Unpacking the technologies

Bournemouth, Dorset and Poole
Renewable Energy Strategy to 2020 Supplement

January 2013

Contents

Introduction

This document is an update to the original Renewable Energy Strategy (2005) appendix "Unpacking the Technologies." Since that time a large amount of useful information on renewable energy technologies has been placed in the public domain[1] and therefore information about how each technology works is not repeated here.

This paper now only focuses on impacts and barriers, opportunities and benefits of each technology and its potential for deployment in Bournemouth, Dorset and Poole. It draws on some of the information in the current Bournemouth, Dorset and Poole Renewable Energy Strategy (to 2020) and associated Renewable Energy Resource Assessment available on the Dorset for you website[2].

However, it is designed to be a stand-alone document for anyone wanting an overview of current local renewable opportunities and constraints. It is set within the context of the Bournemouth, Dorset and Poole Renewable Energy Strategy to 2020 and the aspirational target of at least 15% of Bournemouth, Dorset and Poole's total energy needs to be met from renewable sources by 2020.

Urban and rural renewable energy opportunities

A key characteristic of the Bournemouth, Dorset and Poole area is the different renewable energy and energy saving opportunities available in mainly rural Dorset compared to the conurbations of Bournemouth and Poole. In particular, urban areas tend to lack significant biomass, hydroelectricity and wind energy resources which are mainly found in rural areas, but they have greater opportunities for low carbon district heating, energy from waste and energy efficiency. However both rural and urban areas have common interests in microgeneration (especially solar energy), low carbon new housing, community-based sustainable energy, economic development opportunities and renewable energy planning policies.

[1] information on microgeneration technologies:
http://www.dorsetforyou.com/renewableenergyinfo
http://www.energysavingtrust.org.uk/Generate-your-own-energy

information on larger scale renewable energy technologies:
http://www.decc.gov.uk/en/content/cms/meeting_energy/meeting_energy.aspx
http://www.r-e-a.net/renewable-technologies

community-based sustainable energy:
http://www.sustainabledorset.org.uk/community-energy
http://ceo.decc.gov.uk/

[2] http://www.dorsetforyou.com/402620

Renewable electricity technologies

1. On-shore Wind Power

What is the potential for the technology in Dorset?

Despite large potential wind energy resource and strong support for renewables in general expressed through the public opinion survey and stakeholder events held during the update of the Renewable Energy Strategy in 2011, there is still considerable concern amongst some Dorset residents about the suitability of large scale wind turbines. Opposition to planning applications for large scale renewable energy developments in general has meant that installed capacity is much lower, compared to some other parts of the South West and wider UK. Wind energy shows the greatest discrepancy of all renewable energy technologies in Dorset between the potential resource available and current level of deployment.

No large scale wind turbines have been built in Dorset to date. Recent applications for wind farms in North Dorset near Silton and at East Stoke in Purbeck, each with 4 large turbines, were turned down by planning committees. Both refusals are currently subject to appeal (Feb 2012). Installed wind turbine capacity totalled 0.191MW at the start of 2011, with 28 small and micro wind turbines installed across the area.

A wind energy resource assessment for Bournemouth, Dorset and Poole was carried out during the Renewable Energy Strategy update[3] using the national methodology (as recently applied across all regions of the UK with funding provided by the Department of Energy and Climate Change) with an additional noise filter to create a more realistic assessment of the wind energy resource potential.

This analysis came up with a maximum figure of the potential for large scale wind in the Bournemouth, Dorset and Poole as 900MW or 360 wind turbines using a notional turbine size of 2.5MW as specified in the national methodology. This figure is not a realistic maximum as there are many other constraints to take into account to progress a wind site – such as wildlife surveys, visual

[3] http://www.dorsetforyou.com/402620

impact, cumulative impact, actual wind speed, the need for grid access, etc.

As a result the actual number of turbines that could be deployed in the area is likely to be a fraction of this theoretical maximum figure.

There is also the potential for smaller schemes to be developed, which can be more appropriate in sensitive landscapes and also easier to finance by local investors including farmers, businesses and community groups.

What are the impacts and barriers associated with the technology?

- Planning, public perception and lack of objective information - one of the principal barriers to the development of wind power is the current low levels of planning success within the UK, due to opposition from local and national anti-wind campaigns and often some local residents. The public opinion survey undertaken as part of the Strategy update found that onshore wind polarised opinion to the greatest extent, with over 26% of respondents against or strongly against onshore wind and over 55% supporting or strongly supporting it. Greater provision of objective information about onshore wind is needed to enable people, planning officers and councillors to make a considered assessment of its benefits and impacts. The Bristol- based charity Centre for Sustainable Energy produced a useful and well referenced report in May 2011, Common Concerns about Wind Power[4].

- Visual impact – The potential visual impact of large wind turbines in Dorset's landscape is one of the main concerns often raised about wind energy. Assessing wind turbines' visual impact is somewhat subjective and tends to be based on individuals' opinions and values – some people like the look of them, others don't. This impact can be mitigated to a certain extent through careful siting and sizing of turbines.

  A key action identified in the new Renewable Energy Strategy is to undertake a landscape character sensitivity analysis for various scales of wind energy developments in all the landscape character areas of Dorset.

- Wildlife - there is concern about the impact of development on habitats and the impact turbines can have on birds. However, provided migration flight paths, roosting and nesting areas and designated nature reserves are avoided, bird strike should not be a problem.

  The Royal Society for the Protection of Birds produced useful guidance in 2009[5] supporting wind turbines in appropriate locations.

What are the opportunities and benefits associated with the technology?

- Onshore wind energy is the most economically and technically advanced of all renewables, increasingly able to compete on cost with conventional generation[6] . It is also possible to provide a large amount of power from a single project. For example, Fullabrook Wind Farm in Devon with 22 wind turbines rated at 3 MW each began supplying 66MW of electricity to the national grid in November 2011, which is enough electricity to meet the average annual demand of 27,000 homes.

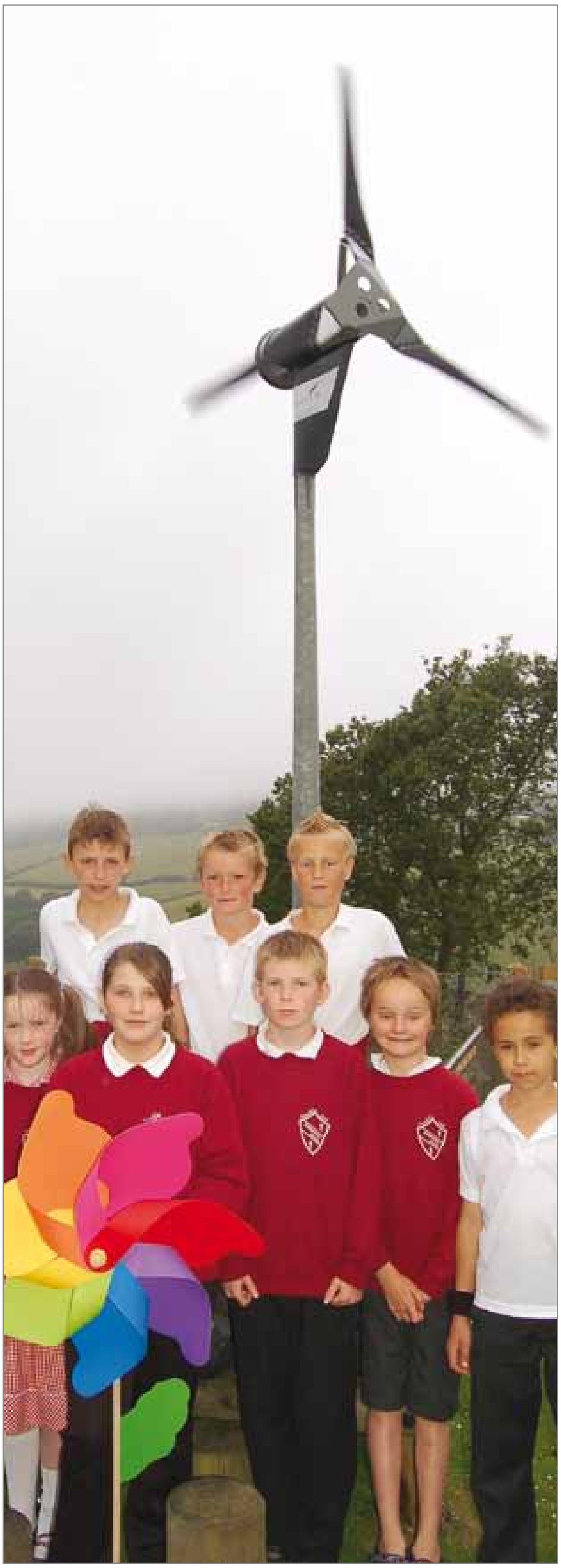
- Diversification of rural incomes - wind farms offer an alternative source of income for farmers, either from land rents, or from shares and equity in turbines. Turbines only take up a small land area

[4]http://www.cse.org.uk/downloads/file/common_concerns_about_wind_power.pdf
[5]http://www.rspb.org.uk/Images/Positive%20Planning%20for%20Onshore%20Wind_tcm9-213280.pdf
[6]http://renewablematters.biz/resources/cai26.pdf

and livestock can still be grazed around the base of the turbines. A number of developers are offering schemes to assist farmers with installing single turbines or a small cluster of turbines. In addition, local income and employment is generated during the construction of a wind farm, for example using local contractors for groundworks.

- Potential for community benefits – local shareholding in community scale wind farms is much more common in a number of other European countries, such as Denmark and Germany, compared to the UK. For example, 7% of the Danish population own shares in wind turbines. New community models are being developed in the UK that can offer greater financial returns to communities from wind turbines, for example through share ownership. In the 2011 Autumn Statement the government announced a new £15m revolving fund to meet the "at risk" costs of community renewable energy projects.

There is also the possibility for communities to work with social enterprises, such as the Communities for Renewables project[7], to develop a wind project where the profits are returned to community through a larger community fund than a commercial developer would provide (e.g. £20,000 to £30,000/MW per year).



