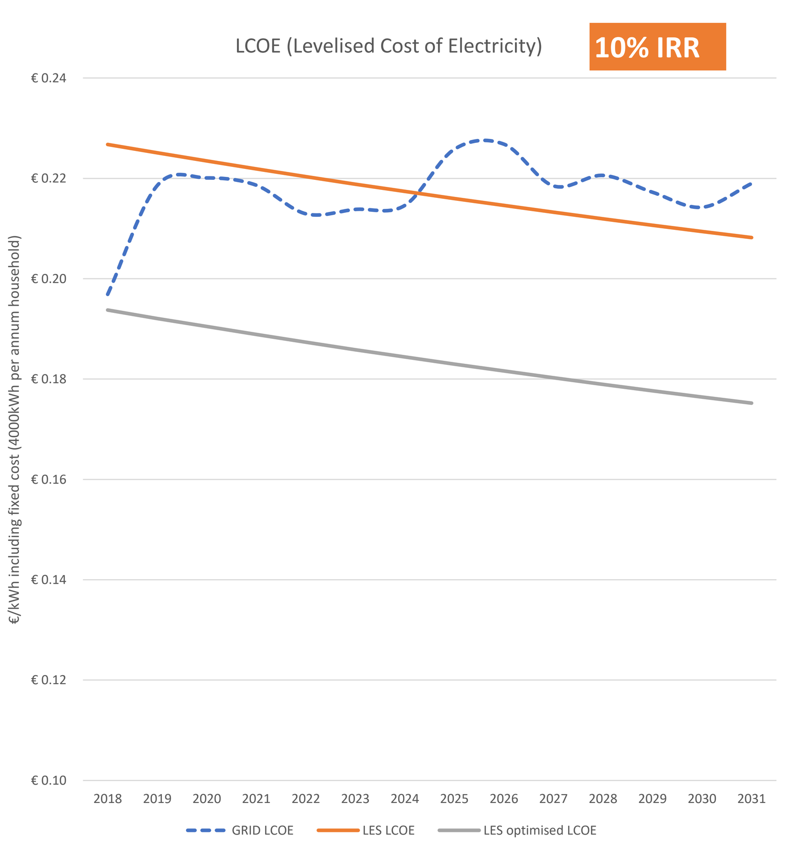
Other aspects of system optimisation can provide further benefits. It may be possible for example, to contract with an existing solar farm (with a fixed PPA) to obtain electricity directly avoiding the need to use and pay for power transmission infrastructure. Further benefits may be obtained by exploiting the fundamental characteristics of a Local Energy System (microgrid) to provide additional services to the DSO network and beyond.

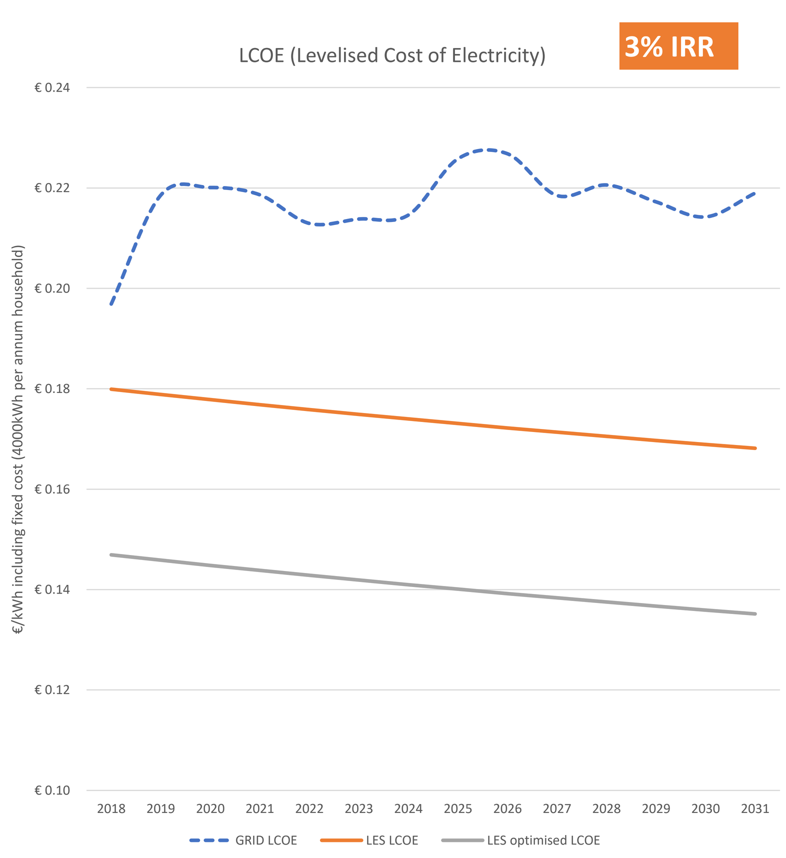
Example of 100% renewable based Local Energy System

The two graphs below illustrate the respective impacts of the points noted above.

A simplified model was used to explore the contributions of the varying CAPEX, cost of capital and value components to the LCOE.

The Local Energy System considered here is based on a new-build residential development supplied primarily by a wind turbine, supported by either a biodiesel generator or grid supply depending on their respective costs during each half hour period.





As a baseline comparison, the broken line represents the projected cost of supply from the UK grid used in UK energy policy.

It can be seen that, for a Local Energy System funded at 10% interest rate, an unoptimized system today has a similar LCOE as the conventional grid supply. If optimised to capture additional revenue streams from the sale of flexibility services, the LCOE, even at today's values, can be competitive with the conventional solution.

In the second graph, with a cost of capital of only 3%, assuming end-user investment in their own Local Energy System, the LCOE already achieves a significantly lower, and perhaps just as important, predictable, long-term, stable cost of electricity. This point illustrates the importance of the physical, engineering configuration of Local Energy System which can be exploited to engage with communities and deliver decarbonisation, security of supply and democratisation of the energy system.

This study was undertaken as part of Delta-ee Local Energy Systems Research Service.
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