Carbon audit of energy demand and supply for the Bude Community Network Area

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Report prepared by

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0 Summary

The carbon audit of energy demand and supply for the Bude Community Network Area shows that local demand is dominated by households and car transport, and hence this contributes the most to local carbon emissions.

The analysis shows how local energy demand is constructed and the contribution to reducing local carbon emissions made by the existing local solar PV arrays and wind turbines.

The area energy demand is constructed by investigating the local energy supply from each of the main energy sources, oil, gas, electricity, coal, LPG and wood. The regulated energy sources (electricity and gas) have detailed and accurate statistics, prepared and issued by central government sources to local level disaggregation. However other energy supplies are less well statistically developed. The statistics are either only available at the County level from government sources, or only from relevant trade associations.

The aim has been to prepare the energy supply and demand analysis with the most up to date figures available. Thus data used is mainly for 2018 and 2019, published in early 2021.

0.1 Energy demand

Electricity

Electricity demand figures show the low commercial and industrial development level in this area, with nearly half of electricity demand coming from the domestic sector. Larger users dominate the non-domestic sector even with the small number of meters estimated.

Total electricity demand is approximately 79,000 MWh pa of which nearly half is household electricity demand.

Gas

Large parts of the local area do not have access to mains gas, with the statistics clearly showing the rural areas totally or largely without mains gas as being Kilkhampton & Morwenstow, Marhamchurch & Widemouth Bay, Week St Mary & Whitstone and Poughill & Flexbury East. Overall around 50% of households in the area have access to mains gas.

A comparison with the electricity consumption table for each Lower Super Output Area shows the non-gas and low gas areas having higher average electricity demand. This indicates the higher use of electricity for heating, as heating is the highest energy use in the home.

Commercial and industrial gas demand is only available at the Medium Super Output Area level and for this area the only area which has commercial mains gas is Cornwall 001 ie Bude town. The statistics indicate that there were some 37 commercial gas meters using around 8,237 MWh of mains gas in 2019. Total gas demand for this area is therefore some 60,258 MWh

Other fuels and space heating

Where mains gas is available this is the predominant source for heating. No local surveys of household and commercial heating fuels are available. Therefore a national survey has been used and adjusted for local conditions.

The results of this indicate that gas provides nearly 60% of local domestic heating with oil second at 22% and electricity third at 13% of heat demand. The expected total of household and non-domestic heating is around 104,000 MWh.

Transport oil demand

The main statistics on transport fuel use are available at the county level, rather than with local disaggregation. Therefore two methods have been used to estimate the total demand for local transport fuels. The 2011 Census has detailed figures on numbers of employees and their travel to work distances and mode of travel. This enables some detail to be worked up to update population figures, estimate the locations of employment and hence distances to determine the mileage travelled and via car fleet age estimate the energy requirements of this travel. With a rough estimate for social and family travel on top this informs a local estimate.

The second method uses the Cornwall level data with a pro-rata estimate based on local population to estimate local fuel demands for transport.

The travel to work estimate concluded that local car travel is around 82 million kilometres or fifty one million miles a year. The energy required to achieve this high figure as well as the freight transport in the area is around 79,000 MWh pa.

Total energy supply and demand

The table below indicates the total energy demand for the region and how that demand is met by the various fuels.

Energy supply and demand estimate for MWh

energy source	domestic	non domestic	transport	total	%
oil	19,112	2,798	117,290	139,200	49%
electricity	38,342	40,555		78,897	28%
gas	52,021	8,237		60,258	21%
LPG	3,927	1,326		5,253	2%
coal/wood	1,857	0		1,857	1%
totals	**115,259**	**52,916**	**117,290**	**285,465**	100%
%	40%	19%	41%	100%	

Oil is by far the largest fuel used, at nearly 50% of supply, with electricity the second highest at 28%. In total the area uses 285,500 MWh pa.

0.2 Energy bill

The local energy bill is around £23 million pa, with the highest expense being the domestic sector at 40% of the cost, some £9.3 million. Transport imposes one third of the local energy bill at £7.5 million. Electricity being an expensive energy source costs the local area half of the total at £12.1 million.

0.3 Local renewable energy supplies

There are a number of solar farms in the local area as well as over 60 wind turbines of varying scale from household 6kW little machines to 2,400kW commercial turbines.

The five larger solar farms along with 600 local roof top PV installations and around 100 smaller land arrays produce around 48,700 MWh for use by the grid. This is over 60% of local electricity demand.

The local wind turbines produce around 22,800 MWh pa nearly 30% of local annual electricity demand.

However wind energy is mainly available in the winter and solar in the summer. A calculation was carried out to provide an indicative estimate of how much this level of local renewable electricity supply actually contributes to local use, vs excess being sent out of the area when supply is higher than demand.