[7] http://communities4renewables.co.uk/

2. Biomass Combined Heat and Power (CHP), using energy crops and treated waste wood

What is the potential for the technology in Dorset?

Combined heat and power (CHP) refers to technologies that generate electricity and heat at the same time. Usually, the heat is produced as "waste heat" as a by-product of generating electricity at a power station. This heat can be usefully used – e.g. by pumping through insulated underground district heating pipes to provide space heating for domestic or commercial buildings or for heating horticultural greenhouses.

Biomass CHP is well developed in Germany, Austria, Scandinavia and the Baltic states, partly because of their large indigenous biomass resources and waste wood from existing forest industries. Most of the biomass CHP power stations are large, sufficient to provide heat and electricity to whole towns or tens of thousands of households. It has not proved to be technically or economically possible to date to build biomass CHP power stations smaller than 1MW electrical generation- sufficient to meet the average needs of approx 1500 homes. In practice 2MW- 3MW is the smallest size of biomass CHP plant commonly available.

CHP using treated waste wood:
Biomass CHP plants can be fuelled by woodchips from treated waste wood (providing flue gas cleaning is installed to Waste Incineration Directive compliant standards). Previously waste wood from Dorset recycling centres was chipped locally and shipped to Sweden as fuel for biomass power stations. However, Eco Sustainable Solutions, who currently export the woodchips, were recently granted permission to build their own 3MW power plant on the site in Parley, near Bournemouth Airport, where the woodchips are currently stored. The £12m investment will burn up to 25,000 tonnes per year of waste wood from recycling centres and supply sufficient electricity to meet the average needs of 4,500 local homes when completed in 2013.

Biomass CHP from energy crops

Locally grown energy crops such as willow coppice and miscanthus can be used as fuel in biomass CHP plants, without the need for additional fuel drying or seasoning. Therefore it is assumed that since Dorset has a limited local sustainable biomass resource, clean dry woodchips produced from sustainable woodland management will be supplied to higher value heating applications such as woodchip boilers in schools and public buildings, whilst a limited amount of lower quality woodchips from energy crops will be used to supply a small number of local 1MW- 3MW power stations, ideally CHP making use of both electricity and waste heat.

Data in the biomass section of the renewable energy resource assessment for Dorset[8] indicates the sustainable energy crop potential in Dorset of miscanthus and willow coppice combined to be between 4,000 – 9,000 dry tonnes per year, considerably less than the waste wood resource which will be utilised at the Eco Sustainable Solutions biomass power plant. This quantity of fuel would supply a 1 MW biomass power station and would require approximately 1000 hectares of land planted with energy crops within a 30 mile radius. This is only 0.2% of the land area available within the capture radius.

A potential niche market may be the use of energy crops such as willow or miscanthus blended with the organic fraction of municipal waste as fuel in the 1MW advanced pyrolysis CHP technology currently being developed by New Earth Energy, based near Poole (see the Advanced Thermal Treatment technology section).

Imported biomass

The UK government has indicated in the Renewable Energy Roadmap[9] (July 2011) proposals to import approximately 24 million tonnes of woodchips per year by sea by 2020 to fuel new biomass power stations at port locations. Many of these large biomass power plants are already under construction or in the planning process, e.g. a £400m biomass power plant in Port Talbot, South Wales is under construction. It will import 3 million tonnes of woodchips per year from North and South America and provide sufficient electricity to supply half the households in Wales. Imported biomass has been included with the national contribution to the 2020 renewable energy target. Concerns were raised in the Renewable Energy Strategy consultation over the ethical, environmental, economic, social and security of supply issues associated with meeting targets through large scale biomass imports. The Bournemouth, Dorset and Poole Renewable Energy Strategy is focussed on maximising the opportunities from developing local renewable energy resources, including sustainable biomass from thinning local currently unmanaged woodlands.

What are the impacts and barriers associated with the technology?

Economic viability – the economics of small scale biomass CHP plants are uncertain and dependent on financial support such as feed-in tariffs for renewable electricity and the Renewable Heat Incentive for heat. To date there has been very limited planting of energy crops in Dorset, several hectares of willow coppice at Kingston Maurward Agricultural College near Dorchester and a small area of miscanthus. The limited experience of energy crops and small biomass power plants in the UK increases risk to both landowners and developers.

[8] http://www.dorsetforyou.com/402620
[9] http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/re_roadmap/re_roadmap.aspx

There is a chicken-and-egg situation with fuel supply for biomass power plants. Farmers are reluctant to plant up the crops without a contract from a power plant developer, and developers can be reluctant to invest unless they are sure that there will be an adequate supply of energy crops in the locality. There are also logistical issues with the fact that supply will probably be required from several farmers, which may require the formation of a producer group, together with the lead time required to establish the growing of the energy crops.

- **Environmental impacts –** The visual impact of growing energy crops and potential loss of biodiversity are concerns associated with this technology. However, experience at the B9 plant in Armagh and farmer Rupert Burr's willow plantation in Wiltshire suggests that instead of reducing biodiversity, willow plantations create new habitats to support a diverse range of flora and fauna. The biodiversity impact will depend, to a certain extent, on land use before planting of the energy crops. The Dorset Energy Group (recently renamed the Dorset Energy Partnership) has produced environmental guidance for farmers intending to grow energy crops[10].
- **Vehicle movements –** a 2MWe power plant would require about four 20 tonne lorry deliveries of energy crops per day. (Note the waste wood power plant at Parley will result in less vehicle movements per day as wood from Dorset recycling centres is currently transported by road to the Parley site, where it is chipped and then transported again by road to Southampton docks for export.)
- **Visual impact of power station –** this is likely to stem mainly from the chimney stacks of the power plant.
- **The food vs. fuel debate -** There is also increasing interest in use of energy crops such as maize or grass silage as fuel in anaerobic digestion plants, which are proven technology using existing harvesting and crop storage techniques. Due to public concerns over the use of agricultural land for fuel instead of food, the total land area available for energy crops in Dorset is likely to be constrained and potential competition between biogas and combustion technologies.
- **The high silica content** of miscanthus and low ash melting point can cause clinker problems in the combustion process.

What are the opportunities and benefits associated with the technology?

Rural diversification - Energy crops could stimulate rural income diversification in Dorset. There is the potential for local job retention in the growing, harvesting, and chipping of energy crops and supplying renewable electricity generated locally.

[10]http://www.dorsetforyou.com/renewableenergyinfo

- Waste wood would otherwise be sent to landfill or exported as a biomass fuel, whilst at the same time the UK imports large quantities of forestry derived woodchips as biomass fuel.
- Willow coppice can provide additional benefits when planted close to watercourses, including nitrate reduction in agricultural run-off and soil moisture retention, thereby reducing flood risk.

Short rotation willow coppice at Kingston Maurward College

3. Biogas, or Centralised Anaerobic Digestion (CAD) of food waste, animal slurry and wet biomass energy crops

What is the potential for the technology in Dorset?

Anaerobic digesters (biogas plants) produce conditions that encourage the natural breakdown of organic matter by bacteria in the absence of air. This produces methane gas, or "biogas", which can then be burnt in either an internal combustion engine or in a gas turbine to generate electricity, and, as a by-product, heat. Recently it has become technically and economically possible to clean biogas and inject it into the national gas grid to be used for space heating and providing hot water via existing gas boilers.

There are a number of biogas plants currently operational, under construction or in planning in Bournemouth, Dorset and Poole using a variety of feed stocks:

- Wessex Water generates approximately 3MW of electricity from biogas plants at sewage treatment works in Dorset.
- A 370kW biogas plant operational at Lowbrook Farm, Blandford Forum using cattle slurry, maize silage and poultry manure as feedstock.
- A 500kW CHP biogas plant operational at Ilchester Estate's Melbury Farm, Dorchester using slurry maize and grass silage as feedstock.
- A 190 kW CHP biogas plant at Blackmore Vale Dairies using waste liquids from the dairy as feedstock.

There are at least 2 biogas plants currently under construction:

- A 700kW biogas plant in Piddlehinton developed by Eco Sustainable Solutions and designed to use up to 25,000 tonnes of food waste and 10,000 tonnes of pig slurry per year.
- A new biogas plant at Rainbarrow Farm, Poundbury, Dorchester which will be the 3rd plant in the UK to inject biogas into the gas grid. The gas output will be sufficient to provide central heating and hot water to the equivalent of 3,000- 4,000 well insulated new homes or an annual hot water needs of approx ` 10,000 homes.

The theoretical maximum feedstock resource for biogas plants available in Dorset has been calculated in the resource assessment for the Renewable Energy Strategy using Environment Agency data. It is estimated

Biogas plant at Lowbrook Farm, Blandford Forum

as sufficient for 7MW installed electrical generation capacity which would also provide a further 8.4MW of heat if the biogas was used to fuel CHP engines. Therefore theoretically there are sufficient resources to allow further development of biogas plants in Dorset. The resources assessed include farm slurry from beef and dairy cattle (16 m3/t), pigs (19 m3/t) and poultry (48 m3/t) and organic waste from domestic (86 m3/t), industrial (17 m3/t) and commercial (35 m3/t) sectors. The numbers in brackets indicate the methane production in cubic metres per tonne of feedstock. Note that domestic organic waste (i.e. food waste) is a very good feedstock for biogas plants, particularly when mixed with maize silage and animal slurry. The Environment Agency report does not include maize silage or other crops grown as dedicated feedstock for biogas plants.

An interesting option which has been researched by the Borough of Poole is the treatment of unsorted black bin municipal waste in a high temperature steam autoclave. The clean recyclables (metals, plastics etc) can then be removed and the liquid residue from the autoclaving process, which is rich in organic matter, can be supplied directly as feedstock to a biogas plant – see the energy from waste section for further details.

What are the impacts and barriers associated with the technology?

- Environmental Impact - biogas plants can have a negative visual impact in an open area. Additionally, issues relating to noise pollution, health and safety, traffic movements and emissions to air, ground and water courses need to be addressed before constructing a plant. However, the plant would reduce the odour that would normally result from farmers spreading raw slurry onto farmland.

