Havant Borough Council

Feasibility of an Energy and Climate Change Strategy for Urban South Hampshire

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Executive Summary

The Partnership for Urban South Hampshire (PUSH) has commissioned Arup to advice on the feasibility of an energy strategy for the sub region.

An underlying vision of how South Hampshire might look in terms of energy in 2026 is presented based on achieving a "local stewardship" approach to meeting the severe challenges ahead. This vision is presented as a contrast to the intensive use of energy and resources that characterise the current use of energy. A fundamental assumption is that "business as usual" is not an option for a future dominated by scarcity and climate change.

The approach adopted focuses on reducing the carbon content of supplies as a means of meeting both these concerns. Low carbon reduces the call on fossil fuels helping to bring down emissions under scientifically "safe" limits whilst simultaneously reducing dependency on fuels that are increasingly expensive and "at risk".

The first task has been to establish an evidence base using official statistics to create a baseline for the South Hampshire area to understand how energy is consumed by different users within the area. The baseline has allowed carbon dioxide emissions to be calculated using official conversion factors.

The study then considers what the magnitude of emissions would be if nothing happened and trends continued aligned to past performance. This step allows the anticipation of expected growth in emissions to be factored into the reduction strategy.

Targeting frameworks are then reviewed identifying current and pending reduction targets together with a risk assessment on the likelihood of new reductions (currently under review by Adair Turner's Climate Change Commission). A key issue for South Hampshire is the speed at which this sub region wants to reduce its emissions.

Total emissions are then broken down into manageable chunks called "wedges" which balance technical achievability against economic acceptability. The measures cover new development as well as the existing building stock. The majority of the potential for securing reductions does, however, originate in the existing building stock. The relative "speed" of reduction is dependent upon the pricing and tax frameworks established by government. Escalating costs of fossil fuels and the pricing of carbon will make it more likely that the pace of change can be quickened without disadvantaging South Hampshire in relation to other areas. The wedges identified above include;

- Greening the Grid;
- Code for Sustainable Homes
- Code for Sustainable Business
- Retrofitting Demand Reduction Measures to the Existing Housing Stock;
- Retrofitting Demand Reduction Measures to the Existing Non Domestic Stock;
- Implementing the Defra Waste Strategy Targets for Recycling;
- Applying Decentralised Generation to Existing Urban Areas;
- Traffic Measures and Demand Management;
- National and EU Measures.

The study has considered that South Hampshire is a low density urban area making constraints for the exploitation of wind power[1]. Significant potential exists for the exploitation of biomass but this will rely on bringing supplies from outside the area. Utilisation of biomass has to be balanced with the need for food production and the viability of collecting/

[1] Modifications to the South East Plan has resulted in the removal of sub regional specific policy targets contained in Policy SH14. PUSH are considering their response to this modification.

processing the low energy density feedstock. This section reviews potential renewable options capable of contributing to South Hampshire's development of renewable energy. A risk is that the adoption of a European Commission proposal for a 20% renewables target across electricity, heat and transport will require a substantial upward revision in the target at a future review.

The study also investigates the risks connected with the strategy many of which relate to uncertainties over the financial viability of measures. Potential solutions move through a development "pipeline" from initial R&D through to technical viability and, economic exploitation. A number of technical solutions exist but have not progressed to the market because of their financial payback. However, payback calculations change as fossil fuels become more expensive. Renewable options are also analysed in terms of their delivery risk and, this again reveals local risks associated with the location of plant to the longer term security of biomass supplies in what is likely to be a highly competitive market.

Under the emergent strategic themes section, a framework for managing the implications of the strategy is presented. The framework has four objectives supported by four enablers. The four objectives are concerned with the creation of:

- "Resilient Places";
- "Resilient Networks";
- "Informed Choices"; and
- "Culture Change".

The four enablers needed to progress the objectives are: "Leadership"; "Skills"; "Finance"; and "Enterprise."

Recommendations

1	**Adopt the carbon dioxide reduction targets shown in Chapter 4 as an overall indicative guide to assess progress. Over the medium and longer term a move towards attaching a greater weighting to carbon dioxide reduction targets allowing flexibility for how reductions are to be met over a period of likely significant technological change.**
2	**The renewable resource assessment in Chapter 6 demonstrates a technical resource potential. Some of this technical capacity will be realised through dedicated new capacity (e.g. a wind farm), however new development is likely to be a major stimulus to the creation of new capacity either in the form of a dedicated facility or embedded in new development itself. It is, therefore, recommended that the indicative targets contained in Chapter 6 should be a guide subject to considerations of economic viability.**
3	**Establish a theme group within PUSH to provide strategic "leadership" but ensure actions are networked across all theme groups. Strategic leadership must not be seen solely as a planning issue and, therefore, must secure corporate ownership.**
4	**Consider incorporating the framework detailed in Section 7 as a basis for Local Strategic Partnerships to approach the management of energy issues in their areas through the Sustainable Community Strategies.**
5	**Agree the need for a procurement strategy for the establishment of an Energy Services Company to deliver outcomes consistent with the PUSH targets[2].**
6	**Review current economic development and skills strategies to establish additional**

[2] Modifications to the South East Plan has resulted in the removal of sub regional specific policy targets contained in Policy SH14. PUSH are considering their response to this modification.

	policies/ measures needed to meet challenges outline in Section 7.
7	**Incorporate energy infrastructure into the sub region's approach to delivering new infrastructure including the use of publicly owned property assets and revenue streams.**
8	**Integrate energy infrastructure needs assessment into future district based infrastructure assessments used to support tariff, S106 or future Community Infrastructure Levy policies and make explicit any trade offs between improved carbon performance and other types of infrastructure.**
9	**Develop a capacity building programme to support the strategic leadership role on energy and carbon reduction including members, public officials and business leaders.**
10	**Ensure that a balanced membership supports the strategic function within South Hampshire representing business and the professions**
11	**The existing housing stock needs to be substantially improved.** **Assess scope for the Local Housing Authorities to work with the Energy Supply Sector to collectively deliver Carbon Emission Reduction Targets and a possible renewable heat obligation.** **Target areas where the public or third sector (RSL) has a significant control to evaluate options for applying site wide low carbon infrastructure.** **Support the development the extension of equity release as a means of releasing capital to fund energy efficiency improvements to the existing stock against a sustainable asset base.** **Ensure housing officers/ Regional Social Landlords are represented on the strategic function within PUSH.**
12	**Commission master planning of the two Strategic Development Areas and the Urban Extensions to deliver exemplar low carbon communities. Consider piloting flexible energy from waste and biomass generation and high quality public transport links.**
13.	**Consider the use of multi area agreements at the level of South Hampshire to take forward actions in the strategy as an extension to the pre existing LAA.**
14.	**Establish a common monitoring framework across South Hampshire for the collection of data on new installed capacity and performance.**
15	**Engage marketing expertise to reach disengaged segments of the population to seek views on potential solutions and encourage changes in behaviour (development of the local stewardship approach).**
16	**Create a strategic link with work undertaken to adapt South Hampshire to unavoidable effects of climate change. Undertake an early review/ assessment of the revised effect scenarios under preparation by the UK Climate Change Impact Programme.**
17	**Integrate energy issues into emergency planning in relation to climate change adaptation and other forms of threat which may disrupt supply into South Hampshire over the next twenty years.**
18	**Work with the North Hampshire authorities to establishes ways in which the South can capitalise on the potential biomass supply base in rural areas.**
19	**Use green procurement as the principle means of shaping behaviour towards energy use among small businesses.**
20.	**Consider scoping an evidence base monitoring system integrated with infrastructure planning to manage this agenda.**

21.	**Work with energy suppliers and transport planners to resilience proof critical infrastructure to protect against extreme weather events and other risks including access to these facilities.**
22.	**Use the network of existing energy from waste plants as hubs for supplying energy need including heat capture.**
23	**Ensure that the South Hampshire Energy Strategy is aligned with the Transport for South Hampshire (TfSH) Reduce Strategy by supporting measures that reduce the overall demand for travel and encourage a greater proportion of journeys by means other than the private motor car.**

Sustainable South Hampshire – A Vision for 2026

Stern (2006) highlights that the opportunities to abate transport emissions are likely to be limited until after 2050. Reconciling the need for mobility to sustain economic growth with a persistent source of emissions and the rapid escalation in the cost of mobility will be a consistent theme for South Hampshire in the lead up to 2026.

Minimising the need to travel will have led South Hampshire's development to follow a compact model based on higher density, mixed use higher density urban development of centred on public transport nodes. This style of development reduces transport fuel consumption without designing in future excessive cooling demand needed to deal with unavoidable climate change.

By 2026, South Hampshire has moved towards becoming a dual city region where its identity is derived from its constituent communities each of which follow the compact urban design principles. Communities such as Gosport, Fareham, Havant and Eastleigh will become centres offering jobs, living space and shopping opportunities to their communities along with Portsmouth and Southampton.

The definition of community will not remain static. Communities will compete with one another for advantage in terms of new investment and residents. The ability to offer cost competitive energy supply will be a key form of advantage to attract both business and residents in 2026.

Regeneration activities increasingly become focused on assembling land to enable new low carbon development or public transportation links to happen. South Hampshire will have also taken steps to establish new centres where the costs of retrofitting the compact model are excessive. Each of these centres contain a significant amount of space given over to green spaces and parks which help break up the urban heat island effects that would otherwise occur. This becomes increasingly important as extreme heat waves become common place.

People and business will secure a significant share of their electricity, cooling and heating requirements from decentralised generation including combined cooling, heat and power (CCHP) networks where heat demand and supply can be matched. People now consider connection to be an advantage given the escalating costs of fossil fuel energy. The economics of these networks will be founded on the stable heat/ cooling loads arising from public and commercial buildings in centres. Over the period, the fuel used in CHP networks will be natural gas however there will be a diversification of the fuel mix to include bio-methane.

The urban fringe areas of these communities become important resources for the future of South Hampshire offering the most economical sites for the processing of biomass crops purchased through long term contracts developed with rural Hampshire to secure supplies. South Hampshire uses planning powers to protect the viability of these locations from encroachment.

Each community also maintains a supply of sites separated from the main centres for burgeoning new businesses concerned with collecting, sorting, recycling and reusing products. A renaissance takes place in the local economy where skills previously deployed in converting primary materials into products are used to extend the life of existing goods. More people in South Hampshire now have to make do and extend the life of products that would have been taken to landfill in previous years. People with the skills to extend the life of consumer durables are valued members of their community. New businesses also emerge to broker second hand goods between suppliers and the market some of which will be mediated by the internet. The need to extend the life of products, will also feed into product design with a greater emphasis on inter operability.

The labour market will have adapted to changing circumstances. The workforce will have become much more sensitised to commuting costs when taking jobs. The notion of the workplace will become more diffuse as businesses use information technology to enable people to work from a variety of locations including worker's home or business "hotels" (shared service locations used by multiple businesses) for meetings/ workspace. These locations will require linkage to high capacity broadband facilities.

This will be symbolic of a larger progression, in which South Hampshire will confirm the step from a successful industrial society to a connected network society from which South Hampshire will secure its place in the global knowledge economy. This will be fostered through the establishment of advanced information communication technologies (ICT). ICT networks will be the basis of social structures, environmental monitoring and economic development. The power of cities will no longer be confined to their spatial boundaries yet be fluent within global networks, it will be South Hampshire's accessibility and connectivity within this network society that will mark its status. South Hampshire will inevitability be better connected and the need for travel will be reduced, yet this will rest on securing high capacity ICT requirements.

After years of skills shortages in the production, installation and maintenance of low carbon technologies, South Hampshire now has an adequate supply of people with the correct skills.

The mix includes the use of micro generation solutions; South Hampshire has entered into a series of compacts with its rural hinterland to supply a mix of biomass into a network of bio refineries on the urban fringe areas. South Hampshire took an ethical stance of only using biomass supplies that have not been derived from food crops e.g. set aside and sustainably managed woodland. The compact also guarantees the conservation of key locations on strategic renewable power generation and storage to meet the sub region's needs.

Following changes in government legislation mandating home owners to upgrade the energy performance rating of their dwellings to the next level in the rating system, around 14% of existing homes are becoming increasingly efficient (based on turnover). Whilst initially unpopular, the rapidity of fossil fuel price inflation has led to increasing public acceptance of the measure. Implementation has provided a major stimulus to the sub region's construction sector leading to opportunities for redeployment from industries formally dependent upon the fossil fuels.

By 2026, South Hampshire has experienced more extreme weather events than ever experienced in living memory. Several severe heat waves led to the premature deaths of many elderly and sick people in older housing unsuited to dealing with excessive external temperatures. South Hampshire communities now offer special shelters to support the needs of the elderly and sick – community centres are fitted with state of the art low energy cooling based on heat exchanger technologies attached to CHP networks. A revamped "Decent Homes" strategy now focuses improvements on poorly performing older properties populated with vulnerable people.

South Hampshire has also invested in a sophisticated geographic information system linked into insurance systems that can record and predict areas of risk in the sub region. This system has highlighted areas of the sub region that have been continually affected by flash floods, ground stability and tornado damage. The insurance industry has long since "red lined" properties within these areas effectively denying occupiers insurance cover and making their properties unsellable. By 2026, South Hampshire has moved to relocate businesses and homes out of these areas and turn these over to green spaces. Areas with a lower probability of impact are subject to special measures enforced on property owners that limit householder's rights to cover garden areas with hard standings.

By 2026, South Hampshire will have established a series of special power zones for key business service and financial information companies in the sub region offering back up renewable supplies and power storage. These facilities offer a level of security and quality of supply to the sub region's key companies. The special power zones include the city centre plus a number of other centres in polycentric South Hampshire.

By 2026, South Hampshire will have come to terms with the need to limit the non essential use of energy especially at times when the wind is not blowing and the sun not shining. All local government buildings and essential infrastructure are fitted with smart metering and sensors that allow for real time management of energy consumption.

1 Introduction

Havant Borough Council has commissioned Arup on behalf of the Partnership for Urban South Hampshire (PUSH) to advise on the feasibility of an energy strategy for the sub region. The feasibility study was also to advise on the relationship between energy and carbon dioxide emissions with a view to developing a sub regional approach to climate change. This report represents our analysis of the prospects and priorities for a strategy to guide the development of South Hampshire over the next 20 years.

The Study Area

South Hampshire is defined as the following local authority administrative areas aggregated into a single area: Havant BC; Gosport BC; Southampton CC; Portsmouth CC; Eastleigh BC; Fareham BC; Test Valley BC (Part); East Hampshire BC (Part); Winchester CC (Part) and New Forest (Part). Certain districts are split into South Hampshire and the rest of Hampshire.

Key Assumptions

- *Human Complicity in Climate Change* – In their last report, the Intergovernmental Panel on Climate Change (IPCC) representing the views of the scientific community came down strongly in favour of supporting the idea that human activity was responsible for changing the climate. This document does not therefore propose to debate the existence of climate change or human's involvement in causing it. This agenda has been taken forward locally in the Climate Change Commission established by Hampshire County Council.
- *Mitigation and Adaptation* - This strategy accepts the scientifically derived view that reducing emissions can help stabilise the climate within a temperature range capable of avoiding run away climate change. Nevertheless, past industrialisation has already resulted in a level of emissions likely to trigger unavoidable climate change that requires action.
- *Fossil Fuel Depletion* - Whilst a consensus is still lacking on when demand will outstrip supply across a range of fossil fuels, most commentators do accept that a peaking of supply will happen. In the meantime, people will continue to debate the scale of remaining reserves and their exploitation potential.
- *Carbon Trading versus Tax or Regulation* – The UK government's preferred financial instrument for tackling climate change is the extension of emissions trading. A lack of consensus exists concerning the merits of emissions trading however no specific view is expressed within this document.

Our Approach

Our approach has combined both a top down and bottom up analysis based on seeking the active involvement of stakeholders in the development of South Hampshire's energy strategy. The findings incorporate the perspectives gained from a stakeholder workshop held on 24th January 2008.

As a primer for the feasibility study, Arup undertook a modelling exercise to identify how much energy was consumed by businesses and households in South Hampshire in 2006. Energy baselines were then converted to carbon dioxide emissions using accepted emissions factors and projected for a 20 year period to 2026 aligning with current growth targets set within the draft South East Plan. Carbon dioxide emissions have been adjusted to take account of waste and water usage. The projection accounted for both housing and employment growth over the 20 year period.

A review has been carried out of current climate change and energy policies that establish a framework for actions undertaken by South Hampshire. Key targets identified as a result of the review have been converted into key performance targets for South Hampshire. The conversion process required back casting carbon dioxide emissions to 1990 for the purpose of calculating the magnitude of emissions reductions needed to comply with national reduction strategies.

Having established the magnitude of carbon dioxide emissions reductions for South Hampshire, a combined assessment of the sub region and good practice has lead to the identification of strategies for the reduction of carbon dioxide emissions. These strategies have been expressed in terms of localised reduction “actions” that can grow in impact over a twenty year period to deliver an overall carbon reduction for the sub region.

Each “wedge” would require a quantum of either energy reduction or renewable power systems to realise the reduction identified. The feasibility of delivering the identified quantity of renewable power is assessed against the evidence used to generate existing sub regional renewable targets contained within the Regional Spatial Strategy and the more local assessments undertaken. An assessment has also been undertaken on the magnitude of renewable power generation appropriate within South Hampshire based on compliance with policy and good practice.

Based on a quantum of power systems capacity, recommendations are made in relation to how stakeholders in South Hampshire might best facilitate the creation of the new capacity over the next twenty years based on an assessment of good practice drawn from the UK.

Post 2026?

Whilst the focus of this study has been the next 20 years, many of the actions started during this period will need to be sustained beyond 2026 if real progress is to be achieved. Some key issues are yet to resolved, for example, whether the hydrogen economy should become a reality (see box).

Should South Hampshire Prepare for a Hydrogen Economy?

Hydrogen has been heralded as a solution to the fuels crisis especially for transport but also on a wider basis. Politically, it has received support from a number of quarters as a solution to energy security or climate change. Unlike oil, pure hydrogen does not occur naturally, it has to be made from another energy source. It is the choice of primary energy source and the conversion technology that ultimately determines whether it adds value to either of these objectives. The derivation of hydrogen from fossil fuels or nuclear fission creates a significant carbon footprint in its own right. Moreover, its low energy density by volume, means that the gas has to be either compressed or processed consuming further energy. The derivation of hydrogen through the electrolysis of water opens up the question as to why it is not better to use that electricity to charge the batteries of electric cars directly rather than incur the conversion losses. A decision to become a hydrogen economy would require a major shift in investment priorities towards creating a supply infrastructure for vehicles and urban areas. Interest has been expressed in viewing hydrogen as a replacement fuel for natural gas to be used in combined heat and power systems, this would potentially remove the need to create a “door to door” delivery infrastructure directly into individual homes and businesses.

2 South Hampshire's Energy and Carbon Dioxide Emissions in 2006

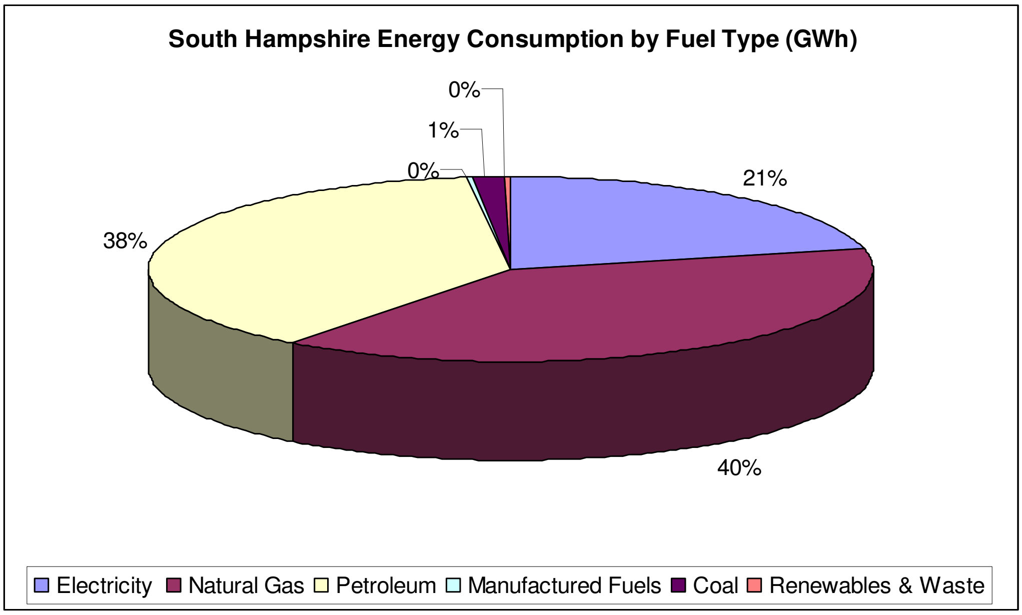
Establishing a Framework for Baseline Development

The establishment of a baseline position for South Hampshire's energy consumption and emissions in 2006 is based on available data and applying adjustments to represent "South Hampshire".

Figures for South Hampshire have been developed by aggregating local authority district data adjusted to take account of the share of population and employment for South Hampshire relative to the rest of Hampshire in districts split between the study area and the rest of the county. The 2006 baseline has been constructed by projecting available base data for 2004/5 forward. The approach to assessing South Hampshire's emissions has been to apply emission factors to the energy projections and adding in waste and water related emissions.

The analysis of energy consumption within South Hampshire reveals the following distribution between secondary fuel types:

Figure (1): South Hampshire's Energy Consumption by Fuel Type

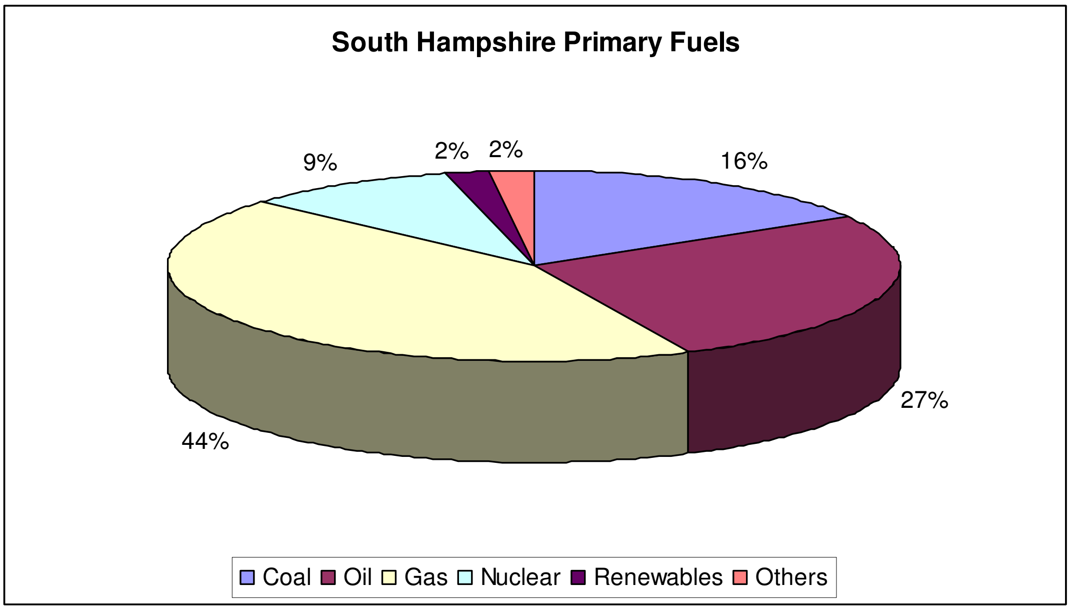


Currently, energy from renewables amounts to less than 1% whilst the majority of final consumption is accounted for by the consumption of fossil fuels. Just over a third of all energy consumption is accounted for by electricity.

Final energy consumption does not however expose the true extent of reliance on fossil fuels. Electricity consumption is itself supported by the combustion of a mix of different primary fuels which is then transmitted/ distributed to consumers in South Hampshire through the grid. The transformation process does, however, lose much of the energy content of the fuels used through the loss of heat and the transmission process. For every unit of electricity delivered to South Hampshire around two further units have been lost in the form of rejected heat and transmission.

Figure 2 shows the primary fuel mix supporting final consumption in South Hampshire. The analysis reveals the much greater role played by coal/nuclear in the supply of energy which is not indigenous but essential to supplying the needs of the sub region:

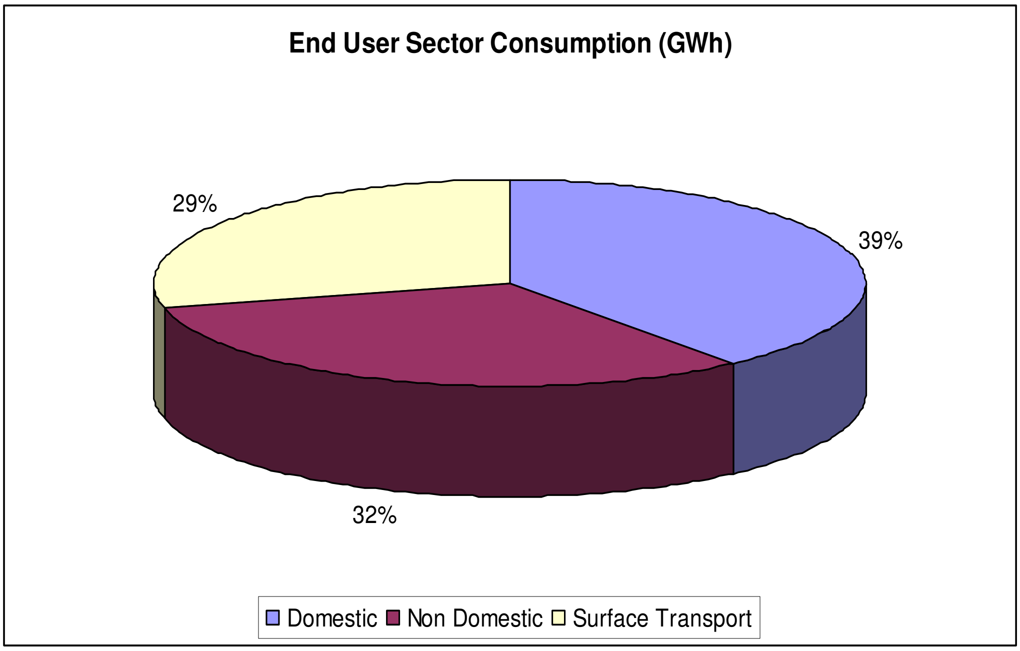
Figure 2: South Hampshire Primary Fuels Analysis



The implication for the sub region is that substituting grid based electricity with a renewable source of power production saves on the transmission efficiencies but also the extensive loss of thermal energy associated with a centralised power generation. Localised power generation also offers an opportunity to use heat generated in the process to supply space and domestic water heating. The efficiencies for power generation alone are, however, slightly lower.

The end user sectors for South Hampshire are described below:

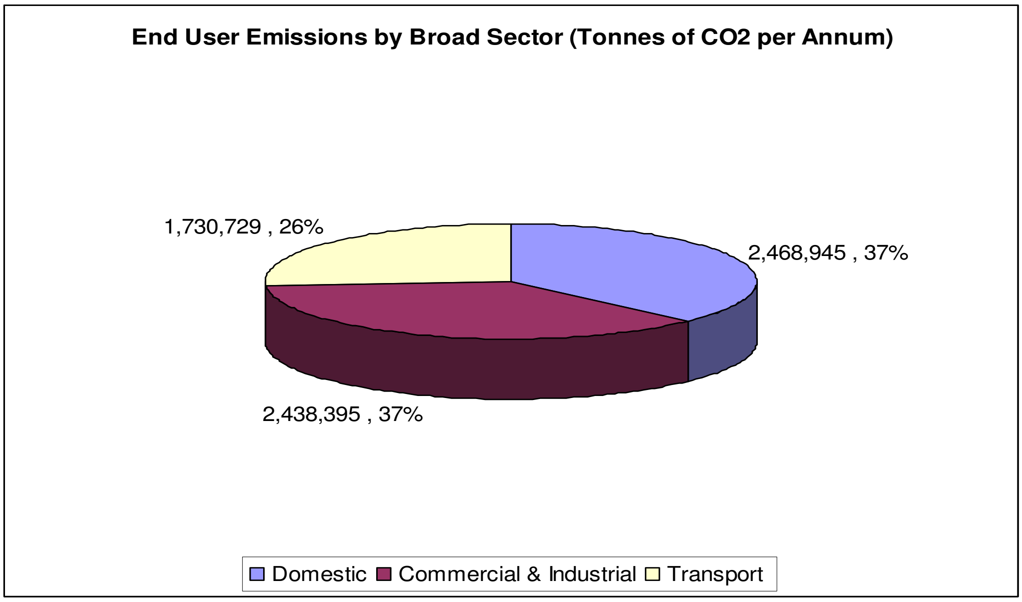
Figure 3: End User Sector Energy Consumption



South Hampshire has lost many of its carbon intensive industries so domestic use of energy accounts for the highest share of energy consumption followed by commercial/ industrial and surface transport.

