Residential Solar PV and Battery potential for the parishes of Earls Colne, White Colne, Wakes Colne, Chappel and Great Tey

Feasibility Study Report April 2023

1. Introduction

1) This Feasibility Study report presents findings from an initial study conducted by Power Circle Projects Ltd. as part of the South East New Energy project. The project is part-funded by the European Regional Development Fund.

2) This Report has a residential focus and is a high-level assessment of the potential for roof top solar installations across the five parishes of Earls Colne, White Colne, Wakes Colne, Chappel and Great Tey

3) A separate study has been undertaken for a local business. By arrangement, Power Circle could provide an example for other local businesses in due course.

2. Summary of key findings

1) There is good potential for solar photovoltaic panels (solar PV) to cut energy costs and carbon emissions across the five parishes of Earls Colne, White Colne, Wakes Colne, Chappel and Great Tey.

2) Battery storage would add further value for residents

3) Householders can act individually, but there can be more value in a community-wide project. This approach need not place a big burden on the community

4) A community project could include a funded option. This is where solar PV is installed and paid for on a 'pay as you use' basis. This would take time to prepare and would need to be of sufficient scale.

5) Householders who already have solar panels could still participate in such a scheme (e.g., by adding batteries)

6) Installing solar PV and a battery would make good sense in its own right. It would also provide a useful step in the journey to a fully net zero carbon home, improving the economics of shifting to electric heating and vehicles.

3. Scope

We have examined the potential for roof mounted solar panels on the roofs of homes across the five parishes of Earls Colne, White Colne, Wakes Colne, Chappel and Great Tey. We have also:

1) Assessed the case for the additional of electrical batteries

2) Considered options for financing and operating a community solar PV and battery project.

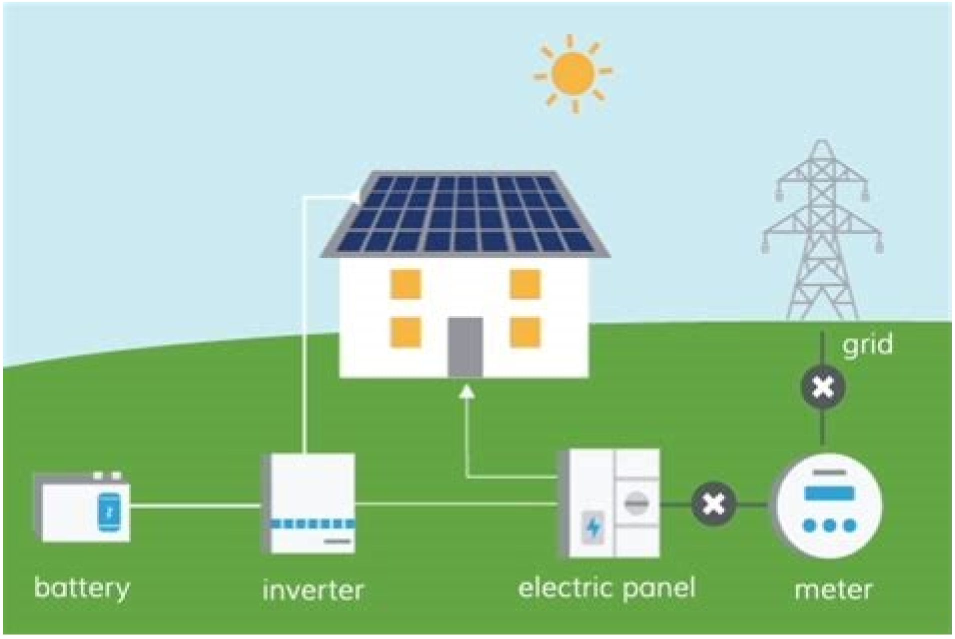
4. Benefits of Solar PV and Batteries

4.1 Solar PV is shorthand for solar photovoltaic panels. An array of panels on the roof of a home can provide a useful contribution to meeting the energy needs of the home. The panels do not require routine maintenance and have a long lifespan (more than 30 years).

