

Delivery No.5&6
LEAF-APP-01-1765
www.falenergy.org.uk



**Fal Energy
Partnership**

Action for local energy wealth

Energy Report 2012

1	Summary	3
2	Context for local action	4
3	Falmouth and Penryn Community Network Area	6
4	Present energy situation in the Fal area	8
4.1	Energy and CO ₂ trends	9
4.2	Electricity grid in the area	10
4.3	Domestic sector	11
4.4	Commercial and industrial sectors	14
4.5	Transport	15
5	Domestic energy efficiency situation	16
6	Renewable energy potential for the area	19
6.1	Solar energy resource	19
6.1.1	Cornwall resource	20
6.1.2	Methodology: active systems	20
6.1.3	Local solar potential	26
6.1.4	Financial Modelling for PV systems	29
6.1.5	Impacts of large scale PV arrays	30
6.1.6	Other solar energy technologies: passive systems	33
6.2	Wind energy	35
6.2.1	Technical wind resource	36
6.2.2	Issues for wind	37
6.2.3	Wind site suggested by Town Councils	40
6.2.4	Conclusion	40
6.3	Hydro potential	41
6.4	Biomass	42
7	Vision statement	44
7.1	CO ₂ reduction targets	45
7.2	How to meet the targets	46

1 Summary

At present the Falmouth and Penryn Community Network Area has an energy bill of around £87million a year, which is nearly 20% of the local GDP. Nearly half of all demand is in the domestic sector and 56% of local energy supply is oil- for transport and home heating. Only 60% of homes have mains gas and those without gas use either oil-often old boilers or night store heaters. The E7 heated homes use on average only 60% of the heating energy of gas heated homes, suggesting that these homes are not well heated. 45% of homes were built before 1919 and hence have solid walls, classifying them as hard to treat.

The case studies showed large potential for solid wall insulation and top up of loft insulation. A programme of internal insulating wallpaper would be a useful first step in reducing heat loss through old walls in the area. There is a major potential for renewable sources of energy for heating in this area, which would significantly reduce both carbon emissions and fuel bills in the domestic sector.

The solar resource is large and a major programme of roof top installations could see potentially 90-150MW installed. This would produce up to the present level of electricity demand in the area. Equally a programme for PV arrays, which is focussed on up to 10% of lower grade agricultural land could see over 100% of the present electricity demand generated locally.

The wind resource could see the installation of 21 2 MW turbines to produce 87% of present electricity demands, and the 500kW machine, which can fit into areas closer to houses as it is quieter could do the same or more. Small turbines can also fit into the landscape, but require huge numbers to have any real impact on local clean energy supplies.

The Vision developed with the community as part of this Leaf project, suggests that the area target is to meet or better the present legal target of 80% carbon reduction by 2050, compared to 1990 levels. This requires an urgent and major programme to start very quickly.

For this area the targets could be met by a programme of one 2MW turbine a year and the installation of 5MW of rooftop and PV arrays, alongside a strong energy efficiency programme to cut demand by 1.2% a year and install a range of other renewable supplies, such as ground source heat pumps, unheated conservatories and biomass boilers and stoves.

This would cost around £10m pa, some 11% of the present fuel bill, but decreasing as fossil fuel costs rise. A pension type fund at £385/person/pa for the Area population would see financial security as well as energy security.

We aim to develop a long term investment plan, which all can join, through the Industrial Provident Society which is the Fal Energy Partnership, a social enterprise. We aim to produce all our own energy needs locally and create local resilience and healthier, wealthier communities



Source ; *International Panel on Climate Change*

2 Context for local action

The world is facing several unprecedented challenges in many and varied forms. The largest challenges are those centred around the global issues of:

- Climate change
- Resource depletion
- Financial system problems

These challenges are all interlinked and have very wide and serious implications, ranging from extreme weather events such as floods or drought and heat waves to high winds, and to energy supply disruptions and rapidly increasing prices. This is worsened by the lack of structural change in the international debt situation, since the financial crash of 2008.

Whilst there is some cause for optimism in the legal requirement to reduce our national emissions by 80% by 2050, compared to 1990 levels as required in the Climate Change Act, this does not cover world emissions cuts nor is the present course of UK government action appearing to support this aim.

It is also apparent that central governments around the world find it difficult to be open with their peoples about the threat of resource depletion and peak oil, and to develop policies to prepare for this inevitable occurrence, which is already in train.

There is a significant strand of academic literature on the collapse of societies in the past and five factors have been identified which contribute to collapse: climate change, hostile neighbours, collapse of essential trading partners, environmental degradation, and failure to adapt to environmental issues: all made worse by overpopulation. Several of these factors can be seen in action

in the world today. Without being melodramatic, it is important for society to deal with these issues.

Some of these factors have been in play for some time and as they lead to slow rates of change there is the problem of *Creeping normalcy*. This refers to the way a major change can be accepted as the normal situation if it happens slowly, in unnoticed increments, when it would be regarded as objectionable if it took place in a single step or short period. It is therefore important for local communities to start their own preparations.

Local actions include

- reductions of demands on the centralised systems, particularly for key daily needs such as food, water and energy.
- Increasing local supplies of food, water and energy
- Increasing installations of renewable energy supplies
- Developing local food production, processing and sales
- Increasing the local trading of local businesses

All these actions have major local benefits including:-

- Increasing local resilience
- Reduction of leakage from local economy
- Increasing local economic activity
- Reducing carbon emissions
- Increasing freshness of food
- Increasing local pride
- Increasing local employment
- Increasing quality of local jobs

Although it is not feasible for the area to do much to combat climate change, there are significant activities which can, and it can be argued **should** be undertaken to both minimise its impacts and for equity minimise the contribution from greenhouse gas emissions from the local area.

These activities will have the effect of also strengthening local resilience to other external shocks such as the impacts of increasing energy prices and disruptions in local supplies of essential goods and services.

The challenges facing us are many and varied, but have a common cause as noted earlier, that of the pursuit of economic growth without regard to the environmental and resource limits imposed by living on a single finite planet. The availability of cheap fossil fuels has driven this expansion. However as noted above the era of cheap fossil energy is now past.

Successful local responses therefore require us to move towards living within local means. Examples of this approach which can successfully increase local resilience in the face of the impacts noted here are:-

This report prepared as part of the Local Energy Assessment Fund project aims to show how the Falmouth and Penryn Community Network Area can prepare for higher resilience and how it can achieve carbon neutrality in the long term.



3 Falmouth and Penryn Community Network Area

The community network area is a new development following local government re-organisation in 2009 and the merging of the district and county councils. This has led onto the new administrative boundaries which are not yet familiar to local residents.

The Falmouth and Penryn Community Network Area is closer to being a natural “bio-region” than the previous district council area of Carrick, as it is mainly the two towns of Falmouth and Penryn with their surrounding parishes and is bounded by the sea, and two major river valleys, with only the western boundary on the high ground being not an obvious boundary.

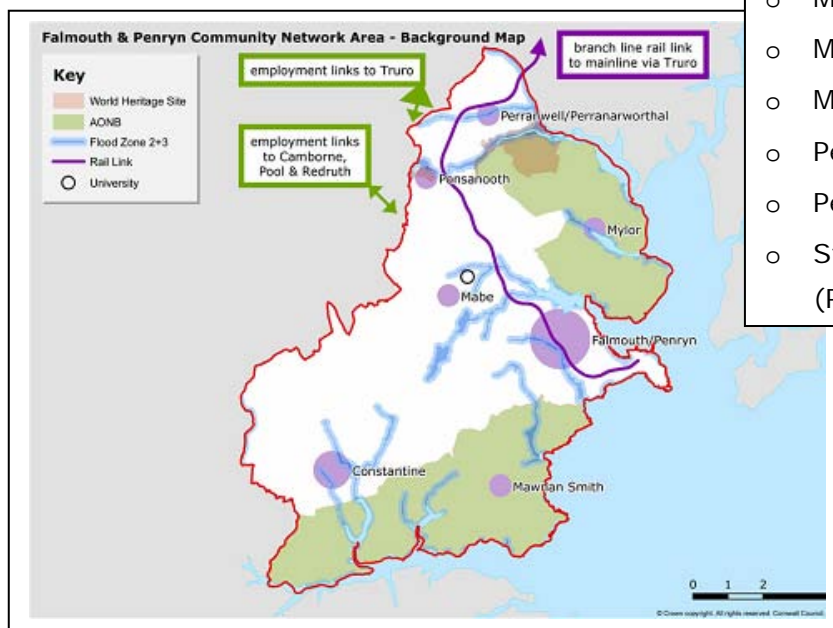
This geography helps with the energy and food actions needed to increase local resilience.

Total population 40,800, with high student numbers in Falmouth and Penryn

The main employment sectors and retail, tourism and manufacturing, with a cluster of marine industries around the Docks.

Parish and Town Councils

- Budock Parish Council
- Constantine Parish Council
- Falmouth Town Council
- Mabe Parish Council
- Mawnan Parish Council
- Mylor Parish Council
- Penryn Town Council
- Perranarworthal Parish Council
- St. Gluvias Parish Council (Ponsanooth)



Land use in Network area

Land use type	ha	%
domestic buildings	177	1%
gardens	780	6%
non domestic buildings	98	<1%
roads	386	3%
rail	11	<<1%
path	19	<<1%
green space	11,135	84%
water	449	3%
other land uses	230	2%
total	13,285	100%

Farmland use in Network area

Farming land use	ha	%
farmland	9,809	
grass	6,539	67%
woodland/other	711	7%
arable	2,559	26%
<i>of which</i>		
cereals	1,336	52%
potatoes	290	11%
beans/peas	90	4%
horticulture/flowers	452	18%
fodder crops	170	7%
other	66	3%
other veg & salad	70	3%
fallow	85	3%
total	2,559	100%



4 Present energy situation in the Fal area

An early task has been to update our understanding of local energy demand and supply and to incorporate any trends into the local energy plan preparation

Energy supply and demand 2008/09 in GWh

Fuel	commercial + industrial	domestic	transport	totals	%
coal	2	10		12	2%
oil	53	122	259	434	56%
gas	47	146		193	25%
electricity	40	96		136	18%
of which renewables				11	1%
totals	142	375	259	775	100%
	18%	48%	33%		

*Sources: DECC statistics Estimate incorporating MLSOA data where available
Totals may not add due to rounding*

The table of energy supply shows the vital importance at the present time of oil and in particular the prevalence of travel in energy use in the area. This is partly because of the high level of tourists accessing the area and the doubling of road traffic in the summer months will be familiar to everyone living here.

Compared to the national average, the use of gas in the domestic sector is low, reflecting the low access to mains gas of rural homes, and hence their relatively high reliance on expensive oil for heating.