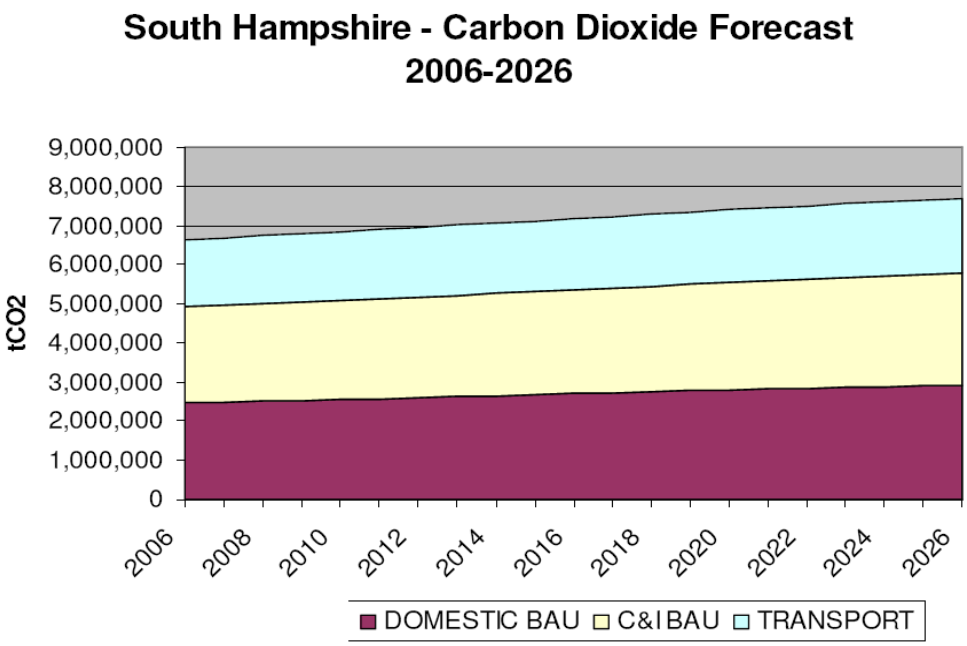
South Hampshire is responsible for 6.6 Million Tonnes of Emissions. For emissions, the higher carbon intensity of the commercial/ industrial sector result in an even split on emissions between domestic and commercial/ industrial. Based on this analysis, emissions per capita have been calculated at 6.7 tonnes of carbon dioxide.

Figure 4: End User Carbon Dioxide Emissions by Broad Sector



Emissions are projected to increase over the next twenty years based on extending trend line performance for the major sectors of use.

Figure 5: Forecast Growth in Carbon Dioxide Emissions over 20 Years



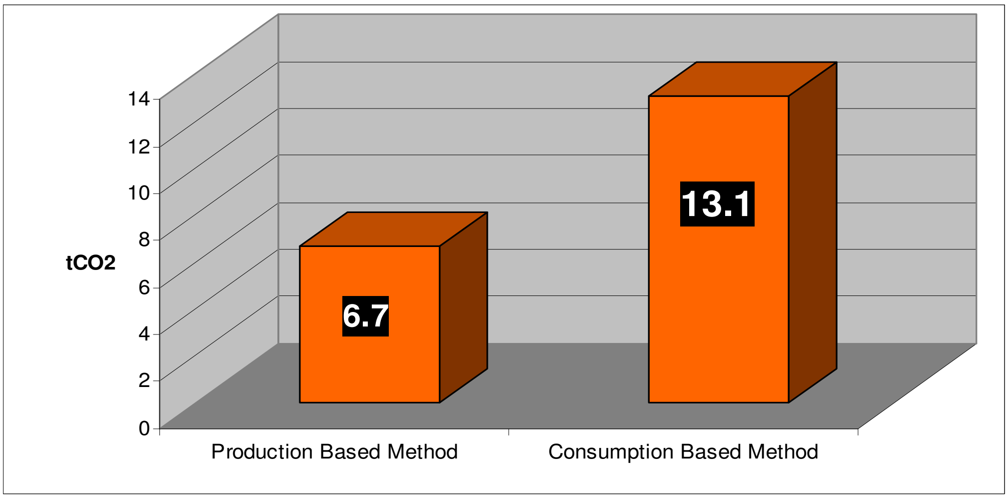
2.1 International Maritime and Aviation Emissions

International maritime and aviation emissions are excluded by virtue of their exclusion from the UK national emissions inventory which makes their inclusion potentially prejudicial to the interests of areas which happen to include ports or airports. An estimate of maritime and aviation emissions has been produced based on allocating emissions associated with sales from international fuel bunkers. Data from the Civil Aviation Authority (international departures) and the Department of Transport was obtained to determine South Hampshire's share of emissions. Maritime emissions have been calculated on the basis of Portsmouth and Southampton's presumed share of total maritime bunker emissions. Aviation emissions are based on Southampton's share of international departures. When combined, total emissions increase by 12% and account for 10% of South Hampshire's total emissions in 2006 (assumes constancy from 2005). Assuming that the volume of emissions remained unchecked or even increased due to anticipated future growth in traffic then these activities are likely to account for an increasing share of South Hampshire's total emissions over time.

2.2 Imported Goods and Services

The UK emissions inventory excludes emissions arising from goods and services produced outside the UK but consumed within it. On the basis of current conventions, the UK calculates that it is responsible for 2% of world emissions. The incorporation of imported goods and services is estimated to increase the UK's attributed emissions to 15% of the total. The Regional Emissions Assessment Programme (REAP) allows a holistic assessment of emissions based on total consumption. An average for the districts considered part of South Hampshire suggests that the area is probably responsible for slightly less than double the emissions derived from activities within its boundaries at 13.1 tonnes of carbon dioxide per capita (REAP, 2008).

Figure 6: Comparison of Methodologies for Calculating Carbon Emissions



3 Energy Supply in South Hampshire

Enough solar radiation reaches the ground to cover fifty two times the amount of energy consumed by South Hampshire over the course of a year. Assuming 55% of the developed surface areas[3] of the sub region were covered with photovoltaic panels, it might be possible to generate 1,140 GWh of power over the course of a year (equivalent to around 5% of the total requirement) taking into account system and area yield factors.

Whilst some of this naturally occurring solar energy is being used passively through natural solar gain in buildings, there are few examples of development using this naturally occurring resource where this is being used actively to generate power directly. A few innovative housing schemes mainly in the social sector have applied active technologies but they are very much in the minority.

Only a tiny fraction of solar energy is captured through photosynthesis that creates biomass (an estimated 7,250 GWh per annum or 0.64%[4] of Solar Energy incident upon gardens and green-space).

Added to solar is the flow of energy available from within the earth's core as a source of geothermal energy some of which is used to supply the Southampton district heating network.

In common with all developed societies, energy demand is currently met from stored biomass accumulated across geological timescales as fossilised plant and animal matter which provides high density fossilised solar energy. As localised deposits have been exhausted, the supply base has extended well beyond sub regional, regional and national boundaries.

Fossil Fuel Based Supply

Current energy needs are met by either delivering carbon based fuels to the sub region along with electricity through a set of fuel/ energy specific supply networks. The regulator Ofgem exercises regulatory control over gas and electricity transmission, distribution and supply companies.

Final consumers are free to purchase energy from a range of suppliers. Market forces drive the price that consumers pay. The forces and signals that control and influence the market are diverse. They range from international energy commodity prices to increases in demand for products driven by tax incentives or publicity. Decisions such as whether or not to install Combined Heat and Power and the level of investment in energy efficiency are made in the context of the energy market.

Oil

South Hampshire plays a significant role in the supply of fossil fuels both locally and nationally. The coastal geography of South Hampshire means that it has been an ideal location to land imported oil for processing into a variety of petroleum fuel products at the Fawley refinery complex.

Opened in 1921, the Fawley Oil Refinery occupies 3,250 acres with 330 tanks and storage vessels on site. There are 750 miles of pipes leading out of the site carrying ten million gallons of finished product (85% of the finished product leaves via pipelines). The refinery output supplies an estimated 1 in 5 cars in the UK. Around 2,300 oil tankers unload at Fawley around twenty million tonnes of crude oil every year. The plant consumes 125,000 gallons of cooling water every minute. Fawley produces petrol, diesel, jet fuel, heating oil and lubricating oil. It also produces the raw materials for a host of other products - from carpets to CDs; from toiletries to trainers.

[3] Based on the assumptions taken from the "Solar ElectriCity Guide"
[4] Boyle (2004) "Renewable Energy – Power for a Sustainable Future" shows that 0.64% of total solar energy is converted through photosynthesis

Electrical Generation

The Fawley area also hosts an associated heavy oil burning power station commissioned in 1969 and now owned by RWE Innogy Plc. This plant was mothballed, however a single turbine has been brought back into production (484MWe) to meet growing need (the remaining mothballed unit is 518 MWe).

In addition, Marchwood Power is building a new £400 million state-of-the-art natural gas combined cycle (CCGT) power plant (840 MW). Scottish and Southern Energy plc ("SSE") has entered into an agreement with ESBI (Ireland's ESB International) to acquire 50% of the shares in Marchwood Power Ltd, in anticipation of the construction of a new gas-fired power station near Southampton. When operational, SSE will supply all of the fuel for the power station and take from it all of the electricity generated. A 22 km long gas pipeline from Romsey to the Marchwood Power Station site has been installed to supply the fuel.

Power Distribution in South Hampshire

Responsibility for the distribution of power lies with the Southern Electric Power Distribution plc which is a wholly owned subsidiary of Scottish and Southern Energy plc. The company has responsibility for the area represented by South Hampshire and beyond. During the year 2006/7, the company distributed 33.9 TWh. The average number of minutes that customers in the Southern Electric Power Distribution area were without supply was 72 (1 minute more than the previous accounting year) and the number of interruptions was 76 compared to 78 in the previous year.

Waste to Energy

Our assessment of other sources of energy is drawn from the official datasets maintained by the Department for Business and Regulatory Reform (BERR). This dataset shows that the energy supply base includes landfill gas (30 MWe) and mass incineration of waste (30 MWe).

Under Project Integra, an agreement has been entered into with Hampshire Waste Services who have built a new generation energy from waste incinerator on the waterside near Marchwood, Southampton. Forming an important part of the integrated waste strategy for the county in disposing of those materials left over once re-use and recycling has taken place, the 165,000 tonne facility is designed to serve the needs of West Hampshire. It has the capability of generating in excess of 14 MW of electricity from the process that will be supplied to the grid powering more than14, 000 local homes. In addition, there is a further facility at Portsmouth which opened in December 2006. It is capable of processing 165,000 tonnes of waste per year, and recovers heat energy from the waste to produce steam. This is used to generate up to 14MW of electricity which is supplied to the National Grid. This is sufficient to power over 14,000 local homes for the life of the facility. In both cases, residual heat is not utilised representing a lost opportunity.

Combined Heat and Power

Information on Combined Heat and Power in South Hampshire has been taken from the Digest of UK Energy Statistics that provides information on large CHP schemes over 1 MWe in size and case study data on smaller schemes from a number of sources. Large scale CHP accounts for 30 MWe of installed capacity which includes a university and hospital.

Southampton District Energy Scheme is the largest commercially developed scheme of its kind. From its launch in 1986, the scheme was initially served by a core of consumers from a geothermal well. The original well now provides only 15% of the system's heat input and is now supplemented by a large scale CHP. This includes a 5.7 MWe unit at the central heat station and 0.7 MWe unit at the RSH Hospital. The heat from the CHP units is recovered for distribution through a 12 km length mains network delivering within a 2 km radius of the heat station. Southampton's scheme also has conventional boilers for "top up" and standby needs at the Civic Centre and Hospital. More than 40 major consumers in the city centre are now served by the scheme including Southampton Solent University, BBC TV and Radio Studio, 4 Hotels, the West Quay Shopping Centre, two private housing developments and the Quays Swimming Complex. This project has already saved 12,000 tonnes of carbon dioxide at a cost of £10 million.

Portsmouth City Council was awarded a grant of £435,263 by the Community Energy programme in 2002. The grant funding assisted the installation of a CHP unit and community heating network serving 538 dwellings, two schools and a new arts and sports centre. A 526kWe spark ignition natural gas CHP engine was installed and an existing heat network upgraded and extended to serve 538 dwellings on the Charles Dickens Estate. The dwellings range from bedsits to two- and three-bedroom flats and maisonettes. The network extends to two schools and a new build arts and sports centre. Power generated by the CHP engine is re-supplied to other council facilities, using a “nominated site arrangement” with Scottish and Southern Energy. The heat network is estimated to save 424 tonnes of carbon per annum, whilst also generating £112,000 in annual fuel bill and cost savings to residents and the Council. Eastleigh BC (Beacon status Council for Climate Change) has also developed a CHP scheme delivering 200 kWe with Utilicom.

4 Targets for South Hampshire

4.1 Policy Review – External Drivers

Public policy on energy and climate change is undergoing a rapid evolution over the last few years as concerns over the twin threats of climate change and fossil fuel depletion have spurred action. The pace of change is unlikely to diminish over the next 20 years.

The policy review identifies a range of targets relating to carbon dioxide emissions; sector based energy efficiency and deployment of renewables. Key landmark policy documents include the Climate Change Bill 2007; Energy White Papers (2003 and 2007); Housing Act 2004 and the Draft South East Plan 2007.

Whilst the targets are many and varied, it is possible to extract some common features that can help inform the creation of a framework for South Hampshire. Some key targets for consideration include:

- Achieving a 26-32% decrease in carbon emissions against a 1990 baseline by 2020 and a 60% reduction in carbon emissions by 2050 (Energy White Paper, 2003);
- Securing 10% renewables contribution to electricity by 2010 and an aspiration for 20% of renewables by 2020 (Energy White Paper, 2003);
- Achieving a 20% improvement in the energy efficiency of the housing stock against a 2000 baseline by 2020 (Housing Act 2004);
- UK should provide renewable sources for 15% of its total energy use by 2020 (electricity, heat and transport) to comply with a EU directive (UK Renewable Energy Strategy Consultation, June 2008).
- Achieving a 10% biofuels mix in transport energy fuels consumption (UK Biofuels Action Plan, 2007);
- Securing an increase in the absolute size of combined heat and power generation in the energy mix (Combined Heat and Power Action Plan, 2004);
- Achievement of zero carbon housing by 2016(“Building a Greener Future”, 2006)
- Achieving zero carbon non domestic buildings by 2019 (2008 Budget Statement);

Some of these policies have been developed at a national level but subsequently cascaded down to regional level using the draft South East Plan as a means of driving essentially national derived targets e.g. renewables. Other targets have been left at the national level to influence decisions taken at a local level and might form the basis of future reviews.

Despite the profusion of targets[5], the basis of a framework for South Hampshire would need to account for the following:

1. Emissions Targets (Energy White Paper);
2. Technology Specific Targets (e.g. CHP); and
3. Local Area Agreements and Multi Area Agreement targets.

[5] Modifications to the South East Plan has resulted in the removal of sub regional specific policy targets contained in Policy SH14. PUSH are considering their response to this modification.

4.2 Fossil Fuel Depletion Policies

Fossil fuels provide 80% of South Hampshire's energy consumption and most of this supply comes from outside the UK. Fossil fuels especially oil have the advantage of having a high energy density and a relative ease of movement. These fuels have, therefore, become the underpinnings of our society's technological base especially for transport. These fuels also provide a vital feedstock for chemicals, plastics and pharmaceutical industries. Global fossil fuel stocks are finite and a significant debate has emerged around future availability.

The debate has been most keenly developed over the future availability of oil. An oil field is considered to have "peaked" when around half the recoverable reserves are extracted. Beyond this peak recovery usually becomes more difficult requiring the expenditure of more energy to get energy. New reserves do, of course, get identified and the recovery efficiency of extractive technologies can also improve. There also seems little doubt that the oil industry has tended to sweat its refining and existing oil field assets as a hedge against price variability. Nevertheless, a review of data on the major oil producing areas of the world has led a variety of industry experts to project dates for peaking between 2006 and 2025. A number of experts group their forecasts around 2010 to 2011 (Source: "Peaking of World Oil Production: recent Forecasts" US Department of Energy/ NETL 2007/1263). The same analysis can be applied to gas which is estimated to lag oil by 20-30 years and, even, coal where reserve reporting has not kept pace with growth.

Because fossil fuels are chemically similar, depletion in one type of resource may cause switching to another by applying a conversion technology. Natural gas can be processed into liquids or coal converted into gases or liquefied. However, each transformation costs energy so the process of delivering energy to meet the needs of current technology will become more costly in terms of the energy needed to get energy. Added to the increased energy cost of getting the fuel in the first place, the prognosis is that the task of fossil fuel based energy is going to be increasingly expensive both financially and in energy terms.

Some industry and energy policy makers see nuclear fission as a means of supplying an alternative to a diminishing and costly fossil fuel supply. A switch to nuclear power would however accelerate consumption of uranium ore with the impact of either creating a "peak uranium" scenario; requiring wide scale adoption of spent fuel recycling (plutonium) and/or extraction from low grade sources of uranium (currently uneconomic and likely to result in adverse environmental impacts). As a consequence, there are risks attached to assuming supply can be secured through the nuclear route.

The outcome of depletion is likely to be a major boost to inflationary pressures in the economy as producers locked into a technology base reliant upon fossil fuels pass on the effects of rising costs. It may not be as easy to offset these energy induced inflationary pressures against lowering of labour costs as newly industrialising countries face pressures from within their own countries.

Relationship between Depletion and Climate Change

The implications for climate change policies are complex. If demand for fuels needed to maintain our technology base are displaced into more biofuels, the task of trying to maintain our current lifestyle is likely to overwhelm the carrying capacity of the world in short order. Displacement is already leading to competition for land between producers of food and energy crops leading to a further inflationary pressure on food already affected by the impact of energy prices on its own production costs. Depletion could, however, introduce the price incentives needed to change behaviours and investment priorities that can help realise this strategy. Reliance on a price mechanism would however have a significant impact on households reliant on fixed incomes or on low wages (with reduced prospect for achieving higher wages due to adverse macro economic circumstances).

Targets that address Depletion and Climate Change

Government has encouraged regions and localities to develop responses to energy issues. The focus has been around climate change mitigation and renewables. Security of supply has tended to be treated as a matter for central government in collaboration with the regulatory bodies. This has not prevented a number of local areas from explicitly developing strategies for dealing with the potentially significant consequences of depletion on their communities. It is, however, possible to see a convergence between policies aimed at decarbonisation for the purpose of climate change mitigation and scarcity. The decarbonisation of South Hampshire's fuel supply should over the longer term reduce dependency on energy sources that import inflationary pressures into the economy and undermine the opportunities for growth. It must, however, be recognised that South Hampshire's economy is still integrated into the wider UK and international economy making it impossible to remove inflationary pressures. Local policies are needed to assist deal with the consequences of fuel poverty and other stresses on the household budget.

Fuel Poverty

Over the next twenty years, energy is going to become more expensive compared to today. Any measures that help mitigate fuel poverty households to use less energy are, therefore, consistent with meeting decarbonisation and fuel poverty objectives. Supplying future energy needs through renewables is, however, less easily reconcilable. Renewable energy is more expensive than fossil fuel prices currently. Regulating the market (through enhancing the Renewables Obligation) to absorb a higher proportion of renewables before their price competitive, means passing this cost onto the consumer including fuel poverty households. Over the medium and longer term, these households will face higher bills for energy in the future making them a priority for energy efficiency measures and subsidies towards renewables capable of offsetting remaining needs. Fuel poverty households in "hard to treat" housing present a particular problem because the payback is negative.

In 2004, one in five households in Hampshire live in fuel poverty[6], this is a lower figure than for England as a whole but slightly above the regional average (19%). Fuel poverty was, therefore, very polarised across the county but significant concentrations of households experiencing fuel poverty were located in the South Hampshire area especially Southampton, Portsmouth, Gosport and Havant. Every ward in Southampton and all but one of Portsmouth's wards fell within the 'worst' county quartile. Fuel poverty in Portsmouth was particularly high at 30%. This was the highest district score in the South East.

4.3 Developing a Targeting Framework for South Hampshire[7]

Emissions

The South Hampshire authorities have all adopted the climate change target as part of their Local Area Agreement targets. These targets and an emergent Multi Area Agreement provide a local setting for action in the sub region.

Technology Specific Targets

No technology specific targets exist for South Hampshire. Technology specific targets obscure underpinning assumptions about the cost competitiveness of one technological solution against another. A "picking winners" strategy is, however, inherently dangerous and could lock South Hampshire into an energy mix that will be unsuited to future need.

[6] A Profile of Fuel Poverty in the South East Region, Centre for Sustainable Energy, 2004

[7] Modifications to the South East Plan has resulted in the removal of sub regional specific policy targets contained in Policy SH14. PUSH are considering their response to this modification.

4.4 What Magnitude of Emission Reductions?

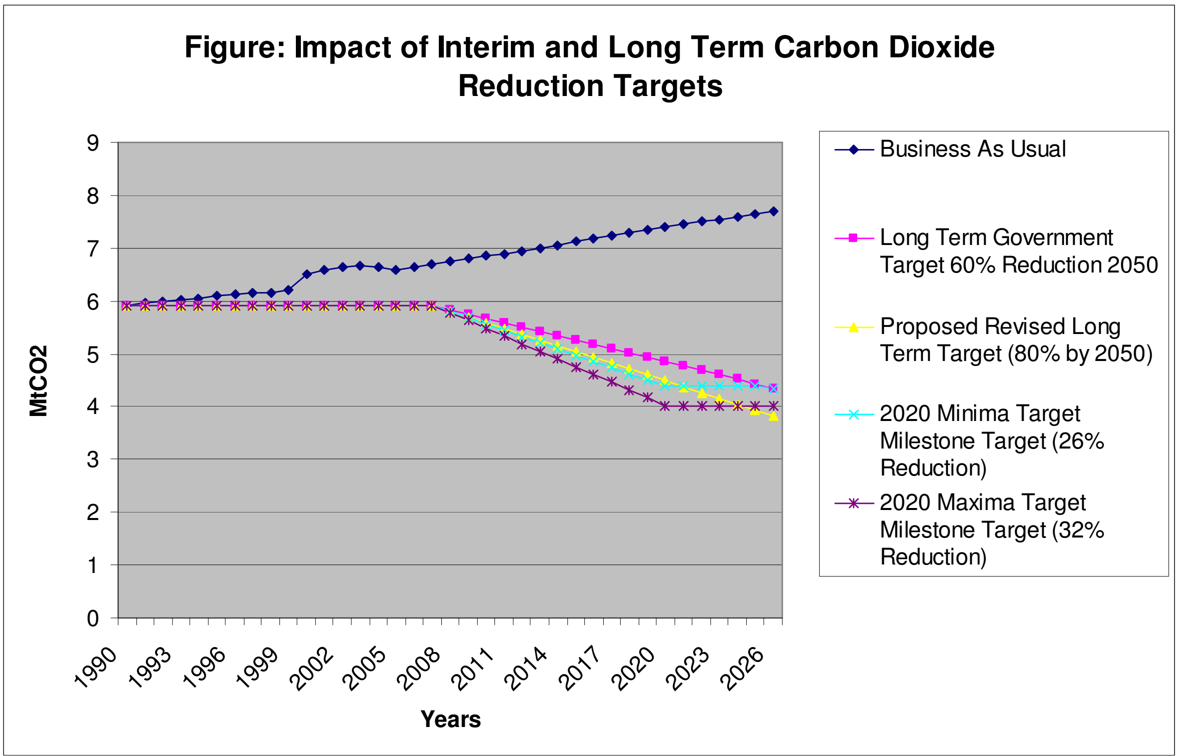
This Study has been premised on the broad scientific acceptance that the rapidity of climate change effects is associated with human action. Until comparatively recently, this strategy would need to have presented a case for substantiating the claim. Beyond the broad agreement that there is a human effect, there is still much scientific debate.

The need to reduce emissions is driven by our current understanding of the science of climate change which has focused on what level of emissions avoids tipping the climate into a chaotic state effectively reducing the carrying capacity of the planet to sustain current and predicted levels of human population.

The 60% cut in emissions contained in current government policy reflected available evidence that suggested such a cut would stabilise carbon dioxide concentration levels at levels that would stabilise the climate. The basis of this original judgement was based on an understanding of climate derived from computer models using evidence available at the time.

The evidence base concerning climate change is continually being refreshed along with the scientific community's understanding of the processes that drive climate change e.g. the role of jet stream in affecting the flooding of 2007. As the models have been improved so has thinking about the policies needed to stabilise the climate. A contributor to the Fourth Assessment Report of the IPCC has suggested that an 80% cut would be required by 2030 to keep emissions below a level consistent with a stable climate. It is now part of the UK's Climate Commission's work (headed by Lord Turner) to review the 60% reduction target with a view to recommending to government whether the higher 80% figure should be adopted (Defra News Release 22nd February 2008, Ref 52/08).

Changes in government policy tend to move more slowly than changes in the evidence base so current scientific thinking has yet to be absorbed by policy makers for the most part. Nevertheless, some local policy makers have accepted the merit of the most recent evidence having gone for more aggressive cuts in emissions e.g. London. As a result, South Hampshire needs to accept that emission reduction requirements may increase as government reviews the evidence base.



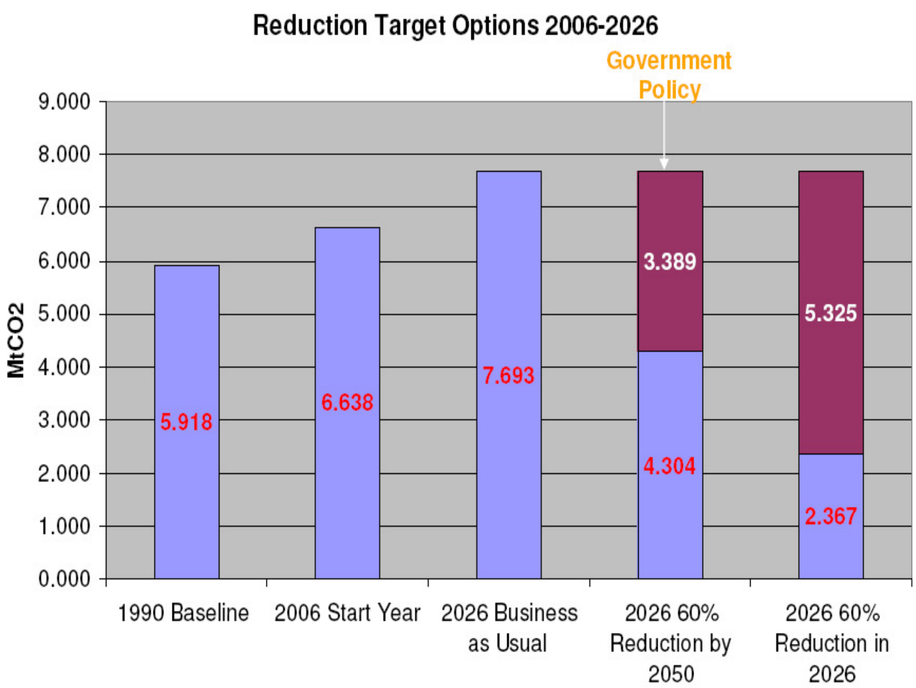
A second issue surrounds the management of the interim targets set for 2020 which are based on a range between 26% and 32% of 1990 emissions. On this basis, the reduction strategy has to be accelerated faster than a straight line reduction on the 2050 target would suggest.

Setting a higher target than government policy currently expects does have the advantage of placing South Hampshire in advance of where central government is likely to go anyway. However, it is arguably the case that central government has not yet changed the way it regulates energy markets and encourages individuals/ businesses to meet the existing 60% target. The revision of the target is likely to lead to a significant share of total reductions being loaded onto actions attributable to future changes in national policy triggered by concerns. Such an approach may help South Hampshire evolve a lobbying response on these issues.

4.5 South Hampshire – A Business as Usual Scenario to 2026

A South Hampshire strategy needs to account for growth as well as current patterns of use and emissions. The draft South East Plan and the commitments related to the government's Growth Point Initiative means that South Hampshire will grow by a significant factor over the next twenty years. Around 80,000 additional houses and 2,000,000 additional square metres of employment floorspace are expected over this period which will generate additional traffic flows for both freight and personal travel. A "business as usual" forecast must, therefore, factor in the implications of this growth on both energy consumption and emissions. Our model has, therefore, sought to develop an understanding of what energy consumption and emissions would look like if no mitigating actions were taken by 2026.

The results show a steady upward drift in both energy and carbon dioxide emissions from 6.6 million tonnes to 7.7 million tonnes of carbon dioxide. This trend runs contrary to the UK's national policy framework which would require a 37% reduction in emissions by 2026 if South Hampshire were to demonstrate alignment with a 2050 reduction strategy. Business as Usual would only become viable if other parts of the UK were willing to reduce their emissions disproportionately to their actual share of the problem.



Agreeing a Target - Stakeholder Workshop May 2008

After discussions with a variety of sub regional stakeholders, various pros and cons of adopting different targets and rates of reduction were discussed. Some points of view supported the adoption of more aggressive targets than the government would allow South Hampshire firms to learn earlier than others how to compete more effectively in a low carbon economy. Others considered the adoption of challenging targets would undermine South Hampshire's ability to deliver its wider growth objectives. The consensus view was that the policy environment was fluid at the moment and the best stance was to adopt government targets but monitor changes in the evidence base and new requirements. The annualised targets for carbon dioxide reductions are shown below based on achieving the 26% reduction in carbon dioxide required by 2020 thereafter reverting to the 2050 trajectory.

Key Points

This section discusses the targets for carbon dioxide reductions based on current government frameworks and commitments.

Interim targets as well as long term targets are considered.

New scientific evidence is likely to inform a future revision of targets (currently under review by Adair Turner's Climate Change Commission).

5 How should South Hampshire meet its targets?

The sheer diversity of potential solutions to reducing carbon is immense. Many practitioners involved with design, construction, engineering and many other disciplines are only starting to come to terms with how these solutions can be made to work effectively and combined to produce the best outcome for the future. Sometimes, the detail of the solutions can obscure some of the issues that surround their application to the real economy. Economic and social factors are critical to understanding how South Hampshire can meet its targets over the next twenty years.

5.1 Economic Choices

Many national and regional studies on carbon reduction have identified interventions in terms of what is technically possible versus what is economically viable to do now. Measures that produce a financial payback have been assessed using life cycle costing techniques that assess a carbon saving intervention against a "business as usual" case over the economic life of the intervention. Interventions failing the economic viability test but are, nevertheless, feasible are typically classified as technically possible. In addition, research and development is increasing our knowledge of what is technically possible to reduce carbon emissions. The boundary between the two is fluid and as "business as usual" becomes more costly and the technologies involved fall in price, interventions can migrate into becoming economically viable. This strategy is looking ahead twenty years making it highly speculative to forecast how viable certain interventions will have become.

This process is however dependent upon the values of the people and businesses making decisions over how to respond to the challenge of carbon reduction and resource scarcity. These decisions influence the direction of primary research, investment in commercialisation and the rate of adoption. Different values can have significantly different outcomes for what gets to market first and the types of solution adopted.

