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TECS RCEF POST FIT FEASIBILITY STUDY

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Section 1. Introduction

TECs has undertaken a feasibility study to assess the technical, regulatory, commercial and financial viability of post FiT solar PV installations at industrial sites in Teignbridge. This was an RCEF funded, WRAP administered study. Climate Positive was selected as our preferred service provider to deliver this study following a competitive tender process.

This study focuses on identifying the feasibility of achieving a financially viable and sustainable stream of Solar PV installations, with a focus on two industrial parks in Teignbridge. We intended to look into the feasibility of such installations in a post-FiT environment making use of Private Wire and Storage arrangements/technologies where appropriate.

The following locations were originally proposed, but other locations and opportunities were also considered:

- Units at industrial parks (see separate spreadsheet for all sites and prioritised sites):
    - Brunel Industrial Park, Newton Abbot
    - Heathfield Industrial Park, Bovey Tracy
- Car parks owned/operated by Teignbridge District Council
- University Technical College in Newton Abbot
- Courtenay Community Centre in Newton Abbot

As part of our initial assessments, we have confirmed that it is highly likely that most of the proposed installations will come under Permitted Development. We have also had discussions with Western Power Distribution, leading to confirmation in principle that Grid restrictions are unlikely to apply, or may be overcome. Both these aspects will require further detailed analysis prior to proceeding with any project.

A number of useful reports provided the context and input for our study, including:

- Stephen Scown and RegenSW "Local Supply: Options For Selling Your Energy Locally https://www.regensw.co.uk/7283018298372873/wp-content/uploads/2015/06/Regen-White-Paper-2nd-Edition.pdf
- MICROGRIDS A GUIDE TO THEIR ISSUES AND VALUE http://www.hie.co.uk/search/google.html?q=microgrid
- RegenSW's Pathway to Parity series "Energy Storage - towards a Commercial Model" https://www.regensw.co.uk/storage-towards-a-commercial-model

Section 2. Objective and Scope of Work

The purpose of this study was to identify the options and solutions for TECs to continue to realise business opportunities, particular for rooftop solar PV projects without financial incentive or subsidy (FiT or grant aid). We wanted to identify the opportunities and limitations of such schemes so that TECs was in a better position to assess future Stakeholder projects. The results of this work will be used to update the current TECs' 5-year Business Plan, Financial Modelling tools and Initial Assessment Criteria for Stakeholder Projects.

Given the essential need to sell almost all the electricity generated at a price significantly higher than 'grid export' prices (though still less than the price consumers pay), we have three main options:

1. Sell nearly 100% to the on-site consumer, this is similar to current business plan priority, sometimes referred to as Micro-generation.
2. Use a direct cable connection to sell power from a PV system to one or more adjacent consumers. The proposed solution varies from that described under Micro-grids for Private Wire connections as described by some of the documents referenced earlier.
3. Partner with an existing licensed supplier to extract a higher rate than current negotiated grid export tariff, through peer-to-peer sales, 'sleeving', local balancing or other options currently being investigated by Ofgem and others. At present, a negotiated rate will at best generate a premium of 1 p per unit, which is too low to give a sufficient return.

We addressed these options by working with interested parties covering Technological, Regulatory and Commercial aspects. Details of this work, and its results, form sections 5, 6 and 7 of this study report, respectively.

Section 3. Steps Undertaken and Key Conclusions

Work carried out under this assessment programme and our conclusions (please refer to later sections for further details):

- Created a long list of all sites on Heathfield and Brunel Road industrial estates, and conducted visual surveys, to eliminate completely unfeasible roofs, identify occupiers (where possible) and flag likely high local use sites.
- Walked around both estates to eliminate any further unsuitable sites and prioritise the remainder.
- Completed HM Land Registry searches of remaining sites, to identify ownership.
- Created an initial shortlist of 20 sites, noting how each should be approached (including identifying personal contacts where possible).
- Met/talked to 8 site owner/occupiers, who agreed in principle, to work with us to explore opportunities for post-FIT installations.
- Engaged with three owners with potential for large rooftop PV, two of whom have proceeded to board level agreement and the possibility of a joint project. We are discussing a private wire solution for two further sites.
- Engaged with a community centre to discuss an energy saving project (LED replacement). Also discussed academic involvement with a University Technical College. While not a post-FIT renewable energy option, this seems likely to provide a valuable additional way forward for TECs.
- Approached several other site owners/occupiers, but none met TECs' financial, environmental and community assessment criteria.
- Applied TECs Initial Assessment Criteria process, which was very valuable, and has allowed us to extend and amend the criteria, to help realise future opportunities.
- Established three possible Private Wire options. One of these was explored in detail. This was a model where multiple sites are fed from a single PV installation, while each remains connected to the grid. WPD initially confirmed that such 'parallel' connections would be allowed provided specific safety requirements are not compromised.
- Contacted engineering/systems solution companies (System Designers) to explore technology options for paralleled Private Wire solutions. A design brief based was prepared for one of our evaluation sites at Forde Rd. in Brunel. A review between the selected system designer and WPD resulted in eliminating this option, see explanation in section on Technology Options.
- Worked with preferred installer on post-FiT rooftop PV and Private Wire to obtain financially viable proposals.
- Discussed options for an alternative route to market for surplus energy. Good Energy and Open Utility (Piclo peer-peer trading system) are unlikely to provide a sufficient income stream at this stage. Information from RegenSW and Ofgem obtained at various events, and from their publications, also indicate that there will be regulatory and market uncertainties for 1-2 years. Furthermore, without significantly larger installations, TECs is unlikely to be a major player in this market.