- Planning permission and legal consents – Planning permission is likely to be required for larger scale projects, including an Environmental Impact assessment. In addition, Integrated Pollution, Prevention and Control Certification (IPPC) and waste transfer licenses may be required.

- Transporting food waste to biogas plants will lead to an increase in local vehicle movements and additional requirements for disposal of the digestate, as it may not be permitted to use it as fertiliser on food crops. Note that use of on-farm slurry and silage crops would reduce vehicle movements to a similar level as conventional silage making.

- Economic viability- as with energy crop CHP, the economic viability of biogas plants are finely balanced. Feed in tariffs for renewable electricity and Renewable Heat Incentive income for using surplus heat should lead to more stable long term income streams and therefore lower cost of finance. Using food waste with the feedstock can increase the economic viability as the alternative disposal route is landfill, with the associated high cost of landfill tax. Therefore food waste producers are willing to pay biogas plants gate fees to take food waste.

What are the opportunities and benefits associated with the technology?

- Environmental - this process can improve local farm waste management, reduce land and water pollution, recycle nutrients, reduce odour in the area and reduce the spread of weeds and diseases through pasteurisation of the feedstock before it enters the fermentation chamber.

- Fertiliser to farmers – the bio-fertiliser (digestate) that results from the digestion process has a higher and more balanced nutrient value than the original slurry, which will enable farmers to reduce expenditure on artificial mineral fertilizer.

- Reduced odour and nitrate run off compared with traditional slurry spreading. Cattle are willing to graze on fields spread with biogas plant digestate after only a few days. They will not graze fields spread with slurry for several weeks.

- Community benefits - local employment will benefit from the construction of a CAD plant with job opportunities in construction, operation and maintenance.

- Building on local experience and capacity building - there is increasing expertise being developed in Dorset in biogas technology.

- Renewable heat – as well as the electricity generated, there is the potential to supply renewable heat for industrial processes, district heating, and/or glasshouses. This will enhance the benefit of the plant in reducing CO_2 emissions.

Rainbarrow Farm biogas plant, Poundbury, Dorchester

4. Micro-hydro Power

What is the potential for the technology in Dorset?

Micro-hydro power refers to electricity generation from small hydroelectric turbines, which in Dorset are usually based on run-of -river schemes where a percentage of the river flow is diverted through a leat, or small canal, and then falls through a hydro-electric turbine back into the river. The vertical drop or "head" is typically only a few meters in Dorset therefore the hydro resource is less than in more mountainous regions with higher rainfall.

The Dorset Energy Group, recently renamed the Dorset Energy Partnership, has produced a micro-hydro guidance leaflet which describes the technology in more detail[11].

Current installed capacity of hydropower in Dorset totals 44 kW (0.044MW) from three projects. In West Dorset, a 7kW turbine in the Town Mill at Lyme Regis was installed in 2007. In Weymouth, a 15kW turbine was installed at Upwey Mill in 2006. In Purbeck, a 22kW turbine was recently installed (2010) in Bindon Mill.

Dorset has only a limited resource for this technology. There are many old mill sites in the county where the original weir and leats remain in good condition and there may be the potential to install modern hydro generation equipment. As well as the Stour, the rivers Frome, Piddle, Lym and Wey are known to have supported water mills in the past, as did the Wicken Stream in Corfe. Mill owners and hydro enthusiasts have set up support groups in West Dorset and the Stour Vale in order share information.

The micro-hydro resource in Dorset has been assessed using Environment Agency data ground-truthed by visits to existing potential micro-hydro sites by local hydro consultant Keith Wheaton-Green. Therefore the data is more accurate than the other renewable energy resource data based on desk top studies alone.

The viable micro-hydro resource in the renewable energy resource assessment has been identified as 1.5 MW in Dorset by 2020. No viable resource was identified in Bournemouth or Poole. The Dorset viable resource would be equivalent to approximately 250 micro hydro turbines rated at 6kW output (i.e. each producing sufficient electricity to meet the annual needs of 4 average households).

There are approximately five or six sites that are planning to install at present. This increased interest is a result of the Feed-in Tariff and increasing awareness of opportunities. If it is assumed that approximately 5 sites are installed each year to 2020 in Dorset, total installed capacity would be 0.394MW by 2020.

[11]http://www.dorsetforyou.com/renewableenergyinfo

What are the impacts and barriers associated with the technology?

- **Need for licenses –** it is likely that most schemes would need an abstraction license from the Environment Agency (EA), and obtaining such a license can take a significant amount of time. In order to protect flora and fauna in the affected stretch of the river, the EA may limit the amount of flow that can be diverted from the river. In some cases, a fish pass may be required in the weir if the scheme is on a migratory stretch of river.

- **Noise –** a low humming noise is produced by the turbine and generator in the powerhouse. This impact can be successfully minimised through higher quality manufacture of equipment together with sound insulation of the powerhouse structure.

- **Visual intrusion –** all the components of a hydro scheme have the potential to create a visual intrusion within the landscape, particularly in areas of scenic beauty. However, careful site design, installation and management of all components including surrounding vegetation can limit effects and is often sufficient to screen even the largest components from view. A new powerhouse would require planning permission from the local planning authority.

What are the opportunities and benefits associated with the technology?

- Industry development- the British Hydropower Association[12] is based in Wimborne, Dorset, providing an existing industry resource for further local development of micro-hydro.

- Local interest -the West Dorset Hydropower Group and Stour and Vale Hydro Group have built up a great deal of practical information and expertise in micro-hydro development.

- Economic viability - although each micro-hydro site has specific requirements and capital costs, the introduction of feed–in tariffs with a guaranteed index linked income stream makes it easier to estimate the financial return before committing to an investment.

- High capacity factor -experience shows that micro hydro has a capacity factor of approx 0.5, i.e. equivalent to over 4,000 full output running hours per year. In practice the output will vary and the plant will be generating some power for most of the year except dry spells in summer if flow is reduced below the abstraction licence limit. In practice all power will be supplied first to a site owner's adjacent property, therefore will offset electricity bills in addition to the feed-in tariff income.

[12] http://www.british-hydro.org/index.html

5. Energy from Waste

5.1 Advanced Thermal Treatment (ATT) -using pyrolysis or gasification

What is the potential for the technology in Dorset?

Both pyrolysis and gasification turn wastes into energy rich fuels by heating the waste under controlled conditions. In contrast to incineration, which fully converts the input waste into energy and ash, these processes deliberately limit the conversion so that combustion does not take place directly. Instead, they convert the waste into valuable intermediates that can be further processed for materials recycling or energy recovery e.g. syngas, oils and char.

- Pyrolysis is the thermal degradation of waste in the absence of air to produce char, pyrolysis oil and/or syngas. This is the same process as used for charcoal production.
- Gasification is the breakdown of hydrocarbons into a syngas by carefully controlling the amount of oxygen present. This is the same process as was used for the conversion of coal into town gas.

These two processes are often combined in the operation of a single plant. The gas produced can be cleaned and used as a fuel for a Combined Heat and Power engine, similar to the way landfill gas or biogas is used to generate electricity.
Non-recyclable municipal solid waste (black bag waste) is a mixture of organic matter (paper, food waste etc) plus non-organic waste (wrappings, inert materials etc). The

organic fraction of waste is classified as renewable energy and electricity generated qualifies for ROCs payments. The usual standard is to deem 50% of the waste stream as organic. Non-standard waste streams are sampled to accurately measure the organic fraction.

A system of 'banding' ROCs was introduced from 1st April 2009, meaning that advanced gasification, advanced pyrolysis and anaerobic digestion (biogas) receive two ROCs per MWh of electricity. Energy-from-waste and standard gasification and pyrolysis all remain on one ROC and landfill gas has been downgraded to just 0.25 ROCs per MWh.

A ROC is currently valued at approximately £45 per MWh of electricity generated, or 4.5p/ kWh. Therefore there is an added financial incentive to deploy more expensive advanced gasification and advanced pyrolysis energy from waste technologies, which allow

Proposed energy from waste pyrolysis plant at Winfrith, near Wool

for gas cleaning and reduced emissions compared to mass burn waste incineration.

New Earth Energy, a pioneering company in advanced treatment of waste that operates nationally is based in Dorset. This business aims to generate renewable energy from refuse-derived fuels and biomass using emerging advanced thermal conversion (ATC) technologies in the form of pyrolysis and gasification. It is also involved in anaerobic digestion projects.

A full-scale, modular demonstration ATC unit has been installed at Canford to trial and prove the process, which has been branded New Earth Advanced Thermal (NEAT). The patented technology will be supplied for New Earth Energy's own energy projects and schemes by third party developers.
New Earth Energy has received planning permission for a 10MW CHP waste pyrolysis plant at the Dorset Green Technology Park, Winfrith, near Wool, a proposed zero carbon business park aiming to create 2000 new jobs in the medium term. The plant will use refuse derived fuel. Therefore refuse derived fuel can be processed at a remote location and transported to the plant, avoiding the need for a waste handling centre adjacent to the pyrolysis plant at the Dorset Green site. Waste pyrolysis plants are still at the demonstration and pilot stage in the UK.

The utilisation of energy from waste is closely linked to long term local authority waste disposal contracts, i.e. only companies with a waste contract have secure access to a waste supply which they can use in energy from waste plant. Since April 2011 waste collection, household recycling centres, waste disposal and waste reduction across 5 Dorset local authority areas has been managed by an innovative in-house new Dorset Waste Partnership.

The Borough of Poole[13] has researched the CO_2 emissions from various waste disposal options including an autoclaving process developed by a local company Aerothermal, whereby unsorted black bag waste is treated with high temperature steam to produce clean recyclables such as metals, glass and plastics and a liquid slurry rich in the organic fraction of waste which can be used as feedstock for a conventional biogas (anaerobic digestion) plant. However this technology is also at the research and development stage.

[13] http://www.poole.gov.uk/environment/sustainability-and-carbon-reduction/carbon-management-programme/

What are the impacts and barriers associated with the technology?

- Commercially unproven technology – the key barrier is that ATT has not been technically or commercially proven at any substantial scale in the UK. Therefore, there is a high level of perceived risk among waste management companies and local authorities about this option at the moment.