5.2 Social Values and Aspirations

In 1999, the UK Foresight Team developed a number of socio economic scenarios based on different values that might influence the rate of adoption. Two extreme scenarios were "World Markets" and "Local Stewardship".

A World Markets Vision of South Hampshire in 2026

By 2026, South Hampshire is starting to benefit from the decision taken by central government to invest heavily in a new nuclear fleet as some of the stations given consent 17 years ago start to come on line. Added to high efficiency coal fired capacity, energy security is looking significantly better as foreign sources of gas come under competitive and political pressure. Southampton Port has formed a partnership with a generation company to build an energy generation plant capable of supplying the area with energy through co-firing large volumes of imported biomass alongside combustible waste and fossil fuels. Many organisations comply with carbon reduction targets through strategic offsetting through the markets

Local Stewardship Vision of South Hampshire in 2026

By 2026, South Hampshire has made the difficult decisions to make a substantive improvement in energy efficiency within the area. Large amounts of the housing stock have benefited from targeted programmes aimed at improving energy efficiency assisted by new legislation mandating improvements in energy performance as a condition of sale. Subsidised programmes have assisted the development of district heating networks and private wire systems into high density areas (through a series of small scale energy centres). The new communities established at the Strategic Development Areas have been planned to very high levels of efficiency including excellent public transport links. South Hampshire business and government have collaborated to establish targeted strategic offsetting to parts of the world with civic links to South Hampshire or key countries of origin *involved in the manufacture of key renewable technologies (helping to assist renewable power technologies to reduce the long term embodied carbon in device manufacture).*

These two pen portraits illustrate two sets of values capable of driving investment and lifestyle choices. The World Markets vision is essentially an extension of "business as usual" focused on accessing a quantum of fuel from whatever sources on a global scale to maintain South Hampshire's current pattern of energy consumption. The emphasis is on integration into the grid; use of the port's handling capacity to absorb available supplies and so forth. The converse is that energy efficiency has a much lower priority for South Hampshire. Under the "Local Stewardship" vision, reducing energy consumption is seen as a critically important intervention as well as the local exploitation of renewable resources

The "World Markets" vision is probably more compatible with current values but it is probably compromised over the longer term by the rising costs of energy. This vision is also most compatible with how the supply side of the energy sector is currently organised around large system solutions to supplying whatever consumers demand from it.

The "Local Stewardship" vision represents where South Hampshire probably needs to reach. The transition process means changing attitudes especially to the expectations of a lifestyle underpinned by high energy consumption. Key questions concern whether it is possible to evolve an economic model that provides a high standard of living and the values of the Local Stewardship model.

The prevailing set of values contained within the above will determine what types of interventions get support and funding. The next section looks at technical potential without weighting them in terms of any prevailing value system.

5.3 Why Local Stewardship?

The choice of vision is fundamental to the future direction of the sub region. The prevailing set of values within each alternative vision will drive attitudes towards investment and behavioural change. A local stewardship approach will cost money to implement and require challenging convention. It is much easier to assume that there will be some kind of "quick fix" to allow the world markets approach to continue. Some opinion will readily cite a whole range of technical fixes (see box on Super Grid) to support a business as usual approach from using mass produced algae to fusion power. However, many of these technical fixes are by no means certain in terms of their technical viability and pose their own challenges in terms of the scale of investment needed and demand on other scarce resources (e.g. water). Most of the solutions posed as part of a world markets scenario concern the delivery of power. Unless power is to be used for space heating and domestic hot water, these solutions do not invalidate localised approaches to managing heat and cooling (non electrical). Heat is not transportable in the same way that electrical power can be (e.g. the proposed Direct Current international grids) and heat demand from the legacy of existing buildings is not going to disappear. A precautionary principle would also suggest that it is more advisable to plan around known technologies rather than the arrival of speculative solutions e.g. fusion or super grids. It does, however, underline the need for the owners of a future strategy for South Hampshire to regularly scan for changes in the technical and economic viability of new technologies.

Super Grid

An alternative trajectory for South Hampshire would be to become a node on a transcontinental direct current based grid capable of transporting power from remote points of supply to centres of population and commerce over great distances. By expanding the geography of supply, it becomes less likely that there will be instances where an active source of renewable power could not be found reducing the intermittency problem that is usually levelled at renewables. In theory, off peak offshore wind in the UK could pump water up hill in Norway to be released as hydro energy to meet demand at another point in time. The nucleus of a DC grid already exists in Europe linking Scandinavia, northern Germany and the Netherlands. Moreover, any connected community will have access to other capacity whether non renewable or renewable. This solution would be delivered through large utility concerns in collaboration with national governments. South Hampshire's role would be one of lobbying for early roll out.

5.4 Assessing Technical Potential

The technical potential for reducing carbon is presented in terms of a series of reduction actions that gather momentum over the twenty year period. The actions originate from work undertaken to establish how emissions can be first stabilised and then reduced to meet global targets. The wedges do represent a level of abstraction but do help illustrate the range of activities and problem areas concerned with achieving reductions.

Using 2006 as a starting position, a line has been drawn to reflect the growth in emissions likely to happen if nothing was done – "business as usual". A second line has been drawn reflecting reduction in emissions expected by 2026 if a reduction of 37% is to be achieved (representing the 2050 target at that point in time). Together, the two lines form an open ended cone with a common point of origin at 2006.

The overall reduction strategy for South Hampshire must aim to find enough scope to fill the cone with potential ways of cutting carbon dioxide emissions.

By reducing carbon dioxide emissions, South Hampshire will be simultaneously increasing its security of supply by broadening its geographic supply base (e.g. many more potential suppliers of biomass) and lessening its actual need for fuels (most renewable power systems are based on fixed infrastructure rather than fuels based).

5.5 Identifying Wedges of Reduction

The process of generating wedges is tied to the use sectors underpinning the model. A carbon reduction strategy must either propose to reduce energy consumption (eliminating a source of emission) or substitute a less carbon intensive energy source for an existing fossil fuel energy source (ideally renewables but the retirement of a coal burning process to be replaced by a less carbon intensive natural gas fuel source would achieve an effect).

The use sectors concerned include:

- Domestic;
- Commercial and Industrial and;

Surface Transport.

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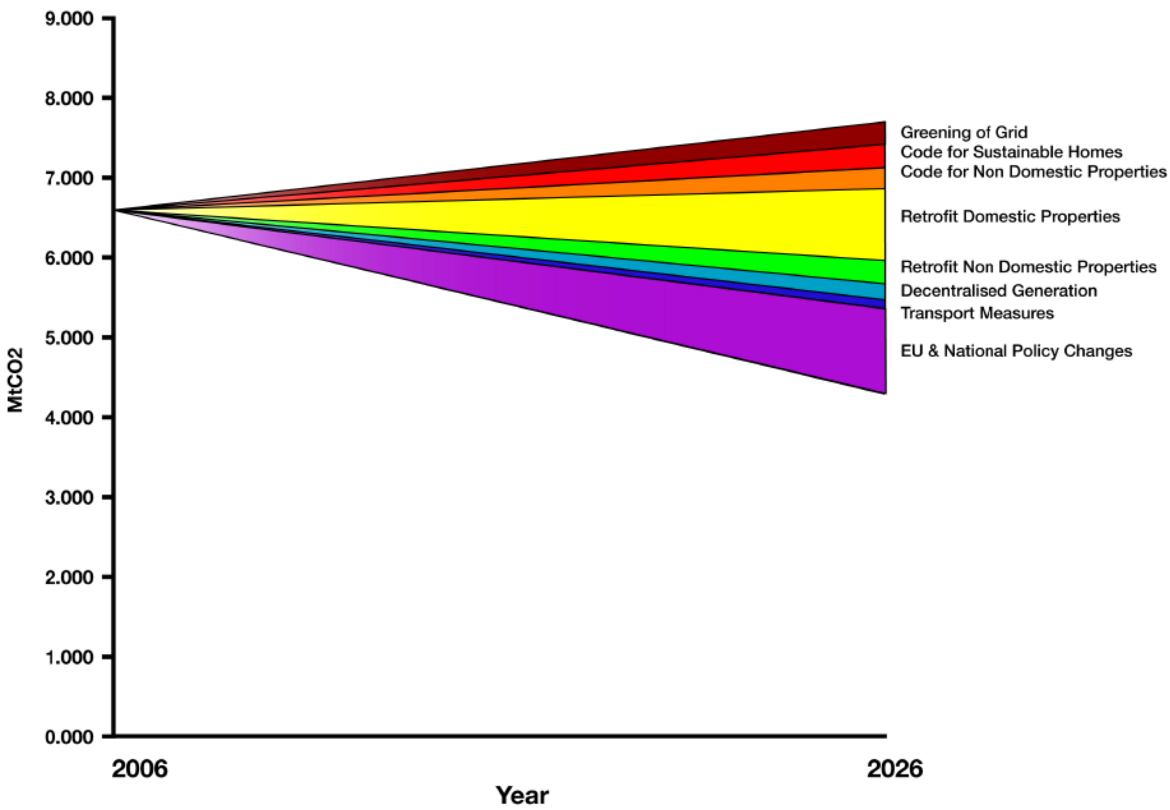
Derivation of the Wedges

Robert Socolow, a professor of engineering at Princeton University, USA first developed the "wedges" idea when asked to consider how global scale reductions could be achieved as part of the global Carbon Mitigation Initiative. When faced with the scale of the problem combined with a confusing evidence base, he took steps, along with a colleague, Stephen Pacala, to streamline the problem. The first step involved establishing a "business as usual" projection based on the assumption that carbon emissions would grow without regard to climate leading to crisis levels of concentration. Fifteen stabilisations "wedges" were proposed where each was considered capable of withdrawing 1 billion tonnes of carbon dioxide. These global scale wedges included mass deployment of wind turbines, carbon capture and storage and solar technologies. The results were published in August 2004.

Eight reduction wedges are presented based on using good practice and evidence drawn from South Hampshire (where available):

1. Greening the Grid;
2. Code for Sustainable Homes;
3. Code for Sustainable Business;
4. Retrofitting Demand Reduction Measures to the Existing Housing Stock;
5. Retrofitting Demand Reduction Measures to the Existing Non Domestic Stock;
6. Applying Decentralised Generation to Existing Urban Areas;
7. Traffic Measures and Demand Management;
8. National and EU Measures.

The application of the modelling process has resulted in the reduction wedges shown below:



5.6 Wedge Reduction Assumptions and Context

5.6.1 Greening the Grid (282,415 tonnes)

Electricity secured from the national grid is important now and will continue to be important to South Hampshire over the next twenty years. Given the nature of the grid it is both a source of security and uncertainty for South Hampshire. It is a source of security because it helps balance out localised supply and demand problems without recourse to expensive localised storage solutions. It is a source of uncertainty because the energy supply mix supplying the grid is the subject of strategic decisions largely made outside the scope of South Hampshire to influence. Over the next twenty years the decommissioning of large sections of the UK's nuclear fleet will increase the carbon intensity of the grid at a time when it is in South Hampshire's interests to see movement in the opposite direction. Whilst increasing intensity is a temporary phenomenon the effect will be a reduction in the effectiveness of actions directed at greening the grid. South Hampshire can, however assist this process by ensuring that no blocks exist to stop major strategic low carbon sources from being "plugged into" the grid as it becomes viable to exploit them. These resources would include tidal power array within Solent which may become exploitable within the time horizon of this strategy.

5.6.2 Code for Sustainable Homes (293,593 tonnes)

Building a Greener Future policy document signals intent to tighten carbon emission standards for new build housing over the next ten years through the Building Regulations. By 2016, zero carbon will need to be secured for all new build housing. Implementation of the higher energy standards should result in the next generation of homes requiring very little heat energy. Improved standards of air tightness, insulation and higher quality glazing should mean that occupants and their appliances generate most of the heat energy needed except in extreme winter conditions. By 2016, a residual space and hot water heating requirement will have to be met by renewables along with renewable power generation capable of meeting lighting and appliance loads. Code requirements suggest a need to provide these generation technologies on or near to site. On this basis they are treated as additional capacity to that provided through the grid.

Achievement of the carbon performance required by the code requires a combination of energy efficiency and use of renewables. The renewables requirement could be met through any number of decentralised generation technologies including district combined heat and power. It is assumed that power generation would be provided through a private wire.

5.6.3 Code for Sustainable Business (284,079 tonnes)

This action is premised on the government's budget announcement to achieve "zero carbon" non domestic new build by 2019. In 2007, Communities and Local Government received a report from the Green Building Council setting out similar milestones for the achievement of low/ zero carbon performance as contained in the "Building a Greener Future" document. The milestones adopted for modelling this wedge have been based on the scenario that assumes these measures can be achieved within 10% uplift in development cost.

Achievement of the carbon performance required by the code requires a combination of energy efficiency and use of renewables. The renewables requirement could be met through any number of decentralised generation technologies including district combined heat and power. It is assumed that power generation would be provided through a private wire.

5.6.4 Retrofitting Demand Reduction Measures to the Existing Housing Stock (913,781 tonnes)

By 2026, the majority of the houses that exist now in South Hampshire will be those that have already been built over successive generations of urban expansion. These houses will be responsible for a significant share of South Hampshire's carbon emissions. Reducing emissions does however present a significant challenge as the scope for achieving emission reductions varies with each generation of housing. Whilst the sub region enjoys a relatively young housing age profile, there is still a significant number of older solid wall construction (mainly built before 1930s) properties especially in the sub region's older urban areas where the economic case of making energy efficiency improvements is lacking. Cavity wall construction housing built from the 1930s onwards to counter the effects of damp offer a much better basis for achieving cost effective thermal efficiency improvements. A number of studies have attempted to quantify carbon savings from the housing stock including the Performance and Innovation Unit of the Cabinet Office and the Environmental Change Institute at Oxford University (who looked at a 60% and 80% reduction strategy). The PIU report identified scope for a 57% reduction in energy demand from economic and technically viable measures. In a BERR consultation on heat energy strategy, the evidence base justification assumed scope for a 51.7% reduction by 2020. These reductions are assumed to represent extensive existing economically viable measures like loft and cavity wall insulation, heating controls, hot water cylinder insulation; condensing gas boilers. Other measures would include a certain level of penetration into solid wall properties. South Hampshire's constituent authorities have renewal programmes aimed at delivering "Decent Homes"; however, the definition of a decent home includes wall treatment where feasible to achieve thermal efficiency standards. A higher standard of retrofit will be needed to reduce demand across the stock,

5.6.5 Retrofitting Demand Reduction Measures to the Existing Non Domestic Stock (312,128 tonnes)

Non domestic buildings are much harder to assess because there is significant variation and little reliable data on them. A study conducted for the Royal Commission on Environmental Pollution examined potential in the service sector (a large share of the non domestic emissions profile). This study suggested that the economic energy savings potential was 22% but this figure included 10% from CHP. It is estimated that the technical potential is nearly 39%. In the absence of more comprehensive data, the best proxy is the age of the stock. The South Hampshire area has a relatively high proportion of non domestic properties built between 1940 and 1970 during a period when energy efficiency was not a high priority. Given the variety of different types of accommodation, an average 15% reduction in energy consumption is assumed arising from retrofit measures.

5.6.6 Traffic Measures and Demand Management (90,588 tonnes)

The Stern Report highlights the problems in identifying serious reductions in transport emissions before 2050 until some major technical choices have been made. Breaking out of a "business as usual" trend line is extremely difficult, a point underlined by the consultation process undertaken as part of this strategy. A number of opportunities may exist to curtail emissions through more efficient driving techniques (so called "eco driving"); retrofitting battery hybrid drive technology to the existing stock of vehicles and more efficient management systems.

Other techniques include the application of congestion charging regimes but the 2002; Inter-modal Study for South Hampshire[8] recognised the problems of applying such a system to the sub region's road network except in Southampton and Portsmouth. By applying, a bundle of measures, it has been possible to identify carbon dioxide savings of 17%. This figure has been set as a reduction wedge.

Changing Role of Transport Energy – "Vehicle to Grid" and Beyond

The technological options for supplying transport energy in the future are still being debated. Futures based on the electrical powered car sometimes referred to as "Vehicle to Grid" (V2G) would involve using the car as a battery drawing off peak supplies of electricity. Cars would be equipped with intelligent metering allowing draw off to coincide with the most advantageous time in terms of flexible tariffs. By shifting the burden onto the grid, the home or business will become more important to "refuelling" than the filling station. This strategy does, however, leave open the questions as to where the primary fuel will come from to meet the additional demand and how robust the distribution network

[8] Halcrow 2002

might be when faced with an additional load. Other solutions to the transport energy problem are localised hydrogen generation. The eventual solution may be a mix of the two technologies.

5.6.7 Decentralised Generation in Existing Areas (154,717 tonnes)

Earlier actions concerned with the energy efficiency of the existing built environment will help bring down demand from dwellings and business premises that exist today. There are nevertheless finite limits to efficiency gains within the existing stock. De- centralised generation can assist decarbonised energy supplies by deploying renewable energy systems; community/ district heat and combined heat and power across the urban areas of South Hampshire.

Estimating the contribution of these systems to existing area energy supply needs is sensitive to the economics of deployment which are affected by a mix of factors including the pattern of heat loads (in terms of densities and use).

District heating/ CHP needs accessible heat densities to support its economic deployment and whilst established built up areas offer the best long term prospects in terms of a persistent need for heat energy, complications exist over the retrofitting in areas where potential customers are already connected into competitor systems.

This wedge is based on an assessment of heat demand patterns using official statistics to identify high density loads associated with high density housing (over 60 dwellings per hectare). This must be treated as indicative. For the purposes of the model, the supply of electricity generated by CHP is treated as an additional benefit generated from meeting the heat load.

The displacement of carbon will depend upon the fuel used within CHP systems to supply need. The choice of fuels will, in turn, depend upon the economics of different fuel types. Early in the time frame of this strategy, the choice is likely to be natural gas where the carbon benefit comes from efficiency of extracting both heat and power from same unit of primary fuel. Other fuel types could include methane taken from the anaerobic digestion of bio degradable waste or through combustion of non recyclable waste. As the number of households increase in South Hampshire, the volume of waste will increase however more rigorous recycling targets will change the calorific content of the waste stream available for energy from waste plants including the existing facilities already operational in the sub region. This factor will change the ability to grow capacity in line with general population and economic growth. However, Hampshire County Council is looking to opportunities for extracting energy from residual matter after recycling has taken place. The use of the waste stream in CHP systems also allows for the extraction of heat energy as an additional benefit.

Decentralised generation is, however, more than the potential for combined heat and power. The term includes any devices attached to the distribution network capable of generating either heat or electrical energy including micro-generation and community renewables. Theoretically, it would be possible to extract some form of usable energy from any location and an estimate has been made that there is a technical capacity for 1.7 installations per house by 2050 for micro-generation or 53.6 million installations in total. In reality, these installations cost more than the savings they create by displacing fossil fuel derived energy. Installations are principally driven by non market considerations and their penetration is estimated to be 100,000.

5.6.8 National and European Union Level Measures (1,012,124 tonnes)

The preceding wedges represent substantive actions to reduce carbon dioxide emissions based on a balance between technical potential and economic development objectives. Each wedge has a cost of abatement which can be positive or negative dependent upon whether an action saves or costs money to implement. An accelerated reduction of emissions without appropriate market incentives places costs on the sub region’s economy threatening wider objectives concerned with overall sustainability. As new policy measures filter through from national and international measures, this wedge will shrink with a compensatory expansion across the other wedges.

These measures essentially focus on the powers available to government to regulate the way the market works in relation to price signals. The power to tax carbon or cap emissions or regulate a certain level of carbon performance all have a significant impact on the speed and effectiveness of how plans can be implemented at a local level (an example is shown in the box entitled "Feed In" Tariffs and Quotas). This wedge is treated as a residual making up the difference between the overall target and the sum of all the other wedges.

Feed In Tariffs and Quota Systems – Which Way Forward for the UK?

UK policy has been to set a quantum of renewable power known as the "renewables obligation" required in the supply mix and let the market determine the price. Power companies have inevitably sought to minimise the price paid by purchasing power from the least cost providers typically wind generators.

In Europe, the policy has been to set an advantageous price able to guarantee a payback across a range of renewable technologies capable of guaranteeing a financial payback and let the market determine the supply. These "feed in" tariffs have encouraged a significant expansion in installed capacity across a number of companies most notably Germany where growth in demand has fostered local supplier industries.

The trade off is between providing investors with long term security through a feed in tariff versus higher cost power and the risk of encouraging immature technologies into the wider fuel mix.

5.7 Proposed Carbon Targets for South Hampshire to 2026

The 2050 trajectory plus the interim 2020 target identified in the Climate Change Bill would be expected to result in the following milestones having to be reached:

Wedge Contributions (tonnes)	**2010**	**2011**	**2014**	**2017**	**2020**	**2023**	**2026**
Greening the Grid	230,382	232,329	238,409	-74,307	**270,606**	276,680	282,415
Code for Sustainable Homes	5,467	10,935	38,586	100,357	**179,394**	240,925	293,593
Code for Sustainable Business	5,435	10,871	35,435	88,468	**153,672**	218,876	284,079
Retrofit Domestic	128,256	177,133	323,994	471,314	**619,518**	766,903	913,781
Retrofit Commercial and Industrial	10,263	29,130	85,730	142,330	**198,930**	255,529	312,128
Decentralised Energy	149,082	149,179	149,479	149,002	**153,902**	154,324	154,747
Transport Measures	84,269	84,652	85,799	86,960	**88,137**	89,322	90,588
EU & National Policy	640,789	730,066	985,089	1,499,419	**1,319,390**	1,133,027	977,506
Target Carbon Dioxide Abatement (Tonnes) based on a 1990 base projection	1,282,899	1,453,345	1,971,872	2,492,417	**3,017,323**	3,169,782	3,343,456
2020 Minima Target for total carbon dioxide emissions based on a milestone Target (26% Reduction)	5,563,306	5,444,937	5,089,833	4,734,728	**4,379,624**	4,379,624	4,349,343

The wedge figures reflect technical evidence findings used in the projections work. It should be noted that the "greening the grid" wedge goes into reverse during decommissioning of nuclear and other capacity leading to an increase in the carbon intensity of grid supplies. New strategic capacity brought "on line" through South Hampshire can help restore the previous trajectory but it is heavily influenced by decision makers outside the control of the sub region.

5.8 Costs of Implementing Carbon Reductions

The actions necessary to achieve each of the reduction wedges identified above either provides users with a financial return or a financial cost for each tonne of carbon dioxide saved. A financial return makes it more likely that people and businesses will be willing to invest their own funds but it is not a guarantee. The financial benefit may not be perceived or realisable due to non financial barriers (e.g. raising the initial credit to undertake the investment). Actions that generate a financial cost provide no incentive to economic incentive to investment however non economic considerations may cause them to be adopted. The lack of demand may be a constraint on achieving production cost savings.

Each wedge represents a mix of these measures some of which are profitable and others are not, a strategy of progressing each wedge should encourage the take up of the financially beneficial measures first (e.g. by reducing non financial barriers) but a point will be reached when additional savings can only be achieved by accelerating technically proficient actions that do not pay on their own account. The risk of accelerating technically viable measures is to encourage deployment of technologies that are not fit for widespread application because their technical capacity is actually under development or they may represent a "dead end."

The actions brought forward under "National and EU Measures" can be expected to change the relationship between the carbon savings and costs involved by the extension of carbon trading; use of green taxes; extension of renewable quotas and technical regulation. Significant numbers of interventions become economically viable if, for example, the cost of carbon increases by 40 Euro per tonne (2002).

Wedge	Comment
Greening the Grid	Costs of abatement vary by technology.
Code for Sustainable Homes	The zero carbon standard is currently considered unviable (McKinsey Report, 2008).
Code for Sustainable Business	The Green Building Council considers that this target can only be achieved at an additional cost.
Retrofitting Demand Reduction Measures to the Existing Domestic Stock	Many structural energy efficiency measures are already economically viable e.g. cavity wall insulation; low energy lighting. However, around 20% of the South Hampshire stock includes older, solid wall housing where the business case is a lot less certain and disruptive.
Retrofitting Demand Reduction Measures to the Existing Non Domestic Stock	Many structural energy efficiency measures are already economically viable e.g. cavity wall insulation; low energy lighting. However, older commercial properties may present a significant problem.
Traffic Measures and Demand Management	Transport has been identified as a problem area within the Stern report. The King report has identified the scope for improved efficiencies (e.g. reduced weight) which can be brought forward now but there is still considerable debate and potential cost associated with alternative fuels.
Decentralised Generation in Existing Areas	By 2020, district heating in city centre schemes are forecast to be financially viable with an estimated abatement cost of -£110.64 per tonne of carbon dioxide[9]. District heating in dense residential areas is similarly is marginally viable with a figure of -£1.63 per tonne of carbon dioxide abated[10]. Figures quoted range from £8.45 per tonne of carbon dioxide for Anaerobic digestion through to £160 per tonne of carbon dioxide saved for Energy from Waste (EfW) (Ernst & Young, 2007)

[9] "Heating Call for Evidence" January 2008, BERR
[10] "Heating Call for Evidence" January 2008, BERR

Key Points

This section sets out ways of achieving reductions in the emission of carbon dioxide based on assessing technical potential alongside economic constraints.

The measures cover new development but also focus on the contribution that must be secured from the existing stock of domestic and non domestic properties.

The relative "speed" of reduction is dependent upon the pricing and tax frameworks established by government. Escalating costs of fossil fuels and the pricing of carbon will make it more likely that the pace of change can be quickened without disadvantaging South Hampshire in relation to other areas.

The costs of abatement potential for different measures can be expected to change over the life of a strategy.

6 Future Energy Supply in South Hampshire in 2026

6.1 Strategic Choices

Section 3 identified the large natural flows of energy into South Hampshire which vastly exceed the fossil fuel flows utilised currently. Theoretically, an area equivalent to 17% of the surface area of South Hampshire could supply this need[11]. Practically, this area exceeds the surface area occupied by buildings and does not account for the way energy is consumed within modern societies.

Incoming solar energy cannot be controlled to match the way homes and businesses use energy (e.g. continuously when the sun is not shining and the wind is not blowing), creating a need to store, and release the energy from the store as demand dictates, if current lifestyles are to be maintained.

Nature's means of storage is through photosynthesis into biomass but this has a low efficiency rating and needs a lot of land to produce a significant volume. Moreover, stored energy must be collected, processed and transported to its point of consumption.

Assuming all photosynthesised plant matter grown on the green-spaces and gardens in South Hampshire were harvestable economically, around 31% of current consumption could be theoretically met from this resource but at the cost of inflicting irreparable harm on food supply and biodiversity in the sub region (see box).

Energy and Food Policy

Scarcity in fossil fuels has been paralleled by problems in world food supplies as reserves of key stable foods like wheat and rice fall to their lowest levels for decades. Whilst the effect of shortages are much more immediate in countries with a low per capita GDP, the impact is global with price rises feeding UK inflation and leaving families in this country with less disposable income to sustain current levels of demand for other goods and services. Energy related uses are an effective competitor for using productive agricultural land which might other wise be used for food. Biofuels are also a direct competitor for food crops themselves as feedstock to the production of ethanol or bio diesel. Fossil fuels are also essential in the food production and distribution systems of the developed world (e.g. food miles). These trends suggest that food security is likely to become a key issue over the next twenty years as over extended food supply chains become exposed to increased risks of disruption. Localised food production may become an increasingly attractive and even essential means of dealing with this risk. As such there may be increasing levels of competition for land to produce food, energy production feedstock and urbanisation. These changes could also cause a shift towards more energy efficient forms of food e.g. a switch away from farming animals towards crops which would have an implication on the biomass resources available.

Given these considerations and the economics of collection, something under 10% of current demand might be capable of development as a resource within the sub region.

Under these circumstances, the sub region must draw on a wider area to meet a significant proportion of need through biomass (the rest of South Hampshire and beyond). This figure does not however take account of biomass originated from waste flows which include the energy value of food stuffs imported from outside the sub region.

Storing electricity presents a problem because the technologies are expensive and often involve significant embodied carbon (e.g. batteries). Storing low grade heat is a potentially less costly option in accumulators and underground stores. Potentially, the storage of heat

[11] Based on a PV module efficiency of 10% applied to solar irradiation average horizontal

can allow technologies that are capable of meeting demands for heat and power to meet the latter when heat is not needed without consequence.

Even if storage were not a problem, South Hampshire's renewable resources are not necessarily the most attractive to exploit before others. Even though one of the benefits cited for renewable energy is the ability to exploit it near to the point of consumption thereby avoiding transmission losses, it is still the case that some of the strategic offshore resources can be exploited remotely and provides carbon benefits without being undermined by transmission losses.

South Hampshire is still likely to remain a big importer of renewable energy over the period being examined by this strategy. This is particularly the case whilst the renewable technologies considered to have greatest short term market potential are weakly represented in the wider sub region (e.g. wind).

South Hampshire does, however, have a choice over the degree of reliance it has on externally sourced energy. This choice is, partially, dependent upon the underlying values informing policy makers' priorities for the area and its assessment of risk in bringing forward technically viable projects in advance of the market.

Under a "World Markets" view, South Hampshire is likely to view renewables from a purely economic standpoint and see merit in selecting sources of supply from whatever part of the country has the comparative advantage in terms of access to wind or other resources to generate electricity and use the grid to transport power to meet demand.

Under a "Local Stewardship" view a greater emphasis would be placed on maximising the use of local renewable resources to supply need as representative of the most carbon efficient and sustainable approach to meeting future needs. However, even under this scenario, maintaining the grid supply would still be important.

6.2 South Hampshire's Contribution

Strategic Renewables Contribution

Key decisions concerning the use of renewable energy within South Hampshire will be made by key decision makers outside the area. Decisions to invest in new capacity elsewhere in the UK and the transmission network capable of transporting that power to key centres of demand will determine a large proportion of the carbon intensity of the grid.

South Hampshire's main contribution to diversifying the grid will depend on the degree to which it can facilitate major offshore capacity being "plugged in" to the grid. The development of a tidal power array in the Solent might, for example, contribute to exploiting this resource. The final decision is, however, so dependent upon the interplay of production costs and market price for energy (both of which are highly unpredictable over the next two decades).