Section 4. Community engagement

We continued to publicise and engage the Teignbridge community in our existing project(s). The contact with short listed site owners for this feasibility study also served to extend this publicity and engagement. Indeed some of the discussions and presentations have resulted in new potential stakeholders, outside our target group on industrial sites, contacting TECs with a view to working on a post-FiT project.

We have also undertaken several sessions to inform and get the buy-in from existing Members about post-Fit opportunities.

Further community engagement and an update to our current Publicity & Marketing Strategy on this may follow as a result of the work undertaken here, but this falls outside the scope of this study.

Section 5. Technology Options

Following discussion, and analysis, of available solutions for Local Supply options, we focussed our investigation on control options to manage the flow of electricity in Private Wire solutions that:

1. maximises local sale to Stakeholders,
2. are flexible, allowing connections to be switched as Stakeholder business use changes, and
3. conform to electrical safety and DNO connection requirements.

The technological challenge regarding the first point is that, where sales are to more than one Stakeholder, it is hard to guarantee a level of supply to each. As a result, we will look to a commercial solution, by proposing a shared benefit arrangement, so all get an equitable benefit, irrespective of where the system is located or level of usage. It is likely that a single unit price will be one element of this, whatever the level of consumption, or existing grid price.

The primary consideration for the second point is the cost of installing cabling, safety equipment and smart meter(s) to establish a new Private Wire should demand change during the life of the project. It would therefore be necessary to consider the capacity and capability of the electrical distribution board and cabling at the time of system installation. This will result either in a higher initial cost, or a lower return, as money is set aside to pay for future changes.

The primary consideration for #3 above is to ensure that electrical installations and electricity flows conform to relevant requirements. We would therefore need formal approval from WPD before proceeding with a technological solution which maximises the sale of electricity generated and provides the flexibility needed to ensure this continues throughout the life of the installation. WPD may require TECs to meet the costs of changes to their network.

The different technology options are detailed in Appendix A. The requirements for supplying multiple buildings through Private Wire with only one grid connection is well established (called “Islanded supply”). The problem is that Stakeholders are unlikely to be willing to give up any existing grid connection, particularly if they are not the owner of the building where the principle grid supply is located. Even if they were, TECs would incur additional costs to ensure its own grid supply could meet all their needs. There are also regulatory and commercial challenges for this option.

Similarly the technology requirements to supply multiple sites from a single location 'Split' PV system are also well understood. Appendix A provides two variants of such a technology solution. The main disadvantage of such a system is that it is difficult to maximise the supply to each stakeholder, and or make changes as Stakeholders' consumption patterns change over time.

Because of the limitations of the options above, we considered the so called paralleled Private Wire option in some detail. Although it was agreed that this may be feasible and even cost effective from a technology viewpoint, it was not accepted by WPD. The description in Appendix A of this 'ideal' PW

solution would, unfortunately, require additional operational safeguards for both the DNO and the Site owner/user. Creating these operational safeguards would be prohibitively complex, expensive and introduce a high element of risk if not followed by anyone working on the electrical wiring. It therefore could not be taken forward.

Section 6. Licence and Regulatory Environment

We are not intending for TECs to obtain a Supply Licence, rather to either sell electricity direct to consumers via Private Wire, or if the former is not possible, use existing suppliers/utilities such as Good Energy, Tempest, Ovo and the Co-op in a 'sleeving' or peer-to-peer arrangement.

