The potential for more solar PV capacity in and around Newtown, Powys.

Jeremy Thorp, Open Energy, August 2021

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1. Introduction

Solar PV (Photovoltaic) panels are panels that generate electricity from the sun's radiation. Although the mechanism was discovered in 1839 by a French scientist Edmond Becquerel, it was not until 1954 that the first practical solar cell was developed, and not until the 1980s that solar panels started to be mass-produced. Since then, the price has plummeted such that currently, for large areas of the planet, solar PV is the cheapest way now to build new electricity generating capacity.

Climate change is now recognised as the most important crisis this century, and unless globally we can reduce carbon emissions, the planet will become increasingly inhospitable for future generations, with the effects already being felt in extreme weather events around the planet.

As part of a local response to this, it is essential for all communities to explore all possible ways to reduce emissions of CO_2 and other greenhouse gases. Building more solar PV to replace fossil fueled generation is one way of reducing carbon. This report explored whether there are any ways that more solar PV could be built within Newtown at a community scale.

2. Executive summary

Since the discontinuation of the Feed in Tariff scheme (FIT), installation of solar PV has become viable in only a limited number of situations. The good news for climate change is that one of these limited situations is in very large ground mounted solar farms, and schemes of this type are going ahead across the UK. The bad news is that this is clearly not an urban solution and is only viable at very large scale (>100 acres) so is not appropriate for a town such as Newtown.

The green spaces were considered for installation of solar PV but ruled out, partly because a scheme on this scale would not be viable, and partly because the green space in Newtown is valuable as a recreation facility, and solar PV is best built on low grade agricultural land that has little value for other purposes.

Small scale rooftop installations are only commercially viable if the installation would feed directly into a building that would use most of the power generated. This report demonstrates that in this circumstance the installation would achieve an acceptable rate of return and we would encourage homeowners and business owners in this situation to consider installing solar panels.

However, It has not been possible to find a location in Newtown where such a building could be developed viably as a community scheme.

Our conclusion is that private rooftop installations of PV in Newtown should be encouraged, but it is not appropriate for a community scale project.

3. History of Feed in Tariff (FIT) in the UK

Solar PV technology was supported in the UK by public subsidy between 2010 and March 2019 through the Feed in Tariff (FIT). Under this scheme, the owner of a qualifying solar PV installation would get paid a set tariff for each kWh generated for a 20 year period following the installation. The tariffs varied depending on the date and size of installation.

The tariffs started very high for early installations (about 40p/kWh for a 4kW rooftop installation) and fell as the installation cost fell. Just before it eventually stopped, the tariff had fallen to a low of about 4p/kWh for the same size of installation. Tariffs for larger installations had lower tariffs.

In March 2019 the scheme was discontinued for new installations, but existing installations would continue to receive the tariff for 20 years from the installation date.

When the tariff ended, there was significant concern that solar PV installations would grind to a halt, because PV could not support itself financially without subsidy. However, although volumes have fallen significantly, some solar PV installations can still be made to be viable but only if certain criteria are met.

4. The current financial viability of solar PV

There are currently no state subsidies for the installation of solar PV panels. Solar installations are however still progressing in two sectors.

4.1. Large ground mounted arrays.

Large scale ground mounted solar PV is reaching the point where it is now viable unsubsidised in the UK as long as the ideal site is chosen. The main factors in an ideal site are:

a) Size: economies of scale are important to drive down costs, and for installations over about 20MW (about 100 acres) a solar park could be viable.
b) Solar irradiation: Solar output is affected by location, with coastal sites generally being less cloudy than inland sites, and southerly sites better than northerly ones.
c) Cost of the grid connection: The most significant cost, after the cost of the panels themselves, is the cost of connecting the array to the grid, and this depends on where the site is relative to existing grid infrastructure and what demands other consumers and suppliers place on the grid. In many parts of the UK, the grid is so congested that the network operators do not allow more generation to be added without charging for significant upgrade of their existing assets, so the costs to a project are not just about the cost of taking wires to the nearest grid supply point, but potentially about upgrading existing infrastructure.

A large ground mounted installation would generally only be able to export power to the grid and so only receive the grid wholesale price, currently about 5p/kWh, but with the right site, this can be made to be viable.

4.2. Rooftop systems with on-site demand

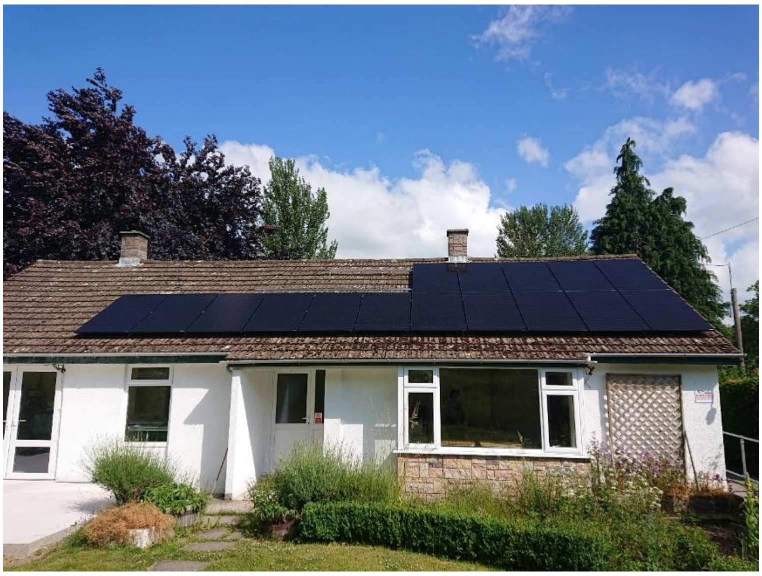
Where PV panels are mounted on a roof, the electricity generated can be consumed by the property if there is on-site demand, otherwise any surplus is spilled to the grid. Any on-site consumption replaces electricity that would be bought at the retail price (currently around 20p/kWh) and any surplus exported to the grid would receive a price of about 5p/kWh from the electricity supply company.

