

This section of the Economic Blueprint focuses on our potential local renewable energy sector, and how we might grow it. All numbers should be taken as roughly indicative rather than an accurate set of figures. For more information about this project, why we're doing it, who and what's behind it, please see the Totnes & District Economic Blueprint Project Overview (available on the Transition Town Totnes website in the Economic Blueprint section).

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A. ABOUT OUR ENERGY ECONOMY TODAY

The aim of this report is to characterise the economic potential of the renewable energy industry in the Totnes and District (T&D) area. However, much of what can be learned and applied for this small geographic region must be interpreted from data and analysis pertaining to South Hams or other geographic boundaries. One major challenge is lack of locally defined data. Another challenge is defined by the nature of the firms operating in the renewables industry who may be based locally, but operate within a much larger geographic radius.

Those caveats noted, we'll make every attempt to be clear about data presented below and how it may apply to T&D. (One additional caveat pertains to the use of the word "energy", which is being used here in its colloquial meaning, referring to both sources and carriers of energy.)

HOW MUCH ENERGY IS CONSUMED AND WHAT DOES IT COST?

Current lifestyles in Totnes and District are possible thanks to an abundant supply of energy for heating, cooking, lighting, transportation, and powering a variety of farm and industrial machinery. Where does this energy come from and how much does it cost? In short, nearly all of this energy is produced far outside the area by the 'Big Six', which are large national and international corporations.

According to data provided by DECC, we estimate total UK energy spending (direct and indirect) to be about £134 billion¹, or £2,128 per capita, and if we remove transport fuel from the equation, it's about £1059 per capita. For residents of T&D, this represents approximately £51 million of gross monetary economic value devoted to energy consumption in one form or another.

But the monetary value of this energy does not account for its full costs, especially in the production of energy derived from fossil or nuclear fuels. Climate change, ecological destruction, social injustice, and human health problems are some of the additional costs of production that are "externalised" from usual accounting methods and not reflected in the monetary prices domestic, commercial, and industrial customers pay for their energy.

In some cases, these impacts are reflected in additional monetary costs felt elsewhere in the national economy, such as in greater health care costs and military expenditures. These impacts may create other economic losses not easily quantified. They also represent important ethical considerations which cannot be translated into economic analyses, but which must be weighed in the formulation of energy related policies.

The total UK energy spend referenced above includes all energy types consumed by all sectors including gas, electricity, transport fuels, coal, etc. This report is focused on characterising the economic potential for local renewable energy, a category that includes many different technologies and resources. For our purposes, we'll focus only on those able to provide a significant portion of the needs of the T&D area in the short term – three to five years.

This means primarily we'll be looking at electricity and heat production from solar photo voltaic (PV), solar thermal, wind turbines, and biomass technologies. These technologies are mature and well matched to the

¹ "1.1.6 Expenditure on energy by final user," DECC, http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/source/total/total.aspx

energy resources that are readily available. This does not mean other technologies are not important or could not be developed in the long term.

Transport fuels account for nearly half of all energy expenditures and there is some business activity in T&D devoted to develop transport biofuels from recycled vegetable oil. However the economic potential of this effort, as well as the near term potential for other technologies, such as tidal energy, is far too limited given the nature of this report.

Given these parameters, it is useful to examine the current levels of electricity and gas consumption in Totnes & District. DECC produces consumption figures for South Hams and we can extrapolate what proportion might apply to T&D. According to the data², South Hams (SH) consumes about 560 GWh worth of gas and 489.1 GWh of electricity per annum across all users, including domestic, industrial, commercial, and public sector.

We've extrapolated these figures for T&D based on the ratio of dwellings (42,340 in South Hams, 9,980 in T&D) used in the Retrofit³ report. As seen in Table 1, below, we estimate that T&D consumes roughly 132 GWh of gas, and 114GWh of electricity – the domestic sector consumes just over half the gas and just under half of electricity.

Table 1 – Gas and electricity consumption in T&D and SH, 2010.

		Domestic				Industrial/Commercial				Total	
		GWh	%	MPANs*	%	GWh	%	MPANs	%	GWh	MPANs
SH	Gas	317.2	57%	23,888	99%	242.8	43%	258	1%	560.0	24,146
	Electricity	212.0	44%	43,508	88%	269.8	56%	5,963	12%	481.9	49,471
T&D	Gas	75	57%	5,631	99%	57	43%	61	1%	132	5,691
	Electricity	50	44%	10,255	88%	64	56%	1,406	12%	114	11,661
Data from DECC.											
*Meters											

Developing monetary values for these consumption levels is a little trickier. We multiplied consumption levels, shown above, with average prices⁴ per kWh for both gas and electricity consumption, for both domestic and industrial and commercial customers, see Table 2 below.

It is evident that these numbers are estimates, but for our purposes they provide a satisfactory indication of the monetary value of local energy consumption from the national grid.

² “Sub National Energy Consumption Statistics”, DECC, http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/regional/regional.aspx

³ Economic Blueprint Totnes: Energy Retrofit Industry, 2012, Reconomy Project

⁴ “Energy price statistics”, DECC, http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/prices/prices.aspx

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Table 2 Estimated domestic and industrial/commercial spend.

		Est. avg. price/KWh	Estimated Domestic	Est. avg. price/KWh	Industrial & Commercial	Totals
SH	Gas	£0.04	£12,686,566	£0.03	£6,241,237	£18,927,804
	Electricity	£0.14	£29,897,855	£0.08	£22,475,865	£52,373,719
	Totals		£42,584,421		£28,717,102	£71,301,523
T&D	Gas	£0.04	£2,990,362	£0.03	£1,471,128	£4,461,490
	Electricity	£0.14	£7,147,212	£0.08	£5,297,807	£12,445,018
	Totals		£10,137,574		£6,768, 935	£16,906,508

Data from DECC.

We estimate that T&D (homes and commercial) consumes roughly 132 GWh of gas and 114GWh of electricity per year. This costs us about £4.5m and £12.5m respectively (£17m in total). This money all leaves the area.

WHERE IS OUR ENERGY PRODUCED, AND FROM WHAT SOURCES?

Currently, nearly all electricity and gas consumed within T&D, and for that matter all of Devon, is imported from other parts of the UK or from international providers. The major providers of both electricity and gas are known as the 'Big Six', which are British Gas, EDF, E.On, Npower, Scottish Power, and Scottish & Southern.