The recently launched Piclo on-line service by Open Utility and Good Energy is one option. The terms and charges for this do not appear to be financially viable, or fall within the current bounds of our Business Plan. This is because the additional revenue from the sale of electricity through sleeving is likely to remain at 0.5 to 1 pence per kWh, which is too low to make projects feasible. It is also unlikely that utilities would enter into a sleeving arrangement for installations of less than some 100s kWpk.

Ofgem is currently consulting on aspects of electricity sale in a 'smart' network, this is likely to impact the regulatory landscape for TECs' sale through Private Wire and/or peer-peer. We will need to keep track of such developments to identify future potential business opportunities.

Section 7. Commercial Agreements

WPD have been consulted/involved in the technology discussions and options, as we identified suitable sites to evaluate the different commercial models and agreements. Three types of site were identified and discussed with potential Stakeholders:

- Single large roof (100-500 kWp) with almost 100% on-site base load. Discussions centred on what financial terms would be required by all parties, to establish the break-even point for installations, and the consequent maximum installation cost. We also discussed what Power Purchase Agreement terms might be possible.
- Several (2-4) owner/occupier units with adjacent/shared walls/roofs and appropriate grid wiring to meet WPD Private Wire conditions (probably a approximately 50kWp PV installation). Discussions centred on the return required by each Stakeholder, and so the level to which owners/occupiers are prepared to share risk/benefit.
- Two sites close to each other where a single PV system (approximately 50kWp PV) would be 'split' to supply the two sites using a Private Wire. Discussions centred on the commercial terms for this arrangement.

We have identified sites for each of the three models above, where owners have engaged in exploring the various options. As a result we have revised and tested our lease and PPA terms with potential Stakeholders and produced Heads of Terms to reflect these changes.

Discussions on LED replacement projects suggest that this may be used as a supplementary source of benefit/revenue with Stakeholders and could provide a further incentive to Stakeholders to engage. The terms of such projects was explored with one Stakeholder, and we are developing a set of suitable Heads of Terms.

Section 8. Business Plan and Financial Modelling

We have updated the TECs 5 year Business Plan to reflect the conclusions drawn from this feasibility study. We have also updated and developed Financial Models to include the different Technology and Commercial options likely to arise. We have identified realistic costs associated with each and undertaken a sensitivity analysis.

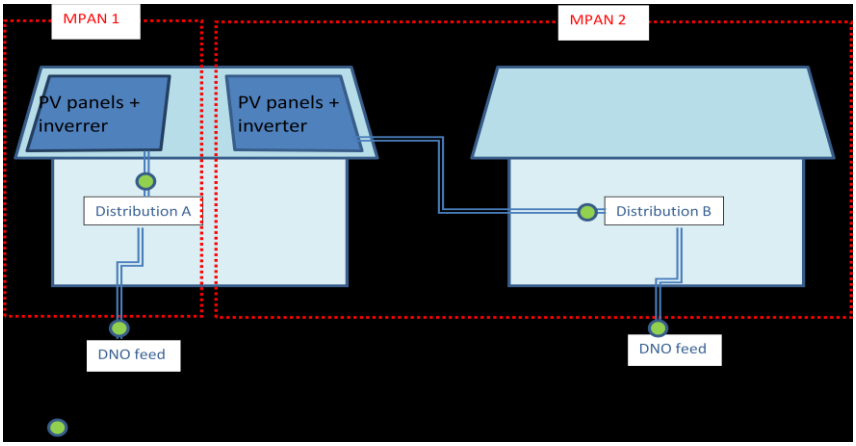
Section 9. Appendix A - Private Wire Arrangements

The following Private Wire technology options were considered and explored. The first covers a fully split PV system with no flexibility in sharing generated energy between sites. The latter two provide a degree of flexibility, but require additional considerations. Indeed the third 'ideal' option from a technology view point, is unacceptable to WPD for operational reasons.

9.1 Split PV System

Each MPAN has its own dedicated PV system, but all are mounted on one roof. The advantages for this arrangement is that there are no regulatory/DNO or technology concerns as this is currently possible with installed examples. There is some impact on contractual arrangements as one Building Owner would take more of the risk in having the installation at their site. It may be challenging to share this risk with other Building Owners.

In addition to the extra costs of the additional inverter and cabling, the arrangement has the same financial risks in our current business plan. The latter can only be overcome if PV system costs fall and/or electricity prices rise sufficiently to compensate for loss of FiT.

