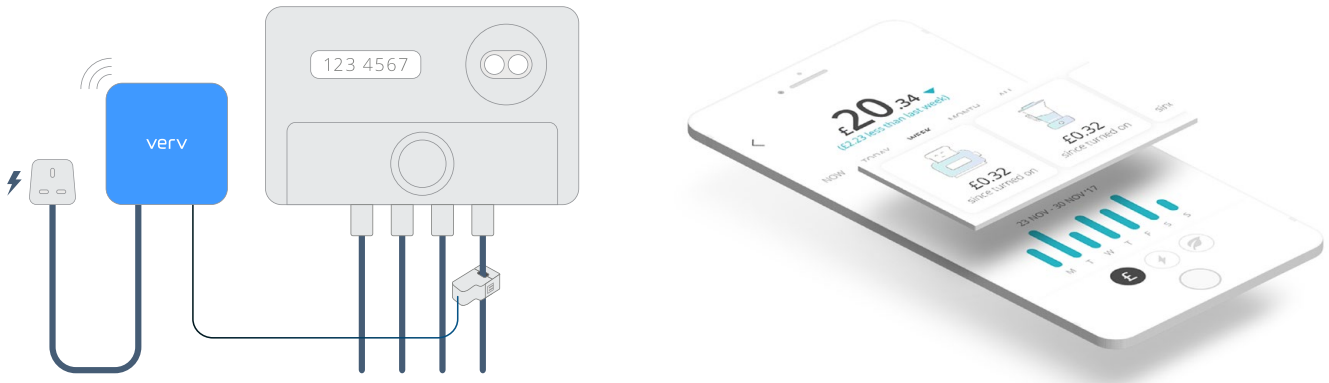


**VLUX**  
Peer-to-Peer Energy Trading  
—  
**Litepaper**  
(Framework Summary)



## Overview

Since 2009, Verv (trading name of Green Running Limited, also referred to here as “the Company”) has achieved significant traction in the UK energy industry for its patented power signature identification technology that uses non-intrusive load monitoring (NILM). The Company calculates that the Verv Consumer Access Device (“CAD” - image below) can sample domestic electricity data 5 million times faster than the average smart meter. This combined with its intuitive machine learning capabilities (an application of Artificial Intelligence) and blockchain framework, create the foundations to rollout (internationally) a peer-to-peer energy trading platform.



## The Evolution of Energy

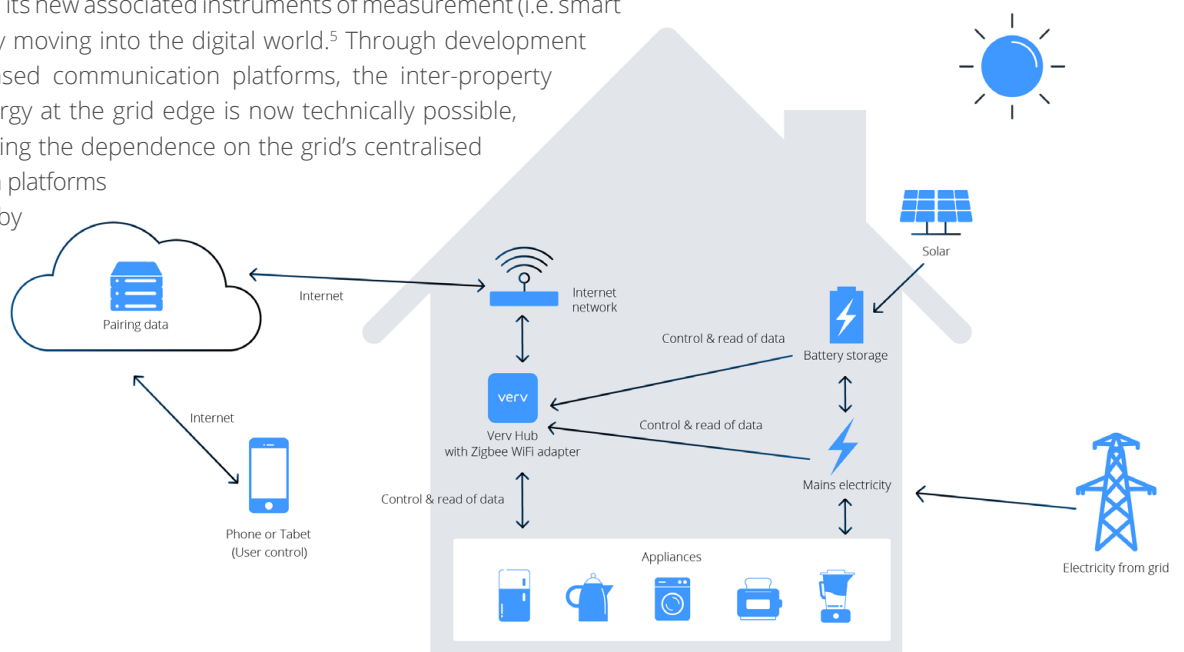
Today, electricity is the pulse behind most dominant technologies sustaining the human race (think - internet, cooling systems, light), and Verv believes that safeguarding it is a collective responsibility.<sup>1</sup> By 2050 in the UK alone, peak electricity is anticipated to grow to 85GW (up from 60GW today), with drivers including the electrification of heat, electric vehicle (EV) penetration and a growing population.<sup>2</sup>