South Hampshire's contribution to renewables targets comes from eligible[12] installed capacity (measured as MWe) within its boundaries based on using:

- energy flows that are capable of interception within the South Hampshire boundary (e.g. wind speeds, solar insulation);
- using renewable raw materials produced within South Hampshire (e.g. municipal waste);
- using transportable renewable raw material produced outside the area as a feedstock for installations located within South Hampshire (e.g. energy crops);
- micro-generation.

[12] Eligible capacity is defined in PPS22 as Renewable Obligation Certificate (ROC) eligible capacity where 1 ROC is awarded for 1 MWh

Energy Flows in South Hampshire

Every part of the UK is subject to kinetic energy flows resulting from wind, solar radiation and the flow of water. The technical exploitation of these flows depends upon the limitations of available technology and the costs of accessing the flow. The resources available to South Hampshire are:

- On shore wind;
- Solar; and
- Geothermal (e.g. Southampton Medium Temperature Geothermal Well).

(Off shore wind and tidal stream lie outside the planning process and the boundary defined for South Hampshire; no significant hydro resource has been identified).

6.2.1 Onshore Wind

In 2004, a study of wind resources in Hampshire County as a whole concluded that onshore wind resources were constrained by a combination of existing natural conservation designations and restraints arising from aviation and defence interests. Overall, technical potential appears to be greater outside the study area but, within the South Hampshire[13] area, the following areas were identified as potential locations for wind power:

- Southampton & Eastleigh : two small areas east of Bishopstoke (close to Southampton airport and therefore may not be viable);
- Gosport, Fareham, Havant, Portsmouth: Small area to the north of Junction 11 of the M27.

These areas may only be sufficient to supply around 12 MWe given the need for unconstrained sites.

Future Trajectory

The resource will remain constant over the next twenty years but the means of exploiting it are expected to change. The costs of wind turbine technology could be expected to fall over the period of the strategy making exploitation more likely. However, the review of the local authority Annual Monitoring Returns does not encourage optimism that the resource is regarded as a priority for the private sector.

6.2.2 Biomass

Biomass requires land either to grow an energy crop or produce a by product like animal manure. The optimum location for energy generation using biomass material is to locate installations close to both the end user and the origin of the resource and the receptor for any residual material. However, biomass raw material is transportable without compromising the carbon benefits of moving the material around. Biomass related urban waste streams are also uniquely well placed for exploitation near to end users.

Biomass Resource	Electrical (MW) (Technical Capacity)	Heat (MW) (Technical Capacity)
Sewage Sludge[14]	0.5	7.6
Energy Crops (Miscanthus on current “Set Aside” land)	56.2	112.4
Farm Animal By products (Cattle, Pigs, Poultry)	9.1	10.9
Cereal Crop Residue[15]	0.2	3.8

[13] Test Valley was excluded from the assessment
[14] Sewage sludge based on total forecast population in 2026
[15] Cereal Crop Residue (Based on a 10% diversion of current estimated straw production from the wheat crop)

Biomass Resource	Electrical (MW) (Technical Capacity)	Heat (MW) (Technical Capacity)
Forestry, Arboricultural Arisings, Coppice[16]	11.2	13.4
Energy Crops on Unoccupied Flood Risk Zone 3 Land (3300 hectares) (Net) - Willow	6.9	8.3
Energy Crops on Unoccupied Flood Risk Zone 2 Land (3300 hectares) (Net) – Willow (9.4 hectares)	1.9	2.4
Sub Total (Based on Hampshire Biomass Resources)	85.0	158.8
Imported Biomass (1 Million Tonnes) through Port[17]	194	0
Total (with Imports)	**279**	**158.8**

(Source: UK Farm Survey June, 2006 in combination with the Arup Bioselex Model and Wood Resource Estimates of Sustainable Wood Fuel Supply)

Future Trajectory

Realising the technical potential is reliant upon decisions made by land owners over the use of their land. Energy crops (including wood) compete with food crops for a fixed land supply and whilst food prices are increasing it may be more profitable to use available land for the production of food. Animal waste related biomass is also subject to any future food security policy that diverts land used to rear meat towards more energy efficient cereals/ vegetable crops. Potential may exist to divert currently non productive land to the production of energy crops. Land affected by flood risk could provide a resource for growing additional energy crops however the feasibility of harvesting and processing of locally grown crops needs to investigated. Over the next twenty years, there may also be innovations in the use of novel biomass resources like algae to act as a biomass feedstock (this has a relatively high energy density meaning that less land is needed compared to other biomass feedstock alternatives). Genetic engineering may also be used to capture solar energy more efficiently. A longer term issue concerns the effect of unavoidable climate change on fresh water to support the growth of biomass.

6.2.3 Micro-generation

The area occupied by South Hampshire has been built over extensively with little attention to using natural forms of light, heating (solar gain) and ventilation when all these services could be provided by fossil fuel generated energy. The legacy has been a collection of buildings that has developed largely in isolation of their surrounding environment creating overshadowing; wind turbulence and poor orientation.

This legacy places limitations on what can be achieved by piecemeal retrofitting active renewables as well as passive (design strategy based) renewable technologies into the built environment. Studies on urban wind potential suggest that urban wind turbines rarely achieve their design peak performance level. Street patterns and orientation of buildings also affect the amount of solar energy available to supply power or thermal requirements.

Future Trajectory

The term “micro-generation” applies to small scale renewables including photovoltaic, solar thermal, micro wind, biomass but also micro combined heat and power and ground source heat pumps (which use fossil fuels more efficiently).

[16] Forestry, Arboricultural Arisings, Coppice (based on a calculated Hampshire County share of the Forestry Commissions estimate of sustainable wood production for the South East using productive woodland statistics as a distribution factor)

[17] Based on importation of 1 Million Tonnes of coconut husks at 13 GJ/t for electrical generation at an efficiency of 40%

The Energy Savings Trust (2005)[18] has suggested that micro-generation could supply between 30-40% of domestic energy needs by 2050. A recent report to CLG prepared as a precursor to the changes in permitted development rights has suggested that the technical potential exists for the following:

Micro Generation Technology	Technical Potential Share of Total Energy Need
Solar PV	30% of electrical demand
Solar heating	50% of domestic hot water
Heat Pump	100% of thermal
Micro Wind	15-20% of electrical demand
Micro Combined Heat and Power (CHP)	100% of Heating; 100% of hot water; 10-30% of electrical

(Source: Entec Study into the Implications of Changes in Permitted Development Rights)

The energy generation potential does however need to take account of the natural constraints on effectiveness.

For solar, it is only reasonable to assume that a proportion of available roof space might be suited to an installation[19] and that a significant amount of this space offer conditions unsuited to meeting peak design performance of the devices. Assuming priority for the generation of electricity, the combined roof space for domestic and non domestic premises might be capable of generating 1,140 GWh of power over the course of a year (equivalent to around 5% of the total requirement) taking into account system and area yield factors.

Scope may also exist for a wider deployment of heat pumps. There are a number of different types of heat pumps that all use compressor technology of a refrigerator to move heat from one place to another. They work by collecting heat from air, water or the ground using compression and expansion to magnify the heat and transfer it. Heat pumps consume energy for their operations (electricity) however for every unit of electricity consumed, between 3 and 5 units are typically returned (dependent upon performance and conditions) where the heat source is the ground. This ratio is expressed as a "Coefficient of Performance" (COP) and varies according to the proficiency of the installation and the heat source (the COP is less for air source heat pumps). Deployment depends upon the right ground conditions in proximity to consumers of heat. Assuming 1% of the existing green-space and garden land were suited it might be possible to secure nearly 19 MWth capacity for meeting heat needs.[20]. The deployment of heat pumps in areas unsuited for CHP network development by reason of a low development density may make for a more economic solution to providing heat and cooling. Heat pumps could also be designed to transfer heat into district heating networks. These installations are very sensitive to the correct installation of the technology (e.g. proper spacing of the pipe network).

Micro CHP has previously been highlighted as a potential contributor to low carbon in the DTI Microgeneration Strategy accounting for a possible 30 – 40% of the UK's domestic electricity demand In November 2005; the Carbon Trust published its first interim report on field trials of micro CHP. The results were lackluster with about a third of the houses were saving carbon, a third were breaking even, and a third were actually emitting more carbon relative to the baseline. It is, therefore, uncertain to state what level of contribution might be achievable from this source.

The technical potential assessment does, however, fail to adequately capture the full extent of site locations of micro generation renewables in urban areas in particular. Variable height buildings and obstructions cause wind turbulence and shading reduce the effectiveness of

[18] "Potential for Microgeneration Study and Analysis" EST/ Econnect/ Element Energy (2005)
[19] Based on the assumptions taken from the "Solar ElectriCity Guide"
[20] Assumes 500 square metres is needed per 10kW

wind and solar renewables well below their peak design performance. In a worst case scenario, their carbon savings may fall below the carbon used to build them in the first place (even though most of this will be "off balance sheet" as manufacture will almost certainly take place outside the UK).

The extended payback for many micro-generation devices makes them unattractive to consumers. The "Unlocking the Powerhouse" report produced by a collaboration of universities including the University of Southampton has concluded that the market place needs to be altered if micro-generation is to play a significant role. Without intervention, the Energy Savings Trust[21] has projected a maximum penetration rate of 7% for the domestic sector by 2050 based on a mix of micro wind (based on a 10% loading factor achieved at urban locations), solar thermal and photovoltaic.

Life Cycle Analysis and Renewable Investments

Life cycle analysis looks at carbon dioxide emissions over the lifetime of a product or service. Under this methodology, emissions related to the production; installation and decommissioning phases of a new renewable device must be considered alongside emissions saved during the operational phase of the device. Devices in marginal locations may find that they fail to make a carbon payback as might be the case in a poorly sited micro wind turbine (low wind speeds and/ or urban turbulence). Currently, the UK carbon accounting policies focuses on operational emissions only and discounts emissions related to goods produced abroad.

6.3 Using Renewables to Support Reduction Actions

It is, however, possible to translate the reduction wedges into a notional amount of additional capacity. Delivery of the wedges involves either a reduction in the use of energy or substituting carbon intensive energy production with less carbon intensive energy production compared to the baseline.

Each of the wedges makes assumptions concerning the scale and nature of energy supply, these assumptions are shown below:

Wedge Title	Energy Supply Assumptions
Greening the Grid	Assumes new capacity is connected directly into the grid contributing the greening of the grid. Strategic renewables are likely to be connected into the transmission network.
Code for Sustainable Homes	Assumes new capacity has to be delivered on or near to development site as part of a decentralised generation strategy within a private wire arrangement leading to reductions in the draw off from the grid.
Code for Sustainable Business	Assumes new capacity has to be delivered on or near to the development site as part of a decentralised generation strategy within a private wire arrangement leading to reductions in the draw off from the grid.
Retrofit Demand Reductions to the Existing Domestic Stock	Assumes reductions achieved by energy efficiency alone.
Retrofit Demand Reductions to the Existing Non Domestic Stock	Assumes reductions achieved by energy efficiency alone.
Congestion Charge	Assumes reductions achieved by a reduction in the consumption of transport fuels.
Decentralised Generation	Assumes an electricity bonus from the supply of existing heat in parts of South Hampshire with a high density of demand.
National and EU Measures	No specific assumption concerning the use of renewables.

[21] "Generating the Future: An Analysis of Policy Interventions to Achieve Widespread Microgeneration Potential" EST (2007)

Some of the reduction wedges are either based on energy efficiency alone or low carbon energy or both. The amount of new capacity that needs to be developed within South Hampshire is, however, a more subjective issue dependent upon the interpretation of the existing policy framework.

"Planning Policy Statement 1 – Climate Change Supplement" expresses the expectation that Local Planning Authorities will seek a proportion of energy from decentralised generation (combined heat and power). "Building a Greener Future" sets progressive improvement targets in carbon performance for new build moving to zero carbon by 2016. The carbon performance standards are linked to those used within the Code for Sustainable Homes although the Code itself is not a mandatory requirement per se.

The Code does, however, provide guidance on the deployment of renewables in housing. The standard awards the highest number of points to houses that provide at least 15% of total energy supply through local renewables and low carbon sources. The technical guide to the Code is more prescriptive stating that "off site" generation is only permissible where supplied through a private wire arrangement (capable of demonstrating additionality). The application of this test would mean that the supply to the new build over the next twenty years should be based on a supply capacity within South Hampshire. New standards are also being advanced for the non domestic sector.

6.4 Energy from Waste

Currently in Hampshire there is an infrastructure capacity of 420,000t with a potential for 35Mw of energy generation. Whilst accepting that not all commercial wastes will be diverted from landfill but that most municipal wastes will (More for Less Strategy), there is scope for significant addition energy recovery or combined energy & heat (CHP) recovery facilities, be these incinerators, aerobic/anaerobic digesters or other conversion technologies. Even if recycling were to be increased beyond 60% in the municipal sector the potential also remains for additional capacity to be available from neighbouring waste disposal authorities as well as, potentially, commercial enterprises outside Hampshire in the wider SE England sub-region as a part of net self-sufficiency aspiration.

At present only the bio-waste fraction (c. 12%) of residual waste energy recovery would be considered to be renewable and would qualify for Renewable Obligations Certificates (ROCs), subject to method of generation, thereby increasing the value of the energy produced. This also equates to an estimated 13MW contribution towards the PUSH's renewable energy generation capacity. The remainder would contribute to reducing the demand for conventional energy (fossil) fuels.

Opportunities to retro-fit current energy recovery infrastructure for heat capture in Marchwood, potentially connecting to the existing Southampton District Heating Scheme, and Portsmouth, potentially connecting to existing public building or to new commercial developments in the facilities neighbourhood, are being investigated.

In addition, logic would dictate that the required development of new residual waste infrastructure, should be located and constructed conterminously with developments in the South Hampshire SDAs, thereby reducing material transfer requirements and costs and so that the heat and energy recovered can be utilised locally thus reducing transmission losses.

The investment necessary to deliver such a district heating scheme would be considerably reduced if the distribution network could be embedded simultaneously alongside the other service infrastructure rather than retrofitted at a later date and be only a minor element of the overall infrastructure development costs. Coordination with infrastructure budgets is essential in this regard, particularly the strategic management of the proposed Community Infrastructure Levy.

Further research has also identified significant potential for energy generation from wood waste.

6.5 Network Connectivity

No physical constraints are known to exist preventing the connection of new capacity to the distribution network run by Southern Power Distribution.

South Hampshire along with the rest of the South East has been the subject of a number of studies concerned with establishing the carrying capacity of the existing infrastructure base in the light of concerns over the implications of large scale housing growth arising from the Sustainable Communities Plan. Whilst South Hampshire is not part of one of the four growth areas, it does have a committed Growth Points that collectively require additional housing building of 40,425 by 2016 (Source: CLG Website Growth Point Briefing).

Most of the infrastructure studies assume Ofgem's administered price review process will ensure sufficient investment in the transmission and distribution network to overcome any problems. However, evidence from other regions has suggested that the planning assumptions used to identify network reinforcement and renewal assume uniformity in load growth over their operational region. The lack of a spatially fine level of resolution may mean that specific needs arising from the growth anticipated in South Hampshire may not be identified. Southern Power Distribution will also face the same financial constraints as other Distribution Network Operators in so far as they are prohibited from investing in speculative new capacity. Problems may occur as projects come forward for connection into the distribution system (it is assumed that the scale of new provision is likely to fall below the level requiring connection directly into the transmission network).

South Hampshire will have a particular interest in ensuring that sufficient investment is made to bring renewable resources on the western edge of Great Britain and Scotland to the locations of significant demand in the South East including South Hampshire. The distribution network will also need reinforcement investment as generation becomes dispersed at the local level. Once renewable generation reaches significant proportions there are likely to be additional problems from the perspective of managing the changing nature of supply against demand (see box).

Energy Demand Responsiveness and Renewables

A demand responsive energy supply system has become an unquestioned assumption of modern life. Energy demand fluctuates daily and over the course of a year with added variety in the form of the mix of fuels demanded. The current supply system has emerged because it has been possible to match need with fossil fuel based systems. Installation based renewables are subject much more variability because the wind does not blow all the time and the sun only shines for a part of the day. It is therefore much more difficult to synchronise supply with patterns of consumer demand without resorting to expensive storage options or back up supplies such as nuclear to provide base load needs.

Ofgem will, however, be faced with conflicting pressures. On the one hand, the need for competitive prices to reduce household exposure to fuel poverty whilst avoiding well publicised international failures in supply where decisions to invest in new generation capacity have now led to systemic failure as demand has crept beyond supply capabilities. An emergent cost for the network will emerge from the need to adapt to the effects of unavoidable climate change (see box).

Climate Change Adaptation and Energy Infrastructure

Unavoidable climate change creates changes in weather patterns that change the performance of energy infrastructure as well as the load patterns from consumers. Energy supply companies will need to improve their forecasting capabilities to deal with the anticipated surge in air conditioning likely to arise from warming. Over the longer term, climate change is likely to cause shifts in population which will similarly change geographic patterns of demand. Climate change can also affect the efficiency and availability of generation assets. Thermal power plants can be sensitive to the availability of cooling water temperatures with a consequent risk that extended periods of drought can reduce efficiencies or even create a need to shut down capacity. In 2003, during the heat wave of that year, the French energy utilities had to reduce power output by 10% because of cooling water constraints. Some climate change scientists also consider that wind patterns will also change as a result of climate change impacting on the viability of wind turbine capacity. A number of power plants are exposed to the risks of rising sea levels or flooding. Parts of the transmission and distribution network is also similarly compromised from flooding and changes in ground conditions (especially in areas where clay soils dry out and saturate in response to extreme weather events).

The loss of significant nuclear generation capacity combined with the enforcement of higher environmental performance standards on coal fired capacity will have a significant impact on the UK's generation capacity leading to a potential shortfall. Government has already signalled an intent to develop a new fleet of nuclear stations and bring forward new "cleaner" coal fired stations but there is a potential timing issue between the loss of old capacity and any new capacity.

These factors introduce uncertainties into the security of conventional supplies of energy over the period of this strategy. The investment in the Marchwood Combined Cycle Gas Turbine can be seen as part of Scottish and Southern's longer term strategy to ensure that it can still supply its customer base in the midst of this uncertainty (assuming gas supplies are not interrupted).

Key Points

This section reviews potential renewable options capable of contributing to South Hampshire's development of renewable energy[22].

The review accounts for the definitions of installed capacity accepted through PPS22.

South Hampshire is a low density urban area. Constraints exist in terms of wind power. Significant potential exists for biomass but relies on bringing in supplies from outside the area. Utilisation of biomass has to be balanced with the need for food production and the viability of collecting/ processing the feedstock.

[22] Modifications to the South East Plan has resulted in the removal of sub regional specific policy targets contained in Policy SH14. PUSH are considering their response to this modification.

7 New Development

Although emission reductions from new development (domestic and non domestic) represent only a small proportion of the total emission reduction potential, it is an area of activity where the Local Planning Authority partners in South Hampshire have the greatest leverage to effect change. This chapter considers issues concerned with bringing forward new development capable of meeting challenging emissions performance standards.

Over the next twenty years, the Regional Spatial Strategy for the South East requires 80,000 houses and 2 million square metres of employment space to be built in South Hampshire. Phased over 20 years, a significant share of the total will need to meet the zero carbon standard set in “Building a Greener Future” policy document and the commitment to achieve zero carbon for non domestic buildings by 2019 (2008 Budget Statement).

Meeting future revisions of building regulations means that a quantum of carbon dioxide (CO_2) attributable to each phase of development must be removed against Part L of the Building Regulations baseline except after 2016 (2019 for non domestic buildings) when occupant-based emissions become part of the baseline.

Each quantity of carbon dioxide can be reduced by:

- Increased energy efficiency within the project including appliances;
- Purchasing of carbon-neutral energy from outside the project (dedicated off site although the nature of this provision would have an implication for achieving a rating under the Code for Sustainable Homes);
- Purchasing carbon-neutral energy from outside the project (non attributable through a tariff which would again have an implication for the rating achievable under the Code for Sustainable Homes);
- “On-site” provision of renewable energy generation.

7.1 Cost Implications of Reducing Carbon Dioxide Emissions in New Development

Carbon dioxide savings can be achieved from energy efficiency. Beyond minimum policy compliance, the level of energy efficiency is an economic choice. In modelling a basic masonry build detached house, for example, it would be possible to achieve a 45% reduction in the Target Emissions Rate (TER) using a combination of air tightness, super insulation and mechanical ventilation energy efficiency but at a high materials cost resulting in a high cost per kgCO2 removed.

The costs associated with designing out energy demand may not always compare favourably in cost terms with the deployment of renewable technologies (however this relationship is in constant flux as innovations occur in materials and renewable generation). As a consequence it is an economically rational choice to factor in a lower level of energy efficiency until such time that the economics of super insulation change in favour of early implementation.

These cost assumptions are however sensitive to the building design, the use of different construction techniques, materials and design all of which can change costs significantly. One company has already established a partnership with an overseas concern to import prefabricated houses that use super insulated panel forms of construction to assemble a 2 bedroom house for £88,000 excluding land cost.

Example of 1000 Detached Houses

80,000 houses are to be built over the next twenty years. Assuming a hypothetical 1,000 houses needed to be delivered to zero carbon standards, different mixes of renewable technology would result in significantly different unit costs per house.

The first design choice concerns the degree to which carbon dioxide savings are to be secured through energy efficiency like super insulation of walls, floors and ceilings; installation of triple glazing, etc.

Reducing energy demand in the first place is usually a desirable design objective however this is likely to involve the use of more materials or more expensive solutions (including an improved quality of finish). In this example, it is assumed that Passivhaus standards of thermal efficiency have been adopted based on achieving 15 kWh/m^2 /p.a.

A low space heating requirement leaves a residual need for energy to provide for peak heating requirements; domestic hot water and electrical appliances.

Potential options for meeting this requirement could include:

Option 1: **Houses equipped with biomass heating and domestic hot water plus wind turbine supplied energy;**

Option 2: **Houses equipped with biomass heating; Domestic Hot Water split 50/50 between biomass heating and solar thermal and wind turbine supplied energy;**

Option 3: **Houses equipped with biomass heating; Domestic Hot Water split 50/50 between biomass heating and solar thermal and power supplied 50/50 between wind turbine and solar photovoltaics;**

Option 4: **Houses connected to site wide biomass fuelled combined heat and power system.**

Based on the capital costs per kilogram of carbon abated (2007), each option would result in the following outcomes per house:

Option1: plus £11,026

Option 2:plus £13,853

Option 3:plus £21,654

Option 4:plus £ 4,410

If the Passivhaus standard was unacceptable, the costs for each option would go up because more heat energy would be needed to compensate for the lower thermal efficiency of the dwelling.

A significant influence on cost is the selection of renewable generation system especially for the generation of power. Essentially, there are two generic types of system: building based functionally autonomous systems and site wide provision. Building based functional autonomy refers to the provision of the necessary renewable generation equipment to enable an individual building to generate the required energy services (over the course of a year) on its own account without recourse to collective infrastructure (this would however include connections into the grid to manage peak load variations). Building based functional autonomy is reflected in options 1 to 3 listed above. The term “site wide” provision refers to systems which negate the need for each building to be equipped for functional autonomy with respect to the delivery of energy services (option 4). Site wide provision relies of an underlying infrastructure of pipes and wires plus generation/ fuel store/ hot water storage facilities which service a range of properties. Site wide provision will require the creation of an organisation capable of managing the collective infrastructure over the life of the project. Site wide solutions also present commissioning problems if sites are built out over phases which may affect the operational effectiveness of the technology. Within the building based functional autonomy model, the occupier/ landlord would hold responsibility for the continued and efficient operation of the building’s system.

The mix of these system types within new development has a significant effect on cost. Based on indicative cost data, option 4 represents the cheapest mix of delivering renewables to meet the carbon targets. This option assumes site-wide infrastructure to meet carbon dioxide abatement targets. The deliverability of this solution is highly dependent upon design density; proximity to complimentary loads (particularly large non domestic consumers of heat) and the existence of a management structure to maintain the site wide infrastructure (e.g. pipework, energy centre and fuels).

The more residential development is delivered at lower densities or micro power used (e.g. wind and solar photovoltaic), the more expensive delivery becomes. Conversely, more residential development delivered at a higher density means a greater potential for site-wide solutions and a lowering of cost.

7.2 New Housing and Economies of Scale

The cost of producing a zero carbon dwelling is currently prohibitive. The government is relying on using regulation to stimulate scale economies in renewables and design methods that will enable costs to be reduced. It will, nevertheless, hold true that the costs of provision can be held down where renewables technology can operate at a scale such that an individual household can receive its low carbon energy through devices that avoid having to equip each house with the equipment necessary to generate its own supplies independently. Combined heat and power offers the potential of substituting the need for an individual boiler with a heat exchanger. The economics of running CHP requires a minimum scale and density/ mix of heat demand. South Hampshire does however rely on a proportion of its housing target being met from “windfall” sites that tend to be smaller. Analysis of housing land allocations in extant planning documents within the South Hampshire area suggest that an average of 44.5% of allocations are located on sites with less than 100 houses. In the more urbanised parts of South Hampshire, the dependency on smaller sites climbs to 88.2% (for Portsmouth). Experience suggests that the best economies of scale are obtainable on sites where it is possible to master plan 200 plus houses. However, the supply market is changing resulting in a possible lowering of the minimum economic size of site that it is possible to service using site wide infrastructure. It does, however, still require an organisation prepared to run and maintain a system and smaller systems are likely to be less attractive as an energy services proposition.

Whilst site wide provision offers economies of scale in meeting low carbon performance standards, the future low unit demand for heat will represent a challenge to the operators of site wide energy generation and distribution systems. The inclusion of heat intensive users within a development has the potential to create a non domestic market for heat otherwise unavailable through domestic sales alone. Efforts should be made to look at ways of mixing in non domestic uses within key development sites such as civic, community, health and leisure uses.

7.3 Implications for Raising the Level of Renewable Energy Capacity in South Hampshire

Despite the County wide study in wind power potential, there has been no firm proposal brought forward to build a dedicated wind farm in South Hampshire where significant constraints exist. Most activity has been focused on Energy from Waste projects or micro community projects (based on a review of LPA Annual Monitoring Reports).

Whilst renewable energy generation will be needed to offset emissions from the existing urban fabric a lot of this activity will take place outside the planning system (as a result of the reform of permitted development rights). It is also recognised that there is a significant lead time to making in roads into the existing urban fabric. For example, Southampton’s district CHP system has taken 10 years to get to its current state of maturity and it is still only responsible for reducing emissions by 1%.

Under these circumstances, new development may need to play a disproportionate role in delivering new installed capacity in the area. New development may act as a catalyst for additional biomass plants with capacity to supply adjacent existing development as well as larger scale community wind power. Whilst the approved modifications to the South East Plan have now removed the sub regional target for South Hampshire, a notional 100 MWe target could be apportioned out to individual Local Planning Authorities based on their share of the new housing and non domestic floorspace allocations which the sub region is committed to deliver over the next twenty years. Such an apportionment strategy would suggest the following district level targets (taking into account the distribution of SDA related housing and strategic workspace):

Table: Indicative Apportionment of a Notional 100 MWe Target for PUSH over the Next Twenty Years

District	Indicative MWe
East Hampshire (part)	0.88
Eastleigh	20.80
Fareham	12.06
Gosport	5.27
Havant	8.04
New Forest (part)	2.93
Portsmouth	14.53
Southampton	19.01
Test Valley (part)	6.93
Winchester (part)	9.55

However, those districts relying on smaller sites will, however, be unable to exploit economies of scale in delivery of cost effective renewable systems (in terms of current costs and technology availability). Heavily urbanised districts such as Portsmouth and Southampton will only be able to meet their targets at a much higher cost because they lack the sites capable of exploiting economies of scale.

The higher cost will have ramifications for the viability of development as a whole by reducing the residual value left in the development able to pay for social/ community infrastructure as well as meeting the expectations of land owners to ensure their willingness to release land in the first place. In the absence of specific site appraisals, the question is essentially one of economic viability rather than technical capability (this will become critical when setting a “Community Infrastructure Levy” (CIL) charging schedule or revising tariffs). Local Planning Authorities may need to develop a robust framework for determining appropriate trade offs between affordable housing, critical infrastructure, social/ community facilities and carbon efficient development.

Under these circumstances, those parts of South Hampshire lacking suitable sites should be encouraged to request commuted sum payments towards strategic low or zero carbon energy infrastructure.

Key Points

The new build programme offers an opportunity for South Hampshire to create communities that maximise standards of energy efficiency and innovative use of renewables.

This section does however highlight the costs associated with delivering low to zero carbon performance.

The greatest scope for delivering viable solutions will be on the Strategic Development Areas and the Urban Extensions where sufficient scale exists for economic delivery.

Locations unable to bring forward development at a scale capable of allowing site wide solutions risks loading significant costs onto development leading either to the displacement of other policy requirements or a deferral of new development by developers and land owners.

Consideration should be given towards the flexible application of Policy SH14 allowing areas reliant upon small windfall sites to make commuted sum contributions towards energy infrastructure where consistent with Circular 05/05 (i.e. contributions necessary to ensure development proceeds).

PUSH will need to regularly reassess the supplier market to assess whether new equipment makes site wide provision more feasible at a smaller scale.

8 Existing Buildings

Whilst new buildings offer the most levers to effect change, the greatest gains can be affected through changing the performance of the existing stock of buildings in South Hampshire.

