A REVIEW OF RENEWABLE ENERGY RESOURCE ASSESSMENT AND TARGETS FOR DEVON

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Abstract

Devon is rich in renewable energy resources. With up to 2356 MW of remaining renewable electricity potential Devon is well able to generate the 851MW needed to produce 15% of its energy from renewable sources by 2020 (the UK's commitment under the EU renewable energy directive). In 2004 Devon adopted its first renewable electricity target of 151MW by 2010. The county's 2009 installed capacity of 33MW falls well short of achieving this target, moreover nor will it be achieved when the 103MW of currently planned projects are installed. Wind is by far the largest resource with up to 1,893MW remaining. The county also has significant solar and biomass resources. Economics favour large scale renewable projects; one large 3MW wind turbine generates more electricity in a year (at 25% load factor) than over 3000 domestic (2kW) PV arrays at a tenth of the capital cost. Looking forward, renewable heat needs to be incorporated into an updated resource assessment for Devon and the Council should consider developing policies to facilitate large scale renewable energy schemes in the county.

Contents

1. INTRODUCTION

The draft South West Regional Spatial Strategy[1] established regional targets for renewable electricity and heat. These targets were based on evidence of the regional renewable energy resource performed in 2004 (REvision 2010[2]) and 2005 (REvision 2020[3]). However, policy is changing. The Coalition Government has brought forward legislation in the Localism Bill to abolish regional spatial strategies in favour of more locally based planning. The removal of regional renewable energy policy gives a stronger role for local authorities to respond to the increasingly demanding national energy policy agenda.

In 2009 the UK adopted a target of 15% of energy from renewable sources by 2020 under the EU renewable energy directive[4]. This target was supported by the Renewable Energy Strategy[5]. In parallel the UK has adopted a legally binding carbon dioxide (CO_2) reduction target of 80% by 2050. The Low Carbon Transition Plan[6] provides a route map to achieve these CO_2 reductions including the role of renewable energy. The Feed in Tariff (FIT) for renewable electricity was introduced in April 2010 and the Renewable Heat Incentive (RHI) is due to commence in 2011. These financial mechanisms are changing the viability of renewable energy technologies. Far-reaching changes to the UK electricity market are also being proposed[7]. The objectives of these market reforms include enhancing the deployment of low carbon and renewable energy technologies.

The 2010 renewable electricity target for Devon of 151 MW was set out in REvision 2010. There are no specific renewable heat targets for Devon or any 2020 targets. However, there is resource assessment work that studies renewable energy resources in Devon and more specific analysis that covers some of districts within the county. Energy consumption in Devon in 2008 was 18.8 TWh. Generating 2.8 TWh (15%) from renewable sources would require a capacity of 851 MW[8] more than five times the 2010 target.

This review considers the process of renewable energy resource assessment and target setting, reviews the work performed since 2004 covering Devon and with in Devon, compares the 2010 renewable electricity targets with current and planned installations and discusses the impact of changes in Government policy and the potential future for resource assessment and target setting in Devon.

2. A METHODOLOGY FOR RESOURCE ASSESSMENT AND TARGET SETTING

The assessment of renewable energy resources and the setting of targets involve sequential processes in which layers of analysis are applied that progressively reduce the total theoretical opportunity to that which is considered practically achievable by a target date.

In 2010 DECC commissioned a methodology from consultants SQW for assessing renewable energy resource. 7 stages were defined to the assessment process as illustrated in Figure 1.

[1] "Draft Regional Spatial Strategy for South West England", SW Regional Assembly, April 2006
[2] "REvision 2010", CSE, Peter Capener et al for GOSW, 2004
[3] "REvision 2020", CSE, Peter Capener et al for GOSW, 2005
[4] Directive 2009/28/EC on "The Promotion of the Use of Energy from Renewable Resources", European Parliament, April 2009
[5] "UK Renewable Energy Strategy", HM Government, July 2009.
[6] "The UK Low Carbon Transition Plan", HM Government, July 2009
[7] "Energy Market Reform – Consultation Document", HM Government, December 2010
[8] assuming the average 2008 UK renewables load factor of 38%

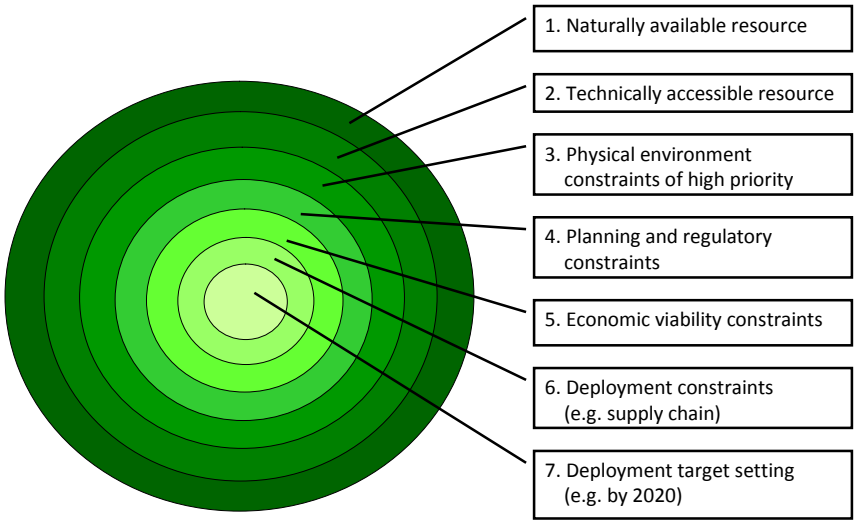


Figure 1: Renewable resource assessment stages

Stage 1 refers to the raw renewable energy resource available (e.g. biomass or wind) and stage 2 the opportunity for harnessing the renewable energy resource using current technology solutions. Stages 3 and 4 address the constraints to the deployment of technologies in relation to the physical environment and planning/regulatory limitations. Stage 5, refers to the economic constraints including the cost of the technology, energy commodity prices, incentives (e.g. FIT, RHI), cost of capital etc,. Supply chain constraints (stage 6) include maturity and capacity of the supply chain to deliver the required renewable fuel or technology (equipment) and to deploy the technology (including qualified engineers and installers). Stage 7 is the point at which all factors can be combined to set a target for an area to be achieved by a particular date.

It is important to recognise the differences between characteristics of the stages. An understanding of the natural resource, the energy that can be technically extracted from that resource and the exclusion of areas where the resource cannot be harvested in stages 1, 2 3 and 4 leads to a fundamental calculation of the amount of renewable energy available which will only change slowly over time. Whereas the latter stages, 5 (economics) 6 (supply chain) and 7 (proximity to a target date), are more time sensitive. For example the introduction or withdrawal of a financial incentive can have an immediate effect on the achievability of a target.

Speed of deployment varies by technology and scale. In general, the larger and more complex the technology, the longer the lead time required to deployment. Individual micro generation installations can usually be quickly and easily deployed. The small individual quantities of energy produced are absorbed into a building or the electricity grid. In most instances planning permission is not needed. The equipment is relatively easily available although there can be exceptions to this when uptake accelerates rapidly (e.g. inverters for photovoltaic cells currently). The speed of uptake is therefore governed by the motivation of building owners which is strongly influenced by regulation (new build) and the availability of financial incentives. The Low Carbon Buildings Programme was a good illustration of the acceleration in uptake of micro renewables when financial incentives are available and the subsequent slump when they are not.

Large scale installations have local impacts and require planning permission. Factors such as visual impact transport, and emissions need careful consideration and often raise concerns in the local community. Access to the electricity grid and the need for grid reinforcement can also be a limiting factor for large scale electricity projects as can the ability of the equipment supply chain to deliver the specialist components for

large projects when global demand for a technology is strong (e.g. some wind turbine components currently). Large scale projects will therefore take a number of years to progress from concept to operation. However, large scale renewables generally produce orders of magnitude more energy and as a result of their scale have better economics. Large scale technologies therefore tend to require less financial support per MWh than small scale technologies.