4.2 The benefits of integrating battery storage into the installation are less well known. There are six types of benefit from addition of a battery. These are summarised as follows:

1) Time shifting (making best use of onsite generation from solar PV, typically allowing electricity generated during the day to be used in the evening
2) Tariff optimisation (making best use of cheaper overnight electricity)
3) Grid services (being paid to help the wider electricity system work with lower carbon and lower cost) see section 7
4) Back-up power (in the event of power cuts)
5) Easing of grid consents (reducing cost and/or time required for grid connection of new onsite generation, where this is an issue)
6) Increased carbon savings

4.3 A battery can be installed internally or externally, that is in the home or in the garden. Below is a diagram of how the battery, panels and existing grid connection work together.



5. Findings

5.1 Solar PV potential for the four parishes.

An initial satellite survey has been carried out for the project by Geospatial Insight[1]. This has used public domain data and images to provide an initial assessment of the residential solar PV potential on homes and other buildings.

Using this initial assessment, the total number of roofs across the five parishes where solar PV was assessed as suitable was 2357. This consists of:

- 1376 in Earls Colne
- 194 in White Colne
- 196 in Wakes Colne and
- 195 in Chappel
- 396 in Great Tey

These roofs could host up to 14 MWp of solar PV!

The average installation per home was 4.5 kWp (enough to generate 4,000-4,500 kWh/year).

We emphasise that this is a high-level initial assessment and does not take account of listed building/conservation area planning requirements which may reduce this potential.

5.2 Type of solar PV panels.

For this study, it has been assumed that 400 kW (kilowatt) solar PV panels will be used. This is the current industry norm. 450 kW panels are available but at present command a premium price. Many different manufacturers provide suitable panels. A selection would typically be made together with an installer when negotiating a supply and installation contract, taking account of performance and price.

5.3 Battery potential

The financial value of battery installation has been assessed taking into account the key financial benefit streams outlined in 4.2 above:

1) Time shifting (making best use of onsite generation from solar PV, typically allowing electricity generated during the day to be used in the evening
2) Tariff optimisation (making best use of cheaper overnight electricity)
3) Grid services (being paid to help the wider electricity system work with lower carbon and lower cost)

On this basis, assuming all three benefit streams, there is a positive business case for battery installation. The size of battery proposed for typical home electricity use and solar PV optimisation is 5 kW power and 5.5 kWh energy. The first figure represents the amount of power the battery can provide at any one time. The second represents the amount of energy which can be stored in the battery.

5.4 Type of battery

[1] https://geospatial-insight.com

Whilst many manufacturers provide residential batteries, for all three of the benefit streams above to be realised, the choice is a lot more. At the size range indicated above, from dialogue with a prospective grid services partner, the battery which has been assumed to be installed for the purposes of this study is an Alpha ESS battery. Should the project progress to implementation, the options will be reviewed in dialogue with a grid services provider closer to the time of negotiating a supply and installation contract.

5.5 PV and battery integration

For a combined solar PV and battery installation, the solar PV-generated electricity can be provided as a DC supply to the battery. There is no inverter installed as part of the solar PV installation as would normally be the case. The battery system incorporates an inverter enabling the battery to provide AC electricity to the home both from the solar PV and from grid electricity which has been imported to the home at cheap times of supply and stored in the battery.

5.6 An example of a suitable battery

The Alpha ESS ‘Smile 5’ battery provides 5 kW power and has a range of energy options. For this study we have assumed the 5.7 kWh version. Details are available here https://www.alphaess.com/smile5-5kw-residential-energy-storage-system

5.7 Broadband connection

The battery management system requires an internet connection. For this study, we have assumed that the householder has a suitable broadband connection and agrees to make use of this connection available for the battery management system to utilise. The system relies on an ‘always on’ connection but only uses a small amount of broadband data. A separate connection can be made, for example via the mobile phone network. This would add to system costs.

5.8 Costs and Benefits Summary

Energy and financial modelling have been undertaken based on the median average solar PV installation for the five parishes of 4.5 kWp. Modelling has been undertaken on a 30 year basis, given the long asset life of the solar PV (in excess of 30 years’ expected life). The battery has an expected life of 15 years, and a replacement has been assumed at year 16.

Costs and benefits are outlined below assuming (a) a householder-financed case and (b) a funded solution. In both cases, a sufficient number of participants (300+) has been assumed to enable grid services revenues to be generated. This volume does not all need to come from the four parishes but can be reached via a combination with other similar projects.