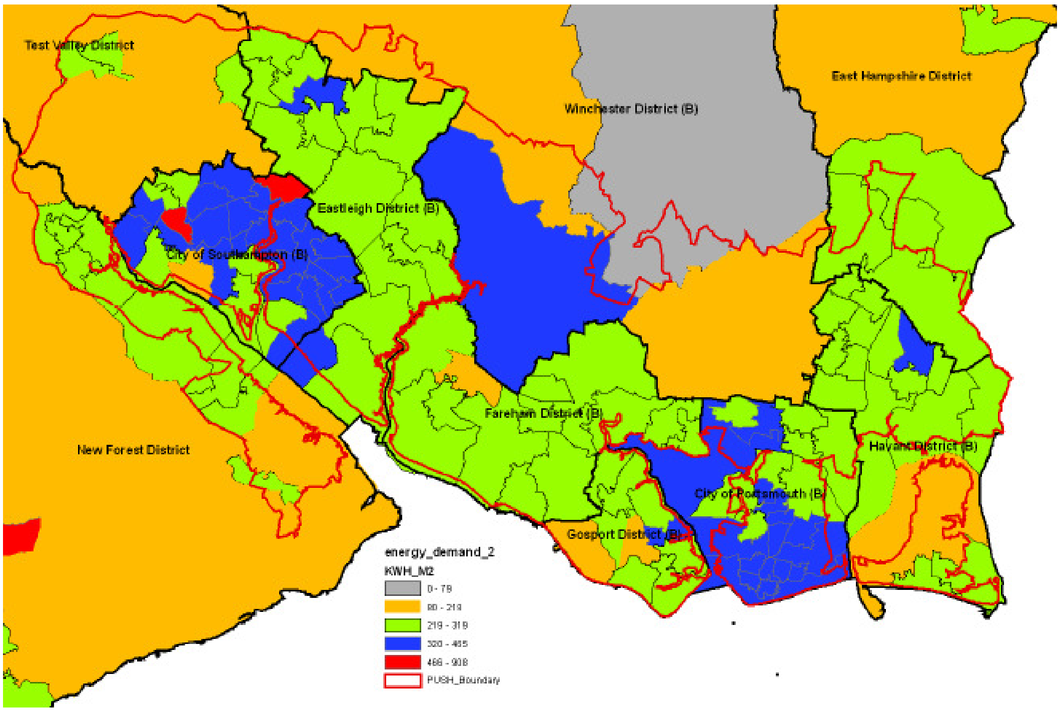
Carbon dioxide emissions from the existing stock reflect the poor energy efficiency of the existing stock of domestic and non domestic stock, the vast majority of which were built before energy efficiency was regarded as a material concern. This factor is not unique to South Hampshire but pervades most urban development in the UK. In an era where people expect to walk around in buildings in their shirt sleeves, the energy needed to compensate for poorly insulated, leaky (in terms of heat) buildings remains high. A house built to thermal standards used in 1975 requires 714% more energy for space heating and domestic hot water compared to a super insulated "eco house" suggested as appropriate now.

The wedge strategy proposes two kinds of approach based on achieving greater energy efficiency to the stock and creating supply systems that help meet residual energy demand. In applying this twin pronged approach, the yields gained from energy efficiency measures must be assessed realistically especially for older properties. The level of investment needed to bring a solid wall premises up to levels of energy efficiency that register on Code for Sustainable Homes would normally be prohibitive and disruptive. Consequently, the residual energy load still needing to be met in existing communities is likely to relatively higher than areas built to more rigorous building standards today and the next twenty years.

As established in Chapter 7, the cost of equipping each building with the requisite equipment needed to generate their own need from renewable sources is typically greater than implementing site-wide solutions especially if the residual load is greater than for new buildings. There is, therefore, a benefit in finding locations where site wide solutions can be brought forward effectively. The preconditions for viable site wide solutions are complex dependent upon densities of energy demand; complimentary energy loads; pre existing energy systems and property owner preferences. Many of these considerations can not be modelled at a macro scale and, therefore, need to be considered on a case by case basis. Nevertheless, economies of scale can be achieved in areas where social housing is prevalent either through Council owned or Registered Social Landlords. Tenure control offers a means of applying site wide measures.

Recent changes in statistics do, however, allow some limited assessment of where energy demand hot spots are using a combination of local land use statistics and BERR energy consumption statistics for gas and electricity.

The map below shows the combined energy demand per unit of domestic/ non domestic land use type (square metres of ground covered). Whilst some of the assignments of consumption to small areas are subject to error, the pattern shown in the map reveals concentrations of energy demand mainly in the middle level super output areas (MLSOAs) covering the key urban centres of the sub region.



Hampshire County Council are in the process of producing a more comprehensive set of detailed heat maps which will help expand understanding of energy use within the existing built environment.

8.1 Improving Energy Efficiency in the Existing Housing Stock

With Government's commitment to increase housing supply, around two-thirds of homes standing in 2050 are likely to have been built before 2005. New build represents only approximately 1% of the total stock each year. Building Regulations have raised energy efficiency standards of new homes significantly in recent years – current (April 2006) standards are 40% higher than for properties built in 2002; 70% more than in 1990. So most of the existing stock will still exist in 2050, were constructed to a significantly lower standards than new build today. The existing stock, therefore, accounts for the great majority of carbon emissions from dwellings, both in terms of their lower energy efficiency and their numbers.

Energy efficiency varies widely across the stock. The energy efficiency of many older homes will have been improved over the original condition as a result of householder improvements such as installing new boilers, draught-proofing and insulation. But, overall, there remains a close correlation between the age of a property and its energy efficiency. Improvements in the energy performance of new build, combined with household improvements have led to an increase in the average energy efficiency of the stock. Two thirds of all properties have SAP values between 41 and 70. There is a clear trend that older properties have much lower energy performance with over 40 per cent of properties built before 1919 with SAP less than 41. By contrast 60 per cent of properties built since 1990 have SAP ratings above 70.

South Hampshire has the benefit of having a relatively young housing stock which is borne out of the stock age profile for the sub region[23] containing South Hampshire:

Age Bands	SAP (UK Average)	Proportion of Stock
Pre 1919	42	18%
1919- 1944	47	16%
1945-1964	50	19%
1965-1980	54	28%
Post 1980	67	19%

8.2 Technical Measures to Tackle Energy Efficiency in the Stock

There are a number of existing technologies that can help reduce carbon emissions from the existing domestic stock. As the majority of carbon emissions are generated by space and water heating, an effective way to tackle emissions without changing behaviour or the carbon content of the mainstream energy supply is to improve the thermal efficiency of the building, so that less energy is needed to heat the property.

Improving efficiency involves a combination of improving insulation and using the most efficient heating systems. More commonly applied potential measures are listed below, with typical costs and potential savings that can be made.

Measures	**Average cost (£)**	**Cost saved (£/yr)**	**Carbon saved (kgC/yr)**	**Pay- back (yrs)**	**Potential homes ('000)**
Hot water cylinder insulation	14	29	53	**0.5**	1,137
Cavity wall insulation	342	133	242	**2.6**	8,500
Loft insulation (full and top-up)	284	104	190	**2.7**	6,186
Improved heating controls	147	43	77	**3.4**	2,102
Draught proofing	100	23	43	**4.3**	9,793
Micro CHP	1,571	230	508	**6.8**	12,000
Solid wall insulation	3150	380	694	**7.5**	7,479
A-rated boiler	1,500	168	177	**8.9**	17,128
Micro wind	2,363	224	263	**10.5**	-
Ground source heat pump	4,725	368	990	**12.8**	17,000
Photovoltaic (PV) electricity	9,844	212	249	**46.4**	9,892
Solar water heating	2,625	48	88	**54.7**	19,330
Windows (Single to Double Glazing)	4,000[1]	41	26	**97.6**	10,746

Note: Based on a three bed semi detached house. Savings are expressed in gross terms and do not, therefore, account for increases in thermal comfort standards of occupants which may clawback up to 30% of savings (Source BRE)

Whilst the sub region benefits from having a younger stock profile, the interventions needed to bring carbon emissions downwards still further become more problematic. Most of the easier measures (e.g. cavity wall insulation) will have been completed leaving either the more expensive options to reduce emissions further with the longer payback periods.

[23] Source: Survey of English Housing, Sub Regional Report for Hampshire and the Isle of Wight

Moreover, as adaptations to the “easier to treat” houses are undertaken, the “hard to treat” parts of the stock are likely to become a large proportion of residual emissions.

The hard to treat stock is generally properties that have any of the following features: solid walls, off the mains gas network, no loft space, high-rise blocks, or for other technical reasons cannot be fitted with standard efficiency measures. Earlier research suggests that 99,000 properties fall into the category of “hard to treat” houses based on a formula that classifies pre 1919 and a proportion of inter war housing as falling into this definition[24]. Local variations are identified in a range of local authority strategies concerned with housing strategies, decent homes, stock condition assessments and fuel poverty. These suggest that a significant share of “hard to treat” housing is likely to be found in the older urban areas. There are no distinguishing socio-economic characteristics of households in hard to treat homes, as recorded in the English House Condition Survey, relative to the whole domestic stock. Nonetheless, as size and age are important drivers in energy performance (and hard to treat properties tend to be older and larger) it is likely that these properties have a relatively higher value in the market, and also tend to be privately owned.

The table below reveals the diversity of conditions relating to the stock in the sub region:

Fareham	93% of it was constructed after 1919 and 60% after 1964. 37% are detached houses and a very low proportion, 9%, is flats. The levels of unfitness or serious hazard are highest in the pre 1919 stock and are also highest in the central and eastern wards of Portchester and Fareham, although this is where the majority of older stock is concentrated.
Gosport	The majority of buildings, (20,124 -77%) have a SAP rating between 30 and 60, which is higher than the national position where 65% fall in this range. Only 783 (3%) dwellings have a SAP rating less than 20, which is lower than the national average of 15%.
New Forest	The average SAP rating as 50. Using the sample of 5,000 Home Energy Reports completed by owner occupiers the average SAP rating is recorded as 61.02.
Portsmouth	Over 46% of Portsmouth’s housing stock originates from the pre 1919 era at very high densities. The average SAP rating for a dwelling in Portsmouth is 48.
Southampton	9% of homes in Southampton have a SAP rating below 30 when the average in the city is 48.
Test Valley	Average SAP rating per property is 48.
Eastleigh	The average SAP rating for a private sector dwelling in the Borough was 55 which compares to an average for all dwellings in England of 51. 81% have a SAP rating between 40 and 70 which is higher than the average in England. 1% (466 dwellings) has a rating of less than 20, lower than the England figure of 5%. The most modern stock has the highest SAP – 59 for the most modern age band, post 1964 era. The private rented dwellings have a mean SAP of 57 compared to 55 for owner occupied dwellings. 950 dwellings (2.3%) are in fuel poverty within the Borough.
Havant	The energy efficiency of the Borough’s housing, as measured by SAP ratings, is relatively high. At 57, the average figure for homes in the Borough is approximately 6 points higher than the England average. *(‘Havant Borough Council House Condition Survey’, 2005, PPS Housing and Environment)* SAP ratings in the social housing sector are especially high.

Current targeting would still leave a residue of reasonably maintained owner occupied and privately rented housing, occupied by non vulnerable households in hard to treat housing. In hard to treat housing, the measures needed to improve thermal performance are likely to still fail any financial viability test due to the complexity of improving insulation properties. As take up of economically viable measures become exhausted, emissions will increasingly become concentrated on hard to treat properties where the economic incentives are weakest.

8.3 Retrofitting Passivhaus components

The wedge covering energy efficiency in the housing stock is a challenging target. Yet, continental policies have been successful in advancing the ‘Passivhaus’ standard for use in

[24] Does not exclude those parts of authorities split between South Hampshire and the rest of Hampshire

existing buildings. Key parameters for “Passivhaus” are a specific space heat demand maximum of 15 kWh/m2 TFA, a specific primary energy demand for space heating, cooling, domestic hot water, electricity for pumps and ventilation and household appliances at a maximum of 120 kWh/m2 TFA, a maximum heat load of 10 W/m2 TFA, and an air tightness of n50 0.6/h maximum.

However, since 2001, more and more renovations in Austria, Germany and Switzerland have been carried out using components that had previously been tested in new passive houses. Different names are used for these houses, sometimes called ‘factor 10-houses’ as the energy demand after renovation is only a tenth of the original demand. In these projects, a specific heat demand after renovation of 15 kWh/m2 TFA, was achieved.

The main elements of the energy concept are typical passive house components:

- Excellent insulation level of opaque building elements: u-values range from 0.10 W/m2K for walls and roof to 0.18 W/m2K for basement ceilings.
- Triple glazed windows with adequate frames and an optimized installation.
- Thermal bridges reduced to a minimum.
- The air tightness was improved by a factor of 6–10, the limiting value for new passive houses was achieved.
- A ventilation system with highly efficient heat recovery installed.
- Thermal solar collectors installed covering up 60% of the annual energy demand for domestic hot water.
- Highly efficient condensing gas boilers were installed; where possible, ducts have been insulated to a very good level; in other projects biomass boilers have been successfully tested.

Benefits of the retrofit programme

Experience with the renovations up to passive house standard is so far very good in the Vorarlberg projects, as well as in projects in other regions of Austria, Germany and Switzerland. Thermal comfort has been improved to a level superior to that of a conventional new house; due to the ventilation system the air quality is improved, and energy bills are reduced drastically. As thermal bridges are minimized, the air tightness is significantly improved and the air exchange is always up to hygienic standards due to the ventilation system; the main causes for structural damage and mould problems are also eliminated.

Austrian and German research has shown that for bigger apartment buildings renovations to passive house standard or very close to it cost about 300% more than a renovation undertaken to national building code standards. Nonetheless, detailed analyses show that most of the measures used in passive house retrofit are economically feasible, for example, the overall lifecycle cost for investment and energy is lower using the passive house insulation of 26 cm compared to the building code insulation of 12 cm. As for most renovations lifecycle costs are not calculated, home owners and housing companies tend to realize suboptimal insulation thicknesses, for example.

8.4 Potential paths to achieving Carbon Emission Reduction by 2026

There are a number of existing and announced policies impacting on the building fabric and affecting domestic energy efficiency:

- the **Carbon Emission Reduction Target** (CERT) is the new flagship (replacing the Energy Efficiency Commitment) instrument to improve energy efficiency in the household sector and works by imposing a statutory obligation on energy suppliers to promote energy efficiency measures directed at householders.

- The **Decent Homes Standard** is a composite of measures to achieve “fitness of habitation”; address disrepair; modernise facilities and reasonable levels of thermal efficiency. The last element has been focused on avoiding excessive hot and cold temperatures through efficient heating and effective insulation including 200mm of loft insulation. A “Decent Homes Plus” standard is proposed to supersede the current standard for 2010 and is expected to include a greater emphasis on thermal efficiency. The standard does, however, only refer to wall insulation if cavity walls exist, placing limitations on what could be done with solid wall housing (mainly pre 1919 stock). The decent homes standard is also only targeted at Council owned stock and those elements of the private stock deemed to currently fail the standard and occupied by vulnerable households.
- **Warm Front:** Government’s main grant-funded programme for tackling fuel poverty, launched in June 2000. The scheme fits packages of measures including insulation and heating systems. Grants are offered up to £2,700 for families and the disabled and a grant of up to £4,000 where the work approved is installation of an oil fired central heating system.
- **Energy Performance Certificates (EPCs)** will be required on sale or rent of buildings. They will give potential buyers/tenants information on the current performance of a house and its cost-effective potential, setting out the cost-effective measures relevant to the property.
- **Building Regulations:** If building work is being carried out on existing buildings, the building regulations are likely to apply. This covers work from building an extension to replacing windows or the boiler. Part L of the building regulations sets standards related to the conservation of fuel and power.

Key Points

Generally, improving the stock has *diminishing marginal returns,* in terms of the incremental carbon saving by adding each additional measure. Once the cheapest (and usually easiest) measures have been fitted (e.g. Cavity Wall Insulation and loft insulation), to make further improvements to the energy performance of the property becomes relatively more expensive.

Retrofitting a property to the highest energy performance standards usually requires some form of low carbon energy source i.e. micro-generation. For properties that are hardest to treat (typically those with solid walls, no mains gas and no loft), retrofitting to an average energy performance standard is currently much more costly as it would generally require either solid wall insulation or micro-generation.

The diminishing returns problem will have being experienced by Energy Supply Companies who may reach a point where they exhaust “easy wins”. Opportunities may exist for PUSH to work with the Scottish and Southern Energy to deliver the CERT programme commitments through targeting programmes more effectively and looking at where community renewable solutions may defray costs of delivering increasingly difficult targets.

9 Transport Energy

9.1 Introduction

Road transport clearly forms a key part of any energy and climate change strategy, as data in the report indicates that it uses 29% of energy and generates 26% of all CO_2 emissions. Moreover, the consumption of energy fuels for transport has become an essential underpinning to economic growth – a point elaborated in the Eddington report.

Car ownership has grown steadily with many households having access to more than one vehicle. The wealthier a household the more vehicles it is likely to own. Under these circumstances, it is unsurprising that there has been an explosion in the car use resulting in an 87% increase in vehicle kilometres per annum, travelled from 1980 to 2006.

According to the UK's Environmental Accounts, household use of private motor vehicles accounted for 40% of greenhouse gas emissions in the transport sector in 2005, having seen a 12% increase since 1990. Road freight transport emissions have grown by 38% over the same period.

Automobile by-products include a degraded air quality including brake and tyre particulates, and air toxins all of which can create a rebound effect on other policies aimed at producing a low carbon South Hampshire. For example, poor air quality can lower opportunities for using natural ventilation techniques in buildings as a substitute for energy intensive air conditioning systems.

Many of the levers available to influence the consumption of transport energy lie outside the powers available to stakeholders within South Hampshire. These include using fiscal measures to change the relative costs of existing fuels; the advancement of new power train systems and the development of alternative infrastructure systems (e.g. of the kind needed to kick start a hydrogen economy).

Nevertheless, there are choices available to local stakeholders that can be aligned to Transport for South Hampshire (TfSH) Reduce strategy around the principles of "reduce, manage and invest".

9.2 Reduce

Much of South Hampshire has been built around a physical separation of differing uses – houses, shops, schools and workplaces into separate zones, and access roads feeding traffic onto a limited set of higher capacity routes. This structure builds in greater distances between activities and forces reliance upon the motor vehicle for most trips (the product of this can be readily observed from the low levels of public transport patronage in the sub region). All studies demonstrate a positive association between lower densities and carbon dioxide emissions arising from transport use. Buildings are separated by car parking further lengthening distances.

The response to this structural driver towards more carbon dioxide emissions must be the development of a different model of urban development. A sustainable urbanism approach promotes a mix of housing, shops, community uses and workplaces within walkable neighbourhoods with shops and higher density activities located in centres, with all uses interconnected by a permeable and walkable street network where lower order needs can be accessed within a five minute walk and higher order needs accessible over longer journey times using public transport where feasible. Journey routes can be integrated into the supporting green infrastructure incorporated into a development. These principles are now being applied in a number of planned urban extensions in England including Northstowe (South Cambridgeshire) and Sherford (an extension to Plymouth in the South West). These principles could be extended into the planning of new settlements in South Hampshire especially the SDAs and the urban extensions. Work undertaken in established communities also suggests that a set of principles can be applied to the restructuring of existing urban areas.

A number of other “Reduce” Strategy / Smarter Choices initiatives can be employed including:

- More car sharing;
- Travel Planning – Workplace / Area / Personalised / Retrofit / Schools;
- Linking transport with health of objectives to promote walking and cycling;
- Alternative Charging Regimes (e.g. Workplace Parking Levy);
- Managing and controlling car parking / car parking standards for new development;
- Encouraging use of walking, cycling and public transport; and
- Use of intelligent transportation systems including information that allow people to make flexible choices.

Many of these can be implemented through the planning system through the use of planning obligations.

9.3 Manage

Whilst “Reduce” strategies can be employed through design and behavioural change, the residual energy consumption is still going to be significant and ensuring the supply of fuels to meet these demands will become a significant challenge over the next twenty years.

Biofuels represent an option currently supported by government policies. However the low comparative energy density of the biomass feedstock needed to create them poses real choices for policy makers in the use of land resources. In a scenario where all Hampshire “Set Aside” (2006) land were available for energy purposes, only 5-6% of either total diesel demand or total petrol demand could be met from this source (based on rapeseed and wheat feedstock respectively). Such a diversion would need to be justified against increasing demand for food crops to be used as food rather than an energy source. However, new feedstocks such as algae hold open the promise of much better yields (a hectare tonnage yield half the size of that discussed in the literature currently could yield sufficient supply to cover diesel needs from a much smaller land area) but these need to be field tested under a variety of conditions and assessed against need for water resources.

Other management options include:

- Driving techniques (“Eco-driving”) which can be employed in public transport as well as cars;
- Retro fitting battery hybrid drive technology;
- Congestion charging;
- Intelligent Transport Management Technologies (that use signalling and information to optimise use of road space thereby encourage improved fuel efficiency); and
- Flexible workspace provision that minimises the need for the standard commuting journey in favour of shorter journeys.

Second Generation Biofuels

Petrol is now routinely mixed with ethanol made from corn and diesel from squeezed rape, oil palm and soya. Evidence now suggests that the diversion of these crops from food supplies and other uses is having a material impact on food/ commodity inflation. The food crops needed to fill the tank of an SUV with bio ethanol just once could feed someone in Africa for a year. However, second generation biofuels are now waiting in the wings based on processing inedible plant material some of which could be harvested from land unfit for food production. The processing technology also opens up the use of corn straw and wood chips. Edible starches extracted from food crops represent a small proportion of total biomass of plants. Most biomass is of a woody, indigestible mixture of lignin and cellulose bound up in the plant cell walls. Lignin will burn but has proven difficult to convert into a liquid fuel. However cellulose is made up of long chains of glucose that can be fermented to make ethanol. The processing problem is one of separating the cellulose from the lignin on a cost competitive basis with first generation bio fuels. Investment is now being targeted at the establishment of bio refineries which are likely to use quantities of water combined with catalytic agents to separate out the sugars. Some companies are experimenting with bio engineered organisms to breakdown feedstock. Additional bio engineering development is being invested in the development of new strains of plant which could be grown on poor quality land whilst having lower lignin content. Should these technologies become cost competitive, a further market will open up for biomass material in addition to the use of feedstock sources for combustion/ gasification to supply energy needs of buildings. Additional demand for water needed to support bio refineries may act as a break on the ability of South Hampshire to develop business opportunities.

9.4 Invest

Despite the need to minimise transport energy, some forms of energy consumption will probably need to increase. In considering options for the exploitation of renewables in South Hampshire, biomass offers significant opportunities for the sub region. In its raw state, biomass feedstock tends to have a relative low energy density per unit of volume compared to fossil fuels meaning that for a given level of energy demand, more volume has to be moved from a point of origin to the point at which it is converted to useful work (either through combustion or gasification).

As more consumers switch to biomass supplies, significant volumes of biomass may need to be transported into South Hampshire resulting in additional loads being placed on a congested transport network.

Planning the logistical movement of biomass from its point of origin into energy generation centres (linked to Energy from Waste) within the urban area will need to be considered carefully if congestion effects and distance travelled are to be minimised. A developer led strategy may lead to a proliferation of small scale movements to meet demand from a myriad of small developments.

Future areas of search for biomass based generation need to consider ways in which congestion and distance travelled can be minimised. Investment options for consideration range from investing in improved highways infrastructure or siting facilities next to rail access points. Alternatively, investments could be made in facilities that use an intermediate process to concentrate the energy content per unit of volume thereby reducing trip generation (this activity would normally take place at locations nearer to the source of the biomass). Biomass could also be gasified and cleaned for distribution through the conventional gas pipe network.

In addition, other forms of investment needed in South Hampshire include:

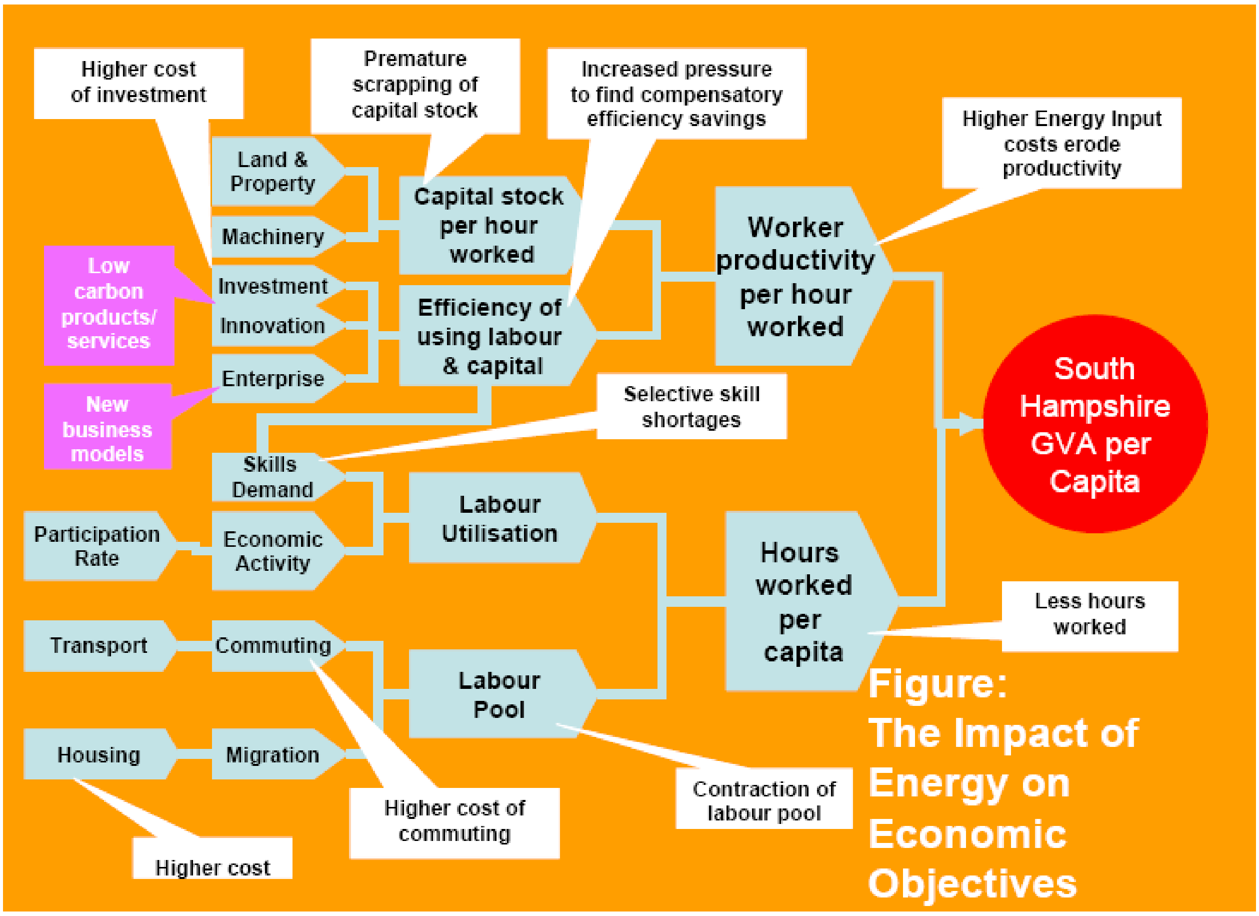
- New public transport facilities, including Bus Rapid Transit; and
- Potential for cleaner and more efficient buses and lorries, through Quality Partnership / Contract arrangements.

Key Points

Addressing the increasing demand for transport has to be a key part of any overall energy strategy and there is a large amount of overlap between the measures proposed as part of the TfSH Reduce Strategy and the Management and Invest part of the TfSH strategy where these provide alternatives to car travel, particularly at peak times. To give this reduction more credibility, it is important that, in consultation with the local transport authorities / TfSH, a full range of appropriate measures are identified and included within the overall strategy.

10 Implications for Economic Development in South Hampshire

The energy agenda has significant implications for the achievement of economic development objectives for South Hampshire. These implications are mapped out on the Figure below:



The white boxes identify risks to the achievement of productivity growth whilst the purple boxes indicate opportunities. These include the potential dislocation of South Hampshire's labour pool; skill shortages; premature scrapping of the capital stock (buildings, machinery) and greater input costs that reduce the value available for distribution as profits/ wages.

10.1 Effect on Commuting Patterns - Contracting the Labour Pool

The focus of activities identified to meet South Hampshire's target has been directed towards the energy performance of the built environment yet, paradoxically, transport has been an essential underpinning to the current form of that built environment in South Hampshire. Car based mobility has been critical to allowing relatively low density urbanisation which has allowed people to enjoy a high quality of life whilst allowing firms to draw their workforce requirements from a wide catchment area. South Hampshire exemplifies what can be referred to as "agglomeration economies".

A fossil fuel price induced reduction in mobility threatens to shrink the accessible catchment area of labour especially in sectors generating a relatively low gross value added per employee (indicative of a lower ability to absorb additional travel costs). Workers priced off the roads would face some awkward decisions over maintaining a job or relocating their home. Low densities especially at the edges of the built up area are not well served by public transport because the economics of providing bus services (in the main) are poor.

Workers would need to allocate much more of their time budget to travel to negotiate the network and the frequencies of operation available to get to and from work.

Evidence tends to suggest that people's willingness to spend time travelling diminishes after a certain point has been reached. Time budgeting is an essential part of modern domestic and business life particularly in a service dominated economy like South Hampshire where productive time available and output are closely related. This will have implications for how people arrange childcare or businesses meet the need for workers outside office hours.

The implication is that constrained mobility will prompt changes in the locational dynamics of people and businesses in the South Hampshire metropolitan area. People and businesses will need to adjust to the pressures by changing location relative to one another. Some pressures could be modified by using new technology to substitute for physical movement e.g. home working or video conferencing using broadband networks. However, some physical reassembly of land uses is likely to be necessary.

Any relocation activity is going to happen by individual households and businesses making decisions on managing their own costs. It is likely to manifest itself in property prices and physical changes of use that will become visible through the planning system. Some of these changes may be unwelcome where change leads to an increase in energy consumption per unit area because the new use was never anticipated.

10.2 Flexible Work Spaces

ICT has made it possible for the individual processes of a business to physically separate yet remain integrated within a single organisation through IT. The rise and migration of the call centre to low cost locations of the world illustrates the way this has been used to achieve economic benefits.

In a more localised setting it has allowed functions that do not need an expensive central business district location to locate to less expensive locations because they have no direct need for extensive contact with customers or other businesses.