As this area is low in industry, the domestic sector uses the most energy overall, showing where action is needed to reduce our reliance on non sustainable energy sources. The highest local energy user is the Docks with several companies and some hundreds of workers.

Cost of energy to the Network area

Fuel	Demand	Costs	
	%	£m	%
coal	2%	0.4	<1%
oil	56%	58.0	67%
gas	25%	10.4	12%
electricity	18%	18.4	21%
totals	100%	87.2	100%

From local figures for Gross Value Added for Cornwall at around £11,000 per capita, a rough estimate for the GVA for the Network area is around £455m. energy costs are therefore nearly 20% of the economic activity in the area.

This is a major loss to the local area as all these costs go to externally owned companies, and hence are lost to the local economy.

4.1 Energy and CO₂ trends

Between 2005 and 2009 personal transport dropped by 6%, against a rise of 3% in freight transport in the area.

Some calculations have been carried out to indicate how energy use has changed over the last fifteen or more years. These show that coal use has dropped from an important source of fuel to a very low percentage, in parallel with the extension of the local gas mains in some of the area.

Estimated changes in energy use in Network area

GWh	1986	%	1999	%
gas	163	18%	241	24%
coal	136	15%	70	7%
electricity	176	20%	201	20%
wood	17	2%	17	2%
oil	370	42%	432	43%
LPG	26	3%	27	3%
RE	-	-	13	1%
	888	100%	1,001	100%
Increase in energy use '86-99			13%	

Sources: calculated from the data in the Cornwall Energy Action Plan of 1989, and the Renewable Energy Office for Cornwall Renewable Energy Strategy for Cornwall 2002-2010.

These figures are not directly comparable with the earlier table as the basis of preparation is different.

The more recent data is thought to be more accurate for electricity and gas supplies as the government now publishes local and regional data, with direct sales figures from the gas and electricity industry.

However the oil figures are less accurate, as they are prepared on a different basis.

Estimate of CO2 emissions for Network Area CO2 tpa

	CO2 co-efficient tCO2/GWh	1986	1999	2009
gas	190	31,023	45,799	43,529
coal	300	40,858	20,963	4,961
electricity	430	75,533	86,381	83,922
oil	240	88,773	103,575	138,971
LPG	214	5,465	5,796	5,000
Totals		241,652	262,514	276,383
increase in CO2 emissions			20,862	13,869
% increase from previous column data			9%	5%

Source: estimated from Cornwall Energy Action Plan 1989 and REOC RE strategy for Cornwall 2002-2010.

This table shows the best information available on the trends in CO_{2e} emissions for the area. However there are several caveats in this information: for example the electricity CO2 coefficient is changing each year as the UK mix changes, the information on local LPG use is no longer available separately and there are major uncertainties in the earlier energy use data from which this is calculated.

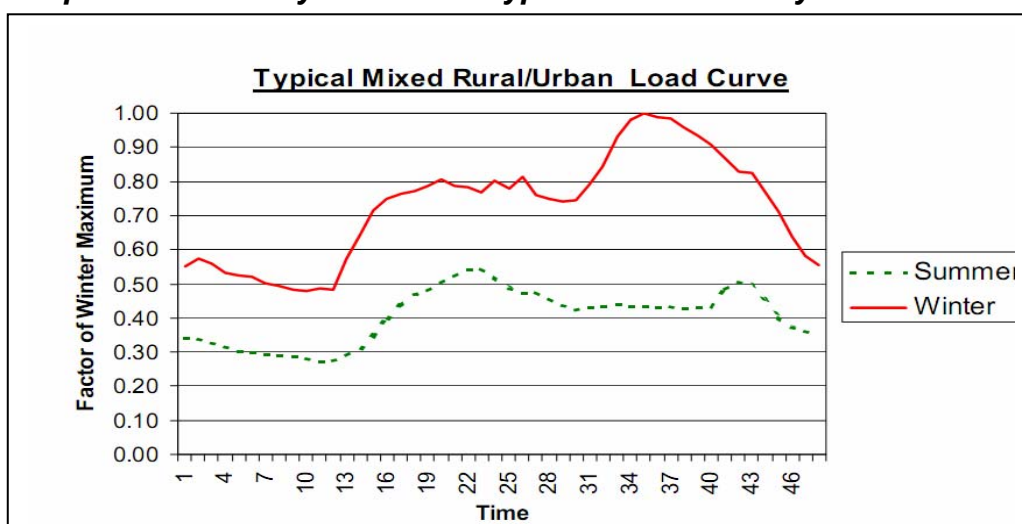
However this table does give an indication that energy and greenhouse gas emissions are not increasing as rapidly as they once were, with electricity, coal and gas use reducing in the last few years. Against that trend oil use is still increasing. In Penwith, another Cornish region it was noted that the transport oil use is reducing while home heating oil use is increasing.

4.2 Electricity grid in the area

The Appendices show the structure of the electricity grid in the local area, with the main inflow of electricity via the Bulk Supply Point at Rame where the 132kV inflow lines are transformed down to 33kV for local distribution to substations around the area.

The graph below gives an indicative example of how the demand for electricity varies through the day in summer and in winter in the South West. This shows the characteristic peak of winter time night demand which indicates a high level of night storage Economy 7 space heating in the area. It should be noted that the information is against each half hour, which is how the grid supply is organised, giving 48 half hours in a day.

Graph of half hourly demand at typical SW electricity substation



Source Western Power Distribution:

This shows that the night storage heaters are around 25% of maximum demand and that E7 water heaters (the summer night time maximum) are around 10% of the maximum, enabling us to work out how much electricity is likely to be used for these purposes.

This background information gives a good grounding for deciding the best ways forward for cutting our energy costs and emissions and for what to tackle to increase local resilience.

4.3 Domestic sector

The following tables show the breakdown of electricity and gas use in six areas within the Network Area. These statistical areas do not exactly match the parish areas but do provide some detailed local statistics from which it is possible to draw conclusions and develop action plans.

Domestic gas use in Network area 2009 MWh

Area	Gas use	Number of meters	Average/meter
NW of Falmouth	6,623	379	17
Penryn	28,636	2,631	11
Falmouth centre-N	35,008	3,057	11
Falmouth centre-Docks	35,938	2,494	14
Falmouth S & W	31,240	2,713	12
SW of Falmouth	8,689	683	13
Totals	146,133	11,957	12

Source: ONS MLSOA energy statistics

Domestic electricity use in Network area 2009 MWh

Area	Electricity use		Number of meters		Average use/meter		% with E7
	Ord.	E 7	Ord.	E7	Ord.	E7	
NW of Falmouth	8,768	8,293	1,872	946	4.7	8.8	34%
Penryn	8,915	4,106	2,578	723	3.5	5.7	22%
Falmouth centre-N	9,796	4,149	2,896	722	3.4	5.7	20%
Falmouth centre-Docks	9,029	4,987	2,550	802	3.5	6.2	24%
Falmouth S & W	9,671	4,269	2,651	583	3.6	7.3	18%
SW of Falmouth	11,959	12,243	2,515	1,470	4.8	8.3	37%
Totals	58,138	38,048	15,062	5,246	3.9	7.3	26%
Grand totals	96,185		20,308				

Source: ONS MLSOA energy statistics

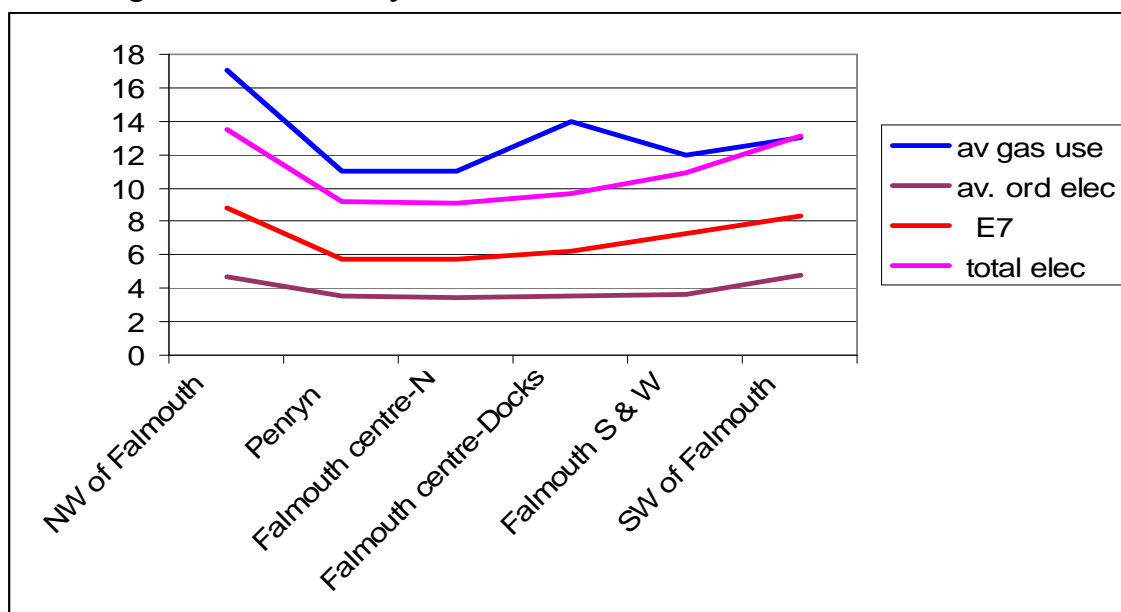
These tables show how the use of electricity for heating (via Economy 7 meters) varies largely with the availability of gas, with only 18% of households having E7 meters in the south and west of Falmouth town, whilst well over one third have them in the rural areas to the south west and north west of Falmouth

A comparison of the electricity and gas use tables shows how the use of energy for heating varies between gas and Economy 7 (ie night storage radiators). On average, E7 households use some 61% of the energy for heating that gas households do. This calculation is on the assumption that a household using gas for heating is not also using Economy 7. This is not always the case as some households may be using both for heating purposes.

Relative energy use in E7 and gas households

Area	Average MWh pa /meter		Ratio of electricity E7 to gas use
	gas	E7	
NW of Falmouth	17	8.8	52%
Penryn	11	5.7	52%
Falmouth centre-N	11	5.7	52%
Falmouth centre-Docks	14	6.2	44%
Falmouth S & W	12	7.3	61%
SW of Falmouth	13	8.3	64%
Network area average	12	7.3	61%

Relative gas and electricity use in Fal areas



On average E7 users are heating their homes to a much lower level consuming only half to two thirds of the levels of gas users. Add to this the fact that night storage heaters tend not to provide a high level of comfort in our variable weather, this suggests E7 users are living in low temperatures, or are in properties with little winter use, such as students and holiday lets.