5.9 Householder-financed case

- Upfront cost: £9,467
- Year 1 savings: £1,235
- Payback period: 6-7 Years
- internal rate of return: 15.41%
- Net Present Value with 4.6% cost of capital: £17,556

5.10 Funded solution

- Upfront cost: nil
- Average annual savings over 30 year life time of panels £305 (25%)

5.11 Assumptions for the average house

Key assumptions:

- Solar install size: 4.5 kWp per home using 400w panels
- Solar PV degradation 0.4% per year
- Annual yield 1241 kWh/kWp
- Standard domestic electricity prices assumed to rise in line with inflation from assumed current level of 34p/kWh. Inflation added as from first year of project, making first year standard price 35p/kWh
- Nominal inflation 3%
- Solar PV Supply and Install Cost £1/watt (based on volume contract).
- Battery Spec and Supply and Install Cost 5.5 kWh 5 kW £5,000.
- Export value long term 10p/kWh real

It is emphasised that the energy market has experienced and may continue to experience large fluctuations both in terms of energy supply and supply costs of renewable equipment. The budget costing upon which these findings are based should be treated with caution in the light of this.

6. Grid Connection

Solar PV and battery installations require approval from the Distribution Network Operator (DNO), UK Power Networks.

7. Grid Services

7.1 Grid Services

These are technical services provided to electricity System Operators (National Grid and perhaps also UK Power Networks as the applicable Distribution Network Operator in this area). There are several such services. They help the system operators meet customer needs at lower cost and with lower carbon emissions. In outline, they smooth out the peaks and troughs avoiding the need for more expensive and dirty generation (like gas 'peaking plants') and reduce the capital investment required by the system operator. Grid services are becoming increasingly important as the grid moves to more intermittent renewable supply and demand grows with the shift to electric heating and vehicles.

7.2 Enabling Grid Services

Grid services are enabled via control of 'flexible' assets such as batteries. There is generally a minimum size threshold for provision . This equates to 1MW of suitable assets. These can be within a single project but can also be brought together with other projects within the same DNO area and can reach the required minimum size on that basis.

8. Planning

Permitted Development Rights in England extend to all domestic rooftop solar PV developments, provided that the home is not a listed building or in a conservation area. For homes which are listed building or in a conservation area, planning consent for the solar PV installation will be required.

9. Flats

This study has assumed that the homes involved are individual houses each with its own separate roof. The solution can also be applied to flats. For flats, the challenge has been the cost of requiring separate installations for each flat if each flat is to benefit. A new solution to this challenge is now provided by the company Allume. The solution is called Solshare, see https://allumeenergy.com/uk/

This solution enables electricity generated by a single solar PV system with a single inverter to be shared by up to 15 flats. At full project development stage, proposals could be costed for blocks of flats with participating households. For privately owned blocks, the agreement of all owners in the block would be required for a solar PV installation on a shared roof.

10. Commercial property

This report is focussed on homes. A separate study has been undertaken for a local business. With its agreement, this could provide an example for other local businesses in due course. This may be in an anonymised form if that is the preference of the business concerned

11. Making It Happen

11.1 Assuming that there is significant interest in the four parishes in making a solar PV and battery project happen an appropriate organisational and funding structure would be required. Households can of course go ahead with solar PV and battery installations independently. A wider project could enable those who can pay the upfront costs themselves to benefit from potentially lower upfront costs which could come with a larger supply and install contract, less time spent in researching which options to choose and a share of the grid services income made possible by a larger project.

11.2 A community energy project could be progressed by the four parishes together or separately. This approach would require local project champions. To help these local champions a new independent County-wide **not-for profit Community Interest Company**, Essex Community Energy CIC (ECECIC) has been created. ECECIC could act as a community energy service company, a Community ESCo, and its role is to help communities and other stakeholders in Essex progress renewable and low carbon energy projects. The project could be developed and managed by the ECECIC, with close input and support from local organisations and individuals in the parishes.

