North Devon's Biosphere Reserve & Torridge District Energy Plan

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North Devon's Biosphere Reserve
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SEACS

Contents

Executive Summary

This study has been commissioned by the North Devon UNESCO World Biosphere Reserves to establish a baseline for energy consumption and generation in northern Devon.

The assessment explores the differing energy types and their uses within the area for various sectors and ultimately explores the strategies for energy demand reduction and for appropriate renewable energy production.

The headline themes are:

- The amount of money spent on energy within the plan area each year is in the order of £300M. This is the equivalent of 15500 full time jobs. This expenditure is not held within the area but is instantly paid outside to energy companies.
- 20% of energy use is on private cars but accounts for 30% of the energy expenditure. Transport policies are better handled from a county and national level to reduce this especially in very rural areas, though local promotion of car share schemes can help.
- Approximately 9% of the homes in the area are described as being in fuel poverty according to the latest definitions. Most of these are in areas where there is no mains gas supplied to the house. Therefore reducing energy demand for expensive energy sources in these homes will support the alleviation of poverty in the area.
- 31% of the energy use in the area is on domestic heating and lighting and accounts for 27% of the area's expenditure. Therefore retrofitting energy efficiency and fuel switching will make a significant reduction in overall expenditure and leakage from the economy.
- 35% of the 79000 homes in the area use oil or electricity as the main heating fuel because they do not have access to gas. Switching to wood based biomass for these would require in the order of 25000 Ha of woodland that was dedicated towards sustainable fuel-wood production. (app 10% of the area)
- Almost half of the properties have inadequate loft insulation which if addressed would be the most cost effective reduction of energy use.
- 31% of homes have uninsulated cavity walls that would make a significant saving and relatively cost effective to deal with.
- 11% of homes have walls that are "hard to deal with".
- 141MW of renewable energy capacity has been installed in the area , onshore wind being the largest representative. This has an estimated base production of 7.1% of our total energy needs at the moment.
- There is much more resource available for wind, domestic solar PV, biomass, anaerobic digestion and waste to energy to meet the gap totalling 1,913,000,000 KWh potential.
- The most significant reduction is a 20% reduction in personal car use.
- Investment via and from local community initiatives will be the most economically effective way of recirculating funds and preventing leakage outside of the area.

More research is needed on resource assessments and improving the fine grain quality of the data relating to housing conditions.

Target area for community action in a rural area and an urban area should be identified from the current data sets for the next stage of the SEACS funded project.

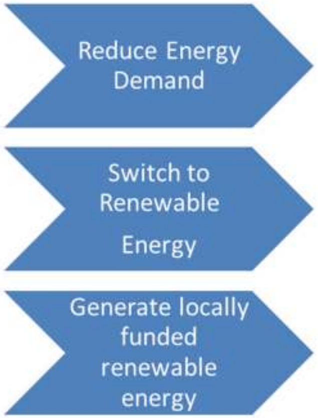
Background to the Project

UNESCO World Biosphere Reserves are a testing ground for approaches to sustainable development and to demonstrate best practice. The North Devon Biosphere Reserve has been chosen as case study area in the Interreg funded Sustainable Energy Across the Common Space (SEACS) project to develop a sustainable energy action plan and make progress towards concrete action to reduce greenhouse gas emissions from the area.

The Biosphere Reserve Partnership in North Devon has aired the concept of having a carbon neutral Biosphere Reserve. To achieve such an aspiration requires action from several sectors including energy conservation, energy provision and land-use change. The SEACS funded project will deal with these first two areas of interest.

A draft Sustainable Energy Action Plan was produced following a meeting of over 40 stakeholders in January 2013. This plan set out the scope and direction of energy conservation and production. It also set out the values of the group in terms of realising local sustainable economies and improving local supply chains and investment.

The overall strategic direction is agreed as being:



The actions were clustered under:

Enabling, Education, Community Action, Visibility, Local Planning Policies, Energy efficiency, Tackling Fuel Poverty, Generation, Land-use change, Transport and Tourism

The plan is steered by a sub group of the original attendees of the first workshop who will regularly communicate with the stakeholders to continue the concerted actions.

This document is intended to provide a robust evidence base for the Sustainable Energy Action Plan (SEAP) from which more detailed and costed actions can be developed to fit into the themes above.

The Energy Plan Area

Description of the study area

The geographical area covered by this Energy Plan includes the North Devon Biosphere Reserve and part of Torridge district that lies outside the Reserve (***Figure 1***). North Devon's Biosphere Reserve boundary crosses the districts of North Devon, Mid Devon, West Devon and Torridge so that 6%, 31%, 85% and 99% of the population of Mid Devon, West Devon, Torridge and North Devon fall within the Reserve respectively. This report has collated existing sources of data and applied them to the study area to establish the potential opportunities for energy demand reduction and renewable energy supply measures. The data sources were available at different levels of spatial resolution including district, ward and "super output areas".[1] To apply this data to the energy plan area different apportionment techniques were employed. Throughout this report the output of all analyses is made available at the district level, according to the proportion of that authority area included in the Biosphere Reserve, as well as for the whole Biosphere Reserve and energy plan area.

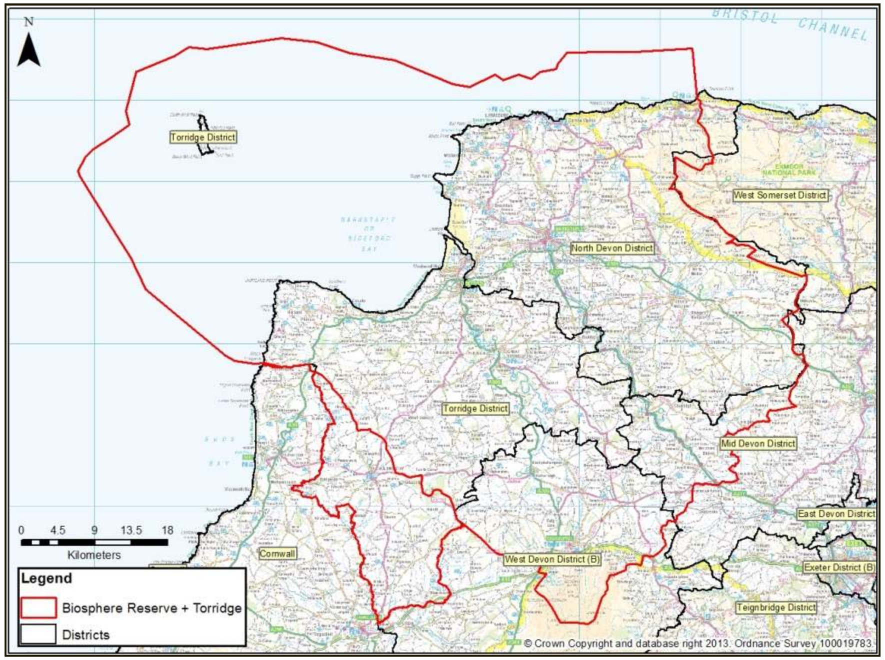


Figure 1 Boundary of the Energy Plan area. The boundary of the Biosphere Reserve and the part of Torridge district which falls outside this boundary is shown in red. The rest of the district boundaries are coloured black.

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[1] Super output areas are small statistical geographic areas: Lower Layer Super Output Areas (LLSOAs) - 1,000 to 3,000 people; 400 to 1,200 households, and, Middle Layer Super Output Areas (MLSOAs) - 5,000 to 15,000 people; 2,000 to 6,000 households.

Energy Plan: Contextual information for the study area

Devon County Council (DCC) undertook an analysis of the main town areas which make up the county in 2011. Using this information we have compiled profiles of the town areas which are covered by the Energy Plan (***Table 2***), as well as the values for the same indicators at the county and national level for comparison (***Table 1***).

Key points:

- ⇒ The proportion of the population 60 years or older is consistently higher in comparison to the national age profile.
- ⇒ The area is very sparsely populated outside of the major settlements; 47% of the population live on only 3% of the land area.
- ⇒ Fuel poverty[2] in the area is high in relation to Devon County and the national average.
- ⇒ Average household income is consistently lower than the national average but house prices are typically much higher. Lack of affordable housing is a key concern throughout the Energy Plan area, and is an important issue as it leads to strains on income available for other needs such as food and energy.
- ⇒ The top two employment sectors in the area are Accommodation & food services, which is in the top three in Devon, and Manufacturing. The next most important sectors are Health and Retail, mirroring both the Devon and national picture.
- ⇒ In comparison to the Devon County, unemployment level is varied through the Energy Plan area, typically being at a similar level or higher; but it is consistently lower than the national level.

Table 1. Key population statistics for Devon County and nationally. (Source: DCC)

	Devon	**National**
Total population (2011)	746,399	60,462,600
Population age 60+ (2011)	30.3%	20.9%
Fuel poverty households[2] (2008)	6.3%	6.1%
Average household income (2008)	£26,800	£35,100

[2] Fuel poverty is defined by the Department for Energy and Climate Change (DECC) (2013) as households which "have required fuel costs that are above average (the national median level), and, were they to spend that amount they would be left with a residual income below the official poverty line" (Fuel poverty: a framework for future action, July 2013)

Top three employment sectors by % employees (2011)	Health (13.7%); Retail (12.2%); Accom & food services (10.1%)	Health (13.2%); Retail (10.2%); Education (9.4%)
Working age population unemployed (2011)	2.2%	4.0%
Overall average house prices (2011)	£233,819	£161,281

***Table 2**.* Characteristics of the town areas of the Energy Plan area. Each area is built from parishes with one or more population centres and the remaining rural hinterlands (Source: DCC)

District	Town area	Population centre(s)	Information	Top five things that most need improving
North Devon	Barnstaple	Major settlement(s): Barnstaple Other pop centres: Fremington Landkey	• Town area population: 53,514 • Population age 60+: 28.1% (similar to Devon, higher than national) • 15.2% of households "residents of isolated rural communities" • Fuel poverty[2]: 6.5% (similar to Devon, higher than national) • Average household income: £26,000 (similar to Devon, lower than national) • Top 3 employment sectors: Health (19.2%); Retail (16.1%); Accom & food services (10.2%) • Unemployment: 2.2% (similar to Devon, lower than national) • Average house prices: £198,504 (lower than Devon, higher than national)	1. Activities for teenagers 2. Wage levels and local cost of living 3. Affordable decent housing 4. Road and pavement repairs 5. Job prospects
	South Molton	Major settlement(s): South Molton	• Town area population: 15,641 • Population age 60+: 32.6% (higher than Devon, higher than national) • 51% of households "residents of isolated rural communities" • Fuel poverty: 7% (higher than Devon, higher than national) • Average household income: £26,200 (similar to Devon, lower than national) • Top 3 employment sectors: Manufacturing (19.8%); Education (13.0%); Wholesale (10.8%) • Unemployment: 1.5% (lower than Devon, lower than national) • Average house prices: £227,958 (similar to Devon, higher than national)	1. Public transport 2. Road and pavement repairs 3. Activities for teenagers 4. Affordable decent housing 5. Job prospects

District	Town area	Population centre(s)	Information	Top five things that most need improving
	Ilfracombe	Major settlement(s): Ilfracombe	• Town area population: 17,758 • Population age 60+: 30.3% (same as Devon, higher than national) • 23.3% of households "residents of isolated rural communities" • Fuel poverty: 7% (higher than Devon, higher than national) • Average household income: £24,800 (lower than Devon, lower than national) • Top 3 employment sectors: Accom & food services (29.1%); Manufacturing (15.2%); Retail (11.8%) • Unemployment: 2.9% (higher than Devon, lower than national) • Average house prices: £201,292 (lower than Devon, higher than national)	1. Activities for teenagers 2. Job prospects 3. Wage levels and cost of living 4. Road and pavement repairs 5. Clean streets
West Devon	Okehampton	Major settlement(s): Okehampton	• Town area population: 27,184 • Population age 60+: 27.1% (lower than Devon, higher than national) • 44% of households "residents of isolated rural communities" • Fuel poverty: 7.2% (higher than Devon, higher than national) • Average household income: £26,600 (similar to Devon, lower than national) • Top 3 employment sectors: Accom & food services (15.0%); Manufacturing (14.5%); Health (12.3%) • Unemployment: 2.7% (higher than Devon, lower than national) • Average house prices: £229,514 (similar to Devon, higher than national)	1. Public transport 2. Affordable decent housing 3. The level of traffic congestion 4. Job prospects 5. Activities for teenagers
Torridge	Bideford	Major settlement(s): Bideford Northam	• Town area population: 40,130 • Population age 60+: 32.1% (higher than Devon, higher than national) • 19% of households "residents of isolated rural communities" • Fuel poverty: 6.8% (higher than Devon, higher than national) • Average household income: £25,100 (lower than Devon, lower than national) • Top 3 employment sectors: Health (15.9%); Retail (15.1%); Accom & food services (11.7%)	1. Road and pavement repairs 2. Activities for teenagers 3. Wage levels and cost of living 4. Job prospects 5. Affordable decent housing

District	Town area	Population centre(s)	Information	Top five things that most need improving
			• Unemployment: 3% (higher than Devon, lower than national) • Average house prices: £196,437 (lower than Devon, higher than national)	
	Great Torrington	Major settlement(s): Great Torrington	• Town area population: 16,117 • Population age 60+: 32.1% (higher than Devon, higher than national) • 45% of households "residents of isolated rural communities" • Fuel poverty: 7.2% (higher than Devon, higher than national) • Average household income: £26,300 (similar to Devon, lower than national) • Top 3 employment sectors: Education (15.3%); Manufacturing (13.1%); Transport and storage (12.8%) • Unemployment: 2.3% (similar to Devon, lower than national) • Average house prices: £199,173 (lower than Devon, higher than national)	1. Job prospects 2. Public transports 3. Wage levels and cost of living 4. Road and pavement repairs 5. Affordable decent housing

The town areas defined by DCC data include not only the major settlements of that town area, but also the rural hinterland in the surrounding area. This means that the overall statistics quoted for each town area may mask any differences that exist between the larger population centres and those rural communities.

This area is one of the more sparsely populated areas in England with the just over half the population of the Biosphere Reserve being scattered through 90% of the land area.

Given that urban fuel poverty is in the region of 7% and the overall fuel poverty is 9% for the study area suggests that fuel poverty in these rural areas will be significantly higher than in the towns.

Population data

Population data sub-classified by age-band was taken from that produced by the Office for National Statistics (ONS) in the 2011 Census (available at LLSOA level) and 2010-based sub-national population projections (available at district level). The results of analysis for the districts within the energy plan area are shown in ***Table 3*** and ***Figures 2-4***.

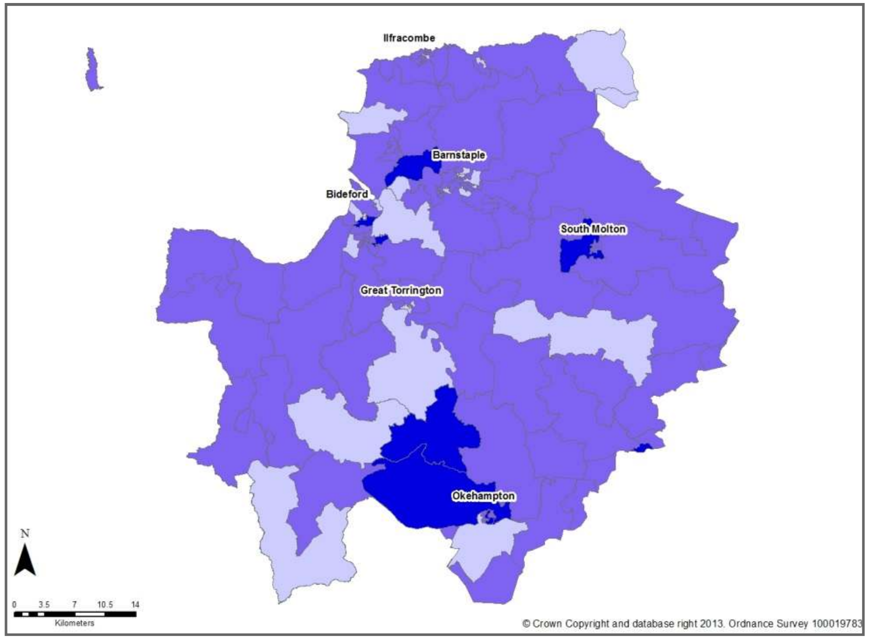


Figure 2 Population change from 2001 to 2011 for each LLSOA in the Energy Plan area. Overall the picture is one of modest increase although population decline in Bideford, Barnstaple and Great Torrington is apparent. (Source: ONS)

There are approximately 180,000 living in the Energy Plan area (***Table 3***). Just over half of these reside in North Devon, a third in Torridge, and West Devon and Mid Devon make up 10% and 3% of the population respectively. The 2011 Census data was apportioned to LLSOA level using GIS to produce ***Figure 2***. The population has increased across most of the study area during the time period 2001-2011. The largest increases are seen on the outskirts of Bideford, Barnstaple, Okehampton and South Molton; mirroring a national trend of increasing urbanisation. Correspondingly, the areas of population decline are mainly rural areas.

Table 3. Population and household estimates for the districts included in the Energy Plan (Source: ONS)

	Total population	Population in Biosphere (% of total)	Total households
Mid Devon	77,750	4,997 (3%)	30,592
North Devon	93,667	92,730 (52%)	37,068
West Devon	53,553	54,792 (31%)	21,634
Torridge	63,839	17,146 (36%)	26,247
Biosphere Reserve	169,665	-	67,920
Energy plan area	178,712	-	71,857

Population change

Figure 3 shows population increases in each of the districts over 25 years. The overall increase in population is 10% in North Devon and Mid Devon, and 16% in each of Torridge and West Devon. The age groups which show the most change are clearly shown in ***Figure 4***. In the 0-64 age bracket, overall there is mild decline (-2%), whilst there is a huge growth in those aged over 64 years.

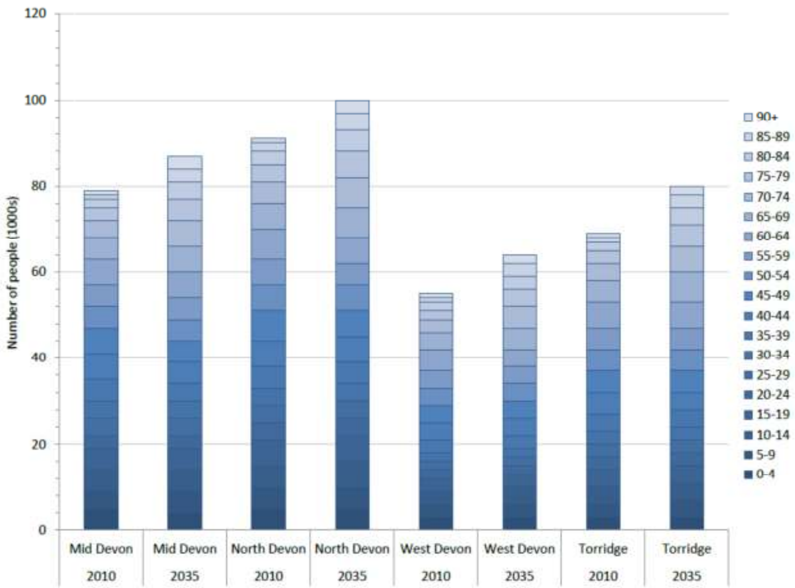


Figure 3 Population projections for 2035 compared to 2010 for each of the four districts within the Energy Plan area broken down by age-band. Population increases can be seen in each district over the time period. (Source: ONS)

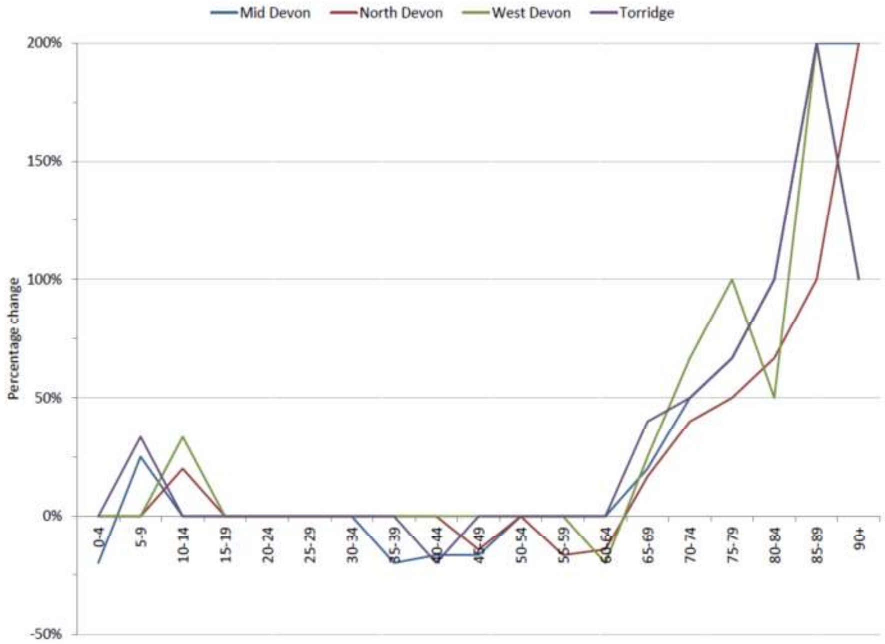


Figure 4 Percentage change in population between 2010 and 2035 across the four districts within the Energy Plan area broken down by age-band. The high increase in the elderly population is evident. (Source: ONS)

Establishing the energy baseline

A combination of data sources were used to establish an energy consumption baseline for the study area. Broadly the methods employed were as follows:

⇒ Energy consumption data for the years 2005 to 2010 were taken from DECC for each district, sub-divided by fuel type and sector, including non-domestic, domestic and road transport sources. The 2010 data was used as the most recent for the analysis.

