# Renewable Energy Manufacturing Opportunities For Camborne, Pool & Redruth

## Appendices

Paper prepared on behalf of Cornwall Sustainable Energy Partnership, funded through Local Area Agreement (LAA) funding and Combined Universities in Cornwall (CUC) Business Support Programme

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Included in these appendices are:

- Detailed analyses of the different renewable energy technologies, in sections A through to I.
- A list of existing renewable energy companies within Cornwall.
- Listings of local component suppliers and manufacturers, which may be able to supply components, depending on specific design.
- List of acronyms used in report and appendixes.
- Bibliography listing where information has been found for the writing of this report.

## A: Micro Combined Heat and Power (Micro CHP):

CHP is a form of cogeneration, generating electricity and heat simultaneously, allowing for higher efficiencies compared to using two separate systems. On larger scale, CHP systems are used to increase efficiencies in thermal power plants (nuclear or fossil fuels), by capturing waste heat from exhaust gases and recycling it. The primary objective for these is to generate electricity, heat being a useful by-product.

On the contrary, micro CHP systems primary objective is to generate heat, meaning the amount of electricity generated is dependant upon the heat required. These systems use one of the following technologies:

- Reciprocating Engines: a piston engine, such as a combustion engine in cars.
- Stirling Engines: a heat engine containing a sealed circuit filled with a working gas such as helium, hydrogen or even air. The system contains 2 pistons, each with a heat exchanger; one hot and one cool (though the cool can just be air). The greater the temperature difference, the higher the efficiency.
- Steam Engine: water is heated and as the steam heats up it expands, and this can be used to create mechanical movement.
- Rankine Cycle Engine: an engine that follows the Rankine Cycle as close as possible (to reach a high efficiency).
- Fuel Cells: rather like a battery, they are an electrochemical energy conversion unit with a supply of reagents. A typical and practical example is the hydrogen fuel cell, which uses hydrogen and oxygen.

Domestic systems are designed to run off natural gas, though it is possible to use other fuels. All are still in their early stages of R&D, though the Stirling Engine and Fuel Cell CHP systems are becoming close to the commercial market.

Micro CHP has had interest in the UK recently, with the carbon trust currently running a trial on small-scale (>25kW) and micro (around 1kW rating) CHP units. The trial started in 2003, with the goal of collecting independent data on performance/saving benefits, and included Stirling engines, Organic Rankine Cycle machines, fuel cells and internal combustion engines.

Data is currently being generated from the 40 units within the trial, which points to the potential of the systems but also that there is still much need for development. A third of systems achieve reduced emissions, another third with little/no difference and the final third with increased emissions. Small CHP systems appeared to be more efficient than the micro CHP, but this could quite possibly be due to more R&D (data from “The Carbon Trust’s Micro and Small-Scale CHP Field Trial Update Report”, November 2005. The studies final conclusions are due to be published in the summer, 2007).

Several UK companies are developing micro CHP systems, but developments are relatively small scale and far from market. There are developments of micro CHP systems from international companies, which have some interest, and in the following instances investment:

- A deal signed between Powergen (consumer trading arm of E.ON) and Whisper Tech (a New Zealand micro CHP developer) for 300 million NZ$ (approximately £99,243,000) occurred in 2004. This will result in the installation of Whispergen CHP systems in 550 family homes in east Manchester as part of a new Lovell housing development. The units are hoped to save £150 - £200 a year off energy bills. Powergen has also committed to purchasing a further 80,000 systems (information and more details on Whisper Tech's "More success for Whisper Tech in the UK" media release, 21st October 2004). The trial in Manchester is nearing completion, and Powergen hope to make their Whispergen modules available in January 2007. They will also be moving manufacturing facilities from New Zealand to mainland Europe.
- Baxi Heating UK has signed a deal with Microgen Energy Ltd to produce a micro CHP unit for the UK Residential market in 2008. The systems are hoped to save £100 a year off energy bills, and to reduce carbon emissions by 1.5 tonnes per household (information and more details on "Baxi signs an agreement with Microgen", a publication on behalf of Baxi released July 2006)

Fig A: Microgen CHP Unit

Due to micro CHP being so far from the commercial market, larger companies taking the best designs (meaning hard competition) and the technical designs of the products, micro CHP systems do not currently match the CPR area. The Micro CHP market should however be monitored, as once it becomes more developed it could suit the CPR area, as there is a gap in the southwest for cogeneration.

| Manufacturing Criteria | Suitable for CPR now | Not suitable for CPR | Future potential but needs major support to develop |
|---|---|---|---|
| Emerging Technology | | | ✓ |
| Demand for technology is growing | ✓ | | |
| Local companies make same or similar parts | | | ✓ (Certain Parts) |
| Some or all materials available locally | ✓ (Certain Parts) | | |
| Requires large scale manufacturing | | | ✓ |
| Doesn't match local skills | | ✓ | |
| Too much competition from multi-nationals (or patent issues) | | ✓ | |

## B: Tidal Power:

### B.1: Tidal Barrages:

Tidal barrages are the older and largest form of tidal power. The most prominent and first creation is of the Rance Barrage, located on the estuary of the Rance River, Bretagne, France. The Construction was completed in 1967 taking 6 years to build, and measures 750 meters long by 13 meters high. The scheme has generated 600 million kWh every yeah, enough for a quarter of a million households (facts and more information from "The Rance tidal power plant, see appendixes). There have been other small developments in the world. In the UK two possible projects have been looked at. These are:

- The Severn Barrage: the largest of the 2 possibilities
- The Mersey Barrage: a much smaller more manageable barrage proposal, but the cost/output ratio would be higher

The barrages work by preventing the flow of water until there is a difference in height between each side of the barricade. When the tide is high, water is trapped behind a barrage, then when low it is passed through turbines, or when low tide arrives tide is allowed passage through the low reserves. This is all due to the difference in water height (head), which allows for the waters weight to drive water through the turbines and generate electricity.