In South Hampshire, there has been some migration of business out of the central area to peripheral business parks and to the homes of their workforce.

This trend has a direct implication for travel energy by weakening the core to periphery flows needed to underpin public transport. It does however offer an opportunity to match building services more closely to how a building is actually used.

A future model could see the emergence of new business property models that locate "hotel style" spaces hired out flexibly to firms for use by their workers nearer to their worker's homes. These spaces would be located within smaller business districts that are more accessible to residences leading to shorter distance commuting trips. The energy trade off would be between the tailored building services that could be designed into a building serving as a "hotel" and energy consumed in undertaking journeys.

> Creating Third Space Environments
>
> Robert Dykstra has been developing commercial property for 27 years. He has however, spotted an opportunity. His new office park …is unlike any traditional office and "more like a community centre". Instead of renting to corporate tenants .. he plans to sell membership as a club does – by the hour, week or month – to nomads (mobile workers) dropping by. Mobile workers come in, find all the services they might need – from tech support to copying and satisfy their needs for "live, work and play" as well with the aid of fitness studios, restaurants, cooking classes and music rooms"
> (Source: Economist "A Special Report on Mobility" April 2008)

10.3 Reducing the Journey to Work in South Hampshire

Teleworking is supposed to reduce the need for the expenditure of energy on commuting. However, few studies have attempted to look at the total energy use across all areas of impact. The potential impact areas are:

Teleworking Impacts that might increase overall energy consumption	Teleworking Impacts that might decrease overall energy consumption
Smaller journeys are made from home with the potential for using more fuel than is saved through not commuting.	Loss of commute journey will decrease fuel.
Each teleworker will need their own computer, telephone and fax/ printer that may have been shared with others in an office environment leading to an increase in ICT energy consumption.	Teleworking might lead to the reduction of the number of desks and equipment retained in offices to support office based working.
Heat/ cooling at home will be increased to accommodate the needs of the teleworker; also increased use of household appliances.	Reductions in the need to fuel heating/ cooling of space in offices as the space needs shrink.
Does teleworking encourage people to live further away from the workplace thereby increasing the commuting length even if the frequency falls?	
Could one teleworker in the household mean that a previous non car user in the family increases their use of the now available car beyond the saved commute?	

(Source: 40% House, Background Paper N)

Some studies suggest that additional journeys are initiated through teleworking but most evidence suggests that they do not out weigh the benefits of loosing the commuting journey. With regard to energy usage in the home, evidence suggests that there were increases in energy usage between 5.5 and 7.9 kWh per telecommuting occasion. However, household energy use increases typically represented between 11 and 26% of the travel savings resulting in total energy savings of between 75% and 89% per telecommuting occasion.

10.4 Sustaining the Energy Needs of Growth Sectors

ICT is a key facilitator of the decentralisation of business functions and associated sectors have grown strongly in South Hampshire over the last few years. ICT has also seen accelerated growth in employment in its own right. Employment data trends show a 36% growth in employees in employment within the “Computing and Related Activities” category and an 11.9% in the “Other Business Activities” sector – another heavy user of ICT within the South Hampshire area.

ICT is highly dependent upon a quality supply of electricity. Nationally, the total domestic and non domestic consumption of electricity by PCs, lap tops, monitors and imaging equipment was estimated as 15.7 TWh in 2004. By 2010, consumption is already expected to rise to over 25.4 TWh. Even accounting for the known savings potential of identified technological changes (Market Transformation Programme, 2005), energy consumption is still predicted to triple between 2000 and 2020.

Dependency on reliable sources of electricity has its own location specific drivers. In some areas, data centres have led to load growth in excess of forecasts. Due to the sensitivity of data centres’ business, businesses have their own dedicated back up energy supplies usually diesel generators. The decentralisation of access to digital information systems has been accompanied by a centralisation of storage mediums in server “farms” or data centres.

Data centres use space intensively as technology has allowed ten servers to occupy the space formerly occupied by a single server several years ago. Compression has, however, led to a need for specialist building services to heat, air condition and ventilate the spaces. Whilst compression has reduced space requirements, the volume of data needing to be stored has continued to grow. The industry is trying to address this problem by cramming more applications on a single server through “virtualisation”. The power required for two new style servers now cost £1,600 a year compared to £10,425 cost for 25 old servers that it replaced (excluding cooling). The air conditioning industry has responded to these threats by suggesting that air conditioning can be more effectively targeted at hot spots in data centres.

10.5 Conclusions

The foregoing assessment highlights a number of risks to South Hampshire which need to be captured within a policy framework. Arguably, South Hampshire's urban form has been a source of competitive advantage in the past by allowing people to benefit from a good quality of life arising from relatively low density styles of living whilst allowing employers to access a labour force. In the future, fossil fuel scarcity could reverse this advantage by imposing considerably higher costs on households and businesses. Some of this disadvantage could be offset by using ICT although this does not come without its own carbon penalty. The cost is, however, more easily manageable than restructuring the metropolitan area.

Key Points

This section deals with the inter relationship of energy and South Hampshire's economic development objectives.

A number of risks are highlighted to both worker productivity and access to a labour pool.

Risks are identified in terms of maintaining current commuting patterns and meeting the needs of growth sectors of the economy.

11 Constraints & Opportunities

This section attempts to draw together an analysis of constraints and actions needed, the actions identified will, however, have to take account of the barriers to implementations which are identified as follows, together with a potential mitigation response:

Action	Barriers	Mitigation Response
Greening the Grid	National trends in carbon intensity of power;	Cost effective tidal stream may coincide with end of strategy timescale.
	Limited on shore wind potential within PUSH boundaries;	Technical opportunities for off shore wind farms (not countable against target).
	Network vulnerability to extreme weather events;	Resilience proof networks against damage.
Code for Sustainable Homes	Zero carbon currently not cost effective;	Pilot developments of zero carbon housing will enable learning economies likely to reduce cost.
	CHP constrained by historically low unit heat loads;	Massing housing to create viable loads for CHP in SDAs; Urban Extensions. Deploy micro generation technologies including mixed technologies addressing heat and power needs e.g. heat pumps.
	Future cooling load arising from unavoidable climate change creating feedback demand for additional electrical power;	Install absorption cooling into CHP networks to provide alternative cooling option. Resilience proof urban areas to reduce urban heat island effects.
Code for Sustainable Business	New office development for PUSH has a low base heat load constraining CHP;	Look at opportunities for mixed use developments that provide a viable base heat load. Deploy micro generation technologies including mixed technologies addressing heat and power needs e.g. heat pumps.
	Growth expected from information technology intensive user sectors e.g. business services;	Reliance on sector offsetting or a successful outcome to the Market Transformation Programme (MTP).
	Future cooling load arising from unavoidable climate change creating feedback demand for additional electrical power;	Install absorption cooling into CHP networks to provide alternative cooling option. Resilience proof urban areas to reduce urban heat island effects.
Retrofit Demand Reductions to the Existing Domestic Stock	Cost effective treatment of older properties (solid wall) unavailable;	Still opportunities to apply known cost effective energy efficiency measures to the existing stock.
	Energy efficiency paradox - financial savings recycled into other energy	Culture change to attitudes to energy efficiency; Smart Metering.

Action	Barriers	Mitigation Response
	intensive activities like flying;	
Retrofit Demand Reductions to the Existing Non Domestic Stock	Cost effective treatment of older properties (solid wall) unavailable;	Still opportunities to apply known cost effective energy efficiency measures to the existing stock.
	Energy efficiency paradox - financial savings recycled into other energy intensive activities like air travel or more appliance based energy consumption;	Culture change to attitudes to energy efficiency; Smart metering.
Traffic Measures and Demand Management	Functionality of South Hampshire metropolitan area reliant upon private motor vehicle;	Long term densification around public transport nodes; Substitute physical movement with digital systems.
	Low aspiration and potential for modal split;	Provision of travel planning information to assist people using the existing network.
	Unrestrained international aviation and maritime threaten to absorb savings;	Dialogue with the airport and port to establish voluntary targets for carbon reductions within sphere of control.
Decentralised Generation	Limited availability of accessible industrial surplus heat;	Map other heat sources in South Hampshire and demand for heat.
	Retrofitting CHP not cost effective in low density development;	Target higher density areas for CHP with non domestic heat loads.
	Much micro generation still not cost effective.	Encourage demonstrators in the urban area.

11.1 Risks to the Renewable Opportunities

A further set of risks are associated with the development of renewables in South Hampshire, these are detailed below:

Risk	Mitigation
It is likely that a proportion of the animal waste bio stream will be either uneconomic to collect or important in maintaining the fertility of the soil;	An assessment needs to be made of the economics of recovery and the role animal waste currently plays in maintaining fertility.
Demand will exist for in situ exploitation to service energy needs of the farming sector and communities in the north of Hampshire;	An allowance needs to be made for the in situ take up and more localised exploitation.
Anaerobic digestion of animal and other wastes are bad neighbour uses by reason of odours, noises, disposal of residue;	Locational requirements may make this use suitable for former industrial land or sui generis land currently used for the handling of waste.
Energy crops will be competing against food crops for space. Ultimately decisions will be	This is a significant strategic risk which needs to be weighed against a future food security risk. The best

Risk	Mitigation
dictated to by international commodity prices;	option might be to subcontract responsibility to an energy supply body.
Animal waste availability is dependent upon decisions to continue meat production which is an energy intensive form of food production in the first place. The twin pressures of commodity prices and fuel cost may persuade farms to divest themselves of animal husbandry where the land quality allows;	A switch to grains or energy crops may reduce access to animal waste but open up opportunities for other types of biomass based on crop residue.
Biomass exploitation will generate further vehicular movements into South Hampshire's already congested road space;	Identify sites that can be supplied on the fringes of the urban area that avoid bringing traffic into congested areas. Use waste reception areas to sort and consolidate supplies.
Micro-generation may remain non cost effective;	Without intervention the technical potential of micro-generation is unlikely to be realised. Unlike mainland Europe, UK government policy has been to require a quota of renewables generation preferring to leave it to the market to select technologies. Germany has however adopted a policy of guaranteeing a "feed in" tariff which builds in a return for the investor. A change in national policy might encourage a greater uptake. Feed in tariffs would itself create a significant risk if adequate provision was not made for renewing an extremely expensive generation asset at the end of its technical life.
South Hampshire residents and businesses will be competing for biomass fuel with other businesses and homes further a field.	The analysis has been necessarily focused on the biomass resources available in the rural hinterland to South Hampshire. However, there is no guarantee that suppliers will contract to supply the needs of other regions. It is feasible to transport biomass material some distance (especially if by sea or rail) without incurring a carbon penalty in relation to transport fuels used. A practical procurement strategy might be to contract with a fuel supplier capable of sourcing fuels from a wide area.

Key Points

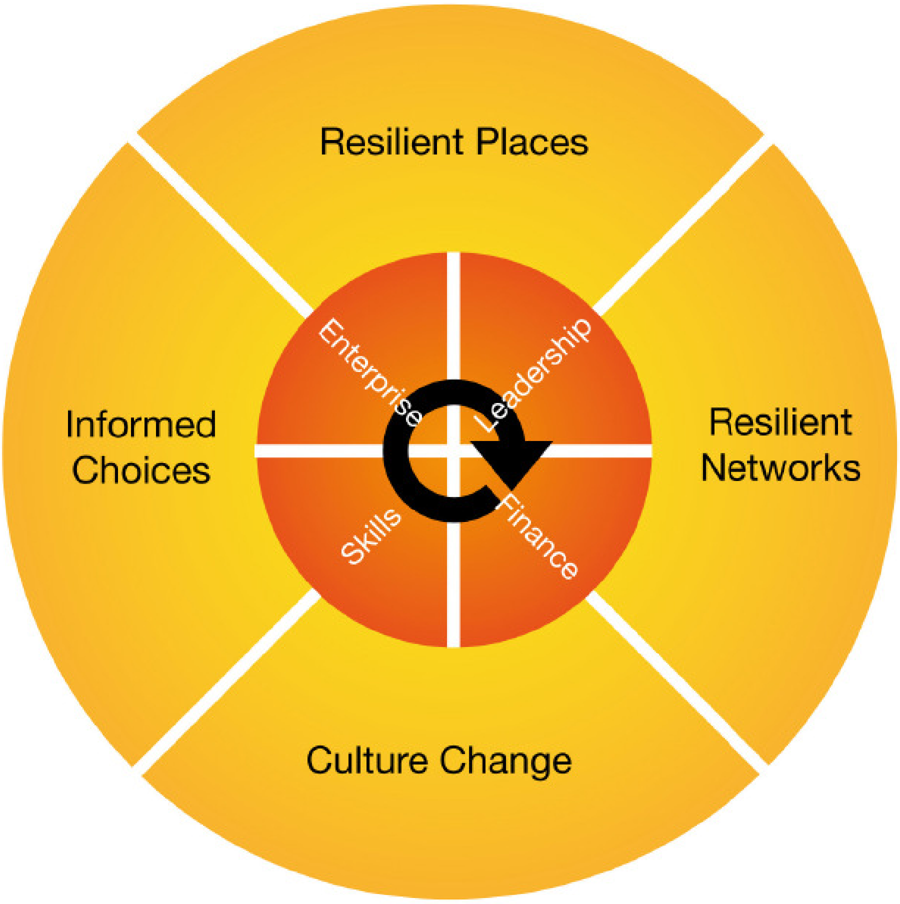
This section highlights the uncertainties over implementing the reductions shown and the delivery risks concerned with pursuing renewable targets especially in biomass.

12 Emergent Strategic Themes

This section attempts to draw together a response to the strategic risks posed in the earlier section by establishing some common strategic objectives for the sub region.

12.1 Identifying Directions of Travel for South Hampshire

Figure 1 presents a limited number of strategic directions of travel that the region needs to take up as part of the long term preparation of the region to meet extremely challenging targets and future pressures.



The strategy identifies 4 primary objectives and 4 core enablers needed to realise the primary objectives.

12.2 Primary Objectives

12.2.1 Creating and Maintaining Resilient Places

The risk analysis identifies the potential for significant dislocation if fossil fuel costs make the South Hampshire area a source of competitive disadvantage for the future. Whilst recognising that there are some huge economic interests that are directed towards finding a viable, environmentally benign solution to mass mobility (e.g. hydrogen, electric car), there is no guarantee that these solutions will materialise at the “right” time and in an affordable way. Stern has already identified problems with identifying viable mitigation of transport related emissions before 2050. On this basis, there is a strong argument based on the application of a precautionary principle to plan around the eventuality that solutions are either delayed or do not happen at all. The cost of ignoring these risks could be severe dislocation undermining economic growth targets for the sub region.

A precautionary principle would argue for planning around the creation of communities or “places” that are resilient to increasing scarcity of fuels (either in absolute terms or for particular groups). However the usefulness of the objectives depends on being able to scale "places" and define the characteristics of "resilience".

Any change in the costs of mobility will cause people and businesses to use existing buildings differently e.g. closer proximity to jobs and workforce. However, the reuse of buildings designed for another purpose may not be the best outcome for reducing energy consumption or the deployment of renewables.

A new model of urbanism may be needed to run alongside choices people and business may have to make to adapt to a changing environment. A new model of urbanism would need to offer access to jobs and services within walking distances or within walking access to public transport services. It would include making room for green spaces to provide shading to buildings to counter the projected effects of overheating due to unavoidable climate change. It would also include the allocation of space for food crops to supply the needs of people affected by food price inflation (driven by the twin problems of climate change and agricultural fossil fuel dependency).

What Size of Place?

The average travel time budget has remained fairly constant through out history (Marchetti constant). This time allotment appears to determine how people live in cities; they tend to prefer to travel on average half an hour for their main journey to and from home. Viable places are therefore likely to be "1 hour wide". The internal combustion engine has allowed this to translate into a large distances. When reduced to walking, an urban area has to shrink to 5 to 8 kilometres in width.

A key reality test is the degree to which a template for a new low carbon urbanism can be super imposed on present day South Hampshire. By and large the public policy tools and funding do not exist to comprehensively remodel communities. Public policy tends to focus on making incremental changes through new development or particular marginal groups or the most poorly performing buildings. In addition, this policy response would be part of a risk management solution rather than addressing an absolute problem. Over the twenty years, more interventionist approaches (e.g. the enforced improvement of a building's energy efficiency rating as a condition of sale) may become necessary forced by rapid climate change or fuel shortages but they do not exist currently.

Resilience proofing would be a more opportunist approach based on looking at development opportunities associated with public land asset disposal (local authorities, NHS, etc); new build; granted assisted affordable housing; regeneration to achieve a bigger vision through:

- Effective deployment of green space to assist cooling;
- Using green space as a productive space for the localised production of energy crops possible on areas sterilised from development by flood risk forecasted through unavoidable climate change;
- Integrating heat pump technology to tap forms of waste heat into the public realm;
- Preserving former industrial land for anaerobic digester plants to supply heat and power using locally generated waste and agricultural waste products;
- Creating heat mains networks to deliver community heating and cooling;
- Demolition of low amenity, low energy efficient dwellings and commercial workspace as part of area regeneration policies using targeted compulsory purchase powers; and
- Use of land swaps with the private sector to secure better distribution of loads types (helping to facilitate CHP).

Urban Ventilation Lanes – Stuttgart

Stuttgart planners introduced a plan aimed to simultaneously reduce urban air pollution by using a natural cold drainage air flow whilst also aiming to improve thermal comfort within the urban area. Based on detailed wind survey data, a flow of cool air generated by nocturnal radiation cooling in the countryside blows through the urban area.

There are, however, some areas where comprehensive resilience proofing is likely to be possible. These areas include:

- Strategic Development Areas;
- Urban Extensions and Surrounds; and
- City Centres/ town centres.

Overtime, resilience proofing template will need to be overhauled to reflect changes in national/ international policy which will have either made the task easier (or more difficult) and changes in the technical and economic potential of measures. As fossil fuel prices increase more actions will become cost effective for individual households and businesses to do themselves. Cost effective measures would not normally be prioritised for action.

An implementation pathway for a resilience proofing approach would be to build a proofing toolkit into the Strategic Community Strategies (SCS) prepared by local authorities. Use of the SCS would mean reviewing the current stakeholders involved to include more organisations using and supplying energy. As the core strategy is meant to represent the spatial expression of the Sustainable Community Strategy the SCS route should allow better integration with the spatial planning process.

12.2.2 Creating and Maintaining Resilient Networks

The development of resilient places needs to be accompanied by a parallel approach to resilience proofing networks. South Hampshire has a legacy of existing infrastructure in the form of hospitals; community centres; colleges. Whilst the underlying business assumptions that gave rise to this infrastructure may have to change, this infrastructure will remain critical to the maintenance of a decent quality of life.

This infrastructure needs to be supplied with energy and people to access these services. A resilience proofing approach would aim to ensure that energy supply to critical infrastructure is protected against extreme weather events and other risks (see box). The approach would also review the degree to which public transport planning allowed access to these facilities.

This objective would involve working with the utility providers and transport operators to review investment proposals.

Energy Infrastructure Security

Events of September 11th 2001 highlighted the vulnerability of infrastructure networks in developed countries. Energy generation assets and a distribution system reliant on long linear and contiguous networks of wires and pipes linking generation/ supply centres to demand, make these systems particularly vulnerable to a range of risks. Low level vandalism, harvesting valuable metals or acts of terrorism is all capable of compromising the operation of these networks. Risk mitigation requires the identification and grading of risks from vandals to organised criminals. Mitigation measures can then be matched against perceived threats ranging from the physical hardening of vulnerable facilities to personal security / screening including electronic monitoring of key facilities and the surveillance of pipelines/ transmission/ distribution lines (based on an independent/ secure supply). A sub regional strategy is likely to overlap with emergency planning strategies for the sub region. Consideration should be given to the vulnerability of mobile telecommunications systems from a large scale system collapse. Over the next twenty years, it is likely that shortages of key metals like copper will result in more aggressive actions by individuals to retrieve valuable metals from the network.

12.2.3 Culture Change

Technology fixes alone cannot provide all the solutions. Renewables and energy efficiency systems are only going to meet their design efficiencies if people believe that they serve a purpose (whether saving money or a wider environmental benefit). A high performance building can rapidly become a low performance building if renewable and energy savings devices are stripped out in favour of poorer performing solutions. Attitudes to the use of energy and carbon emissions must change if these targets are going to be realised. Local Authorities' general well being power offers a route into the extremely difficult and wide ranging task of changing values among businesses and individuals including public sector policy makers. The policy pathways into addressing this issue are so diverse that managing to keep messages coherent becomes a problem.

As the next generation are going to be disproportionately affected by energy and de-carbonisation, culture change must address the relative absence of representatives from this generation in discussions to date. Innovative forms of consultation and feedback need to be developed that encourage young people (see Appendix 2) to come up with solutions on the understanding that these will be taken seriously alongside the existing supply side institutions. Measures include:

- Mass media publicity for strategy - Events;

- Digital marketing techniques – E Mails; Text Messaging; “Blogging”; and
- Competitions.

Culture change also needs to be accompanied by measures that encourage change to be visible. Using iconic buildings as an opportunity to demonstrate the use of low carbon technologies would communicate the message of change.

CRed: Community Carbon Reduction.

CRed is the Community Carbon Reduction project based in the East of England, established to support communities, businesses and individuals to reduce their carbon emissions.

The CRed project is based around an online pledge system which enables individuals to sign up to specific ‘carbon reduction pathways’, including; Behavioural, Lighting, Heating, Transport, Insulation, Food and Renewable. These pathways provide simple, feasible and low cost recommendations for how people can reduce their carbon emissions through behavioural change and technological adaptations.

For businesses and communities CRed offer extended support, including a full energy audit and support to devise and community/business specific strategy and targets to reduce their collective carbon emissions.

In addition CRed have developed the Schools Energy programme. The club has recruited schools from across the eastern region to try and encourage young people to become more aware of the issues around climate change and ways they can support carbon reduction within the school environment and at home. To date the scheme has generated hundreds of carbon reduction pledges and encouraged young people to consider ways of reducing energy use in their school and supported them to produce. The Howard Infant School devised a simple but effective system for encouraging people to switch off lights. They designed posters to promote their scheme and rated each of the classrooms on its performance with red, amber and green lights. Awards were made to the best performing rooms. All the children involved in the scheme received a certificate in the spirit of encouraging and celebrating success, which is fundamental to CRed. This has empowered young people to make changes in their behaviour and encourage others to do the same.

CRED is an example of a project developed in the East of England to support the wider community to reduce emissions using an “on line” pledge system which encourages behavioural change. A separate line of activity has been developed to support schools.

12.2.4 Informed Choices

Culture change must be supported by information that allows people to make informed choices. The government is committed to using the price mechanism as a means of communicating the cost of carbon through carbon trading. However, “informed choices” can be extended to include the use of a social cost of carbon in appraising new public policies or the use of smart metering. Informed choices would include:

- Specifying the use of smart metering in all public buildings (see Box below);
- Helping young people make career/ enterprise choices that support implementation of the strategy;
- Mapping heat and power demand;
- Encouraging the pricing of carbon in everyday transactions.

Xcel Moves Forward with Smart Grid City

Xcel Energy has announced it will put in motion its vision to make Boulder, Colorado, the first fully integrated smart grid city in the US. The advanced, smart grid system, when fully implemented will provide customers with a portfolio of smart grid technologies designed to provide environmental, financial and operational benefits.

The smart grid city could feature a number of infrastructure upgrades and customer offerings – for the first time fully integrated through the partnership’s efforts in Boulder including:

- **Transformation of existing metering infrastructure to a robust, dynamic electric communications network, providing real time, high speed, two way communications through out the distribution grid.**
- **Conversion of substations to “smart” sub stations capable of remote monitoring, near real time data and optimised performance.**
- **At the customers’ invitation, installation of programmable in home control**

devices and the necessary systems to fully automate home energy use.

- **Integration of infrastructure to support easily dispatched distributed generation technologies (suc has plug in hybrid electric vehicles with vehicle to grid technology, battery systems, wind turbines and solar panels).**

12.3 Strategic Enablers

The four strategic objectives must be realised by using four enablers:

- Skills;
- Finance;
- Leadership; and
- Enterprise.

12.3.1 Finance

The resilience proofing approach is a pragmatic approach recognising the incremental routes to change. It is nevertheless another case where financial freedoms are necessary to address real opportunities. Much of the expertise needed to resilience proof communities and design solutions exists within the private sector. Steps should be taken to use the local authority's ownership of land/ assets and purchaser of energy to reduce the risks of private investment in new renewable and low carbon solutions.

12.3.2 Skills

Resilience proofing will require a mix of practical and professional skills, most of which are in short supply. Any expansion in activity may well create supply bottlenecks through the lack of professionals with the capabilities to specify and design solutions long before the lack of skilled manual trades is encountered.

12.3.3 Leadership

The Partnership for Urban South Hampshire (PUSH) has taken the initiative in addressing this agenda. The individual local authorities within PUSH have specific powers available through primary legislation that give them a basis for claiming leadership.

12.3.4 Enterprise

Whilst the basis of leadership exists within the local authority partners, the delivery of strategic objectives will typically lie outside the local authorities within companies who build or run energy systems. These companies will have the skills to project manage solutions effectively and they offer a means of accessing skills without developing them "in house".

Key Points

This section sets out a strategic framework for a South Hampshire Energy Strategy.

The framework has four objectives supported by four enablers.

The four objectives are concerned with the creation of "Resilient Places"; "Resilient Networks"; "Informed Choices" and "Culture Change";

The four enablers are "Leadership"; "Skills"; "Finance" and "Enterprise."

13 Strategic Enablers I – Skills

13.1 Skills

The type of actions identified in this strategy has direct implications for skills supply available in the South Hampshire economy. The implications cross over all grades of staff from the skilled trades involved with energy efficiency measures; general construction labour needed to install heat mains through to the professions that specify, design and regulate solutions.

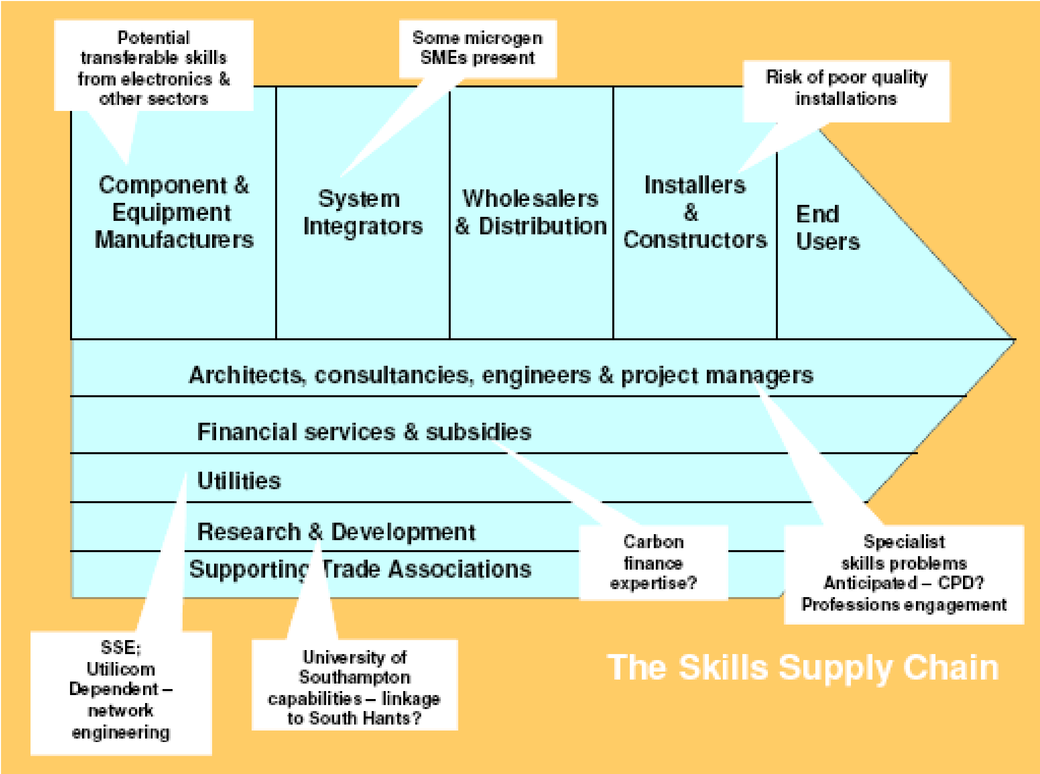
A key catalyst for change is the existing regulations and policies set by governments that create a demand for these skills.

13.1.1 Overview of Existing Drivers

Driver	Description	Skills Implications
Building Regulations Part L (2006)	The Building Regulations, Part L (2006) came into force on 6 April 2006. For the first time, domestic new and existing buildings, and non-domestic new and existing buildings, were each addressed in separate Approved Documents. The energy efficiency standards for all types of buildings have been improved, and more work has been brought into the scope of the Regulations. This will result in new dwellings being about 20% more efficient than under the 2002 Regulations. The next version of the Building Regulations is expected to be published in 2010.	• Energy efficiency standards must be demonstrated by an energy rating carried out by a competent person; • Designers and specifiers must understand and use 'design limits' for insulation, efficiencies and controls; • Sample air pressure tests must be carried out by independent accredited testers; • More trigger points for energy efficiency works on existing buildings.
Microgeneration Strategy: Power from the People (2006)	DTI's Microgeneration Strategy suggests that by 2050, microgeneration could provide 30-40% of the UK's electricity needs, and help to reduce household carbon emissions by 15% per annum. Microgeneration is included in the Low Carbon Buildings Programme, and CERT 2008-2011.	Some traditional occupations (for example plumbers, electricians) may come under increasing pressure as demand increases. Sales and marketing function is also underdeveloped.
EU Energy Performance of Buildings Directive (EPBD)	The EPBD is driving a number of changes in energy efficiency, including certification of the energy performance of new buildings, and of existing buildings on change of occupancy; and inspection regimes or energy efficiency advice for large boilers and heating, ventilation and air-conditioning plant.	• New- build requirements delivered via Building Regulations (see above); • Marketed sales of existing homes delivered via Housing Act (see below); • Mechanism for sales of existing non-dwellings and rental sector not yet known; • Inspection regimes /energy efficiency advice for large buildings and heating, ventilation and air conditioning plant.
Housing Act (2004)	Homes offered for sale must provide a Home Information Pack (HIP - also known as the Seller's Pack.	The full HIP will be prepared by accredited Home Inspectors. The Department for Communities and Local Government has estimated that 7,500 Home Inspectors will be required in the sales sector and a further 6,500 in the rented sector in the UK. However, the July 2006 announcement that only Energy Performance Certificates will become compulsory elements has shaken the confidence of the fledgling industry. Work is underway to develop National Occupational Standards and qualifications for Domestic Energy Assessors.