3. DEVON'S RENEWABLE ENERGY RESOURCES AND TARGETS

Devon's renewable energy resources have been assessed through a variety of region-wide work. In 2004 the REvision 2010 study provided resource assessments and county targets for renewable electricity. The following year REvision 2020 extended this work to heat and set 2020 regional targets for renewable electricity and heat but provided no specific targets for Devon. In 2010 regional Wardell Armstrong carried out a regional wind assessment and the Environment Agency / AEA a regional biomass assessment. Both these studies provide results by district. Also in 2010 the CEE undertook a wood fuel resource assessment for Devon. Most districts in Devon have commissioned some renewable energy resource assessment work. Relevant studies covering areas within Devon are summarised Appendix 1. While these assessments provide a considerable amount of analysis and information there are inconsistencies in assumptions and the categorisation of resources and energy conversions technologies which make comparisons between different sources difficult in some instances.

3.1. WIND

There has been extensive wind resource assessment covering Devon. The REvision 2010 wind resource assessment for Devon gives a "technical resource" of 559 MW based on 1.3MW turbines. Recent work by Wardell Armstrong[9] provides a district by district analysis using the resource assessment methodology to stage 4 and 2.5MW turbines. The results are summarised in Table 1.

District	Number of 2.5 MW turbines	MW	GWh	% of Devon
East Devon	17	43	98	2%
Exeter	0	1	2	0%
Mid Devon	118	295	731	15%
North Devon	206	516	1352	26%
South Hams	46	115	325	6%
Teignbridge	51	128	348	6%
Torridge	183	458	1137	23%
West Devon	175	437	966	22%
Total Devon	**796**	**1993**	**4959**	

Table 1: Wardell Armstrong's 2010 wind resource in Devon by district

The Wardell Amstrong assessment excludes physical and environmental constraints, places a 600m buffer around buildings and is based on larger turbines. Revision 2010 adds the constraints of practical access to sites, landowner willingness for development to go ahead, political will, the time to complete planning procedures and the distance to nearest electricity grid connection. These additional constraints together with smaller turbines yield a lower resource.

Devon's REvision 2010 wind target was derived by overlaying the 599 MW constrained resource with the landscape sensitivity analysis shown in Figure 2.

[9] Wind Resource Assessment for the South West Following SQW energy Methodology, Wardell Armstrong, July 2010 see http://regensw.s3.amazonaws.com/wind_resource_methodology_text_only_b71959af94c39e86.pdf

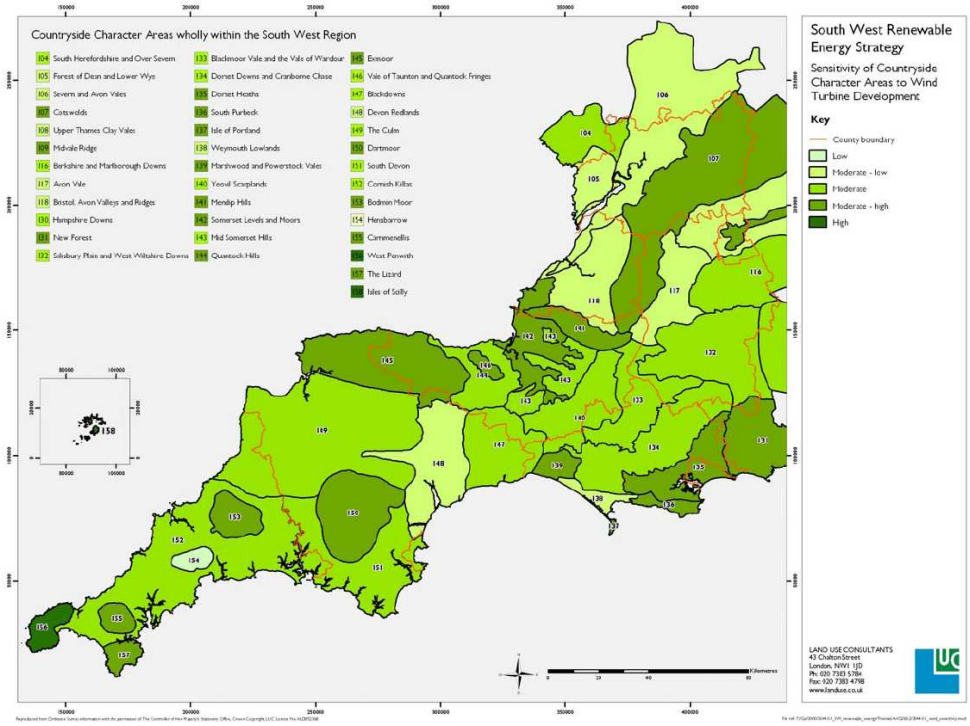


Figure 2: REvision 2010 wind landscape sensitivity

The landscape sensitivity analysis reduced the constrained resource by 56% to 254 MW. The 89 MW of the 151MW Devon 2010 RE target apportioned to large scale wind represents 35% of the landscape adjusted resource and 16% of the constrained resource. These proportions reflected the perceived limits to the speed of deployment by 2010.

At district level North Devon's resource assessment (based on REvision 2010) yields a technical resource of 146MW based on 1.3 MW turbines or 26% of the Devon resource. Teignbridge's 2010 study identifies a resource of 50 MW for large scale wind and 169 MW for small scale wind.

3.2. BIOMASS

The biomass assessment in REvision 2010 covers a subset of the biomass resource suitable for electricity generation. REvision 2020 is more exhaustive but does not provide a breakdown by county. The Environment Agency's 2010 report[10] fills this gap by providing an analysis of the unconstrained biomass resource (with the exception of energy crops and sewage sludge) by district. The results for Devon are shown in Appendix 2 together with the CEE's 2010 resource assessment for wood fuel in Devon[11] which includes an assessment of energy crops in the county. The County's sewage sludge resource is assumed to be fully developed where viable by South West Water and the heat and electricity produced is consumed on the company's sites.

[10] "Regional potential for sustainable renewable energy: biomass south west", Environment Agency, 2010

[11] "An updated biomass resource assessment and analysis of the supply and demand for wood fuel in Devon", CEE, 2010

Table 2 provides a comparison of the wood fuel resource assessments for Devon from the two studies and shows that the total woody biomass resource is equivalent to some 37 MW of potential electrical capacity.

Non-crop resource	**AEA ,000 odt**	**CEE (extended)[12] ,000 odt**
Forestry & sawmill residues	132	117
Arboreal arisings	5 (allocated by population and not including garden waste)	59 (allocated by area and population also includes element of clean garden waste from ca sites)
Clean wood waste	12	20
Total clean resource	154	196
Contaminated wood waste	27 (includes some clean garden waste)	
Total non-crop	176	
MWh at 5.3 MW/odt	932,800 MWh	
MWe at 5.3 MW/t and 25% efficiency	27 MW	
Crop resource	**AEA ,000 odt**	**CEE (extended) ,000 odt**
Miscanthus		55
SRC		8
Total crop		63
MWh at 5.3 MW/odt		335,299 MWh
MWe at 5.3 MW/t and 25% efficiency		10 MW

Table 2: A summary of recent woody fuel resource assessments for Devon

The REvision 2010 biomass targets are split by technology and cover only those biomass resources considered potentially suitable for electricity generation. The REvision 2010 regional target for energy crops and forestry residues is allocated to Devon on the basis of the then proposed 23 MW Peninsular Power plant at Winkleigh. Subsequently this facility was refused planning permission and the consequent delays meant that the plant's grant funding expired and the proposal was dropped. The assumptions behind this target are therefore no longer valid.