As can be expected, tidal barrage systems are designed, constructed and installed uniquely for each application, and although there are some parts which could be used universally (such as turbine design), tidal barrage technology would not have a large enough market on its own.

| Manufacturing Criteria | Suitable for | Not suitable for CPR | Future potential |
|---|---|---|---|

| | CPR now | | but needs major support to develop |
|---|---|---|---|
| Emerging Technology | | | ✓ |
| Demand for technology is dropping/ static | | ✓ | |
| Little/No local companies make same or similar parts | | ✓ | |
| Some or all materials available locally | | | ✓ |
| Requires large scale manufacturing | | ✓ | |
| Matches some local skills | | | ✓ |
| Too much competition from multi-nationals (or patent issues) | | ✓ | |
| Little competition | ✓ | | |

## B.2: Tidal Streams:

These technologies harness ocean currents/streams, similar to how wind turbines harness wind. Still very new and in the R&D stages, there are several different types being developed, including the Marine Current Turbine, developed by Marine Current Turbines Ltd, as part of IT Power. These are rather like underwater wind-turbines. Mounted to fixed steel piles driven into the seabed, the turbine itself can be moved up and down this for maintenance and positioning. Another system in development is the Stingray Tidal Generator, which use "hydroplanes", rather like aerofoils in design. The system works rather like a whale's tail, the currents moving the hydroplanes up and down on a lever, which is used to drive the generator.

As is clear, these technologies have much potential. They are modular, so R&D is much easier and the resource can be exploited gradually. This could be done by installing new modules as old ones finish their payback period. Much work is needed on them before a full scale system exists. Manufacturing will likely be large scale, for generating electricity for national use. These 2 points in mind, tidal stream technologies would not be suited for construction in the CPR area.

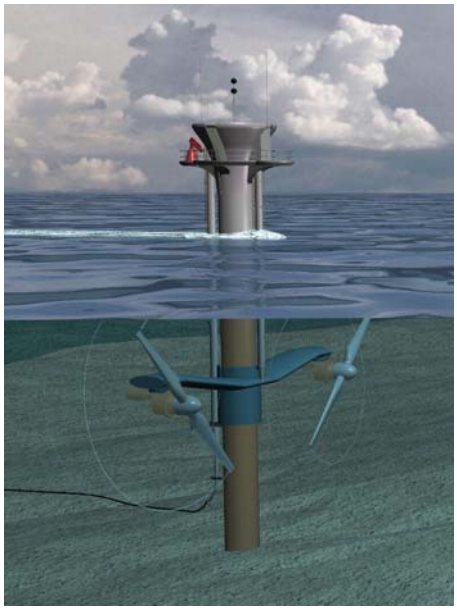

Fig B: Artists Impression of a MCT Seagen pile-mounted twin rotor tidal turbine

| | Suitable for CPR now | Not suitable for CPR | Future potential but needs major support to develop |
|---|---|---|---|
| Technology in R&D stage | | ✓ | |
| Local companies make same or similar parts | ✓ | | |
| Some or all materials available locally | ✓ | | |
| Requires large scale manufacturing | | ✓ | |
| Matches some local skills | | | ✓ |
| Little competition | ✓ | | |

## C: Wave:

Wave energy, like tidal stream technology, is still very much in the development stage. There are several methods being used to attempt to harness the resource onshore. Many work on capturing a wave, and releasing it through a turbine system. Others use the wave's force to push air back and forth through a turbine, and this has proved the most successful. These onshore wave harnessing devices are rather like tidal barrage schemes, as the best successes come from using the existing landscape, designing systems around this.

Offshore devices are much harder to design and maintain, as there are greater difficulties out in the open water, however there is a much larger resource size and getting permission to build is easier as they do not change the landscape.

These devices either have to be fixed to the seabed or floating. Fixed devices have usually been designed around the oscillating water column (OWC) principle, working on the same principle as the most successful onshore designs, running air back and forth through a generator (generally using a Wells turbine).

One of the major problems with wave energy devices is their output varies wildly due to wave conditions, which means that the quantity they generate is hard to estimate and in small/isolated grid systems the supply is too varied. Floating devices are some of the newest forms of harnessing wave energy. All but one are still in the prototype stage, though the potential for this sector is high.

The Pelamis Wave Energy Converter is a floating wave device that is currently the only working model, with the creator Ocean Power Delivery (OPD) Ltd having signed an €8.2 million order for a Portuguese consortium, to deliver the initial phase of the worlds first commercial wave farm.

Because the technology is still in its infancy and when it is used it will be used in large scale, this technology does not suit being manufactured within the CPR area.

| Manufacturing Criteria | Suitable for CPR now | Not suitable for CPR | Future potential but needs major support to develop |
|---|---|---|---|
| Technology in R&D stage | | ✓ | |
| Local companies make same or similar parts | ✓ | | |
| Some or all materials available locally | ✓ | | |
| Matches some local skills | | | ✓ |
| Little competition | ✓ | | |

## D: Hydroelectric:

This form of renewable energy works by harnessing the potential energy within water. This is often done using a dam system or another form of harnessing gravity's effect on water to force it through a turbine, and hence generating energy.

For large hydroelectric schemes they require large head and flow rate. For instance, the last power station at Galloway power stations in Scotland has a head of 32 meters and a max flow rate of 127 $m^3/s$. The UK is thought to have exploited its large scale hydro resources, though there are still large scale hydro developments in the world, such as Three Gorges Dam in China.

There is however still more potential for small scale hydroelectricity. As discussed the technology is very simple, and the resource could simply be a

small stream flowing down a hill. For the purpose of manufacturing, it needs to be mini and micro hydro in order for there to be a large enough market, as for larger systems a dam is often used, which means installations are specific.