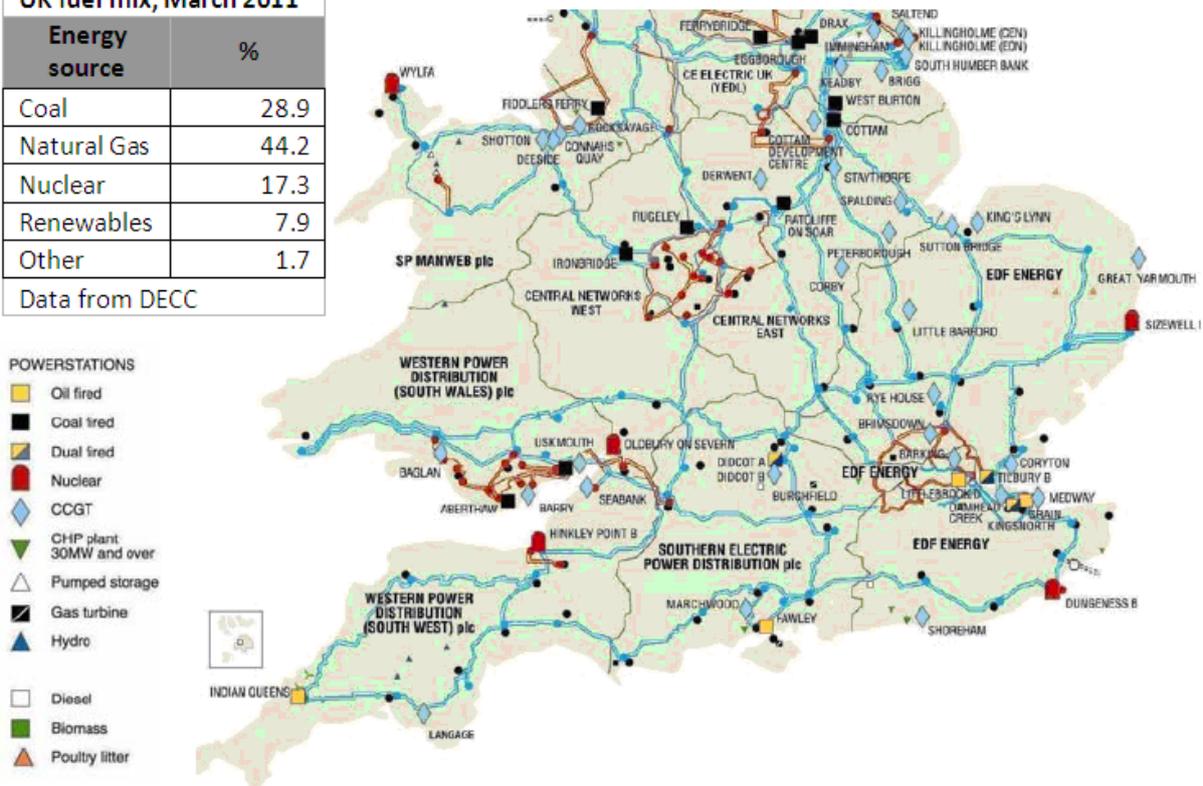
In the UK, there are over 2,000 power stations producing electricity from several sources including coal, nuclear, gas, and renewables, see Figure 1, below. Although some electricity is imported from France, most all electricity production occurs onshore. Fuels, however, such as uranium, gas, and oil, rely on imports.

Figure 1
UK fuel mix, March 2011

Energy source	%
Coal	28.9
Natural Gas	44.2
Nuclear	17.3
Renewables	7.9
Other	1.7

Data from DECC

Electricity Supply System Map, detail.



B. RENEWABLE ENERGY POTENTIAL

WHAT RENEWABLE ENERGY RESOURCES DO WE HAVE?

The South Hams enjoys an abundance of energy resources that include solar, wind, and biomass. Accordingly, we'll focus our on discussion on those energy sources and the most important technologies to harness them.

Solar

As is evident from the map below, "Global irradiation and solar electricity potential – United Kingdom"⁵, the South Hams enjoys the highest potential to exploit solar power in the UK - over a megawatt per square meter per year. But to exploit that potential, PV (for electricity) and thermal panels (for hot water) must be positioned on roof tops and other structures to be able to effectively collect that energy.

In the South Hams there are approximately 42, 340 dwellings and, perhaps, another few thousand commercial and industrial buildings. Solar PV panels can be ground mounted or situated on other structures not defined as building rooftops, per se, but for our purposes here, let's just consider domestic rooftops.

⁵ Šúri M., Huld T.A., Dunlop E.D. Ossenbrink H.A., 2007. Potential of solar electricity generation in the European Union member states and candidate countries. Solar Energy, 81, 1295–1305, <http://re.jrc.ec.europa.eu/pvgis/>

According to DECC, the number of installed PV systems registered for the Feed-in Tariff programme is 1,370 domestic and 1,405, overall⁶. There will be more systems installed that are not part of the FIT programme, but these are a minority so we'll use these numbers as a guide.



Solar PV experts in the area offer a general rule of thumb that approximately half of the dwellings in the South Hams could be fitted with PV, taking into account factors such as aspect (not north facing), shading, size, structural integrity, and so on. If there are 42,340 dwellings in South Hams, and half of these could host PV systems, the potential is roughly 21,170 rooftops. This means that in South Hams, almost 94% of the potential for PV remains untapped.

We can roughly estimate the number of installations in T&D, and the overall potential, in a couple of different ways. There are roughly 9,980 dwellings and if half could be fitted with solar PV, then about 4,990 rooftops would represent the potential. Given the same ratio of installations as South Hams, that would give us an estimated installed base of 323 systems in T&D already.

Transition Town Totnes' Transition Streets programme reports that it funded the installation of 141 PV systems⁷, which raises the question of how many more installations occurred outside their programme, or whether our estimates for current T&D installations are overly optimistic. In any case, the fact remains that the potential for PV in T&D is large

and remains largely unexploited.

The other solar technology worth mentioning here is solar thermal or solar hot water heating. This technology relies on the sun's heat to raise the temperature of water and would supplement, or be supplemented by, a conventional water heating system. Depending on the type of system, solar thermal can supply about half of the hot water needs of the average family.

According to UK Guardian article last year⁸, there are about 140,000 homes in the UK fitted with solar hot water heaters, however due to the fact that DIY versions of the systems also exist, that number may be higher, especially in rural, off-grid situations. Solar thermal and PV can co-exist on the same roof, but it's clear that sometimes rooftop capacity would be limited to supporting one or the other, especially given our relatively small average roof space in Totnes.

In evaluating the potential for solar thermal, suitable roof structure is one criteria, but there are other factors, too, such as existing boiler type and other features of the property, such as pipe dimensions and runs. While we could find no reliable data, extrapolating from data already presented implies that the current installed base of solar thermal would be about 10% that of solar PV, with theoretical untapped potential at around 99%.

⁶ "Feed-in Tariff statistics," DECC, http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/source/fits/fits.aspx

⁷ "Final project report September 2011 - Transition Together," Transition Streets, <http://www.transitiontogether.org.uk/files/Transition%20Streets%20-%20final%20report%20-%2027%20Sep%202011.pdf>

⁸ <http://www.guardian.co.uk/environment/2011/oct/13/solar-heating-household-hot-water>

Wind

In addition to abundant sunshine, the South Hams also has significant wind resources. According to the Devon Association for Renewable Energy report, “South Devon Renewable Energy Scoping Study”⁹, the area contains numerous sites that consistently receive wind at least 7.5 metres/second at 65 metres above ground, making them suitable for commercial scale wind turbines. The map below, Map 1, depicts wind speed resources across the South Hams, however many of those parcels with suitable wind speeds to support large-scale wind turbines fall within the boundaries of the AONB.