13.2 Overview of Skills Impacts

The mapping of skills effects are shown in the figure below:



13.2.1 Activity Area Impacts

	Greening the Grid	Code for Sustainable Homes	Code for Sustainable Business	Defra Waste Strategy	Retrofit Energy Efficiency Measures - Domestic	Retrofit Energy Efficiency Measures - Non Domestic	Transport	Decentralised Generation in Existing Areas
Gas Fitters					✓	✓		
Oil Fitters					✓	✓		
Cavity Wall Insulators					✓	✓		
Loft Insulators					✓	✓		
Solid Wall Insulators					✓	✓		
Plumbers & HVAC Installers					✓	✓		
CHP Installers		✓	✓	✓				✓
Electrical Trades								

General Construction	✓	✓	✓					✓
Heavy Electrical Engineering	✓							
Renewable Energy Installers	✓	✓	✓					✓
Architects, Surveyors, Engineers		✓	✓	✓	✓	✓	✓	✓
Home Energy Inspectors/ Assessors					✓	✓		
Green Financial Services Specialists		✓	✓					
Energy Crop Farmers and Processors		✓	✓					
Building Control		✓	✓		✓	✓		✓
Planners		✓	✓				✓	

13.2.2 Skills Needs in the Renewables Industry

The renewables industry requires a wide range of skills including:

- Professional project development skills associated with the exploitation of business opportunities (e.g. financial management, business planning, project management, legal skills, marketing and sales and services);
- technical skills associated with the manufacture, construction and installation of renewables;
- energy projects (e.g. electrical, mechanical, civil, combustion, process, electronics, software and environmental engineering);
- specialist technical skills in engineering, environmental and planning at a professional level associated with consultancy services, project development and R&D activities;
- specialist knowledge of complex form manufacturing, such as gear profile manipulations, modelling and design;
- heavy engineering and specialist skills in marine offshore technology associated with the design, development and installation of offshore wind, wave and tidal projects;
- skills necessary to develop and maintain a fuel supply system for energy crops;
- power system design and engineering which includes specialist software and hardware;
- control skills to allow for monitoring more complex networks that result from increased renewable projects.

13.2.3 Renewable Skills Concerns

- Level and quality of general technical skills: nationally the general availability of graduate engineers and trained craft workers has led to an inadequate number of suitable candidates. The low appeal of the engineering profession has been cited as a potential cause which is difficult to address directly. Continuity of training and work as opposed to fragmented contracting arrangements could be another contributor. Sponsorship is necessary to attract more undergraduates.
- Level and quality of specialist resource: similar recruitment problems have been identified with particular emphasis on electronics and control instrumentation, design and manufacture of composites, geophysics, specialist fabrication, combustion engineering, energy crop experience and project installation and commissioning.
- General Management and Project Management: a generic skills area that has been cited as an area of shortage but may reflect the current abundance of projects under development and the relative immaturity of the industry, however given the transferability of these skills it suggests there is scope for raising the profile of the requirement, possibly amongst those with thermal power sector experience.

Companies are presently addressing potential recruitment problems through either in-house training or recruitment from overseas. In-house training has cost implications in terms of time and the inability to fully utilise the resource during the training period. Companies also operate technical apprenticeship schemes to increase individual competence and to obtain professional progression to degree and chartered status.

There are also a range of skills that can be transferred from other more mature and developed technologies, for example:

- skills relating to the marine offshore technologies including project management procedures and construction facilities, underwater intervention technique skills and experience. These have been developed for the North Sea oil and gas industry and may be transferred to the offshore renewable industry.
- the PV industry is characterised by its interface with the established construction industry, which is served by the required trades. The obstacles faced by the PV industry is accessing skilled personnel (electricians, roofers and facade installers) could be transferred from the construction industry rather than needing the evolution of a new specific skilled trade.

Skill transference from other more mature technologies, such as the oil and gas industry or the traditional power generation industry, may be limited if the basic resource is limited either by the number of people involved in it or age profile.

Renewable Energy Jobs Soar in Germany

Renewable energy jobs have almost doubled over a three year period to 2007 employing 249,300 people and this is expected to more than double by 2020. Solar technologies showed the biggest jobs growth especially photovoltaics followed by biomass technologies. Heat pumps and geothermal have also seen an expansion in employment. This spectacular growth has been attributed to Germany's feed in tariff which has incentivised an expansion of demand.

13.2.4 Policy Development

There are a huge array of policies, initiatives and other activities driving the market for skilled workers in the energy efficiency and renewable energy industries.

The main difficulty for the energy efficiency and renewable energy sectors in terms of skills and training is that they are not covered by one Sector Skills Council. Rather, no less than 14 of the Sector Skills Councils have energy efficiency / renewable energy occupations within their footprint to a greater or lesser degree.

There are two key ways in which the Sector Skills Councils and the Sector Skills Development Agency can work with employers and education and training providers to support skills development of the workforce and productivity. The first are Sector Skills Agreements, which have been introduced as a way for Sector Skills Councils to exert strong influence throughout their sectors to help shape the supply of relevant training and skills and to raise employer commitment to skills. It is imperative that energy efficiency and renewable energy are included at an explicit level within the Sector Skills Agreements.

National Occupational Standards are the second method. They define the level of competence needed for a particular job role or occupation and provide the building blocks for the assessment of skills and training needs. Energy efficiency is often left uncovered in National Occupational Standards, and is assumed to be included as a part of 'current, relevant legislation'. In an environment of rapidly changing legislation and policy, some aspects may be overlooked and employers and training providers may be unaware of the need to update the training or assessment procedures. This means that presently energy efficiency and renewable energy are unlikely to be covered adequately.

Key Points

This section concerns the enabler – "Skills"

Skills problems are mapped onto a supply chain for delivering a low carbon infrastructure in South Hampshire.

Strengths and weaknesses are identified – e.g. specifiers as a potential weakness and research and development as a potential strength.

Local economic development policies need to be developed to address potential skills problems of the future.

14 Strategic Enablers II - Finance

The scale of investment required to deliver this agenda is unprecedented involving comprehensive treatment of most areas in South Hampshire. The Stern Report (2006) makes the case for intervention to accelerate the rate of change faster than might occur under a “business as usual” scenario if excessive environmental and social costs are to be avoided.

Whilst the cost effectiveness of energy efficiency and non carbon sources of energy are continually changing with the price of fossil fuels making it more likely that the private sector will invest, accelerated intervention on the scale required will mean looking for new financial freedoms for key stakeholders in the public sector.

Moreover, it can not be assumed that just because a particular solution is viable that it is going to happen. The division of cost and benefit between different organisations and people can be a significant barrier e.g. landlord (making the invest in energy efficiency) and tenant (receiving the benefit).

The investment funding problem is probably greatest in the existing built environment of South Hampshire where the scale of the problem is significant but scope for intervention fragmented.

14.1 Review of Sources of Funding

From the perspective of the stakeholders in PUSH, a number of potential funding streams could be tapped to deliver South Hampshire’s investment requirement include:

- Development Funding;
- Loans;
- Grants;
- Capital Receipts;
- Equity;
- User Charges

These streams can be used individually or in combination to fund investment needs in South Hampshire:

14.1.1 Development Funding

An opportunity may exist to fund some of the investment needed through the development process using either existing powers available under Section 106 of the Town & Country Planning Act 1990 or the Community Infrastructure Levy to fund low carbon infrastructure. However, Circular 05/2005 requires the level of obligation to be set at a level commensurate with meeting the effects of new development which may limit opportunities for comprehensively treating new build alongside the existing built environment where the two interact. Also some doubts exist as to whether utility infrastructure deemed to be within utility companies’ settlement with Ofgem can be counted into the CIL calculation. This source of investment may therefore face limitations and may not provide an answer for retrofitting existing areas.

14.1.2 Loans

Local authorities have extensive experience of raising loans for capital projects whether from the Public Works Loan Board or alternative sources such as the European Investment Bank for infrastructure projects. Local Authorities have been given powers to borrow money under the “prudential borrowing power”. A rolling loan fund available to building occupiers to upgrade the energy efficiency of their properties in return for regular repayments over an extended period would offer potential to intervene in the existing built up area. An example of this type of initiative can be found in Southampton where a scheme has been established to give loans to householders secured against a share in the equity of a house for energy efficiency improvements. However, borrowing must remain within the limits set by the Treasury. However, the use of loans to finance new infrastructure does not deal with the problems of limited capacity to manage the on going revenue implications from newly created assets and the capacity/ skills problems involved in their management.

14.1.3 Grants

Grants have been a longstanding means of implementing energy policy through programmes like Warm Front or the Low Carbon Buildings Programme. Eligibility criteria controlling access will reflect prevailing political priorities and lessons from review programmes.

Whilst sector specific programmes targeted at energy outcomes are a means of delivering outcomes, they are often over subscribed. Energy focused programmes are also dwarfed by some of the mainstream grant funding programmes like Decent Homes or Affordable Housing development which have wider targets to deliver against. Flexing mainstream programmes to deliver higher levels of low carbon performance would create a bigger impact but at the expense of targets elsewhere. A house built to code 6 standards could cost an additional 25% on standard build cost of an equivalent house built to standards acceptable under current regulations and the Eco Homes Very Good Standard.

The availability of grant funding is usually heavily dependent upon the general state of the economy and pressure from other service obligations. Grants are usually accompanied by targets that may not reflect energy issues. Energy efficiency is typically seen as a non core activity relative to the demands of education and social services.

14.1.4 Capital Receipts

Local authorities receive receipts from the sale of assets. Potentially, these receipts are recyclable into energy infrastructure investment. However, the use of receipts is controlled by regulations in relation to the redemption of debt.

14.1.5 User Charges

User charges can offer a revenue stream that can make a project an attractive prospect for the private investor. User charges could be paid directly by the end user or by government who is then free to determine how much of the charge is passed onto the end user.

14.1.6 Equity

Equity investment through the private sector can be realised on infrastructure projects where private sector funding is acceptable in terms of public objectives and the level of return available. Access to equity depends upon partnership with the private sector.

14.2 Securing Greater Financial Freedoms

In the past, public authorities have tended to make isolated use of particular funding streams such as grants or loans to fund additional investment within government borrowing regulations.

With government borrowing increasingly constrained, conventional funding mechanisms are likely to be wholly inadequate relative to the scale of task identified earlier. New financial freedoms will be needed to meet the challenge where the public sector can use its resources to create an environment capable of drawing in private investment.

In the 1980s and 1990s, Public Private Partnerships were mainly associated with the Private Finance Initiative which has been criticised for its prohibitively high deal making costs which tended to mean projects had to have a value in excess of £20 Million. Since then, institutions and government have learnt lessons from the earlier phases which have allowed more targeted and lower deal cost vehicles to be developed.

Innovative approaches have been adopted whereby local authorities use their existing resources as an underpinning for private financial investment by reducing risk for the private investor. A number of potential mechanisms exist for local authorities to use their existing capabilities to attract private investors by reducing risk:

- Asset base;
- Revenue Activities.

14.3 Asset Backed

Local authorities own land and buildings to support the delivery of services. These assets offer an attractive form of security to the private sector and a means of creating added value. Under performing surplus assets can be put into a special purpose vehicle (company limited by guarantee) where the private sector invests capital in return for a share in uplift in value. The uplift is normally realised after a 25 to 30 year period along with a share to the public body (which could be retained as a capital receipt or recycled into infrastructure).

Over the next 20 years, access to reliable energy infrastructure is likely to be a source of sustained value. Proximity to a heat main may provide equivalent levels of value to way increased accessibility created by a road. Local authority property holdings could be invested in an asset backed special purpose vehicle where the private sector invests in the infrastructure on the basis of receiving a share of the uplift value at disposal. This type of strategy would require the development of a land disposal strategy linked to strategic energy infrastructure.

14.4 Revenue Backed

Revenue based approaches involve using one or more of the following:

14.4.1 Public Sector Backed Revenue Streams

Local authorities pay for the on going costs of service provision including the purchase of energy to run services. A guaranteed purchaser of a newly created energy supply may provide a means of increasing confidence to a private investor.

14.4.2 Other Revenue Streams

A revenue stream from an end user charged for the use of the infrastructure without any public subsidy. Infrastructure may be designed to deliver specific requirements to high value users willing to pay for access.

Local authorities can use their purchases of energy as a means of guaranteeing a revenue stream to a private sector investor who puts up the funding for infrastructure. As a regulator, local authorities can also assist the private sector gain access to potential revenue streams by facilitating access to neighbourhoods or developments.

14.5 Special Purpose Vehicles (SPVs)

Any of these arrangements need to be locked into place with a “special purpose vehicle” that clearly defines the objectives and expectations of the private sector partners and the local authority / public bodies. For larger projects like those funded under the Private Finance Initiative there are specific provisions concerning the establishment of an SPV but more generally they act as a legal safeguard for managing a complex set of relationships. SPVs can either be statutorily based (e.g. Urban Development Corporations) subject to public sector financial controls or non statutory with financial freedoms unavailable to the public sector.

14.6 Forward Funding

Whilst the funding needed overall is significant, the timing of investment creates a further problem. Energy infrastructure can take some time to turn cash positive especially where the take up is uncertain e.g. retrofit district heating into areas with pre existing supplies. A rolling fund can enable upfront investments in essential infrastructure capable of unlocking development potential.

A Rolling Fund would be initially capitalised by the public sector initially using sources like:

- Single Pot Funds;

- Growth Point Funds;
- European Investment Bank.

The Rolling Fund then makes the initial upfront investments in energy infrastructure which generates "downstream" revenue streams from developments that are released/ enabled or served by the infrastructure. These funds can be structured to support both the asset and revenue backed models of infrastructure development. The nature of these funds does, however, require a banker to finance the cashflow of the fund during the start up phase.

"SolarCity Offers new Financing Programme"

San Francisco, United States

SolarCity has announced a new financing programme that could change the way residential solar is purchased. The company has launched its SolarLease program which will offer homeowners an affordable way to use solar power for their homes without high upfront costs generally associated with residential solar. The programme will allow homeowners to purchase power from systems owned and installed by SolarCity.

SolarCity will own the solar panels and will take advantage of commercial tax credits that it will then apply to customer financing. A four bedroom homeowner can install a solar system for an initial payment of about $2,000. The programme is being backed by Morgan Stanley.

14.7 Conclusions

Conventional funding mechanisms are unlikely to offer the scale of funding or the flexibility to deliver the strategy. New financial freedoms will be needed to deliver the scale of activity needed over the next twenty years. This will require partnership with the private sector.

Key Points

Funding instruments for the public sector to undertake tasks that the market is not yet ready to do is going to be essential.

Constraints do, however, exist on financial freedoms available to authorities.

Alternative delivery vehicles could help overcome current financial constraints.

15 Strategic Enablers III – Leadership

Strategic leadership is essential to maintaining overall momentum and direction in delivering this agenda.

The Partnership for Urban South Hampshire has led on this issue by undertaking this current work and it is apparent that PUSH's core local authority membership has powers that support a leadership role. These powers are identified in the table below:

Functional Capabilities	Powers
Local Planning Authorities	Development Planning; Development Control; Master Planning; Management of Planning Obligations
Local Housing Authority	Management of Council owned stock; Strategic leadership
Waste Planning Authority	New Waste Planning Projects
Local Education Authority	Provision of statutory education services
Transport & Highways	Transport Planning/ Highways Maintenance
Economic Development	Economic Well Being; Promotion of new investment opportunities; Regeneration; Community Economic Development
Building Regulations Enforcement	Implementation of national standards concerning the thermal performance of buildings (Part L)
Energy Efficiency	Housing Act 2004 – Energy Efficiency promotion (former HECA role)
Emergency Planning	Management of incidents arising from climate change
Leisure and Recreation	Open space development and maintenance
General Capabilities	
Services Procurement	Procurement; Private Finance Initiatives; Public/ Private Partnerships
Exemplars of Good Practice	Management of council assets; maintenance regimes
Civic Strategic Leadership	Local Strategic Partnerships; Implementation of Community Strategies; Local Area Agreements; Regeneration

These powers are of course available individually to authorities (with the exception of powers related to County functions) however the South Hampshire sub region offers a means of achieving economies of scale in how authorities deal with the issues concerned in this strategy.

15.1 Reaching Small Business

During the stakeholder meeting the issue of engaging business in the energy strategy was discussed. Small business was identified as a target community of interest which has traditionally been hard to reach for the public sector. Suggestions included using representative organisations particularly trade bodies, Chambers of Commerce and the professions. The stakeholder meeting did however identify public procurement as offering the most cost effective means of reaching this group. The PUSH local authorities have significant purchasing power and opportunities exist to integrate energy efficiency outcomes into these purchases.

15.2 Sustainable Community Strategies

It is proposed that the resilient places framework would be applied through the Sustainable Community Strategies prepared by Local Authorities with key partners on the Local Strategic Partnership (LSP). The stakeholders engaged in the process may, however, need to be broadened to include more private sector input from the energy sector or a nominated ESCo.

15.3 Local Area Agreements/ Multi Area Agreements

The local authorities have already adopted the climate change reduction target as a core target for monitoring performance.

15.4 External Leadership

The local authorities can also help access external experience through participation in networks where cities exchange ideas on how to achieve stretching carbon reduction targets:

- World Renewable Energy Network and European Energy Network;
- EU Project Networks e.g. POLYCITY;
- City Networks on Energy;
- Cities for Climate Protection e.g. Climate Alliance and Cities for Climate Protection;
- Brundtland City Energy Network;
- Renewable Energy Strategies for European Towns (RESETnet);
- Association of European Local Authorities Promoting a Local Sustainable Energy Policy (Energie-Cites);
- Forum European Energy Award;
- Grow Programme (EU); and
- Twinning Agreements (see box).

Strategic Carbon Offsetting

Kyoto has created a system that allows the developed world to invest in the developing world not participating in the protocol. The Clean Development Mechanism and the Joint Implementation protocol allow the developed world to “buy” carbon reductions from the developing world through a regulated system that verifies the reductions. Some of the countries in receipt of these funds are also becoming centres for the manufacture of renewable generation equipment. One opportunity would be to manage this flow of funds to mitigate the effects of the lifecycle emissions associated with the manufacture and distribution of the equipment back to the developed world including South Hampshire. Strategic investments in the energy supply systems of developing nations could be seen as a means of decarbonising the equipment to enhance the lifecycle benefits of renewable generation. South Hampshire local authorities could look at using international links to develop an investment strategy and routes to maximise the beneficial effects of offset investments.

Key Points

This section concerns the enabler "Leadership."

Local authorities have a range of powers essential to this agenda.

The Partnership for Urban South Hampshire can provide leadership and create economies of scale across the sub region by accelerating essential learning of how to deal with this agenda.

16 Strategic Enablers IV – Enterprise: The Potential Role of an Energy Services Company in South Hampshire

This Section discusses the critical role of "enterprise" in bringing together the other enables into a single package. This section also addresses the specific requirement of the brief for this feasibility study which asks for specific advice in relation to the role an Energy Services Company might play in delivering a strategy for South Hampshire.

This section examines the role that an Energy Services Company (ESCo) could play in delivering a future strategy for PUSH. A critical test will be whether an ESCo can deliver the flexibility and financial freedoms needed (see Section 13.2).

16.1 Delivering New Energy Infrastructure

Chapter 7 demonstrated the way site wide low or zero carbon infrastructures can be used to deliver low cost solutions. However, site-wide infrastructure solutions need to be owned and maintained by a competent body. Although the electricity supply industry is heavily regulated, the structure of organisations was created around a centralised model of supply and distribution.

The creation of new site wide infrastructure with generation attached to the distribution network requires an alternative model of management and regulation. Energy Services Companies are cited as potential solutions.

16.2 Defining an Energy Services Company

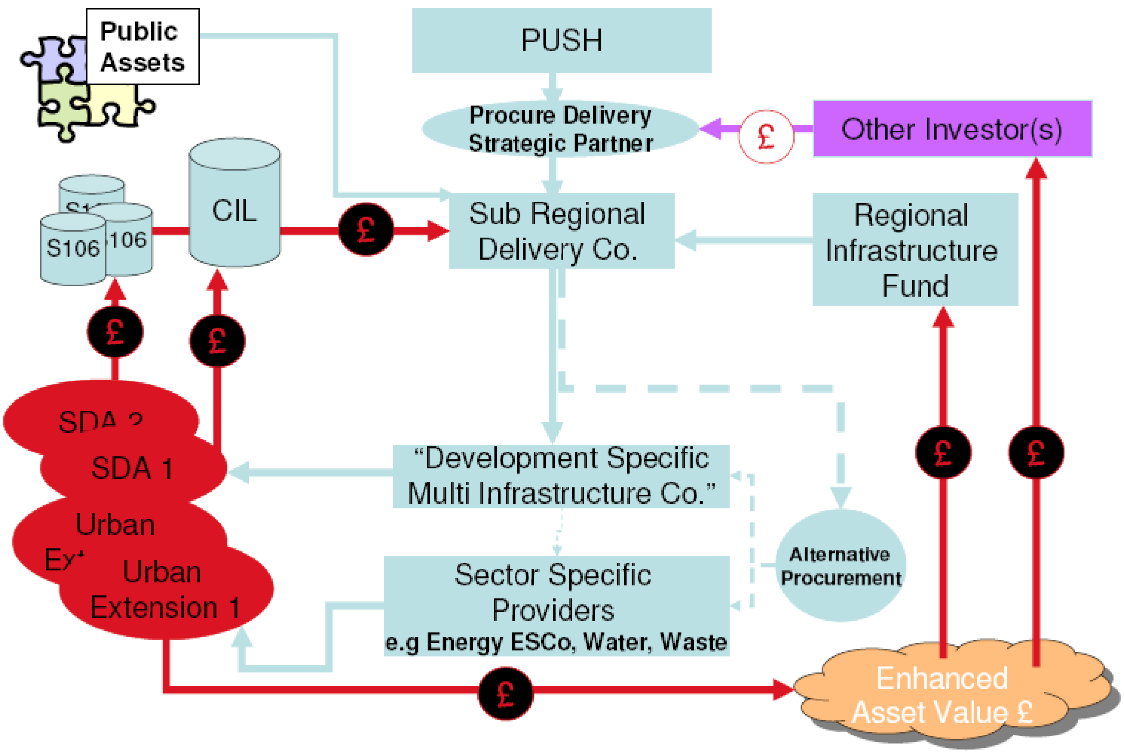
The term "ESCo" has no formal single legal definition; it is rather definable in terms of its characteristics. 'Energy Service Companies in Europe' defines these characteristics as:

- guaranteeing energy savings and/or provision of the same level of energy service at lower cost;
- securing remuneration is directly tied to the energy savings achieved; and
- finance, or assist in arranging financing for the installation of an energy project they implement by providing a savings guarantee.

The term energy service has been applied to energy analysis/ audits; project design; property management; provision of services. The term can apply to an existing development or brought into the strategy for building out a new development. The service mix can include energy supply to energy efficiency measures.

Figure 1 describes a potential way of integrating ESCos to the delivery of development in South Hampshire. Under this model, the ESCo or a Multi Utility Service Company (MUSCO) becomes a delivery vehicle to recycle developer contributions harvested from the new build programmed over the next twenty years. As much of the infrastructure needs to be provided in advance of development, it is likely that the ESCo will need a banker to handle the early negative cash-flows associated with early investment in infrastructure e.g. heat main. In some parts of the country, the banker role has been filled by English Partnerships however alternative funds may exist at a regional level. The Multi Utility Company route may seem intrinsically attractive however there may be difficulties finding a supplier market.

Delivering New Energy Infrastructure



16.2.1 Contracting Models

Energy Performance Contracting models	Energy Performance Contracting (EPC) can be defined as 'a form of 'creative financing' for capital improvement which allows the funding of energy efficiency upgrades from cost reductions'5. Performance guarantees are given by the ESCo in terms of the level of energy service or the level of cost and/or energy savings. The savings are then split between the ESCo and the client who could potentially reinvest this into more improvements. Under a shared savings model, the ESCo finances the project through its own funds or by borrowing from a third party. Under a guaranteed savings model, the customer raises the finance for the project but the ESCo guarantees performance and absorbs the risk of non performance. Any savings realised are however shared.
Energy supply contracting	This type of service tends to be delivered on a low risk – low margin basis with suppliers' business models often focusing on developing long term operation and maintenance contracts. Typically this route has less motivation for the contractor to continually improve the energy performance experienced by the client. The Chauffage Contract involves an end user being sold energy at an agreed rate and level of service. The contractor provides all associated maintenance and operations support throughout the duration of the project. These contracts typically have a time scale of 20 to 30 years and are useful when the customer wishes to outsource facility services and investment. Under a "Build-Own-Operate-Transfer" (BOOT) contract energy ownership of equipment is transferred from the ESCo to the client at the end of a long term contract with the BOOT operator, before which the ESCo may have designed, built, financed and operated the equipment. The charge incurred by the client includes the recovery of operating costs, capital and project profit.

16.2.2 Financing an Energy Service Company

Financing of an ESCo depends upon the type of service contract involved and constituent projects. Service performance type contracts which do not involve significant capital spend can be managed through the working capital of the Energy Service Company.

Project risk assessment would determine whether individual projects were ring fenced as discrete cost centres within the business and may even be set up as individual companies. ESCos.

Smaller ESCos would be more vulnerable to poor cashflow from an individual project if that project accounted for a large share of the total turnover. Larger ESCos with a varied portfolio of projects is better able to deal with variations.

ESCos needing to raise capital funding must look to either:

- Equity;
- Leases;
- Debt;
- User Charges;
- Grants.

ESCos share many of the same issues concerning the financing of capital expenditure that are common to the rest of the business community. Ideally, capital expenditure is financed by the customer lowering the risk of a project to the ESCo. Much depends upon the financial structure of the ESCo versus the customer.

16.3 Defining a Wider Role for the ESCo

The ESCo approach could be extended to tackling the existing housing stock by using it as a delivery vehicle to undertake a wider range of service tasks. The existing built environment represents the biggest challenge currently outside transport fuels. Currently, interventions have tended to be restricted to grant aiding programmes targeting vulnerable households with measures. However, the scale of challenge and the need to secure reductions may well prompt a wider role where an ESCo undertakes a wider range of housing improvement services. An ESCo could be linked into an equity release scheme where funds for energy efficiency triggered by either market increases in the cost of carbon based fuels or future regulatory requirements (e.g. proposal to require owners to improve energy rating).

Key Points

This section investigates the enabler "enterprise."

The section examines the options for the establishment of a special purpose vehicle to manage implementation as distinct from the provision of strategic leadership.

The section considers the "pros and cons" of different approaches for the establishment of an Energy Services Company (ESCo).

17 Future Evidence Base Development, Sub Regional Monitoring & Energy Infrastructure Planning

17.1 The Enhanced Role for Local Planning Authority in Energy Development

A number of recent reforms suggest that the PUSH authorities will need to enhance their capacities to understand and respond to energy planning issues over the longer term. Many of these drivers are coming through the planning process in relation to infrastructure in general.

Firstly, test of soundness (viii) requires that clear mechanisms for the implementation and monitoring of development plans should be in place alongside other requirements concerned with the need for a robust evidence base. The recently updated PPS12 (June, 2008) provides further clarification of what this means in relation to LPAs responsibilities for infrastructure planning and delivery (paragraphs 4.8 and 4.9):

'The Core Strategy should be supported by evidence of what physical, social and green infrastructure is needed to enable the amount of development proposed for the area, taking account of its type and distribution. This evidence should cover who will provide the infrastructure and when it will be provided. The core strategy should draw on and in parallel influence any strategies and investment plans of the local authority and other organisations.

Good infrastructure planning considers the infrastructure required to support development, costs, sources of funding, timescales for delivery and gaps in funding. This allows for the identified infrastructure to be prioritised in discussions with key local partners. This has been a major theme highlighted and considered via HM Treasury's CSR07 Policy Review on Supporting Housing Growth. The infrastructure planning process should identify, as far as possible:

- *infrastructure needs and costs;*
- *phasing of development;*
- *funding sources; and*
- *responsibilities for delivery.'*

This emphasis on delivery corresponds with the government's wider vision of a spatial planning approach, which goes beyond traditional land use planning, to bring together and integrate policies for the development and use of land with other policies and programmes which influence the nature of places and how they can function. This includes energy.

The second reason why LPAs have an inherent interest in the infrastructure planning process is their crucial role in contributing to infrastructure funding through the collection of developer contributions. Establishing a robust evidence base to justify developer contributions and ensuring that the amount of finance that can be raised is optimised are clearly of importance.

Both the spatial planning function and power to capture s106 contributions mean that LPAs have a key role to play in an infrastructure delivery partnership, but it is also suggested that the resourcing implications of producing a delivery plan should not fall solely with the LPA. A wide range of both public and private sector organisations have vested interests in ensuring that the planning, financing and delivery of infrastructure progresses as smoothly as possible. The production of a delivery plan will in any case depend on the timely provision of information by partner organisations and discussion of funding options. A partnership approach to delivery plan preparation led at a corporate level is therefore recommended.

It should also be noted that infrastructure planning in this context is very much an emerging discipline. The recent CLG publication, *Infrastructure Delivery – Spatial Plans in Practice: Supporting the reform of local planning* (June, 2008), advises as follows:

'One of the main challenges in addressing this topic is that relatively few local planning authorities have yet reached the stage of having an adopted core strategy or other development plan document which outlines infrastructure requirements. Many local authorities are only at an early stage of grappling with this aspect of the new spatial planning arrangements, and as a result, the extent of current experience and practice that can be drawn upon in the form of 'good practice' examples if relatively small.'

