Energy Islands - Renewable Energy for Everyone

Problem Definition

'You don't know what you have until it's gone'. This must be the experience after a disaster faded everything away. On top of this millions of households have no access to energy at all which effects the quality of their lives in many ways. The absence of facilities like climate control, time saving devices and light makes them suffer for example from unproductivity due to temperature, not being able to study in order to get better jobs and no access to internet.
A solution to this could be the ability to set up a local grid.

How to set up a grid in an environment without a public grid?

Solution

A grid can be set up by creating a local network of devices. At least one of the devices should be able to produce energy. By doing so a self supporting local energy network is created.

We call this stand alone network an Energy Island. The Energy Islands could be connected to each other allowing energy trading between Islands, which will make the model more efficient.

How

From every device the energy production and consumption is read by a battery meter and sent to a server (local or remote). These figures are input for the Matching Logic, which is running on the server. The Matching Logic will match the demand and supply based on the preferences of the consumer. Preferences are criteria used to define which devices make a deal, for example considering cost level or priority of a device.

Once a match is made a smart contract will run on the Ethereum node which is also running on the server. The machine to machine energy transaction is now registered and paid for.

The consumer will be provided with a web interface where he can drill down from household to device to transactions.

To avoid waste of produced renewable energy a Predictive Model is outlined using Artificial Intelligence (we have information here as well). This model is looking at the historical behaviour of the devices and managing the consumption or production accordingly. It will balance the demand and supply as much as possible.

Investment

The implementation of an Energy Island can be done rather quickly, probably in two days.

The shopping list for one Energy Island would look like this:

- Battery + Islanding power inverter (to kick off the Energy Island and to provide flexibility)
- Generator (solar panels, if not already present) + Grid parallel power inverter (needed to convert the direct current from the solar panels into alternating current)
- Consuming devices (i.e. lights, TV, washing machines, computers etc.)

Depending on the total power consumption of the devices the costs will vary. A minimal installation of a household running basic facilities will roughly end up around $10.000,- This includes low rate wages for installation costs (ex VAT).

Cost details:

solar panels	0.316 $/Wp standard polycrystalline solar module (average spot market price). Standard module (1 m x 1,6 m) has roughly 280 Wp nowadays.
Grid parallel power inverter	$250 per kVA (larger units are cheaper per kVA)
Solar panel rack and installation of panels and inverter	Mounting system is roughly $50 per module. Installation costs (i. e. salary for people doing the mounting, connection, etc.) depending on region.
Battery	Typical battery price: 600 $/kWh usable capacity. Some manufacturers are a lot cheaper (e. g. Tesla Powerwall) but probably not applicable for island situations
Battery inverter (with islanding capability)	700 $/kVA (that's pretty expensive; non-islanding systems cost about 500 $/kVA)

Note: Solar + inverter prices are falling slowly; battery prices are falling quickly.

Opportunities & Challenges

The concept of Energy Islands will not only provide a solution for a non grid environment. It will also contribute to increased use of renewable energy. It should be noticed however that the use of renewable energy is more efficient when used in a network of more devices.

The solar inverter is capable of switching of the production when production exceeds consumption. This is to protect the network from a blackout. For future developments it is recommendable to add a module who can switch off devices when consumption exceeds production.

Research can be done on the cryptocurrency part since Ethereum is quite volatile at the moment it may be a solution to develop a stable coin.

The question is how an area in demand is going to pay for such an investment. Potential investment models could be:

- External investors “selling” the electricity to the area in demand by owning the battery, solar panels and inverters;
- External parties giving a donation (100% of the amount);
- Areas in demand could build trust in order to get a loan by saving up before investment, e. g. into a tethered cryptocurrency (say, 50 % save, then investment, then payoff of the remaining 50 %)