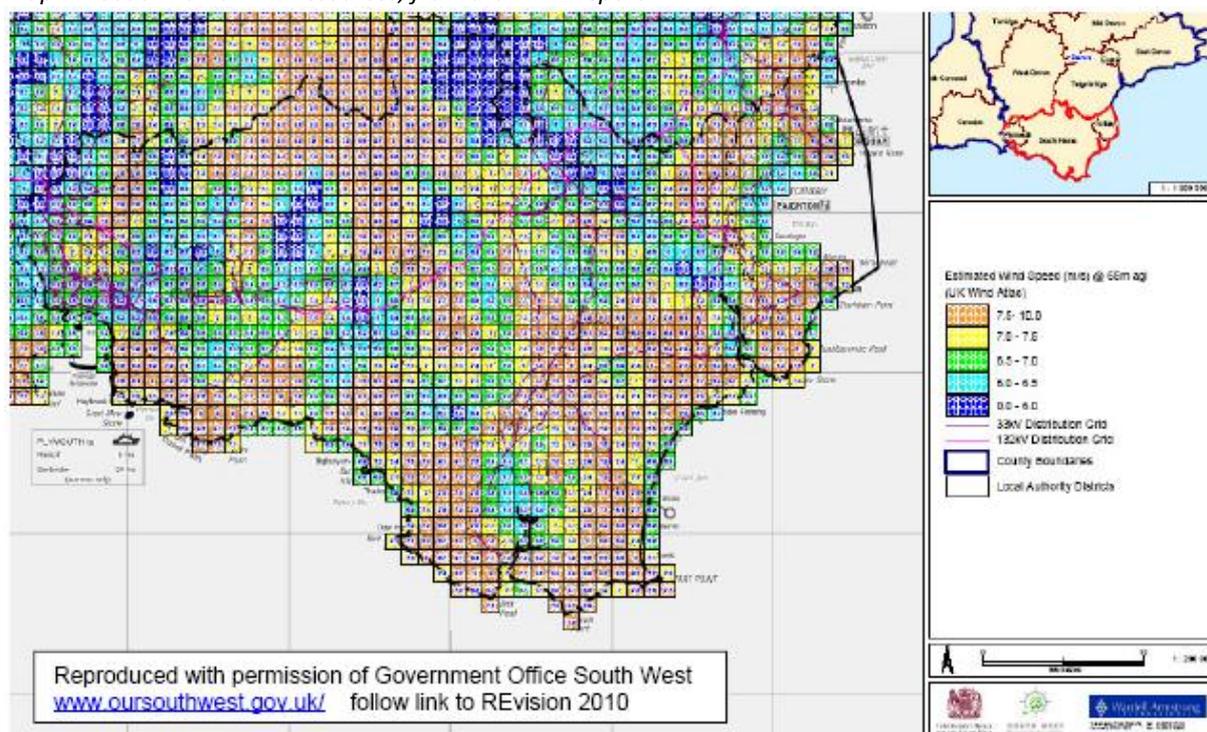
In practical terms, planning restrictions due to this factor, and related siting issues, may significantly reduce the number of sites that would support large scale wind turbines. Currently, there is only one community-owned wind farm project in the planning pipeline which would install two large turbines with nominal capacity of 2.3 MWh each. The site is at Luscombe Cross near Harbertonford, which is one of only a handful of suitable sites within T&D – indeed, due to the factors mentioned above it may be the only site. Given possible planning constraints due to proximity of AONB, Dartmoor National Park, as well as other issues, this may represent the extent of commercial wind power potential for the area, at least in the short term.

There is also the theoretical potential for small or domestic-scale wind power and large-scale off-shore wind power. Small-scale wind would not be constrained by the same issues as large-scale onshore wind. Smaller turbines are not as tall, reducing impacts on neighbours and AONB views, but because they’re not as tall, they rely on wind speeds closer to the ground. That fact means that air turbulence caused by trees, structures, and topographic features becomes a limiting factor, relegating small-scale wind turbines to rural sites with unobstructed wind corridors.

DECC counts about 18 small wind turbines installed in South Hams and registered for the FIT, however there may be a few more installations that are not FIT registered. Because small-scale wind represents only a niche application, the potential is trivial in the context of this report. Similarly, there is marginal potential for an off-shore wind installation, but it offers no opportunity in the foreseeable future and will not be considered in this report.

⁹ “South Devon Renewable Energy Scoping Study”, 2006, Devon Association for Renewable Energy, <http://dare.btck.co.uk/>

Map 1 – South Hams wind resources, from the DARE report.



Biomass

In addition to wind and solar, there is also biomass. The biomass resources in the area primarily consist of woodland and waste, with relevant technologies consisting of wood fuel boilers, anaerobic digestion (AD), and advanced thermal treatment, such as gasification. According to the Renewable Energy Progress Report: South West Annual Survey, produced by Regen Southwest, there is over 13MWh of installed biomass capacity in Devon. How much of this is in the South Hams or the T&D area is unknown.

According to the DARE report referenced earlier, there is about 3144ha of woodland and forest cover in the South Hams, of which 2440ha is deciduous hardwoods and 704ha coniferous. Assuming sustainable management and harvesting of each resource, the potential yield could be on the order of 6,100 dry tonnes per year hardwood, and 2,816 of softwoods accounting for timber used for construction use, yielding a theoretical potential of almost 37GWh in energy terms. Additional capacity could be developed with short rotation coppicing (SRP), such as with poplars. (SRC willow coppicing is another strategy but requires special equipment.) This study provides a useful starting frame, however the issues around wood fuel and biomass cropping and their resulting supply chains are complex with many variables and assumptions, suggesting that a more in-depth and localised study would be beneficial.

If we assume that a similar proportion of this resource lies within T&D, we can use the ratio of T&D dwellings to South Hams dwellings (9980/42340) to approximate quantity. This method estimates the potential wood fuel resource in T&D would be about 2,100 tonnes with an energy potential of 8.7GWh. This energy potential could be utilised by domestic scale wood fuel boilers or by commercial scale boilers or district heating schemes. The study also points out that individual wood stoves and boilers are between 70%-90% efficient. In addition to woodland product, agricultural waste can also be pressed into pellets and used in these systems. There is a 400kWh biomass boiler installed at KEVICC, for example. While the number of domestic-scale systems installed in T&D is unknown, anecdotal evidence is that installations are increasing in response to the rising cost of gas and electricity.

There is also energy value in the biomass included in waste products. As mentioned above, some agricultural waste can be pressed into pellets and used in pellet stoves and biomass boilers. There is also energy value in animal slurry from dairies and other farm operations which can be used as feedstock in AD systems.