Estimate of heating demand in area GWh pa

Energy source	Commercial & industrial	Domestic	Total
gas	47	146	193
oil	53	122	175
coal	2	10	12
E7		38	38
	102	316	418

This estimate provides a rough guide only to the space and water heating demands of the area, but does provide useful numbers for assessing the potential both for savings and for renewable energy supply. On the assumption that around 20% of domestic heating is for hot water, this suggests that space heating demand in the domestic sector is around 253 GWh pa. It has already been noted above that some areas use significantly less energy for space heating than others and this does not correlate with well insulated homes.

A more detailed assessment would in particular need to obtain details of the temperature of heat demands in the commercial and industrial sectors as this has a major impact on how to save energy as well as suitable sources of renewable supply.

4.4 Commercial and industrial sectors

As with the domestic sector electricity and gas statistics are available at a lower level of disaggregation than other energy sources, making useful local conclusions possible. Due to the shortage of time for this present analysis, little extra work has been done on this sector.

Electricity use in the sector 2009 MWh

Area	Use	Number of meters	Average MWh pa/meter
NW of Falmouth	5,109	304	17
Penryn	4,711	346	14
Falmouth centre-N	6,548	376	17
Falmouth centre-Docks	9,858	491	20
Falmouth- SW	3,850	168	23
SW of Falmouth	10,211	460	22
Totals	40,287	2,145	19

Commercial and industrial gas use MWh 2008

Area	Use	Number of meters	Average MWh pa/ meter
NW of Falmouth	2,018	11	183
Penryn	9,313	21	443
Falmouth centre-N	4,528	28	162
Falmouth centre-Docks	14,901	53	281
Falmouth-SW	4,689	18	260
SW of Falmouth	7,398	10	740
Totals	42,847	141	304

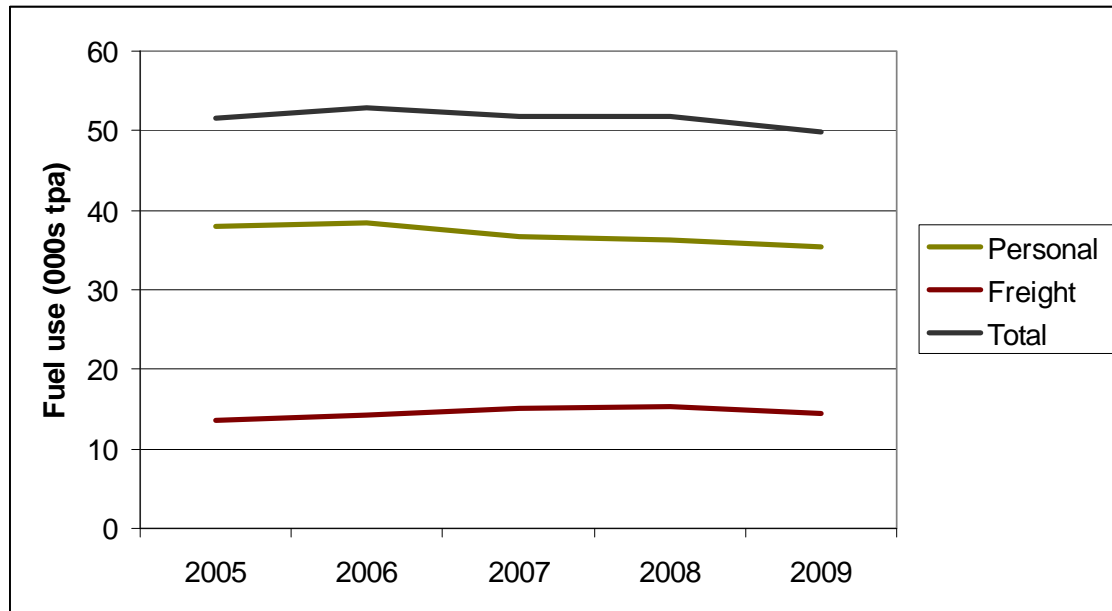
This shows that the largest number of gas users in the Network area are situated in Falmouth, and in particular are located in the centre of town and in the Docks area.

The main electricity use partly mirrors this with high use in the industrial heart of Falmouth around the Docks and also in areas with little gas to the south west of the town in Mabe, Constantine and Budock, where there are industrial estates.

4.5 Transport

Oil is now nearly half of local energy use, reflecting the high mobility demanded by today's population as well as the high number of tourists using cars for their visits.

Carrick District area transport fuel use 2005-2009 (ktpa)



source DECC Energy trends statistics

This graph shows that there is a slight downward trend in personal car use and that freight in the area is fairly static, neither reducing nor growing. The key element of the personal car use is that the downward trend started before the 2008 financial crash and recession. As personal transport is 71% of the total oil use, it is important to develop action plans to reduce this.

A student mini survey, carried out by Blanka Marushkova in the Falmouth and Truro area during one week at morning and evening rush hours discovered that in the morning 80% of cars had one person and in the evening only 58% had one person.

As transport is not part of the present study it has not been possible to take this work any further. It will however be included in future work and Energy Planning for the network area.

5 Domestic energy efficiency situation

The Case studies and the leaflets developed during this part of the project are one of the deliverables – Deliverables 3 and 4

The domestic energy efficiency situation in this area is not well known.

Some years ago the Cornwall Energy Project carried out a housing survey as part of its assessment of the energy efficiency potential in the first energy plan for Cornwall. This does give an indication of the breakdown of housing types in the area.

Cornwall housing types breakdown

Age of build		Type of build	
Pre-1919	45%	Detached	26%
1920-64	16%	Semi detached	17%
1965-75	23%	End terrace	10%
Post 75	16%	Terrace	47%

Sources Cornwall Energy Project Domestic sector energy conservation potential, ONS UK housing statistics

This information was used to determine which housing types should be used for the Case Studies to be carried out by Community Energy Plus, for the FEP team. As the budget only extended to four case studies it was important to choose as wide a representative sample as possible.

it was decided to have two each of on gas and off gas, as mains gas is only available to around 60% of local homes, The main housing type is pre-1919, which represents around 45% of houses in the area, and homes built in the decade of 1965-75 when there was a large amount of house building in the area, amounting to around 23% of the present stock.

The final homes assessed were as shown in the table below.

Case study homes

Case study no	Type	Gas
1	Pre-1919, detached, oil heated,	No
2	Pre 1919, end terrace,	Yes
3	1965-75, bungalow	Yes
4	1965-75, detached, oil heated	No

The table below shows the best information we have on housing conditions in the Network area. This shows a high level of under-insulated lofts with Mabe and Budock having over one third of homes in this condition. Whilst increasing levels of central heating increase the comfort in a home, it does not necessarily lead to reduced energy use within the home. This table shows that the first task to tackle energy waste in the local domestic sector is to increase loft insulation levels. This pays for itself very quickly both in terms of increased comfort and in reduced fuel bills.

Housing conditions in the Network Area

Ward	No. of homes	% under insulated lofts	% under insulated cavity walls	% without central heating
Mabe & Budock	1,863	34	12	13
Mylor	2,663	32	11	13
Constantine, Gweek, Mawnan S.	1,839	30	8	15
Penryn	3,039	21	11	24
Falmouth				
Arwenack	2,971	27	11	15
Boslowick	2,406	24	16	17
Penwerris	2,531	19	10	24
Trescobeas	1,594	21	14	21
totals	18,906	26	12	18

*Source: Energy Saving Trust's Homes Energy Efficiency Database (HEED)
Online Data Pack prepared for Cornwall Council January 2010*

Boslowick - 4th in top 5 wards with highest potential for cavity wall insulation

March 2004 - 4% of Falmouth/Penryn housing considered 'unfit'

March 2004 - 12% of Falmouth/Penryn dwellings with a serious hazard i.e. damp, excessive cold, mould growth

Dwellings in Falmouth/Penryn have an average SAP rating of 47 (Average for England is 51)

Source Community Energy Plus

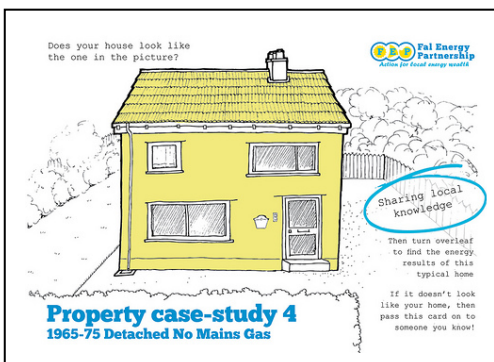
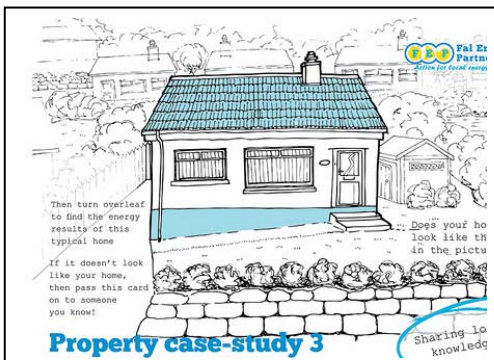
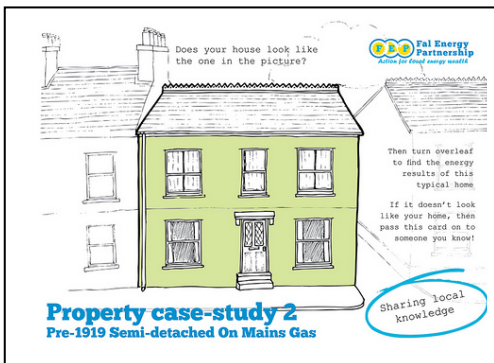
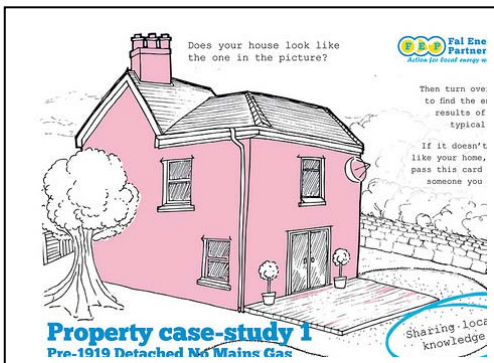
The case study results were not entirely consistent with the survey results given above as the case studies had on average higher levels of insulation. However as the case study homes were self selected they were obviously householders with more than an average interest in energy matters.

The EPC results and short reports to the householders show some of the problems with using a standard approach to energy in the home. Whilst it is useful to compare one home to another and this can be done with the EPC information it does have major limitations.