⇒ Carbon dioxide emissions (tonnes) by use and sector were obtained at a 1 km x 1 km resolution from the UK National Atmospheric Emissions Inventory (NAEI). The latest data available was from 2010 and was broken down into sub-categories for the domestic and non-domestic sectors, and a single road transport value.

⇒ To apply the 1 x 1 km carbon data to the study area a Geographic Information System (GIS) was used. The NAEI data grid was overlaid with the boundaries for the study area and each district authority. The proportion of the NAEI values within the boundary of each district was used to generate a coefficient for each sectoral sub-category and this coefficient was used to calculate energy consumption of each sub-sector based on DECC and Energy Savings Trust (EST) data at the district level (***Table 4***). This allowed the uneven geographic distribution of energy use within any DECC reporting area to be accounted for.

⇒ To apportion energy consumption to the district level, the proportion of the population of each district within the study area boundary was calculated using Census 2011 data from ONS at the LLSOA level and GIS. The ONS population data was overlaid by the district boundaries within the study area and a coefficient for each district calculated, which was then multiplied by the total energy consumption for that district.

⇒ The Department for Environment, Food and Rural Affairs (DEFRA) Carbon Conversion factors were used to convert carbon dioxide emission values to energy consumption by fuel.

⇒ To calculate energy consumption per person, Census 2011 from ONS was used which had data at the district level. The total energy consumption for each district was divided by the total population.

⇒ Current prices for each fuel type were obtained from DECC based on average price for all months in 2012.

⇒ Energy cost per person was calculated using the total energy cost for each district divided by the total population of each district.

⇒ Predicted future prices were based on a recent DECC analysis and UK Future Energy Scenarios, National Grid 2011.

⇒ Key indicators for each sector (population, housing, transport and energy) were mapped using GIS and data from ONS, NAEI and EST.

Table 4. Summary of the sources for each of the main energy sectors and sub-sectors and the corresponding NAEI data used to calculate a coefficient for apportionment of energy consumption to district level

Main sector	Sub-sector	Source	NAEI coefficient
Transport		DECC	Roadtrans
Domestic	Electricity, gas and solid fuel	DECC	Domcom
	Oil	EST	ONS pop
Non-Domestic	Electricity, gas, and solid fuel	DECC	Indcom
	Other petroleum	DECC	Othertrans
	Agriculture fuel	DECC	Agri

Energy usage

Current energy consumption

Key points:⇒ In terms of total energy consumption there is an approximately equal split across the three broad sectors in the Biosphere Reserve and the Energy Plan area (***Figure 5***). The energy consumption of each of the authority areas in the Biosphere Reserve was calculated according the proportion of that area that falls within the Reserve boundary. Thus North Devon has a higher total energy consumption than Torridge, which uses more than West Devon which uses more than Mid Devon; which was expected as there is a positive relationship between population and energy use.

⇒ Energy intensity (energy per person) was calculated using the total values for energy use in each sub-sector and the total population of each district to find the average energy consumption per person across the whole district. West Devon has the highest non-domestic intensity than the other authority areas, reflecting the presence of the Taw Valley Creamery site (Arla Foods UK Plc) (***Appendix: Map 15***). Both West Devon and Mid Devon have similar transport intensity which is higher than the ther authority areas, probably influenced by the presence of two major A roads (A361 and A377) in Mid Devon, and the rurality of West Devon, which includes Dartmoor National Park, and the A30 and the A386.

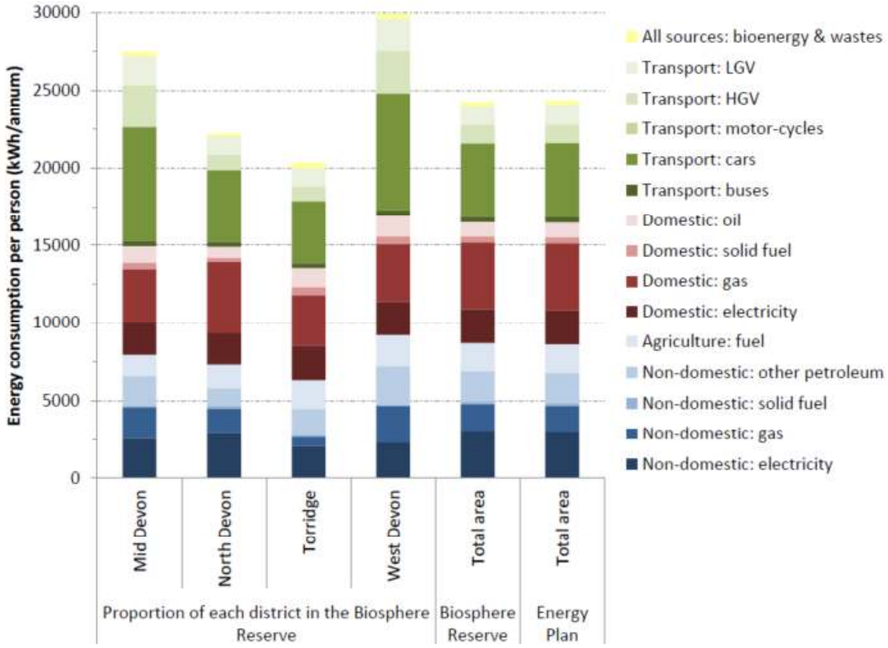


Figure 5 Total energy consumption per person across each authority area within the Energy Plan area by sector and fuel type.

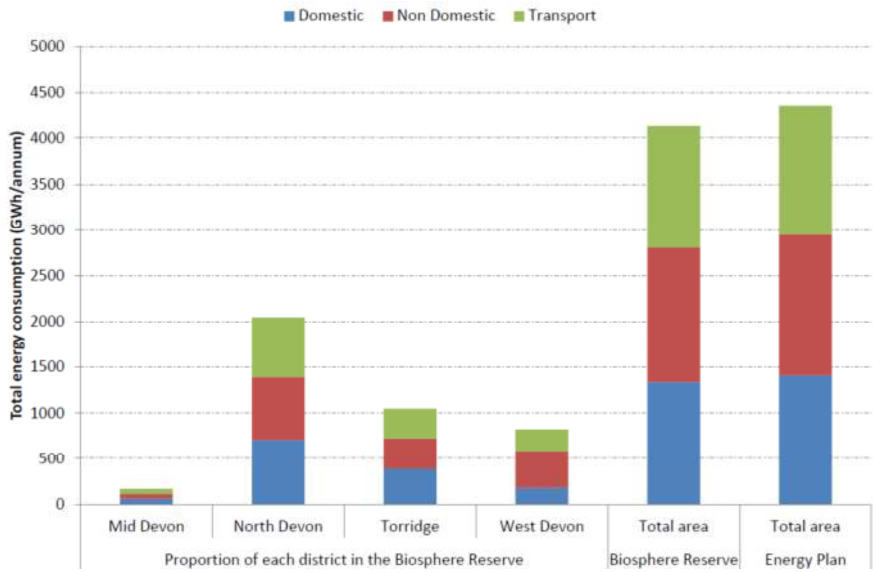


Figure 6 Total energy consumption in each authority area within the Energy Plan area for the three broad sectors.

Key points:

⇒ There is a mix of fuel types in each sector. In comparison to the national picture (23% gas; 4% electricity) there is a much smaller proportion of domestic gas use to electricity or oil in the study area. In the non-domestic sector, nationally gas is the most important fuel type whereas in the Energy Plan area electricity makes up the highest proportion.

The highest transport energy use is by cars (***Figure 7***), reflecting the rural nature of the study area with people having to travel some distance to reach their nearest food supplier (***Appendix: Map 7***) and town centre. ***Figure 8*** clearly shows that cars use over half of transport energy. GIS mapping of the commonest mode of transport to work also highlights the dependency of the population on cars, with many travelling individually instead of car sharing (***Appendix: Maps 43, 48***) and the vast majority of households in the study area having access to at least one car (***Appendix: Map 53***).

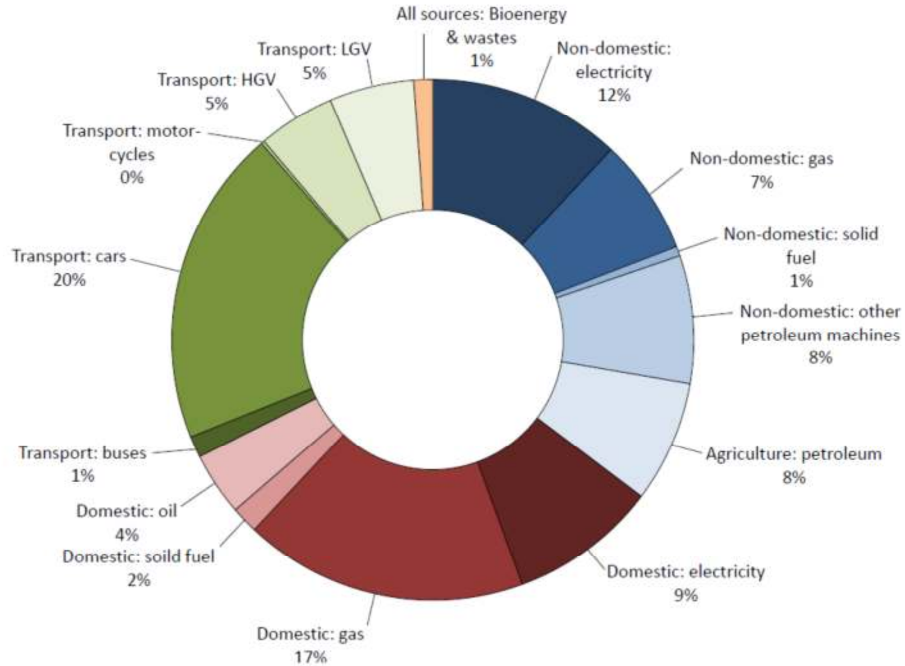


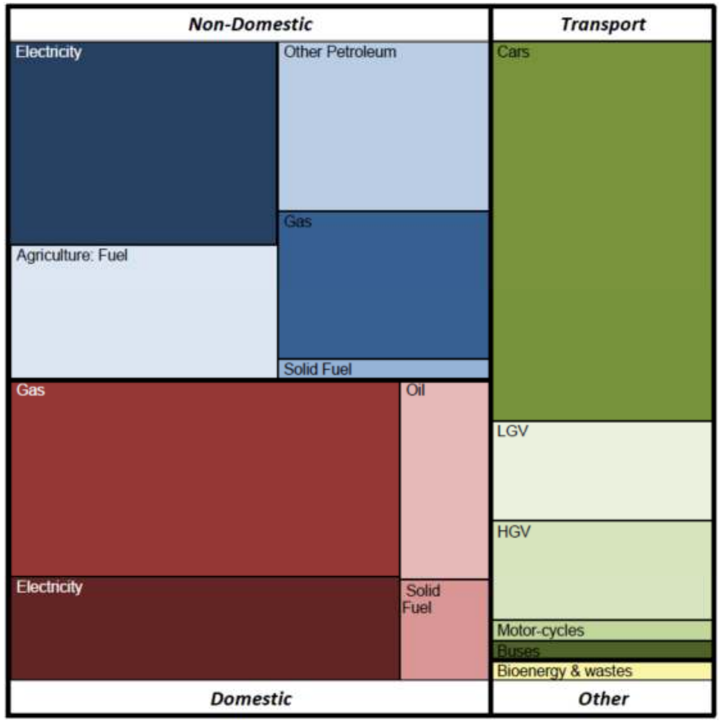
Figure 7 Split of energy consumption across the Energy Plan area by sector and fuel.

⇒Rail and shipping are not accounted for in the transport energy use as the contribution of either to the total energy consumption in the area is negligible;

- The majority of shipping traffic is from international routes passing through and therefore this energy use is not *owned* by the people of the study area.
- There is only one railway line in the study area that runs from Barnstaple to Exeter and therefore this energy use will be too

small to impact on the analysis by being excluded.

* It is noted that rail and shipping may be an important part of transport energy demand reduction measures and so they will be considered in this context later in the report



Graphical representation of energy use by sector and fuel.

Future development and impact on energy use

Growth in the area

By 2035, the total population of the Energy Plan area is projected to increase by ~13% which is two thirds of the increase seen nationally (18%) over the same time period. The largest growth locally will be seen in the elderly (over 65). Future planning policy by each authority within the study area proposes new housing development according to ***Table 5*** and ***6*** to accommodate this growth.

Table 5. Planned growth in North Devon and Torridge districts for the urban centres in the Energy Plan area from 2011—2031 (Source: North Devon and Torridge Local Plan).

District	Local centres	Housing supply	Employment land supply (Ha)
North Devon	Barnstaple	4,000	45
	Braunton/Wrafton	340	10
	Fremington/Yelland	370	8
	Ilfracombe	1,550	15
	South Molton	1,100	30
Torridge	Bideford	3,790	30
	Great Torrington	470	9
	Holsworthy	650	10
	Northam	1,550	-
North Devon and Torridge	Rural area	2,200	-
West Devon	Okehampton	1,760	10
	Hatherleigh	250	-
	North Tawton	190	-
Area total		18,220	10

Impact of growth and government policy on energy use in the area

In estimating the change in energy use following growth and policy implementation consideration was given to:

- Projected changes in population and housing;
- Predicted changes in the economy;
- Potential impacts of national energy reduction policies.

Two scenarios were projected. The first takes a 'business as usual' approach and assumes no implementation or impact of national policy; only changes in population were considered for their potential impact on energy demand and therefore future CO_2 emissions. The second scenario takes into account national energy reduction policies that will impact the Energy Plan area without further action being taken by the local authorities; a 'passive' scenario. A third scenario will be developed which takes into account the passive scenario and the assumption that actions proposed by this plan will be delivered.

The national energy reduction policies that were identified as likely to impact the study area are summarised in ***Table 7***. The latest report from the Committee on Climate Change (CCC) (2013) gives information on the national performance against climate change targets and projections for the future based on key government policies. The CCC projections were used to estimate changes in non-domestic energy use in the Energy Plan area to the end of the 3rd UK carbon budget period (2022) because there aren't any large carbon intensive industries in the study area which would be the ones first and foremost impacted by national policies. The remaining polices that require local intervention and action were not accounted in the "passive scenario".

Table 7. National policies likely to impact the study area without further action by the local authority. (Sources: CCC, DECC, DfT)

Sector	Sub-sector	National policy	Local authority impacts	Energy/emissions reduction
Domestic	Residential buildings	All new builds to be zero carbon (Code 5) from 2016	• All new builds to be Code 4 until 2015 • From 2016 all new builds to be Code 5	• Code 3 = assumed to be average of current emissions per household • Code 4 = 44% CO_2 emission reduction compared to Code 3 • Code 5 = CO_2 emission neutral
	Residential buildings	Smart-meters to be rolled out from 2014; all homes by 2019	Assumed similar level to national	5-15% annual electricity saving
Non-domestic	Electricity	Taken from CCC report	Assumed similar level to national	3% reduction
	Non-electricity	Taken from CCC report	Assumed similar level to national	16% reduction
Transport	Private vehicles (cars)	Implementation of EU vehicle emissions performance regulation (133gCO2/km by 2015; 95gCO2/km by 2020)	Assumed similar level to national	• Annual replacement rate of private car fleet • Average annual mileage per private vehicle • 1% annual reduction of current annual mileage due to fuel price increases

Key points:

⇒ Overall, in the 'business as usual' scenario, the population growth projected in the area results in a 47% increase in CO_2 emissions due to increased demand by 2022.

⇒ Under the 'passive' scenario, the impact of national policies in the area in conjunction with changes in population and housing results in a 16% reduction in CO_2 emissions by 2022.

⇒ The greatest impact in the study area is seen in the transport sector, where national policy results in a 32% reduction in CO_2 emissions. This is not surprising as private vehicle use has already been shown to be very important in the Energy Plan area.

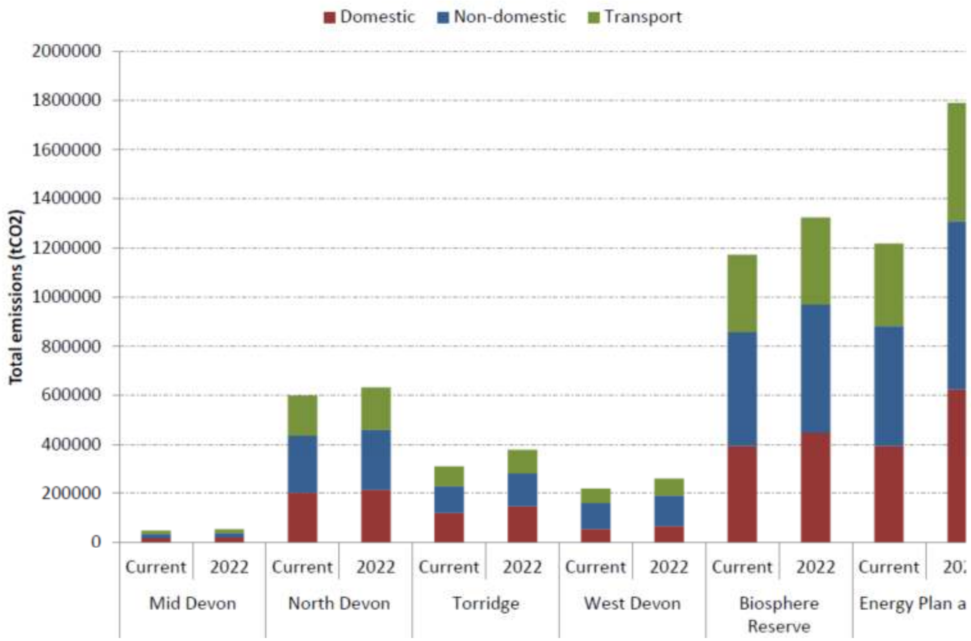


Figure 8 Estimated changes in CO2 emissions in the Energy Plan area between current levels and 2022 as a result of projected population change in a 'business as usual' scenario.