The REvision 2010 assessment of AD is based on notional centralised plants with 20% of the animal population contributing with slurry collected for 50% of the year which together with all commercial and industrial food waste, gives a regional resource of 15 MW. The regional target is 15MW with 3MW (20%) apportioned to Devon. The EA resource assessment of wet biomass wastes includes all animal slurry (without reductions for non-collection) and organic waste from domestic (MSW), commercial and industrial sources. Estimated capacity in Devon is 11MW.

The CEE's AD study[13] assessing the potential for anaerobic digestion in Devon illustrates the difference between quantifying the raw resource and establishing its energy contribution. The broad conclusions from the CEE's study are that for cattle based systems, the economic analysis indicates that the most competitive AD systems were the high tech options based on slurry from 1,000 LU (livestock units), with viability beginning to be achieved from perhaps around 600 LU. In Devon there are 119 holdings with over 200 dairy cows. Of these, only a very small number will have over 1,000 LU.

[12] The CEE's "extended" case includes the potential for development of the current biomass resource
[13] "The Potential for On-Site Farm AD in Devon: A Review of Existing Policy and Literature", CEE, 2010

Poultry litter resource in REvision 2010 is based on 25% of the bird population contributing and on the basis that 10,000 birds produce 365t/year and with 12,000 t/year equating to a thermal 1MW capacity. A regional electricity capacity of 14 MW is calculated of which 4 MW is Devon. The 2010 target is 100% of the resource. The EA's recent work shows a wet resource of 57,726 t per year of poultry litter in Devon (a similar order of magnitude to the REvision resource). However, the EA resource assessment assumes that poultry litter is used in AD generating 1MW of electricity.

Although REvision 2010 set a LFG target of 9 MW LFG capacity in 2009 was 18.6MW. It can therefore be assumed that LFG is fully exploited in Devon. Declining output from LFG will need to be made up with other forms of renewable generation.

REvision 2010's calculation of capacity from energy from waste using combustion and thermal treatment assumes 1/3rd of MSW goes to thermal treatment and that 10,000 is needed for each MW capacity or 1 MW is generated from each 30,000 t of MSW arising. From Devon's resource of 54MW (or 1.62 million tonnes of arisings) a 15 MW target is adopted. The EA's work on biomass identifies wood collected at municipal civic amenity sites and organic (kitchen) waste in MSW rather that total MSW. These figures cannot therefore be compared. Portions of the REvision 2010 EfW resource are included in the EA's treated waste wood and biomass resource assessment.

Devon's total REvision 2010 biomass and waste based renewable electricity generation target is 57MW.

3.3. SOLAR

The potential solar resource reflects the ubiquitous nature of sunlight and yields a huge technical resource. Solar resource is exploited through solar photovoltaic and solar thermal panels and by heat pumps. While the potential solar resource is large solar energy is currently relatively costly to extract and deployment rates depend on economics. The FIT provides significant support to solar PV and it is anticipated that the RHI will support solar thermal and heat pumps. In February the Government announced a review of the FIT particularly the level of support to larger ground based PV arrays. It can therefore be assumed the MW scale PV is likely to be a temporary phenomenon driven by miss-pricing of the FIT.

The practical resource for solar PV and thermal technologies is usually associated with buildings with suitable south facing roofs and is therefore a function of the built environment rather than the resource itself. The choice of whether solar PV or solar thermal technology is installed (or a combination thereof) is a decision taken building by building.

REvision 2010 considered solar PV. The numbers of installations were calculated on the basis of £5m grant funding in the SW (under microgeneration grant schemes such as the low carbon building programme). This sum was considered sufficient for 50% funding of 1,000 sites with 2kW PV systems costing £10,000 each, a £2,500/kW subsidy. By 2010 195 installations were anticipated in Devon giving 0.4 MW capacity. With the FIT making significantly more funding available this assumption is clearly out-dated going forward.

AEA has undertaken an assessment of micro generation technologies for the south west[14] using the DECC methodology[15].

[14] "South west micro generation assessment" AEA Technology, November 2010 see http://regensw.s3.amazonaws.com/sw_micro_generation_report_eac3ff0542b1111c.pdf
http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/renewable%20energy/ored/1_20100305105045_e_@@_methodologyfortheenglishregions.pdf

[15] "Renewable and low carbon energy capacity methodology", DECC, January 2010 see http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/renewable%20energy/ored/1_20100305105045_e_@@_methodologyfortheenglishregions.pdf

Technology	Domestic		Commercial		Industrial	
	% of roofs	Capacity	% of roofs	Capacity	% of roofs	Capacity
Solar PV	Existing 25% (including flats) New 50%	2kW	40%	5kW	80%	10kW
Solar water heating	Existing 25% (including flats) New 50%	2kW	0%	n/a	80%	10kW
Heat pumps	Existing 100% off gas grid, 75% detached & semi, 50% terrace & 25% flats on gas New 50%	5kW	10%	100kW	0%	n/a

Table 3: DECC methodology assumptions for the assessment of microgeneration (solar) resource

The assumptions made by the methodology set out in Table 3 are based on roof space and do not account for the potential overlap of technologies either within the three solar based microgeneration technologies considered or with other technologies such as biomass heating or small scale wind.

The resource calculated is allocated by district. The results for Devon are shown in Table 4.

Local Authority	Photovoltaic electrcity kW	Solar water heating kWth	Heat Pumps kWth
East Devon	70,093	65,363	258,043
Exeter	62,141	57,501	203,806
Mid Devon	45,923	43,133	143,695
North Devon	52,957	49,607	178,627
South Hams	56,750	52,880	188,417
Teignbridge	61,543	57,003	232,660
Torridge	37,753	35,753	121,621
West Devon	31,611	29,551	101,162
Total	418,771	390,791	1,428,031

Table 4: Microgeneration (solar) resource in Devon calculated under the DECC methodology

It is important to note that the two columns for solar water heating and photovoltaic generation should not be summed as the methodology used is based on available roof space. The figure for photovoltaic generation is higher as solar water heating has not been included for commercial buildings. The figures for solar should therefore be regarded as the maximum for both technologies and the split between them can be arbitrary, up to the maximum figure for solar PV.

If it is assumed that the cumulative subsidy for PV under the FIT is £2,500 per kW the cost of delivering Devon's PV resource would be over £ 1 billion. On 25% of the UK's 25m homes (ignoring commercial and industrial installations) the cost would be over £31 billion. The financial constraints on the deployment of solar technologies will therefore be significant.

The methodology assumes that heat pumps are suitable for the majority of homes. Heat pumps use electricity. The carbon savings they achieve are a function of heat pump performance and the emissions factor (kg CO_2 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 most suitable for well insulated properties off the gas grid or in new developments with high performance building fabric. In practice, levels of investment in heat pumps will depend largely on how building regulations relating to low carbon are implemented and whether or not the Renewable Heat Incentive is made available for heat pumps and if so at what tariff level. If the electricity grid is decarbonised in the future, heat pumps may offer a low carbon alternative to

buildings on the gas grid. However, there are considerable challenges with this scenario. The widespread uptake of heat pumps will significantly raise electricity demand and potentially create a situation where space heating is increasingly competing for an electricity resource that has more essential uses (e.g. electronics, motors and lighting). Greater electricity demand will also require more low carbon electricity generation at a time when there is already a high cost to replace the fossil fuel generation fleet with low carbon sources to meet existing levels of demand. 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.

3.4. HYDRO

REvision 2010 assessed constrained regional undeveloped hydro resource at 20MW. REvision 2020 assessment was a regional constrained resource at 15MW. Constraints considered include the seasonality of water flows, the willingness of landowners and riparian rights owners to advance projects, environmental issues and the need for Environment Agency acceptance and the financial viability of projects (i.e. level 5). Recent work by the Environment Agency assesses the South West's unconstrained hydro resource (i.e. level 1) as 74MW.