For example it does not cover appliances electricity use and hence gives little information on how to reduce this major energy use. The EPC reports also seem to be constrained by some standard and behind the times set of what is advised for energy efficiency measures, in as much as both old oil boilers were proposed to be replaced by condensing oil boilers. Whilst this does save energy it does not relate to the realities of the peak oil world in which we now live, when all efforts need to be made to reduce/ remove oil use. This will not only save householders increasing amounts of money over time, it also increases their energy security.

The EPC reporting system also does not seem to allow the possibility of the Renewable Heat Incentive which will change the payback time for renewable heating investments.

Case study properties



Suggested measures from the properties surveyed include:-

- Internal/external wall insulation or insulating wallpaper
- Cavity wall insulation
- Top up loft insulation
- Draught proof doors and windows
- Close curtains at night
- Improve boiler and heating controls
- Replace boiler with condensing boiler of same fossil fuel
- Improve hot tank insulation
- Switch off appliances when not in use
- Install low energy lights
- Install PV
- Install solar water heating
- Install energy monitor

Other measures which could improve the properties' low carbon credentials and reduce fuel bills include:-

- Install wood pellet boiler or log furnace instead of old oil boiler
- Install ground source heat pump
- Install solar air heating on south wall – especially for damp solid wall homes
- Insulate underfloor when replacing floors, and install underfloor heating at the same time.
- Install insulating and heat reflecting mats behind all radiators
- Use the solar clothes drier- a washing line
- Arrange electrical especially computers & their peripherals on one plug extension so that it is easy to switch off all of them at once when they are not in use.
- Install unheated conservatory, with fan to blow warm air into inside rooms

Further details available in the Fal Energy Pack



6 Renewable energy potential for the area

This Leaf project concentrates on an improved understanding of the wind and solar resources of the Fal network area. We also have information on other renewable energy resources, such as biomass which is included where possible.

This is Deliverable 5 of Leaf project

Deliverable 6 assess in detail one wind site as identified by Town Councils included here

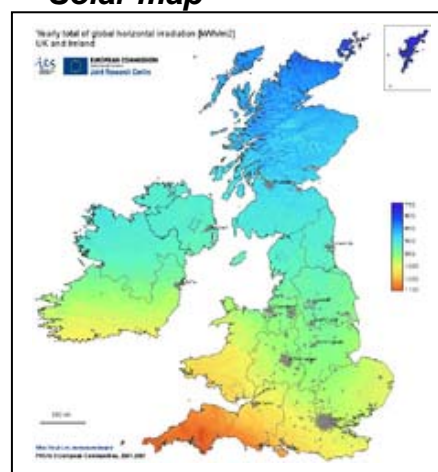
6.1 Solar energy resource

This section of the report has been prepared by Blanka Marushkova

Solar Photovoltaic (PV) and solar thermal are common examples of RE technologies that use the vast solar resource that is available to us to produce renewable electricity and heat respectively. PV is the direct conversion of light into electricity in panels placed on roof tops or in arrays directly on land, angled to face the sun. Solar thermal uses the sunlight to heat water (or air) in flat plate or evacuated tube panels placed to tilt towards the sun.

Feed in tariffs (FITs), the governmental renewable electricity incentive, continues to encourage the PV technology uptake while Renewable Heat Incentive (RHI) and the Green Deal are yet to be implemented. Recently, the PV industry has experienced significant cost reductions that will further accelerate the technology uptake. Solar thermal, on the other hand, is already well established and represents an effective way of replacing or complimenting conventional hot water systems. Cornwall in particular is benefiting from relatively high solar irradiation and its utilization will hopefully help to achieve the challenging carbon reduction targets.

Solar map



source: European Commission

6.1.1 Cornwall resource

The map below shows that Cornwall receives the highest levels of solar irradiation compared to the rest of the UK. This report used various sources of data (*refs PV Sol, PVGIS, RET screen*) to obtain the most realistic values of the solar resource.

The conclusion is that Cornwall receives on average 3,400 Wh/m²/day which amounts to approximately 1,240 kWh/ m²/year. After allowing for conversion losses 14% efficiency and 14% system losses this translates into a power output of 1,000kWh pa per kWp installed.

These are the base figures used in this report

6.1.2 Methodology: active systems

Due to the limited time available for the report completion, several assumptions and guesstimates had to be made. These, however, were well considered and based on sound evidence or good references. In order to obtain more accurate data, a detailed assessment of the Network area would be required. The following sections explain the individual methodologies and assumptions.

Main assumptions for the local area

Assumption	Value
Roof pitch (domestic)	30 degrees
Roof pitch (industrial)	low pitch or flat roof, suitable for standard/thin film technology
“Suitable dwelling” factor	43% domestic, 65% commercial/industrial
Non-usable roof area factor	30%
“Usability” roof factor	70% domestic 50% industrial and commercial
Solar PV installed capacity thin film	90Wp/m ² average
Solar PV installed capacity standard	145Wp/m ² average
Solar PV installed capacity hi efficiency	180Wp/m ² average
Solar PV output	1000kWh/kWp/year
Solar thermal – area required	evacuated tubes 1 m ² /person flat plate 1.25m ² /person
Solar thermal installed capacity	500Wp/m ²
Solar thermal heat output	420 kWh/m ² /year
Solar irradiation (year)	1,240 kWh/m ² /year
Solar irradiation (day)	3.4 kWh/m ² /day

For each type of system two main scenarios were assessed, a high scenario and a low, constrained scenario. However, the purpose of the report is to highlight the technical potential regardless the planning or economical constraints, which is likely to change over time. Therefore the emphasis is on the technical potential

A) PV domestic roof mounted systems: assessment of suitable dwellings

Initially, Google Maps and Google Earth satellite imagery were used to survey several areas of residential buildings within the Network area. Twenty six individual areas were considered and the proportion of suitable dwellings recorded. A suitable dwelling can be roughly described as a dwelling with roof-orientation ranging from southwest to south east, ideally true south. From this data representative values were calculated.

In the High Scenario the full technical potential was investigated, ignoring potential local and site constraints.

In the Low Scenario, the value was reduced by a factor that represents dwellings in AONB or other designated areas, listed buildings, unsuitable buildings and specific local constraints.

Available roof area

PV potential for roof mounted domestic installations was considered under two scenarios based on two different data sets.

“All buildings” scenario

- Calculation based on provided total domestic building area
- Provided floor area data of all domestic dwellings in the Network area were used to carry out calculation for the total available roof area. In this calculation, trigonometry rules were used and 30 degree roof pitch assumed as it is a typical roof pitch for local homes
- Total available area was then used as a basis for the HIGH and LOW scenarios as mentioned above.
- High scenario represents the maximum technical potential
- Low scenario values are reduced by suitable dwelling factor and unusable area factor (note: roof area reduction due to the roof constraints such as skylights, chimneys, shading, edge buffer, etc)

“Specific buildings” scenario

- Calculation based only on 3 types of dwellings -terrace, detached and semi-detached houses
- Provided data of housing types and numbers were used and flats, apartments, caravans as well as maisonettes excluded (3,000 excluded dwellings, from the total of 18,183)
- It is assumed that these properties offer little roof area and can therefore only accommodate limited installed capacity (<1kWp). This size of installation is currently considered not feasible due to the economies of scale.

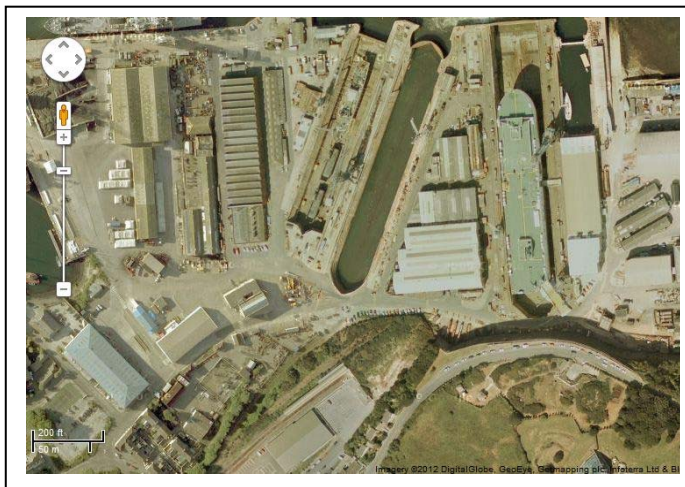
- The three property types were assessed on basis of SAP guidance for typical floor areas and similar calculations of power outputs and installed capacity performed.
- Total available area was considered under both, HIGH and LOW, scenarios.

Additionally, the model takes into account that the roof space will have to be shared between a solar PV and a solar thermal installation. This fact is also included.

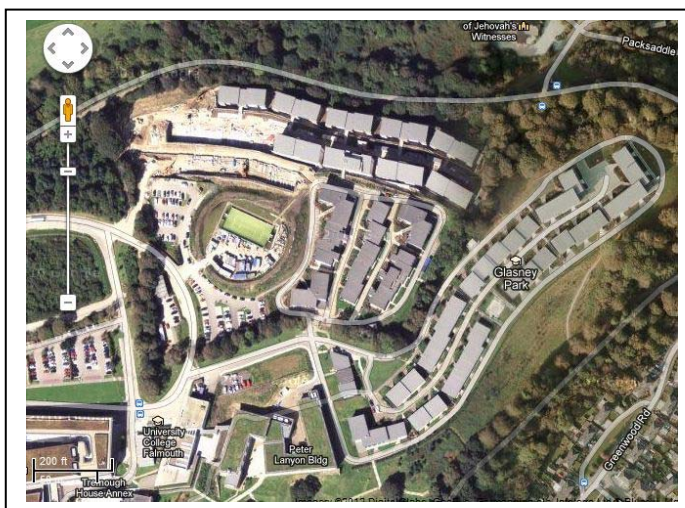
B) PV commercial/industrial roof mounted systems

Similarly to the domestic PV survey, a commercial and industrial buildings desktop survey was conducted, using Google Maps and Google Earth online tools. Nine prominent locations within the Network area were considered and suitable proportion of buildings recorded. Again, buildings included were orientated towards the south, plus/minus 45 degrees. Seemingly flat roof buildings were also included, as a flat roof can provide space for optimally inclined frame-mounted PV system.