12. How Essex Community Energy CIC (ECECIC) can help

12.1 ECECIC could address the following barriers.

- affordability
- slow return on investment
- perceived risk and lack of familiarity with the technologies involved and suppliers
- lack of expertise, time, data, information

ECECIC addresses these problems by:

- Provision of information on the costs and benefits of installing solar using geospatial data (giving households a starting point for discussion)
- Aggregation of projects to seek low-cost finance and capture economies of scale, including earning ‘grid services’ income for electricity system operators in a way which individual householders cannot do.
- A ‘Pay as you Save’ option for households with limited finance, meaning that ECECIC meets the upfront costs and does the work of specifying and managing the installation

12.2 Developing the project in collaboration with ECECIC could work as follows

- Discuss and enter a short agreement between one or more local ‘anchor’ organisations and ECECIC. This would outline the mutual intent and respective roles. A key role for local organisations would be local householder engagement.
- Conduct a geospatial survey of the area to identify potential energy projects (this has already been undertaken in this case)
- Engage with the community, communicating the potential benefits to participating householders and others
- Undertake full project development. Note: Planning authority responses to applications on listed buildings and in conservation areas will be an influencing factor. Residents in such properties would be responsible for meeting the cost of seeking planning consent, using solution design material provided by the ECECIC.
- Raising finance for full project development and delivery (this may be undertaken taking other Essex projects into account)
- Securing appropriate grid consents
- Securing a commercial partnering agreement with a grid services provider
- Procurement of installation, commissioning, and maintenance support
- Entering of conditional contracts with households (conditional on item 10 below)
- Financial close with funders and contractual close with suppliers
- At this point:

a) Households that want to buy the equipment purchase it

b) Households that cannot afford or do not want to purchase the equipment enter into a ‘Pay as you Save’ agreement – see below

- Build and commission project – with scope for additional households to join later

12.3 The ECECIC offer to residents and businesses

This is as follows:

1) Free information on the scale of potential of their house/business

2) Outline design for their house/business

If they decide to join the scheme:

3) Survey of the house/building to check the detailed design

At this point, there are two options:

Option 1: Pay for the installation.

The householder could enter agreement with the CIC to receive grid services benefits and with the CIC's supply and install contractor for supply and installation of equipment

Option 2: Funded option

The householder would enter an energy services agreement with ECECIC. The CIC would act as energy services company. For energy needs beyond what can be provided by the property's own panels the householder would choose their own supplier. Households will have two bills – one from their conventional supplier, and another from ECECIC.

The household on the funded option has an option to buy their panels and batteries outright. If the householder wishes to sell the house, they have the option to panels and batteries outright (so the system becomes bundled into the sale of the house) or for the sale to be subject to the purchaser entering an agreement with ECECIC.

The funded option can be regarded as a 'Pay as you Save' model with no upfront costs and the ECECIC recovering its costs through payment of energy charges which result in overall savings to the household.

Two diagrams are provided in an Appendix. One illustrates how things work in the home. The other shows the broader community picture

How about homes not suitable for solar PV?

Some houses and businesses cannot have solar on the roof. This is usually because they are shaded by trees, the landlord will not permit installation, the roof is under a warranty that would be voided by installation, or the building is listed/in a conservation area. There are two potential routes for involvement of householders in homes not suitable for solar PV:

- Peer to Peer supply. This involves purchasing electricity from another building which is generating more electricity than it needs. The generator may be within the project itself i.e., another local household or business but may also be from further away (still in the UKPN area). Once again, there would need to the right volume of households, across the projects, which wish to participate in this way. This approach is still financially beneficial to both the generator and the consumer.
- A 'Solar Allotment' option. Under this option, ECECIC could install a ground mounted array in a suitable area that could provide power to homes and businesses. This enables everyone in the community to participate in some way. A larger ground mount array near to the settlement could provide power. The householder would secure the rights to a certain amount of power generated by this array to compensate for the fact they cannot put solar on their roofs. There is potentially a way of combining a small, local, ground mountain array with either food growing (a community initiative) or actual allotments.

How about homes which already have solar PV

Where there is existing solar PV at the home and there is scope for more the homeowner could fund additional solar PV and the battery themselves. If they wish to progress with a funded solution that is a bit more complicated. For the panels to have two sets of owners they would need to be separately metered so there would need to be enough extra potential on their roof for this to make economic sense.