The REvision 2010 hydro target reflected the order of hydro installed in 2005 with little or no additional capacity anticipated. On a regional basis it is considered that due the constraints some 5% of the region's 15MW hydro resource could be utilised, to produce 1 MW i.e. less than 0.2% of the regional target. While recent work by the Environment Agency[16]assesses the South West's unconstrained hydro resource (i.e. level 1) as 74MW. Studies in Dorset by Regen SW suggest that perhaps 7% of the unconstrained resource may be developed by 2020 which if reflected across the region would equated to deployment of 5MW in the South West a proportion of which perhaps 0.5MW to 1MW may be in Devon.

3.5. SUMMARY

REvision 2010 provides the only county by county renewable electricity targets for the South West. Devon's target for 2010 is shown in Table 5.

Technology	MW	%	GWh	%
Small hydro	5	3	11	2
PV	0.4	1	0.3	0
Energy crops / FR	26	17	208	29
AD	3	2	26	4
Poultry litter	4	3	30	4
LFG	9	6	78	11
EfW	15	10	125	18
Onshore wind	73 – 103 (89)	58	191 – 270 (231)	33
Total	151	100	709	100

Table 5: Devon's REvision 2010 electricity target breakdown

[16] "Opportunity and environmental sensitivity mapping for hydropower in England and Wales", Environment Agency, 2010

Table 6 compares the estimated level of resource with the target.

Resource	Unconstrained resource MW	Constrained resource MW	REvision 2010 target MW	Resource assessment source
Small hydro	75	8	5	EA study
PV	419	n/a	0.4	AEA assessment
Energy crops / FR	37	n/a	26	EA & CEE studies
AD	11	n/a	3	EA study
Poultry litter	1	n/a	4	EA study using AD
LFG	n/a	n/a	9	
Treated wood / EfW	5	n/a	15	EA study
Onshore wind	n/a	559 – 1993	89	REvision 2010 & Wardell Armstrong
Total			151	

Table 6: A comparison of Devon's renewable electricity resource assessment and 2010 target

4. CURRENT AND PLANNED RENEWABLE ENERGY INSTALLATIONS IN DEVON

Figure 3 shows the installation of renewable electricity in Devon over the period 2005 to 2009.

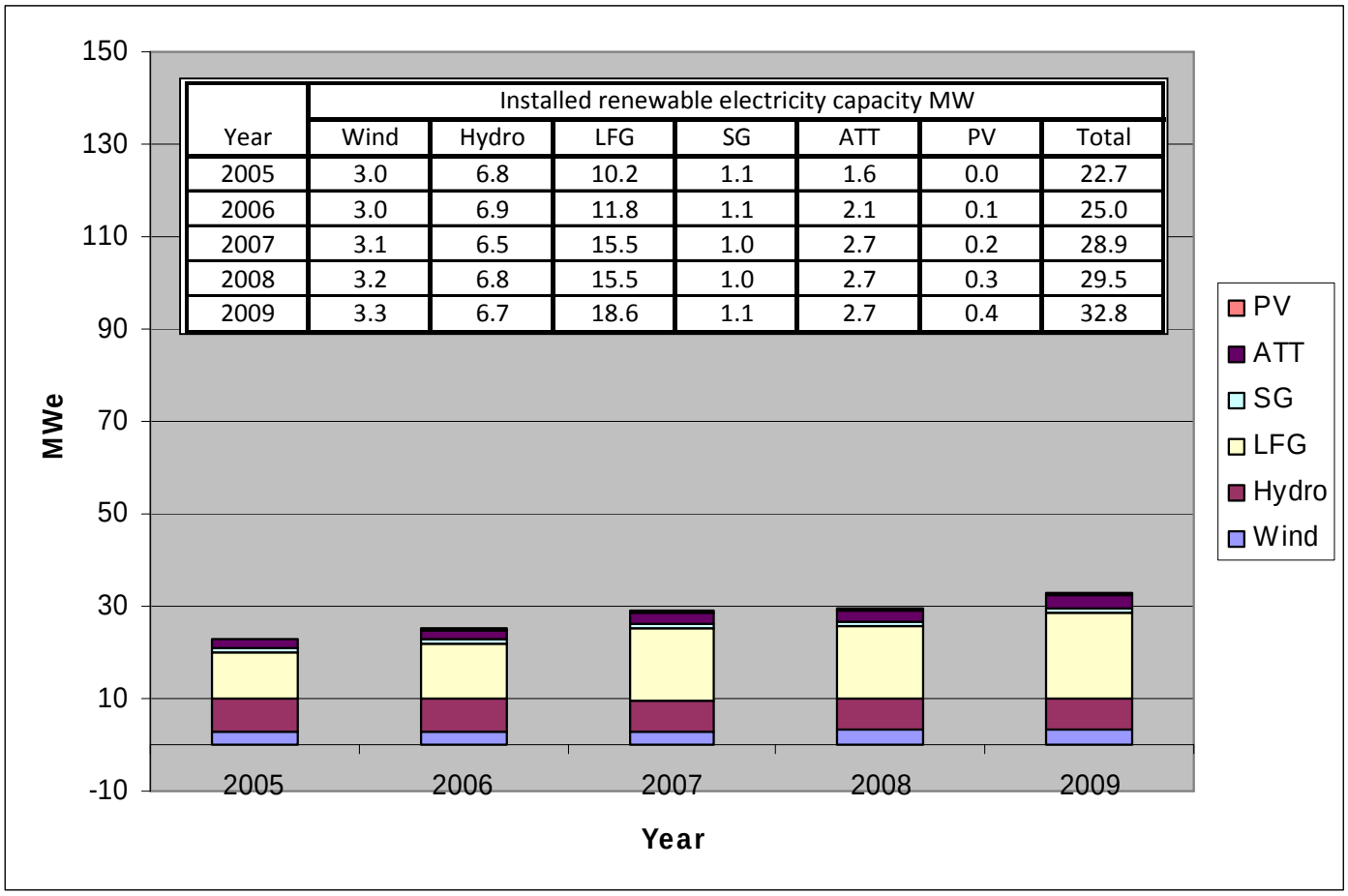
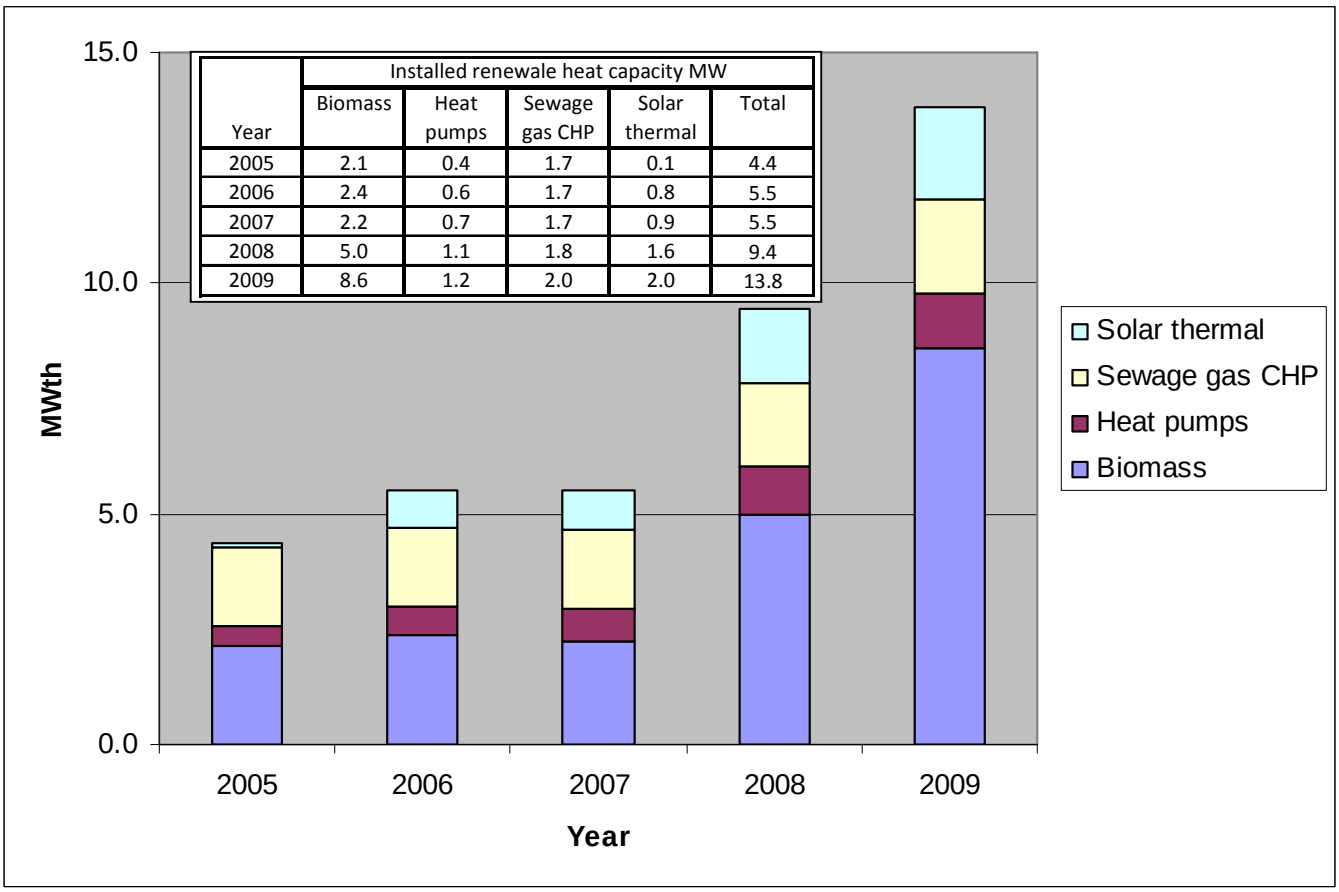