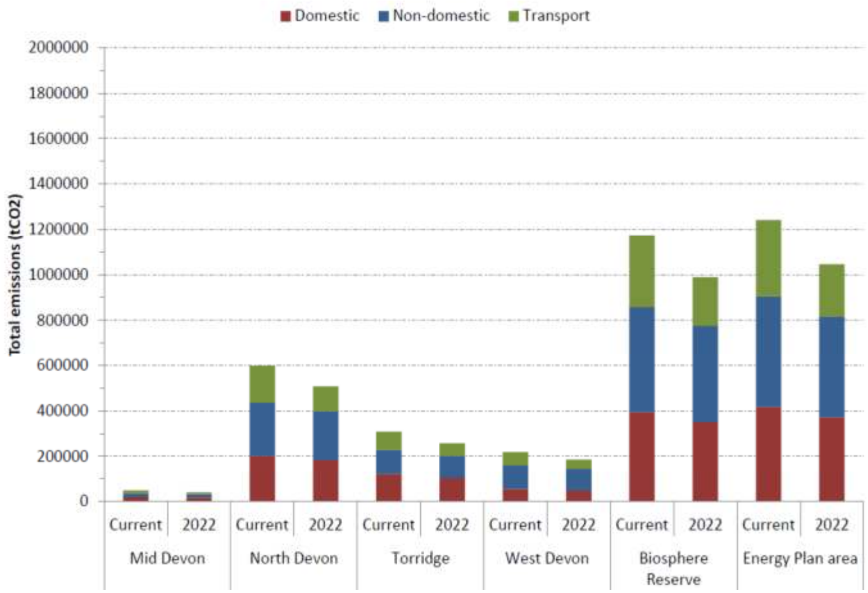


Figure 9 Estimated changes in CO2 emissions in the Energy Plan area between current levels and 2022 including the impacts of national energy reduction policies in a 'passive' scenario.

Energy expenditure

Current energy expenditure

The estimates for energy use from section **4** and current fuel prices from various sources (***Appendix: Table 1***) were used to estimate the current spend on energy in the study area. ***Figures 9-12*** illustrate these findings graphically. Key findings:

⇒ In contrast to energy use, there is not an even split of spend across the three main sectors. Transport accounts for ~50% of the energy spend in the study area (***Figure 9***).

⇒ The cost of electricity is greater than fossil fuels which explains why non-domestic electricity represents a greater proportion of the spend in that sector than it does consumption (***Figure 10***).

⇒ The total annual spend on energy in the study area is estimated to be over £398million (***Figure 11***); with almost half of that spend in North Devon, as would be expected for the authority representing over half the total population of the Biosphere Reserve (***Table 2***).

⇒ The equivalent of over £2,200 is spent per person per year on energy (***Figure 12***).

⇒ Approximately £300 is spent a year on domestic energy use per person, equating to over £700 per average household annually

⇒ The equivalent of approximately £700 is spent on private vehicle use per annum. This may be exaggerated as it likely includes people travelling through the area.

⇒ Overall, the amount spent on energy in the whole area every year is equivalent to 11% of it's economic output (Gross Value Added, GVA), or the equivalent of ~14,500 full-time jobs (FTE) (***Table 8***).

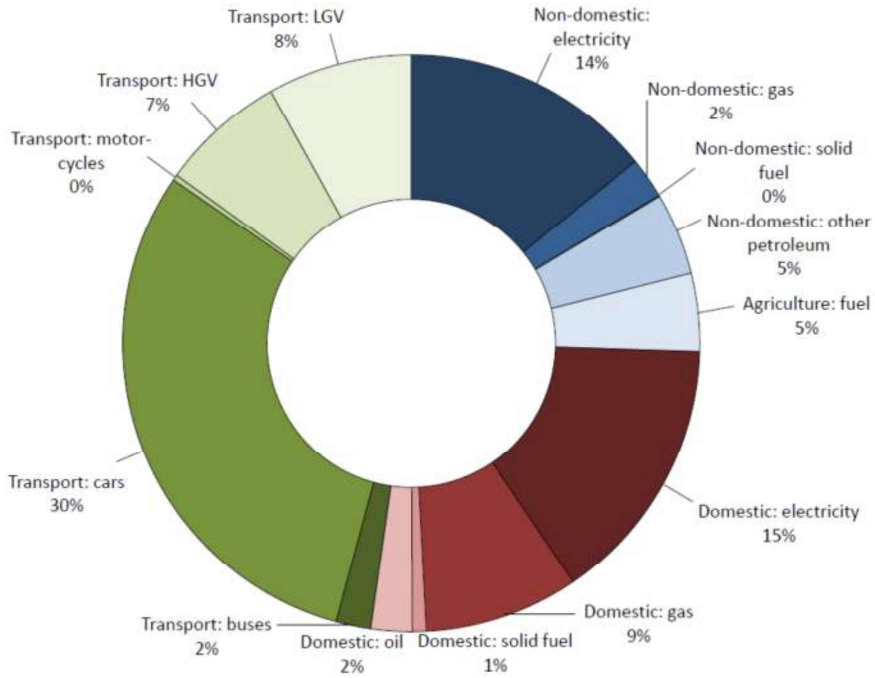
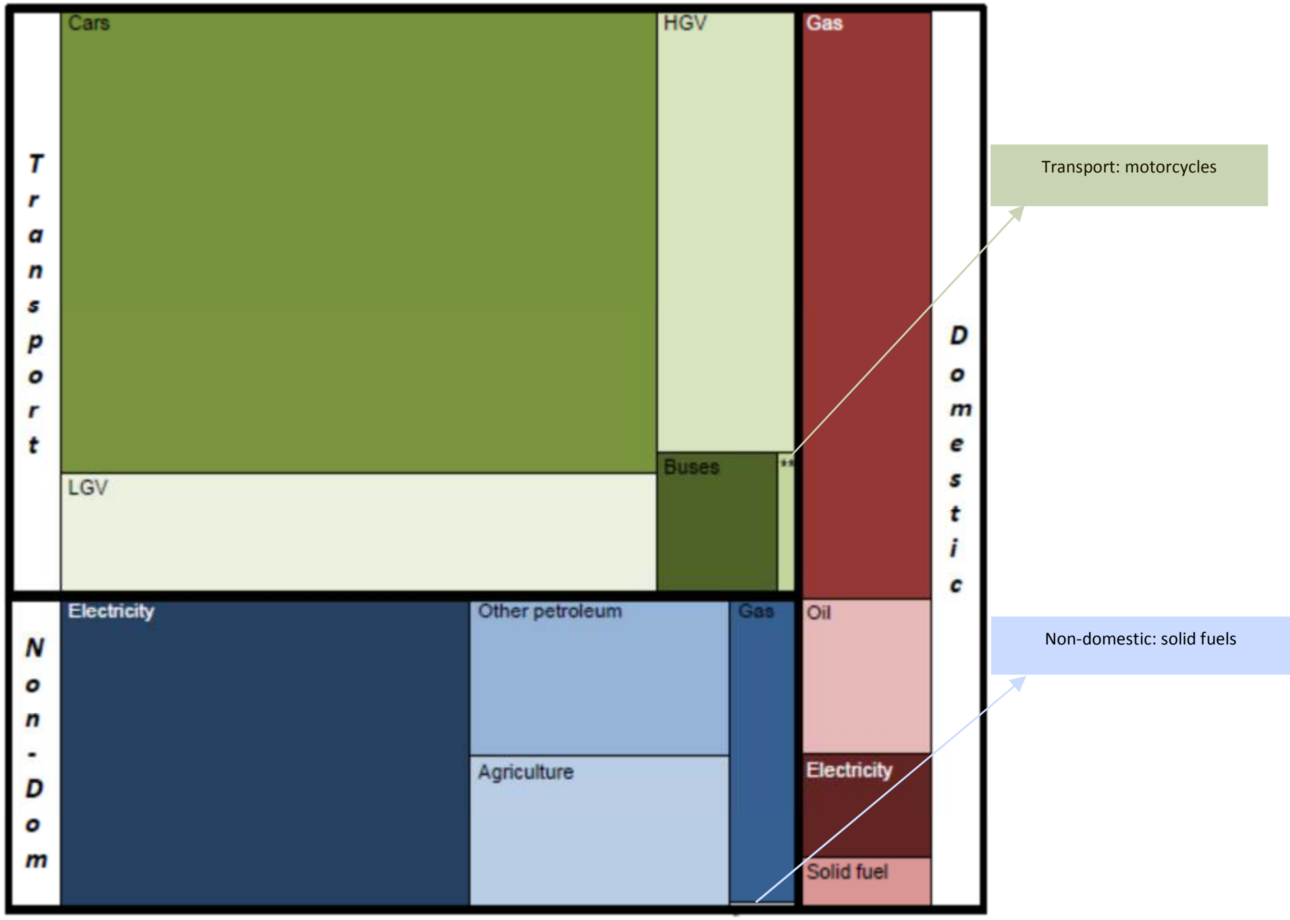


Figure 10.Split of energy spend across the Energy Plan area by sector and fuel.



Graphical representation of relative spend.

Table 8. Economic indicators for energy spend in the Energy Plan area (Source: Devonomics).

	Energy spend				**% Energy spend of GVA**	**Energy spend as equivalent FTE**
	Non-Domestic	Domestic	Transport	Total		
Mid Devon	£2,967,013	£4,762,488	£7,794,813	£15,524,314	1.8%	502
North Devon	£46,861,303	£51,012,812	£91,829,087	£190,703,201	13.7%	6172
West Devon	£22,922,442	£30,128,935	£45,311,354	£98,362,731	15.2%	3290
Torridge	£24,515,478	£13,931,902	£33,245,017	£71,692,397	11.2%	2414
Biosphere Reserve	£97,266,235	£100,836,136	£178,180,271	£376,282,643	10.5%	12378
Energy plan area	£101,627,986	£106,696,509	£190,323,356	£397,910,042	11.3%	14544

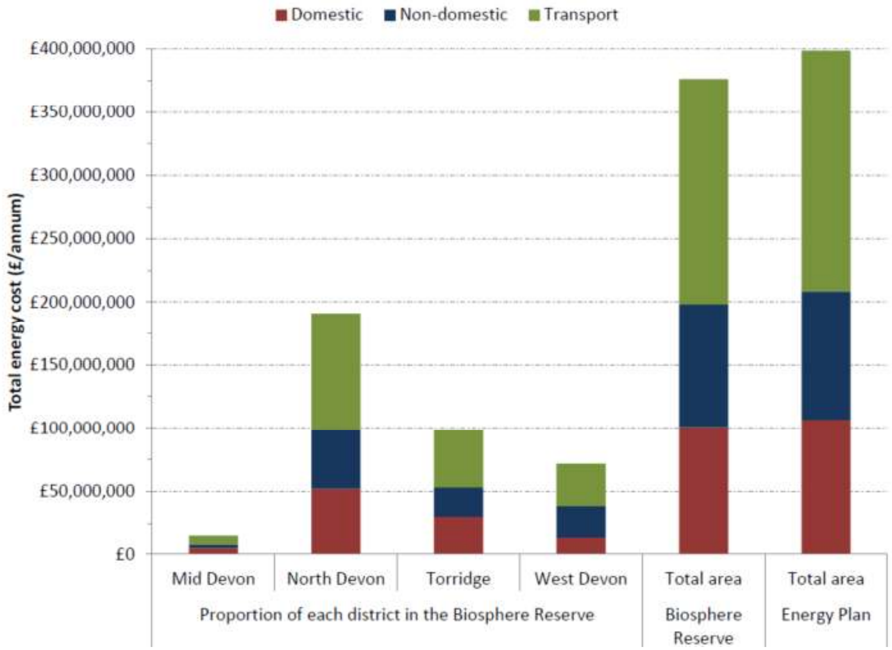


Figure 11 Total energy spend in each authority area covered by the Energy Plan for the three broad energy sectors.

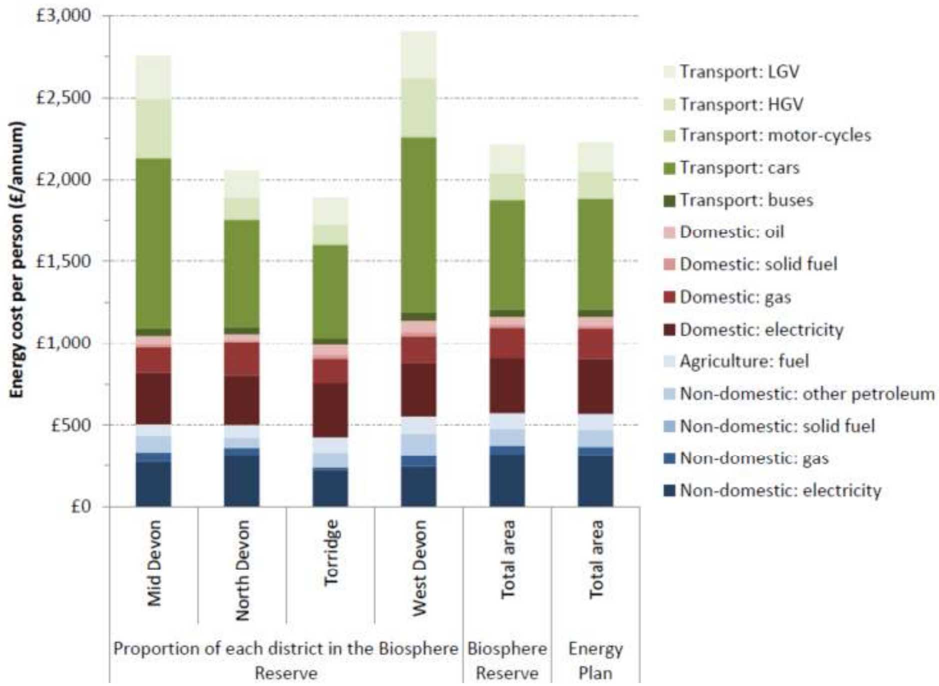


Figure 12 Total energy spend per person across each authority area covered by the Energy Plan by sector and fuel.

Predicted future energy expenditure

An estimate has been made for the future energy spend in both scenarios, based on predicted future prices and the growth in energy demand predicted by our models. The future prices were taken from DECC projections.

The business as usual scenario results in £110,660,210 more spent on energy per year (28% increase). This is equivalent to 13% of the area's economic output (GVA) or ~14,200 full-time jobs (FTE). On the other hand, the 'passive' scenario only results in a 1% (£4,717,722)increased spend per annum, as a result of projected future price increases, which equates to 10% of GVA or ~12,100 full-time jobs (FTE).

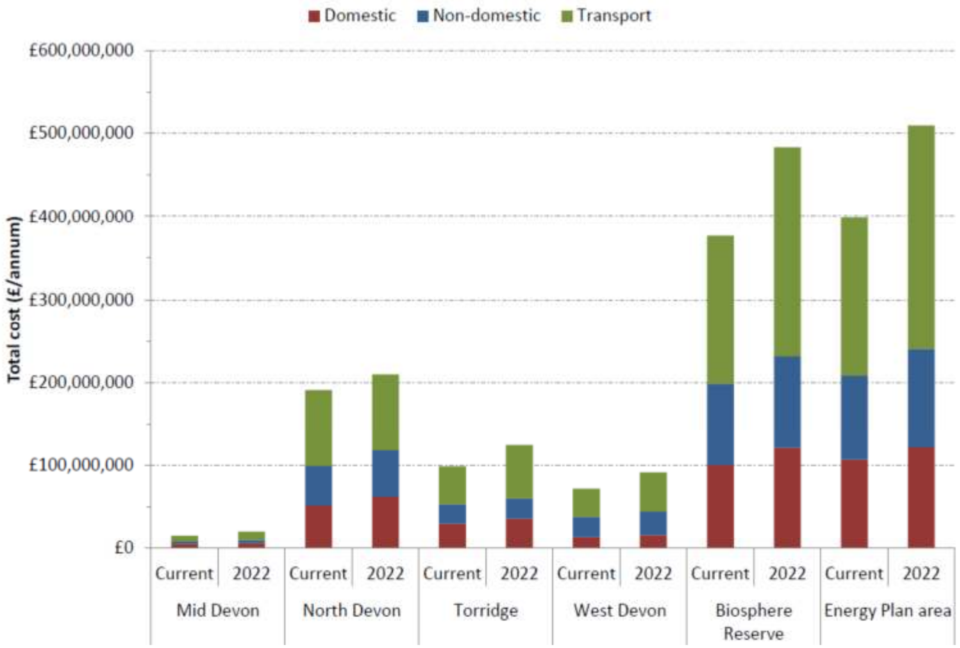


Figure 13 Total predicted energy spend in each authority area covered by the Energy Plan in a 'business as usual' scenario.

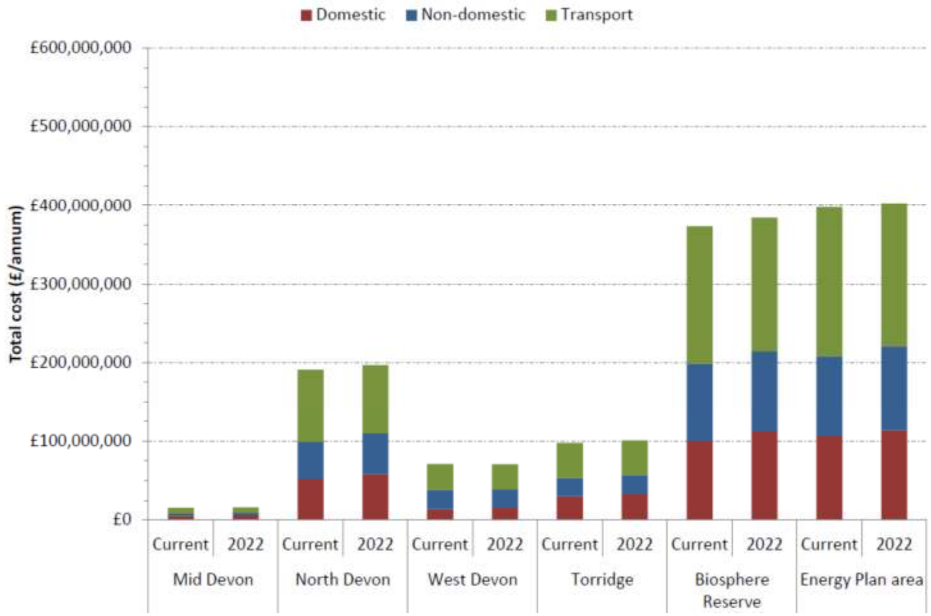


Figure 14 Total predicted energy spend in each authority area covered by the Energy Plan in a 'passive' scenario.

Opportunities for energy reduction

Introduction

Much of the action in the Biosphere Reserve SEAP will focus on domestic energy conservation and use because most of the transport and major energy initiatives are beyond the scope of the Biosphere Reserve partnership and local agencies.

The first part of this section explores in more detail the energy use in the domestic sector.

Data on property heating, fuel and insulation characteristics was taken from the Home Energy Conservation Assessment 2013 (HECA) at ward level and the Home Analytics Data derived from the Energy Savings Trust . GIS was used to select the data from the study area.

The average CO2 emissions per person in the Energy Plan area is 6.9 tonnes. This compares to the UK national average of 7.6 DECC (2012). The average CO2 emissions per household is 17.3 tonnes. Although this areas has a lower CO2 emissions per person than the UK average, this is largely due to the absence of the large carbon intensive industries (fossil energy production, concrete manufacturing, heavy engineering etc.) and large energy demanding processes.

For these reasons the report focusses on the domestic sector to explore the financial and carbon emission savings that might be made.

The data limitations

The Home Analytics data is produced by a mix of modelling and actual data. The models are more accurate with a higher amount of actual data included within the database within the region being queried. At the moment there is no indication of the proportion of real or modelled data that makes up the data in any particular area within the Biosphere Reserve.

The database provides information on separate issues such as loft insulation, wall insulation and double glazing and main source of heat, but there is no way of interrogating these outputs to identify the number of houses that have combinations of these factors. The data also quotes solid walls, however we do not know which of these walls are stone or cob, nor can one tell the thickness or thermal performance of the different wall types.

Current picture

Property types

The properties in the area show a high degree of variation according to age, type, and construction.

⇒ 25% of houses were built between 1955-1979 and 28% of houses are post 1980 (***Figure 15.***)

⇒ ~40% of houses in the study area are detached (***Figure 16.***). Detached homes are typically less energy efficient but these houses are also harder to target as they have to be done as individual projects whereas a terrace of houses could be targeted at the same time.

⇒ ***Maps 35 - 42*** in the Appendix illustrate the spatial distribution of the different property types in the study area.

⇒ 25% of houses have solid walls which are hard to treat in terms of insulation (***Figure 17.***).