- Public concern over incinerators, emissions of dioxins,etc – this has been a key constraint for the development of new energy from waste incineration plants in the past. However, due to the high temperatures and thermal processes involved, ATT plants do not emit dioxins. Furthermore the emissions of particulates are considerably lower than those for incineration. Although increased transport may be a concern, there should be no net increase, as the deliveries would offset those to the landfill site. Nonetheless, public perceptions of energy from waste being "a bad thing" may persist, and act as a barrier to developing an ATT plant.

- Concerns over waste hierarchy concerns are sometimes expressed (e.g. Friends of the Earth) that energy from waste plant could conflict with priorities for re-use and recycling. However, the figures suggest that after allowing for recycling there is still a considerable quantity of residual waste with recoverable energy that would otherwise go to landfill.

- Friends of the Earth[14] have also expressed concerns that any digestate from a biogas plant supplied with liquid from an autoclaved black bag waste feedstock may not be usable as a fertiliser due to pollutants and heavy metal contamination.

What are the opportunities and benefits associated with the technology?

- Local scale waste management solution – ATT is much smaller scale than waste incineration and can be utilised as part of a local waste management strategy.

- The potential advantages of ATT in comparison to incineration include:

  - lower environmental impacts (e.g. less particulate emissions, opportunities for gas cleaning before combustion.)

  - higher electrical conversion efficiencies.

  - greater compatibility with recycling and CHP – ATT can be combined with a materials recovering facility (MRF) before energy recovery.

  - landfill avoidance - there are also environmental and economic benefits (reduced landfill tax) associated with minimising the amount of waste sent to landfill.

5.2 Energy from Landfill Gas

What is the potential for the technology in Dorset?

Bio-degradable organic wastes placed in a landfill usually begin to generate methane after approximately 6 to 12 months. The production of methane usually reaches a peak after 3 to 6 years and begins to decline after about 15 years. Therefore, landfill sites that carry out operations over a number of years offer the potential to produce gas over 10 to 20 years. Much less bio-degradable

[14] http://www.foe.co.uk/resource/briefings/gasification_pyrolysis.pdf

waste is currently land filled due to risk of contamination of water courses from landfill run-off and increasing financial penalties per tonne of biodegradable waste sent to landfill. Also as existing sites are filled it is becoming increasingly difficult to find new sites.

Landfill sites are usually capped by an impermeable layer covering the waste. This cap is usually made from clay and protects the waste from rain and air, whilst ensuring the gas does not escape to the atmosphere. Methane is then collected from a series of gas wells. Gas wells are perforated plastic pipes that have been drilled into the land filled waste material.

Regen SW January 2011 renewable energy survey records show installed capacity for landfill gas as 7.4MWe in Dorset and 6.9MWe in Poole, a total of 14.3MWe. However, once a landfill site is capped landfill gas is a depleting resource. It is estimated that production at a typical landfill site will fall between 5% and 10% per annum, suggesting initial reductions in capacity in the area of up to 1.4 MW per year (declining over time). On this basis landfill capacity in the area could typically decline to some 9.4MWe in 2015 and 5.5MWe in 2020.

Note landfill gas currently supplies over 75% of the renewable electricity generation in Dorset.

Waste source separation, AD plant, Piddlehinton

6. Solar Photovoltaics (PV) (Solar electricity)

What is the potential for the technology in Dorset?

The Dorset Energy Group solar photovoltaic information leaflet on the Dorset for You website[15] provides detailed information on solar photovoltaic panels and how they work. However the information on solar photovoltaic feed-in tariffs is now out of date due to rapidly changing government policy. The Generate Your Own Energy section of the Energy Saving Trust website[16] provides good up- to- date information on solar PV including a payback calculator based on postcode area and quoted installed prices.

The 2005 Bournemouth, Dorset and Poole Renewable Energy Strategy suggested there may be 145 domestic solar PV installations by 2010. In practice there were approximately 30 installations by January 2010, mainly because of high installed prices leading to low demand and relatively long payback periods of 20 years (or a simple 5% rate of return), even for householders who managed to secure one of the limited number of grants available.

The introduction of feed-in tariffs for small scale renewable electricity in April 2010 provided a guaranteed index linked income for 25 years and transformed the UK solar PV market. The market expanded exponentially with 3000 solar PV installations in Bournemouth, Dorset and Poole by the end of October 2011 and a further 1500 installations in 6 weeks before12th December, the date from which the government announced an early 50% reduction in the feed- in tariff rate. The government believed an early reduction was justified by to the increasing demand and cost of the feed-in tariff subsidy to householders, at that time approximately £3 per year added to all domestic electricity bills.

However, the early reduction before a public consultation had been completed was declared unlawful following a challenge in the High Court. The Solar Trade Association estimates there will be 250,000 solar PV installations in the UK registered by 3rd March 2012, representing 1GW of installed capacity and the 8th largest global solar PV market.

Solar PV installed prices in the UK are now just over half of what they were 2 years ago, therefore accessible to more people.
Due to the rapidly expanding global PV market and increasing production in China it seems likely that a solar PV feed-in tariff will no longer be required in the UK by 2016-17 provided householders can benefit from net metering, i.e. receiving the same price for PV electricity they export to the grid as the price for electricity they purchase from their electricity supplier[17]. At that point the PV demand in Dorset is expected to rise again steadily until up to half of households with suitable roofs (estimated at 25% of domestic dwellings) may have PV installed by 2025.
The Department of Energy and Climate Change has recently indicated a much higher level of ambition for solar PV of 22GW by 2020 and for all social housing with suitable roofs to have solar PV installations once the grid parity point is reached. Solar PV will now be included as a key technology in a revised national Renewable Energy Roadmap to be published in summer 2012.

[15] http://www.dorsetforyou.com/renewableenergyinfo
[16] http://www.energysavingtrust.org.uk/Generate-your-own-energy
[17] http://renewablematters.biz/resources/cai26.pdf

What are the impacts and barriers associated with the technology?

- Design factors - a key limitation in PV installations is the need for a roof aspect between SE and SW. In addition shading (e.g. from trees, nearby buildings and chimneys) should be avoided. As the PV modules are connected in series like batteries in a torch, even removing the output of 1 panel by partial shading will dramatically reduce the performance of all other panels in the same series or string.
- Visual impact – this can be an issue for listed buildings and in conservation areas. PV systems require planning permission in such situations whereas outside these areas they are usually permitted development, with certain conditions. Local planning departments should be contacted in cases of doubt.

What are the opportunities and benefits associated with the technology?

- Installed costs have fallen dramatically due to economies of scale delivered by a rapidly expanding global market.
- Integration into built environment – of all the renewable electricity technologies, PV lends itself most to incorporation into buildings. It has the major advantage that it generates no noise, has no moving parts, generates electricity for more than 25 years and is low maintenance.
- Encouraging behavioural change – there is widespread evidence that households that have installed solar panels become more aware of energy use in the home and install additional energy saving measures.
- South West England has the best solar energy resource in the UK. It is also predictable on an annual basis (i.e. kWh of electricity produced from a PV system at any location can be calculated accurately in advance)
- Competition in the electricity supply marketplace- householders and businesses with PV systems are small scale electricity generators. After the PV grid parity point is crossed solar PV will provide effective competition to fossil fuel and nuclear derived grid electricity supplies, especially with the introduction of the "floor price of carbon," effectively a tax on carbon emissions from fossil fuel power stations, proposed from April 2013.

6.1 Solar parks or solar farms

There was a large and somewhat unexpected interest in solar parks (or solar farms, large free-standing arrays of solar panels) following the launch of the feed-in tariff in April 2010. No solar farms before 2015 were anticipated in the Government's impact assessment modelling that accompanied the introduction of FITs. Due to concerns about the potentially high proportion of the total feed-in tariff budget being allocated to solar parks, (approximately 100 solar farm planning applications were in the pipeline by April 2011, mainly in Cornwall) the government introduced an early fast-track review of tariff levels for large scale solar PV and reduced tariffs to uneconomic levels from July 2011, which effectively halted the large scale solar PV industry.

However, the government has continued to offer 2 Renewables Obligation Certificates (ROCs) to solar farm developers, a similar rate to offshore wind energy or electricity from energy crops. In addition to the value of the ROCs, the renewable electricity generated can be separately sold into the grid at wholesale prices of up to 6p / kWh through Power Purchase agreements, representing a total value of approx 14-15 p/ kWh, considerably better than future feed-in tariff prices on offer for building mounted solar PV. Therefore larger scale solar farm planning applications not viable through feed-in tariffs are starting to come forward in Dorset supported by ROCs, whilst at the same time domestic and smaller scale installations supported by feed-in tariffs are becoming less economically viable. ROCs banding is currently (Feb 2012) subject to a government consultation and may be reduced for solar PV from March 2013. Hence solar farm planning applications in Dorset are likely to come forward over the next 12 months before any potential price reduction.

Slepe Farm Solar Park, near Wareham

7. Offshore/ Marine Technologies

7.1 Offshore Wind Energy

What is the potential for the technology in Dorset?

Currently there are approximately 500 offshore wind turbines installed in UK waters with a combined generating capacity of 1,500MW. There are a further 560 offshore wind turbines under construction. Within the next 4 years (by 2016) there will be 8 GW of capacity installed. The Crown Estate has granted licences for offshore wind farms with a total installed capacity of 18 GW by 2020. In terms of contribution to net UK electricity consumption offshore wind supplies around 1.5% today, estimated to grow to between 7% and 8% in 2016 and to around 17% in 2020. In comparison, nuclear power currently supplies 14% of grid electricity due to closure of ageing reactors in recent years.

At the beginning of 2010, The Crown Estate awarded the Dutch utility company Eneco the lease to develop the Zone 7 (West of Wight) offshore wind energy development zone[19]. The project has been named the Navitus Bay windfarm. The total zone area equates to 723.7km2, and 197km2 of this is proposed to be developed. At its closest turbines would be sited 8.2 miles from Peveril Point, Swanage and its northern boundary would be located 10.2 miles from Bournemouth and 8.4 miles south west of the Needles. The type (and therefore height) of turbines will be determined following further research and consultation. This in turn will dictate the number of turbines within the development. Eneco currently state there will be approximately 180-300 turbines spaced 1.5km apart with a total power capacity of 0.9GW, powering between 615,000 and 820,000 homes.