On a two seasonal basis with summer and winter assessments at six months each indicates that the winter supply of local RE is around 73% of demand and the summer supply is 160% of local demand. This oversupply is not counted as a contribution to the local carbon footprint: the local supply is taken to be some 56,000MWh out of the 71,500 MWh generated.

0.4 Carbon footprint for energy use

Total energy use as shown earlier being some 285,465 MWh is assessed for each energy source contribution to local carbon dioxide equivalent emissions in terms of tonnes CO2e.

Carbon emissions from local energy use

Energy source	Total energy use		Emissions coefficient	Carbon emissions	
	MWh	%	kg CO2e/kWh	t CO2 e	%
Oil	139,200	49%	0.2613*	36,373	49%
Electricity	78,897	28%	0.3072	24,237	33%
Gas	60,258	21%	0.2046	12,329	17%
LPG	5,253	2%	0.2303	1,210	2%
Coal ^	1,857	1%	0.3629	337	<1%
Totals	**285,465**	100%		**74,486**	100%

**weighted average of domestic oil, & petrol and diesel at the pump – 5% biofuel mix*

^ assumes that half of the coal/wood used is wood with no carbon footprint.

Again this calculation shows the pre-eminent position of oil in local energy and emissions being from oil use, with nearly half of emissions. Electricity is second with one third of emissions.

However it is clear to see the value of the significant local electricity supplies from renewable sources which save around 17,200 tpa CO2e, from the 56,000 MWh local use. This amounts to a saving of 23% of the total energy related carbon footprint.

This suggests an effective carbon footprint for energy use in the Partnership area of about 57,300 tonnes CO2e pa.

1 Introduction

The direct carbon emissions of an area are broadly divided between fossil fuel energy use and land use emissions. This report focuses on the energy situation in the Bude Community Network Area which is about 75% of the total direct carbon dioxide and other greenhouse gas emissions. The embedded carbon is not included in this assessment.

The energy carbon audit starts with an assessment of the energy demand and supply of the area or organisation under investigation. This requires searching the appropriate government statistics. As the relevant statistics are released annually after some delay, this assessment is covering the figures for 2019 which are the latest available at present for most elements of the analysis.

Energy supply and demand statistics are available at several levels of detail in government statistics. The smallest area statistics are generally for the Lower Super Output Area (LSOA), which covers around 1,500 people or 650 households. The LSOAs are pulled together for Medium Super Output Areas (MSOA) which cover a whole town or local area and provide information for around 7,500 residents or 4,000 households. The MSOAs are added together to cover the County or Unitary Council area.

Each level has its own codes and name labels. Parishes also have their own codes, but fewer statistics are directly available at the Parish level. Hence for the Bude CNA it is necessary to assess population figures for the relevant LSOAs and as a percentage of the local MSOA to estimate relevant statistics for the area.

For the Bude Community Network Area the following are the relevant codes and names in use by all government statistical compilations.

Parish codes

E04011409	Bude-Stratton
E04011449	Jacobstow
E04011452	Kilkhampton
E04011465	Launcells
E04011482	Marhamchurch
E04011492	Morwenstow
E04011498	North Tamerton
E04011513	Poundstock
E04011549	St. Gennys
E04011606	Week St. Mary
E04011609	Whitstone

Lower Super Output Areas

E01018936	Cornwall 001A	Bude Wharf, Summerleaze and Golf Course
E01018937	Cornwall 001B	Bude East
E01018938	Cornwall 001C	Bude South and Lynstone
E01018959	Cornwall 001D	Poughill and Flexbury East
E01018960	Cornwall 001E	Stratton
E01018961	Cornwall 001F	Flexbury West
E01018943	Cornwall 002A	Kilkhampton and Morwenstow
E01018951	Cornwall 002B	Marhamchurch and Widemouth Bay
E01018974	Cornwall 002C	Week St Mary and Whitstone

Medium Super Output Areas

E02003931	Cornwall 001	Bude
E02003932	Cornwall 002	Bude rural

County Cornwall E06000052

Post codes EX23 all

EX22 about 25% of the area

2 Energy demand and supply

2.1 Electricity

The most accurate source of information on energy supply in each local area is for electricity and mains gas. The table below shows the demand information available for electricity in the CNA. The Office of National Statistics used to provide very detailed neighbourhood level statistics, but the present level of information is less detailed[1].

Domestic electricity in Bude CNA 2019

Area demand	meters-number	MWh demand	average kWh /meter	median kWh /meter
Cornwall 001A	941	3,152	3,349	2,538
Cornwall 001B	898	3,008	3,350	2,852
Cornwall 001C	896	3,290	3,672	2,993
Cornwall 001D	774	3,599	4,650	3,341
Cornwall 001E	1,139	4,019	3,529	2,911
Cornwall 001F	801	2,692	3,360	2,528
Cornwall 002A	1,054	6,255	5,934	4,391
Cornwall 002B	1,184	6,167	5,208	3,725
Cornwall 002C	1,092	6,162	5,643	4,171
Total	**8,779**	**38,342**	**4,299**	**2,993**

The table indicates that there are some 8,779 meters with a total demand of 38,342 MWh pa of local domestic electricity demand.