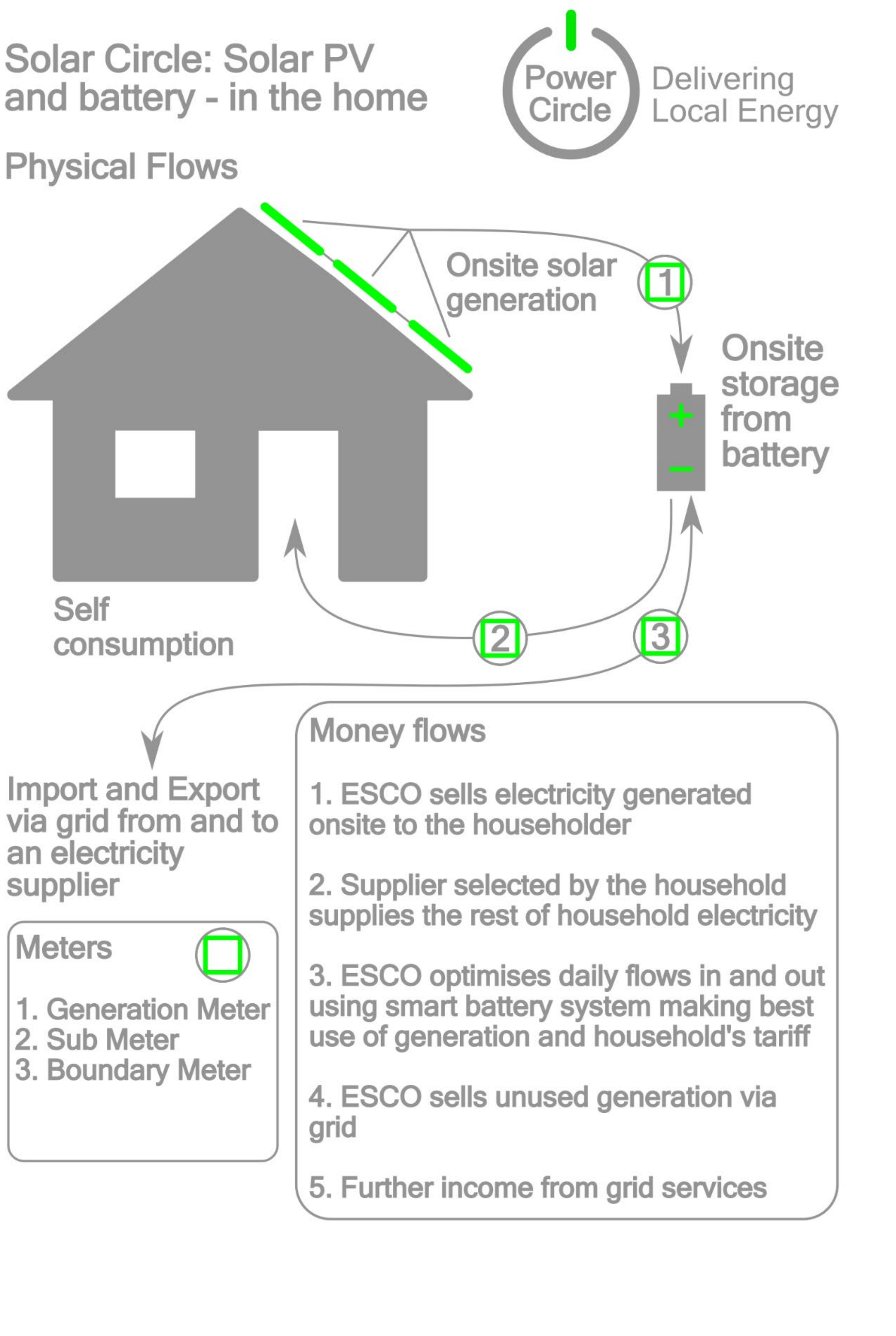
13. Conclusions

There is considerable opportunity across the four parishes for the installation of rooftop solar PV, equivalent to a small solar farm.

Whilst not every household will wish to take part there are options for all those who would like to be involved, even if their own properties are not suitable for an installation or if they cannot make a financial contribution.

There are mechanisms and organisations in place to help the community take a scheme forward should they wish, addressing financing, technology, data, operation and maintenance. If over time the community wishes to set up their own not-for-profit organisation to manage the project locally, there is scope to facilitate that process.

APPENDIX 1: How the Community ESCo solution works in the home. Referred to here as Solar Circle



APPENDIX 2 – How the Community ESCo works in the wider context