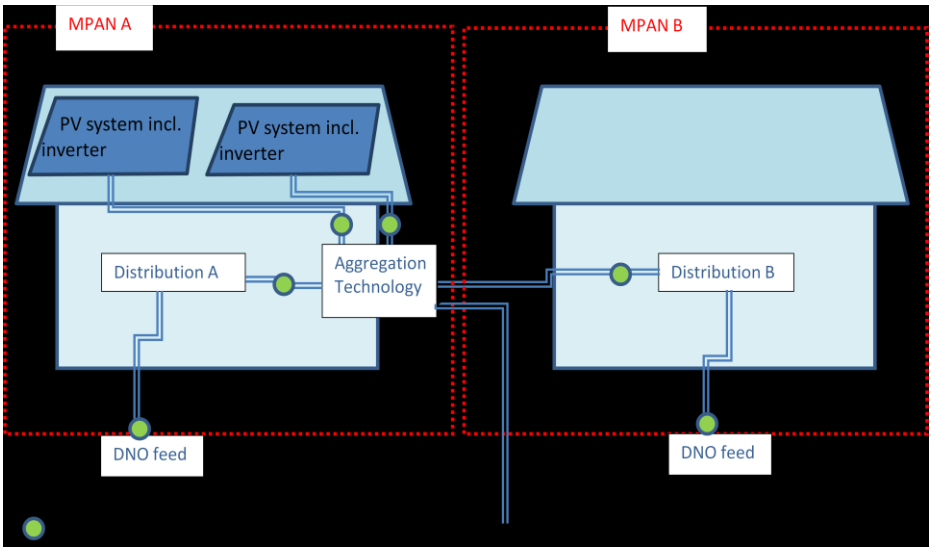


9.2 Partially Shared PV System

A variant of the 'Split' PV system which comes close to achieving the benefits of the 'ideal' solution is shown in the diagram below. The "aggregation technology" would be able to 'switch' a number of PV sources to feed a number of grid connected sites. Such a system monitors demand at each site in real time and connects the appropriate PV source(s) to the appropriate site based on demand. The product relies on having 'segmented' PV systems (i.e. multiple inverters at different peak capacities matched to normal demand) which can then be aggregated/disconnected, but not shared by more than one site (i.e. any inverter can only feed one site at a time). This solution overcomes many of the operational safety requirements associated with the 'ideal' solution for shared 'paralleled' PV systems.

Although a degree of flexibility is introduced, the cost of such a solution is in direct relation to the number of PV sources and sites being supplied by the "aggregation technology". At this point it is unclear at what point such a solution may be come cost effective, but initial estimates are that a 1MWpk is likely to be the minimum overall system size.

One option to minimise the additional cost is to configure/wire the PV system at installation so that it can be easily extended later if it becomes necessary. The financial modelling and contractual arrangements will need to be explored to establish under what circumstances this becomes feasible.



9.3 Fully Shared 'Paralleled' PV System

The diagram below shows the main elements needed to achieve the desired objectives for the option where multiple grid connections are retained, i.e. paralleled grid connections. This configuration was initially accepted in principle by WPD, provided certain safety criteria are adhered to. Considerations for this 'ideal' solution include:

- Sizing of the PV system, grid supply and site Private Wire consumption will need to be calculated/set to prevent 'cut-off' relays operating under non-fault conditions. Continuous/regular monitoring of this 'balance' may also be required, e.g. a mechanism to ensure grid side changes are notified.
- MPAN A & B will need to be fed from the same LV substations (transformers) and will most likely have to be fed from the same 'string' or LV supply cable(s). This is necessary to prevent the 'cut-off' relays from operating as a result of electricity flows between the two grid connections due to potential difference within the grid supply side.
- Excess electricity from the PV system (i.e. electrical power not used by any of the Private Wire consumers) may only be exported to the grid via one grid connection (DNO feed A). This, however, would only be necessary if appropriate safety procedures to isolate or switch off the PV system were not robust enough.
- Appropriate metering will be required to ensure correct consumption is measured/billed.
- Reverse Flow of electricity must be automatically detected and prevented (by use of appropriate relays) at the 'cut-off' points shown. This is primarily a safety requirement when paralleling DNO supply points (grid connections).
- Specifically a fail-safe setup must be achieved to prevent parallel import of electricity under fault conditions at either site which would compromise the operation of the DNO's cut-out fuses. We would also need to consider the conditions and consequences of the 'cut-off' relay operating and how this is reset while remaining tamper-proof. The possible need for battery storage to 'balance' electricity flows may be necessary especially where consumption patterns change over time.
- The earthing, potential difference, frequency variations and emergency supply cut-off issues associated with generation at one site and supplying another, while generally considered, will require further detailed analysis. It is also important to be mindful of 'fail-safe' arrangements for all the elements under 'emergency' situations, e.g. electrical faults, fire, maintenance of site/grid.