Note that 1,000kWh equals 1 MWh.

The average demand in Cornwall via Economy 7 (overnight cheap rate) meters is around 34% of total domestic electricity, from 23% of the domestic meters. This can give a clue about the amount of electricity used for space and water heating, the main use of E7 meters, but the data is not now available for E7 electricity use at this level of detail.

The time series for this data indicates the average use of electricity per household is slowly reducing, by for example some 8% over the last five years. Areas without gas do not show such a big drop, possibly due to a much higher proportion of household electricity being used for heating. The

[1] https://www.gov.uk/government/collections/sub-national-electricity-consumption-data

drop for on gas households is in line with national figures and is thought to be due to increasing energy efficiency in for example home appliances, as well as some increased installation of solar panels. Domestic solar PV displaces some imported electricity into the households which have PV and this shows up as “negative demand” in electricity sales and grid information.

The commercial use of electricity in the area is not available directly in the local statistics. Non-domestic electricity demand is available at the MSOA level, which for the CNA comprises two areas, as shown in the table below.

Commercial non half hourly electricity demand 2019

MSOA	**Meters no.**	**MWh demand**	**average kWh /meter**	**median kWh /meter**
Cornwall 001	612	6,012,	9,824	4,935
Cornwall 002	778	10,210	13,123	5,855
Total non HH	**1,390**	**16,222**	**11,474**	**5,395**

However the Cornwall level statistics show that the Half Hourly metered non domestic electricity demand is some 248% of the non half hourly. Half Hourly metered supplies are the larger demand locations with an average demand over 100kW. This includes secondary schools, hospitals, large hotels, and larger businesses including manufacturing and supermarkets.

As this area is not home to a large business or manufacturing base it is assumed that the local percentage of larger business demand compared to the local non half hourly is 150% of the local non half hourly demand.

This suggests the total commercial electricity demand is therefore around 40,555 MWh pa with some 1,520 meter points.

This figure however is likely to be an underestimate as many of the smaller businesses such as smaller Bed and Breakfast and holiday accommodation providers will be under the demand automatic limit for classification as commerce and may be being supplied as domestic premises. This is also likely to be the case for consultants and service providers working from home in normal circumstances.

Total electricity demand 2019

Demand	Meters no	MWh	% of demand	
Domestic	8,779	38,342		49%
Non domestic non HH	1,390	16,222	40%	
Non domestic HH **	134	24,333	60%	
Total non domestic	1,524	40,555		51%
Total electricity demand	**10,303**	**78,897**		**100%**

*** approximate figures*

Total electricity demand is therefore approximately 79,000 MWh pa of which nearly half is household electricity demand.

2.2 Gas demand

Government statistics show there are large areas of the CNA without mains gas. The lack of mains gas makes it more difficult to accurately assess the fuels used for heating in the area as the statistics for non-gas heating are less well developed.

Domestic gas demand 2019

Area LSOA	meters no	demand MWh	mean demand kWh/meter	median demand kWh/meter	% households not on gas grid
Cornwall 001A	762	9,301	12,206	9,426	12%
Cornwall 001B	865	7,876	9,105	7,763	3%
Cornwall 001C	658	7,315	11,117	9,569	25%
Cornwall 001D	369	4,410	11,950	10,872	51%
Cornwall 001E	960	10,128	10,550	8,903	6%
Cornwall 001F	646	7,524	11,647	9,932	19%
Cornwall 002A					100%
Cornwall 002B	282	3,494	12,390	11,109	78%
Cornwall 002C	146	1,974	13,522	11,763	87%
Totals	**4,688**	**52,021**	**11,561**	**9,751**	**46%**

This table shows clearly the rural areas totally or largely without mains gas as being Kilkhampton & Morwenstow, Marhamchurch & Widemouth Bay, Week

St Mary & Whitstone and Poughill & Flexbury East. A comparison with the electricity consumption table for each LSOA shows the non-gas and low gas areas having higher average electricity demand. This indicates the higher use of electricity for heating, as heating is the highest energy use in the home.

Non domestic gas demand 2019

Commercial and industrial gas demand is only available at the Medium Super Output Area level and for this area the only area which has commercial mains gas is Cornwall 001 ie Bude town. The statistics indicate that there were some 37 commercial gas meters using around 8,237 MWh of mains gas in 2019.