The authors of the DARE report make the assumption that an AD plant in West Devon is of a scale that could work in South Hams given very similar numbers of farms, cattle, etc. They estimate that there are over 50 dairy operations in the area, for example. In that case, the assumed potential for AD based on animal slurry is about 14,400MWh. Also suitable for AD systems is food and garden waste generated by households, restaurants and other food businesses. Here the DARE report calculates that the potential energy value from food waste in the South Hams is about 6,500MWh. It's conjectural, however one might assume a more narrowed potential for AD in T&D of about 4,000 or 5,000 MWh, taking into account both animal slurry and food and garden waste.

Finally, there is additional biomass to be found in the municipal solid waste (MSW) stream in the form of paper and wood products, natural fibres, and so on, as well as in commercial waste. According to the DARE report, about 70% of MSW and commercial waste could be used as feedstock advanced thermal processing, either pyrolysis or gasification. Both of those processes are environmentally superior to incineration. This works out to approximately 30,000 tonnes of potential feedstock that would produce about 85,000MWh of usable energy. Again, the potential for T&D is conjectural - perhaps 21,000MWh could be generated from local waste streams.

WHAT IS THE POTENTIAL ECONOMIC VALUE OF THIS ENERGY?

The above section attempts to calculate the potential energy available from our solar, wind, and biomass resources in Totnes & District. Solar PV and wind turbines are mature technologies and deliver reliable estimates on what proportion of solar or wind energy could be converted to electricity. Estimates for other wood fuel and solar thermal are a little more difficult, and finally, AD and gasification are more dependent on variable feedstocks.

Solar Value

There are a few technology choices for solar PV and they typically work within an efficiency range of 10-20%. Given our relatively high latitude, it's assumed that a 1kw panel would deliver about 800kw over the course of a year. Assuming the 4,990 available residential roofs in T&D could take on average a medium sized, or 2kw system, the total value of energy produced in terms of domestic retail electricity prices is about £1.1 million per year.

We are assuming installations on residential properties but have not taken into account the additional capacity represented by commercial, farm, industrial, and government buildings. Those buildings would host much larger capacity systems in most cases, potentially adding a significant boost to our current estimates.

Quantifying potential from solar thermal is slightly trickier. It's unlikely that all rooftops that could support PV could also support solar thermal. In addition, other constraints may make solar thermal impractical, such as the need for a water cylinder or integration with a combi-boiler – constraints that apparently can be overcome with the right expertise, but nevertheless remain as perceived barriers and add to costs.

A recent study by the Energy Savings Trust¹⁰ found that performance for installed solar hot water systems delivered a median value of 1,140kWh per year and satisfied 39% of an average family's needs, however

¹⁰ "Here comes the sun: a field trial of solar water heating systems", 2011, Energy Savings Trust

performance depends on several variables including usage patterns, level of insulation, etc. If we assume 4,990 rooftops in T&D are fitted with solar thermal and are reducing the demand for gas, the value at current retail gas prices is £227, 544. The estimate of the number of homes and rooftops capable of hosting a system is rough, and it may be more realistic to assume installations where water is currently heated by more expensive fuels, however these estimates overall are conservative and based on available data.

Wind Value

Wind turbine performance over the course of a year can also be reliably calculated given known characteristics of the site. The wind farm proposed for Luscombe Cross would have two 2.3MW wind turbines and these would be expected to operate at about 29% capacity over the course of a year, yielding about 8.8GW, or enough electricity to power about 2,600 homes. At retail prices, this amounts to about £1.6 million per year.

Biomass Value

Estimated economic value for biomass is less reliable due to a number of unknowns, however the estimated energy potential provided in the DARE report gives us a starting point. The report estimates a potential energy value for wood fuel at about 37GWh per year for South Hams and we've assumed about 8.6GWh applies to T&D. If we assume that fuel is used in wood fuel/biomass boilers that are, on average, 80% efficient, the available energy would be about 6.9GWh.

If this energy is used instead of gas for heating, the value at current retail gas prices would be about £278,261 per year. It's likely that this is a conservative estimate as wood fuel heating systems would more likely replace non-gas heating systems, such as oil or electricity, which cost substantially more than gas. If comparing against electricity, for example, that value would be almost £1 million.

Finally, whereas sunshine and wind are freely available, wood fuel is not. Wood chips and wood pellets cost between £100-200/tonne, for example. If the local area can produce about 2,100 tonnes of wood fuel, that could be worth between £210,000 and £419,000, or roughly between 3p-4p/kWh.¹¹

The Dare report also offers an estimated energy value for rather crudely estimated quantities of biomass feedstocks from waste streams. Be that as it may, we can work with rough figures to provide an indication of the economic value this resource may present. Assuming AD produces gas for heating from locally available feedstock, that is feedstock available in T&D, the value at retail gas prices would be about £160,000. An advanced thermal conversion system, like gasification, could be used to produce electricity from the locally available solid waste stream equivalent to £2.9 million at current retail prices.

These waste streams are either currently not effectively managed, as may be the case with animal slurries, or may be collected and composted, recycled, or landfilled. These methods represent value to those firms that handle that waste, and a cost to those who must pay for their removal. We've not attempted to model these factors, here, but they are important economic aspects of this particular energy resource. Another factor not modeled here is ongoing pressure to reduce the volume of the solid waste stream. This suggests a diminishing supply of feedstock over the long run, however rising population might have a mitigating effect.

¹¹ "Fuel costs per kWh", Biomass Energy Centre, http://www.biomassenergycentre.org.uk/portal/page?_pageid=75,59188&_dad=portal

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Table 4 – Potential economic value of renewable energy resources given current retail energy prices.

	Potential installs	kWh	kWh/year	Total kWh/year	Price	Total Value
Solar PV ¹	4990	2	1,600	7,984,000	£0.14	£1,125,744
Solar thermal ²	4990	-	1,140	5,688,600	£0.04	£227,544
Wind farm ³	2	2,300	5,843,000	11,686,000	£0.14	£1,647,726
Wood/biomass ⁴	1	-	6,956,543	6,956,543	£0.04	£278,261
AD ⁴	1	-	4,000,000	4,000,000	£0.04	£160,000
Gasification ⁵	1	-	21,000,000	21,000,000	£0.14	£2,961,000
Total potential value at current retail energy prices						£6,400,276
¹ Assumes medium scale PV system on average.						
² Assumes 3m ² system, replacing gas boiler load						
³ Assumes turbines working at 29% capacity, provided by Infinergy.						
⁴ Assumes systems replace gas heating load						
⁵ Assumes systems produces electricity						

The estimates given above and summarised in Table 4, offer calculations of potential economic value based on retail pricing. In part, this represents the potential value of annual payments for energy that would otherwise leave the local economy and go to the Big Six and other providers for gas and electricity, but with a couple of exceptions. For domestic microgeneration schemes, locally generated energy could be consumed on site, with only the excess fed back into the grid. In the case of systems feeding directly into the grid, that “savings” is purely theoretical. Another way to look at this scenario is to calculate the value that investors in these systems would realise from feed in tariff schemes.