Because of the economies of scale, a roof-top scheme of any size could not be viable if all the energy were sold at 5p/kWh, but if a significant quantity is used on-site (giving it an effective value of 20p/kWh) the viability improves. Given sufficiently high on-site use a rooftop scheme can be viable.

(note, most domestic homes would have relatively low on-site use because this has to coincide with the times when the panels are generating. PV panels produce most output during the middle of the day but many domestic homes are unoccupied during the day, and most houses have highest consumption after dark in the evenings.

4.3. Case study 1

The viability of domestic scale PV can be demonstrated via a Newtown case study.



Pen Dinas is a community site in Newtown owned by NPTC (Neath and Port Talbot) College and leased to Circular Economy Mid Wales as an incubator site for small social enterprises. On the site is a standard domestic bungalow now used as a commercial kitchen and office. This building is used by Cultivate, a social enterprise championing local food in Newtown.

There is significant on-site electricity usage from the kitchen and from a CEA (Controlled Environment Agriculture) unit.

Grant funds were sourced by Cultivate for solar panels in conjunction with the installation of the CEA system. This grant was obtained through Social Farms and Gardens as a pilot to demonstrated the benefit of controlled environment food growing (hydroponics and aquaponics). This type of growing is energy intensive because the light is provided by artificial light.

The grant application and installation of the panels was managed by Cultivate with some support from Open Energy. Three quotes were obtained, with the most competitive quote offering the following prices (April 2021)

8.58kW solar PV	= £6,955 + VAT	= £7,302*
8.58kW solar PV + 8.2 kWh battery	= £9,851 + VAT	= £10,343
4.68kW solar PV	= £5,205 + VAT	= £5,465
4.68kW solar PV + 8.2 kWh battery	= £8,233 + VAT	= £8,644

*Note that VAT for domestic installations is currently 5% and for commercial installations is 20%

Interpolating from these prices, for this scale of installation, the PV installation price is approximately £850 per kW installed and the battery is approximately £370 per kWh installed.

It is interesting to note also that when the FIT started in 2010, and 4kW domestic PV system would have cost around £20,000, a cost per kW of about £5,000, so prices are now less than 20% what they were 10 years ago.

4.3.1. Financial payback

To establish the financial payback, we need to make a few assumptions as follows:

Onsite usage	How much of the electricity will be used on-site and how much exported. If the installation is small and the building is occupied and used during the day, this could be quite high. If the building is unoccupied during the day (e.g. everyone out at work) the on-site use could be very small.

Export price	What price is obtained for electricity spilled to the grid. The government has introduced the SEG (Smart Export Guarantee) under which electricity suppliers have to pay for electricity exported to the grid but there is no set price. The best SEG price currently on offer is 6p/kWh.
Value of on-site use.	If you use the PV electricity on-site, you avoid paying for grid electricity at your retail price. The daytime retail price of domestic electricity is currently around 20p/kWh
Solar yield	The output of solar panels depends on how much sunlight they receive. For South facing panels in Mid Wales, the output would be around 860 kWh generated per year per kWp* of installed panels. Any shading, or if the panels are not south facing, would reduce this output. (*kWp (kilowatt peak) refers to the maximum the panels would generate under ideal conditions in full sun directly perpendicular to the panels. In reality the output will rarely achieve this)
Panel degradation	Solar panels gradually degrade over time. The industry expectation is that they will fall in output by about 0.4% per year.
Maintenance	There may be some maintenance cost or safety checks in the future, or cost to repair e.g replace the invertor. We have assumed on average that for an 8kW array, there would be an average maintenance cost of £100 per year.

If we put these assumptions into a financial model, we get the following results for an 8.58 kW PV system.

8.5kW rooftop PV installation			
Onsite usage	Avoided costs on imported electricity	Income from SEG	Overall return
10%	£ 151	£ 339	0.6%
30%	£ 452	£ 264	5.5%
50%	£ 754	£ 188	9.4%
80%	£ 1,206	£ 75	14.5%
System cost: £8,346			

We can do the same for a 4.7kW system (most of the domestic PV systems installed with the Feed in Tariff were just under 4kW). The results are as follows:

4.7kWp rooftop PV installation			
Onsite usage	Avoided costs on imported electricity	Income from SEG	Overall return
10%	£ 82	£ 185	-2.2%
30%	£ 247	£ 144	2.1%
50%	£ 411	£ 103	5.5%
80%	£ 658	£ 41	9.8%
System cost: £6,246			

We can see from this that at these prices, a rooftop solar PV system is an attractive financial investment if the on-site usage is high, but not a sound investment if the on-site usage is low.

For a smaller system, the return is reasonable as long as the on-site use is around 50% or higher, for a larger system, the on-site usage can be lower (around 30%)

Data on domestic on-site consumption is scarce, but what little there is appears to suggest that the figure is typically between 25 and 45% Source: Solar photovoltaic self-consumption in the UK residential sector: new estimates from a smart grid demonstration project. If this is the case, a PV installation with a price similar to that show here would be an acceptable investment for a household even without subsidy.

4.3.2. Cost effectiveness of a battery system

Installers are keen to sell batteries at the same time as PV panels and quotes have been obtained for battery systems. One quote for this is referred to above. When bought with a PV system, the additional cost of the battery is about £3,500 for an 8.2kWh battery system.

This is sufficient to store 8.2 units of electricity. That is roughly the same amount of energy as in 1 litre of petrol.

In practice, batteries are not fully discharged under normal circumstances, as this is damaging to the battery, so the battery is programmed to stay within a limited "depth of discharge" or DOD, which is typically between 80 – 90%. This means that a battery with a headline capacity of 8.2 kWh may only be able to deliver an actual load of 6.6 kWh. We will use the figure of 7kWh in our case example below.

The typical electricity consumption for a domestic home is about 3,500 kWh per year, or about 9.5 kWh per day, so the battery could store just under the amount of power the home would use in a day. Of course this varies a great deal from house to house.

In theory, if this amount of electricity were to be generated from solar panels during the daytime, for use in the evening, it could save the household £383* per year.

(*We have assumed this electricity is valued at 15p which is the difference between value they would have got exporting this to the grid (5p) and what they would pay for peak rate electricity (20p). The calculation is therefore 15p x 7 kWh/day x 365 days = £383).