Figure 3: Devon's installed renewable electricity capacity from 2005 to 2009
Source: Regen SW

In the period 2005 to 2009 installations increased by 10.1 MW or 44% with land fill gas being the main contributor 8.4MW (83% of the total). Land fill gas recovery has been driven by environmental standards and the financial incentives on operators through Renewable Obligation Certificates (ROC's) on the electricity produced. The next largest contribution comes from the expansion of the Holsworthy anaerobic digestion plant (recorded under the ATT category). Overall the 33MW of renewable electricity installations in Devon in 2009 fall well short of the 151 MW REvision 2010 target

The installation of renewable heat is shown in Figure 4.



Year	Installed renewale heat capacity MW				
	Biomass	Heat pumps	Sewage gas CHP	Solar thermal	Total
2005	2.1	0.4	1.7	0.1	4.4
2006	2.4	0.6	1.7	0.8	5.5
2007	2.2	0.7	1.7	0.9	5.5
2008	5.0	1.1	1.8	1.6	9.4
2009	8.6	1.2	2.0	2.0	13.8

Figure 4: Devon's installed renewable heat capacity from 2005 to 2009
Source: Regen SW

Renewable heat installations have increased 9.4MW from 2005 to 2009 or 214% with the main contribution from biomass (6.4MW or 44%) and solar thermal (1.9 MW or 20%). The increase in biomass installations can be largely attributed to grants available from the Governments biomass capital grants scheme. Solar thermal installations have received support from the Low Carbon Buildings Programme.

Larger scale renewable electricity schemes in Devon with planning approval are shown in Table 7.

Scheme	Technology	Capacity	Status	Est. start
Fullabrook	Wind	66 MWe	Under construction	2011
Darracott	Wind	3.9 MWe	Construction not started	2012
Glasworthy	Wind	9.2 MWe	Construction not started	2012
Den Brook	Wind	18 MWe	Construction not started	2013
Cranbrook	Biomass CHP	6 MWe	Construction not started	2014
Total		103.1 MWe		

Table 7: Large scale renewable electricity schemes in Devon with planning approval

Figure 5 shows the level of current and planned renewable electricity installations.

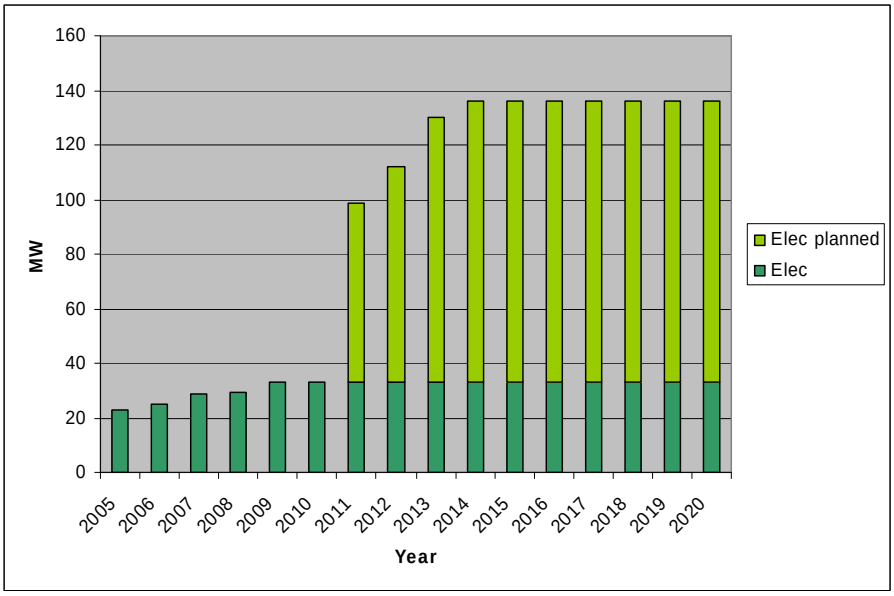


Figure 5: Current and planned renewable electricity installations in Devon

Larger scale renewable heat schemes with planning approval in Devon are shown in Table 8.

Scheme	Technology	Capacity	Status	Est. start
Cranbrook	Biomass CHP	17MWth	Construction not started	2014
Total		17 MWth		

Table 8: Large scale renewable heat schemes in Devon with planning approval

Figure 6 shows the level of current and planned heat installations.

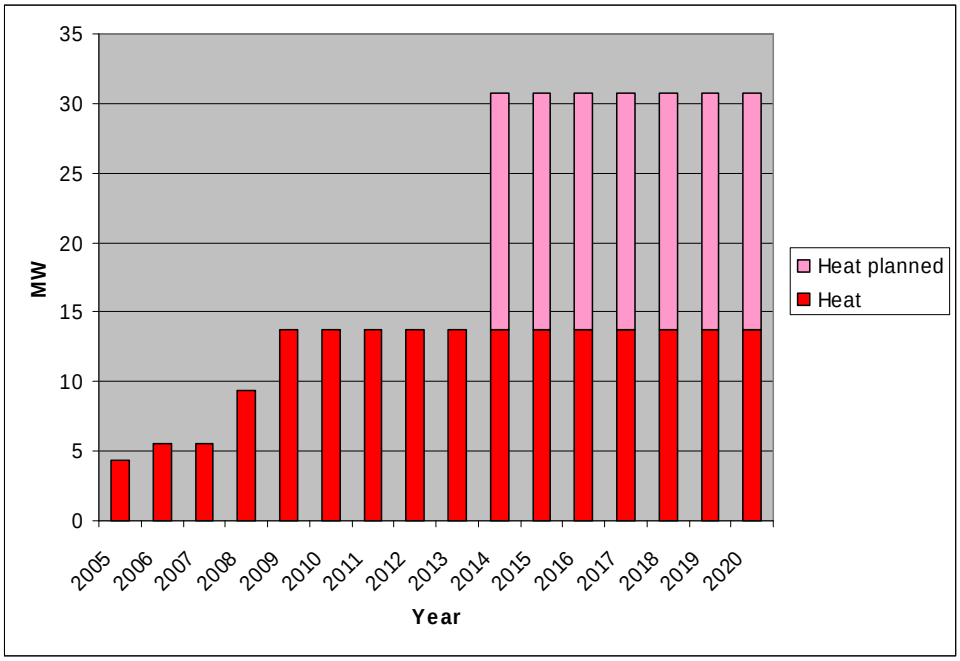


Figure 6: Current and planned renewable heat installations in Devon

Table 9 summarises Devon's renewable electricity resource, targets and installations.