Total gas demand for this area is therefore some 60,258 MWh

2.3 Other fuels

Other non transport fuels include coal and manufactured fuels, LPG and oils used for heating in commerce and the domestic sector. The statistics for these fuels are only available at the Cornwall level, and have been allocated to the CNA on a population pro-rata basis. This is assessed against other sources and an understanding of the main characteristics of the local area. Other statistics can be used as surrogate data to estimate the missing data, for example the survey of off gas-grid homes space and water heating fuels.

LPG sales data is not generally available, except at the national scale. According Liquid Gas UK – the LPG trade association- around one million tonnes pa of LPG is used in the UK, and around 193,000 households use LPG for their space heating. Most, if not all, of these homes will be off the gas grid, of which there are around four million, according to Ofgem figures, though the trade association quotes two million off gas-grid homes. The trade association estimate suggests that around 4.8% of off gas-grid homes use LPG for space heating nationally. The OFT study indicates that 8% use LPG. The figure to use then depends on the quality of the data source, which in this case is assumed to be the government sourced data.

The estimates for the other fuels are given in the section below on heating as that is their main use.

2.4 Space heating demand

In areas on mains gas, this is the major fuel for domestic and commercial heating. However, here where there are wide areas with low or no mains gas supplies, other fuels are used for space heating local homes. No direct surveys of fuels used for space heating in the local area or in Cornwall are available. Therefore a country wide survey of off-gas grid space heating was used as the starting point for estimating the domestic space heating energy demand[2].

Estimate of domestic space heating energy demand in CNA 2018

Heat energy source	UK non gas heating survey		Bude CNA households off gas grid		All homes	Estimated MWh/ home	Heat demand	
							MWh	%
	Rural	Urban	Rural	Urban				
gas					4,688	11	52,021	59%
oil	53%	1%	1,532	11	1,593	12	19,112	22%
LPG	8%	8%	239	89	327	12	3,927	4%
coal/wood	10%	1%	298	11	309	6	1,857	2%
electricity	29%	90%	865	996	1,862	6	11,169	13%
Totals	**100%**	**100%**	**2,984**	**1,107**	**8,779**		**88,087**	**100%**

Source: Percentages from OFT study of off-gas grid space heating in UK

Whilst the study on which this is based was carried out ten years ago, it is recognised that domestic heating systems are changed only infrequently, usually when house refurbishment or a required new heating system occur. This suggests that direct fossil heating provides approaching 90% of heating locally and electricity provides approximately 13% of local space and water heating.

The same non gas area heat source survey has been used to assess the non-domestic demand for heating fuels, with some adjustments. It is assumed that no coal is used in businesses in the area, that 18% of establishments use oil and 6% use LPG for their heating, with LPG also used for some cooking. Around 22% of establishments are thought to use electricity for heating.

Taking the commercial estimates using this off gas-grid heating survey suggests that around 460 MWh of oil is used and 330 MWh of LPG is used in the non domestic sector.

[2] Office of Fair Trading: Offgrid energy: an OFT market study Oct 2011

Estimate of commercial heat demand by fuel source 2018

Energy source	% of demand	Demand MWh
gas	52%	8,237
oil	18%	2,798
LPG	6%	926
LPG for cooking	3%	400
electricity	22%	3,464
Total heating and cooking		**15,826**

This breakdown of heating fuel demand is an important factor in the potential future development of local strategies for changing to Zero Carbon for the local area.

2.5 Transport oil demand

Oil is used in the area for transport and for heating in both domestic and non domestic buildings. The major use is for transport. Statistics for transport energy use are less disaggregated that for electricity, with the smallest regional information available being at the local authority ie Cornwall level.

Estimating the transport energy for the Bude area CNA be made via two different statistical sources. The most disaggregated method is the 2011 Census data which gives miles travelled to work at the MSOA area level. This is taken as the basis of the figures developed in this section, and the raw data CNA be accessed via the NOMIS database in the Office of National Statistics website.

Whilst this is now data which is ten years old, it is not thought that there are many changes in proportions of travel distances

Travel to Work Bude area by method of travel- number of people

Distance travelled	all	home	public transport	car or van	other methods
all	**7,498**	**1,690**	**102**	**4,161**	**1,545**
<10km	**2,989**	0	31	1,841	1,117
10km to 30km	**978**	0	19	861	98
>30km	**971**	0	29	769	173
at home	**1,690**	1,690	0	0	0
other - away/varied	**870**	0	23	690	157

These data are from the 2011 Census and gives distances in a straight line from home to workplace post code by the local population in work at that time. Therefore the figures are an underestimate of the actual mileage travelled on a weekly or annual basis, but do provide a starting point.

There are about 10,300 cars registered in this area – based on post code information from the ONS, meaning an average of more than one car per household.

The assumed distance for each travel distance band has been adjusted by reference to a commercial route finder giving distances to local towns as a better estimate of actual distances driven. The number of journeys pa is estimated from the percentage of full and part time workers assuming 5 days per week FT and 3 days per week PT, with 43 and 40 weeks pa respectively. This is taken to give some allowance for the seasonal nature of some work in the local area.