Project scoping will continue through 2012 and a consents application will be placed on its completion. Eneco hope to be awarded permissions in 2013, and this will be followed by construction contract bids and port selection in 2014. Construction will commence in 2016, completing in 2018-19 to a 50-year design standard. Foundation design is yet to be decided, (key determinates being depth, seabed geology and sediment type), but this in turn will dictate construction techniques. Power transmission cabling associated with the development will include the use of underground cabling on landfall linking to an existing electricity substation.

[19] http://www.thecrownestate.co.uk/energy/offshore-wind-energy/

All UK offshore wind energy developments are licensed by the Crown Estate and planning permission is awarded by central government, currently by the Infrastructure Planning Commission. Many organisations are consulted as "statutory consultees" prior to a planning decision, including local authorities, Natural England, the Maritime Coastguard Agency, community stakeholders, etc.

No other sites for offshore wind are likely to come forward in the area before 2020.

What are the impacts and barriers associated with the technology?

- Major barriers to project developers Eneco will include technical challenges presented by the relatively deep water in the development zone and the economic challenge of construction within a budget to enable commercial viability at the electricity premium price available for offshore wind energy, currently 2 ROCS per MWh, or approx 8p- 9p per kWh (plus the wholesale price of electricity sold into the national grid, approx 4p-4.5p/ kWh).

- A major impact is likely to be the visual impact, particularly from the Dorset AONB and the Jurassic Coast World Heritage Site and the potential effect on tourism, including major holiday destinations of Bournemouth, Poole and Swanage. However there is uncertainty over the size and number of offshore wind turbines whilst pre-planning technical studies are still in progress, hence the extent of the potential visual impact. Also the impact on tourism is difficult to predict as the nearest turbines will be 8-10 miles from popular tourist destinations.

- The environmental impact on birds and marine species will be assessed in reports to accompany the planning application to the Infrastructure Planning Commission.

- There could be potential impacts on sailing and shipping, although as the turbines are spaced 1.5km apart smaller vessels will be permitted to navigate between the wind turbines. The development zone within the licensed area has been selected to minimise impact on shipping routes used by larger vessels.

What are the opportunities and benefits associated with the technology?

- In addition to the benefits identified for onshore wind, offshore wind offers reduced visual impact and no noise impact. The other additional benefit is that wind speeds are generally higher offshore than on land and the UK has 40% of Europe's total wind energy resource.

- Offshore wind energy will provide significant economic opportunities to the UK, which by 2020 will be by far the largest offshore wind energy market in the world. The Eneco Navitus Bay offshore windfarm if built will represent a £2 billion- £3 billion capital investment and approximately 100 new jobs in servicing and maintenance, likely to be based in Portland Port or Poole.

- Offshore wind energy is likely to be cost competitive with fossil fuel derived electricity by 2030- 2035, i.e. within the lifetime of a new offshore wind farm[20].

- Offshore wind energy may already be considered to be cost competitive with whole lifetime costs of nuclear power. For example, the current cost of nuclear decommission is £2 billion per year publicly funded through the Dept of Energy and Climate Change (DECC). The total estimated decommissioning budget for the UK's older Magnox reactors remaining in public ownership is £78 billion. The total construction cost of the recent 25GW Round 3 offshore wind farms around the whole UK, licensed by the Crown Estate, is estimated at £75billion. The Magnox reactors and Round 3 windfarms will provide similar whole lifetime quantities of electricity into the National Grid.

7.2 Wave energy

What is the potential for the technology in Dorset?

The Dorset Coast Forum commissioned consultants Royal Haskoning to undertake an Offshore Renewable Energy Capacity Study for Dorset[21], which was completed in April 2010.

The resource assessment identified that there are no suitable areas for commercial scale wave energy deployment in the waters off Dorset, i.e. the energy in waves off the Dorset Coast is much less than the wave resource off the Atlantic coast, for example Cornwall and Western Scotland. However,

[20] http://renewablematters.biz/resources/cai26.pdf
[21] http://www.dorsetforyou.com/media.jsp?mediaid=148390&filetype=pdf

a suitable resource for small scale prototype wave deployment was identified.

Potential prototype deployment sites need to be as close to the coast as possible, where suitable local grid connections exist in conjunction with adequate port servicing facilities. Within the study area, the waters within the eastern half of Lyme Bay would be most appropriate, where water depths and resource are suitable. However, despite the presence of suitable resource and grid connection points in close proximity to the coast, the distance from shore where water depth is greater than 25m may restrict the attractiveness of this area to wave energy device developers. In addition, there are existing wave energy test facilities elsewhere around the UK and many devices in the marketplace have already been through this stage of development.

7.3 Tidal Current Turbines

What is the potential for the technology in Dorset?

Tidal current technology is based on extracting the energy in tidal currents in order to turn an electrical generator, similar in concept to an "undersea wind turbine".

However, the size of tidal current turbines can be much smaller than wind turbines with a similar electrical output, as the energy in more dense moving seawater is greater than moving air.

Tidal current should not be confused with tidal range (e.g. a tidal barrage) as has been proposed for the Severn Estuary. There is an insufficient tidal range off the Dorset Coast to support tidal barrage technologies.

Tidal current devices are currently at prototype and pre-commercialisation demonstration phases; therefore the economics of commercial scale electricity generation are unknown.

The 2010 Royal Haskoning Offshore Renewable Energy Capacity Study for Dorset found that that there is only one tidal current Potential Development Area off the Dorset Coast, that being off Portland Bill. This is consistent with the previous studies that have assessed tidal current resource within the area (e.g. South West RDA 2004, SDC 2007 and ABPMer 2009). Further areas around St Albans ledge may also be suitable in the future should technology progress to enable commercialisation in slightly lower tidal current resource areas. Typical requirements for cost-effective power generation from a 300kW tidal current prototype generator are a mean spring peak velocity exceeding about 2.25 to 2.5m/s (4.5 to 5 knots) with a depth of water of 20 to 30m.

At this juncture it is considered that only the waters off Portland represent a viable resource based on the current technology status.

What are the impacts and barriers associated with the technology?

- The tidal current resource area off Portland Bill has a number of key development considerations, notably relatively shallow water depths which may be insufficient to allow the installation of high capacity devices and eccentric current flows (ABPMer, 2007). Flow reversals of up to 35% have been recorded.

- The Portland Bill Potential Development Area has significant shipping activity and may be included in the Marine Conservation Area proposed off the Dorset Coast. This designation may restrict but not necessarily exclude tidal current developments. The impact on the marine natural environment will require careful consideration
- In addition the cumulative effects on energy removal from multiple arrays in this relatively constrained resource area has been identified (ABPmer 2007). The theory behind this being that if multiple arrays are densely packed together (as would be the case in confined resource areas) then cumulative affects on the tidal current energy may start to affect the capacity of the devices, and therefore the project economics.

- Tidal current technology will need continued financial support as it moves down the cost curve towards parity with other forms of renewable energy generation (onshore wind, solar PV etc). When it will become price competitive with other forms of renewables is unknown, but the rate of development over the next five-ten years should help to inform this. It has been signalled by government that strong financial support in the form of the Renewable Obligation Certificates and capital grants will continue up to 2017 after which time the "contracts for difference" system will come into force. How this system will work is still to be clarified, but it is envisaged that the financial support from the ROCS will not stop suddenly but will phase out over a period of time.

What are the opportunities and benefits associated with the technology?

- Tidal current technology has minimal visual impact
- Electrical generation is predictable and available more hours per year than, for example, solar PV or wind energy
- There is a good access to the electricity grid at Portland.
- There is scope for some job creation building on local marine engineering expertise (note however there will likely be greater employment opportunities

in the Bristol Channel area due to the much larger tidal stream energy resource available there [22]).

- The south west has been awarded special development area status for marine renewable energy, providing the opportunity to work with experienced partners such as Regen SW[23] and Plymouth University.
- There are a wide variety of tidal current prototypes currently in development, some of which may be suitable for deployment off the Dorset Coast. Therefore tidal stream opportunities should be monitored closely.

Tidal current turbine

Burton Bradstock

[22] http:/www.southwestrda.org.uk/news_and_events/2010/october/offshore_renewables_study.aspx

Renewable heat technologies

1. Heat from Renewable Combined Heat and Power (CHP) and biomass district heating

What is the potential for the technology in Dorset?

Heat from Combined Heat and Power

For the three forms of CHP technology considered in the Renewable Electricity section (biomass/energy crops, energy from waste and biogas) there is the potential to make use of the waste heat. This can be used to provide heat for:

- process heat for industry,
- e.g. industrial estates
- district heating for housing, and other, non-domestic buildings
- heat for horticultural glasshouses

District heating woodchip store

However, in order for this to be used, the CHP generating plant will need to be placed close to these heat loads. Perhaps, therefore, the greatest potential is when siting generating plant on new (or extended) industrial estates, and installing heat mains to supply heat to neighbouring industry. Background research to the 2005 Bournemouth, Dorset and Poole Renewable Energy Strategy included a study of how energy crop biomass CHP sites could be linked with proposed new industrial estates in Dorset, so that those estates could make use of the heat.

Based on the use of a steam turbine, for every 1MW of electricity produced by biomass CHP, there would be 3-4MW of heat available. Therefore for a typical 5MWe biomass CHP steam turbine there would be 15- 20 MW of renewable heat available to meet heat loads. Based on data supplied by Dorset County Council, the study identified 11 proposed new, or extensions to, industrial estates that could accommodate a biomass CHP plant.

The study also looked at potential locations for a Centralised Anaerobic Digestion (biogas) plant. Potentially, such a plant could be located at an industrial estate close to a major food processor, to make use of that producer's food waste. This could be combined with animal manures from surrounding farms. However, a survey of large food processors in Dorset found that there was no obvious single producer of large quantities of food waste. Therefore, potentially a biogas site could be integrated with one of the industrial estate extensions mentioned above.