Among governments and international organisations, there is a globally-recognised need to redesign our electricity systems to meet the energy demands of all citizens, while limiting damage to the environment. Further, in reaching for a sustainable future, the Company believes these new systems should extend to empowering the 1.1 billion people without access to electricity.<sup>3</sup>

With renewables achieving grid price parity, and existing energy sources (such as coal and oil) under environmental scrutiny, pathways for new energy systems are being quickly established.<sup>4</sup>

## Energy and Technology - The Age of Information & Communication (IoT)

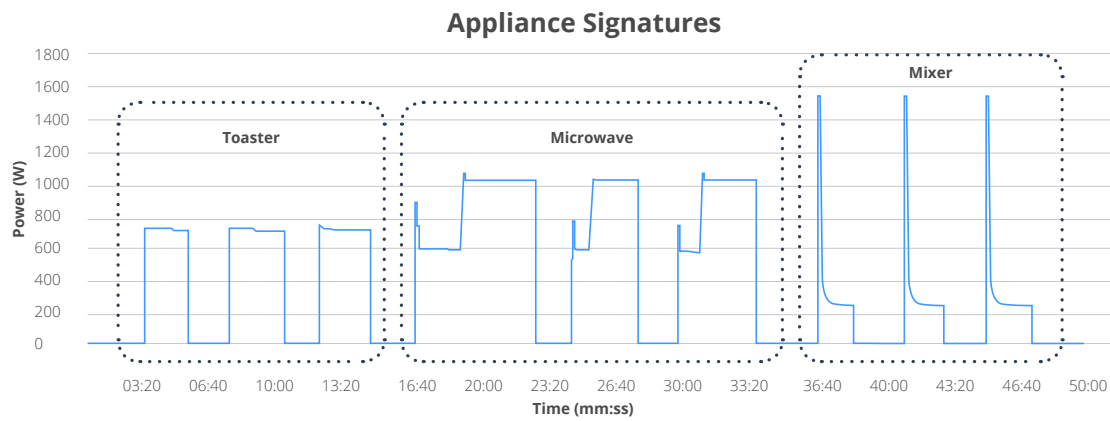
Considered a sector with significant potential for new value creation, the energy industry, through its new associated instruments of measurement (i.e. smart meters) is rapidly moving into the digital world.<sup>5</sup> Through development of new cloud-based communication platforms, the inter-property exchange of energy at the grid edge is now technically possible, potentially reducing the dependence on the grid's centralised power generation platforms (those operated by large utilities).



## The Verv Home Hub

Cloud connected, Verv applies machine learning algorithms to the self-install CAD unit to derive a comprehensive, real-time profile of the most common household appliances - both current status (e.g. on/off) and condition (e.g. fault prediction allowing preventative action to be taken).