In practice there would not be enough PV energy to fully charge the battery for much of the winter months so the saving will be less.

More detailed calculations on the financial savings that could be achieved from a battery system taking into account seasonal adjustments are described in Appendix A. In this, we see that in the best case, the payback is 10 years, and in the worst case the payback is 31 years.

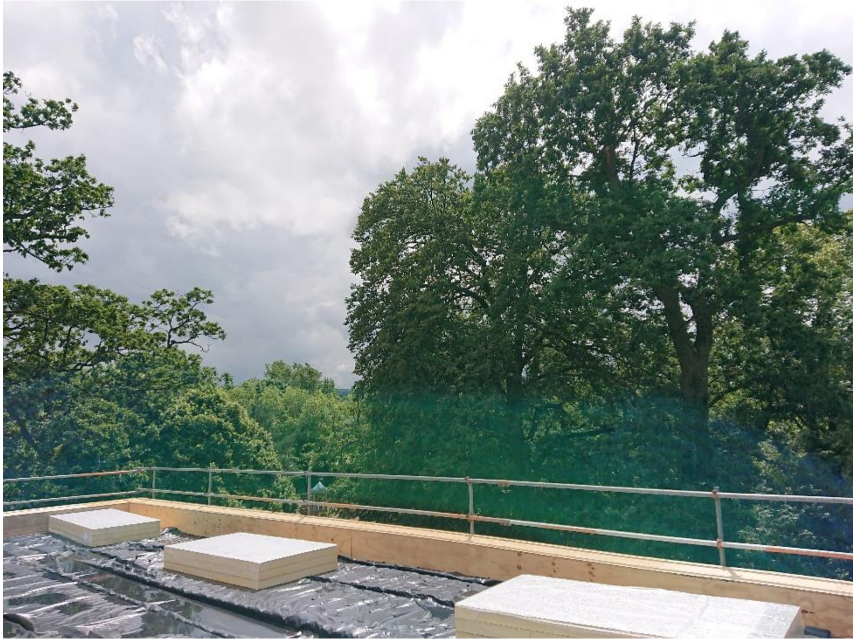
Given that the battery may well only last 10 years, our conclusion is that even in the most optimistic scenario, batteries do not make financial sense at present, but are close to the tipping point, so given that prices are continuing to fall, very soon it will become financially attractive to add a battery installation to your PV installation.

4.4. Case study 2:

A second case study has been investigated for Open Energy to identify the benefit of a solar PC scheme at a different scale. This is for solar panels on the new Riverside Venue building in Newtown.

This building has a flat roof that is large enough to accommodate about 30 kWp of solar panels. The use of the building as a community space incorporating a small café means that there will be significant on-site energy consumption and therefore the value of the energy generated will be high.

The one detrimental aspect is that there is some shading on the site, as there are several trees to the south of the building. It is hard to estimate the exact degree to which this will affect the output. The fact that the building is fairly tall (2 stories) means that this is somewhat less than would have occurred if the panels were mounted on the ground.



View facing south from the top of the new Riverside Venue building

A quote has been obtained for a 30kW array on the building, and the value of this is £20,560 + VAT, which works out at £692 per kW (excluding VAT).

Similar payback calculations to the ones done above can be carried out with this system, however, this time we have included an allowance for loss of yield from shading. The results are as follows:

29.7 kWp rooftop PV installation (install cost £20,560 ex VAT)				
Shading	Onsite usage	Avoided costs on imported electricity	Income from SEG	Overall return
20%	10%	£ 417	£ 1,033	1.8%
40%	10%	£ 313	£ 775	-2.0%
20%	50%	£ 2,087	£ 574	10.8%
40%	50%	£ 1,565	£ 430	6.3%
20%	70%	£ 2,921	£ 344	14.5%
40%	70%	£ 2,191	£ 258	9.5%

The lower cost per kW installed because of the greater scale helps to improve the payback on this system in the unshaded scenario. For this building we can also assume that the on-site use is quite high.

A very plausible scenario is that the shading could be around 20%, and on-site usage would be around 50% in which case the overall return would be around 10%, a very satisfactory return.

4.4.1. Funding mechanisms.

This scheme on the Riverside Venue has been investigated as a possible community installation with the investment coming from a community share offer.

The fundamental barrier with this approach is the small scale which means that the overhead costs of running the community scheme admin and finances would be too high for such a scheme to bear. Any community scheme would involve some level of administration and bookkeeping to ensure that the shares are properly accounted for. This would certainly cost at least £2000 p.a. for an administrator to do, which is a comparable sum to the total savings that this scheme would achieve and therefore would be unviable. This is in line with guidance seen elsewhere which suggests that for a community project to be viable, it needs to be at a scale of at least £200,000, i.e. 10 times the size of this scheme, for the overheads of administering the scheme to be manageable in comparison to the other elements of this project.

We have presented these financial results to Open Newtown (who are managing this building) and recommended that the scheme is viable but that it is best funded as a direct internal investment as this would involve lower overhead costs.

5. Other sites investigated

Various sites around Newtown were investigated as possible Solar PV installations for a community scheme. As commented above, to be viable as a community scheme the installation would have to be significantly larger than domestic scale to be able to absorb the overhead costs that would be associated with a community scheme. These overhead costs would include the legal costs associated with obtaining permissions with the building owners, administration costs and cost of finance. The following sites were investigated.

5.1. Rooftop solar

5.1.1. Primary schools

Across the UK, primary schools have been the host for a large number of community energy schemes. Schools in general are a good match for solar PV because they tend to have suitable buildings and use significant quantities of electricity during daytime hours.

Newtown has several primary schools (Treowen, Ladywell Green, Hafren, St Mary's, Maesyrhandir) which all are local authority controlled.

The local authority was contacted and a conversation was held with the Sarah Astley, Schools Transformation and Welsh-medium Education Programme Manager regarding making use of the school roofs for solar PV installations. Sarah advised that all the primary schools in Newtown are currently under review as part of the 21st Century Schools plan, and hence there is no certainty that any particular building would remain as a school building in the future. This would mean that any solar installation would potentially need to be dismantled before it had achieved a payback on the investment, rendering these sites unsuitable for a PV installation.