There have already been a number of small scale hydro installations within Cornwall, largely due to Evans Engineering with another 220 kW installation by western hydro. Between the 2 companies, they have installed approximately 15 small hydro schemes, generating 986 kW of electricity. The technology itself has been around for years, and there are a range of turbines for different circumstances:

| Head (m) | <1 | 1 to 10 | 10 to 100 | >100 |
|---|---|---|---|---|
| Flow Rate $m^3/s$ | | | | |
| <10 | Francis | ↔ | Propellor & Kaplan | Propellor & Kaplan |
| 10 to 60 | Pelton & Turgo | ↔ | Francis | Francis |
| >60 | Pelton & Turgo | Pelton & Turgo | ↔ | Francis |

Fig D: Table showing different applications of turbines
Note: ↔ means that either turbine to the left or right can be used

After correspondence with Rupert Evans, and looking at hydro installations in Cornwall and the UK as a whole, it has been found that the small and micro hydro industries have a great difficulty with legislation. Though 20 years ago many hydro projects were being installed, it is now very hard and takes a long time for a project to be completed, and many consumers wish for a higher return and faster payback than is possible. This is mainly due to tighter planning and environmental regulations, but also the consumers have been more

There is still a lot of hydro potential in Cornwall and the UK, but it is hard for them to be developed. UK manufacturers have a big problem as with all UK manufacturing industries of competing with cheap, poor quality imports from SE Asia. This is a big problem, as many of these products *appear* to be a better deal, but they fail to last.

Due to this, unless there is a change in government legislation which would make it easier for projects to go ahead, or there was a change in public opinion/knowledge of hydro (a lot of people only think of PV and wind when asked about renewables), the manufacture of this technology for CPR would not be suited.

Fig C: Rupert Armstrong Evans with a range of Pelton Turbines, 1996

| Manufacturing Criteria | Suitable for CPR now | Not suitable for CPR | Future potential but needs major support to develop |
|---|---|---|---|
| Established Technology | ✓ | | |
| Demand for technology is dropping/ static | | ✓ | |
| Local companies make same or similar parts | ✓ | | |
| Some or all materials available locally | ✓ | | |
| Requires small scale manufacturing | ✓ | | |
| Doesn't match local skills | | ✓ | |

## E: Solar Photovoltaic (PV):

Solar PV is a method for generating electricity directly using the sun's light. It works by using 2 thin layers of semiconductors, one positive and one negative. These are generally made of crystalline silicone, though there have been others developed using heavy metals and gallium arsenide. It must be noted, there is a shortage of high grade silicon used in the manufacturing of PV, which has affected the market in the quantities and prices of the technology. There are 3 main types, with a fourth in development:

- Monocrystalline: the first type of PV panel, created from single wafers. They give high efficiencies, but are also expensive to produce.
- Polycrystalline: the second type of PV panel. Shards of silicon are used instead of single blocks, which means they are less efficient but cheaper to produce.

- Amorphous: these cells use thin films of silicon, and although current production costs are high, these cells can be produced on a faster and larger scale which in time will lower costs. These cells have lower efficiencies than the previous 2.
- Third generation: though still in infancy development, once in production these cells will be the thinnest and least efficient, however they have the opportunity to be manufactured on a production line basis, lowering costs drastically.

| | amorphous silicon | monocrystalline silicon | polycrystalline silicon |
|---|---|---|---|
| efficiency | 3 - 6 % | 12 - 15 % | 10 - 13 % |

Fig E: average PV efficiencies

Currently the most cost effective out of these cells are polycrystalline (giving the cheapest £/kW), however as the technology develops the cheapest and thereby most efficient in monetary value will move down this list. The market is currently strongest in Germany, which thanks to its lenient tariff mechanism funding which awards solar generators more than other technologies, has control of much of the market. China and Japan also have a large amount of PV manufacturing.

The production is industrially intensive, needing large manufacturing facilities. Another problem facing PV manufacturing is a shortage of high quality silicon. This means a PV manufacturer needs a large site for the production, and good transport links for both importing components and exporting the panels. For these reasons, as well as the need for skilled labour for PV production which doesn't match that of CPR, solar PV is not suited for being manufactured in the area,

| Manufacturing Criteria | Suitable for CPR now | Not suitable for CPR | Future potential but needs major support to develop |
|---|---|---|---|
| Technology in R&D stage | ✓ | | |
| Emerging Technology | | | ✓ |
| Established Technology | ✓ | | |
| Demand for technology is growing | ✓ | | |
| Little/No local companies make same or similar parts | | ✓ | |
| Materials not available locally | | ✓ | |
| Requires large scale manufacturing | | ✓ | |
| Too much competition from multi-nationals (or patent issues) | | ✓ | |

## F: Biomass:

Biomass is any fuel derived from living or recently living biological matter. This is sometimes plant or animal waste from industry, or it can be grown specifically. Crops grown specifically include miscanthus and short-rotation coppice for solid fuels, and oil seed rape and other oil-producing plants for bio-diesel.

Though these energy devices do not save carbon, they are close to being carbon neutral; the fuel sources absorb carbon from the air and soil, reducing the amount of carbon present. Then when burnt they release the stored carbon.

There has been much interest in the renewable biomass industry of late, as it provides an alternative to fossil fuels. Though working systems have been designed, there is still R&D to find a better compromise between fuels and boilers. In order to gain higher efficiencies, most biomass-boilers require the fuel to be processed first, creating wood pellets or chips. Biomass boilers tend to need servicing on a more regular basis, due to the fuels being less efficient. For this reason, the technology in an area should compliment the available fuel.

Some national funding will be available to aid growers and consumers; however, it is unlikely there will be funding available for manufacturers. In section 24 of PPS22, the guidelines state that the distance travelled by the fuel sources to the fuel refineries must be kept to a minimum, though other issues such as grid connection and the use of waste heat should also be considered.

Bio diesel and other liquid bio fuels (such as bio ethanol) have also been gaining much interest, and some areas are beginning to produce and use the resource. This is not surprising; the combustion engine was designed to run on ethanol and the diesel engine to run on peanut butter oil. A community-based bio diesel project in South Wales, run by Sundance Renewables has been set up, using locally sourced used vegetable oils and has had good reception from the local community.

In order for biomass systems to operate, there needs to be a fuel supply, but without the systems, there is not the need for the fuel, resulting in a catch twenty-two situation. This presents the biggest barrier to growth in the biomass industry. In this area, it has been highlighted in the CPR sustainable energy feasibility study that there is a limited supply of biomass fuel in the area. There are some suppliers within the southwest, mainly supplying wood fuels (BiCal, Wood Energy, Renewable Energy and South West Wood fuels) which could supply a small to moderate supply of wood fuels.