### Non-Intrusive Load Monitoring



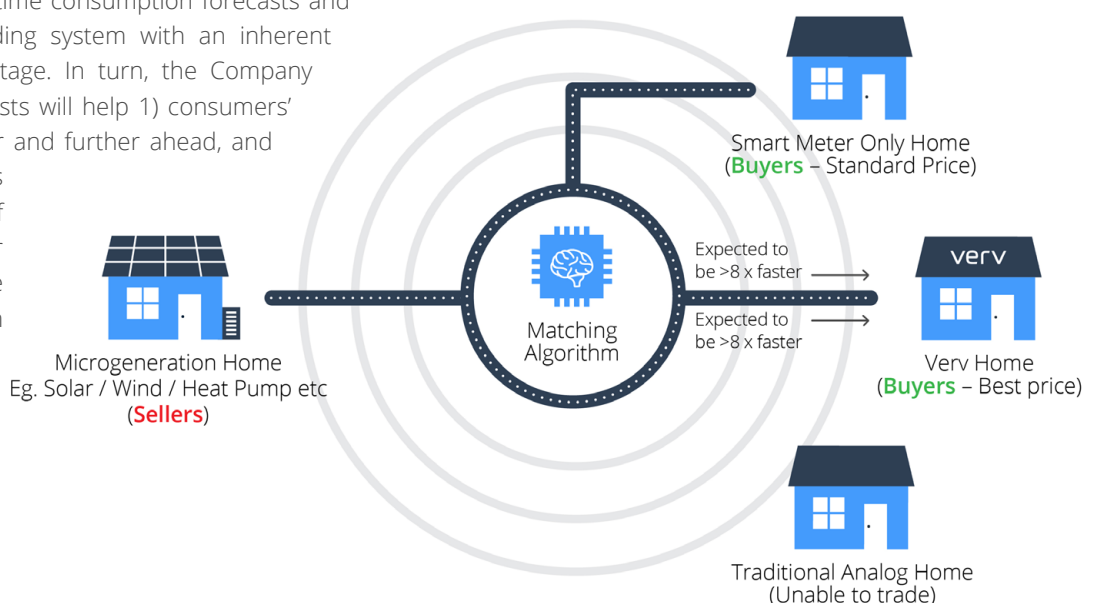
Having recently launched, Verv's multi award winning product is being sold internationally, and benefiting from early adopter feedback, identification of new consumer-led business opportunities, and enhanced machine learning know-how (from the growing library of training data). Designed for the needs of the consumer rather than an energy corporation, Verv's CAD unit is able to monitor domestic power consumption both with a smart meter (augmenting the smart meter's capability) and without:

On the rollout of smart meters, Centrica's director of technology was quoted in the Times stating, "What we call a smart meter today is pretty dumb. It's dumb because the amount of signals it takes is like one every ten seconds... When something new comes in [with reference to Verv] we have to recognise there is something better. We have to find a way of opening it up so it can be put in."<sup>6</sup>

The Company believes the Verv CAD unit, through an in-depth understanding of the drivers of electrical demand in the home, will be a linchpin behind the future of peer-to-peer energy trading.

## Verv's Energy Trading Framework

Verv believes it has an advantage in delivering peer-to-peer trading thanks to its ability to deep dive into consumption data at the appliance level to build up a history of consumer interaction patterns. The Company believes detailed historical context will enable better real-time consumption forecasts and the creation of a trading system with an inherent information-first advantage. In turn, the Company believes reliable forecasts will help 1) consumers' systems to trade faster and further ahead, and 2) prosumers' systems (micro generators of energy) to tune their generation/storage assets for maximum economic utility.



Verv expects blockchain to be the pivotal transaction technology in enabling the scale up of this peer-to-peer trading in the future. Verv has designed a system whereby local trading network hosts (e.g. community groups or energy retailers) will require VLUX utility tokens (Ethereum ERC20) to access the Company's energy trading framework and secure peer-to-peer trades.

Verv expects that their blockchain platform will enable energy to be traded and accounted for in ways previously unattainable, while maintaining decentralised records of value.