The figures below show some of the potential industrial areas suitable for medium scale roof-mounted PV installations

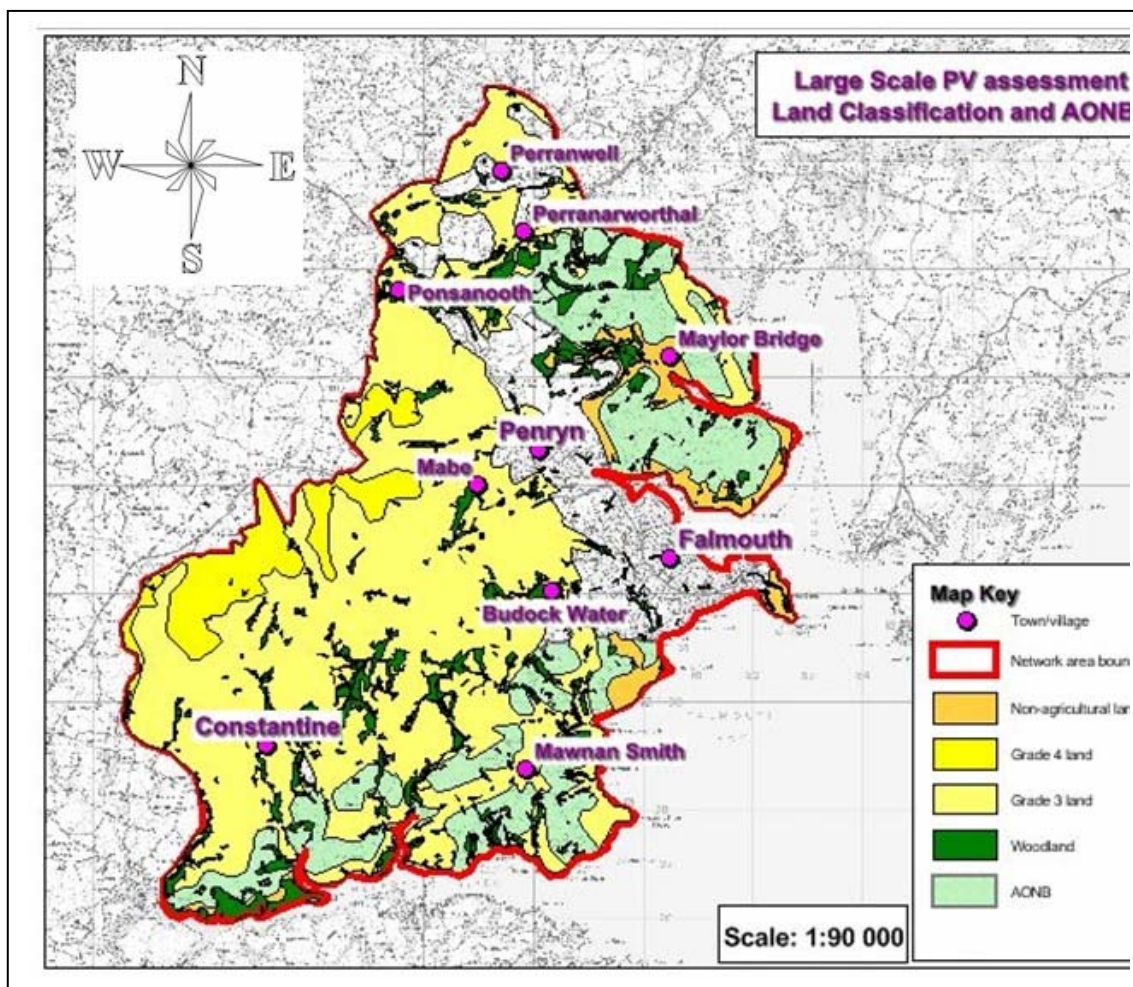


Falmouth Docks area



University Campus Tremough, Penryn

GIS mapping: land classification within the FEP network area



The following table gives a description of individual classes:

Source: <http://www.lawsonfairbank.co.uk/agricultural-land.asp>

Land use grades

Grade	Principal use
Grade 1	Intensive arable cropping eg bulbs, vegetables, roots and cereals. No forestry
Grade 2	Arable cropping/intensive grassland eg cereals with roots an/or dairy cows. Limited forestry.
Grade 3	Extensive arable cropping, rotational grassland eg cereals, oilseed rape & beans or grass leys for dairy cows, beef, sheep. Hardwood forestry mainly.
Grade 4	Permanent grassland/rough grazing eg beef and sheep rearing with limited dairying and cereals. Commercial softwood forestry.
Grade 5	Rough grazing often with rock outcrops, eg principally summer grazing with hardy sheep breeds and hill cattle. Limited softwood forestry.

There is no Grade 5 within the Network area.

Exclusions

- The reason for the exclusion of AONBs in the Low or constrained scenario is the current planning climate. These areas are more likely to attract planning objections, or in any case are likely to need an Environmental Impact Assessment, increasing the risk costs.
- Ancient woodlands and wooded areas were excluded as being unsuitable.
- There are about 30,000 miles (48,000 km) of hedges in Cornwall. It is assumed that existing Cornish hedges will be retained as a vital element within the landscape and an important refuge for wildlife. Hedges are also excluded to reduce shading issues.

Due to inability to foresee future land use scenarios and hence the potential area available to the PV installation, several trajectories were assumed. The result table includes 10%, 20% and 30% suitable land utilization.

Row spacing

The assumptions on row spacing requirements for the installation were based on the general industry rules of thumb and the Wheal Jane case study PV solar farm as follows:

Wheal Jane solar farm specifications

Parameter	Value
Ground area of the installation	2.914 ha 7.2 acres 29,138 m ²
Installed capacity	1.4 MW
Number of panels	5,680
Panel power rating	250 W
Annual power output:	1,437 MWh
Installed capacity	48W/m ²

Source: Solar century: <http://www.solarcentury.co.uk/media/press-releases/solarcentury-turns-old-tin-mine-into-solar-power-plant/>

A 4:1 spacing rule expresses the requirement of space between the individual rows. It is the ratio of row width to the system height. This is the common industry practice unless the sitting or terrain requires otherwise. In theory, for the optimal inclined system the area of the ground required would be 3x the area of panels installed. Both approaches : the Wheal Jane case study and the 4:1 spacing rule, yield similar results.

Commercial ground mounted large scale installations require a careful and thorough planning approach. Any further analysis is outside the scope of this report. A detailed desktop study would be required before considering any commercial commitments. The desktop study would have to take into account

factors such as local designations, suitable slope, land type and grid connection, amongst others.

D) Solar Thermal – domestic requirements

Solar thermal assessment was carried out on basis of the total population within the Network area and on the following recommended value often used in solar thermal system sizing:

- 1.25 m²/person for flat plate

Simple multiplication of population in the area (40,800 – or rather 42% of it due to the suitability factor reduction) and panel-area-per-person value gives approximate results for the potential total roof area requirement.

The solar thermal potential is taken as the requirements of the present population in both High and Low scenarios

NOTE: The solar thermal calculations are also included in the final domestic PV potential (first, reducing the roof area by solar thermal followed by the PV system occupying the rest of the roof space)

E) Solar thermal- commercial and industrial – roof mounted

A similar approach was chosen for the assessment of the commercial/industrial roof potential. However, in this case it was more difficult to estimate the realistic PV/solar thermal ratio. It would have to be assessed individually and would probably depend on the type of business and its energy demand patterns.

6.1.3 Local solar potential

The calculations outline above and in the appendices show the potential for the main solar technologies considered here.

Other technologies which can be used are passive solar use in conservatories, sun spaces and in building design.

Summary of High Scenarios

HIGH SCENARIOS		installed capacity kW		Energy generated MWh/year	
		Standard	High efficiency	Standard	High efficiency
Photovoltaic systems					
Domestic	all	54,806	68,035	54,806	68,035
	some	43,367	53,835	43,367	53,835
Industrial	all buildings	92,176	114,425	92,176	114,425
PV arrays	10%	232,837	N/A	232,837	N/A
land inc	20%	465,673	N/A	465,673	N/A
AONB	30%	698,510	N/A	698,510	N/A
Solar thermal					
Domestic	all needed	25,500	N/A	21,420	N/A
Industrial	all	317,850	N/A	266,994	N/A

If the High scenario is met the area can install around 43-68 MW domestic PV and 92-114 MW industrial PV depending on the proportions of standard and high efficiency modules used. This would produce around the present level of electricity demand in the area.

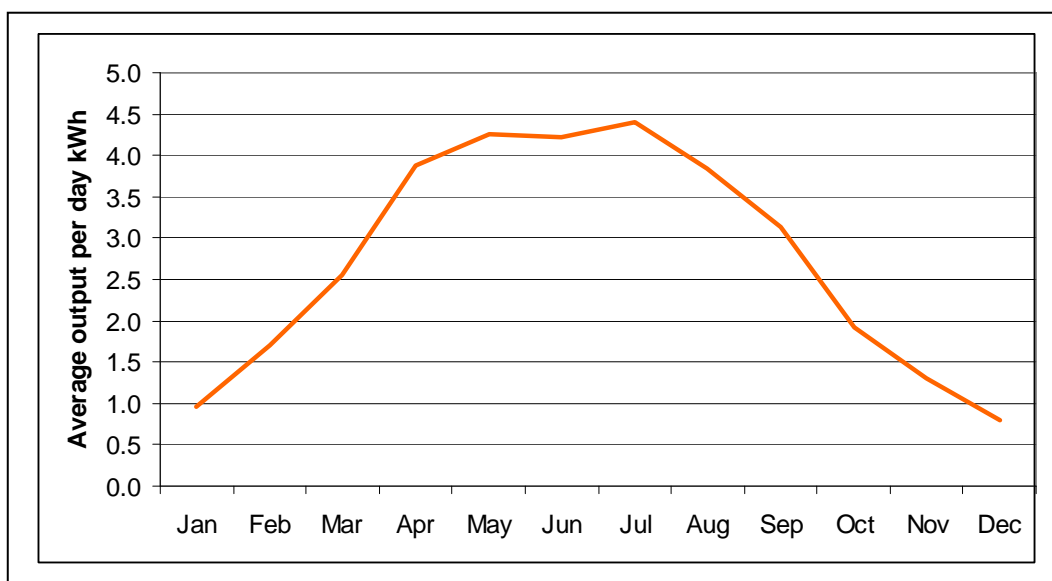
Summary of Low Scenarios

LOW SCENARIOS		Installed capacity kW		Electricity generated MWh/year	
		Standard	High efficiency	Standard	High efficiency
Photovoltaic systems					
Domestic	all	36,146	44,871	6,146	44,871
	some	29,341	36,423	29,341	36,423
PV industrial		46,088	80,098	46,088	80,098
PV arrays	10%	175,369	N/A	175,369	N/A
land use	20%	350,737	N/A	350,737	N/A
excl. AONB	30%	526,106	N/A	526,106	N/A
Solar thermal systems					
Domestic	all needed	25,500		21,420	
Industrial	some	222,495	N/A	186,896	N/A

If the low scenario is met then around 98 MW of roof top PV would be available in the area, producing around 70% of present day electricity demand.

The graph below indicates the average electricity output from a 1kWp system, and shows as expected the increased output during the summer months. It can also be seen that the spring and autumn also produce worthwhile amounts of electricity.