We estimate the retail value of the energy that could be generated from our solar, wind and biomass assets is about £6.4m per year. This is 38% of our current energy spend.

WHAT ARE THE RELEVANT GOVERNMENT SUBSIDIES AND MARKET PRICES?

While the South Hams and T&D enjoy relatively abundant natural energy resources, development of these resources would be spurred by government incentive programs. Targets to reduce CO2 emissions and increase the share of energy produced by renewable technologies has led to the Renewables Obligation and Feed-In Tariff (FIT) for electricity generation, and the Renewable Heat Incentive (RHI), a similar program but for heating systems.

The Renewables Obligation has been in place since 2002 and is designed to support development of large-scale renewable electricity projects, such as wind farms. The Renewables Obligation Certificates (ROCs) are issued to generators of renewable electricity, who can then sell these on to electricity suppliers who are obligated to generate renewable electricity, or buy ROCs on the open market. Currently, the wholesale

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electricity price has been hovering around £49/MWh, while the ROCs are issued at £38.69/MWh for onshore wind. ROCs, however, can be traded and are currently trading around £41, but the long term trend is falling.

The FIT provides a price per kWh for electricity that smaller renewable systems generate and may feed into the national grid, varying according to the type and scale of the system. Generous FIT levels have spurred rapid growth in solar PV and wind turbine installation over last two years. Recent government mishandling of proposed changes in the amount of FIT available has led to some uncertainty in the industry, and may have contributed to the demise of some marginal firms. Recently revised FIT values are dramatically lower, now 21p/kWh for a typical household PV system where previously it was 45.4p/kWh, but the new values provide a reasonable return in many cases. Electricity fed back into the national grid earns an additional 3.2p/kWh. FIT values will continue to come down in the future.

The Renewable Heat Incentive is designed to incentivise investment in renewable heat technologies such as ground source heat pumps, solar thermal, wood fuel/biomass boilers, anaerobic digestion, etc. The RHI was introduced last year to non-domestic users, along with the Renewable Heat Premium Payment (RHPP) scheme for domestic users. The programme is currently in Phase Two, with the full implementation of domestic RHI due to coincide with the rollout of the Green Deal in late 2012 or early 2013. For non-domestic installations, there is a FIT-type of payment based on metering, but for the RHPP there is a one-off rebate payment for investments in some types of systems, with strict eligibility criteria being an important factor. The current configuration of RHI/RHPP and the likely features of RHI when fully implemented, deal with a range of technologies not fully addressed in this report, but which would provide additional economic value to the area if exploited, such as air source and ground source heat pumps, for example.

Assuming then, that investors in the kinds of systems we've looked at in Table 4 meet the qualifying requirement of the three programmes and were compensated by ROCs, FITs and RHI/RHPP payments, or otherwise could sell their electricity to the national grid at wholesale prices, the potential economic values for the energy produced are shown in Table 5, below.

Table 5 – Potential value of current subsidies and wholesale prices.

	Potential installs	KWh	KWh/year	Total KWh/year	ROCs, FIT, RHI/RHPP	Export FIT, Whsle price	Total Value
Solar PV ¹	4990	2	1,600	7,984,000	£0.21/kWh	£0.03/kWh	£1,676,640
Solar thermal ²	4990	-	1,140	5,688,600	£300.00/system*		£1,497,000
Wind farm ³	2	2,300	5,843,000	11,686,000	£41.00/MWh	£49.00/MWh	£1,051,740
Wood/biomass ⁴	1875	-	7,500	14,062,500	£950.00/system*		£1,781,250
AD - gas ⁵	1	-	4,000,000	4,000,000	£0.07/kWh		£260,000
AD - electricity ⁵	1	-	4,000,000	4,000,000	£0.18/kWh		£716,000
Gasification ⁶	1	-	21,000,000	21,000,000		£49.00/MWh	£1,029,000
Sub-total potential for one-off payments*							£3,278,250
Sub-total potential for annual payments per year							£4,473,380

¹Assumes medium scale PV system on average.

²Assumes RHPP payment, good until March 2013.

³Assumes turbines working at 29% capacity, ROC plus wholesale

⁴Assumes domestic systems qualifying for RHPP with estimated consumption.

⁵Shows two scenarios, under RHI producing gas and FIT + export producing electricity.

⁶Apparently not subsidised at this time.

In addition to wholesale prices paid by electricity suppliers, these values represent payments from the government schemes to investors in these systems, which we assume for the moment are local, and therefore this represents potential economic value injected into the local economy.

For solar PV and wind turbines, the estimates are straightforward and assume current pricing. Solar thermal estimates reflect the RHPP payment, which is a one-off compensation for installation of a qualifying system, however solar thermal may also receive ongoing RHI payments for defined period, which will be known when the RHI programme is full delivered.

The assumption for wood fuel is highly speculative. The value is based on the RHPP rebate for installation of a qualifying system which would be available to homes not currently on gas mains. We assume, based on the South Hams Housing Condition Survey referred to in the Retrofit section, that the number of homes in T&D that meet this criteria would be around 3,750. However, it's probable that many of these already have a wood fuel system of some type, perhaps a stove, that would inhibit investment in a new, RHI compliant system. It's also probable that many who would invest in a renewable wood fuel system would still opt for less expensive wood or pellet stoves, rather than a biomass boiler. However, we'll assume for this exercise that a generous half of these, or 1,875, could host an RHI compliant wood fuel or biomass system. Further assuming that roughly 7MWh/year is required to heat an average efficient home, we arrive at a potential wood fuel consumption level of 14,062MWh/year.

Finally, the assumptions for anaerobic digestion offer two sets of values based on production of gas or electricity. Given the theoretical nature of that assumption set, it's possible that a system, or systems, could be configured to derive more or less compensation from either programme, or both. Advanced thermal processing of solid waste, such as gasification, may not qualify under either scheme, but could produce relatively clean and renewable electricity from the solid waste stream, selling it into the national grid.

Let's return to the question of wood fuel heating for a moment. If 1,875 new wood fuel systems operating at 80% efficiency consumed 14,062MWh per year, that would be more than double the fuel T&D could produce, and half of what the entire South Hams could produce given our assumptions. At current prices, as mentioned above, wood chips and wood pellets cost between £100-200/tonne. If the local area can produce about 2,100 tonnes of wood fuel, that could be worth between £210,000 and £419,000, or roughly between 3p-4p/kWh.¹² But the remaining demand would have to be satisfied from outside the area. That's based on current woodland and forest cover estimates. This resource could be planted out to increase supply, however it suggests that wood fuel can only provide a fraction of the area's needs at current consumption levels.