Resource	**Un-constrained MW**	**Constrained MW**	**2010 target MW**	**Current MW**	**Planned MW**	**Current and planned MW**	**Remaining resource MW**	**% remain - ing**
Small hydro	75	8	5	6.71		6.71	1	13%
PV	419	n/a	0.4	0.42		0.42	418	100%
Energy crops /FR	37	n/a	26	0		0	37	100%
AD	11	n/a	3	3.83		2.7	7.17	65%
PL	1	n/a	4	0		0	1	100%
LFG	n/a	n/a	9	18.59		18.59	n/a	
Treated wood /EfW	5	n/a	15	1.13	6	6	-1	0%
Onshore wind	n/a	559 – 1993	89	3.26	97.1	100.36	459 – 1893	82% - 95%
Total			**151**	**32.81**	**103.1**	**137.41**	**Up to 2356**	

Table 9: A summary of Devon's renewable electricity resource, targets and installations

The 151 MW REvision 2010 renewable electricity target has not been achieved and will not be achieved with currently planned installations.

Wind is the largest remaining resource by a factor of 4.5 followed by solar and biomass.

5. THE IMPACT OF NATIONAL POLICY CHANGES ON DEVON'S RE TARGETS

While resource assessment methodologies have evolved over the period reflecting the availability of data and, in some instances technology changes, the renewable energy resource in Devon is relatively well established and largely unaffected by Government policy. On the other hand renewable energy targets are very significantly influenced by Government policy.

There have been fundamental changes in the policy framework effecting renewable energy since the REvision 2010 work in 2004 including the Feed in Tariff for electricity and the adoption of zero carbon new homes and new buildings and consequent changes in building regulations. The Coalition Government has announced further changes including the Renewable Heat Incentive and the reform of the electricity market with underlying support to low carbon technologies. These changes fundamentally improve the viability of renewable energy schemes and consequently mean that in most instances significantly more of Devon's renewable energy resource is financially viable than was the case in 2004 and 2005. Devon's 2010 renewable energy target is therefore out of date.

Through the Localism Bill the Coalition Government has set out a number of far reaching changes to the planning system, including the scrapping of Regional Spatial Strategies. The details at local level have yet to be fully clarified. However, as planning becomes a more local activity the need to understand renewable energy resources and deployment at county and district level will become more important.

The impact of policy changes varies by resource / technology type. Micro-generation has been the beneficiary of the current and future tightening of building regulations, feed in tariffs and the renewable heat incentive. Given this very strong national policy framework micro generation is quickly becoming main stream and it is difficult to see how additional county or district level action will materially enhance rapidly accelerating installation rates. However, while micro generation will contribute to a renewable energy target, its significance will always be limited relative to large scale technologies. One 3MW wind turbine generates more electricity in a year (at 25% load factor) than over 3000 domestic (2kW) PV arrays at a tenth of the capital cost. Wind is of course a controversial technology in Devon, yet this technology is needed to deliver significant amounts of renewable energy. Despite support from national policy wind has yet to fulfil the underlying resource potential. Local support and community involvement is needed to enable more widespread uptake.

Devon has a significant solar resource but it is expensive to deploy. The DECC microgeneration resource assessment methodology suggests Devon has some 419MW of solar PV resource which it is estimated would currently cost over £1 billion in financial incentives were it to be deployed.

Devon has a significant biomass resource. Biomass is a broad classification of resource (from clean wood chips to sewage) which varies in composition from one locality to another and requires a range of different energy conversion technologies. This complexity means that County level approaches to the biomass resource is essential to co-ordinate efficient use and develop fuel supply chains.

6. DISCUSSION OF RENEWABLE ENERGY TARGETS FOR PLANNING IN DEVON

While setting renewable energy targets is a straightforward concept in practise, the number of resources and technologies together with a large and varied geographical area such as Devon mean that target setting is a complex process requiring a considerable amount of data and a large number of assumptions about future parameters.

The resource assessment stages highlight the information required to understand a resource and derive a target. It is important to distinguish between the assessment of the constrained resource (to stage 4) and developing a target (stage 7) from this information as much of the complexity is introduced between these stages. The resource is essentially fixed over reasonable periods of years whereas targets are by their nature time bound and dependant on assumptions about the future.

Targets can have unintended consequences; Devon's 151 MW 2010 renewable electricity target is likely to be achieved over the coming 5 years. There may be a perception at this point that the job is done when in fact the 2010 target is a first step to the fuller development of Devon's renewable energy resource. For example, the 2010 target allocated to wind (89 MW) represents only 4% of the recent resource assessment and is only 18% of the 851MW needed to generate 15% of Devon's current energy needs.

Setting targets also requires assumptions about technology and technology choices. These choices are particularly apparent for biomass where different technologies (e.g thermal or biological) can be applied to the same resource with differing outputs (electricity and or heat or methane) with different efficiencies depending on the site chosen for their application (e.g heat only, CHP or electricity only). The County's large biomass resource makes these issues important in Devon.

Areas with two tier local government also face the question of what work is best done at county level and what is best done at district level? North Devon has a 2006 resource assessment, Exeter has also done a significant amount of work on renewable and low carbon energy and Teignbridge has recently completed a renewable energy and sustainable construction study. These studies inform the district local development frameworks and enable the development of district policy.

However, it is also clear that large scale renewables have implications across districts and interact with policy areas for which DCC is responsible such as waste and transport. DCC's involvement in the planning process also requires that DCC has a thorough understanding of renewable energy across the county.

With the abolition of the regional tier, counties now form the link to national renewable energy policy and related national and EU commitments on renewable energy and climate change. Government will therefore inevitably look to work with upper tier local authorities to deliver national policy objectives.

The REvision 2010 analysis provided a firm but time limited basis for Devon's 2010 renewable electricity target. However, as the target date passes the target expires either requiring a new target date and target level or some other approach. Critically, the understanding of renewable heat needs to be brought to the same level as renewable electricity.

If new targets for 2015 and 2020 are to be adopted fresh work is needed building on the recent regional analysis including that by Wardell Armstrong on wind and the Environment Agency on biomass. Once established targets should probably be refreshed on an annual basis to account for changes in deployment dynamics (economics, supply chain etc.).

While it is clear that DCC needs an understanding of each of the renewable energy resources it may be appropriate for DCC to take differing stances on different resources. For example, it could be argued that micro-generation building based technologies are of more concern to districts which have responsibility for building by building planning and development policy. Another example is the remaining hydro resource which is arguably too small to merit significant attention.

In terms of deployment, DCC's policy areas are more concerned with larger scale developments which have implications across district boundaries and / or transport and waste implications. This suggests a stronger emphasis and role for DCC in wind and biomass (all biomass not just woody biomass).

Recent work by Wardell Armstrong gives a constrained wind resource of 1993 MW a factor of 3.6 times larger than the REvision 2010 resource of 559 MW. Current wind installations of 3 MW will expand to 100MW over the coming years as planned projects are constructed. However, 100MW of wind deployment in Devon represents only 5% of the WA resource and 18% of the REvision 2010 resource.

Biomass deployment is a comparatively complex resource which overlaps with the waste resource, varies in make up from one locality to another and requires a range of different energy conversion technologies. This complexity means that a county based approach to biomass resource is essential to co-ordinate efficient use and develop fuel supply chains. Biomass is therefore an area where DCC activity could potential make an impact.