Electricity produced by a 1kWp PV system



As most of the electricity is produced in the summer months and only in daylight this does not provide a secure and reliable supply for winter months or overnight. Some storage would be needed for overnight supplies and larger amounts for use in winter, unless the solar electricity is complemented by a renewable resource with higher winter availability

C) Large scale PV arrays : scenarios excluding AONBs

Scenario			10%		20%		30%	
Land type	area (ha)	land – hedges (ha)	MW	electricity produced MWh pa	MW	electricity produced MWh pa	MW	electricity produced MWhpa
Non agric.	59	48	2.3	2,302	4.6	4,604	6.9	6,906
Grade 3	3,870	3,142	151	150,985	302	301,970	453	452,954
Grade 4	566	460	22	22,082	44	44,164	66.2	66,246
Total	4,495	3,650	176	175,369	350.7	350,737	526	526,106

Totals may not add due to rounding

This shows that 10% of each of the present non agricultural land, grades 3 and 4 agricultural land would provide a 128% of present electricity demand.

D) Solar thermal- domestic

Only one type of solar collector has been considered in this assessment, that of flat plate. Evacuated tubes are a more efficient and expensive option, but are rapidly increasing their share of the market,, because of their ability to provide useful amounts of winter hot water as well as most of the summer hot water demand. This table shows the demand if all domestic requirements for dhw are met from solar panels.

Solar Thermal (domestic and commercial – roof mounted)

Solar Thermal assessment: domestic	
Solar Thermal	Flat plate
Population	40,800
Panel area/person	1.25
Total Area (m2)	51,000
Total installed (kW)(*)	25,500
Total output (MWh/year)(**)	21,420
Notes: Total Installed	*500W/m^2
Notes: Total output (heat)	**420 kWh/m^2/yr

E) Solar thermal :commercial and industrial

Solar Thermal assessment: industrial		
Solar Thermal	FP (HIGH)*	FP (LOW)
Total Area (m2)	978,000	978,000
Suitable (m2) (65%)	635,700	635,700
Usable (m2) (70%)	NA	444,990
Total installed (kW)	317,850	222,495
Total output (MWh)	266,994	186,896



The use of the commercial and industrial roof space for solar thermal is very dependent on the occupier's summer hot water requirements. As this is a tourist area, the large number of hotels and catering establishments catering for the tourist trade are an obvious potential early beneficiary of this technology.

6.1.4 Financial Modelling for PV systems

A) Domestic PV

Simple financial model with current module prices (REC, standard modules) and FITs (new tariffs, from 1.4.2012 onwards) is shown in the table below. Illustrative system sizes have been quoted by a local PV installer. It is important to note that the prices of installations can vary depending on the services included, module and inverter type and quality, roof type and the method of fixing.

Financial model for different size systems

System size	Costs	Output	FiTs ¹	Export ²	House bill Savings³	Total savings	Payback	CO2 saved ⁴
kWp	£	MWh pa	£ pa	£pa	£pa	£pa	years	t pa
1	5,500	1	378	15	75	468	11.8	0.6
2	7,800	2	756	30	150	936	8.3	1.2
3	10,100	3	1,134	45	225	1,404	7.2	1.8
4	12,200	4	1,512	60	300	1,872	6.5	2.4
5	14,500	5	1,645	75	375	2,095	6.9	3.0
10	24,400	10	3,290	150	750	4,190	5.8	5.9

Notes on table

1 Feed In Tariff <4kW 37.8 p/kWh

4-<10kW 32.9 p/kWh

2 Export tariff 3p/kWh and assumed 50% exported from dwelling

3 Reduction on household electricity import bill at 15p/kWh and 50% reduction in imports

4 Electricity not used or exported saves 591kgCO₂/MWh

The of PV value to the householder depends on the following key variables and how they change over time:-

- views on increasing electricity and other fuel prices with time
- present and future FiT tariffs for each scale of PV
- dependability of future FiT tariffs
- confidence to invest

As this is aiming to look in the longer term to increase energy security for the local area, the assumption is therefore made that the financial side will be favourable during the next few years as the programme is put into place for this area.

6.1.5 Impacts of large scale PV arrays

Large scale PV installation can undoubtedly have a significant impact on the surrounding landscape if not designed and sited carefully. There are several guidelines advising developers on the best practices, in particular the Cornwall Council's PV development documents (for large scale and small scale installations).

- "The Development of Large Scale (>50kW) Solar PV Arrays in Cornwall"
- "The Development of Domestic and Medium Scale Solar PV Arrays of up to 50kW in Cornwall"

These documents can be found on: www.cornwall.gov.uk

The document recognizes the importance of the renewable technologies on one hand, but emphasizes environmental protection on the other. The impact on visual amenity, hydrology, habitat and biodiversity has to be carefully assessed. Large scale installations of > 50kWp are not likely to require the full EIA unless the sitting is within an area of environmental sensitivity. However, as with all planning for renewable energy a scoping report and request is desirable.

Potential issues for significant impacts are:

- Gradient of the site and the surrounding landform,
- Extent of the site,
- Height and layout of the panels,
- Colour of the panel's surrounding frames,
- Treatment of the ground below and between the panels, for example to grow crops, graze livestock, or to lay down mulch to reduce maintenance,
- Type and style of perimeter fencing.

Example of a large scale installation, the 1.4 MW Wheal Jane solar park near Truro



The Environmental Statement for Wheal Jane PV produced by Wardell-Armstrong can be viewed on:

<http://planning.cornwall.gov.uk:8181/rpp/showimage.asp?j=PA10/03993&index=21107&DB=8&DT=4>

The objections often raised are the visual intrusion, loss of habitat and land use competition amongst others. These, however, can be successfully mitigated. In the case of Wheal Jane the previous land use was for the processing of tin ore and consequently the land is contaminated and has been unused for a number of years.

Land use options

Example PV in the Cornish countryside



The land underneath PV arrays does not have to become a wasteland. It can accommodate grazing sheep or poultry, possibly even cattle if the support frames are taller and stronger.

The boundary of an installation can create a secure and protected area for purposes of free range birds of various types from laying hens to geese and other poultry, as the area within the security fence can easily be fox-proofed .

Grass will continue to grow and may create an opportunity for different habitats to be established. Wild meadows could support the declining population of bees and other important insects.

Grazing under PV arrays



Wheal Jane solar as re-use of industrial land



Suitable crops could be grown between the individual array rows, using alley cropping methods a successful approach adopted in permaculture. Alley cropping gives higher yields from the edge effect

6.1.6 Other solar energy technologies: passive systems

Solar energy can be harvested in several ways as noted using the technologies above. The simplest is to have large windows on the south side and to use conservatories or sunspaces- which are not heated from the house heating system. All these methods collect the sun's heat and can be used to warm buildings during the heating season.

Conservatories and sun spaces

Conservatories provide useful living space in spring, summer and autumn and reduce heat loss during colder weather. They are useful for drying clothes in wet weather so reducing the use of electricity in the household.

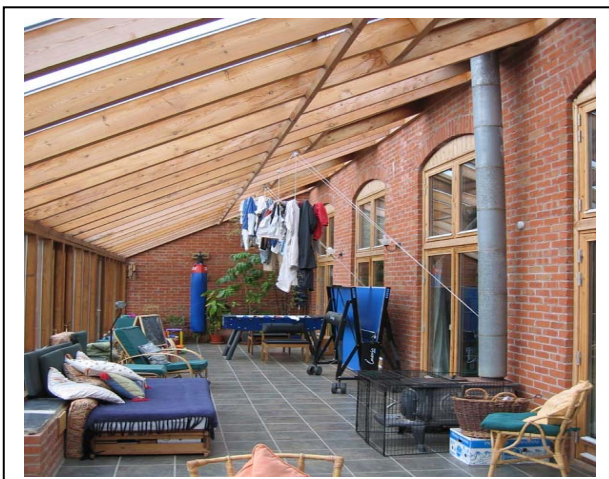


Direct solar drying- the low energy clothes line- is also under-rated in its potential for cutting energy demand in the home. This is particularly important for high rainfall areas such as Cornwall



An appropriately sized conservatory on the sunny side of a home can provide a significant proportion of the building's space heating needs, up to around 18% providing the following conditions are met:-

- the solar space is not otherwise heated
- the hot air is taken by fan into the building to be heated
- the solar space receives enough direct sunshine
- lower wall and base is insulated to minimise heat loss
- high thermal mass materials are used for the flooring



If around 20% of suitable properties installed conservatories the energy savings would be around 12%

of all domestic space heating requirements, some 31,000 MWh a year of saved fossil fuel imports, costing over £2.6m to the area at present day prices.

This would involve nearly 4,000 conservatories, unheated, with appropriate PV powered temperature controlled fans to move warm air to cooler inside rooms.

A five year programme of local installations would stimulate a multimillion pound local business, providing sustainable approaches to reducing fossil fuel imports to the area, and providing increasing benefits as fossil fuel prices increase.

Conclusions

As it is evident from the Results summary the solar potential of the region is significant. If every suitable non-domestic building could be used up to 57 MW of capacity could be accommodated on the industrial and commercial roofs . This figure is even higher for the domestic sector: an impressive 68 MW of capacity could be installed. These figures, however, represent the technical potential and the highest scenario. Lower values are more realistic in the short term but the technical assessment is an important indication of the future potential.

For large scale PV installations, there are considerable uncertainties in the calculations regarding land classification and planning constraints. However, if 10% of suitable land is utilized, up to 233 MW of PV arrays could be producing around 133 GWh each year, which is about the present demand for electricity in the Area.



6.2 Wind energy

The wind resource depends largely in each area on what size wind turbines have been installed. Cornwall is a windy location and has some experience with windfarms, as there are eight windfarms and many smaller turbines throughout the county. The Network Area has one small windfarm of two 850kW wind turbines on the high ground behind the University, and the owners have agreed to allow some educational value from this site. The renewable energy degree students are able to use this site for some of their learning about windfarms.

Although the area has a very large wind resource, how much of this will be used in the future will depend on many financial, energy, cultural and local policy issues.

This resource assessment is in the first instance looking at the technical potential for wind energy, before consideration of cultural and planning issues.

The potential electricity production from the wind in the Network Area depends in part on what scale wind turbines are to be installed. The larger the average wind turbine installed in a specific area of land, the higher the electricity generation from that area. This is in part because the larger turbines are on taller towers, so they reach the higher windspeeds at higher elevations. At present there is an increase in smaller wind turbines being installed throughout Cornwall as the Feed In Tariff brings them within the reach of smaller investors.

The main resource assessed is using larger turbines. Turbine size is chosen by reference to the requirement that no turbine should cause a noise nuisance to neighbours.