The system is being developed so that the prosumer's trading system will analyse key consumption, generation, and storage variables to determine when to sell surplus electricity. In tandem, the consumer's system will actively look for the cheapest available supplier of energy. A trade matching algorithm, guided by price limits pre-set by each party, will pair prosumer bid prices with consumer ask prices until a match is generated and a smart contract for the sale and purchase of energy is formed.

## Traction and Roadmap

Spearheaded by Peter Davies, an Electrical Engineer and energy entrepreneur, Verv's team of 40+ full time employees includes the former Technical Director of YCam, Managing Director of Acer Computers (UK) and Financial Director of Opus Energy, as well as 14 machine learning specialists and a team of 8 blockchain professionals. Angel investors in the Company include the former CEO of Scottish & Southern Electricity and the founder of Opus Energy, and academic advisors include professors of energy from University College London and the University of Bath.

To date, Verv has received investment from Centrica's Ignite fund (social impact focus),<sup>7</sup> angel investors (including the above), and 1,000 private investors from a £1.1m crowdfunding campaign. Verv is being actively trialled by large European energy utilities. Other key supporters of the company include the UK government (from Innovate UK and BEIS), Google's selective Global Launch Pad, and Amazon's Launch Pad.<sup>8</sup>

### Blockchain Development

Development of Verv's energy blockchain started in late 2016, with 2017 and Q1 2018 seeing a rapid expansion in R&D (blockchain technologists growing from 1 to 8). Having benefited from the support [financial and technical] of Innovate UK, The Energy Entrepreneurs Fund, and Ofgem (shortlisted), Verv is now engaged in a community energy blockchain project with Hackney Council and RePowering London.<sup>9</sup> Activation of Verv's energy trading platform is underway:<sup>10</sup>

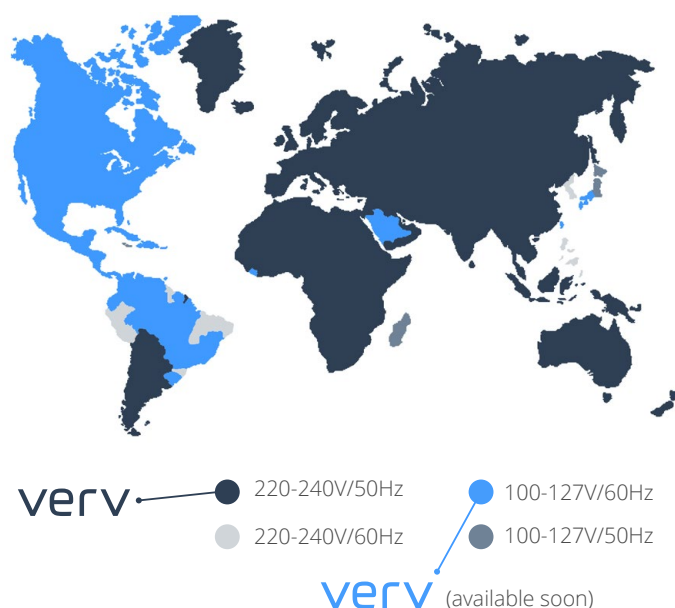
- **UK 60 Homes (BEIS)** – This has enabled Verv to build its trading algorithm and simulate using it across 60 homes that have onsite storage (7 different home battery types being tested) and solar generation to determine potential trading levels, system economics and algorithm efficiency.
- **Hackney Bannister Housing Estate (Innovate UK)** – The Company through its initial field-trial, across 40 community flats believes they are on course to be the first company to legally conduct peer-to-peer energy trading in the UK.

Development of Verv's energy trading framework is on-going, with the Company targeting 2018 for rollout to early adopters in the UK, and international rollout targeted for late 2018.

Geographies in the dark blue highlight immediate expansion opportunities for Verv's CAD unit. By the end of Q3 2018, Verv hopes to have launched a modified system suitable for rollout in the USA and Canada.

Going forward, Verv will test the potential for applying its peer-to-peer trading platform to Electric Vehicles, Microgrids, DSO management, and Carbon Trading.

Building on Verv's competency in householder electricity disaggregation, and with support from industry experts and FTSE 100 companies, Verv believes its energy trading platform is positioned to lead the paradigm shift in making energy decentralised, low cost and carbon free.



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