(For a more thorough analysis on this question, see "Can Totnes Feed Itself", Rob Hopkins, Mark Thurstain-Goodwin and Simon Fairlie, 2010, <http://transitionculture.org/wp-content/uploads/cantotnesfeeditself1.pdf> and also an analysis of wood as a fuel by Rob Hopkins <http://transitionculture.org/2008/05/19/is-burning-wood-really-a-long-term-energy-descent-strategy/>.)

We estimate that current government subsidies and incentives relevant to our local RE assets is worth around £3.3m in one off payments, plus £4.5m in annual payments including sale of the energy at wholesale prices.

¹² "Fuel costs per kWh", Biomass Energy Centre, http://www.biomassenergycentre.org.uk/portal/page?_pageid=75,59188&_dad=portal

WHAT COULD IT COST TO DEVELOP THIS POTENTIAL?

We’ve outlined above the potential value of developing local supplies of electricity and heating from renewable energy technology. We’ve seen what this might be worth compared with current costs for electricity and gas from the national grid. We’ve also looked at what the potential value of the renewable energy generated locally could be worth, in terms of government subsidies available to renewable energy generators, as well as the value of that energy sold back into the grid. But what would it take to build the infrastructure?

The Energy Savings Trust provides some guidelines for solar PV and solar thermal costs. For solar PV, current industry norms are around £2,000 – £2,500 per kWh installed, depending on size of the project, technology deployed, etc. For solar thermal, an average system would cost about £4,800 installed, according to the Energy Savings Trust. The estimated cost for developing the wind farm at Luscombe Cross would run about 6.5 million, including road access, site preparations, etc.

The estimated costs for wood and pellet stoves, as well as biomass boilers, come from the Energy Savings Trust. If 3,750 homes would potentially invest in wood fuel or biomass heating systems, it’s likely that some, as many have already done, would opt for less expensive wood stoves or pellet stoves, neither of which would fall into the RHPP or RHI programme. While wood or pellet stoves run in the area of £4,000 installed, a biomass boiler for the average home will cost about £11,500. We’re talking about potential, so we’ll assume investment in RHI compliant wood fuel or biomass boilers. Finally, the costs for AD and gasification plants are ballpark estimates based on industry sources and are presented here purely for indicative purposes. See Table 6 below.

Table 6 – Estimated development and installation costs.

	Potential Installs	KWh	Equipment & Installation/unit	Equipment & Installation Total
Solar PV ¹	4990	2	£5,000	£24,950,000
Solar thermal ²	4990	-	£4,800	£23,952,000
Wind farm ³	1	4,600	£6,500,000	£6,500,000
Wood/Biomass boiler ⁴	1875	-	£11,500	£21,562,500
AD ⁵	1	350	£3,000,000	£3,000,000
Gasification ⁶	1	500	£5,000,000	£5,000,000
Total potential value equipment & installation				£84,964,500
¹ Assumes medium scale PV system on average, £2500/kWh installed.				
² Average cost from Energy Savings Trust				
³ One wind farm, 2 2.3MW turbines, estimate from TRESOC				
⁴ Assumes average cost/installed unit cost, from Energy Savings Trust				
⁵ Figure includes feedstock handling equipment.				
⁶ Includes feedstock handling.				

According to our estimates, approximately £75.4 million would be required to build the renewable energy infrastructure we’ve discussed above. Some of this investment would go toward the purchase of materials, equipment and expertise not locally available. However, a good portion of these costs could be captured by local firms involved in installation, engineering, woodland management, feedstock handling, etc. We’ll discuss these opportunities in more detail below.

We estimate that developing our renewable energy assets would cost around £85m

C. OUR LOCAL RENEWABLES INDUSTRY

WHAT BUSINESSES ARE CURRENTLY OPERATING IN THIS SECTOR?

The renewable energy industry is, roughly speaking, comprised of manufacturers, installers and other service providers, and developers or financial investors. There are virtually no manufacturers of renewable energy systems in the T&D area, although there is at least one company developing a small scale renewable energy system. Solar PV panels, inverters and other components are manufactured far outside the area, and much of the kit comes from manufacturers outside the UK. The same is true for wind turbines, biomass boilers, and other systems.

There are, however, several local firms engaged in installation and other services. The Microgeneration Certification Scheme lists over 120 certified installers of PV, solar thermal, and ground source heat pumps within a 30 mile radius. There are 3 listed within Totnes itself. It is also known that there are additional installers not listed on the MCS site but are located within T&D, such as Totnes Solar and Beco Solar. These firms tend to be small; however Beco Solar was recently acquired by Kier, a £2.2bn engineering company. Overall employment figures are not known.

Given the changes to the FIT, uncertainty about government support going forward, and the potential effects of the Green Deal and Renewable Heat Incentive, this segment of the industry looks poised for change. It seems likely that expansion and consolidation would be strong possibilities for this sector.

On the investment and development front there is one community-owned company in T&D. TRESOC¹³, the Totnes Renewable Energy Society, is an Industrial and Provident Society (IPS) with shares owned by members of the local community. Their mission is to invest in renewable energy projects that benefit the community. Returns are distributed to community owners, as well as to development partners, depending on the project. TRESOC is behind the Totnes Community Wind Farm Project to be located at Luscombe Cross, near Harbertonford. They are also looking to invest in a range of projects including solar PV, AD, and micro-hydro.

WHAT'S THE POTENTIAL FOR GROWTH?

The potential for renewable energy in the T&D area is mostly unrealised. Only a small fraction of rooftops have been fitted with solar PV and an even smaller proportion with solar thermal. The T&D area holds the potential for at least one commercial wind farm with one project ready to be developed, as mentioned above, but awaiting planning approval. Similarly, the potential for domestic biomass systems is relatively untapped, and there are no AD systems online. The energy potential of surrounding woodland remains available in theory, but the potential locked into the MSW and commercial waste streams is currently, well, going to waste.

The availability of financing/investment, qualified installation and consulting firms, and customer education will be important factors in the development of this sector going forward. Government incentives are poised to stimulate demand. Until recently, the growth of the solar PV industry has been unsustainable, driven by a (perhaps overly) generous FIT. Recent government mishandling of consultations concerning FIT revisions has led to a slowdown of installations as the market readjusts expectations, causing problems for installers which are typically small companies vulnerable to dramatic market shocks.

¹³ Totnes Renewable Energy Society <http://www.tresoc.co.uk/>

The Green Deal, when it is introduced later this year or early next year, may provide funding options for domestic PV installations. Anticipation of this programme is inducing some potential PV customers to remain on the sidelines, at the moment. These factors are dampening demand, but it seems that once the programmes are fully in play, the FIT and new potential funding options will have a positive effect.