The new school, Dafydd Llwyd, built on the High School grounds in 2015 does have a 10kW PV array on the roof.

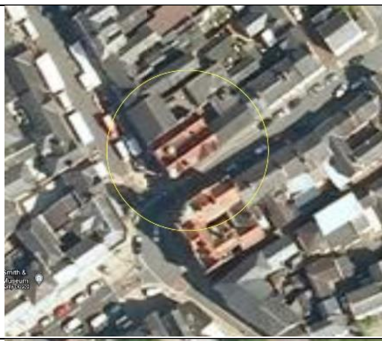
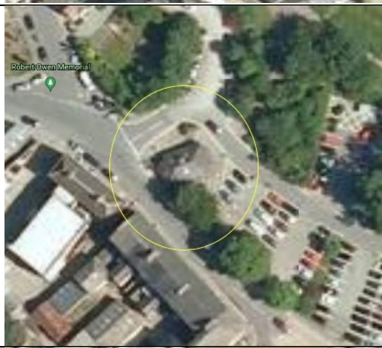
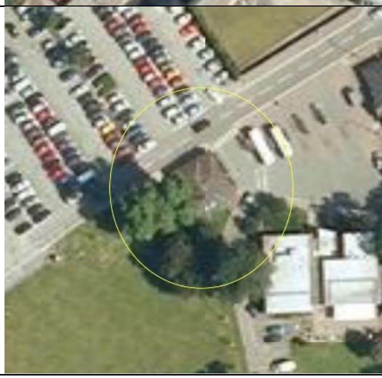
Because of the 21st century schools programme, primary schools are unfortunately not available for community PV installations.

5.1.2. Secondary schools

Newtown High School is also a suitable candidate for solar PV installation. Gareth Richards, the PCC Energy Management Officer was approached about this being a site for a community solar PV installation. The response was that the council were currently investigating a range of energy measures on the high school, including solar PV panels, and if viable would seek to fund this themselves. Hence this site is not available as a community energy site.

5.1.3. Town Council buildings

The town council have expressed support for community energy and were willing for their portfolio of buildings to be considered. These buildings were assessed but non found to be suitable for installation of PV as shown in the table below.

1) The Town Hall, at The Cross.		This has a complex roof containing several dormer windows that would make installation of PV expensive.
2) Public toilet in Shortbridge Street		South facing roof but shaded by a large tree to the south of the building
3) Pubic toilet in Back Lane car park.		Unsuitable for PV because of tall trees to the south of the building

5.1.4. *<u>County council buildings</u>*

The main county council building in town is the administration building in Dolerw Park. This building already has a 10kW solar PV array installed.

5.1.5. *<u>Commercial buildings</u>*

The option of putting community funded PV on commercial roofs was explored. A door to door calling campaign was carried out on the Mochdre Industrial Estate to see if any businesses were interested in exploring the option of installing PV on their roofs. In this process, several buildings were already found to have PV installed. Many of the businesses approached explained that the building was rented and therefore they did not have the authority to have these conversations.

In general, although installing community energy schemes on commercial buildings has been done in a few places in the UK, it is harder to achieve than doing the same on public buildings. This is for various reasons including:

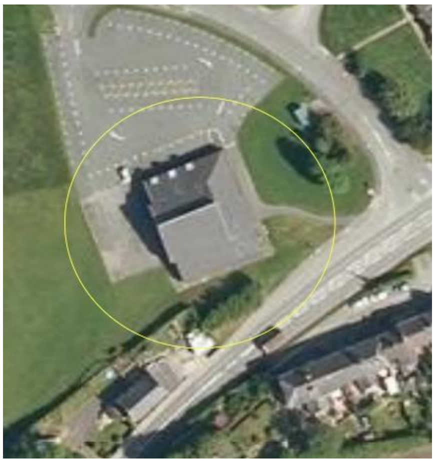
1) Businesses tend to say in the same building for a shorter duration than say a school, because businesses are often growing and therefore need to move to more suitable premises. This means that any arrangement to sell the electricity to the occupant would become void when the occupant changes and it is hard to find a mechanism to guarantee income if this happens.
2) Commercial buildings are often leased, which means that both the occupant and the landlord need to be party to a contract.

3) Commercial companies will make their own investment if they see that the return is viable.

No sites were identified that could be progressed as a community scheme.

5.1.6. Evangelical church

The evangelical church on the Llanidloes road has a large south facing roof highly suitable for PV. The church welcomed discussion on the potential for putting solar PV on the roof of the church.



There is an area of about 250 square metres, which could accommodate about 40 kW of solar panels.

On detailed discussion, it emerged that the church has a practice of discouraging the charging of interest as a point of principle, and this would be necessary if money was to be raised for the PV installation either by the issue of community shares or from a loan.

The church ultimately decided that for this reason, they did not wish to proceed with further investigations for installation of a community solar PV installation.

5.2. Ground mounted solar

5.2.1. Ground mounted on the green spaces

One of the initial reasons for this project to be set up was that the town was to gain control of a significant area of land within the town, and that this could have potential for generation of green energy.

The principal areas of land that are under the control of Open Newtown are Dolerw Park, the playing fields on the floodplain, and Trehafren Hill.

All of these spaces have significant recreational use, and using any significant area for PV panels would be highly detrimental to the value as recreation space. PV panels can be located and are equally beneficial wherever they are, as long as there is a grid connection, so it makes more sense to use the lowest value or quality of land for this purpose, i.e. away from significant areas of population.

The conclusion is that recreation space in town is highly unsuited for significant capacity of solar PV panels.

5.2.2. Land at Black hall

There is an area of land, referred to as "Black Hall" which was potentially on the list of land that might come under the control of Open Newtown through the asset transfer. This is close to the bypass and on the edge of the Mochdre Industrial Estate. This is potentially a useful PV solar site, being south facing, and the south side having little recreation value.