⇒ ~30% of dwellings have un-insulated cavity walls which should be prioritised for improvements (***Figure 17.***).

⇒ ~60% of hard-to-fill walls is due to a wall fault. 21% of hard to fill walls are due to system builds which would require either or both internal or external insulation (***Figure 18.***).

⇒ ***Map 24*** in the Appendix shows the spatial distribution of houses with solid walls in the area.

⇒ The vast majority (76%) of houses are owner occupied which makes it easier to target the home for improvements (***Figure 19.***).

⇒ ***Maps 16 - 21*** in the Appendix show the distribution of the type of tenure for properties in the Energy Plan Area.

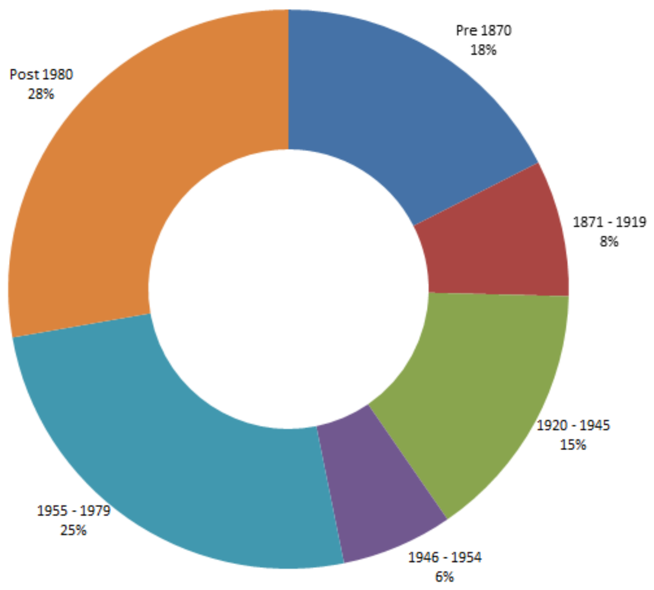


Figure 15 Age of houses in the Energy Plan area. n=79114

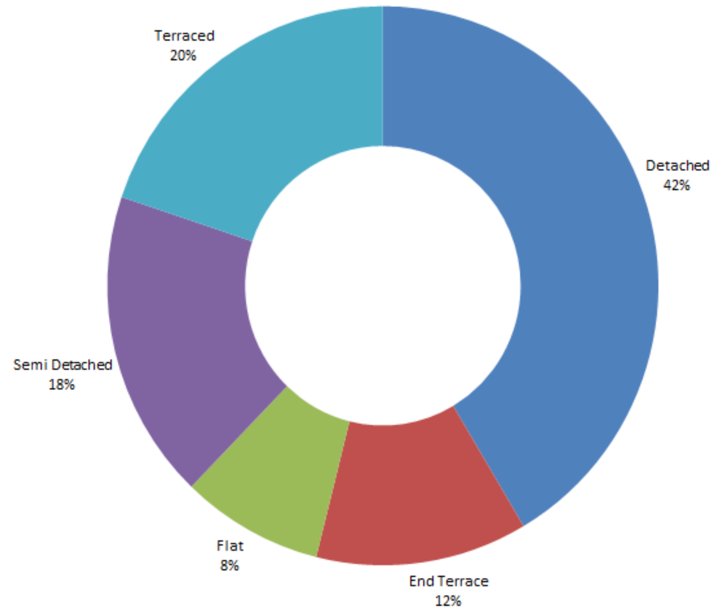


Figure 16 House type of dwellings in the Energy Plan area. n=79114

Construction types and tenure

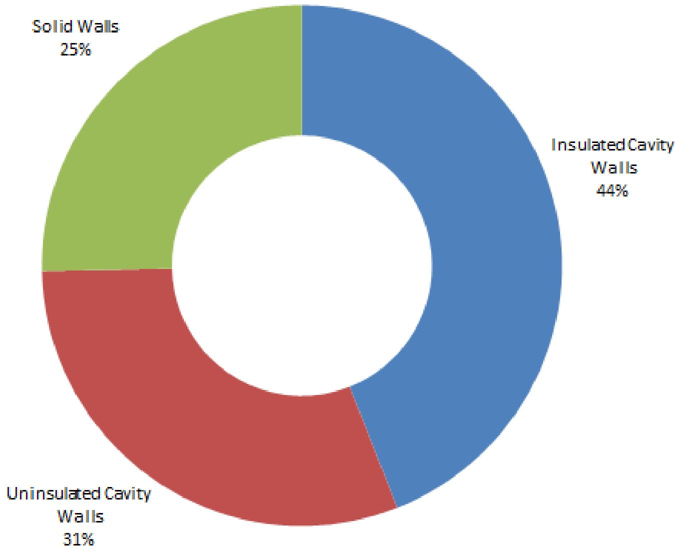


Figure 17 Construction type of houses in the Energy Plan area.

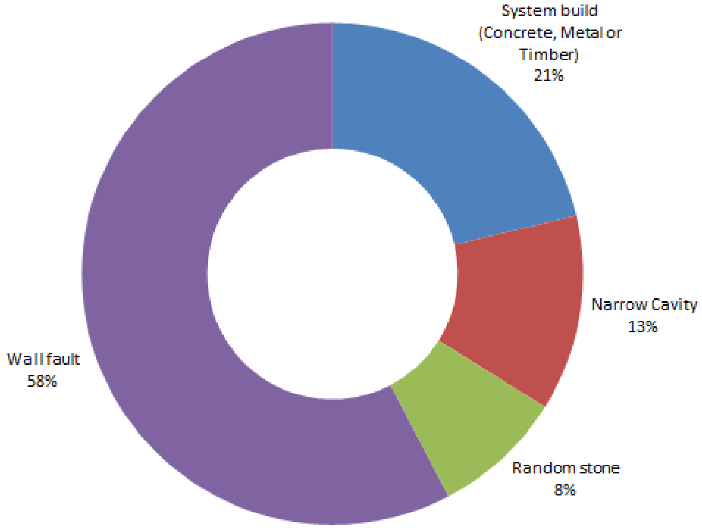


Figure 18 Hard-to-fill cavity walls in the Energy Plan area. n=8283

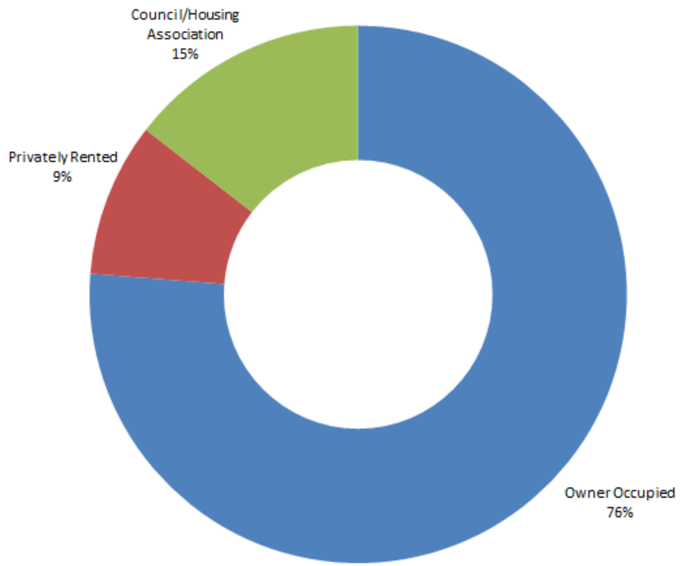


Figure 19 Tenure of houses in the Energy Plan area. n=79114

Insulation characteristics

⇒ Almost half the properties in the study area have no insulation or have insulation that is below the optimum/recommended thickness of 270mm (***Figure 20.***).

⇒ Most of the properties in the study area are double glazed (***Figure 21.***).

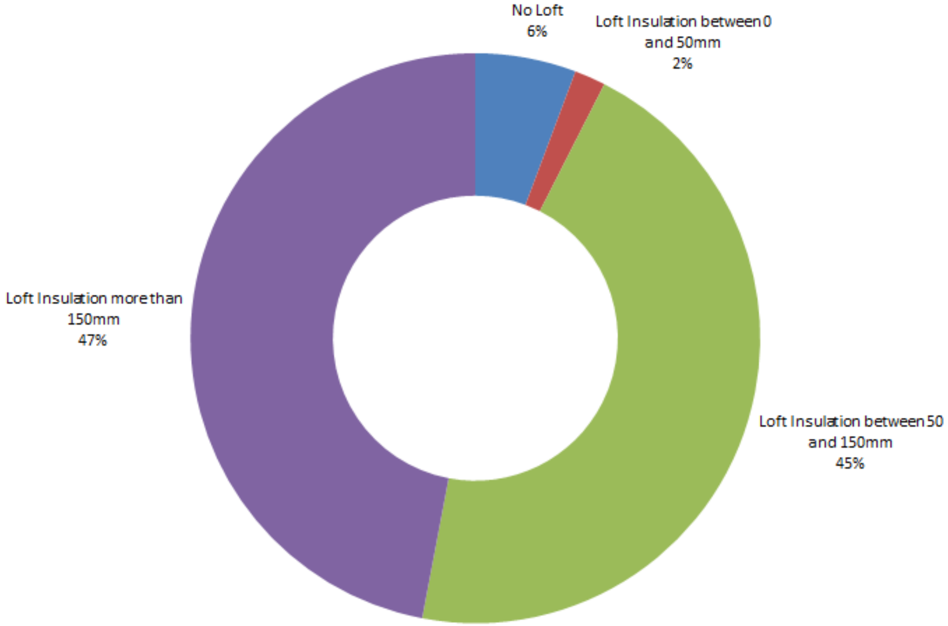


Figure 13 Presence and thickness of loft insulation of properties in the study area. n=79114

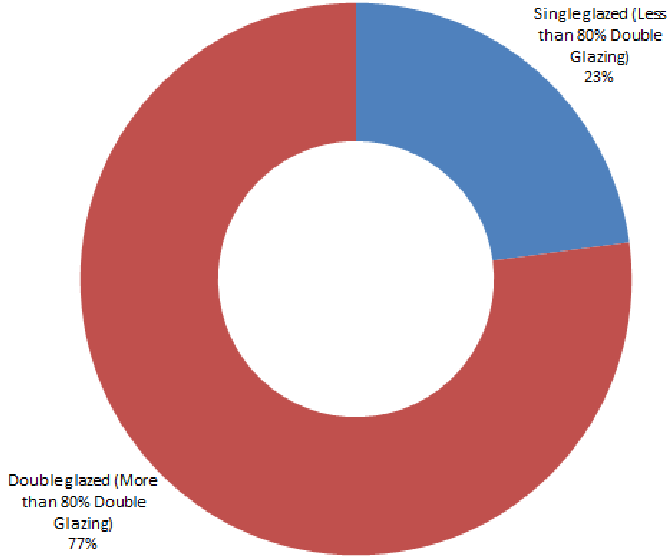


Figure 14 Types of window glazing of properties in the study area. n=79114

Fuel source and boiler type

⇒ 43% of properties in the study area do not use gas as the main fuel. (***Figure 22.***).

⇒ Oil and electricity are the main heating fuel for 18% and 17% respectively of the properties in the study area (***Figure 22.***). Fuel switching to wood heat for all of these homes may require 25000 Ha of woodland to be brought into management or extra planting. A good resourse assessment is therefore needed.

⇒ 75% of the properties in the study area are heated using non-condensing standard boiler (***Figure 23.***). (Condensing boilers can be used fuelled by oil or gas, therefore 59% of the homes could be improved by more efficient boilers)

⇒ ***Maps 11 - 13*** and ***26*** in the Appendix illustrate the distribution of the gas and electricity use. This information can be used to target particular areas for fuel switching measures.

⇒ ***Maps 26 - 34*** in the Appendix show the spatial distribution of main fuel use in the area.

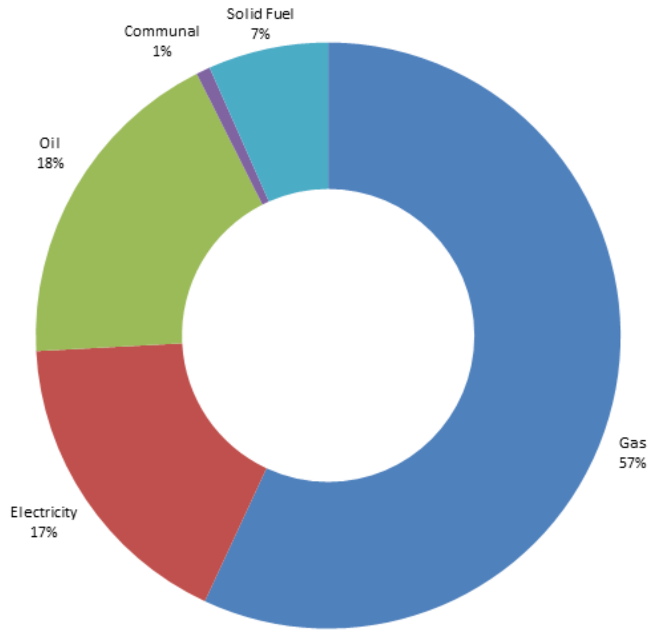


Figure 15 Main fuel of properties in the study area. n=79114

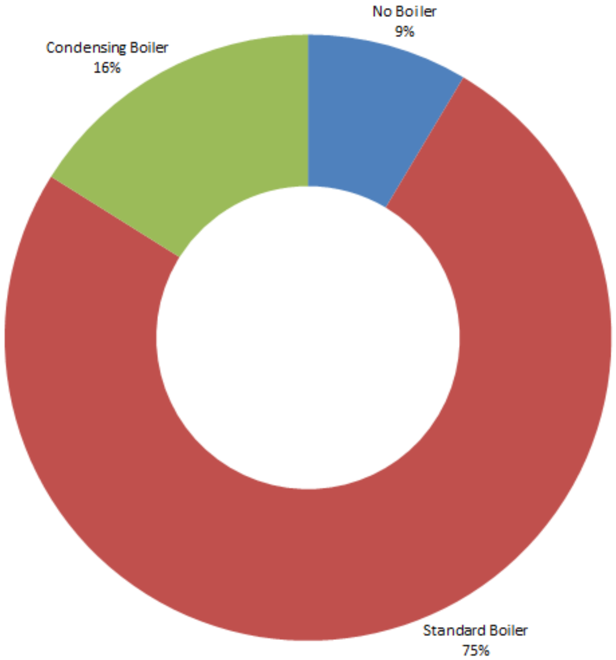


Figure 16 Boiler type of properties in the study area. n=79114

Transport

⇒ Private vehicles are responsible for the highest proportion of CO_2 emissions in the Energy Plan area (20% of the total energy consumption). ***Figure 24*** and ***Table 9*** below show the average number of cars per household, the average mileage per vehicle, and an estimation of the CO_2 emissions per household and per car.

⇒ In the Energy Plan Area, more than 40% of households have 1 car and 30% 2 cars and overall the average of number of vehicles per household is 1.7.

⇒ The national average annual mileage per private vehicle is 8200 compared to an estimated 11890 miles per annum In the study area.

⇒ Map 53 in the Appendix illustrates the large proportion of the area that has access to at least one car.

⇒ In rural areas car ownership is always going to be high where public transport can not be provided viably. Car Clubs and Car Share schemes may be an alternative. Car clubs normally report a 25% reduction in individual mileage by participants. And because the car is normally an efficient car the emission reduction is likely to be more than 25%

Table 9: Summary of transport statistics for the Energy Plan Area

Average number of cars per household	1.7
Average mileage per vehicle (miles)	11890
Average CO2 emission/private vehicle (tCO2)	2.4
Average CO2 emission/private vehicle/household (tCO2)	3.9

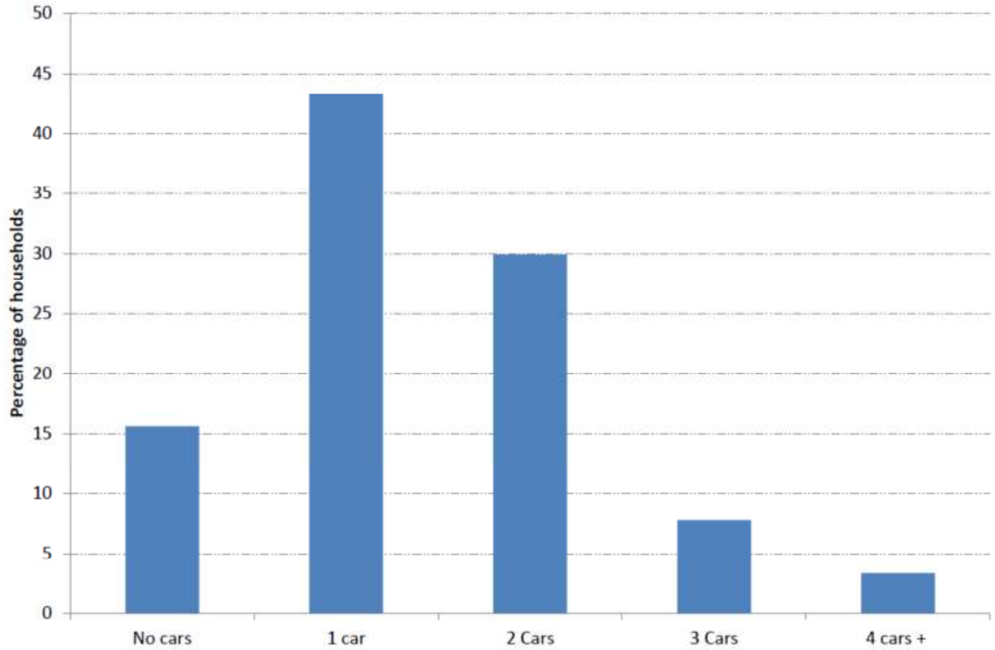


Figure 17 Number of cars per household in the Energy Plan Area

Strategy development for Domestic Emission Reductions

Analysis

For this part of the study , the data was taken from the Energy Saving Trust's Home Analytics and HECA data base.

After initial analysis of the data, 4 key carbon emission drivers have been identified. The insulation and the heating method of the household are the most important factors in reducing CO2 emissions. This meets the SEAP strategy of reducing demand through energy efficiency measures such as insulation appropriate to the home and switching to a more efficient heater for the given fuel type. Finally, switching fuel type to a less carbon intensive renewable option (such as biomass) (see Chapter 7 for a discussion of renewable energy in the Energy Plan area in more detail):

⇒ Type of wall: a high proportion of properties in the area still have un-insulated cavity walls or solid walls which have high rates of heat loss.

⇒ Presence and thickness of loft insulation: high rates of heat loss through sub-optimal thickness of loft insulation

⇒ Boiler type: the majority of properties in the area still use inefficient boilers

⇒ Main fuel: there is a high usage of fuel oil and electricity in the area. The carbon intensity of fuel oil is 0.27kgCO2/kWh compared to 0.185kgCO2/kWh for natural gas.

These measures were chosen initially based on the HECA data; the factors which had the highest percentages across the Energy Plan area were identified so that the greatest impact could be made if our recommendations were implemented. We then used MAC curves to assess each individual energy reduction or efficiency measure that was available to see if the same factors we had identified as being important in the area were also cost effective and economically viable solutions.

Data from the EST was used to estimate the cost of installation, the CO2 emissions saving and the energy bill saving for different energy efficiency improvement measures (In appendix ***Table 2***).

The EST data was based on a model house that used gas heating and was semi-detached with 3 bedrooms. The savings quoted here are estimates and will vary for a particular house, depending on the size and construction, and the way occupants use the heating system. The calculations are based on current prices, the price of installation and the cost can evolve in the future due to increases in fuel price and of some materials.

The greatest CO2 emissions savings can be made by switching the main fuel from electricity or coal to wood, with switching from oil or LPG to wood bringing the second largest reduction. Reducing heat loss through insulation of solid walls, either external or internal, contributes the greatest CO2 emissions saving from the insulation measures proposed.