7. CONCLUSIONS AND RECOMMENDATIONS

Considerable resource assessment and targets setting work has been done which covers all or parts of Devon. Target setting is more complex than resource assessment as targets require more assumptions about viability and the time constraints on the delivery of renewable energy schemes.

Devon has large renewable energy resources with a potential capacity ranging to over 2000 MW. Wind is the predominant resource. In capacity terms the wind resource is some 4.7 to 30 times the other renewable energy resources in the County.

Devon has a renewable electricity target of 151MW by 2010. There are no Devon specific renewable heat targets or 2020 targets for electricity or heat.

Current renewable electricity installations in Devon total 33MWe of electricity and 14MWth of heat. Installations with planning consent increase these totals to 136MWe and 31MWth but Devon has not met its 2010 renewable electricity target nor will it when currently planned installations are operating.

Review of the Revision 2010 (2004 vintage) targets shows that targets are time limited. National renewable energy policy has changed significantly since the target setting work and policy enhancements such as the zero carbon buildings, the feed in tariff and renewable heat incentive mean that higher targets are now likely to be derived particularly in building scale technologies where new financial support is strongest.

Targets are of value where the parties whom the targets effects have influence over achieving them. To be effective targets also need to have regular progress measurement and sanctions available if they are not met. When the target date is passed new more ambitious targets need to be set. Targets also need regular review to reassess the assumptions made when they were derived are still valid. Renewable energy target setting is therefore a long term commitment that needs to be adequately resourced. Targets set without any further follow up may lead to the assumption that no more needs doing.

Understanding of the underlying resource potential is critical for setting the relevant policies. Many of the districts in Devon have undertaken renewable energy resource assessment work of their own to inform local plans and policies. Co-ordination of district approaches to energy is likely to become increasingly important.

DCC could consider a county-wide resource assessment. However, it may be appropriate for DCC to take differing stances on different resources. For example, if could be argued that micro-generation building based technologies are of more concern to districts which have responsibility for building by building planning and development policy. National policy support and the rapid main streaming of these technologies leave less room for local policy intervention. Another example may be the remaining hydro resource which is arguably too small to merit significant attention.

In terms of deployment, DCC's policy areas are more concerned with larger scale developments which have implications across district boundaries and / or transport and waste implications. This suggests a stronger emphasis and role for DCC in wind and biomass (all biomass not just woody biomass) particularly given the size of the wind resource and complexity of optimum biomass resource deployment.

The recommendations from this review are to:

- Assess the County Council's role in supporting national renewable energy policy in particular 15% of energy from renewable resources by 2020
- Assess the implications of not achieving Devon's 2010 renewable electricity target
- Ensure that all future resource assessment, target setting and policy development includes renewable heat
- Decide if further renewable energy targets should be set for Devon
- Integrate future renewable energy resource assessments and resulting policy at district level
- Commission a consistent and updated resource assessment for Devon drawing on recent work by Wardell Armstrong and the Environment Agency to provide the base for policy formulation and to provide districts with an overarching framework using a common set of assumptions
- Focus County activity and policy development on large scale technologies which require the County's contribution with large scale wind and biomass an immediate priority
- Consider specific barriers to the deployment of large scale technologies and develop a strategy for overcoming these (e.g community involvement to assist with deployment of large scale wind and biomass).

APPENDIX 1

RENEWABLE ENERGY WORK UNDERTAKEN BY DISTRICTS IN DEVON

A number of Districts in Devon have undertaken work on renewable energy over the last 5 years.

East Devon
In 2007 the East of Exeter Growth Point commissioned the "Energy Strategy for the East of Exeter" by Element Energy. The July 2008 report examined CO2 emissions from new development across the City and provided evidence that for larger scale developments a site wide low carbon energy solution was less costly than a house by house approach.

Exeter
The Exeter Climate Change Strategy Analysis (CEE, January 2008) provides a detailed review of the City's CO_2 emissions to meet a 30% reduction by 2020. Energy efficiency was identified as the key measure but low carbon and renewable energy including the opportunities for CHP in the City was identified as saving 18,000 t CO_2 per annum. These savings include those from the EfW plant in Marsh Barton. Follow-up work by the Centre has included studies on electrically heated housing, the City's industrial parks at Sowton and Marsh Barton and ongoing review of larger scale new development projects. Recent work in the City centre suggests that a district heating scheme which has the potential to reduce CO2 emissions by 2,000 t per annum (26% in the buildings served) may be viable.

The City's Climate Change Strategy 2009 - 2018 (ECC January 2008) identifies actions the City will take to tackle climate change and includes extensive (although un-quantified) actions on renewable energy.

A Renewable Energy Scoping Study for the City (DARE November 2008) identified 400 kW of micro hydro potential on the River Exe as it flows through the City.

Mid Devon
In 2005 Mid Devon commissioned renewable energy consultants Dulas to undertake a workshop and provide a guide to Planning for Renewable Energy. While providing some GIS information the work stops short of quantifying Mid Devon's RE potential.

North Devon
"Renewable Energy in North Devon Reviewing the Targets for 2010" by CSE in March 2006 was an extensive review of the District's resources derived form the REvision 2010 and 2020 datasets. Accessible (constrained) resource in North Devon is shown in Table A1.1

Technology or Fuel Source	Annual Resource	Equivalent Installed Capacity [MW]		Equivalent Annual Yield [GWh]
Resources for Electricity				
Poultry litter	-	-	[4]	-
Food waste	2,555 (t)	0.06	[3]	31
Cattle waste	746,833 (t)	3.81		
Pig waste	6,553 (t)	0.046		
SRC (Short Rotation Coppice)	1,444 (odt)	0.18	[26]	32
Miscanthus	31,264 (odt)	3.9		
Straw	-	-	[1]	-
EfW (Energy from Waste) – Municipal Solid Waste	17,390 (t)	1.74	[54]	54
EfW - industrial	47,330(t)	4.73		
Landfill gas	-	-	[9]	-
Onshore wind	145.6 (MW)	145.6	[559]	383
Small/micro hydro	0.4 (MW)	0.4	[5]	1
Tidal barrage	45 (MW)	45	-	118
Building integrated (PV/wind)	See below	-	-	-
Total	-	**205**	-	**619**
Resources for Heat				
Woodland	5,655 (odt)	10		19
Solar water heating (SWH)	See below	-		-
Heat pumps	See below	-		-
Heat from CHP	52 (MW)	52		132
Total	-	**62**		**151**

Table A1.1: A summary of North Devon's renewable energy resources

The CSE study recommend the District adopt a 2010 target of 61MWe and 19MWth some 30% of the potential available constrained resource.

South Hams

South Hams has conducted extensive work around the Sherford development but no quantitative district wide renewable energy resource assessment.

Teignbridge

Teignbridge conducted a Renewable Energy and Sustainable Construction Study in 2010 as part of the evidence base for its LDF. This work, undertaken by CSE, includes an up to date appraisal of renewable energy resources in the District. Tables A1.2 and A1.3 below summarise the "technical" and "constrained" resource identified in the study.