In February Dorset County Council, with funding provided by the DECC Local Carbon Framework, undertook a district heating feasibility study for central Dorchester including a heat network to link the County Hospital, County Hall, Dorchester Prison and potentially the Charles Street new-build development. The study recommended installing a natural gas CHP unit at the County Hospital to supply surplus heat to the other loads. The project has not progressed further but biomass could also be considered at a future date if economically viable.

North Dorset District Council is currently researching opportunities for a biogas CHP plant at an industrial estate. Blakemore Vale Dairy and Melbury Farm Dairy have now both installed biogas CHP units as they have a constant heat load, need for electrical power and food processing waste on site.

Woodfuel only district heating

Woodfuel can also be used for heat only district heating installations, for example where a single large woodfuel boiler can supply multiple buildings on the same site through a heat network. For example there are already several woodfuel district heating networks at public sector sites including:

District heating pipe work

- 1.2 MW woodchip boiler at Guys Marsh Prison near Shaftsbury
- 800kW wood chip boiler at QE School, Wimborne
- 300kW wood chip boiler at St.Osmunds School, Dorchester,
- 150 kW wood chip boiler and 1.2km heating network supply a church, country house and 12 cottages at East Stoke near Wareham
- 3 wood pellet boilers supplying 60 low carbon new build properties at the Olympic Sailing Village Site, Portland
- A wood pellet boiler supplying 66 homes at the exemplar Perryfields Passive House development on Portland, currently the largest Passive House development in the UK.

In addition, there is currently interest in seeking sites in Dorset for village scale biomass heat only district heating networks (e.g. to supply approximately 30 houses). This should prove to be more cost effective than each house installing a separate biomass central heating boiler, in addition to providing cheaper running costs than oil central heating.

What are the impacts and barriers associated with the technology?

District heating pipework is expensive- currently approximately £1m per mile for high quality steel insulated district heating pipework installed under roads in urban areas. It can be difficult to get several independent heat users to connect to a district heating network due to unfamiliarity with the concept and fear of complex legal issues.

What are the opportunities and benefits associated with the technology?

In conventional power stations at least half of the energy content of the fuel is wasted as heat during the generation of electricity. Using this waste heat reduces CO^2 emissions and conserves valuable energy resources.

District heating pump

2. Solar Water Heating (Solar Thermal)

What is the potential for the technology in Dorset?

In the UK, solar water heating systems are used mainly as a source for domestic hot water and to a lesser extent for swimming pool heating. For modern well insulated houses water heating can represent almost the same energy demand as space heating. Therefore as a solar water heating system will typically save about 50% of a household's annual fuel consumption for water heating, this is a very useful contribution to the overall energy demand of a well-insulated house.

The theoretical potential for solar thermal in Dorset, as for the UK, is of course huge. However, it is limited by financial and practical reality. In practice less than 25% of households in Dorset would have a suitably orientated un-shaded roof and many of these properties may also be unsuitable since they have combi boilers (see barriers below). In addition there can be a conflict over roof space between solar thermal and solar PV. Not all households will have roof space or be able to afford both technologies.
The 2010/11 Regen SW annual renewable energy survey estimated 173 recorded solar thermal installations in Bournemouth Dorset and Poole by January 2011. However Regen SW only started to collect data in 2006 and the total number of domestic solar water heating installations is currently difficult to assess accurately.

The 2005 Renewable Energy Strategy assessed that pro-rata using national statistics from the Solar Trade Association Dorset had about 500 solar water heating systems installed, estimated to increase by 20 per year (broadly in line with Regen SW recorded installations). Therefore it can be assumed there are over 673 solar thermal installations in the sub-region. This number will be used as a baseline when monitoring renewable energy generation in line with the aspirational target in the 2012 Renewable Energy Strategy. More accurate data will become available once the domestic RHI becomes operational in late 2012.

What are the impacts and barriers associated with the technology?

- Relatively long payback times - solar water heating still requires high levels of capital investment by households (typically £3-£5,000) and the RHI rate and requirements for domestic solar thermal installations have not been clarified.

- Design factors - a key limitation is the need for a roof aspect between SE and SW

- Visual impact – this can be an issue for listed buildings and in conservation areas; systems will require planning permission in such situations (although they are usually permitted development otherwise). However solar thermal installations only require 4m2- 5m2 of roof area, much less than solar PV installations.

- Combination (combi) boilers - in an effort to increase efficiency in domestic heating and hot water, combination boilers, which do not require a hot water storage tank, are increasingly being installed. However, the use of a hot water storage tank is a key prerequisite for solar thermal installations, to ensure water heated during the day by solar energy is available for use in the mornings and evenings. Solar thermal can be used to pre-heat water into a combi boiler, but only if the boiler is designed for this and a mains pressure (unvented) pre-heat tank will also need to be installed, adding to the cost.

What are the opportunities and benefits associated with the technology?

- If correctly installed the technology is long lasting and low maintenance
- Dorset has one of the best solar energy resources in the UK
- Target market sectors - there is good potential for installation within the tourism sector, for example, camping and caravanning sites, youth hostels, hotels and guesthouses where there is a match between high demand for hot water in the summer months and high levels of sunshine.
- The technology can also be cost effectively utilised in conjunction with swimming pools which is an attraction for both domestic and commercial pools.
- New build housing developments – the Building Regulations governing new homes specify the maximum carbon dioxide emissions per square metre of floor area.
- The proposed new zero carbon homes standard due to introduced in 2016 will also include a requirement for a percentage of on-site renewable energy. Solar water heating can be effective at meeting the renewable energy target as very well insulated homes have low heat losses. Therefore the energy required for hot water heating can be more than the energy needed for space heating.
- Additional financial support for domestic solar thermal installations is due to be introduced through the Renewable Heat Incentive (RHI) from November 2012. Commercial solar thermal installations up to 200kWth installed after July 2009 can already benefit from RHI payments of 8.5 p/kWh of metered heat for a period of 20 years.

3. Ground, Water and Air Source Heat Pumps

What is the potential for the technology in Dorset?

We are all familiar with heat pumps, even if we don't realise it. In the home the refrigerator is a heat pump, as are air conditioning units in offices. Ground Source Heat Pumps (GSHP) make use of solar energy stored in the ground, rather than geothermal energy from the earth's core. Air source heat pumps extract heat from the outside air. Both types of heat pump deliver this heat within the building at lower temperatures and over a longer period of time than conventional space heating methods. This means that they are more suited to use with underfloor heating systems.

All heat pumps use electricity when operating. The cost and carbon savings they achieve are a function of heat pump efficiency (Coefficient of Performance, or how much heat is generated per unit of electricity needed to operate the heat pump) and the emissions factor (kg CO2 per kWh) of the electricity they use. Research by the Energy Saving Trust suggests that with the current grid electricity emissions' factor, heat pumps are presently most suitable for highly insulated properties off the gas grid or in well insulated new developments, where underfloor heating can be installed during construction. The Energy Saving Trust[24] research indicated that many of the 83 heat pump installations they monitored during field trials were performing at a lower efficiency than manufacturers' data, believed to be due mainly to lack of understanding of heat pump controls by householders and a wide range in quality of installation.

The government's UK Renewable Energy Roadmap published in July 2011 anticipates that 8 technologies will together meet 90% of the renewable energy to meet the national 2020 target. One of these technologies is heat pumps, mainly in the non-domestic sector. However, there are many uncertainties and unknowns, including the technical and economic performance of heat pumps, the insulation levels in existing non-domestic buildings and the number of well insulated new non- domestic buildings likely to be built before 2020. Other unknowns include how Building Regulations relating to low carbon are implemented and the operation of the Renewable Heat Incentive and Green Deal in practice.

An estimate of the potential for heat pumps in Dorset has been included in the microgeneration resource assessment background paper to the Renewable Energy Strategy, which was initially based on the national SQW methodology from the Department for Energy and Climate Change. Subsequently, Regen SW took advice from AEA technology as the SQW methodology assessment was regarded as unrealistically too high. The final highly theoretical medium scenario was revised down to approximately 700 commercial air and ground source heat pumps rated at 100kW each installed in Bournemouth, Dorset and Poole by 2020 and 14,000 domestic heat pumps rated at 5 kW each. In comparison there were 88 recorded heat pump installations in January 2011, up from 2 recorded installations in 2005. However, the introduction of Renewable Heat Incentive (RHI) payments for domestic heat pumps in autumn 2012 is likely to lead to increased demand. There is currently still uncertainty whether the income from the RHI can be used to pay off a Green Deal loan to finance a combined heat pump installation plus insulation upgrade.

A social enterprise, Poole Tidal Energy Partnership, is currently working with

[24] http://www.energysavingtrust.org.uk/Generate-your-own-energy/Air-source-heat-pumps/Heat-pump-field-trial-report

Bournemouth University and the Borough of Poole to research the potential for a water source heat pump installation based on extracting heat from sea water. This technology is currently used to supply a district heating network in Stockholm, Sweden, but has not previously been widely used in the UK.

What are the impacts and barriers associated with the technology?

- Large scale deployment of heat pumps would significantly raise electricity demand, requiring more low carbon electricity generation and potentially creating a situation where space heating is increasingly competing for an electricity resource that has more essential uses (e.g. electronics, motors and lighting).

- Electricity transmission infrastructure will also need to be upgraded at all voltage levels. The extent of network upgrades needed, especially at lower voltage levels, is not yet fully understood and may be a significant constraint on deployment of heat pump technology if a significant number are installed.

- Technical and performance issues, for example the issues identified in the Energy Saving Trust's heat pump field trials report including lack of installer training and householder understanding of heat pump controls.

- High capital cost - the heat pump market is still relatively small and cost reductions are expected to occur as the technology matures in the UK.

- A large area of ground is required for a ground loop heat pump installation, which makes retrofit difficult in urban locations unless a more expensive borehole system is utilised.

- Installation of underfloor heating or oversize radiators in existing older properties would lead to additional disruption.

- Thermal conductivity of the ground - as heat is extracted from the ground it needs to be replaced over time, usually by solar energy warming the surface. The solar heat is carried underground by rain to replenish the heat extracted by the heat pump coils. Therefore heavily shaded areas and coils laid under impervious tarmac can lead to reduced performance.