Development process

Synthesis of options for energy saving

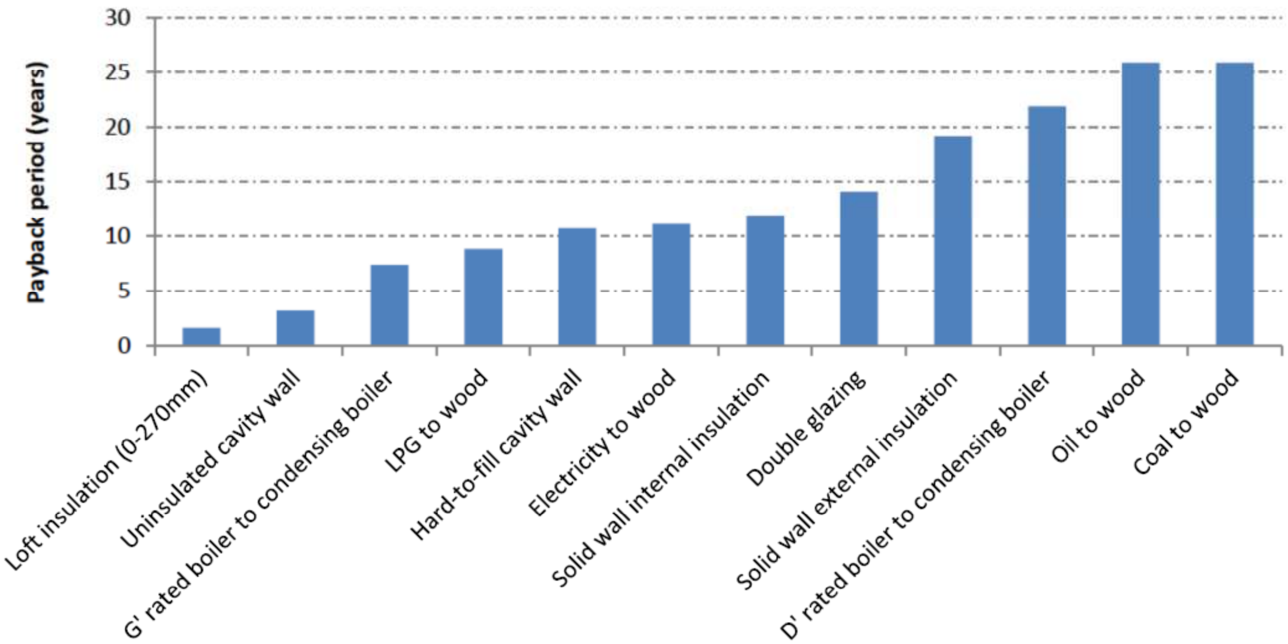


Figure 18 Payback period for individual energy efficiency and reduction measures

The pay back period and the Marginal Abatement Cost (MAC) curve graph confirm the choice of the four key factors put forward. The payback period (***Figure 25***) shows the first three measures quickly payback the capital costs.

The maximum payback period is ~25 years for the measure 'switch coal to wood'.

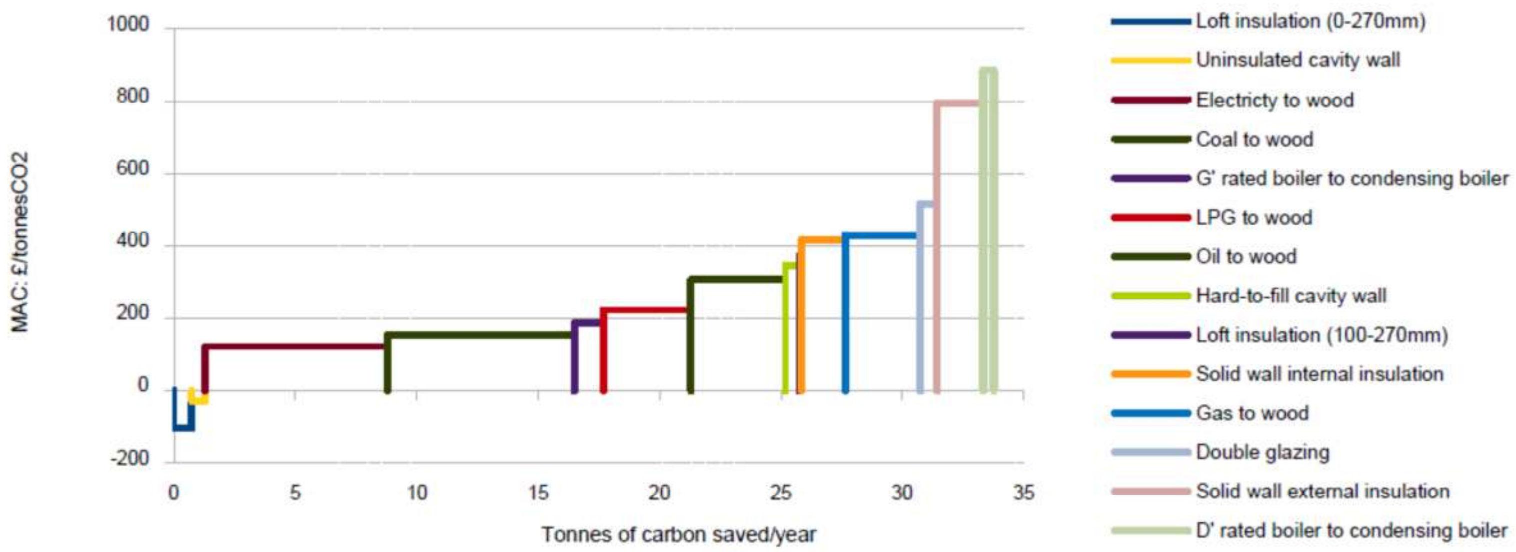


Figure 19 MAC curves for individual energy efficiency and reduction measures.

Different information is shown with the MAC curve graph (***Figure 26***):

⇒ Loft and cavity wall insulation offer financial savings even after the initial costs of installation have been factored in.

⇒ The measures which save the most CO2 are switching the main fuel to wood.

⇒ Third focus can be the solid wall and hard to fill measures, they correspond to old houses (pre-1920) with the least efficient energy ratings.

Model	Key attributes			
	Construction type	**Fuel type**	**Boiler type**	**Loft and solid wall insulation**
Cavity a	Un-insulated cavity wall	Oil	Non-condensing, G rating	<150mm loft
Cavity b	Un-insulated cavity wall	Electricity	Non-condensing, G rating	<150mm loft
Cavity c	Un-insulated cavity wall	LPG	Non-condensing, G rating	<150mm loft
External a	Solid wall	Oil	Non-condensing, G rating	<150mm loft, external solid wall
External b	Solid wall	Electricity	Non-condensing, G rating	<150mm loft, external solid wall
External c	Solid wall	LPG	Non-condensing, G rating	<150mm loft, external solid wall
Internal a	Solid wall	Oil	Non-condensing, G rating	<150mm loft, internal solid wall
Internal b	Solid wall	Electricity	Non-condensing, G rating	<150mm loft, internal solid wall
Internal c	Solid wall	LPG	Non-condensing, G rating	<150mm loft, internal solid wall

Following analysis of individual measures we generated a typology of ‘model houses’ that were representative of the study area and could be analysed as packages of measures implemented in combination rather than individually (***Table 10***).

The packages of measures that give the greatest CO2 emissions savings have higher initial costs (***Table 3*** in appendix). Packages including loft insulation and cavity wall insulation improvements have almost paid for themselves after 10 years (***Figure 27***). However, packages including solid wall insulation improvements will take longer to pay back. Any government funding available would make these options a lot more appealing as the high costs of installation may be reduced or negated.

The MAC curve analysis of these packages found that the capital costs of all the models means that savings are not possible within a 5 year period (***Figure 28***). However, when in combination some of the measures that were not cost effective as an individual action become more economically viable. If funding options were available, the capital costs of these packages may be reduced enough to find savings within 5 years.

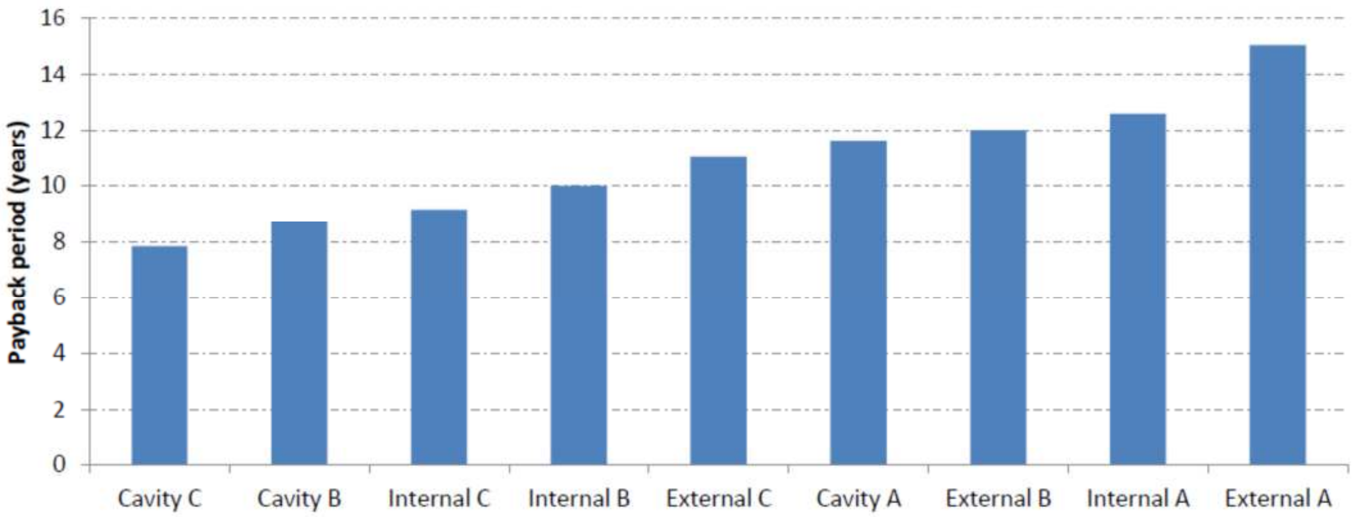


Figure 20 Payback period by model package

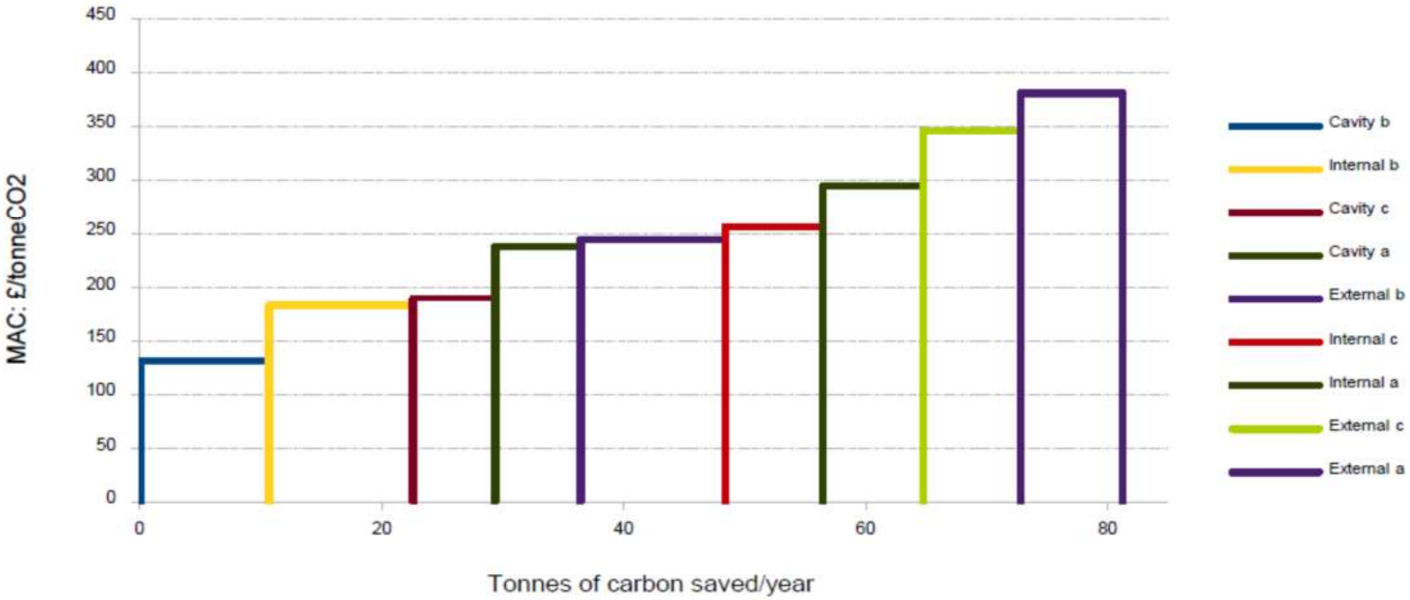


Figure 21 Marginal abatement cost curve by model package

Conclusions for Domestic Energy Approaches

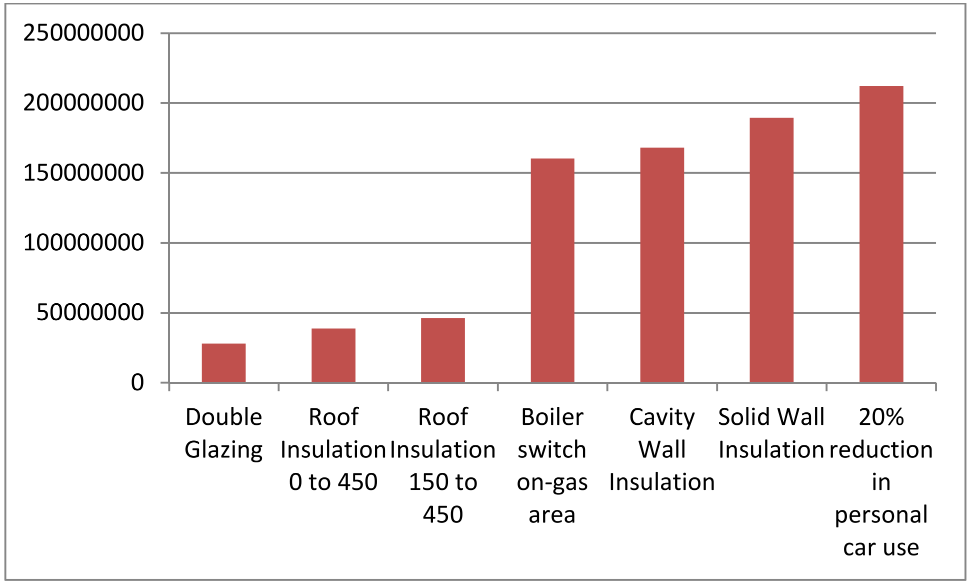
Key carbon emissions drivers within the domestic heating sector in the study area are:

1. Lack of loft insulation

2. Inefficient construction types

3. Fossil fuels with high carbon intensity

4. Inefficient boilers



The measure applied collectively and comprehensively across the Biosphere Reserve will result in approximately 20% reduction in energy demand.

⇒ Loft and cavity wall insulation are the most cost effective individual measures.

⇒ Switching from fossil fuels to wood has a large impact on reducing CO_2 emissions but has high initial costs and is only possible in areas with the right conditions.

⇒ When packages are considered, the payback period is reduced and fuel switching becomes economically viable. It may be subsidised by the renewable heat incentive when it becomes available to the domestic sector to support its adoption.

⇒ The hard to treat measures such as solid walls need to be targeted for funding to make them affordable options for households

Renewable energy assessment

In 2012 renewable energy in the UK had increased by 3.8% from the 2011 figure, accounting for 4.1% of total energy consumption. The majority of this growth was in renewable electricity generation, with the contribution of renewable heating remaining constant. Despite these positive figures, more needs to be done if the UK is to comply with the EU Directive. The interim target for the UK in 2011-2012 was 4.04%, but the average contribution of renewables to the UK energy budget over these two years shows a provisional achievement of 3.94%, falling short of the target by 275 ktoe (3,200 GWh).

	Generation capacity	Electricity generated	Thermal energy generated
% change from 2011 - 2012	+27%	+19%	+7%

Table 11. Percentage change in renewable energy contribution to the UK energy outlook. Source: DECC

From the end of 2004 there was growth of 10-60% of annual renewable energy capacity for many technologies and this growth accelerated in 2009. During this year wind power was the largest growing power capacity of all renewable technologies but solar PV capacity showed the fastest growth rate. By 2010, renewable power contributed a third of newly built power generation capacities. Scientists now project that 100% of the world's energy could be powered by wind, hydroelectric and solar technologies by the year 2030.

Part of the growth in renewable technology uptake and installation can be attributed to falling costs as technological change, mass production and market competition all drive down prices. Hydroelectric and geothermal installations are now the cheapest way to generate electricity in suitable locations but as renewable energy costs continue to drop the cost of electricity from other sources such as wind power, solar pV and some biomass technologies are declining.

Data on the number of installations and installed capacity for different renewable technologies was taken from RegenSW Annual Survey of the South West at the postcode district[3] level. For the postcode districts EX16, EX17, EX20 and EX22 only a proportion of the postcode falls within the Energy Plan area, this proportion was applied to the total number of projects for each renewable technology. The selected data was then input into ArcGIS and presented both graphically and in maps where appropriate.

References:

http://regensw.s3.amazonaws.com/2013_progress_report_web_a9553fc4f7a1cbaf.pdf
https://restats.decc.gov.uk/cms/regional-renewable-statistics/
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/208607/renewable_energy_in_2012.pdf
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/80246/11-02-13_UK_Renewable_Energy_Roadmap_Update_FINAL_DRAFT.pdf
http://www.energysavingtrust.org.uk/Generating-energy/Choosing-a-renewable-technology/Wood-fuelled-heating

[3] [1]Postcode District: A Postcode District is the first half of the Postcode (e.g. UB7 from UB7 0EB). There are approximately 2,800 Postcode Districts covering the UK - Districts are often used for sales territory and franchise area applications. Source: Royal Mail

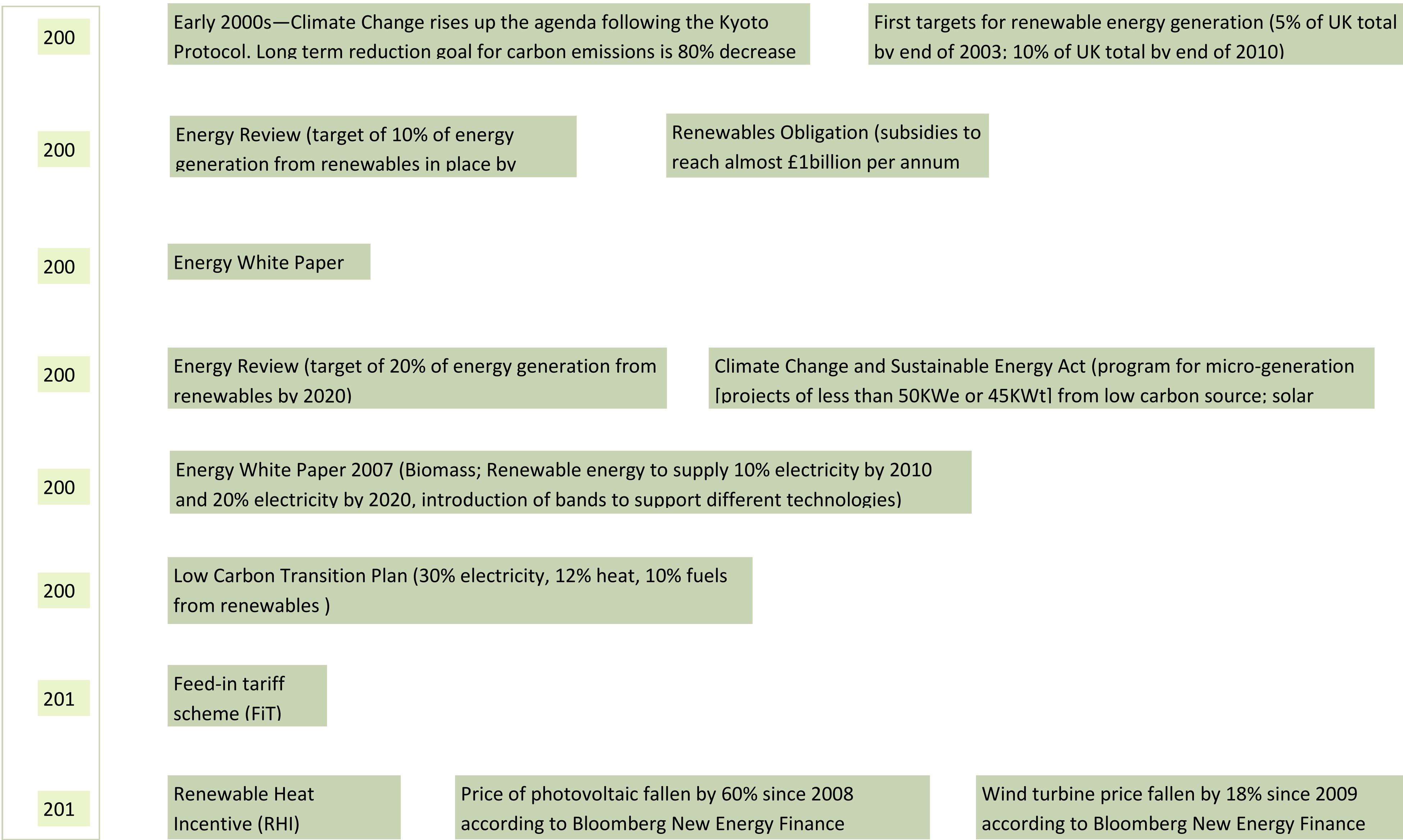


Figure 22 Evolution of the UK renewable energy policies since 2000

Current renewable energy contribution

The total installed renewable energy capacity of the Energy Plan area is 141MW from 4,200 installations. The total installed renewable energy capacity is highest in the two districts which are entirely within the Energy Plan boundary (***Figure 30***), which is not surprising as there is a larger area represented. However, it is interesting to note the large difference between North Devon and Torridge, with North Devon's installed capacity 66% greater than that of Torridge despite being similar in geographic area (Torridge: 995.9 km^2; North Devon: 1085.88 km^2). This largely attributed to the Fullabrook Windfarm Development. North Devon has a high proportion of renewable energy capacity from onshore wind whilst Torridge has a much higher number of projects and proportion of anaerobic digestion, hydro and solar thermal projects. These projects tend to be on a small scale or in the case of hydro technology are very site specific, thus achieving a smaller energy generation potential.