6.2.1 Technical wind resource

As a first rough assessment of the potential wind resource all potential sites with a 500m separation from all houses were plotted on the digital map in the Windfarm programme. This yielded some 21 potential sites for large wind turbines, with at least 500m to the sea and any houses. A range of wind turbines were tested on the noise model to ensure that it was feasible to install machines at each site without a noise nuisance. The 2MW noise reduced machine produced only a minor noise nuisance ie levels of 35-36dB at a few nearby houses for this machine.

The site locations were plotted and the NOABL windspeed assessment model was applied. This is not the most accurate of methods of assessing likely windspeed. However the assessor with some years of wind experience in Cornwall was able to amend unlikely figures with local data and knowledge of the area. The low noise model 2MW Vestas machine was used for an estimate of annual output and 7% losses applied to each turbine output. This yielded the figures in the table below.

The same procedure was applied for different size turbines to find the technical potential for smaller machines. The technical potential is only part of the equation for the practical potential for wind turbines.

The table below indicates the technical potential for the larger 2MW and 500kW machines which could produce a high proportion

Technical potential for wind

Separation from houses m	Turbine	No of sites	Installed capacity MW	Potential output GWh pa	% of present demand	
					electricity	energy
500	Vestas 2MW	21	42	118	87%	15%
350	EWT 500kW this is a down rated 900kW	73	36.5	137	101%	18%
50+	Endurance 50kW	Needs 1,071	54	To meet 137	101%	18%

At 118 GWh pa this level of resource use compares favourably with the present area electricity demand of 136 GWh pa.

This analysis has the following constraints on wind turbines :-

- offset from any home by 500m to avoid noise issues
- turbine size in this analysis 80m diameter c. 2 MW
- no turbines within 500m of the coast

The results show that 21 large turbines could provide nearly all the present demand for electricity in this Area.

It is important to note that this is a generalised study to investigate the community's overall potential to generate energy from wind, not a proposal to site wind turbines in any particular location. This report is designed to be an aid

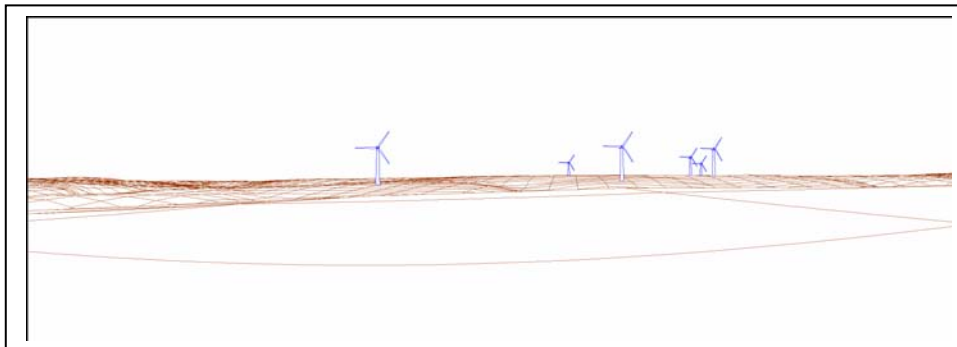
for extensive community consultation rather than a recommendation to site wind turbines in a particular place. The aim is to show the potential in the long term, so that as climate change and energy security issues come to the forefront of local thinking, the pathways to carbon neutrality and high resilience will be clear and already being worked up.

6.2.2 Issues for wind

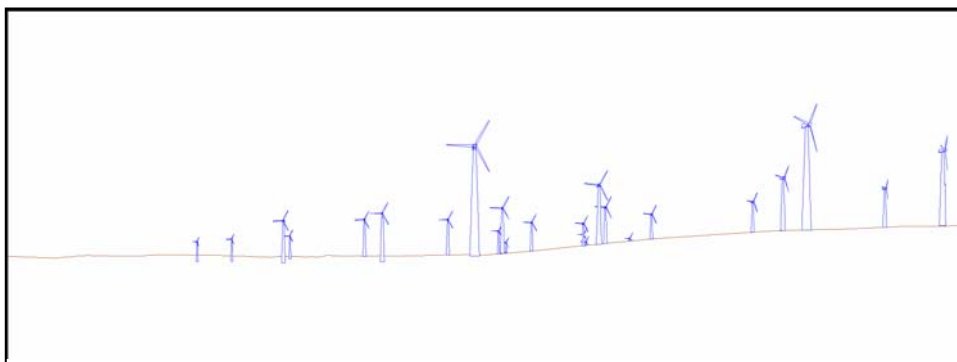
As wind turbines are by their nature very visible in the landscape, it is important to spend time on site assessments so that only suitable sites go forward to planning. One factor not often noted is that all opinion polls indicate that the majority of the public like or accept wind turbines in the landscape.

The most recent Ipsos/MORI poll from April 2012 shows that 67% of the public are in favour of the use of wind power in the UK, with only 8% opposed, and only 3% are strongly opposed. In addition a majority (57%) find the look of wind farms on the landscape acceptable and a fifth (20%) find them completely acceptable. These figures provide more evidence to show that while there is small but vocal anti-wind energy contingent, a majority of the public support the UK's abundant wind resources.

Example of largest number of 2MW visible from one location with all sites used



Example of close up on 50kW machines in large numbers



These two wirelines show the different impact of using the wind and choosing different scale wind turbines. The top wireline shows the location with the largest possible number of turbines in view in one direction in the 21 turbine sites set of 2MW potential machines. The lower one shows 30 small turbines of 50kW, which would not produce as much electricity as the fewer larger wind turbines, so for this 30 there is only an installed capacity of 1.5MW, not even the equivalent of one of the 2MW machines.

This is an illustration of the landscape value of choosing fewer larger wind turbines when working up the local resilience plan.

Following the route of fewer larger turbines also minimises disturbance to birds, bats and other wildlife as well.

As large wind turbines are significantly cheaper per installed kW and have more output for each installed kW, these turbines are also more financially viable in a constrained future where it is anticipated that electricity generation subsidies of all sorts will be much less available. The grid connection and grid integration costs for fewer larger turbines are also likely to be significantly lower than for smaller turbines.

The wind resource is therefore taken as large enough to meet present day electricity needs. This can be met by any combination of small, medium and large scale wind turbines.

For site owners the decision on turbine size is likely to be a combination of several factors including:-

- Project aim
 - To maximise return on investment
 - To maximise return on land use
 - To provide some or all of own electricity demand
 - To provide a local community energy service
 - To use as a pension
 - Any combination of these and other aims
- Site specific issues
 - Landscape and cultural factors
 - Space available
 - Distance to homes
 - Grid connection issues
- Electricity market
 - Potential differentials between different electricity markets such as direct sales, Feed in Tariff constraints, Renewable Obligation Certificates price and availability
 - Length of power contracts available
- Site owner issues
 - Cash available to take a project through the risk stages
 - Owner appetite for risk
 - Owner management time available for the process

Discussion on realisable wind resource

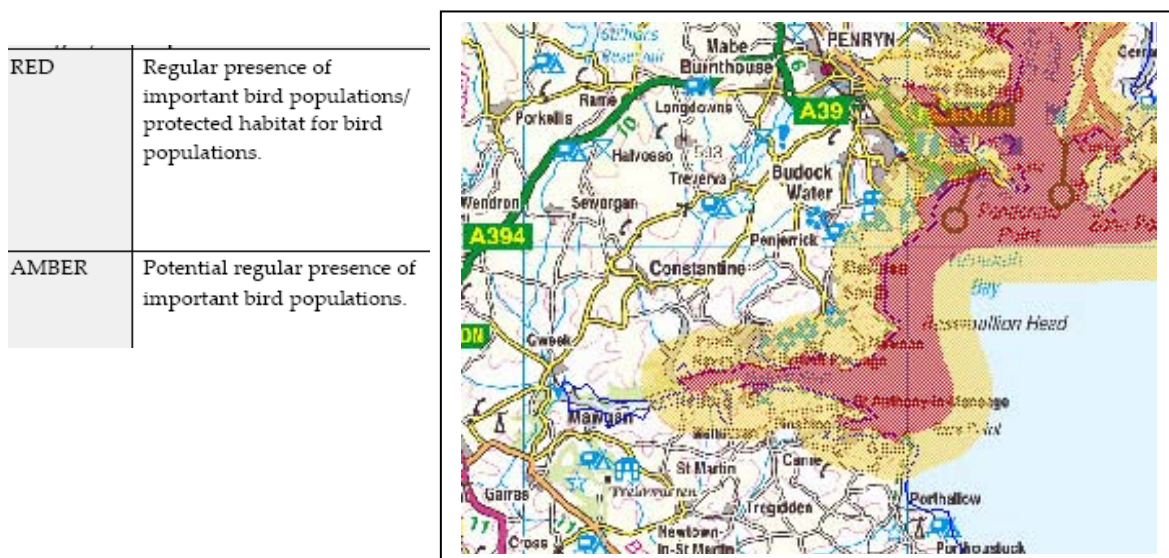
This analysis makes no assumptions about :-

- Planning and landscape policies in place over the next 30 years or so, as resource constraints tighten.
- Grid strengthening which may occur over the next few years.
- Improved wind turbine technologies

The significant issues for obtaining planning in the near future include assessment of bird and landscape and visual issues

Birds

RSPB: windfarms and birds in the SW



This shows that the coastline is to be avoided when siting wind turbines, which this assessment has done. Next to the red areas are amber markings. These are areas where bird monitoring should take place for two years before a planning application and hence site design should take account of local bird movements. Therefore the inland areas of the FEP area are likely to be free of major bird issues for planning purposes, although bird surveys would still need to be carried out potentially for the larger machines.

Landscape

The most recent, 2011, landscape character assessment carried out for Cornwall Council reaches different conclusions on the suitability of this area's landscapes for the acceptance of wind turbines compared to the work carried out in 2004/5. In 2004/5 the conclusions were that this area could readily accept medium sized clusters of wind turbines in several areas. In 2011 the conclusions are moving to a more restrictive view on what is acceptable within the landscape. In that short period of time, the landscape has not changed. What has changed is the attitude towards the landscape and changes in it. This shows that cultural and policy issues are a large determinant of planning.

This resource assessment is based on the aim of meeting long term energy needs for society by low carbon and carbon neutral means. Once climate change and resource depletion issues really bite, it is to be expected that cultural attitudes towards changes in the landscape will change again.

6.2.3 Wind site suggested by Town Councils

The site proposed is on the boundary between Falmouth and Penryn and this has been assessed initially as potentially suitable for two 50kW wind turbines. The planning assessment indicates that this area is not prominent or highly visible from the main traffic routes, being on the hill above one of the main roads, but shielded from most views by the shape of the hill and a high hedge at the lower side. The turbines would be visible only from a distance and hence not prominent in the landscape.