Biomass cont…

| Manufacturing Criteria | Suitable for CPR now | Not suitable for CPR | Future potential but needs major support to develop |
|---|---|---|---|
| Emerging Technology | | | ✓ (smaller scale) |
| Established Technology | ✓ (larger scale) | | |
| Demand for technology is growing | ✓ | | |
| Local companies make same or similar parts | ✓ | | |
| Some or all materials available locally | ✓ | | |
| Doesn't match local skills | | | ✓ |
| Too much competition from multi-nationals (or patent issues) | | ✓ | |

## G: Geothermal: Ground Source Heat Pumps (GSHP):

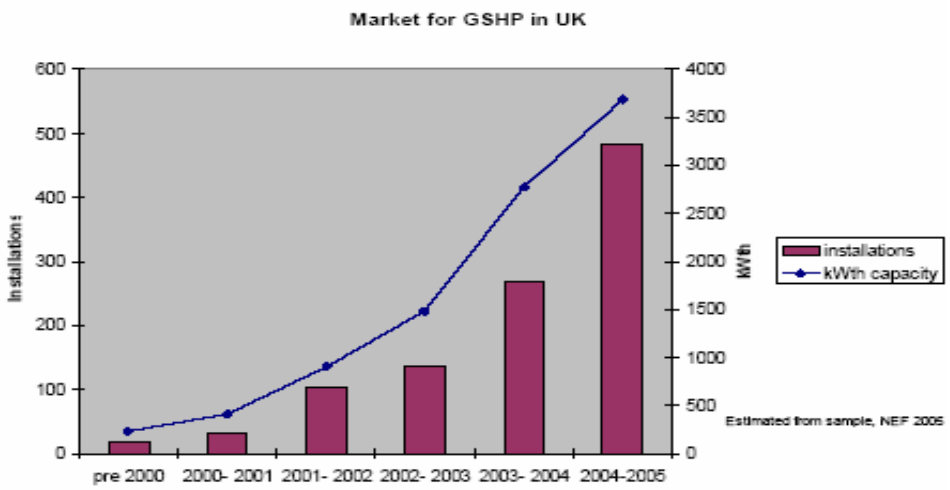

Fig F: GSHP Installations

GSHP are one of the fastest growing sustainable industries, with over 500,000 installations worldwide and over 400 UK installations in the last year (figure from UK GSHP association). As GSHP popularity has grown, the rate of installations has increased, producing the following graph.

They provide an efficient and cheap form of heating, condensing boilers in mains gas areas provide the only comparable energy efficient heating. This makes ground source heat pumps a great application in off gas areas. The system itself

is renewable, though the motor can have a “parasitic” energy use, but uses very little energy and can be powered by another renewable technology

GSHP were invented over 50 years ago, although Richard Trevithick (Camborne inventor of the steam locomotive) invented the first heat pump for use as a refrigerant on ships. Unlike air source heat pumps, GSHP use the ground as a heat sink instead, providing a much more consistent form of heating. There are open loop systems, which use lakes and wells, though the general system is a closed loop of tubing which runs either vertically in bore holes, or horizontally along the ground.

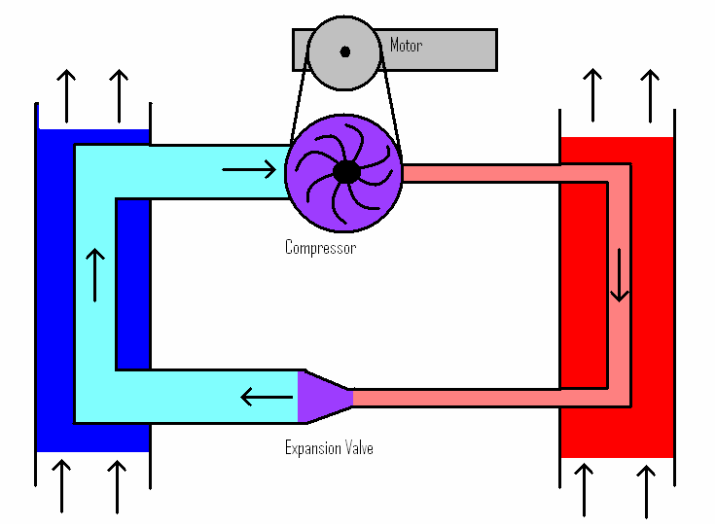


Fig G: Simplified GSHP unit

A GSHP unit can be split in to three parts. The first is the earth pipes, either horizontal or vertical, which collect heat from the ground, displayed as blue on the diagram. Horizontal provide the most efficient and cheap option, a trench is buried where coiled lengths of MDPE piping (medium water piping) is laid, otherwise known as slinkies. For vertical pipes a bore hole must be drilled, and a vertical ground loop of pipe is used. Multiple boreholes are sometimes needed to provide enough heating. As can be imagined, the drilling of the boreholes is what adds most to the cost for vertical systems. Water can be used for these pipes, however in the UK an anti-freeze solution is used to prevent freezing.

This heat is exchanged to the unit itself with either a heat exchanger or wrapping the pipes together. The fluid in the unit itself is a refrigerant, and its heat is stepped up using a compressor, driven by a motor. The fluid then carries on round at a higher temperature. Heat is transferred between this and the heating system of the house (red on the diagram) using a heat exchanger. Under floor heating is best suited for use with GSHP, though central heating can be used. The refrigerant passes through an expansion valve to complete the loop, which returns the fluid to its normal, cooler state.