Demand for other domestic systems, such as wood fuel boilers and solar thermal could also see a boost from the Phase 2 RHPP and RHI schemes. Similarly, these schemes may provide the needed financial incentive to bring commercial scale systems online. Community-owned firms, such as TRESOC, can provide funding for these kinds of projects, as they have done for the community wind farm project, and are looking for other investment opportunities. There may be further opportunities to develop community-based models, such as TRESOC, to provide the financial resources required to build our local renewable energy capacity.

If this industry were to expand, demand for qualified workers would likely increase. In order for systems covered by FIT and RHI to meet criteria, installations would have to be completed by workers or firms certified under Microgeneration Certification Scheme, Solar Keymark, or other schemes. Local organisations, such as South Devon College, which offer training, seem well positioned to support the needs of expanding local firms with qualified workers and apprentices.

Finally, if this industry were to realise its potential, customers must be sufficiently informed and motivated. Given the nature of the benefits, both in financial and comfort terms, the key remaining factor is communications. But the current state of complicated and confusing government incentive programmes has created corresponding levels of hesitation and uncertainty in the market that must be clarified and overcome. Campaigns to communicate the workings and benefits of government-sponsored incentive programmes could play a vital role in supporting the growth of the local industry.

D. WHAT ARE THE POTENTIAL BENEFITS?

ON OUR ECONOMY AND JOBS

Intuitively, we know that the transition from a fossil fuel powered economy to a clean and renewable energy economy could provide enormous benefits to our local economy. There is always opportunity in change. But we can begin to form a picture of what the economic value of this change might be by looking at some of the estimates we've already developed above.

We calculated the potential value of locally generated energy in terms of current retail prices for grid-based electricity and gas – these payments that currently leave the local economy bound for the accounts of the Big Six and other power suppliers, some of which would be recaptured through local generation (e.g. the energy that a household gets for free when it uses its own solar PV energy directly).

We also calculated the potential value of payments coming into the local economy from government incentive programmes, such as FIT and RHI. Combining the potential savings with FIT and RHI/RHPP payments, as shown in Table 7, we can see part of this economic benefit strictly in terms of energy provisioning at current prices/payments.

ECONOMIC BLUEPRINT FOR TOTNES & DISTRICT: OUR RENEWABLE ENERGY SECTOR

Table 7 – Snapshot of combined economic value of retail grid savings plus inflows of annual subsidies, whole sale energy sales, and one-time RHPP equipment rebates.

	Grid Savings or Local Fuel Source	Subsidy or Market Price	Totals
Solar PV ¹	£562,872	£1,676,640	£2,239,512
Solar thermal	£227,544	£1,497,000*	£1,724,544
Wind farm		£1,051,740	£1,051,740
Wood fuel ²	£315,000	£1,781,250*	£2,096,250
AD2	£160,000	£976,000	£1,136,000
Gasification		£1,029,000	£1,029,000
Sub-totals (one off)*		£3,278,250	£3,278,250
Sub-totals (annual)	£1,265,416	£4,733,380	£5,998,796
Totals	£1,265,416	£8,011,630	£9,277,046

1Assumes half of energy is consumed locally, half fed into the grid at FIT rates.

2Assumes local source for pellets and chips, 50/50. Also RHPP rebate, but does not include potential ongoing RHI payments.

This reordering of the economic energy regime would inevitably boost direct employment, as well as benefiting the rest of the local economy through local multiplier effects. In the case of solar PV, households will enjoy lower energy costs over all, with savings (or income) which will find its way back to the local economy. Those who install solar thermal will enjoy a subsidy to defray the cost of the system and enjoy lower energy costs associated with water usage. Members of TRESOC will gain returns on their investment in the Totnes Community Wind Farm and may reinvest those returns in additional projects or spend that money locally.

Households who shift from high cost heating to wood fuel heating will have the initial costs of their systems offset, in part, by RHPP subsidies, but then their spending will go primarily to local sources. Local investors in AD and gasification plants – there are no plans on the table, at the moment, but could theoretically be developed by TRESOC or another community-owned company – would see good returns and potentially reinvest or spend locally. Those types of plants may be designed as combined heat and power (CHP), thus providing heat locally, as well, the positive economic impacts of which we have not otherwise considered here.

Finally, much of this economic value, such as ROC, FIT and RHI represent ongoing annual subsidies that, although will eventually be reduced, provide good financial incentives for the next 10-25 years, depending on the system. Meanwhile, the long term trend for wholesale prices is rising. These numbers are obviously speculative, but the potential local economic benefits are clearly significant. And the cumulative investing, spending and saving will translate into direct employment locally in the sector, as well as employment elsewhere in the economy.

The money that local people could save on their energy bills, or that businesses could earn from selling fuel like wood adds up to around £1.3m per year. Plus the income they would get from the subsidies brings in another £3.3m as a one off, with another £4.7m per year. Local multiplier effects will increase the value to our local economy even further.

Employment across the range of technologies we have examined would generally break down into installation and construction jobs, and ongoing operations and maintenance jobs. There can be no single, simple multiplier to determine employment effects of this renewable energy potential in our local economy. However, there are studies from which we might borrow multipliers that give a glimpse into potential job creation benefits.

According to a survey of studies led by a team at UC Berkeley¹⁴, potential full time equivalent construction and installation jobs per installed MW can be as high as 37 for solar PV and 11 for wind turbines, with lower levels of ongoing employment for maintenance and operations.

We've estimated potential installation of nearly 10MW of residential solar PV, so the number of potential jobs in this area could be in the hundreds. There would be few if any manufacturing jobs here in the short run, due to the fact that the systems and related components we've discussed are not made locally.

Developing biomass potential, especially in dealing with waste streams, would lead to relatively higher jobs on an ongoing basis than the other renewables we've discussed. Some installations will require investment in additional energy efficiency measures in order to comply with incentive schemes, so adding further economic value to the Energy Retrofit sector.

ON SOCIAL AND ENVIRONMENTAL FACTORS

With a cleaner, greener economy come a host of benefits, some of which are difficult to quantify. Because there are clearly defined statutory commitments to both CO2 reductions and contributions from renewable energy generation, meeting these objectives means that we have met the legal commitments we've made as a society. A transition to a renewable energy based economy, the potential of which we've outlined above, would lead to a dramatic reduction of green house gas emissions.

Current estimates provided by DECC show total CO2 emission per capita in T&D are around 7.9 tonnes/year, or about 189,000 tonnes/year for the entire district. In contrast, using figures in the DARE report, the renewable energy systems outlined here could represent a reduction of about 12,350 tonnes/year or 7% (clearly this reduction % is much higher if we just look at the emissions relating to home heating and electricity).

There may be additional benefits in terms of wellbeing. More people would enjoy meaningful livelihoods in a growing sector of the economy. Many homes could become warmer and more comfortable, their occupants enjoying better health as a result. People might feel less worried about the future knowing that they are part of the solution. Being more energy self-reliant makes the community more resilient, too.

Sustainably managed woodland may help protect local biodiversity. Raised awareness about clean and renewable energy might have knock on effects with other attitudes and behaviours changing. Establishing a leading renewable energy strategy might boost eco-tourism, as well as educational visits from professionals and government leaders from elsewhere.