- Integration with solar PV - some householders may consider that solar PV and a heat pump can be installed in combination to use low carbon PV electricity to operate the heat pump. Unfortunately they are not well matched as in practice only a small proportion of PV electricity is generated during the winter months when the heat pump electricity demand is highest. However, in well insulated properties with a suitable resource, micro hydro and heat pumps are an excellent match.

4. Local woodfuel heating including woodchip, wood pellet and logs

What is the potential for the technology in Dorset?

Detailed information on biomass heating including the differences between logs, woodchips and wood pellets is provided in the small scale biomass heating information sheet available on the Dorset for You website[25]. Further information and guidance is available on the South West Wood Shed - http://www.southwestwoodshed.co.uk

Biomass (which includes woodfuel and any solid organic material used as fuel) provided 5MW of the 7.3 MW of renewable heat capacity in Bournemouth, Dorset and Poole installed by January 2011. Dorset has 11% land under woodland cover (30,700 hectares), with 60% of that broad leafed woodland. Included in the total are 1360 small woods between 0.1- 2 hectares that are currently unmanaged as there is no economic motivation for thinning or management.

Woodfuel from management of existing unmanaged woodlands has been identified as the second largest renewable energy resource in Dorset (after wind energy). The Dorset AONB Woodfuel Supply and Demand Study[26] (2009) indicated 97,000 tonnes of additional woodfuel available annually in Dorset from sustainable management of existing unmanaged woodland (i.e. only removing half of annual natural re-growth as woodfuel and maintaining the same or an increasing total area of woodland cover). The sustainable woodfuel resource estimate in the above study used Forestry Commission methodology for sustainable yield, also taking into account timber production for conventional markets.

[25] http://www.dorsetforyou.com/renewableenergyinfo
[26] http://www.dorsetaonb.org.uk/assets/downloads/Woodfuel/Woodfuel_Supply__Demand_in_Dorset_low_res.pdf

Annual sustainable woodfuel potential in Dorset from ANOB study (2009)

Source	Amount available (000 tonnes @ 30% MC)
Woodland	97.2
Arboricultural arisings	6.3-7.1
Heathland arisings	2.6-2.6
Sawmills	0.2
Energy crops	0.3
Total	**105.6-107.4**

A Regen SW woodfuel resource analysis using Environment Agency data, which is available in the resource assessment accompanying the Renewable Energy Strategy, also indicated approximately 100,000 tonnes of woodfuel per year potentially available from sustainable woodland management and arboricultural arisings (from roadsides, public parks, etc). However, in practice, the potential resource should be reduced by at least 20%-30% to take account of the fact that not all woodlands are accessible and there will be environmental benefits in leaving some woodland completely unmanaged

The Dorset AONB study found that in 2009 there were 28 wood burning central heating boilers in Dorset, which combined were using approximately 1500 tonnes of woodfuel, i.e. only 1% of the sustainable resource available. However, since then a number of larger woodchip and wood pellet boilers have been installed, for example at Guy's Marsh Prison and Queen Elizabeth School, Wimborne. Therefore the current woodfuel demand from boilers is about 2,500 tonnes/ year.

There are several companies supplying wood chip fuel in Dorset, including Forest Fuels, Daniel Upton Timber and New Forest Fuels. A number of companies offer energy services (ESCO) contracts whereby they install, maintain and provide fuel for a woodfuel boiler and sell metered heat to the customer. The installer can part- finance the ECSO business model through the receipt of Renewable Heat Incentive payments for each kWh of heat generated, in addition to selling the metered heat to the customer.

Wood pellet fuel is not currently manufactured in Dorset, but Danish company Verdo Renewables, has built a large wood pellet manufacturing plant in Andover, Hampshire, from where they can supply clients in Dorset. The wood pellets are manufactured from dried and processed timber, mainly sourced from the New Forest.

However, nearly all studies of the woodfuel market and renewable energy installed capacity ignore domestic woodstoves, due to lack of data. This is surprising as the Stove Industry Alliance[27], a useful source

[27] http://www.stoveindustryalliance.com/

of information on domestic woodstoves and wood burning, estimates that 500,000 domestic woodstoves were installed in the UK over 3 years 2008-10 inclusive. Pro- rata for households in rural areas of the UK (assuming very few woodstoves are installed in city environments) this equivalent to approximately 10,000 woodstoves installed in Dorset over the 3 years 2008-10.

The Energy Saving Trust estimates that a million tonnes of woodfuel is used to heat UK homes every year[28]. Fortunately reasonably accurate data is available for households with woodstoves in Dorset, due to the 557 responses to the renewable energy questionnaire[29] circulated to the Dorset Citizen's Panel in March 2011.

The survey covered all the district council areas in Dorset and excluded households in Bournemouth and Poole. The resulting data indicated 13% of Dorset households who responded had woodstoves (i.e. 72 households). However, the questionnaire was circulated to 1000 members of the Citizen's Panel and there is no data on the households who did not reply. Assuming none of those households have woodstoves (highly unlikely) the minimum number of woodstoves in Dorset, assuming 72 households out of 1000 have a woodstove, is estimated at 13,680 woodstoves pro-rata for the 190,000 households in the county.

Assuming each woodstove uses one tonne of logs per year at 30% moisture content, equivalent to heating a medium sized room half of the time during winter months, woodstoves have a significant impact on of the available sustainable woodfuel resource currently being used (an increase from 2,500 tonnes to 16,180 tonnes). This is equivalent to an additional 41 GWh per year of renewable heat - a useful contribution towards the 1200 GWh by 2020 aspirational target in the Bournemouth Dorset and Poole Renewable Energy Strategy. Domestic woodstoves will be included in future reporting, subject to further analysis and more data being available.
There are a number of initiatives across the SW to support local communities to purchase woodland and/or set up a local log supply through social enterprises. These schemes can include volunteers managing existing woodland in exchange for a share of logs[30], or planting new community woodland. A community woodfuel scheme is currently being developed in the Bridport area of West Dorset.

What are the impacts and barriers associated with the technology?

- High capital cost of biomass boilers and associated infrastructure, wood chip or wood pellet stores, augers, etc.

- Planning permission may be required for the flue of domestic biomass boilers if more than 1 metre above the roof or the installation is in a conservation area or World Heritage Site. Commercial woodfuel boilers will need planning permission, which may include emissions data. Most wood fuelled heating systems operate at high efficiency levels which keep emissions comparatively low. A well installed system using high quality dry fuel will usually burn without any visible smoke.

- Only approved smokeless woodstoves can be installed in smoke control areas. See http://smokecontrol.defra.gov.uk/

- Wood fuel supply quality - especially for wood chips and logs which both should be seasoned and dried down to at least

[28] http://www.energysavingtrust.org.uk/Publications2/Generate-your-own-energy/A-buyer-s-guide-to-wood-fuelled-heating
[29] http://www.dorsetforyou.com/402620
[30] http://axewoods.org/

30% moisture before use. Woodchip fuel supply brokers such as Westwoods[31] are able to tender for a fuel supplier on behalf of clients and arbitrate to resolve any fuel quality issues. Guidance on woodfuel quality is also available on the SW Woodshed website[32].

- Biomass boilers are usually more labour intensive than oil or gas boilers (de-ashing etc)
- Biomass boilers are not so easy to switch quickly on and off, therefore perform more efficiently with a buffer tank or thermal store.

What are the opportunities and benefits associated with the technology?

- Domestic woodstoves are visually attractive and considered a desirable feature, especially in rural areas.
- Significant local employment opportunities in the woodfuel supply chain and in woodfuel heating systems installation.
- There is evidence that traditional sustainable woodland management, including thinning and coppicing, can allow more light to reach the woodland floor resulting in an increase in plants, insects and biodiversity.
- Woodfuel heating boilers are well proven and common technology in many mainland European countries. Most major manufacturers' models are generally reliable, provided good quality fuel is used.

- Logs (and sometimes woodchip) can be a very cheap fuel for anyone such as farmers and landowners with access to woodland and the necessary machinery.
- The Renewable Heat Incentive (RHI) currently provides a guaranteed 20-year income stream for heat supplied by non-domestic woodfuel boilers, which over time can offset the higher capital cost. Domestic woodfuel boilers (not woodstoves) will be able to benefit from the RHI from autumn 2012.
- New build housing - biomass heating including small scale district heating networks can be used to meet on-site renewable energy planning requirements and low carbon standards required in Building Regulations which are due to be tightened from 2013.
- Off-gas areas – as with all the renewable heat technologies, off-gas areas are particularly attractive for this technology, as oil and LPG are more expensive fuels than mains gas.
- Village scale biomass district heating retrofit may be cost competitive with oil heating and a more practical option than individual woodfuel central heating boilers in each house.

[31] http://www.westwoods.org.uk/
[32] http://www.southwestwoodshed.co.uk/static/wp-content/uploads/woodfuel-standards.pdf

5. Deep geothermal energy

What is the potential for the technology in Dorset?

There are a number of locations in the UK that offer the potential to extract heat from deep underground, i.e. heat generated below the earth's crust, and to use it for electricity generation or space heating. Two geothermal technologies have been piloted in the UK, heat from hot dry rocks in Cornwall and heat from underground water sources or aquifers, as currently used to supply a district heating network in Southampton.

There is no hot dry rock resource in Dorset, but there is a geothermal aquifer resource within the Wessex Basin under the Bournemouth area, which appears to be one of a limited number of attractive areas in England for possible future geothermal exploitation.

What are the impacts and barriers associated with the technology?

- Without a subsidy the cost of heat from the Wessex Basin aquifer resource has previously been estimated at 3.5p- 4p / kWh or more. This cost is higher than heat from conventional industrial boilers (approximately 2p-3p/kWh), therefore not economically viable. However, the Renewable Heat Incentive introduced for non-domestic installations from December 2011 includes a tariff for deep geothermal heat, temporarily 3p/kWh, similar to large scale heat pumps. The deep geothermal tariff is due to be reviewed in 2012 and may make deep geothermal heat cost competitive.