Allowing for operational capacity factors for each technology, the total energy output of the installed RE is in the order of 312GWh, i.e 7.1% of our total energy usage. The pattern in the Energy Plan area reflects the national picture in that wind and solar electricity generation are the biggest contributors. Nationally wind generation makes up 47% of the total renewable electricity capacity of the UK and solar PV makes up 3%. Grid references were available for 75%, 78% and 86% of Commercial, Community and Public sector installed capacity respectively. This information was mapped using GIS to produce ***Figures 25***.

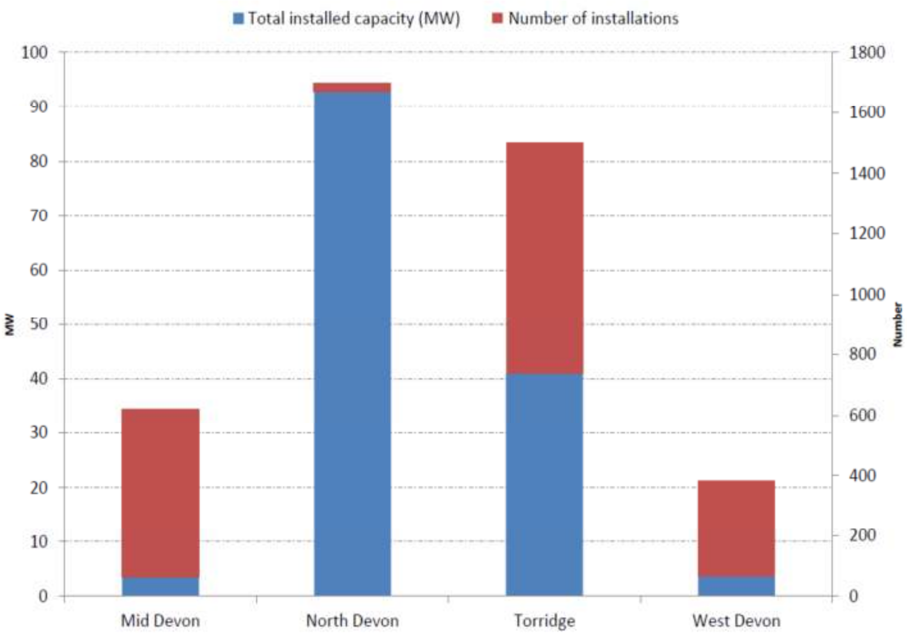


Figure 23 The total renewable energy capacity and the number of projects in each district of the Energy Plan area to date

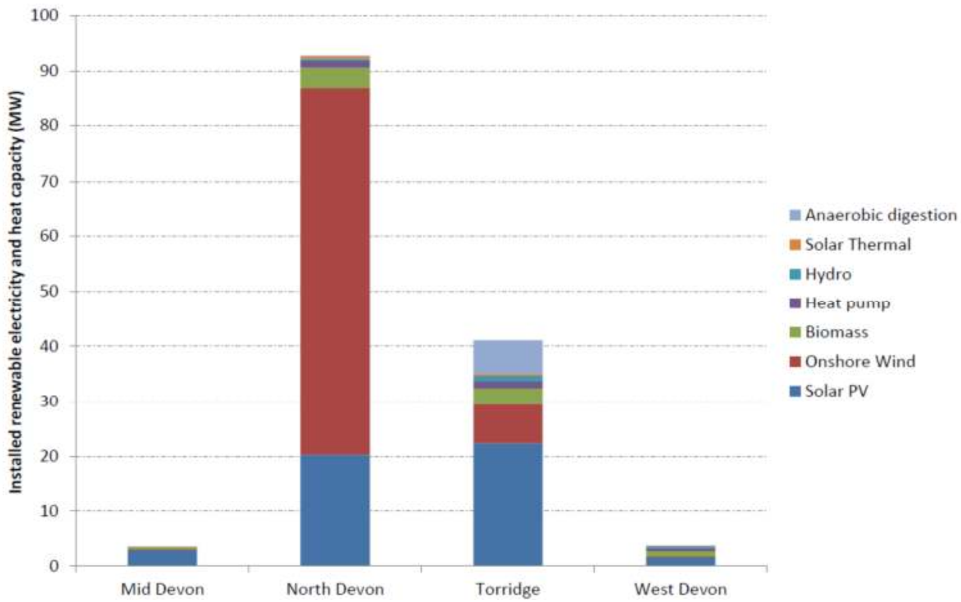
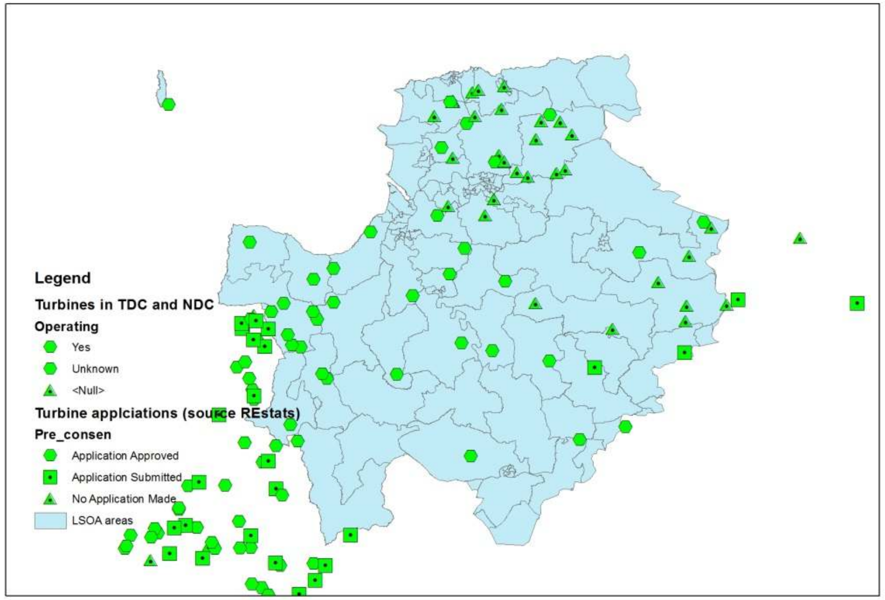


Figure 24The energy capacity in each district of the Energy Plan area by renewable technology.



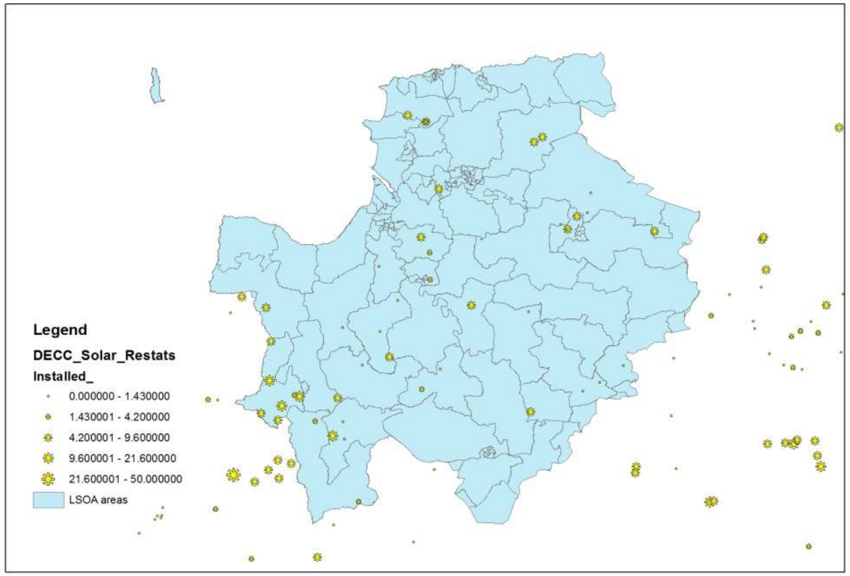


Figure 25 Map of the distribution of different renewable energy technologies by sector in each district of the Energy Plan area.

The vast majority of renewable energy generated in the area is for electricity, with only 8% of the installed capacity being for thermal generation (***Figure 33***). The first renewable technology employed in the area were commercial hydro projects in the late 80s, followed by small-scale, low capacity domestic biomass installations from the late 90s. Geothermal technology such as heat pumps followed in 2002 and solar and wind energy installations also appeared in the early 00s (***Figure 34***).

The early part of the period saw only a small number of installations being built each year but in 2010 this began to increase with a dramatic peak in 2011 at ~1,900, the majority of which were domestic solar PV installations (***Figure 34***). This pattern corresponds with the introduction of Feed-in Tariffs (2010) and the Renewable Heat Incentive (2011) providing financial incentive to install renewable energy. The price of technologies has also decreased over the time period, in 2011 the price of photovoltaic was reported to be 60% lower than in 2008, and wind turbine price had also fallen by 18% over the same period (***Figure 34***).

In 2010 there was a large onshore wind farm built in North Devon (Fullabrook Down Wind Farm) which explains the large jump in electricity capacity in that year (***Figure 33***).To date, onshore wind makes up the highest percentage of the total installed energy capacity of the Energy Plan area (***Figure 36***) and is able to generate more energy per installation than all the other technologies in the area, other than anaerobic digestion (***Table 12***). Solar PV is the second highest contributor to the total energy capacity of the area (***Figure 36***), this is due to the high volume of installations rather than a high capacity for electricity generation

(***Table 12***). Although there are a high number of biomass, heat pump, and solar thermal installations (***Table 12***), these technologies do not have a high capacity for energy generation and only make up relatively small proportions of the total energy capacity of the Energy Plan area (***Figure 36***). There are only 6 hydro installations in the area, despite being an economically competitive option this technology is often not viable due to constraints from terrain and low seasonal flows in rivers.

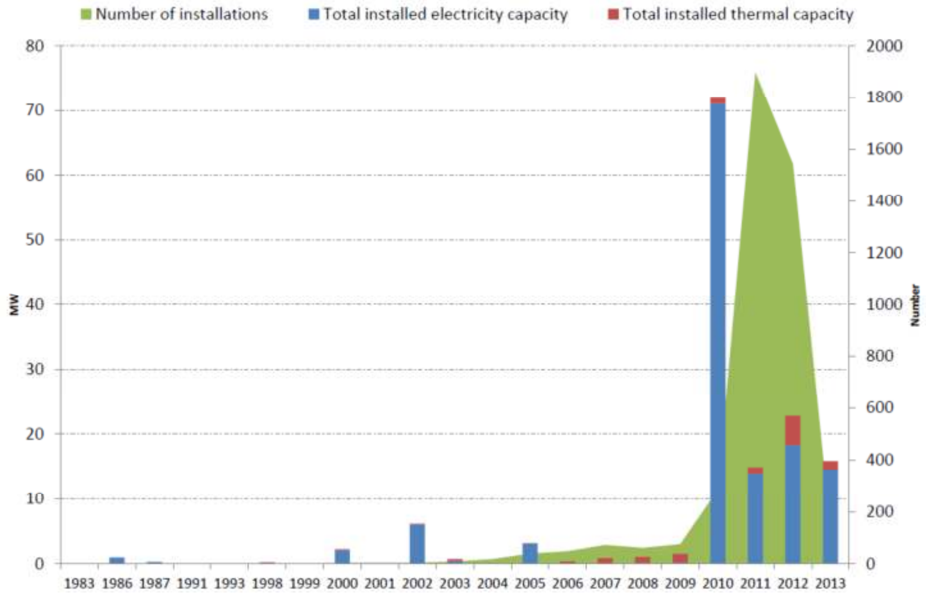


Figure 26 The installed electrical and thermal capacity from renewable energy in the Energy Plan area and the number of installations, per year from 1983 to 2012

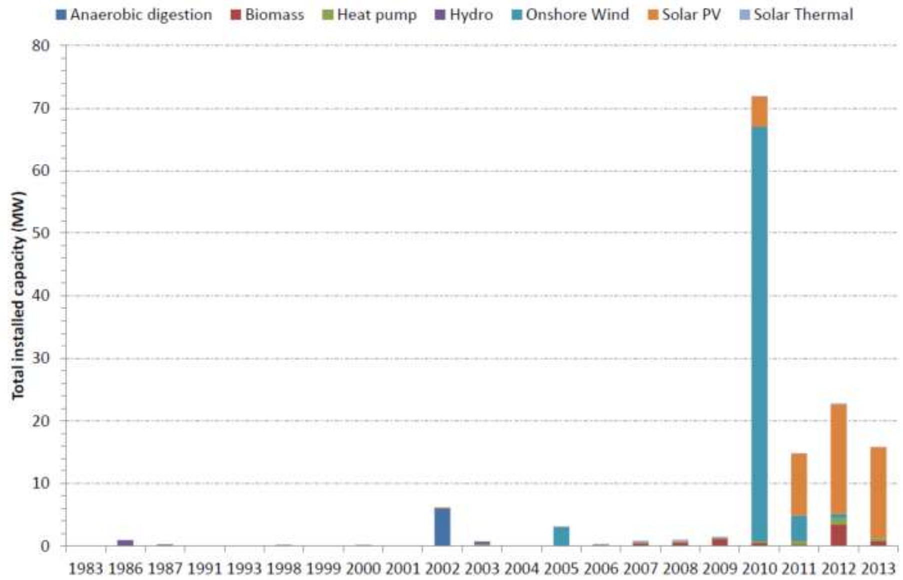


Figure 27 The total installed capacity of each renewable energy technology per year in the Energy Plan area

Commercial renewable energy projects contribute the greatest proportion of installed capacity in the Energy Plan area, which is logical as there are generally more funds available and a larger scope for building bigger projects (***Figure 35***).

The domestic sector makes up the next highest percentage of the total installed capacity with a large number of small capacity installations making up the value (***Figure 35***). Community renewable projects provide an alternative way of funding larger scale installations for the domestic sector, although they contribute relatively little to the total installed capacity to date, this report will discuss potential future projects of this nature with a view to promote wider uptake in the future.

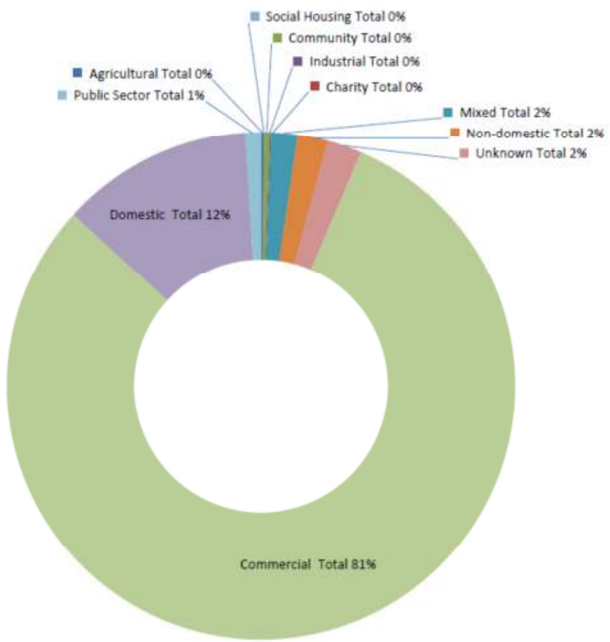


Figure 28 The percentage of the total installed capacity (MW) generated by each sector in the Energy Plan area

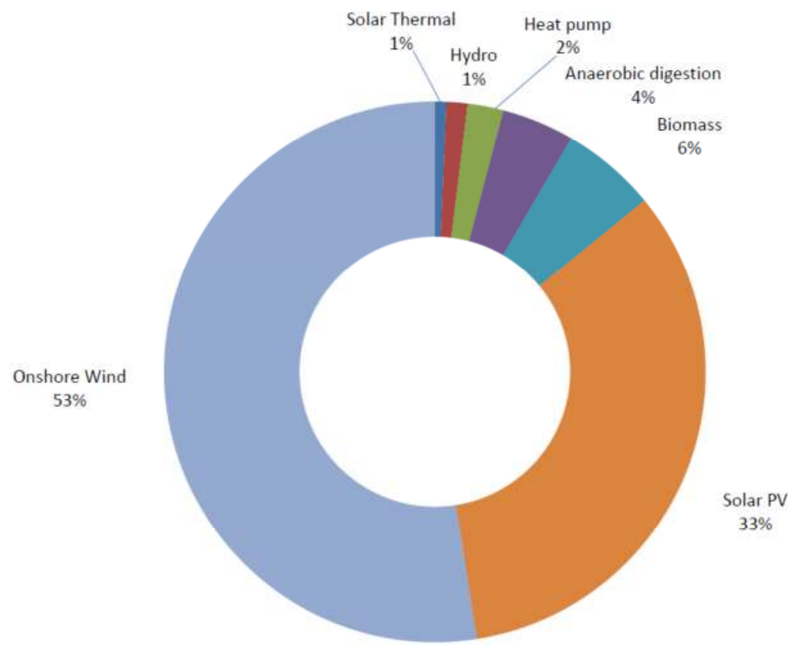


Figure 29 Relative proportion of the contribution of each technology to the total installed capacity of renewable energy in the Energy Plan area

Table 12. Comparison of the installed capacity of renewable energy in the Energy Plan area and the average capacity per installation for each technology.

Renewable energy technology	Total installed capacity (MW)	Number of installations	Average capacity per installation (MW)
Anaerobic digestion	6.1000	2	3.0500
Biomass	8.0174	134	0.0598
Heat pump	3.0236	283	0.0107
Hydro	1.7648	6	0.2941
Onshore Wind	74.0596	89	0.8321
Solar PV	47.1904	3433	0.0137
Solar Thermal	0.9801	253	0.0039

Comparison of different technologies

Biomass

Biomass systems burn wood pellets, chips or logs to generate thermal energy; capable of warming a single room, to power central heating, or hot water boilers. Using such a system can save a household over £600 per annum compared to electric heating (***Table 2*** *in Appendix*).

The benefits of wood-fuelled heating include cost savings through differences in price as well as government financial support in the form of Renewable Heat Premium Payment and the Renewable Heat Incentive. And lower emissions than burning fossil fuels as long as the wood is farmed sustainably.