¹⁴ Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the US?, Max Wei, Shana Patadia, Daniel M. Kammen, http://rael.berkeley.edu/sites/default/files/WeiPatadiaKammen_CleanEnergyJobs_EPolicy2010.pdf

E. GROWING THE LOCAL RENEWABLES SECTOR

PROPOSED APPROACH, PROJECTS AND ACTIVITIES

The benefits of transitioning from an old, dirty energy regime, to a clean and renewable energy economy are clear – more jobs, more wealth retained and spent locally, a healthier environment, obligations to reduce carbon emissions met, and so on. The path seems clear, too. We have some local firms poised to do the work and there are government incentives ready to lend support.

What kinds of things can we do to help accelerate this transition and boost our local industry?

Engage local firms

- Provide a forum for bringing local professionals together for learning and networking. Could be same group as for the retrofit network. (Needs funding/resource.)
- Help this network to create a programme that primarily supports local firms and workers for local projects - a collaboration between local installers to grow the market together. Support them with raising awareness and creating demand - see below. (Needs funding/resource.)

Research

- Collect data on actual installed capacity and provide a simple means to keep this current, i.e. work with local installers to provide this info then maintain it themselves. (Needs funding/resource.)
- Undertake a feasibility study investigating all current financing options for RE installations for householders and public and private bodies. Informs possible follow-on work to ensure the options are available locally. (Needs funding/resource.)
- Undertake a feasibility study investigating a community-owned biomass/wood fuel scheme. (Needs funding/resource.)

Planning

- Work with South Hams District Council to review their planning process, for example, to provide fast track priority for renewable energy projects, with a presumption of approval.

Promote demand

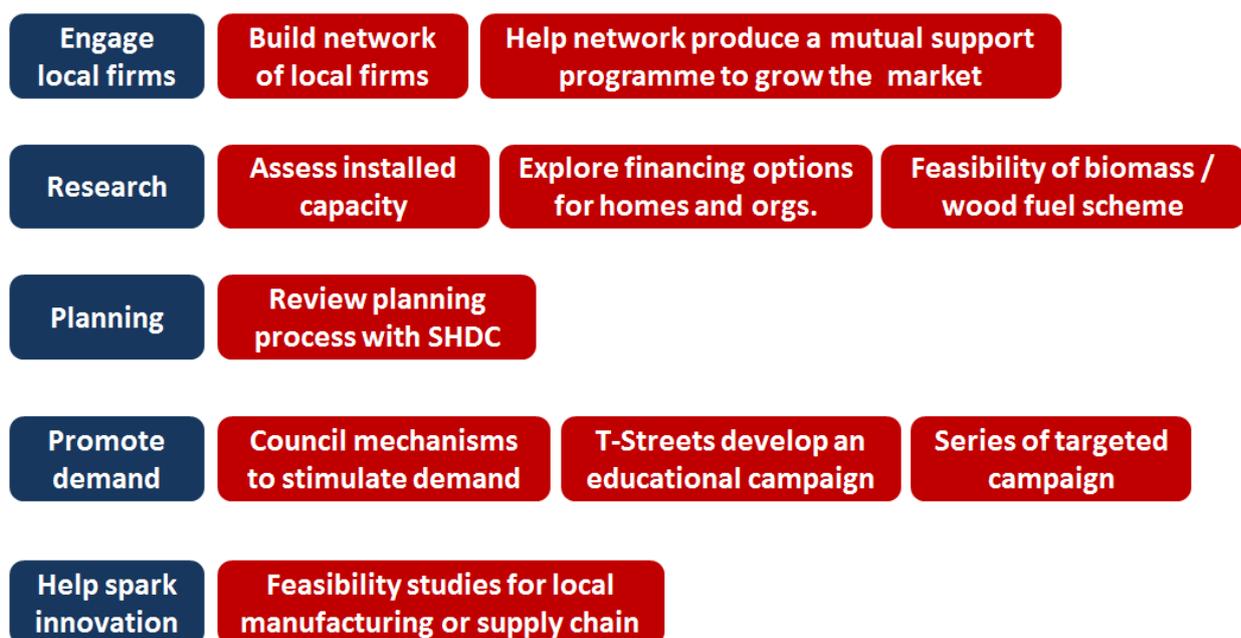
- Research mechanisms to help stimulate demand, for example, SHDC offer reduction in business rates for landlords who install solar PV, or planning requires all new homes and new commercial buildings to include one or more renewable energy systems. (Needs funding/resource.)
- Work with Transition Streets to develop an educational campaign for householders that clearly lays out the pros and cons of RE, including the rebates and subsidies and options for financing the balance. (Needs funding/resource.)
- Define a number of campaigns that focus on 'best' RE technology and household/commercial potential e.g. develop a wood fuel campaign targeting Follaton Estate, develop a campaign to fit publicly owned buildings with PV. (Needs funding/resource.)

Help spark innovation

- Work with local manufacturers and colleges/universities to study feasible manufacturing and supply chain provisioning opportunities. (Needs funding/resource.)

All of the above projects have been considered by the REconomy Forum partners, and priorities have been suggested to help give clarity on where to focus our efforts, including fundraising. A summary is provided in Figure 2, with a traffic light system of red (not yet started), amber (partially underway) or green (fully underway) used to show current status. The priority projects, along with those from the other areas of this work, have been put onto a timeline that reflects what will happen when, any dependencies and who is responsible. The latest version of this plan will be available on the TTT website.

Figure 2 Summary of proposed projects for next 3 years, and current status shown by traffic light colours.



INDICATORS

How will we know if the economy is changing in the desired way? We suggest that a small number of indicators need to be defined, and then monitored long-term. Defining these in more detail is not within the scope of this work, but this will be picked up by the team who takes this work forward as a priority action and in association, we hope, with credible academic partners who can help provide appropriate process and rigour. This work will include providing baselines for each indicator, building on the work in this report.

Suggested indicators include:

- % local energy spend of total
- # energy-related jobs
- Energy-related skills profile
- % of viable energy-assets in production (on kWh basis)
- # tonnes carbon saved due to installed RE capacity

RENEWABLES PARTNERS, ORGANISATIONS AND LINKS

- Centre for Sustainable Energy - www.cse.org.uk
- Energy Action Devon - www.energyactiondevon.org.uk/
- Microgeneration Certification Scheme - www.microgenerationcertification.org
- Our Solar Future - www.oursolarfuture.org.uk
- Planning for Climate Change - www.planningforclimatechange.org.uk/renewables/
- REGEN SW Policy planners tool kit - www.swplanners-toolkit.co.uk
- Renewables UK - www.bwea.com
- South West Wood Shed - www.southwestwoodshed.co.uk
- TRESOC – www.tresoc.co.uk
- Yokk Solar – www.yokk-solar.co.uk
- You Gen - www.yougen.co.uk

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