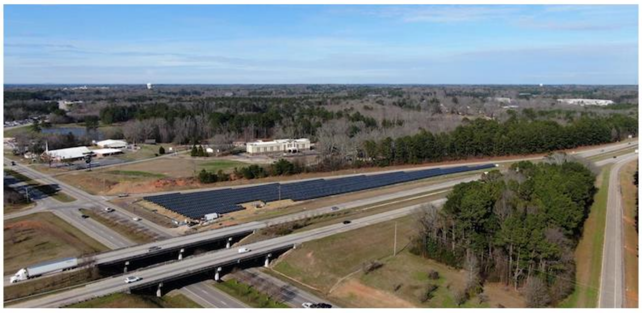
However, currently this area of land has not been transferred to the town council because of the possibility that it could be useful in the light of the bypass works. Currently therefore this area is not accessible for community PV but remains a site that could suit this purpose well if it did come into community control.

5.2.3. Bypass verges

A bypass has recently been completed for Newtown, resulting in large areas of land designated as verge for this road. Potentially this land could be suitable for solar PV.

Investigations were carried out to see if this is practical. The main concerns would be those of distraction for drivers, including from glint or glare, and any safety issues in the case of collisions.

This idea is gaining acceptance elsewhere in the world. In the USA, the new Biden administration has approved plans to use roadside land to host renewable energy installations.



New USDOT drive for more roadside solar panels

BY TOM STONE ON APRIL 28, 2021 ENVIRONMENT & EMISSIONS

The US Department of Transportation (USDOT) has announced its plan to modernize the US electric grid and utilize highway right-of-way (ROW) land to host transmission lines, build renewable energy projects, deploy broadband, and support electric vehicle charging.

The newly published guidance document "supports the consistent utilization of the ROW for renewable energy generation, electrical transmission and distribution projects, broadband projects, vegetation management, inductive charging in travel lanes, alternative fueling facilities, and other appropriate uses."

It also encourages FHWA Division Offices to share the document with State DOTs for their consideration for these alternate uses of highway ROW.

The announcement from the Biden Adminstration, which was also backed by the Department of Energy, was hailed as a great step forward in the fight against climate change by Georgia's sustainable mobility testbed The Ray.

https://www.traffictechnologytoday.com/news/emissions-low-emission-zones/new-usdot-drive-for-more-roadside-solar-panels.html

In addition, in Europe, similar plans are being investigated in the Netherlands

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Motorway central reservations could be turned into solar farms

Business Society June 15, 2021

Motorway verges and central reservations are a significant potential source for solar energy, government roads department Rijkswaterstaat has told broadcaster NOS.

The agency, which owns the spaces close to the roads, has calculated that solar panels could generate 1.2 to 4 terrawatt hours of electricity – enough for hundreds of thousands of households.

The department is currently carrying out ten pilot projects to investigate if the land around the motorways is suitable for solar panels, for instance by measuring glare and noise.

https://www.dutchnews.nl/news/2021/06/motorway-central-reservations-could-be-turned-into-solar-farms/

However, the Welsh Government Department for Economy and Infrastructure were contacted to discuss this, and the response received from Richard Morgan, Head of Planning, Asset Management & Standards who dismissed the idea on several grounds including safety, visual impact and habitat. No further progress could be made.

5.3. Other

Various other ideas for installing PV within the town were investigated as follows:

5.3.1. Canopy over the town car park

Canopies over car parks have been installed in various locations in the UK and worldwide. The concept is attractive, since the PV can coexist without causing any detriment to the function of the car park, indeed there are advantages in terms of protecting cars from sun and rain, potentially creating the opportunity for installation and supply to car charging, and actually improving the visual amenity of the car park.

Cost is an issue in that installing over a car park is more expensive than installing in an agricultural field, so to be viable there would have to be a local consumer that the power could be sold to at higher value than the wholesale price of electricity. This is potentially the case for the Back Lane car park in Newtown, where there are several potential consumers close by.

PCC were approached about the idea but this was rejected on various grounds as evidenced by this excerpt from the response

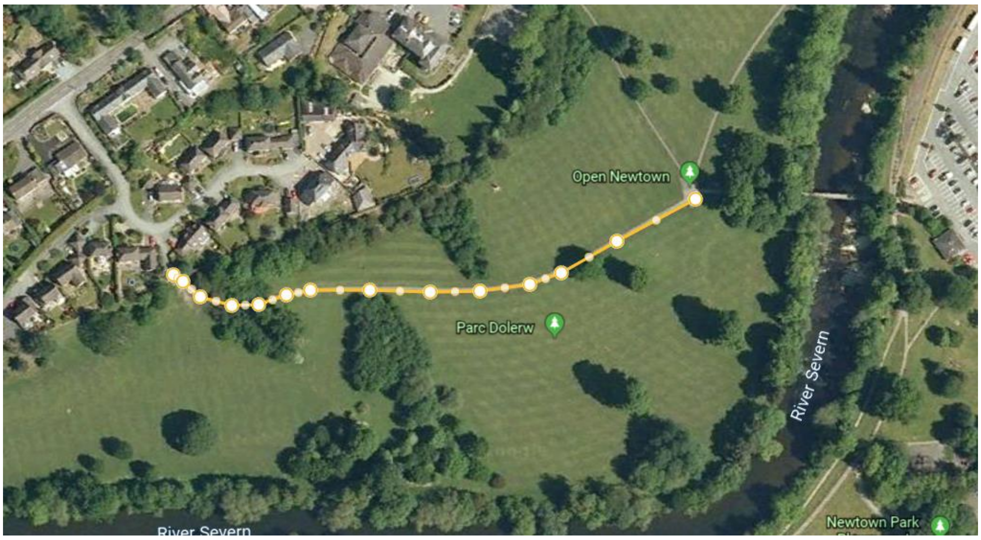
> *"Whilst you consider no detriment I would beg to differ as there would be losses of spaces during construction, potential reduction of space due to the canopy structure, potential for loss of space if/when it is damaged or needs repairs, impact upon the fair, rally or other event that uses the car park from time to time and so on."*

No change to this response could be obtained from the council.

5.3.2. Canopy over bike paths

Given that the green spaces themselves cannot be used for installing PV because of the detriment to the recreational value of the land, another option was investigated that would potentially enhance the recreational potential of the land. This is to install PV panels over a covered path across the green spaces, serving three purposes, to generate energy, the protect walkers and cyclists from the weather, and to enable these paths to be lit at night and hence make them more attractive to use after dark.