The compressor used is a small-scale scroll compressor, with the best quality produced by Copeland, which have distributors located in Exeter. There is a heat exchanger in the house-heating side, and an option for one in the ground-piping side, though this isn't necessary it does improve efficiency. The rest of the unit consists of basic plumbing components including an expansion valve, which can be found from plumbing suppliers.

| Manufacturing Criteria | Suitable for CPR now | Not suitable for CPR | Future potential but needs major support to develop |
|---|---|---|---|
| Established Technology | ✓ | | |
| Demand for technology is growing | ✓ | | |
| Local companies make same or similar parts | ✓ | | |
| Some or all materials available locally | ✓ | | |
| Requires small scale manufacturing | ✓ | | |
| Little competition | ✓ | | |

## H: Solar Hot Water Heating:

Being one of the simplest of renewable devices, a solar hot water heater works by heating water through the sun's energy. In its most basic form this is with a flat plate collector, which works at lower efficiencies but has a lower embedded energy. The other is a solar evacuated tube, which has higher efficiencies yet higher embedded energy. The system is fitted in the same positions as PV, preferably on the roof. Circulation of the water can be pumped (which may lead to parasitic energy use) or thermo siphon (the passage of water through the acts of heat exchanger). In order for thermo siphoning the hot water collector must be slightly below (about 18 inches) the hot water tank.
Solar hot water systems cannot supply all our hot water needs in the UK, which means a boiler is still needed. This can lead to some unpopularity, yet they do provide hot water for much of the year, and even in winter will reduce the use of the boiler.

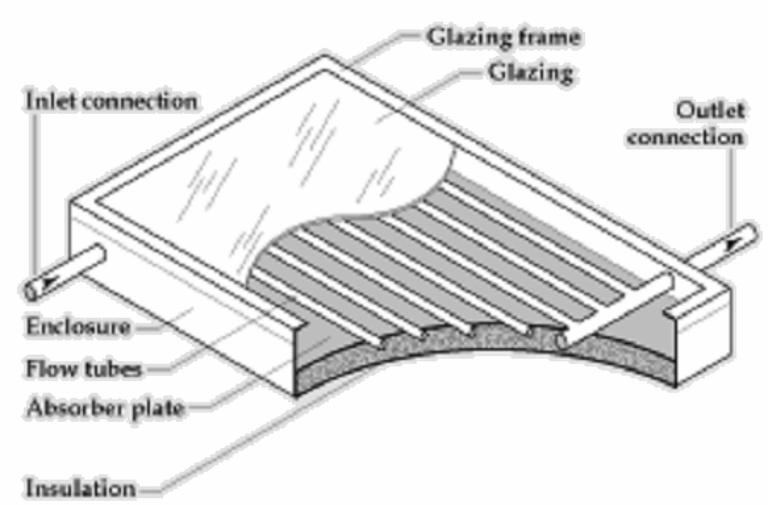


Fig H: Flat Plate Collector

Above is a diagram of a flat plate collector. As shown, the system is simple, and the components are not complicated:

- Enclosure: well insulated to avoid heat loss.
- Glazing frame: well insulated and sealed to avoid heat loss and keep box sealed to outside conditions.
- Glazing: Well insulated to avoid heat loss.
- Absorber Plate: a plate designed to capture the sun's rays; dark coloured with a black chrome coating, to increase efficiency in catching solar thermal energy.
- Flow Tubes: arranged rather like radiator systems, with pipes running as shown in above diagram or in a serpentine configuration (pipes snake around). In either case the objective is to distribute pipe area evenly within the collector.
- Outlet/Inlet Connections: a simple plumbing application to connect collector to plumbing system.

One of the problems with solar collectors in the UK is of freezing. There are a number of methods to prevent this:

- Direct Systems: where the water passes through flow pipes a draining system is used in low temperatures to empty water from system to prevent damage due to freezing.
- Indirect Systems: where an antifreeze solution is used in the solar collector and a heat exchanger in the tank is used to transfer heat. This is the more common solution in colder (UK) climates.

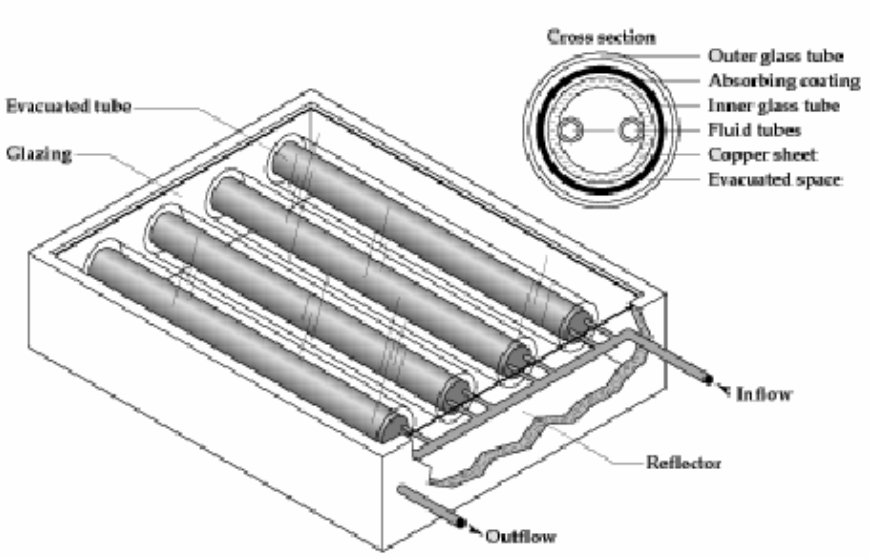


Fig I: Solar Evacuated Tube Collector

Above is a diagram of a solar evacuated tube collector. Instead of using standard pipes, it uses glass tubes containing a vacuum. This dramatically reduces heat loss from the pipe without reducing solar gain. However the cost and equipment needed in order to produce these are much higher, hence not suited to CPR. Solar plate collectors are better suited to small manufacturing companies, but as the external systems are the same, the company could import tube systems.

| Manufacturing Criteria | Suitable for CPR now | Not suitable for CPR | Future potential but needs major support to develop |
|---|---|---|---|
| Established Technology | ✓ | | |
| Demand for technology is growing | ✓ | | |
| Local companies make same or similar parts | ✓ | | |
| Some or all materials available locally | ✓ | | |
| Requires small scale manufacturing | ✓ | | |
| Matches local skills | ✓ | | |
| Little competition | ✓ | | |

## I: Wind:

Wind has been harnessed for hundreds of years, be it grinding our corn or powering our ships. Soon after the invention of the dynamo generator wind turbines were developed, but it was not until the 1930s that this was done on a commercial scale, for use as charging ships batteries. There was a second technological breakthrough in the 1980s as the early wind farms began being installed. In 1991 the UK's first commercial wind farm was installed in Delabole, North Cornwall. Since then Cornwall has had 7 more wind farms installed as well as some other small wind turbine installations.