Resource/technology	Capacity [MWe]	Capacity [MWth]	Annual electricity yield [MWh]	% of Teignbridge's 2008 electricity consumption	Annual heat yield [MWh]	% of Teignbridge's 2008 gas and other non-electricity heating fuel consumption	Emissions reduction potential [tonnes CO_2 per year]	Emissions savings as % of Teignbridge's 2007 total emissions
Large scale wind (level 1 constraints)	359	0	942,795	188.1%	0	0%	405,402	39.7%
Small scale wind (level 1 constraints)	376	0	329,131	65.7%	0	0%	141,526	13.8%
Micro scale wind	12.3	0	5,366	1.1%	0	0%	2,307	0.2%
Solar PV	33.6	0	26,462	5.3%	0	0%	11,378	1.1%
Solar Water Heating	0	28.5	0	0%	17,845	1.5%	3,301	0.3%
Hydro	3.6	0.0	20,498	4.1%	0	0%	8,814	0.9%
Woodfuel (woodland residues)	0	414	0	0%	1,279,899	108.8%	199,137	19.5%
Woodfuel (energy crops)	70.5	176.34	628,783	125.5%	1,571,957	133.6%	492,416	48.2%
Waste (MSW)	2.2	5.5	17,299	3.5%	43,246	3.7%	15,439	1.5%
Waste (Ind &Comm)	4.2	10.5	23,794	4.7%	59,486	5.1%	21,236	2.1%
Waste (Agr, food)	1.8	4.4	13,987	2.8%	34,967	3.0%	12,483	1.2%
Total	**863**	**639**	**2,008,114**	**401%**	**3,007,400**	**256%**	**1,313,441**	**129%**

Table A1.2 Teignbridge technical resource

Resource/technology	Capacity [MWe]	Capacity [MWth]	Annual electricity yield [MWh]	% of Teignbridge's 2008 electricity consumption	Annual heat yield [MWh]	% of Teignbridge's 2008 gas and other non-electricity heating fuel consumption	Emissions reduction potential [tonnes CO_2 per year]	Emissions savings as % of Teignbridge's 2007 total emissions
Large scale wind (level 2 constraints)	50	0	131,729	26.3%	0	0%	56,643	5.5%
Small scale wind (level 2 constraints)	169	0	148,443	29.6%	0	0%	63,830	6.2%
Micro scale wind	12.3	0	5,366	1.1%	0	0%	2,307	0.2%
Solar PV	33.6	0	26,462	5.3%	0	0%	11,378	1.1%
Solar Water Heating	0	28.5	0	0%	17,845	1.5%	3,301	0.3%
Hydro	3.6	0	20,498	4.1%	0	0%	8,814	0.9%
Woodfuel (woodland residues)	0	414	0	0%	1,279,899	108.8%	199,137	19.5%
Woodfuel (energy crops - 5% landtake)	3.5	8.82	25,044	5.0%	62,609	5.3%	19,612	1.9%
Waste (MSW)	2.2	5.5	17,299	3.5%	43,246	3.7%	15,439	1.5%
Waste (Ind &Comm)	4.2	10.5	23,794	4.7%	59,486	5.1%	21,236	2.1%
Waste (Agr, food)	1.8	4.4	13,987	2.8%	34,967	3.0%	12,483	1.2%
Total	**281**	**471**	**412,620**	**82.3%**	**1,498,052**	**127.3%**	**414,183**	**40.5%**

Table A1.3 Teignbridge constrained resource

The wood fuel resource in this assessment is incorrect and likely to be revised.

West Devon

In 2008 DARE undertook the West Devon Renewable Energy Potential Study. The study identifies an unconstrained wind resource of 1155MW or 3.04 TWh nearly twice the district's energy demand of 1.61TWh. The study goes on to suggest an arbitrary wind development potential of 40 x 3MW turbines (120MW or 0.32 TWh) some 10% of the unconstrained resource.

The study identifies 1.3MW or 6.4 GWh of possible micro-hydro schemes ranging in size from 4kW to 260 kW but concedes that much of this is unlikely to be developed concluding that "most of the potential power that could realistically be produced from West Devon's rivers, has already been developed"

Sustainable forestry resource of 36 kt pa is identified which combined with an assumption of 50% managed woodland gives an 18 kt pa resource delivering 75GWh. Biomass from energy crops, although discussed is not quantified.

Biofuels and anaerobic digestion are discussed but the resource is not quantified.

APPENDIX 2

RECENT BIOMASS RESOURCE ASSESSMENTS COVERING DEVON

Unconstrained biomass resource in Devon by district
(excluding energy crops and sewage sludge)
Environment Agency (AEA), 2010

Local Authority	Forestry (odt)	Clean Wood Waste (odt)			Treated Wood Waste (odt)			Total wood resource (odt)
		Arboriculture	Industry & construction	Sub-total	MSW	Demolition	Sub-total	
East Devon	16,647	843	2,145	2,988	3,321	1,414	4,735	24,370
Exeter	347	718	1,817	2,535	2,830	1,205	4,035	6,917
Mid Devon	16,119	471	1,296	1,767	1,855	790	2,645	20,531
North Devon	20,138	584	1,589	2,173	2,302	980	3,282	25,593
South Hams	14,273	612	1,612	2,224	2,413	1,028	3,441	19,938
Teignbridge	23,415	837	2,080	2,917	3,300	1,405	4,705	31,037
Torridge	20,069	394	1,073	1,467	1,551	661	2,212	23,748
West Devon	20,949	332	929	1,261	1,309	557	1,866	24,076
Total	131,957	4,791	12,541	17,332	18,881	8,040	26,921	176,210
Energy conversion MWh/t	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Energy content MWh heat	699,372	25,392	66,467	91,860	100,069	42,612	142,681	933,913
Electricity capacity MW	20	1	2	3	3	1	4	27

AEA 2010 wet bio-resource

Local Authority	Agricultural Waste (Tonnes)				Organic Waste (Tonnes)			Total wet waste tonnes / m3
	Beef	Dairy	Pigs	Poultry	MSW	Industrial	Commercial	
East Devon	2,843	153,227	28,799	8,289	10,826	0	3,421	207,405
Exeter	73	1,992	7	3	9,226	38	2,915	14,254
Mid Devon	4,866	133,038	13,259	26,210	6,046	24,031	1,911	209,361
North Devon	6,855	90,653	3,528	4,347	7,503	0	2,371	115,257
South Hams	6,710	77,004	4,543	2,563	7,865	0	2,485	101,170
Teignbridge	5,807	26,605	5,924	1,164	10,755	0	3,399	53,654
Torridge	4,235	182,014	6,455	14,304	5,055	0	1,598	213,661
West Devon	11,329	59,472	4,085	846	4,266	38,313	1,348	119,659
Total	42,718	724,005	66,600	57,726	61,542	62,382	19,448	1,034,421
Methane yield m3/t wet	16	16	19	48	86	17	35	23
Methane vol m3	683,488	11,584,080	1,265,400	2,770,848	5,292,612	1,060,494	680,680	23,337,602
Energy conversion MWh/m	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
Energy content MWh heat	6,451	109,332	11,943	26,152	49,952	10,009	6,424	220,263
Electricity capacity MW	0	6	1	1	3	1	0	12

Devon's wood fuel resources, CEE, 2010

Source	Resource, $ODTy^{-1}$		
	Current	High	Extended
Forestry	37,000	45,400	102,400
Arboricultural arisings	12,000	23,400	58,500
Clean waste wood	20,150	20,150	20,150
Sawmill co-product	5,300	6,500	14,660
Miscanthus	3,710	22,100	55,473
Short rotation coppice	753	1,520	7,791
Total, $ODTy^{-1}$	78,913	119,070	258,974
Total energy content, MWh	416,483	628,426	1,366,806
Total energy available for heating (85%), MWh	354,011	534,162	1,161,785

GLOSSARY

Term	Meaning
AD	Anaerobic digestion
ATT	Advance thermal treatment
CEE	Centre for Energy and the Environment
CHP	Combined heat and power
CO_2	Carbon dioxide
DCC	Devon County Council
e	electricity
EA	Environment Agency
EfW	Energy from waste
FIT	Feed in Tariff
GWh	Giga Watt hours or thousands of MWh
Hydro	Hydro electric
kg	Kilogram or thousands of grams
kW	Kilo Watts of thousands of Watts
kWh	Kilo Watt hour or thousands of Watt hours
LFG	Land fill gas
LU	Livestock units
MSW	Municipal solid waste
MW	Mega Watts of thousands of kW
MWh	Maga Watt hours or thousands of kWh
odt	Oven dried tonnes
PV	Photovoltaic
RHI	Renewable heat incentive
SG	Sewage gas
t/year	Tonnes per year
th	thermal
TWh	Terra Watt hours or thousands of GWh
WA	Wardell Armstrong