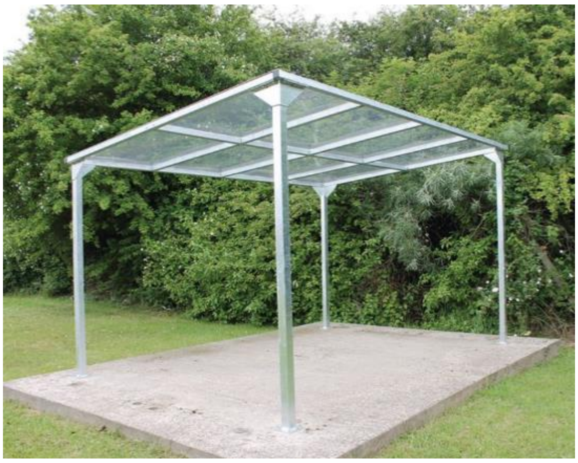
There are many footpaths and cycle paths over Dolerw Park and the playing fields. The one chosen for more detailed study is the path across Dolerw Park from Dolerw Bridge to the housing along Milford Road.



Suggested route for a covered cycle path with PV panels

The choice is dictated by a number of factors, the main one being shade, as some of the paths are shaded by trees. The route between Cambrian Bridge (by MacDonalds) and Llanllwchaiarn would be ideal as there are already requests for this to be better lit at night, but this is not on Open Newtown controlled land so would be difficult to get permissions.

The design of such a canopy was investigated. There are various cycle canopies on the market designed for storage of bikes, and the canopy for a path would just be an extended version of this. The need for groups to be able to walk or cycle along would dictate that a twin-legged style (as the example on the left) would be preferable to a single-legged style (as per on the right). If the concept could be done, it could easily be fabricated and manufactured locally as there are metal fabrication companies available locally.



5.3.3. <u>Grid connection</u>

Scottish Power were approached to see what the cost of connecting such a scheme to the grid would be. A budget estimate was received that to connect 150 kW would cost around £60,000 and a suitable connection point was available at the Dolerw Park Drive end of the path.

5.3.4. <u>Planning permission</u>

Planning advice was sought from the PCC planning department (pre-application advice) to see if such a development would get approval.

The main issue highlighted was the fact that it would visually break up the panorama of the open space in the middle of the town. This would have to be weighed up against other benefits, but the likelihood was that it would be rejected.

Another issue would be whether it would be detrimental to the function of the floodplain to absorb flood water, although this was seen as a lesser potential problem.

The final issue would be possible light pollution if the scheme incorporated night lighting. This again was probably manageable if the lights had appropriate controls e.g. fitted with motion sensors so that they are not on all the time.

Overall the main issue was likely to be the visual impact. The route selected across the main section of the park would have the most impact in this respect and other routes might be more acceptable.

5.3.5. <u>Approximate costings and payback</u>

Approximate costs for the major components of the project were estimated as follows:

PV panels

The length of the path is approx. 250m. If the canopy was 4m wide, this would provide an area of about 1000 square meters, which would be sufficient for about 125 kW of installed PV capacity. Based on a price of £560 per installed kWh, the cost for this quantity of PV would be about £66,000

Canopy supply and erection

Based on the cost of off the shelf bike shelter/canopies, the cost of supply for a 250m pathway would be in the order of £150,000, and a further £20,000 was allowed for the cost of installation.

There would be other small costs to cover such as project management, legal costs, planning permission etc. The total capital cost would be likely to be in the region of £300,000

The yield of electricity from such as scheme would be approximately 120,000 kWh per year (based on the PV calculator tool at https://ec.europa.eu/jrc/en/pvgis. The income from this would be about £6,000 based on a grid wholesale price of 5.5p/kWh. (simple payback of 50 years)

Based on the above, a simple financial model can be prepared. However, when this is done, the scheme is very far from being viable. This is down to several factors:

1) Sale of electricity. There is no single big user that could be connected to use the electricity direct, so the power would be exported to the grid at the grid wholesale price of approximately 5p/kWh.
2) Cost of infrastructure: The cost of the canopy is considerably more than the cost of normal PV mounts, and this extra infrastructure cost would not be covered by the income from the electricity.

The clear message from the financial model is that a scheme such as this is not self-funding, and a large proportion of the installation cost would have to come from a grant. The scale of this would be in the order of £150,000 - £200,000 which would be the cost of the installation over and above the cost of installing that capacity of PV in the cheapest way.

5.3.6. Public consultation

Due to the restrictions of Covid, widespread consultation was not possible, but views from a number of individuals was obtained. This was balanced with a some positive and some negative responses. The negative responses did as expected focus on the visual impact, but there was significant positive response too, mainly based around the fact that it would make that particular path more usable in the dark in Winter. It is apparent that people are not willing to walk or cycle along dark paths in winter through the park, and providing lighting along some of these paths would encourage more winter cycling and walking. This is an issue that could be taken up in other forums.

5.3.7. Canopy over the MUGA (Multi Use Games Area)

A canopy over some of the hard surfaced games areas in town would be a possible location for PV. There is a MUGA at the entrance to the Vaynor estate in town that would be a suitable location.

This MUGA is approximately 30m x 30m, and a pitched roof could potentially hold about 80kW of panels on one aspect, or 160kW if both aspects were covered. If the pitch is low, even North facing panels could be viable given the falling cost of panels and if they are sharing a connection with south facing panels.

The approximate cost of the PV installation would be about £80,000. A quote was obtained for a basic open sided building suitable for mounting the arrays, and this construction cost is around £80,000, so the total cost of the project would be in the region of £160,000.

The advantage of this location is that it is close to a potential electricity consumer, which would mean that the value of the electricity generated would be higher than the grid wholesale price. There would also be potential for installation of electric car charging points which could enhance the viability. The project would however be dependent on this on-site consumption.

The scheme is still unlikely to be entirely self-funding, but the financial models suggested that a contribution of the order of £30,000 could make the project viable, and would provide the benefit of a covered, lit all-weather recreation area for young people from the adjacent housing estate to use.