Estimate of total distance driven from Travel to Work Census 2011data

Distance to work	People number	%	assume each journey km	journeys pa on average FT vs PT	distance pa km total	% of distance
<10km	1,841	44%	5	120	2,209,200	5%
10km-30km	861	21%	25	208	8,945,790	19%
>30km	769	18%	70	215	23,146,900	49%
other away/varied	690	17%	50	181	12,475,200	27%
Totals	**4,161**				**46,777,090**	**100%**

This table clearly shows the major impact of daily travel distance by residents with 44% of workers travelling under 10km and contributing only 5% of the mileage, whilst the 18% who travel over 30km to work use nearly half the

annual mileage driven. These figures also show some of the issues to be tackled when planning for zero carbon.

Since the 2011 Census the local population has increased by 6%, suggesting that more miles will be being driven for work and for social reasons.

Estimate of mileage driven with present population 2018

Reason	**km driven**
Travel To Work	46,777,090
Social/family extra %	66%
plus social	30,872,879
total 2011	**77,649,969**
plus extra population	6%
Extra km driven	4,658,998
Total 2018 km	**82,308,968**
miles 2018	51,144,548

This calculation suggests that around 82 million kilometres or some 51 million miles are collectively driven by the local population.

The energy demand of this large number of miles is calculated by reference to the average age of the local car fleet and the fuel efficiency of cars at that time.

Calculation of energy demand from mileage driven by residents

Element of calculation	**petrol**	**diesel**	**total**
Percentage petrol and diesel in Cornwall 2018	**52%**	**48%**	
Miles driven for each fuel type	26,433,962	24,710,586	51,144,548
2009 mpg median assume age of av. car 1.6l engine for average size of England fleet	**43**	**49**	
Fuel used gal pa fuel	614,743	504,298	
Fuel used l pa	2,794,623	2,292,537	
Energy content of fuel kWh/l gross cv	9.60	10.90	
Total energy MWh	**26,828**	**24,989**	**51,817**

This calculation, derived from the TTW Census 2011 figures, suggests that around 52,000 MWh is used for car travel by local residents and workers.

This approach is supplemented with reference to the county level information on fuels used for transport in Cornwall as a whole. If the energy used is adjusted on a pro rata basis by local population this indicates that a higher demand for car transport energy is occurring in the Bude area. The Cornwall level data when adjusted for population indicates that around 75,300 MWh is

used for car travel, compared to the nearly 52,000 MWh from the previous calculation.

Energy use in transport Bude CNA as % of Cornwall data MWh 2018

Mode	Petrol	Diesel	Total	%
buses		3,024	3,024	4%
cars	38,912	36,375	75,287	95%
m/cycles	691		691	1%
totals	**39,602**	**39,399**	**79,001**	**100%**
%	**50%**	**50%**	**100%**	

The difference in these two figures for car travel of 75,300 MWh from the Cornwall level data and the Travel to Work calculation at 52,000 could be due to the county level data also including tourist travel in the local area. An early estimate for tourist travel could therefore be around 23,300 MWh in car travel locally. To allow for this possibility the higher figure of 75,300 MWh for car travel will be used.

Freight transport energy statistical information is available at the county level and when a pro rata calculation is carried out for the local area this indicates that around 38,300 MWh is used in the Bude area of which 98% is diesel

Estimate of total transport oil demand for 2018

Transport oil demand		MWh	%
Personal	car	75,300	64%
	bus	3,000	3%
	motor cycle	690	<1%
	total	78,990	67%
Freight		38,300	33%
Total		**117,290**	**100%**

This table indicates that personal travel is two thirds of local motorised transport and freight is one third, with a total oil demand for transport being 117,300 MWh.

2.6 Total energy demand

The table below indicates the key elements which need to be addressed as part of moving to Zero Carbon for energy.

Energy supply and demand estimate for MWh 2018

energy source	domestic	non domestic	transport	total	%
electricity	38,342	40,555		78,897	28%
gas	52,021	8,237		60,258	21%
oil	19,112	2,798	117,290	139,200	49%
LPG	3,927	1,326		5,253	2%
coal/wood	1,857	0		1,857	1%
totals	**115,259**	**52,916**	**117,290**	**285,465**	100%
%	40%	19%	41%	100%	

The clear picture emerging from this table is that the domestic sector and transport are roughly equal in their energy demands, at 40% and 41% with the non domestic sector being less than 20%. The main fuel source at nearly 50% of local energy supply is oil. This major reliance on oil indicates some of the fragility in local energy supply.

2.7 Fuel poverty

In considering the issues around getting to Zero the area may also wish to work on equity issues, which in relation to energy tends to show up as fuel poverty.