For manufacturing, the sizes are split into micro and larger scale. There are several construction differences between these types:

- Larger scale turbines usually use hollow masts in order for maintenance. The building of the mast is also more complicated as it has to support a larger weight and cannot use small scale techniques such as cables.
- For micro turbines, the blade materials are a lot simpler. Aluminium or fibreglass is often used, as this helps keep costs down. Larger wind turbines need lighter/stronger blades, so tend to use advanced materials such as epoxy resins.
- For medium/large scale turbines, blades must be tested rigorously for safety reasons. Although small/micro turbines must still be tested, this is easier to facilitate, and could be carried out by the manufacturer.
- The electrical and gearing systems in larger turbines are more complicated in order to cope with the larger forces and weights involved.

For the purpose of the CPR area, small and micro scale would be best suited as it suits small-scale manufacturing, and is more likely to match local skills. The small scale wind industry is also growing at a fast rate, as it is relatively recent yet proven technology.

### I.1: Large Scale Wind:

| Manufacturing Criteria | Suitable for CPR now | Not suitable for CPR | Future potential but needs major support to develop |
|---|---|---|---|
| Established Technology | ✓ | | |
| Little/No local companies make same or similar parts | | ✓ | |
| Materials not available locally | | ✓ | |
| Requires large scale manufacturing | | ✓ | |

## I.2: Small Scale Wind:

| Manufacturing Criteria | Suitable for CPR now | Not suitable for CPR | Future potential but needs major support to develop |
|---|---|---|---|
| Technology in R&D stage | | ✓ | |
| Emerging Technology | ✓ | | ✓ |
| Demand for technology is growing | ✓ | | |
| Little/No local companies make same or similar parts | | | ✓ |
| Local companies make same or similar parts | ✓ | | |
| Some or all materials available locally | ✓ | | |
| Requires small scale manufacturing | ✓ | | |
| Matches local skills | ✓ | | |
| Little competition | ✓ | | |

## J: Existing Cornish RE Companies:

| Company | Category | Web Site | Phone | Address |
|---|---|---|---|---|
| All Wind (UK) Ltd | Wind Consultancy & Support Services | http:// www.all-wind.co.uk | 01326 565561 | Unit 2, BT Workshops Tyacke Rd Helston TR13 8RR |
| Atlantic Energy Ltd | Energy & environmental consultancy. | http://www.atlanticenergyservices.com/ | 01209 860068 | Quenchwell Carnon Downs, Truro Cornwall TR3 6LN |
| Celtic Solar | Solar water heating specialists | http:// www.celticsolar.co.uk | 01566 781509 | The Shippon, Lanzion Egloskerry Launceston PL15 8RZ |
| Cornwall Environmental Consultants (CEC) | Consultancy & Support Services | http:// www.cec.gb.com/ | 01872 262510 | Five Acres Allet Cornwall TR4 9DJ |

| | | | | |
|---|---|---|---|---|
| EarthEnergy Systems | Consultants in geothermal energy and ground source heat pumps | http:// www.earthenergy.co.uk | 01326 211070 | Falmouth Business Park Bickland Water Rd Falmouth TR11 4SZ |
| Esterco Biofuels Ltd | Supplier of biofuel | http://www.billings.webspace.fish.co.uk/ | 01726 66763 | Esterco Biofuels 33 Trevarthian Road St Austell Cornwall PL25 4BT |
| Evans Engineering | Hydro Turbines | http://www.evans-engineering.co.uk/ | 01566 782285 | Trecarrell Mill Trebullett Cornwall PL15 9QE |
| Geoscience Ltd | Earth Science Consultancy | http:// www.geoscience.co.uk | 01326 211070 | Falmouth Business Park Bickland Water Rd Falmouth TR11 4SZ |
| Green Peninsula | Wind Project Development | http:// www.greenpeninsulaco.com | 01726 222970 | Green Peninsula The Old Pottery, Old School Lane Charlestown, St Austell PL25 3NL |
| Kensa Engineering Ltd | GSHP Manufacturers and suppliers | http:// www.kensaengineering.com | 01326 377627 | Chough Close Tregoniggie Industrial Estate, Falmouth Cornwall TR11 4RT |
| Nuon Renewables | Wind farm developer | http:// www.nuonrenewables.com | 01736 330171 | 15 Cuxhaven Way, Lons Rock Penzance Cornwall TR20 8HX |
| Offshore Wave Energy Ltd (OWEL) | Developing wave energy converter | http:// www.owel.co.uk/ | 02392 818745 | Tamaris House · Lezant · Launceston · Cornwall · PL15 9PP |

| | | | | |
|---|---|---|---|---|
| Pure Energy Professionals Ltd | Renewable energy investment adviser | http:// www.peprenewables.com | 01326 572720 | 10 Coinagehall Street Helston Cornwall TR13 8EB |
| Reflex Marine Ltd | Offshore Installation consultancy company | http:// www.reflexmarine.com | 01872 321155 | Meridian House, Heron Way Truro Cornwall TR1 2XN |
| Seacore Limited | Marine Drilling; Offshore Wind Developers | http:// www.seacore.co.uk | 01326 221771 | Lower Quay Gweek, Helston Cornwall TR12 6UD |
| Solar Flair Renewable Energy Ltd | Supply and installation of solar thermal systems | - | 08000 748810 | Kenwyn Church Rd Truro Cornwall TR1 3DR |
| Sycamore Innovation Management Ltd | Engineering Management | http:// sycamoreinnovation.com/ | 0870 112 1813 | Tamaris House Lezant Cornwall PL15 9PP |
| Wardell Armstrong International | Environmental Consultancy and management | http:// www.wardell-armstrong.com/ | 01872 560 738 | Wheal Jane Baldhu Truro TR3 6EH |
| Wind & Wave RE Consultants | Wind & Wave RE Consultants | - | 01736 719505 | The Gears, Gears Lane Goldsithney Cornwall TR20 9LB |
| Windelectric Ltd | Wind Consultancy & Support Services | http:// www.windelectric.co.uk | 01840 214 100 | Deli Delabole Cornwall PL33 9BZ |
| Windfarm Construction & Maintenance Ltd (WCM) | Wind Operation & Maintenance | - | 01208 813336 | Unit 3 Trenant Industrial Estate Cornwall PL27 6HB |

## K: CPR/Cornish Component Suppliers:

The Following are lists of component suppliers and manufacturers that may be useful for a manufacturer/assembler of renewables. They are likely to be able to supply the desired component, though it depends on the specific designs decided by the RE manufacturer. Responses to calls were met positively, being either pro renewable energy or pro regeneration of the area, hence aiding themselves and their local community.