However, repeated attempts (with the assistance of the town council) to contact the developers of the sheltered housing complex being built adjacent did not result in any response or interest from this potential energy client, and hence no progress could be made.

5.3.8. Canopy over the skate park

A canopy over the skate park was also considered as a possibility. The size would be similar to the MUGA identified above, but the skate park did not have an electricity consumer adjacent that could have taken much of the generated electricity. The only buildings close by are a children's nursery that would not use much electricity, and the temporary buildings of the air and army cadets which again have only very light use. The police station is close but the connection would have to cross a road which would make it too expensive.

5.3.9. Canopy over football spectator stand

One final location for PV was considered. There are some playing fields on the flood plain of the river that are increasingly used for youth matches. At present these do not have any spectator facilities and there is a desire to upgrade the facilities here. It is possible that a new spectator stand could be constructed that could double as a platform for PV.

Several conversations were held with the football club and there was considerable interest. However, this was at the point when Covid lockdown occurred causing a complete cancellation of the football schedules, with no knowledge of when playing could resume or whether these clubs would still be in existence then. The conversation was put on ice until the future of the club was more certain.

The downside of this scheme is that again there is no consumer of electricity close enough to take a direct wire, so the electricity could only be sold to the grid at the wholesale price. The scheme would therefore not be self-funding and the majority of the cost for the building would need to come from other sources. This makes such a project highly depending on further grant funding.

6. Conclusion regarding installation of PV at scale in Newtown

The conclusion from the above is that it is very hard to find locations for community scale PV installations in Newtown. There is potential for more PV to be installed, either as individual domestic installations or as individual commercial installations and the two case study examples given at the top indicate that even without subsidy these can be attractive if there is on-site use. However, it appears to be very hard to find a location for a community scale PV installation for which permissions could be obtained and which was financially viable without grant support.

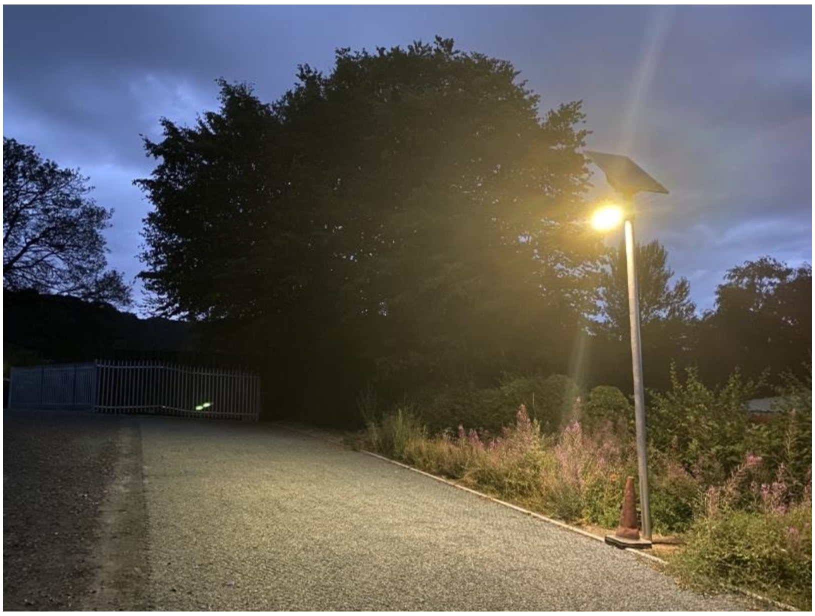
7. PV trials in Newtown

Two PV pilot schemes were implemented in Newtown funded by this project. These were the Solar/PV street lamps on the Pump Track, and a self-contained PV/battery system on the new bike hub.

Pilot 1: Solar PV street lamps.

Newtown has a new pump track installed by Open Newtown at the base of Trehafren Hill for recreation use. For info on what a pump track is, see wikipedia.org/wiki/Pump_track

However, this facility becomes unusable on dark winter evenings because of the lack of light. The cost of the electricity connection that would enable conventional street lighting to be installed would be prohibitive. A solution now becoming feasible is to install solar PV/battery lights that charge during the daytime and provide lighting during the night, avoiding the need for an electricity connection.



PV/solar lamps illuminating the pump track in Newtown.

The effectiveness of this solution was investigated. There are relatively few supplies for these lights, but a supplier, Dragons Breath Solar, was identified in Pembrokeshire. References were sought and glowing recommendations were received from St David's council who have installed these lights on the skate park in their own town.

Various different specifications and wattages are available, but given that these lights are likely to be less powerfull than mains ones, the brightest were chosen to give the best change for their success. The cost of these, including the post, is about £1,700. This does not include installation. A quote for installation was obtained from a local landscape contractor with a cost of £285 per lamp.

Two lamps were ordered, at a total cost of approximately £4,000. These were installed at the pump track in July 2021.

The effectiveness will be evaluated over the next few months (obviously they will not really be necessary until the evenings draw in) but it is hoped that by piloting them here, they can be assessed for other similar locations around the town.

Planning issues

The lights are being installed in a location where other work was going on at the same time and the lights could be included within the planning application for the whole area. The only planning issue for an installation such as this would be whether the light pollution would be seen as detrimental, either to humans or to wildlife. Given that in this location they are close to the floodlights of the football club, there was clearly no way that there could be an objection to a 15W LED lamp in this location. However, if these were to be installed somewhere where there was less existing light pollution (e.g. along footpaths through Dolerw Park) it is likely that light pollution would be an issue that the planning application would have to address.

<u>Pilot 2: PV/Battery at the Bike Hub</u>

A new bike hub has been built close to the new riverside venue in Newtown. This building will be used as a base for bike hire, and to provide a safe facility for bike parking and storage for the public, and for charging of electric bikes.

A mains connection was investigated, but would have cost a very high figure because the network does not have a high capacity at that point, and Scottish Power (who provided the connection to the Riverside Venue) would not permit an additional building to be connected in addition to the connection provided to the Riverside Venue. For this reason, alternative means of supplying electricity were investigated.

The option of a self-contained PV/battery system was proposed. The main use for electricity will be lighting and charging of electric bikes, neither of which will require a very heavy supply.