Government statistics[3] for the local area show an average approaching 11% of households being in fuel poverty. The statistics are for the Lower Super Output Areas of which there are nine in the local area. Bude, Summerleaze and Golf Course has the highest area of fuel poverty, closely followed by Stratton, Marhamchurch, Widemouth Bay and Week St Mary and Whitstone.

Estimate of fuel poverty in the Bude area 2019

Lower Super Output Area		**Number of households**	**Number in fuel poverty**	**Proportion fuel poor (%)**
Cornwall 001A	Bude Wharf, Summerleaze	791	102	13.0
Cornwall 001B	Bude East	863	80	9.0
Cornwall 001C	Bude South and Lynstone	891	73	8.0
Cornwall 001D	Poughill and Flexbury East	749	64	9.0
Cornwall 001E	Stratton	875	106	12.0
Cornwall 001F	Flexbury West	785	82	10.0
Cornwall 002A	Kilkhampton and Morwenstow	990	110	11.0
Cornwall 002B	Marhamchurch, Widemouth Bay	1,053	126	12.0
Cornwall 002C	Week St Mary and Whitstone	1,112	132	12.0
Totals		**8,109**	**875**	**10.8%**

This relatively high figure of fuel poor households suggests that work is required to include these households in any planning for zero carbon for the Parish, to enable climate justice to be achieved.

[3] *Source ONS Annual fuel poverty statistics by LSOA*

3 Carbon footprint for energy supply

It is recognised that direct energy use is responsible for about 75% of greenhouse gas emissions in each region, and agriculture and land use for the other 25%. The land use emissions figures are much less reliable than the direct energy use calculations of carbon emissions. This report focuses on the direct energy emissions.

Carbon emissions for 2018 figures

Energy source	Total energy use		Emissions coefficient	Carbon emissions	
	MWh	%	kg CO2e/kWh	t CO2 e	%
Oil	139,200	49%	0.2613*	36,373	49%
Electricity	78,897	28%	0.3072	24,237	33%
Gas	60,258	21%	0.2046	12,329	17%
LPG	5,253	2%	0.2303	1,210	2%
Coal ^	1,857	1%	0.3629	337	<1%
Totals	**285,465**	100%		**74,486**	100%

**weighted average of domestic oil, & petrol and diesel at the pump – 5% biofuel mix*

^ assumes that half of the coal/wood used is wood with no carbon footprint.

The tonnage of CO2eqivalent emitted each year from energy demand in the CNA is determined from the amount of each type of energy source required multiplied by the emissions coefficient for each. The figure for each fuel source is taken from the government figures released each year to allow for annual changes[4], particularly in the carbon emissions in grid electricity which is reducing each year as more renewable sources come online.

The CO2e tonnage is an overall estimate for all the main greenhouse gases involved in fossil fuel energy. CO2 is the main gas and is taken as the unit of measurement. Other gases are counted as CO2 multiplied by their comparative Global Warming Potential and added to the CO2 number for each energy source.

This table shows clearly which energy sources produce the largest proportion of carbon emissions for the area. It is important however to be aware that the carbon content of electricity in the UK is dropping every year. The emissions

[4] https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2018

co-efficient figure used in this table is for 2018 electricity. This figure includes the Transmission and Distribution losses – ie the line losses between generator and customer. In Cornwall this is likely to be lower, because of the relatively high local generation from renewables, but within the confines of this work it is not feasible to estimate how much lower this would be.

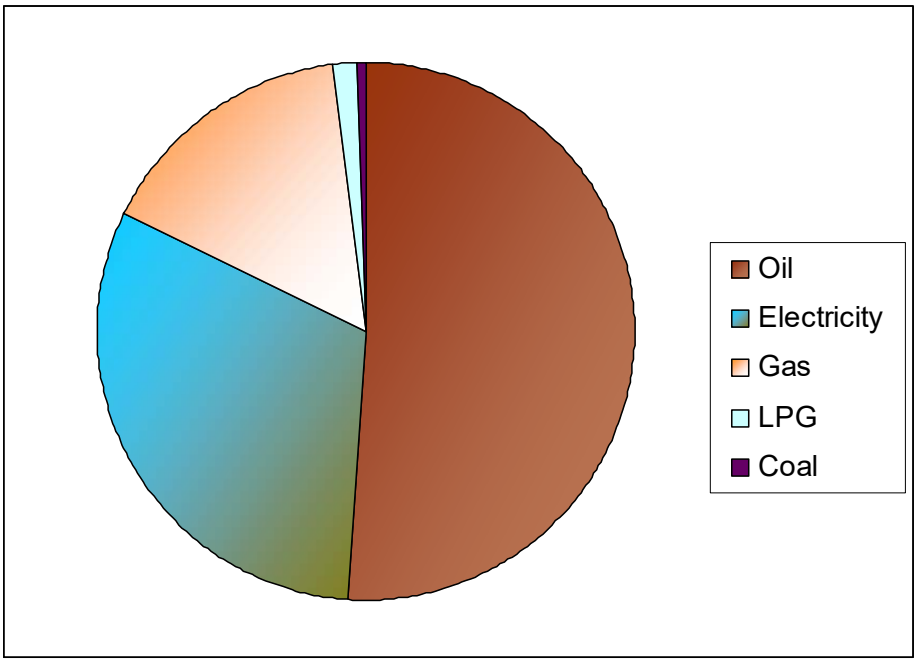
The emissions coefficient figures are from:-