### K.1: GSHP:

| Component | Company name | Product | Phone Number | Address |
|---|---|---|---|---|
| MDPE Piping | penryn palstics | PVC building materials | 01326 376 030 | 6 jennings road, kernick ind estate, penryn, cornwall, tr10 9ly |
| Pumps/MDPE Piping | West Cornwall Hose & Hydraulics | Hydraulics | 01209 313 594 | 15a Treleigh Ind Est, Redruth, TR16 4AX |
| Pipeline & controlls | FWB SW | Plumbing/pipes | 01872 243 500 | Threemilestone industrial estate, truro, TR4 9LD |
| Pumps & Motors repairs | Grosvenor Pumps Ltd | pumps | 01209 831500 | Trevoole, Praze, Camborne, TR14 0PJ |
| Pumps & Motors | Industrial Electrical Repairs | Motors and Bearings | 01209 214 764 | Mount Ambrose, Redruth, Cornwall, TR15 1NR |
| Refrigeration Fluid | harris refrigeration | Refrigeration Engineers | 01736 752 745 | 10 meadowside close, hayle, cornwall, tr27 4jl |
| Refrigeration Fluid | bartlett | Refrigeration Engineers | 01209 712 030 | 2 college st, camborne, cornwall, tr14 7le |
| Refrigeration Fluid | cornwall cooling | Refrigeration Engineers | 01209 832 840 | bolankan, crowan, praze, camborne, cornwall, tr14 9nd |
| Refrigeration Fluid | refigeration south west ltd | Refrigeration Engineers | 01208 813 148 | unit 5c, palmers way, wadebridge, cornwall pl27 6hb |
| Refrigeration Fluid | caradon refrigeration | Refrigeration Engineers | 01579 346 748 | trelawney wood cottage, attwood lane, liskeard, cornwall, pl14 5qu |
| Refrigeration Fluid | air conditioning & refrigeration services south west | Refrigeration Engineers | 01736 762 552 | rose croft cottage, lower downs, halamanning, penzance, cornwall, tr20 9ht |
| Refrigeration Fluid | s m refrigeration & electrical ltd | Refrigeration Engineers | 01566 775583 | quarry crescent, pennygillam ind. estate, launceston, pl15 7pf |
| Refrigeration Fluid | f & t refrigeration ltd | Refrigeration Engineers | 01209 713 541 | unit 12, cogegoes business park, camborne, cornwall, tr14 0qb |
| Underfloor Heating | Continental Underfloor Heating Ltd | Underfloor Heating | 0845 108 1204 | Continental House, Kings Hill, Bude, Cornwall, EX23 0LU |
| Plumbing Components | Delta Plumbing & Heating Supplies Ltd | Plumbers Merchants | 01326 379 124 | Unit 14, Kernick Business Park, Annear Rd, Penryn, TR10 9EW |
| Plumbing Components | Plumbase | Plumbers Merchants | 01209 215 676 | 10 Chapel St, Redruth, Cornwall, TR15 2DE |
| Plumbing Components | Plumbase Plumbing & Heating Merchans | Plumbers Merchants | 01736 367 555 | Unit 6E, Long Rock Ind Estate, Long Rock, Penzance, TR20 8HX |
| Plumbing Components | Plumb Crazy Ltd | Plumbers Merchants | 01326 565 405 | water-ma-trout, ind est, helston, cornwall, TR13 0LW |
| Plumbing Components | Jayhard Ltd | Plumbers Merchants | 01872 276 000 | Unit 6, Heron Way, Newham, Truro, Cornwall, TR1 2XN |
| Plumbing Components | Bill Davies Plumbing & Heating | Plumbers Merchants | 01326 316 151 | 37 Old Hill, Falmouth, Cornwall, TR11 2PR |

## K.2: Solar Thermal:

| Component | Company name | Product | Phone Number | Address |
|---|---|---|---|---|
| Pumps & piping | West Cornwall Hose & Hydraulics | Hydraulics | 01209 313 594 | 15a Treleigh Ind Est, Redruth, TR16 4AX |
| Pipeline & controlls | FWB SW | Plumbing/pipes | 01872 243 500 | Threemilestone industrial estate, truro, TR4 9LD |
| Pumps & Motors repair | Grosvenor Pumps Ltd | pumps | 01209 831500 | Trevoole, Praze, Camborne, TR14 0PJ |
| Pumps & Motors | Industrial Electrical Repairs | Motors and Bearings | 01209 214 764 | Mount Ambrose, Redruth, Cornwall, TR15 1NR |
| black chrome plating | alderney plating ltd | chromium plating | 01202 744 664 | Thrush rd, parkstone, poole, doreset, bh12 4np |
| Glass | Warrior | Glass | 01209 715 500 | 1 chapel rd, tuckingmill, camborne, cornwall, tr14 8qy |
| Glass | ray hayes glass | Glass | 01736 754 023 | the glass shop, hayle terrace, hayle, cornwall tr27 4bs |
| Glass | crystal clear (SW) ltd | Glass | 01209 613 960 | dolcoath industrial park, dolcoath rd, camborne, cornwall, tr14 8rr |
| Glass | truro glass co | Glass | 01326 375 124 | Commercial rd, penryn, cornwall, tr10 8aq |
| Glass | redruth glass company | Glass | 01209 211 028 | 85 higher fore st, redruth, cornwall, tr15 2ar |
| Glass | glass tech | Glass | 01736 755 892 | unit 6d, guildford rd industrial estate, hayle, cornwall, tr27 4qz |
| Plumbing Components | Delta Plumbing & Heating Supplies Ltd | Plumbers Merchants | 01326 379 124 | Unit 14, Kernick Business Park, Annear Rd, Penryn, Cornwall, TR10 9EW |
| Plumbing Components | Plumbase | Plumbers Merchants | 01209 215 676 | 10 Chapel St, Redruth, Cornwall, TR15 2DE |
| Plumbing Components | Plumbase Plumbing & Heating Merchans | Plumbers Merchants | 01736 367 555 | Unit 6E, Long Rock Ind Estate, Long Rock, Penzance, TR20 8HX |
| Plumbing Components | Plumb Crazy Ltd | Plumbers Merchants | 01326 565 405 | water-ma-trout, ind est, helston, cornwall, TR13 0LW |
| Plumbing Components | Jayhard Ltd | Plumbers Merchants | 01872 276 000 | Unit 6, Heron Way, Newham, Truro, Cornwall, TR1 2XN |
| Plumbing Components | Bill Davies Plumbing & Heating | Plumbers Merchants | 01326 316 151 | 37 Old Hill, Falmouth, Cornwall, TR11 2PR |