The main limitation would be to ensure there was sufficient power in the winter months when the amount of daylight is least. Some simple calculations were carried out to work out the likely power requirement for lighting during December and January, and working out what PV capacity would supply this (using the PV estimator at PV GIS) . The system as eventually specified included the following:

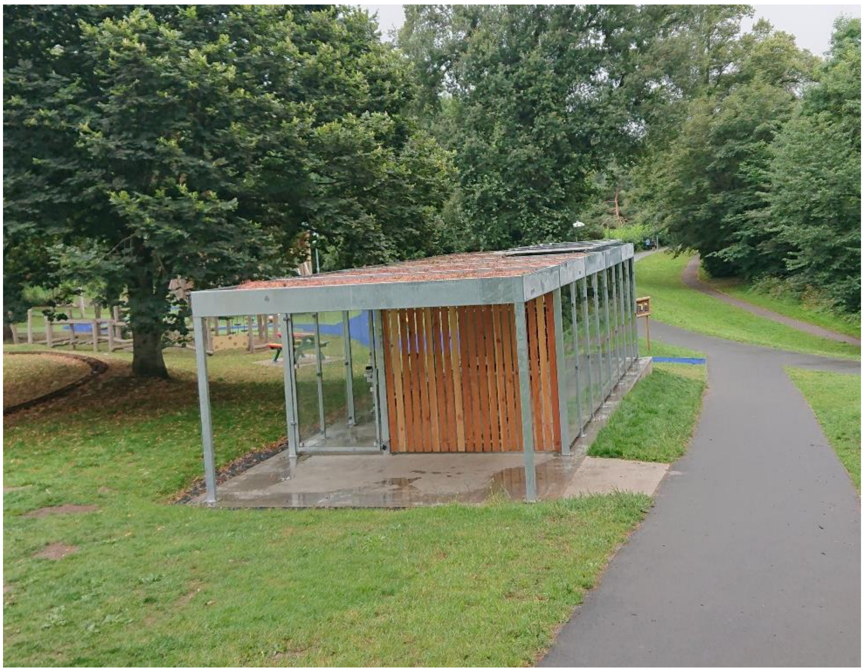
System specification for bike hub PV/battery

- 4 x 305W solar panels
- 1kW inverter
- 12V 140aH lead acid battery (1.6 kWh of storage)

The total cost of installation, including equipment and installation was £5,362.

One problem that arose in the installation is that since the discontinuation of the Feed in Tariff, many of the local solar PV installers have stopped this part of their service. One local installer was identified for the work, but part-way through, and before we got to the installation phase, they informed us that the one staff member that looked after PV installations has retired and they were not intending to continue with PV installation.

An alternative local supplier was found, but Newtown has gone from having several local installers to just one still active in this sector, because of the cuts to PV funding.



PV panels mounted flat on the roof of the bike hub, providing light and charging for electric bikes.

The system was installed in July 2021 and is now functioning and providing the building with light and power. Monitoring its effectiveness will allow us to assess whether this would be an appropriate solution in other situations.

8. Conclusions

The PV sector has changed very significantly over the last couple of years due to the discontinuation of Feed in Tariff. The situation is now as follows:

Large scale ground mounted solar PV ("solar farms") are still being built, and indeed are going up in scale. A few years ago, a 1MW installation was a large installation. Currently the largest installation is the Shotwick solar farm in Flintshire at 72MW, with a 350MW solar farm being developed in Kent which will cover 900 acres. The sector rule of thumb appears to be that a ground mounted installation, if it is just feeding electricity into the grid, has to be at least 20MW to be viable.

Smaller scale schemes, including rooftop schemes, are only viable if they are predominantly supplying on-site demand. This could be a commercial site, or school, or a private home if electricity is used during the day.

Our case studies of the Riverside Venue and Pen Dinas demonstrate that where this is the case, a rooftop installation is viable.

However, there is relatively little scope for community scale PV in Newtown. No suitable sites were found which had sufficient on-site use, a suitable south facing site, and a willing landlord or landowner.

Appendix A: Detailed calculations on the cost effectiveness of a domestic battery system.

If we take a typical 4kW domestic PV array, we can calculate the expected yield per day for each month of the year. The software PV_GIS (https://ec.europa.eu/jrc/en/pvgis) has been used for this, with the following results

Expected daily and monthly yield from a 4kW roof mounted PV array in Newtown, Mid Wales		
	Expected kWh per month	Average kWh per day
Jan	97	3.2
Feb	153	5.1
Mar	303	10.1
Apr	417	13.9
May	438	14.6
Jun	454	15.1
Jul	440	14.7
Aug	390	13.0
Sep	319	10.6
Oct	212	7.1
Nov	136	4.5
Dec	85	2.8

We can then use this to estimate how much would be stored daily in the battery.

If the daily electricity consumption is 9.5 kWh per day, and this consumption is timed to coincide with then the PV panels are generating, then the surplus to store in the battery is the value in the blue column minus 9.5, or zero, whichever is greater.

If the daily electricity consumption is 9.5 kWh per day, and this consumption does not coincide at all with when the PV panels are generating (i.e. all at night), then the surplus to store in the battery is lesser of the value in the blue column or 8.2 (which is the battery capacity).

Making these calculations, and valuing the stored electricity at 15p/unit gives the following value.

	min kWh per day caught by battery	max kWh per day caught by battery	
Jan	-	3.2	
Feb	-	5.1	
Mar	0.5	8.2	
Apr	4.3	8.2	
May	5.0	8.2	
Jun	5.5	8.2	
Jul	5.1	8.2	
Aug	3.4	8.2	
Sep	1.0	8.2	
Oct	-	7.1	
Nov	-	4.5	
Dec	-	2.8	
Savings achieved by the battery	£ 112	£ 361	per year
Payback	31	10	years

We see that in the best case, the payback is 10 years, and in the worst case the payback is 31 years. Given that the battery may well only last 10 years, our conclusion is that even in the most optimistic scenario, batteries do not make financial sense at present, but are just about on the tipping point, so given that prices are continuing to fall, very soon it will become financially attractive to add a battery installation to your PV installation.