In the Energy Plan area growth of biomass energy project has been exponential since 1998. (***Figure 31***). Low energy generation capacity but high volume of installation has resulted in this graph as the first generation technology biomass has been available for a long time have become one of the most economically viable options for small scale installations. Within the Biosphere Reserve and Energy Plan area there will be a tension between the land dedicated to biomass, food production and biodiversity. A careful approach is needed to assess the trade-offs and viability of land-use changes needed or avoided as demonstrated in the CSE research in 2007[4].

The ***Figure 30*** Shows that the domestic sector is the main user of biomass technology.

[4] http://www.cse.org.uk/pdf/Devon%20Biomass%20and%20Woodfuels%20Statement%20(low%20res%20images).pdf

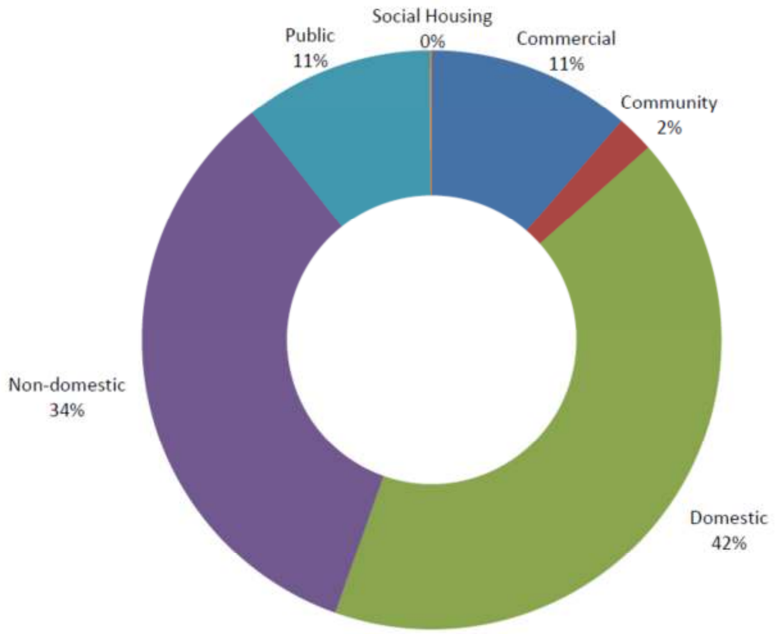


Figure 30 Total installed capacity by sectors for the Biomass technology.

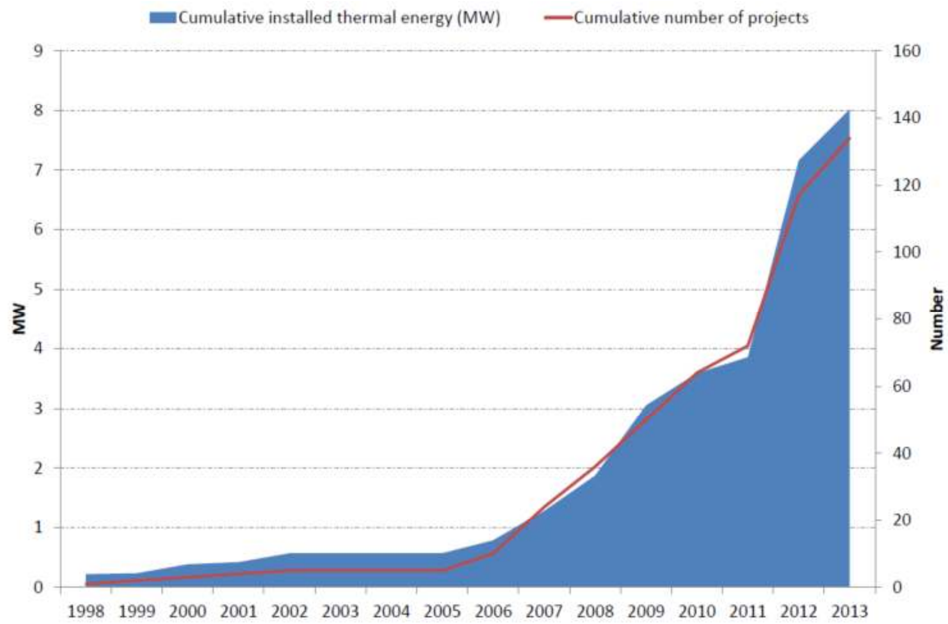


Figure 31 The cumulative number of biomass energy projects built in the Energy Plan area since 1998 and the potential cumulative capacity for energy generation. Source: RegenSW

The potential for Biomass in the area from all forms is in the order of 911KWH per year based on forest residues. (this assumes all woodlands are managed and that sites are harvested regularly)

Heat pumps

There are 3 type use in the Energy Plan area, Air source (ASHP), ground source (GRHP) and water source heat pump (WSHP). All 3 work by extracting heat from the source which is then passed through a compressor that rise the temperature further in order to transfer the thermal energy to the heating and hot water circuit of the house.

The benefits of heat pump systems include lower fuel bills, financial reward trough the renewable heat incentive, lower carbon emissions and low maintenance.

Air source heat pumps are usually easier to install than ground source as they don't need any trenches or drilling, but they are often less efficient than GSHPs. Water source heat pumps are only able to be installed in homes near to rivers, streams and lakes. Using such a system can save a household over £500 per annum compared to electric heating.

The figure 40 shows an exponential growth in heat pump installation and capacity due to high volume on a small scale. Domestic projects make up a small part of the installed capacity the majority being installed in the mixed sectors. (***Figure 39***).

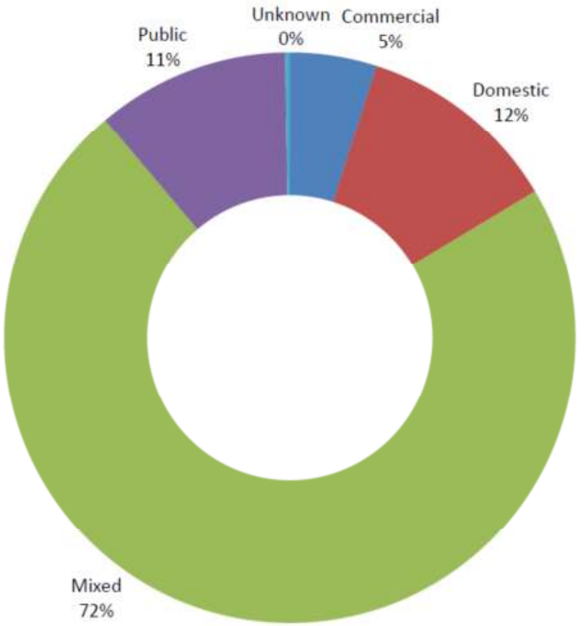


Figure 32 Total installed capacity by sectors for the Heat pump technology.

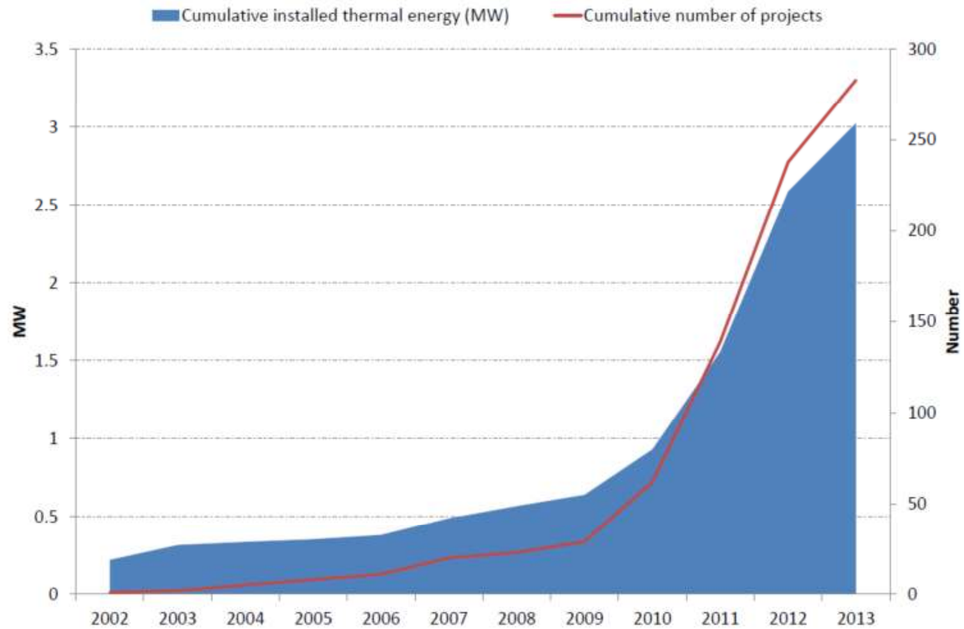


Figure 33 The cumulative number of heat pump energy projects built in the Energy Plan area since 2002 and the potential cumulative capacity for energy generation. Source: RegenSW

Hydro

Hydropower system harness the potential energy of water flow and convert it into kinetic energy in a turbine which drive the generator to produce electricity. The higher the height the water flows from and the greater the volume of water increases the amount of electricity that can be generated.

The benefits of using this system include lower electricity bills, financial reward through the Feed-in-Tarif, excess energy that can be used to heat the home and zero carbon emissions. The hydroelectric technology was the first system employed in the Energy Plan area. Since 1986 only 6 installations have been built due to specific environment requirements such as terrain and consistent high river flows.

In the energy Plan Area only one of the hydro installations is in the domestic sector, the rest are all commercial projects. Surveys suggest there are 65 sites in the area not of high sensitivity which gives a total of 540Kw of power. Seasonal low flows in the rivers will present some uncertainty in continuity of supply.

Although hydro has a high energy generation capacity, only small amount of electricity can be generated by the projects installed in the Energy Plan area due to the small scale of installation as a result of constraints discussed above (***Figure 34***).

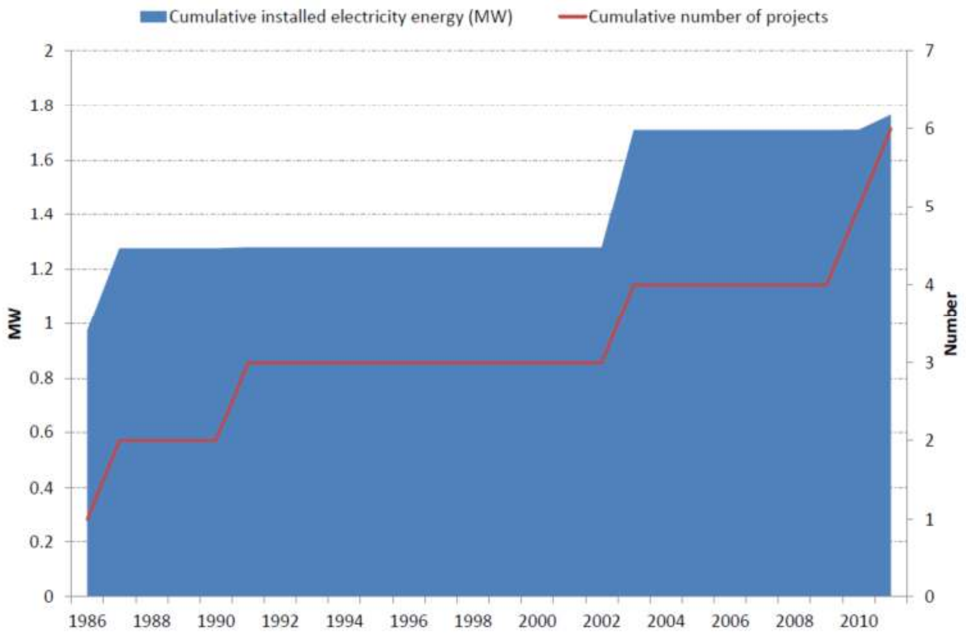
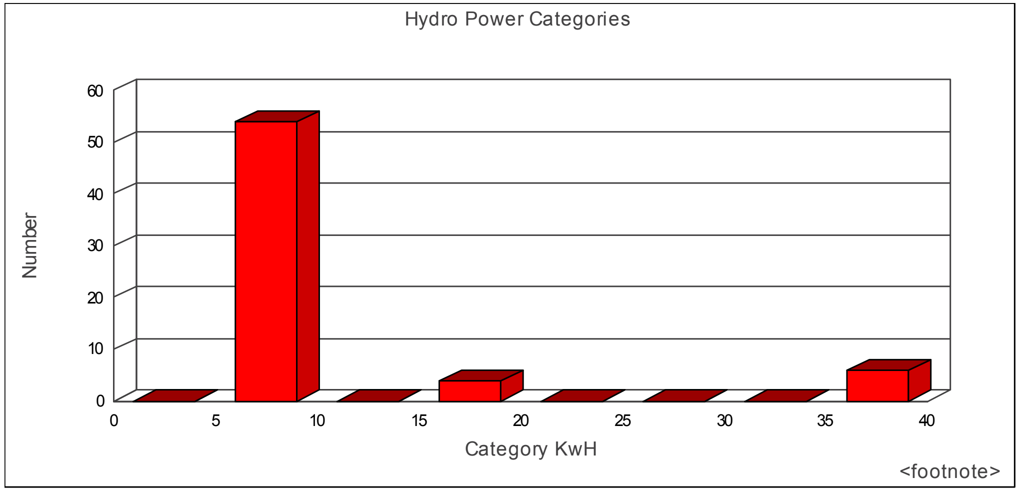


Figure 34 The cumulative number of hydro energy projects built in the Energy Plan area since 1986 and the potential cumulative capacity for energy generation. Source: RegenSW



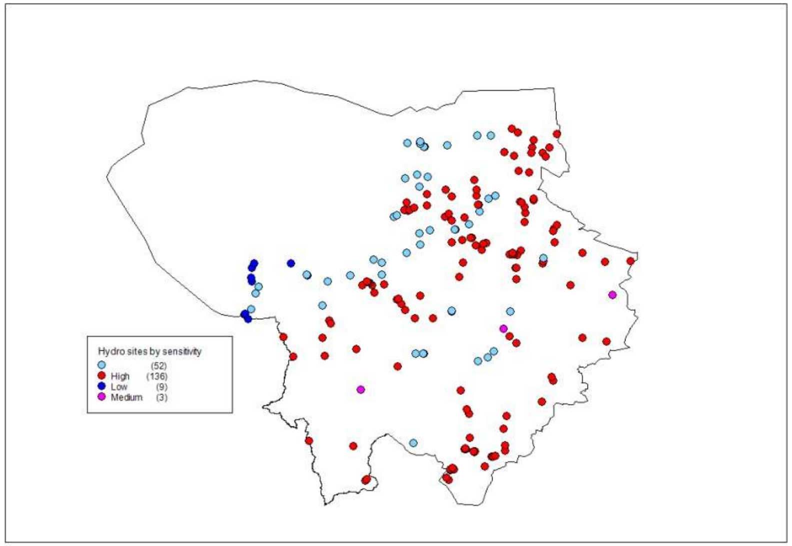


Figure 35 Hydro Power opportunities and locations according to sensitivity

The potential from hydro power is in the order of 5,070 Kw which totals 44,423,200 KwH per annum. However many of these sites are deemed as sensitive. The sites with less than "High" sensitivity are only 10% of this total.

Onshore wind

Wind turbines capture energy through wind forcing the blades to turn and drive a gearbox mechanically which generates electricity.

The turbines can be split into 2 classes, small scale domestic turbines (typically 6kW and upto 10 metres high) and the larger scale commercial turbines which can be in excess of 200 metres to tip and have capacities up to 7 MW for major offshore installations or more typically 2.5 to 3MW for onshore uses to date at around 130m total height.

Wind power has the greatest energy output per area of footprint and is about 80% of the cost per unit energy through solar power.

The figure 37 shows that until 2009 all of the onshore wind energy projects were small scale with low electricity generation capacity. However in 2010 a large commercial of onshore wind farm was built, boosting the total installed capacity. To date, the vast majority of wind turbine installations have been by the commercial sectors (***Figure 36***). Wardell Armstrong in a report in 2010 suggest a total wind capacity in the order of 1200MW for the Energy Plan Area.

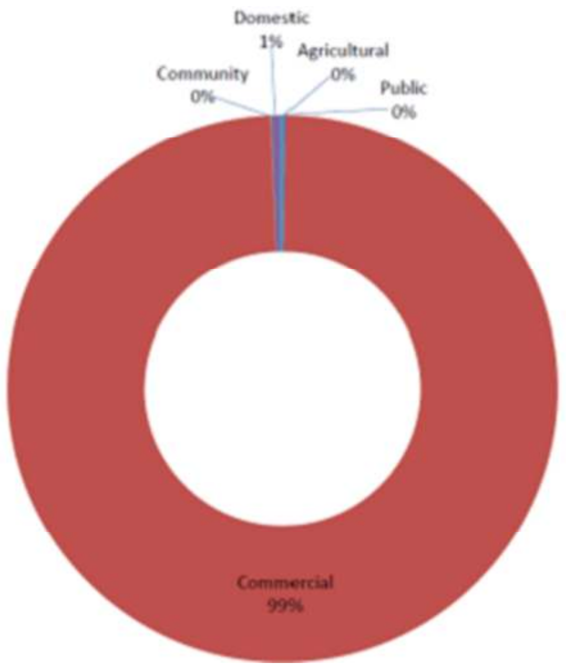


Figure 36 Total installed capacity by sectors for the Onshore wind technology.

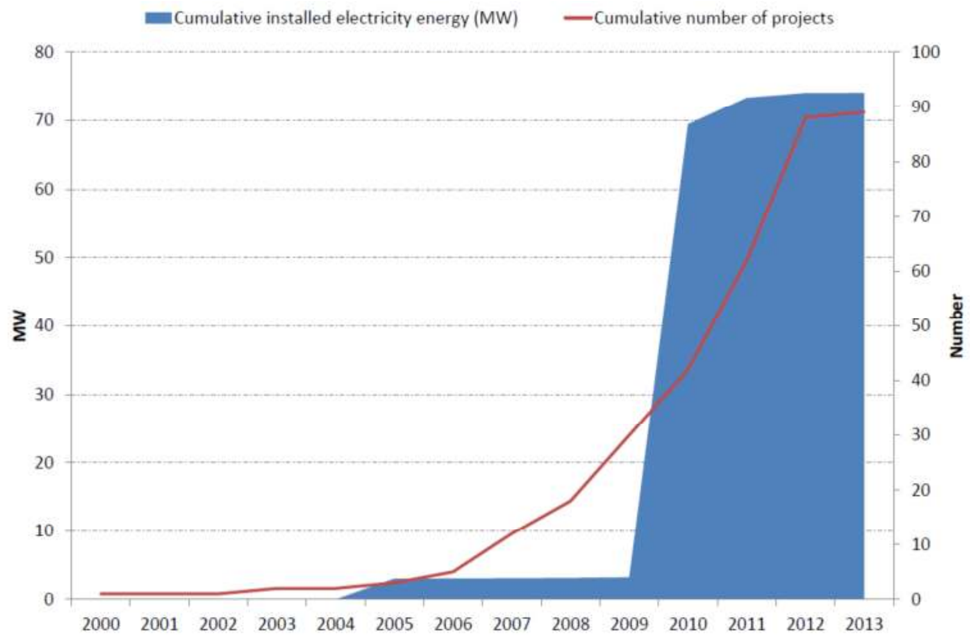


Figure 37 The cumulative number of onshore wind energy projects built in the Energy Plan area since 2000 and the potential cumulative capacity for energy generation. Source: RegenSW

The Wardell Armstrong study[5] presented a number of options based on a number of different constraints that might be applied.

The constraints applied relate to various buffers from settlements, protected landscapes and other infrastructure. This has not been tested against the joint district landscape sensitivity mapping. The map indicates the level 6 constraints set against small scale wind turbines (10m high, 6kw). The resulting values equate to a potential 522MW installed, or expected 7180 MWH per year of energy.