UK Government GHG conversion factors for company reporting. 2019

This is a joint BEIS and DEFRA report produced each year with updated emissions factors, as each fuel varies a little, and electricity varies more, with increasing renewable energy proportions.

The table also shows the great importance of tackling oil use as a major part of reducing local carbon emissions, alongside cutting electricity demand and replacing electricity demand with local renewable supplies.

Chart of greenhouse gas emissions from energy supply



The table and pie chart above show that the area is responsible for nearly 75 thousand tonnes pa of carbon dioxide equivalent emissions. Of this, just under half is due to the use of oil mainly for transport with around 14% for space and water heating. The remainder of the demand is divided between electricity at one third and gas at 17% of demand.

The non domestic sector buildings use nearly 41,000 MWh pa of electricity in the CNA, though this figure excludes the smaller businesses operating on a domestic electricity tariff.

Carbon emissions are however dominated by the emissions from car travel in the area for some 51 million miles a year, contributing around thirty thousand tonnes CO2e pa to local carbon emissions.

These figures indicate that the main actions to reduce carbon emissions in the Partnership area need to focus on reducing car transport requirements and increasing fuel efficiency in local homes.

4 Local renewable energy production

4.1 Solar PV

Local solar electricity produced on household and commercial rooftops will not affect the present purchased mains electricity. Local supplies are in addition to the purchased electricity in the government statistics, as they occur “behind the meter”. The present rooftop PV therefore does not affect the present carbon emissions, as it is already taken into account as being “reduced demand”.

A search of databases and planning records reveals that several local solar arrays and wind turbines have been refused planning permission, and that there are five large solar arrays in local operation. These are shown in the table below.

Large local operational PV arrays

Site	**Location**	**Installed MW**
Northmoor	Whitstone	5
East Langford Farm	Kilkhampton	5
Creathorne Farm	Poundstock	1.8
East Woolley Farm	Morwenstow	5
Canworthy Water	South Wheatley	25
Total		**43.8**

It is noticeable that these solar arrays were all installed before the present low electricity selling price for renewable electricity came into force, with the latest being commissioned in 2015. It is expected that these sites will in total be producing around 45,400 MWh pa. This amounts to 58% of local electricity demand.

A search of installed renewable energy data bases also showed that in addition there are larger numbers of smaller schemes as outlined in the table below.

PV installations under 1MW

PV installations	Number of installations	Total kW installed	MWh generated	Assumed generation available to local grid	
				%	MWh
100-999kW	1	100	105	95%	100
30-99	33	1,542	1,619	85%	1,376
6to29	79	917	963	75%	722
<6kW	592	2,224	2,179	50%	1,090
Totals	**705**	**4,866**			**3,288**

The installations under 6kW are small scale mainly domestic rooftop panels which generally export to the grid only a proportion of the electricity generated and the export is not metered. The use of solar on site takes place “behind the meter” so appears as reduced demand in electricity sales statistics. This means that if there were no solar panels the local demand for electricity from the mains would be somewhat higher.

The table indicates the approximate amount of electricity available from each scale of installation, with increasing percentages being assumed for use onsite for the smaller installations. These installations are likely to be exporting around 3,300 MWh pa to the local grid, which is about 4% of local demand.

4.2 Wind energy

Database searches show that there are a number of single wind turbines in the CNA, but no windfarms as such.

wind turbine scale		number	total kW	Capacity Factor	electricity produced MWh	electricity exported	
						%	MWh
large	250-2,400	11	6,650	30%	17,476	100%	17,476
medium	50-240	27	2,161	28%	5,300	92%	4,876
small	<50	26	347	25%	760	60%	456
Totals		**64**	**9,158**		**23,537**		**22,809**

There are about 64 individual wind turbines around the Partnership area with a combined installed capacity of over 9 MW. The table shows the expected electricity available to the local grid from these wind turbines, according to the Capacity Factor and expected proportion not used on site.

Capacity Factor is a measure of the annual proportion of electricity generated compared to the 100% which would be achieved if the installation operated at 100% of output all year. No electricity plant achieves this, as all have downtime for maintenance or in the case of renewables when the driving energy is not available.

Larger wind turbines, being taller, have higher Capacity Factors as the wind is higher speed at height. It is likely that local wind energy produces around 29% of local electricity demand.