- The warm water under the Wessex Basin is saturated brine due to dissolved salts, which has a number of technical, economic and environmental impacts. If hot brine is pumped from a well it cannot be used directly but has to be directed through stainless steel heat exchangers using stainless steel pumps. The brine may also contain heavy metals in solution, and has to be discharged somewhere. The ideal is to have two adjacent boreholes, a production borehole for producing hot water and an injection borehole for disposing of used brine, but this increases drilling and pumping costs. At Southampton Geothermal Well there is only one borehole and the used brine and any associated trace element content is discharged into Southampton Water (already a polluted estuary).

- For geothermal aquifers to be economically viable there needs to be a suitably large heat demand, e.g. an inner city area supplied via a district heating network or a number of large industrial heat users.

- Due to the high inherent up-front risks in developing a geothermal resource grant funding is likely to be required, such as another round of the 2009 Deep Geothermal Challenge Fund[33] . Any grant funding should not prevent eligibility to on-going support for 20 years from RHI deep geothermal payments, especially as additional significant capital expenditure would be required for a district heating network.

What are the opportunities and benefits associated with the technology?

- There is a well established deep geothermal heat district heating network in nearby Southampton, which has expanded over time to cover a number of large commercial premises in the city centre. It is managed by a successful partnership between the developers Cofely (previously Utilicom) and Southampton City Council.

- Utilicom has previously prepared a district heating feasibility study for central Bournemouth based on gas CHP, which to date has not been taken forward due to the need for grant funding or a financial incentive to make the project economically viable.

- Deep geothermal heat, if commercially viable, is low carbon with minimal visual environmental impact. The Southampton district heating pumping station is located in the city centre without most passers-by being aware of it.

[33] http://www.decc.gov.uk/en/content/cms/meeting_energy/geothermal/geothermal_uk/geothermal_uk.aspx

Appendix A

Capacity Factor

The "capacity factor" of a particular technology, is an approximate way of estimating how much energy per year a certain installed capacity of generation will produce. The figures used for different capacity factors are based on experience from existing installations. Because capacity factors are in effect just a guide they can cause confusion among non-specialists about the length of time over which a particular technology is generating.

For example, a capacity factor of 0.1 or 10% for PV does not mean that a PV system in the UK will only generate electricity for 10% of the year. What it means is that all of the energy generated by the PV system over the course of a year is equivalent to the PV system generating at its full installed capacity for 10% of the year.

Similarly, well-sited onshore wind turbines have an approximate capacity factor of 0.27, or 27% in the UK. However a wind turbine will typically be generating electricity for 80% of the year, but will only be generating at full power for a smaller % of time, say 10- 15%. The rest of the time it is operating, the turbine is generating somewhere between full power and "cut-in", when it first starts to generate.

Another example would be a gas boiler or heat pump which may only operate at full capacity for 20% of the year, as no central heating is required in summer or during the night in winter.

Renewable energy technologies with low capacity factors are referred to as "intermittent", and this includes wind, PV and hydro. They are intermittent because the wind does not always blow, the sun does not always shine, and so on. Technologies with high capacity factors are referred to as "reliable", and these include biomass CHP, landfill gas and CAD. No energy technology, renewable or non-renewable has a 100% capacity factor, as there will always be a certain amount of downtime for maintenance, and for faults.

Typical capacity factors for each of the technologies are shown in the table below. To work out how much energy a technology will generate: multiply the installed capacity, (in MW) by the capacity factor, and by the number of hours in a year (24x365=8760), to give annual energy output in MWh (Megawatt hours).

Renewable technology	Large onshore wind (2.5MW)	Small onshore wind (15KW)	Solar PV	Small Hydro power	offshore wind	Tidal
Capacity factor	0.27	0.23	0.1	0.5	0.35	0.35

Renewable technology (HEAT)	Waste incineration compliant biomass CHP	Anaerobic digestion	Heat pumps	Solar thermal	Landfill gas	Sewage gas
Capacity factor	0.9	0.9	0.1	0.1	0.8	0.9

The Issue of Intermittency

UK Energy Research Centre produced a detailed report on intermittency in 2006 which stated:

"UKERC's report represents a definitive picture of the costs and impacts of intermittent energy supplied by renewable sources, such as wind. Some commentators have suggested that renewable energy is made much more costly, or is drastically limited by intermittency. The report finds that these views are out of step with the vast majority of international expert analysis and that intermittency need not present a significant obstacle to the development of renewable sources.[34] "

If a technology is intermittent, this does not necessarily mean that it is less good, or less valuable than a reliable one. For example although wind energy may be intermittent or variable over a day or week, wind turbines in the UK produce on average 2.5 times more power in winter months, when electricity demand is highest, compared to the summer when demand is low. All renewable technologies have their part to play in the mix, and the key point is that every unit of electricity generated by an intermittent source of renewable electricity will displace 1 kWh (or more in the case of embedded generation) of electricity that would have been generated by burning fossil fuel in power stations.

One concern often voiced about intermittent renewables is that they will need fossil fuelled power stations to provide back-up. Currently 7% of the UK's electricity supply comes from renewable sources, of which approximately 3% is wind energy, with most of the rest from hydropower, from landfill gas and biomass power stations, all of which are much less intermittent.

In order to match supply and demand and to cover the possibility of large conventional power station shut downs at short notice, the UK grid requires several power stations in standby mode ready to be rapidly be brought on-line. This is known as "spinning reserve", usually supplied by gas or diesel- fired turbines. Spinning reserve is required to balance supply even without intermittent renewables in the grid. Therefore existing spinning reserve can be utilised to match intermittent renewable energy without the need for significant extra back-up until higher levels of renewable generation are reached.

It has been estimated that with 10% of UK electricity demand being met by wind power around 700MW (one gas fired power station) would be needed as additional standby spinning reserve - a little over 5% of the total installed capacity of the wind turbines (Milborrow, 2004).

At higher levels of renewable electricity supply, studies have shown there are no technical limits or supply security issues up to at least 20% of electricity coming from intermittent sources such as wind, although there is a small financial cost. Independent studies, for example from Oxford University Environmental Change Institute[35], have shown that if 20% of UK electricity supply came from wind power, this would add about 5% to the price for electricity currently paid by consumers, or 0.7p/kWh.

[34] http:// www.ukerc.ac.uk/support/Intermittency
[35] http://www.eci.ox.ac.uk/publications/downloads/sinden05-dtiwindreport.pdf

Financial incentives for renewable energy: feed-in tariffs and ROCs

Renewable energy, in common with many other technologies entering new markets, requires financial support before reaching price competitiveness with existing technologies. This financial support can be delivered through carbon taxes, research and development funding, capital grants and soft loans, obligations on energy companies to supply an increasing percentage of renewable energy and premium prices for renewable energy generation. The current principal financial support mechanisms in the UK are renewable energy obligations with tradable certificates (ROCs) and premium prices for renewable electricity and renewable heat (FITS and the RHI).

The Renewables Obligation legislation requires UK licensed electricity suppliers to source an increasing proportion of the electricity they supply from renewable sources. This percentage was initially set at 3% in 2003 and had increased up to 11.1% by 2011.

Suppliers meet their obligations by presenting Renewables Obligation Certificates (ROCs). Where suppliers do not have sufficient ROCs to cover their obligation, a payment is made into a buy-out fund, with the cost passed on to consumers. The buy-out fund is re-distributed to electricity supply companies in proportion to the number of ROCS they present each year. In addition, larger renewable energy generators sell electricity into the grid at the wholesale price (i.e. the electricity and ROC certificates can be sold separately.)

Renewable energy technologies are rewarded at different levels depending on their level of technical and commercial maturity. The default is that one ROC is issued for each megawatt-hour (MWh) of eligible renewable output. Some technologies get more, some less. For instance, offshore wind installations and large solar photovoltaic (PV) farms currently receive 2 ROCs per MWh, onshore wind installations receive 1 ROC per MWh and landfill gas-fired plants receive half a ROC per MWh.

Since its introduction the Renewables Obligation has more than tripled the level of eligible renewable electricity generation (from 1.8% of total UK supply in 2003 to 7.0% in 2010)

A criticism of the ROCs scheme is that it has been designed for large licensed electricity suppliers and is inaccessible to smaller-scale renewable energy generators such as business, households and community groups. This criticism was addressed in April 2010 through the introduction of feed-in tariffs (FITs) for renewable electricity generators below 5MW. Feed-in tariffs offer long-term contracts for electricity generated to renewable energy producers, typically based on the cost of generation of each technology. Technologies such as wind power, for instance, are awarded a lower per-kWh price, while technologies such as solar PV and tidal power are offered a higher price, reflecting higher costs.

In addition, feed-in tariffs include "tariff degression", a mechanism through which the price (or tariff) for new installations is reduced over time. This is done in order to track and encourage technological and market volume cost reductions. In 2008, a detailed analysis by the European Commission concluded that "well-adapted feed-in tariff regimes are generally the most efficient and effective support schemes for promoting renewable electricity"[36]. In 2011 feed-in tariffs were in use in approximately 50 countries.

[36] http://ec.europa.eu/energy/climate_actions/doc/2008_res_working_document_en.pdf

Feed-in tariffs are paid to smaller scale renewable electricity producers by electricity supply companies, which recover the cost by adding a surcharge to the electricity bills of all customers. The UK Government has indicated the cost of feed-in tariffs will add approximately £6 per year to household electricity bills by 2020 (currently adding approximately £4 per year). However feed-in tariffs have also delivered wider financial benefits such as reducing solar PV installation costs by 50% between April 2010 and December 2011 due to the increased market size. In the medium term renewable energy is likely to deliver lower electricity prices compared to a business-as-usual scenario based on fossil fuel electricity prices[37].

The Renewable Heat Incentive (RHI) is a similar scheme developed by the UK Government to reward renewable heat based on a long term payment per kWh of heat generated. It is the first such scheme to be launched in the world and is being closely watched by a number of other countries. Unlike the feed-in tariff for renewable electricity it is financed through general taxation. The RHI was introduced for non-domestic renewable heat installations in November 2011 and is due to be launched for domestic installations including solar water heating, heat pumps and biomass boilers in early 2013.

[37] http://renewablematters.biz/resources/cai26.pdf

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