The Wardell Armstrong analysis of large scale wind infrastructure follows a similar constraints patter, but due to the extra heights reaching higher winds, the thresholds of physical constraints lead to more potential areas for exploitation. This analysis has not been subjected to the landscape sensitivity analysis. The resulting values equate to a potential 3253 MW installed, or 7,125,530 MWH/year. These would result in a very intensive energy landscape, therefore figures are likely to be a third of these quotes. A more constrained approach to level 8, which takes noise into account, reduces the expected production to 559,764MW.

A micro assessment for wind has been done allows for smaller domestic turbines. This was done with 6Kw turbines which may be optimistic.

[5] http://regensw.s3.amazonaws.com/wind_resource_methodology_text_only_b71959af94c39e86.pdf

Solar PV

The solar photovoltaic (PV) technology use the power of the sun to generate electricity. Sunlight create an electric field across layers of semi conducting material inside PV cells, the stronger the sunshine the more electricity is produced. They will still produce energy on cloudy days. Solar PV is intensive in land-take, although theoretically some reduced grazing can still be done in some of the commercial installations.
On a domestic scale, the benefits of using this system include lower electricity bills, financial rewards through Feed-In-Tarifs, lower carbon emission and excess electricity can be sold back to the grid, and providing the roof is structurally fit for purpose, the panels are relatively easy to fit.

Solar PV technology installation accelerated after 2009 probably due to a combination of factors including decreasing costs of installation and introduction of financial incentives such as Feed-in-Tarifs (***Figure 39***). This in turn brought down the unit cost of solar panels which made the investment all the more attractive.

Commercial and domestic installation make up over 90% of the total installed capacity for solar PV in the Energy Plan area (***Figure 38***).

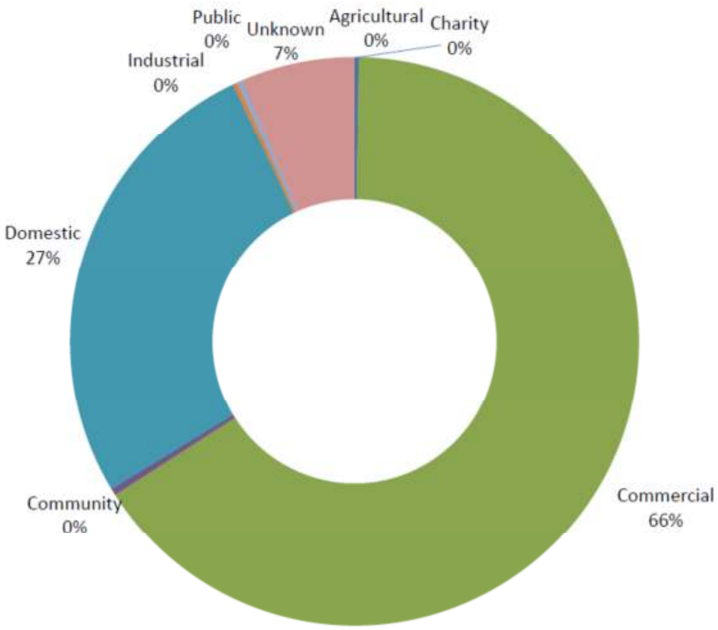


Figure 38 Total installed capacity by sectors for the Solar PV technology.

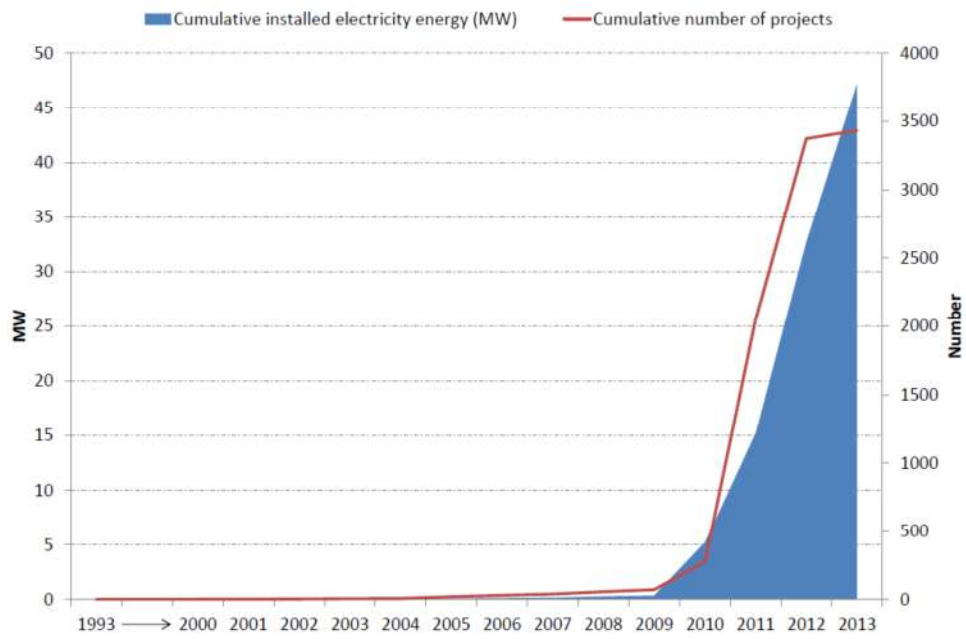


Figure 39 The cumulative number of solar PV energy projects built in the Energy Plan area since 1993 and the potential cumulative capacity for energy generation. Source: RegenSW

Solar thermal

The solar thermal technology uses the power of the sun to heat water for the home. The heated water is stored in a hot water cylinder and a backup boiler or immersion heater can be used to further increase the temperature. The benefits of using this system include lower electricity bills, and lower carbon emission.

Solar thermal technology installation accelerated from 2001 as cost of installations decreased. (***Figure 41***).

Domestic sector is the most important user of solar thermal technology, contributing 48% of the total installed capacity (***Figure 40***).

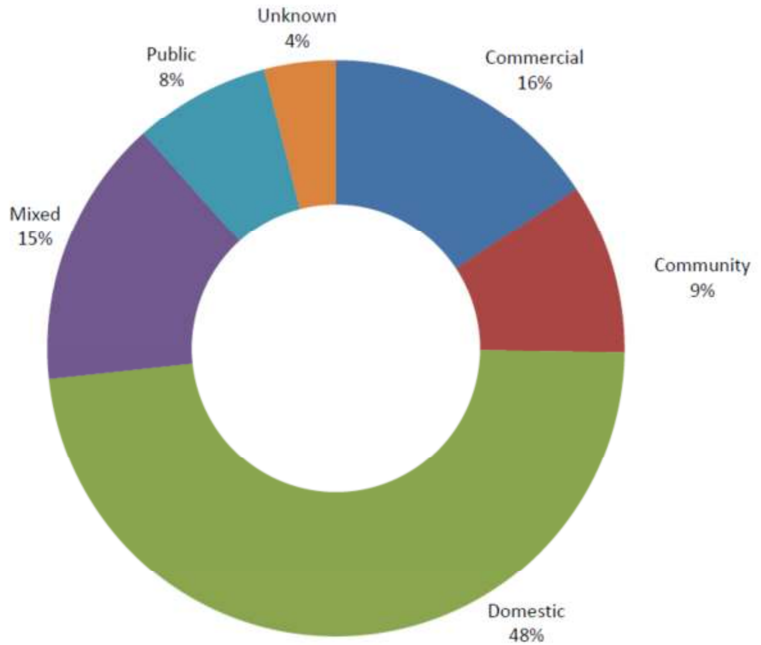


Figure 40 Total installed capacity by sectors for the Solar thermal technology.

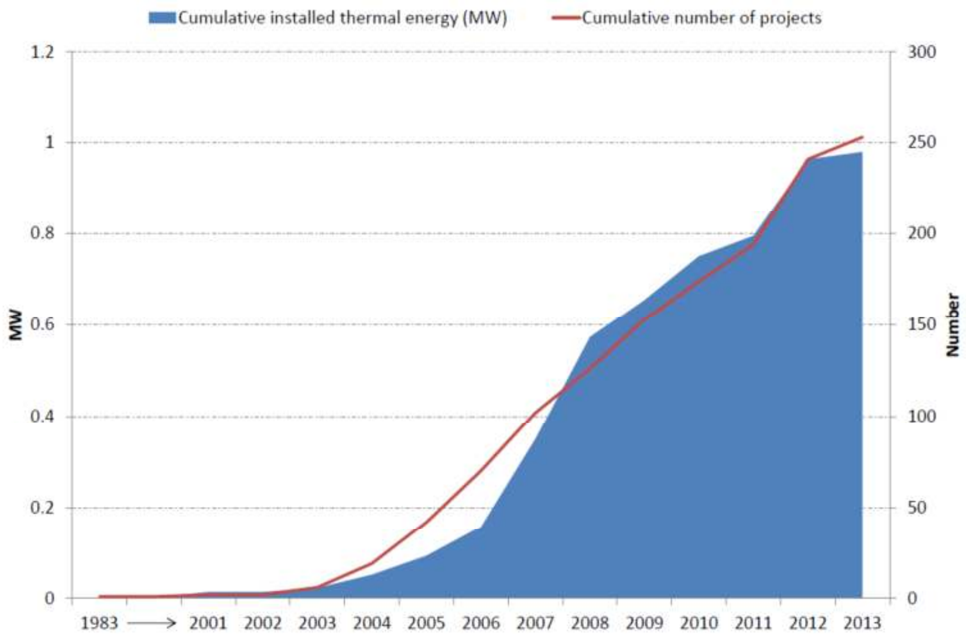


Figure 41 The cumulative number of solar thermal energy projects built in the Energy Plan area since 1983 and the potential cumulative capacity for energy generation. Source: RegenSW

Tidal Energy

Tidal Energy is very attractive as a proposition. It comes in various forms with varying degrees of impact and complexity. Some people have considered the impoundment method as used in La Rance in Brittany. This method holds back a tidal volume for delayed release which then drives a turbine. Even though the energy capacity of such a project is 45MW, a proposal on this large scale is going to have a large impact on the ecology and ecosystem services of the area and therefore requires serious analysis before even suggested as a viable proposal.

More benign uses of tidal power are passive turbines mounted on the seabed which is the regular diurnal flow of the tides in ebb and flow to generate electricity. The amplification of tides and therefore currents along the north Devon coast lend itself to exploring how marine current turbines might be deployed. Large scale technologies typically require 40m of depth, solid bedrock for mounting into and peak currents of 4 Knots. No such sites exist within the Biosphere Reserve. However arrays of smaller turbines can be mounted in less demanding locations and can prove to be effective for generation. Impacts on marine life and other local economic activity such as fishing would need to be assessed. Critical to the viability of the marine projects is the shore connection to the distribution infrastructure.

There are no tidal installations currently in north Devon, though the options are clearly available with the possibilities being developed off Lynmouth. Optimium energy capture and distribution within the Biosphere Reserve is along the coast from Combe Martin to Foreland Point. A small area of this coast (from Combe Martin to Foreland Point) has been set aside by the Crown Estate to set up tidal energy demonstration projects. The project area is in depths of less than 20m and therefore the scale of installations will be quite small initially. Conservative estimates are that with technology development, pilot projects will produce in the order of 10MW.

http://www.regensw.co.uk/projects/offshore-renewables/tidal-energy

http://www.northdevon.gov.uk/renewaction-2.pdf

http://regensw.s3.amazonaws.com/south_west_renewable_energy_resource_assessment_results_report_november_2010_1e09ec9f64c4579f.pdf

http://www.devon.gov.uk/reviewofrenewableenergyresourceassessmentandtargetsfordevon.pdf

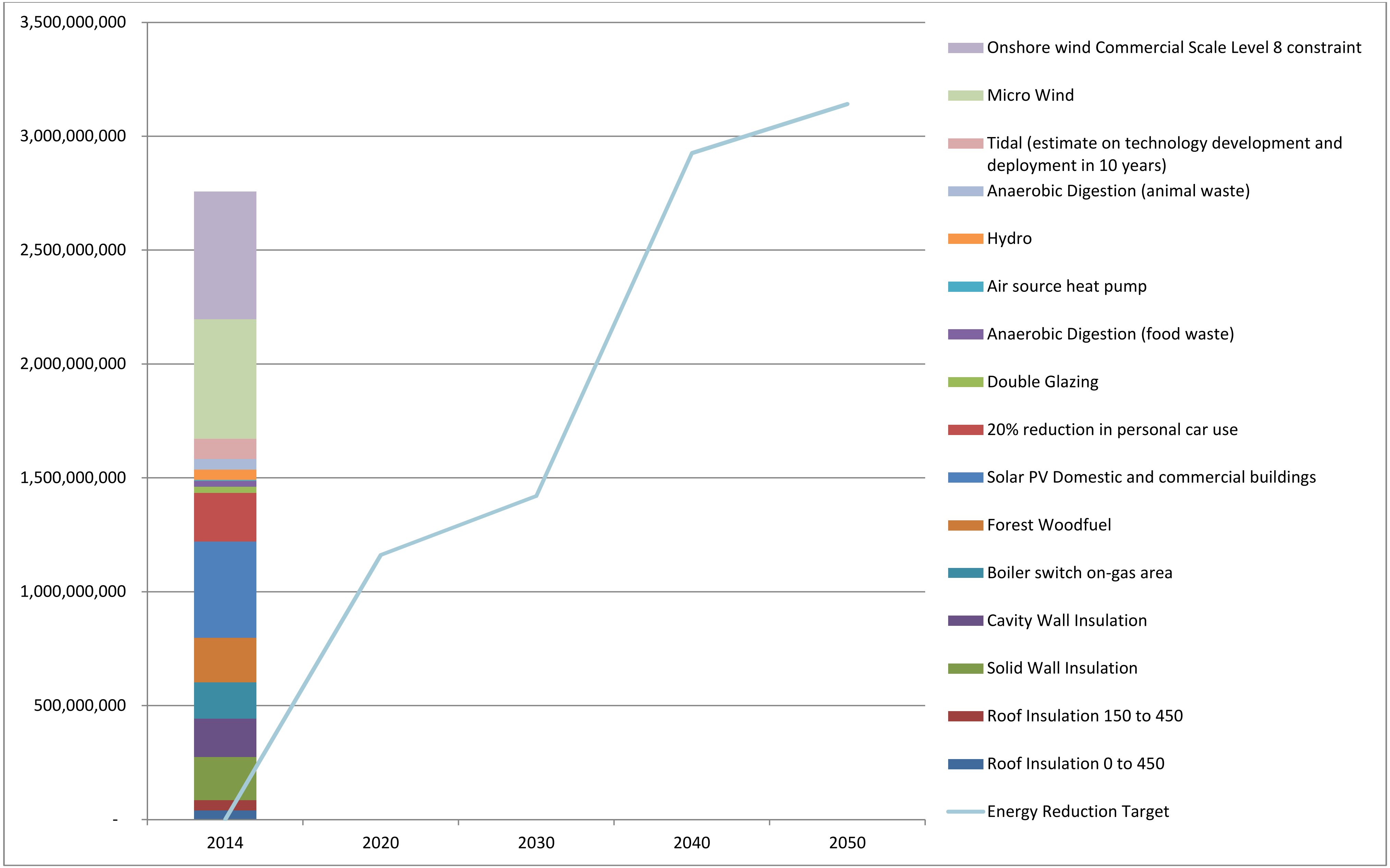
http://regensw.s3.amazonaws.com/wind_resource_methodology_text_only_b71959af94c39e86.pdf

Summary points on availability of renewable energy production

There are many opportunities to install a range of renewable energy types. The level of deployment of the various types is open for debate.

Generation Technology	KWH/year	Comment
Onshore wind Commercial Scale Level 8 constraint	559,764,000	Even at this constraint the landscape implications are significant. Local community ownership might be the best method.
Micro Wind	525,003,300	Over assessment based on 6Kw turbines
Solar PV Domestic and commercial buildings	423,752,867	Based on micro assessment for all buildings to have PV
Forest Woodfuel	194,748,912	Based on AEA assessment
Tidal	87,600,000	Estimate on technology development and deployment in 10 years, in passive systems
Anaerobic Digestion (animal waste)	47,601,645	Beef and Dairy waste accounted for
Hydro	44,413,200	Based on exploiting non sensitive sites
Anaerobic Digestion (food waste)	24,852,800	Commercial and municipal waste arisings
Air source heat pump	5,620,215	Applied in off gas areas

The following chart indicates all the measures stack and set against the national emission reduction targets. The order of stacking is dependent on factors such as desirability, technical feasibility and cost. However, the data indicate that applying all of the measures does not meet the energy or emission reduction targets. Therefore other measures such as transport will need to be addressed more vigorously and land-use/land-use change/forestry is another emission source that can present opportunities in the area. Alternatively all of these measure need to be introduced completely by 2040. In the intervening years, other technologies may support the extra targeting.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-
2014
2020
2030
2040
2050
Onshore wind Commercial Scale Level 8 constraint
Micro Wind
Tidal (estimate on technology development and deployment in 10 years)
Anaerobic Digestion (animal waste)
Hydro
Air source heat pump
Anaerobic Digestion (food waste)
Double Glazing
20% reduction in personal car use
Solar PV Domestic and commercial buildings
Forest Woodfuel
Boiler switch on-gas area
Cavity Wall Insulation
Solid Wall Insulation
Roof Insulation 150 to 450
Roof Insulation 0 to 450
Energy Reduction Target

Renewable Energy Ownership: Community renewables

To date, much of the investment in renewable energy schemes have been by larger externally investors such as RWE, BT, Devon Energy. This has meant that any gains from the investments are mainly swept back out of the area for the investing company and shareholders with the exception of small to moderate sized "community chest" funds. However, many of the technologies that have been identified in this study can be applied effectively at a community scale and therefore lends itself to being a local enterprise.

With returns on projects being in the order of 15 to 20%, there is an opportunity for local groups and residents to develop their own energy projects and reap the rewards for local re-investment. Investment directed this way will mean that energy will be generated in forms and scales that the community find acceptable. Since the community would be the promoter of such schemes, then the opposition to such schemes will be less and therefore more efficient to develop. There have been some successful locally funded schemes such as in Wadebridge in Cornwall[6], BroDyfy in Wales, Gamblesby Village Hall, Udny Green in Aberdeenshire. In the latter case, the single turbine will generate £100K in profit per year for the local shareholders and community investment[7].

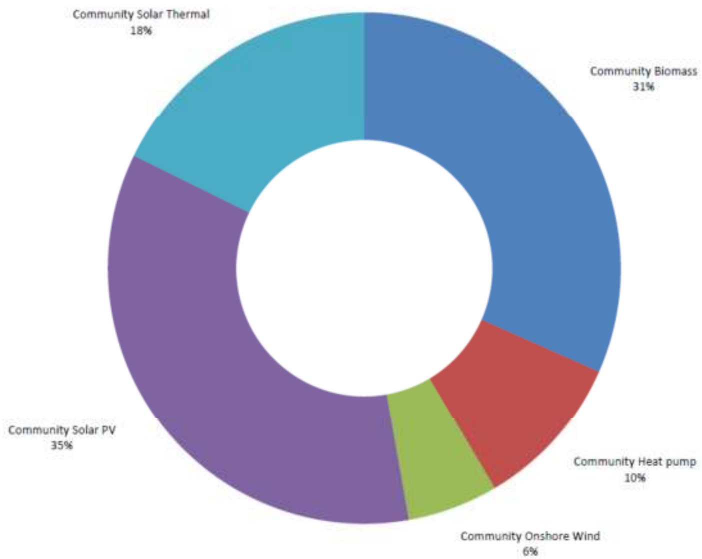

Figure 42 Renewable technologies installed by community based bodies.

[6] http://www.communitypowercornwall.coop/downloads/community_renewables_-_richard_hoggett.pdf
[7] http://www.greenenergynet.com/communities/articles/udny-community-wind-turbine-community-energy-case-study

To date within the Biosphere Reserve and Torridge area there has only been 1.933MW of capacity installed in the public and community sectors.

The financial mechanisms to develop community renewables are being developed quite quickly and the perceived risks in the investments are diminishing. A blended approach of external investment and local investment can make many of the projects possible.

To optimise the economic benefit locally to the area from installed renewables the following strategies might be adopted:

- Invest locally and recoup the interest and profit for local re-investment.
- Seek high levels of “community chest” payback into externally funded renewable energy ventures
- Establish local supply chain and skills within the community to boost employment and inward investment.