4.3 Renewable heat

Information on the installations of renewable heat systems under the Renewable Heat Incentive is less well developed than for renewable electricity installations. The best information is at the Cornwall level, which shows that Cornwall residents have installed around 3,000 heating systems comprising 605 air source heat pumps, 16% ground source heat pumps, 12% biomass heaters and some 11% solar thermal systems.

Assuming the Bude area has installed systems at the same rate, there will be around 100 installations locally with 60 or so air source heat pumps, and 15 ground source heat pumps.

Information on the Non Domestic Renewable Heat Incentive is even less well developed, with only the indication that in Cornwall there are some 439 installations totalling 66MW thermal. This would suggest that there are very few Non Domestic RHI installations in the Bude area.

This information is not firm enough to be able to make any estimates of local renewable heat supplies.

4.4 Local renewable energy supplies

Significant supplies of local renewable electricity are available from the solar and wind installations already operating in the area.

As wind produces around 75% of its output in the winter and solar PV produces 72% of its annual output in the summer months, these two supplies complement each other well. A suitable balance of wind and solar supply can assist in reaching local supply resilience and zero carbon electricity for the area.

The table below indicates some of this with the present supplies of wind and solar electricity.

Seasonal renewable energy supply and demand in the Bude area MWh

Seasons	**Apr-Sep**	**Oct-Mar**	**Annual total**	**Apr-Sep**	**Oct-Mar**
Present local supply of wind and solar electricity					
Wind availability	25%	75%	22,809	5,702	17,106
Solar availability	72%	28%	48,711	35,072	13,639
Seasonal availability totals			***71,520***	***40,774***	***30,746***
Annual electricity demand			**78,897**		
Present annual local RE supply		% of demand	91%		
Rough seasonal assessment of supply vs demand					
Present electricity use demand					
winter heating	11,169				11,169
non heating electricity	67,728				
assume % of non-heating demand		winter use			
lighting	17%	66%		3,838	7,599
appliances	65%	65%		15,408	28,615
other	18%	50%		6,095	6,095
Total seasonal demand				**25,341**	**42,309**
seasonal supply				40,774	30,746
% of demand				**161%**	**73%**

The table shows that whilst, in theory, the local existing solar and wind installations provide some 91% of local electricity demand, in practise this is actually an overabundance, with 160% of demand, in the summer and a lower supply of 73% in the winter.

This is a rough estimate using industry standard figures for household electricity demand breakdown, which may be different for the local area, but gives an indication of issues for the pathway to zero carbon planning.

4.5 Carbon savings from existing local renewables

This assessment allows a more accurate calculation of the local carbon footprint to be made. This calculation is not totally accurate regarding the amount of electricity which is exported from the local area, which would require a full half hourly analysis of supply and demand to be carried out for a sample year.

An indicative figure for the carbon saved locally by the use of local wind and solar installations is shown below.

Estimate of carbon savings from local use of local wind & solar

Seasonal assessment		**Annual total**	**Apr-Sep**	**Oct-Mar**
Total seasonal demand			25,341	42,309
	seasonal supply		40,774	30,746
	% of demand		161%	73%
Local supply consumed locally			**25,341**	**30,746**
	Total supply used locally	**56,087**		
Carbon savings				
	Carbon coefficient	0.3072	kg CO2e/kWh	
	CO2 saved	**17,230**	**tonnes pa CO2e**	

Whilst this is an indicative figure only, it does show a significant reduction in the local area carbon footprint of over 17,000 tonnes CO2e pa., or some 23% of the total.

This suggests an effective carbon footprint for energy use in the Partnership area of about 57,300 tonnes CO2e pa.

5 Local Energy Bill

The unit prices of each type of energy supply have been obtained from the BEIS energy price statistics series which are updated regularly and available for each sector and type of fuel. There are some difficulties in assigning prices to specific commercial and industrial sectors, especially for the less well regulated fuels such as heating oils and LPG. The figures given are therefore approximations.

The costs given in the table do not include standing charges, but do include VAT as applied, the Climate Change Levy and other taxes where required.

Estimated energy bill for the Bude area

Energy supply	**Cost**		
	£ 2020 prices		**%**
Transport fuels		7,501,423	**33%**
Domestic sector			
heating	4,416,909		
electricity	4,891,140		
Total domestic		9,308,049	**40%**
Commercial sector			
heating	1,281,544		
electricity	4,975,612		
Total commercial		6,257,156	**27%**
Total all energy costs		**23,066,628**	

The total energy bill for the Bude Community Network Area is around £23 million pa. Transport costs one third of the bill, even though it consumes over 40% of local energy demand: indicating that oil is one of the cheaper fuels available.

The most expensive energy source is electricity and this makes up over half the local energy bill for under one third of the energy demand. Clear financial savings for the area can therefore be seen in reducing electricity demands through electricity efficiency and demand reduction measures.