## K.3: Micro Wind:

| Component | Company name | Product | Phone Number | Address |
|---|---|---|---|---|
| Generators | Solutions uN Ltd | Generators | 01208 815 040 | Broadmeadows, Prdstow Rd, St. Breock, Wadebridge, PL27 7LS |
| Generators | Associated Electrical Repairs | Generators | 01326 375 063 | Unit 46, Parkengue Rd, Kernick Ind Est, Penryn, Cornwall, TR10 9EP |
| Generators | Quantum Offshore Ltd | Generators | 01326 377705 | 5 Tregoniggie Ind Est, Falmouth, R11 4SN |
| Motors | Industrial Electrical Repairs | Motors and Bearings | 01209 214 764 | Mount Ambrose, Redruth, Cornwall, TR15 1NR |
| Motors | Loher UK Sales Office | Motors | 01208 816 543 | The Foundry, St Breock, Wadebridge, Cornwall, PL27 7LQ |

| | | | | |
|---|---|---|---|---|
| Motors | Stocklister | Motors | 01579 382 533 | Rear of Florence Rd, Keelly Bray, Callington, Cornwall, PL17 8EQ |
| Motors | Gleason Works Ltd | Gears | 01752 766 900 | Plymbridge Rd, Estover, Plymouth, Devon, PL6 7LQ |
| gearbox | westcountry transmissions | gearbox manufacturers and repairs | 01208 772 22 | the mews, church square, bodmin, cornwall, pl31 2dp |
| gearbox | southern commercial | gearbox manufacturers and repairs | 01840 213 317 | unit 1, highfield industrial estate, camelford, cornwall, pl32 9ra |
| gearbox | hnc gears & manufacturing | gear cutters & manufacturing | 01761 471 361 | unit 12a, timsbury ind est, hayeswood rd, timsbury, bath, avon, BA2 0HQ |
| gearbox | kingsway engineering ltd | gear cutters & manufacturing | 01179 613 168 | 1a lower hanham rd, hanham, bristol, avon, bs15 8hh |
| Blades | C F S Partnership | Fibreglass | 01209 821 028 | United Downs Ind Pk St Day Redruth |
| Blades | Gendall Rainford Products | Fibreglass | 01209 713 858 | Mew Unit Dudance La Pool Redruth |
| Blades | South West Glass Fibre | Fibreglass | 01209 613 033 | Dolcoath Rd Camborne |
| Blades | P R Laffin Fabrications | Aluminium | 01209 217 556 | Carn Tannery, Wilson Way, Pool, Redruth |
| Blades | Technical Fabrications Ltd | Aluminium | 01736 366 247 | unit 4, long rock business park, penzance |
| Blades | CFS partnership | fibreglass | 01209 821 028 | unit A, united downs ind pk, redruth |

## K.4: Generic:

| Component | Company name | Product | Phone Number | Address |
|---|---|---|---|---|
| Steel Sheet/bars/etc | Craze | Steel Stockholder | 01209 821 166 | 13 United Downs Industrial Estate, St Day, Redruth, Cornwall, TR16 5HY |
| Steel Sheet/bars/etc | Andrew S J & Sons | Steel Stockholder | 01209 213 171 | south turnpike, redruth |
| Steel Sheet/bars/etc | Inmac engineering | Steel Working | 01209 313 088 | 13-15 Parc Erissey Ind Est, New Portreath Road, Redruth, Cornwall, TR16 4HZ |
| Steel Sheet/bars/etc | Terril Bros Founders Ltd | Steel casting | 01736 752 168 | 2 Guildford road ind est, guildford rd, hayle |
| Steel Sheet/bars/etc | Cornish Steel | Steel Fabricators/erectors | 01209 314 644 | wilson way, pool, redruth |
| Steel Sheet/bars/etc | PR Laffin Steel Fabrications | Steel Fabrications | 01209 217556 | Unit 9, the tannery, wilson way, pool, redruth, TR15 |
| Engineer Consultants | GPJ Consulting Engineers Ltd. | Engineer Consultants | 01209 612 030 | 4 the setons, tolvaddon energy park, camborne |
| Engineer Consultants | Quadratics Consulting | Engineer Consultants | 01209 710831 | 2 newton road, troon, camborne, cornwall |
| Heat Exchanger | Heat Exchangers South West Ltd | Heat Exchangers | 01579 384 777 | Unit B8, Florence Rd Business Park, Kelly Bray, Callington, Cornwall, PL17 8EX |

## L: Acronyms:

**CCC:** Cornwall County Council
**CEP:** Community Energy Plus
**CHP:** Combined Heat and Power
**CPR:** Camborne, Pool and Redruth
**CSEP:** Cornwall Sustainable Energy Partnership
**CUC:** Combined Universities in Cornwall
**DC:** District Council
**GSHP:** Ground Source Heat Pump
**PV:** Photovoltaic
**R&D:** Research and Development
**RE:** Renewable Energy
**Regen SW:** Regeneration South West
**SWRDA:** South West Regional Development Agency
**URC:** Urban Regeneration Company

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