The noise assessment indicates that this site would not cause a noise nuisance to the nearest properties. Local investigations are continuing to identify and approach the landowner, with a view to agreeing an option on the land.

6.2.4 Conclusion

There is a large wind resource in this area: enough to provide all or most of the present electricity demand. How much of this will be developed depends partially on issues such as future views on energy security and pricing, developments of policies to encourage resilience and how much the climate change chaos predicted begins to be more visible to people locally.



6.3 Hydro potential

The most detailed resource study for hydro potential in Cornwall was the Cornwall Energy Project in 1989, but Rupert Armstrong Evans. The table below has been extracted from that work.

Hydro potential in Network area

Report no	River	kW	MWh pa
141	Carnon	26	108
142	Perranwell	15	65
143	Kennal	14	57
144	Mylor	10	41
145	Mabe	22	92
146	Budock	7	30
147	Bosanath	10	40
148	Treglidgwith	30	126
149	Comfort	14	60
150	Constantine	8	35
151	Bonallack	4	15
152	Gweek	33	139
153	Pembod	10	42
		203	850

Source: Cornwall Energy Project: Survey of hydropower potential in Cornwall: report to the Cornwall Energy Project by R J Armstrong Evans. 1989.

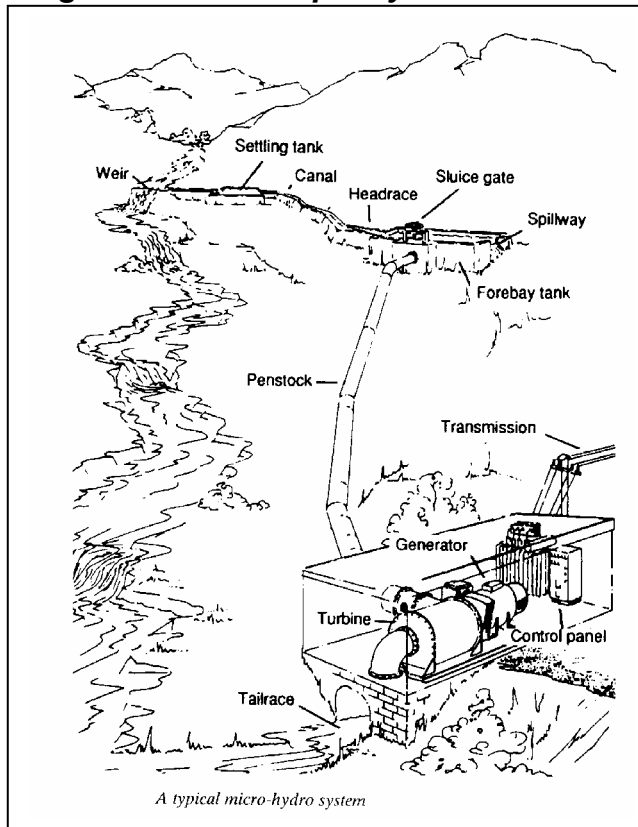
Example hydro powerhouse in woods nr Helston



200kW plant

The resource table shows that there are thirteen rivers with potential, and some rivers have more than one potential site. The maximum which could be developed would be some 200kW which would provide around 850 MWh pa of electricity. Although this is not a large resource, the projects are worth developing as they are long life plant with a relatively reliable output, which can provide a useful resource in a mixed renewable energy grid.

Diagram of an example hydro site



6.4 Biomass

Present land use in the area includes a small proportion of woodland amounting to around 3% of the greenspace in the area. In order to develop a local biomass market at any scale it will be necessary to plant more land to woods and coppice crops.

An early piece of community work leading up to this Leaf project was an assessment of how to provide local food resilience for the Network Area. This came to the conclusion that the local population can be fed a quality diet using local land, with little need for imports. This work also showed that there would be room for both biomass plantings and space for PV arrays.

A detailed assessment of the land use implications of local food and energy resilience is beyond the scope of this report.

The local food resilience concluded that some 1,900 ha could be made available for woodland plantings and this would still leave around 2,000 ha for PV arrays or other uses.

This potential 1,900 ha of coppice which yields around 12 t/ha/a provides enough fuel on a 2,000 hour heating season to fuel around 2,200 biomass systems of an average of 25kW. As many biomass pellet burners are smaller than this, no doubt a significant fraction of households could be at least in part heated with locally grown biomass from coppice. Potentially around one third could obtain some or all their heating from this potential 1,900 ha of coppice.

This does require some long term thinking on the part of the tree planter and the development of a local programme alongside business development.

7 Vision statement

This Vision has been developed during the Leaf project with considerable community involvement, and it constitutes one of the Leaf Deliverables- Del 2

Set up Fal Energy Partnership as social enterprise Deliverable 1

The Fal Energy Partnership (FEP) draws together organisations and interested individuals who care passionately about creating a low carbon future for Falmouth, Penryn and its surrounding areas.

We are keenly aware of multiple challenges before us in Cornwall. These worldwide challenges include climate change, resource depletion and financial issues. Each of these issues impacts us locally. All tend to decrease the security of supply of important daily needs like food and energy, either by increasing prices or by disrupting supply chains.

With higher local energy efficiency we can produce all our energy from local renewable energy resources, building on local expertise

FEP is collaborative, inclusive and will be the catalyst to make our area resilient, energy efficient and sustainable over the next 25 years and beyond.

Short term

- Distribute energy efficiency leaflets widely
- Increase domestic energy efficiency by 15%
- Produce all our own energy needs locally
- Raise local awareness and grow
- the local investment base

Medium term

- Produce 30% of local electricity needs
- locally from wind and sun
- Create local quality jobs and businesses
- Initiate a community wind turbine/solar array scheme
- Plant 1,000 hectares of new woodland for coppice

Long term

- We aim to develop a long term investment plan, which all can join, through the Industrial Provident Society which is the Fal Energy Partnership, a social enterprise
- Produce all our own energy needs locally
- Create local resilience and healthier, wealthier communities



7.1 CO₂ reduction targets

In line with the government legally adopted target in the Climate Change Act 2008, we feel that a target of at least 80% reduction in carbon emissions by the year 2050 against emissions in 1990 should be adopted.

http://www.legislation.gov.uk/ukpga/2008/27/pdfs/ukpga_20080027_en.pdf

As the whole world has to be part of the solution rather than the problem, it is the responsible action to take for each area of the country and the world.

This target is challenging but amounts to cutting demand by 1.2 % each year from 2013 on for the following 37 years, along with increasing renewables supply by 11.3 GWh pa each and every year.

For the Falmouth and Penryn Community Network Area, this means in common with the rest of the country significant change in our energy situation, both in terms of its effective use and where our energy comes from.

The intended budget gives a 42% reduction of greenhouse gas emissions by 2020, relative to 1990 levels.

There are no District or Falmouth level energy statistics for 1990, but there is a 1987/8 estimation made during the Cornwall Energy Project, which is disaggregated in the table below.

Carbon dioxide emissions from the Network area 2009

Fuel	totals	%	kgCO ₂ e /MWh	CO ₂ e t	%
coal	12	2%	413.42	4,961	2%
oil	434	56%	320.21	138,971	51%
gas	193	25%	225.54	43,529	16%
electricity	136	18%	617.07	83,922	31%
RE & waste*	11	1%			
totals	776	100%		271,383	

* RE and waste not included in electricity totals to avoid double counting

Sector CO₂ emissions 2009 tonnes CO₂e

Energy source	C+i	Domestic	Transport	Total
coal	827	4,134		4,961
oil	16,971	39,066	82,934	138,971
gas	10,600	32,929		43,529
electricity	24,683	59,239		83,922
Totals	53,081	135,367	82,934	271,383
	20%	50%	31%	
1990 level				236,076

This shows that the main effort in reducing carbon emissions needs to be in the domestic sector and specifically in reducing electricity demand, which is some 43% of total domestic sector emissions. In addition there is a great need to change the large number of oil boilers to more efficient local renewable energy supplies such as ground source heat pumps or biomass boilers or furnaces.

Meeting the Climate Change Act targets for this area therefore means increasing fuel and energy efficiency as well as a major change towards renewable energy supplies.

Reductions in carbon emissions required to meet legal UK targets tCO₂e

Year	Target reduction on 1990	Means reduce by	Allowance to meet target	Means reduction on 2009	
2020	26%	61,360	174,640	89,955	34%
2030	44%	103,840	132,160	132,435	50%
2040	62%	146,320	89,680	174,915	66%
2050	80%	188,800	47,200	217,395	82%

This table shows the impact of applying the national legal targets at a local level, which is where these targets will have to be met as well as nationally.

This level of carbon reduction suggests the need to ensure that all electricity supply and most heat supply is from non fossil sources. It also requires a significant cut in demand for energy for all purposes, as has been noted above

7.2 How to meet the targets

Assuming that half of the target is met from reduced demand and half from local renewable supplies, this suggests the following specific targets are needed.

50% reduction of energy demand by 2050. Although this seems like a major undertaking, given the time in which it needs to be undertaken, a long term programme of 1-2% energy reduction every year over the next 37 years would meet this target.

The large sources of emissions in the domestic sector are in electricity and in oil use. This suggests that a major campaign of energy reductions in these areas would be valuable to reduce GHG emissions.

Domestic energy demand has already been reducing, as shown by the ONS figures for Cornwall and the Districts for 2005-2008. This shows the domestic demand for electricity and gas has dropped by 8% and the domestic use of oil has dropped by 5%. How much is due to increased prices and improved energy efficiency vs increased fuel poverty is not known. The domestic sector

actions provide details on proposed programmes to meet this demand reduction target.

The commercial and industrial sector has seen significant reductions in demand for energy in the last few years. How much is due to the recession is not known, although the local statistics show an increase in the number of businesses using gas and electricity. It may be that higher prices are increasing awareness and driving energy demand reductions.

Transport has also dropped in volume, but only in personal transport. Significant reductions in freight as well as personal transport will be needed to meet the carbon reduction targets.

Local renewable energy supplies

Along with the 50% of targets from reduced demand comes a target of 50% of energy supplies from local renewable supplies.

The section on renewable energy sources shows significant potential from wind, solar and biomass in the near term. The targets therefore are most likely to be met if this is planned into a local energy investment programme.

Meeting a local investment target of over 11GWh extra RE each year implies a programme of around £10m pa. This would be needed for one 2MW wind turbine each year and around 5MW of PV installation plus smaller amounts of biomass, ground source heat pumps etc.

A large percentage of the building mounted PV would be happening in any case if the FiT survives, as PV is well thought of in Cornwall and installations are still increasing.

FEP will be working up programmes and an investment aim based on the idea of a pension fund to build up local incomes from secure investments in renewables. If thought of as a pension the cost of the programme would be around £385 per person pa for the people of the Falmouth and Penryn Community Network Area.