Without a definitive approach available 'off the shelf', it will be necessary for LPAs and their partners to customise a process of infrastructure planning including energy that takes account of local circumstances, and the stage of review of the Local Development Framework and other plans and strategies.

17.2 Monitoring Support Systems

To support PUSH pursue this role, an integrated database could be developed to help assist in this task. This will provide a platform for the PUSH authorities to:

- Supply base evidence from different energy service providers (e.g. Local Authority Infrastructure Delivery Plans, Energy Supply and Distribution companies) under one source. Currently supply and distribution verges on being monopolistic however decentralised generation may encourage a decentralisation of control with a greater role for small companies. Currently, planning information by the large utility companies is typically regarded as commercially confidential. In the future, the issue of confidentiality is likely to make the evidence base on what is happening in South Hampshire even more difficult to get at unless the Local Planning Authority uses its powers to access data on energy use/ demand as part of planning agreements;
- Evidence on supply needs to be integrated into an information system that can be related to changes in demand. Communities (CLG) New Growth Point monitoring, Annual Monitoring Report data, Regional Funding Allocation process etc.) need to be feed into a common reporting database;
- Data on energy infrastructure needs to be feed into a common data template that relates energy to other forms of infrastructure who are either reliant upon energy delivery or act as a vital link e.g. water resources (pumping, storage); and
- Capture of data on microgeneration through closer integration with district network operator and functions like building regulations within the local authorities.

It is possible that such a database will also provide a basis for agreeing priorities for future rounds of the Regional Funding Allocation (RFA) process.

These requirements provide a strong case for the creation of a 'live' infrastructure planning to support this type of work. The storage of information in a database rather than paper document would allow for the filtering and analysis of energy projects by sector, category and geographical sub-area, enabling improved understanding of overall requirements. The aim would be create layers representing different types of infrastructure and then develop a capability to take a cross sectional view through multiple layers representing the combined needs of a specific community. Ultimately it should be possible to look at infrastructure from a three dimensional perspective picking up critical pathways and linkages essential to the early identification of bottlenecks and barriers. Ideally, this could be linked to capital programming activity and even involve interfaces out to external providers. The incorporation of the database within a Geographical Information System (GIS) would allow for further visualisation of what is likely to present a complex picture (see example below[25]).

[25] Urban Energy Systems Project 2nd Annual Report January 2008 (BP- Imperial College)

17.3 Indicators

As part of this project, we have used secondary data available from central government to benchmark and baseline activity within South Hampshire. The boundary defined for PUSH does however pose problems for data collection. Generally, official datasets go down to Middle Layer Super Output Areas (MLSOA). Currently, the boundary of PUSH splices a number of MLSOAs requiring apportionment of data using proxies like employment or population. Monitoring trends in energy will be assisted if it were possible to adjust boundaries to assist alignment with available sources of data.

Central government data on energy consumption cover the major end user sectors of energy – domestic, industrial and commercial and transport. However, data on energy consumption and emissions related to the port and airport are usually either excluded or anonymous.

The analysis of emissions for this project has accorded with the government's environmental accounting system where emissions are identified with their point of production with the exception of electrical energy which is redistributed to their point of consumption. This accounting convention does however exclude embodied emissions contained in the vast array of goods and services consumed by residents and businesses of South Hampshire. The report identifies the much larger carbon footprint that results from measuring emissions associated with consumption. However, the authorities may wish to consider whether this is to be a future monitoring requirement.

The following indicators will need to be monitored:

- Emissions by end use – gross and per capita (Defra);
- Carbon Footprint Assessment (optional);
- Energy consumption by end use sector (BERR) – industry/ commerce, road transport, domestic;
- Average emissions per household; and
- Average emissions per unit of non domestic floorspace.

Key Points

A robust evidence base is essential and likely to be a long term issue.

Key drivers are to be found in the planning system.

The evidence base needs to be multi dimensional to allow energy; land use and other infrastructure to be integrated effectively.

Scope exists for integrating energy evidence into a wider evidence base to be used for infrastructure planning.

Geographical Information Systems probably offer the best medium for managing this agenda.

18 Conclusion

All developed economies face a massive task in decarbonising the way energy demand is met. This feasibility study has been to focus on deconstructing the scale of the task facing South Hampshire into manageable proportions called “wedges”. Each wedge is designed to carry a certain transparency in terms of the source of emissions and the types of businesses and people involved with causing the problem. This transparency also helps identify who needs to own the eventual solution.

The process of deconstructing the problem is essential to demonstrating the possibility of tackling it, deconstruction risks fragmenting the problem. South Hampshire’s task is essentially to manage a reduction in resource consumption across a range of activities whilst retaining activities. This objective is sometimes expressed in terms of reducing the ecological footprint created by an area which brings into play transport; logistics; waste; water; waste water and food as well as energy. Given the inter dependencies between the way these resources are used e.g. waste can supply energy need; it is more desirable to consider these collectively.

Achieving this objective is hard enough for a new community but the problem increases by an order of magnitude for an existing community serviced by a legacy infrastructure spanning several centuries that was designed for an entirely different era. For these reasons an energy strategy must be driven through the Strategic Community Strategies with binding targets merged into Local Area Agreements. Each South Hampshire authority has already adopted the climate change performance target. Certain targets should be agreed across local boundaries within Multi Area Agreements where the functionality of the issue, demand cross boundary working e.g. establishing biomass logistics supply chains involving rural Hampshire.

A1 Energy Services Companies – Background

A1.1 Energy Service Companies: The Pros and Cons

ESCos are seen as a popular solution to organising future energy provision. The positive aspects of using the ESCo route are detailed below alongside some of the potential downsides involved.

	Advantages	Disadvantages
Technical capacity and capability	Expertise; Efficient maintenance; Single contact point; Turnkey capital projects; Defray personnel responsibilities.	Complexity of set up – initial leadership; Legacy arrangements; Definition confusion; Late engagement in project development.
Performance Risk Management	Transfers risk; Incentives to reduce energy costs; Large scale private wire – insurance against grid outages; Upgrades to national standards; Price predictability; Opportunity to bundle projects to achieve economies of scale; Equalised billing arrangement for heat to fuel poverty households.	Includes a profit margin & ESCO operational costs; Commercial competency; Another Mini Utility; Risk adversity; Preference for larger scale; Long term customer lock in; Blocks to bundling projects that prevent economies of scale may be lacking; Tenant/ Landlord.

A1.2 Policy & legislation

A decision to use this route needs to be set in the context of some of the policy drivers that will influence the final decision. The decision to form an ESCo effectively creates a new entrant into an extremely complex regulated market place dominated by a small number of very large companies that act as "gate keepers" into the energy market place. For practical reasons, the economies of scale in transmission and distribution networks have favoured operation by large companies. In South Hampshire, Scottish and Southern Electric exert considerable influence on who can gain access to the network. The apportionment of reinforcement costs, especially any upgrades of the transmission network can act as a significant deterrent to new entrants seeking to supply smaller scale generation capacity.

Policy and Legislative Drivers	Impact
Built Environment Performance Standards	The Code for Sustainable Homes and the proposed improvements in Building Regulations require low/ zero carbon energy generation that favours economies of scale in provision. These performance standards create a market for collective provision.
Government Intent	David Milliband charged the RDAs and the Core Cities with examining the potential for ESCos.
Market Reform	Ofgem are consulting on ways in which decentralized generation can be encouraged.
Primary Legislation	The Utilities Act 2000 enables electricity to be generated, distributed and supplied by those that are licensed to do so or are exempted. Small suppliers, i.e. most site specific ESCos, are authorised to generate, distribute and supply electricity under The Electricity (Class Exemptions from the Requirement for a Licence) Order 2001. It is difficult for new suppliers to enter into the energy wholesale market. However, through partnership with energy suppliers, this problem can be reduced.

Home Energy Certificates	The Home Information Pack will be an essential requirement for all domestic new-build developments and existing properties sold. The pack will provide details of all aspects of the property for prospective buyers. Section H will cover energy in the property and include the Home Energy Certificate, rating the properties level of energy efficiency and carbon emissions on a scale of A to G. This rating scheme represents a major incentive for new-build developers to maximise the energy efficiency ratings of their properties. It has the potential to encourage developers to think longer-term about their developments and engage service providers to finance energy efficiency measures and low carbon energy generation. Private wires, district heating schemes and community CHP plants become increasingly attractive with incentives such as this.
Carbon Emissions Reduction Targets (CERTs)	The Carbon Emission Reduction Target (CERT) in the United Kingdom (formerly the Energy Efficiency Commitment) is a target imposed on the gas and electricity transporters and suppliers under Section 33BC of the Gas Act 1986 and Section 41A of the Electricity Act 1989, as modified by the Climate Change and Sustainable Energy Act 2006. The original Energy Efficiency Commitment 1 (2002-2005) program required that all electricity and gas suppliers with 15,000 or more domestic customers must achieve a combined energy saving of 62 TWh by 2005 by assisting their customers to take energy-efficiency measures in their homes: suppliers had to achieve at least half of their energy savings in households on income-related benefits and tax credits. In the current (2005-2008) Energy Efficiency Commitment 2 scheme, energy saving targets were raised to 130 TWh suppliers, and here suppliers with at least 50,000 domestic customers (including affiliated licenses) are eligible for an obligation. The CERT which commenced in April 2008 increases the target and includes scope for applying renewables as part of the package. This may act as a stimulus to the market and create opportunities for sub contractors able to offer integrated solutions. It could also act as a stimulus for large distribution companies to develop new business models (SSE is already investing in a number of subsidiary companies suggesting a development of its thinking).
Local Government White Paper	Central Government's backing of ESCO development at a local scale is evident in paragraph 4.85 of the Local Government White Paper which advocates the use of ESCOs as a mechanism for local authorities working together with other agencies to tackle climate change, stating "we particularly encourage partners in our major cities to take up the challenge locally"11. Ongoing PFI projects and the lead taken by Woking Borough Council suggest that private sector involvement will be encouraged.

A2 ESCo Case Studies

A2.1.1 Mini Utility Model

Utilicom provide outsourced building and energy management solutions and are part of the French energy management company IDEX. They work with both private and public sector companies to provide finance and full contract energy management packages. They take full responsibility for the energy generation plant on a contract basis ranging from 10 to 30 years, taking full responsibility for plant efficiency. Utilicom are currently working with Barratt Homes and Sanctuary Housing Association to develop over 250 dwellings, which are powered by sustainable means using a centralised heat and electricity network. Utilicom also own and operate the Southampton District Heating Scheme, which supplies over 40 major consumers, and hundreds of domestic consumers, making it the largest commercially developed district heating scheme in the UK. The scheme is unique as it incorporates geothermal resources. Utilicom are also responsible for the University of London's CHP schemes which incorporate over 4.5 MW of CHP over the main campus site and a rolling out of the approach in Birmingham.

A2.1.2 Medium- to small-scale energy service provision

There are a number of medium scale companies, which offer energy service provision in addition to other services. Renewable Energy Systems (RES) design, build and operate wind farms and have recently begun to develop renewable heat and power technologies for the private and public sector. They are part of the RES group which is led by Robert McAlpine Enterprises Ltd. RES enter into long term contracts with both producers and consumers to provide sustainable energy resources without risk to the consumer. Their head office is Beaufort Court which is a zero carbon emission building incorporating wind and solar energy generation. RES own and operate a number of wind farms including Four Burrows in Cornwall, Forss in Caithness and Dyffryn Brodyn in Dyfed.

EcoCentroGen was established in 2001 to deliver low carbon and energy efficient solutions to businesses. They provide funding towards design and construction in addition to taking responsibility for the on-going operation and maintenance of on-site energy generators. They have been involved with Urban Splash who are property developers specialising in inner city regeneration. They were commissioned to assist in the Budenberg Haus Projeckte in Altrincham, which is to provide nearly 300 high specification apartments. EcoCentroGen are to provide finance, design services and supervision of the construction of an energy service solution. The energy plant will consist of 200kWe CHP as well as a gas fired boiler plant.

A2.1.3 Local authority involvement in energy service provision

Local Authorities are involved in energy services contracts in a number of ways, including setting up and employing specifically constructed ESCos to finance, operate and maintain either existing or proposed energy plant. Examples are described below.

The Nottingham District Heating Scheme has been running since 1973 providing heat and power to 4,800 homes, schools, residential homes, etc. through an energy to waste scheme which incinerates 145,000 tonnes of waste annually and a 15MW CHP plant. In order to ensure that the plant continues to run efficiently, Nottingham City Council contracted Dalkia to optimise, maintain and operate the scheme. Dalkia also run the Pimlico District Heating Scheme which first opened in 1950 using waste heat from Battersea Power Station. When the power station closed down in the 1980s, Westminster Council had to make alternative arrangements to supply heat to the scheme. Dalkia financed and designed three new boilers which generate hot water which is supplied to over 4,200 dwellings. Dalkia also bulk buy fuel for the Council to enable them to make savings and offer ongoing energy efficiency advice.

The most well publicised example of a local authority involvement in energy service provision is Woking Borough Council's ESCO, Thamesway Energy Ltd. Thamesway Energy Ltd was set up in 1999 to enable the expansion of an existing private wire network. This project was initiated by Woking Borough Council's energy manger with support from senior management. Thamesway Energy is a public/private joint venture consisting of Woking Borough Council and the energy company Xergi A/S. The company has enabled Woking to increase its energy generation by 800% since 2002. Despite the range of entities specialising in energy service provision and those specific to a particular project or aspect of service provision, the current take-up of energy services is limited and slow.

A2.2 "Do Nothing" or "Do Something" Decision

The first key decision is whether there is a sufficiently strong case to "do something" as opposed to "do nothing".

The "do nothing" would leave decision making on an ESCo arrangement to individual authorities and projects within those authorities. The Utilicom partnership with Southampton City is an example of what has been achieved locally. Local authorities could act as a catalyst for the most appropriate ESCo arrangement in their area seeking partnerships with providers capable of meeting their needs. This option risks each authority incurring the same learning overhead in terms of legal and administrative burdens. Arrangements entered into outside the big cities may also lack a sufficiently large customer base to give the necessary scale economies.

The "do something" decision assumes the existence of a legal entity capable of entering into commercial arrangements for South Hampshire. South Hampshire would be seen as providing a sufficient scale to be attractive to a commercial operator and a saving on the overhead. It would, however, need to consider how the existing legacy arrangements fitted with a sub regional model and resolve the complications of having dual arrangements apply in districts that are partially in the South Hampshire area.

A2.2.1 Options for the "Do Something" Approach

A number of options need to be considered for delivering an ESCo in South Hampshire. The first option would be to roll out a tested model such as the one established with Utilicom. This model is most closely aligned with the "chauffage" approach outlined above where Southampton City has entered into an agreement that shifts risk to Utilicom in return for a guaranteed energy price and management of the scheme.

The risk is that this arrangement focuses on energy supply but does not encompass energy efficiency, a significant means of reducing carbon emissions. Procurement regulations would preclude a single tender and consideration would need to be given to the protection of consumer interests where a long term contract has been entered.

A2.3 Options for "Doing Something"

A2.3.1 A Generic Public Sector ESCo

The concept of having a generic ESCo derives from the fact that the potential market for providing guaranteed energy services to the public sector is huge but is currently constrained by the limited extent to which existing providers are attracted to these projects and the resources associated with the implementation.

A generic ESCo could offer substantial benefits in terms of economies of scale:

- Relatively standard contracts could be developed and handled by experienced people who can help the client to work quickly;
- The initial legal and financial costs could be built in as an overhead rather than being born by a single project;
- The economies of scale associated with a large number of projects could provide access to attractive project finance;
- A 'joined up' approach could enable attractive and less attractive projects to be 'bundled' so that all projects can benefit from an overarching package of services;
- Long term working relationships can be established;

- A concept of this nature should attract the level of commitment and leadership required to accelerate implementation within the public sector; and
- Provision of a one stop shop advisory resource.

Limitations

Clearly the public sector does not have universal rules so variations would need to be developed for specific types of entity. The following examples relate specifically to ESCos set up in partnership with local authorities.

Variation 1: Local Authority Co-Financed ESCo

This model is a development of the Thamesway ESCo, which has been operating successfully for many years supplying energy and energy services to customers in Woking, Surrey. Such an ESCo would be a public/private joint venture with backing from all the LA's involved and, if needed, an external financier. The objective would be to realise energy and environmental goals across the area served. This could include local authority targets such as reducing fuel poverty as well as 'softer' targets such as increasing awareness of renewable energy. It is anticipated that this model may best be deployed when ESCo services are being provided to a single council only. Bringing together several councils to agree and make investments into a pooled 'pot' is likely to be an extremely difficult process.

Objectives of the ESCo

- To promote and increase energy efficiency, energy conservation and environmental objectives by providing energy and/or environmental services;
- To develop and implement projects for the production and supply of energy;
- To produce and supply energy (and any related by-products) in all its forms; and
- To provide financial, managerial and administrative advice, services and assistance.

ESCo Structure

Under this ESCo model it is proposed that the financier (local authorities, third party, or both) provides the necessary project financing to the ESCo via a loan contract, the ESCo provides the service via a performance contract, the customer pays the ESCo if the project meets its performance standards, and the ESCo repays the financier for the project loan.

In this case the customer repayment risk is borne by the ESCo. As a consequence, the financier will manage its risk by "looking through the ESCo" to ensure the viability of projects. As the ESCo is also financed by the councils and serving council areas there is a mutual benefit in ensuring projects are sustainable.

The contract between the Customer and the ESCo is often made up of two parts:

1. Key Performance Indicator payments – the contract will specify a number of KPIs against which the performance of the ESCo will be measured. These could be in terms of equipment installed or reduction in energy use or cost. If these targets are met then the full amount is payable. Typically KPI payments constitute 30% of the total bill.

2. Baseline Costs – these spread costs cover the initial set up and purchase of capital equipment (capital investment) necessary to achieve the energy savings and cost reductions guaranteed. These costs may also cover the provision of energy sourced from a supply/utility or other distributed generation. The ESCo contract will be structured to provide incentives for continual improvement rather than simply rewarding an initial step change in performance. The ESCo will commit to guaranteed maximum levels of energy usage subject to the use of the facilities.

The ESCo will subcontract the delivery of services and energy supply to partner companies with the necessary expertise. These companies will supply a range of services including:

- Energy management services;

- Energy efficiency technologies;
- On-site generation expertise and technologies;
- Renewable energy expertise and technologies;
- Energy sourcing.

Advantages & disadvantages of model

This model derives benefits from the level of buy-in of participating councils. Total commitment will reduce many of the problems and delays associated with the traditional supplier/client relationship and normal tendering processes. In particular if an ‘open book’ approach is used right from the beginning, there should be an objective of working together within the partnership to establish a win-win situation for everyone.

A project of this nature that involves local authorities providing an element of the finance, having a degree of accountability for the performance of the ESCo, and providing the project base, would be very attractive to lenders. This arrangement, along with the potential scale of the project portfolio, would enable attractive finance rates to be secured.

Often projects are delayed by high initial costs incurred even before contracts are drawn up. It is likely that this model would reduce these initial costs by virtue of a growing base of experience and expertise. Subject to the agreement of the steering group it may be possible for the ESCo to cover these initial costs on the basis that they are later bundled into the final finance package.

Legal issues for consideration

As local government finance is strictly controlled by Central Government, councils do not have the same flexibility as private sector organisations in determining the capital and revenue budgets. In addition, the Local Authorities (Companies) Order 1995 states that local authorities cannot invest more than 20% in private companies, otherwise the company would be treated as a local authority controlled company and be limited by central government’s capital controls.

A2.3.2 Variation 2: Independently Financed ESCO

This model is very similar to the previous one with the exception that the Local Authorities do not contribute financially to the ESCo. Instead, the ESCo relies entirely on private finance and the local authorities (LAs) contribute by way of providing direction, project ideas, and making legal commitments to ‘buy in’ to the model. The involvement of LAs in the ESCo formation is important in that it will focus the ESCo on providing client value. If LA derived stakeholders are effectively involved in the ESCo development then there is no excuse for any shortfalls in terms of the ability of the ESCo to meet its clients’ needs.

It is envisaged that this model would be suitable for the development of a ‘South Hampshire ESCo’ which would have the commitment of the ten South Hampshire local councils. Although this level of inter-council cooperation is unusual and can be difficult to operate, these councils already collaborate through membership of PUSH. PUSH is a partnership between the ten local authorities within the South Hampshire who co-operate on issues, both statutory and non-statutory, where there is the possibility of improving service delivery by working together.

The joining together of the ten councils on a basis where they are required to pool investment could be highly problematic and time consuming. There would also be complexities associated with how differing levels of investment and uptake are taken into account.

ESCo characteristics

In order for the ESCo to be worthwhile it is important to ensure that ownership of the capital equipment, bought to bring about the required energy savings, defaults to the LA after its has been paid off (typically after 15 – 20 years). The ESCo can manage the Operation and Maintenance (O&M) contract for all the capital equipment installed.

Advantages & disadvantages of model

This model has the obvious advantage that it does not require capital commitment from the participants although this will consequently increase the financing costs. Fundamentally though, the advantage of this model in relation to the potential application being discussed is that it is likely to be much quicker and less complicated to set up and operate in financial terms.

A disadvantage is that the lack of financial commitment could lead to less ongoing commitment from the local authorities. The establishment of an ESCo champion within each local authority (LA), acting on behalf of their LA on the ESCo steering group, may mitigate this problem.

A3 Electricity and Gas Industry

British Gas was privatised in 1986 and the electricity industry was privatised three years later in 1989. The structure of the energy industry has more organisational layers than that of the water and sewerage industry and therefore the economic regulator, Ofgem, is required to promote efficiency and competition in a number of ways. The roles of the numerous stakeholders are summarised below:

- **Generators (electricity) and wholesale gas suppliers** – Generators own and operate power stations. The majority of Britain's gas comes from offshore gas fields in the North and Irish Seas. Since market reforms in 1996, wholesale gas has been traded like any other commodity. Generators and wholesale gas suppliers sell to energy supply companies (see below).
- **Transmission Network Owner** – Both the electricity and gas transmission networks in England and Wales are owned and operated by National Grid.
- **Distribution Network Operators (DNOs)** – Distribution networks carry electricity and gas from the transmission network to homes and businesses. The south west region is served by three electricity DNOs: Western Power Distribution, Central Networks and SSE-Southern. Energy transportation businesses are natural monopolies so in order to encourage efficiency and protect customers' interests; Ofgem regulates the companies through five-year price control periods. Electricity network companies raise revenue by levying three broad types of charges on both generators and energy suppliers: use of system charges to pay for network reinforcement and maintenance; connection charges to cover the cost of new connections; and balancing charges, to meet the costs of matching supply with demand.
- **Energy Suppliers** – Household and business consumers buy electricity and gas from the energy supply companies. At present this competitive market is dominated by the 'big six' supply companies: E.on (Powergen), Centrica (British Gas), EDF Energy, Scottish and Southern Energy, RWE (npower) and Scottish Power.

Beyond proposals for major infrastructure items such as power stations and gas storage facilities, elements of the energy industry that are likely to be of greatest interest at the local level are:

- the cumulative impact of grid connections on the transmission and distribution networks; and
- the implications of decentralised generation on the form of the electricity distribution network.

In relation to the first of these, an accumulation of connection requests can 'trigger' deeper Grid reinforcements, to increase capacity at bottlenecks. By waiting for requests from developers and suppliers, network operators are able to build an evidence base to show planning authorities that new lines are needed. This approach also allows operators to avoid investing in lines which may prove uneconomic at a later date. The disadvantage is that long delays to delivery can result when the trigger point for the additional capacity is reached.

The second issue relates to the form of the electricity distribution network and its ability to integrate the decentralised generation technologies promoted by planning policy, such as CHP and small wind farms. The distribution network can be described as resembling a tree, with power flowing from the root and trunk and out along branches. There is little interconnection between the branches and therefore maintaining reliability can present technical challenges. Once decentralised generation is introduced, networks would need to cope with voltage fluctuations and reverse power flow. Thought the higher-voltage lines are monitored and managed centrally, the lower-voltage parts are not. Most faults still require on-site intervention to restore supply. If decentralised generation is to become widespread, improved monitoring and control techniques are likely to be required, with more automation and more interconnectivity between branches.

A4 Engaging with Young People (Culture Change)

Engaging young people in policy development has traditionally posed a number of difficulties. Young people are often considered ‘unaware’, ‘un-interested’, ‘unknowledgeable’ or not relevant for inclusion within consultation and local decision making. Barriers to engaging young people include meeting venues that are considered threatening, jargon that young people may not understand, mediums of communication that young people find hard to relate to and issues being discussed portrayed as irrelevant to young people.

Engaging young people is vital, however, in developing and delivering carbon reduction policy and practice. They are the future and their actions and environmental ethos will determine the success of such policies. They also have the potential to influence how their wider family behave in relation to energy use.

Techniques to engage young people that could be considered include;

E-participation methods- online forums, online pledge systems (see CRed case study Section 12) which allow young people to engage remotely in discussions around carbon reduction. These can be linked up to existing social networking sites (facebook, myspace) to encourage membership. Young people are particularly high users of mobile phones, and SMS reminders may be another option for promoting engagement and action in reducing carbon emissions.

Schools based sessions- these could be delivered through schools themselves or via an external organisation (please see CRed case study for Schools Energy Club) which aims to engage young people in discussions around carbon reductions and identify practical measures for reducing their schools’/colleges’/youth clubs/youth centres carbon footprint.

Youth forums and/or youth councils (often delivered by local youth services) provide a useful forum for young people to be engaged in discussions around carbon reduction policies and practices.

Through drama and arts in local communities. Arup recently carried out a theatre production based around sustainability and Arup’s SPeAR model (sustainability appraisal toolkit). This allowed young people to become engaged through a non intimidating forum and allowed them to learn about sustainability and make promises to improve their environmental sustainability.

Though sports and leisure activities. Engaging young people in cycling schemes for example, raises their health and wellbeing and encourages them to consider sustainable transport.

Creating Young Peoples Climate Change Champions within the region. These young people could be those that express an interest in being involved either online or at school and/or communities events. Ideally they would be supported by their relevant councils and or local businesses to attend discussions and look at funding projects that they design and deliver to engage their peers in climate change reduction and more widely through the variety of voluntary work opportunities open to engage young people; this is an important pool of young people, keen to gain experience that may be of use to them in the work place (e.g. V, CVS, Princes Trust).

There are several ‘Good Practice’ techniques that should be considered when engaging with young people;

- use venues which young people frequent (youth clubs etc);
- use informal/creative activities to engage participants;
- make the topic of discussion relevant to young people’s needs;
- informal dress;
- enable young people to take ownership, set targets and groups objectives;

- Work with those agencies/people that have relationships with young people (youth services etc) who can encourage young people's attendance and introduce you to the group.

Glossary

Term	Definition
Absorption Refrigeration	Plant that uses heat instead of electricity as its principal energy source and utilising for example water as a refrigerant and typically operating as a chiller unit serving air conditioning and process cooling.
Alternating Current (AC)	A direct current means that electrical current flows in a single direction through a conductor. DC must be converted to alternating current (AC) to be used for a typical 120-volt or 220-volt household appliance. DC is used directly in industrial applications and appliances that use battery power.
Albedo	The **albedo** of an object is the extent to which it diffusely reflects light from the sun. It is therefore a more specific form of the term reflectivity. Albedo is defined as the ratio of diffusely reflected to incident electromagnetic radiation. It is a unitless measure indicative of a surface's or body's diffuse reflectivity. The word is derived from Latin *albedo* "whiteness", in turn from *albus* "white". The range of possible values is from 0 (dark) to 1 (bright).
Baseload	Electricity from generating plant that runs constantly through the day and night.
Biomass	Anything derived from non fossil plant or animal matter. Biomass sometimes needs processing prior to use such as chipping or digestion.
Bio Oil	Solid biomass can be converted into a carbon-rich liquid, which can be used to produce chemicals and fuels. This liquid, or bio-oil, is produced through a process called pyrolysis, in which the biomass is broken down into liquid in an oxygen-free, high temperature environment.
Calorie	4.1840 Joules (Kilocalorie/kcal = 4.184 kilo Joules)
Climate	Climate is usually defined as the average weather which in turn means using statistics to describe weather (temperature, precipitation and wind) in terms of the mean and variability.
Combined Cycle Gas Turbines (CCGT)	Combined cycle gas turbines use both gas and steam turbine cycles within a single plant to produce electricity with high conversion efficiencies.
Clean Development Mechanism	The **Clean Development Mechanism** (**CDM**) is an arrangement under the Kyoto Protocol allowing industrialised countries with a greenhouse gas reduction commitment (called Annex 1 countries) to invest in projects that reduce emissions in developing countries as an alternative to more expensive emission reductions in their own countries. A crucial feature of an approved CDM carbon dioxide is that it has established that the planned reductions would not occur without the additional incentive provided by emission reductions credits, a concept known as "additionality". The CDM allows net global greenhouse gas emissions to be reduced at a much lower global cost by financing emissions reduction projects in developing countries where costs are

Term	Definition
	lower than in industrialized countries.
Climate Change Levy	The aim of the CCL is to encourage improvements in energy efficiency and reduce emissions of greenhouse gases. The CCL is a tax on the use of energy in industry, commerce and the public sector with offsetting cuts in employer's national insurance contributions and additional support for energy efficiency schemes and renewable energy.
Combined Heat and Power	A combined heat and power (also referred to as a cogeneration or a CHP) unit is an installation in which heat energy released from a fuel is transmitted to electrical generator sets which are designed and operated in such a way that energy is partly used for generating electrical energy and partly for supplying heat for various purposes. The thermal efficiency of a combined heat and power unit is significantly higher than that of electricity only unit.
Community (or District) Heating	Uses one central source of heat to supply multiple buildings by they homes, schools, hospitals or offices
CLG	Communities and Local Government
Direct Current (DC)	The type of power produced by a photovoltaic panel and by storage batteries. The current flows in one direction and polarity is fixed.
Decent Homes Standard	The decent homes standard is a composite of measures to achieve "fitness of habitation"; address disrepair; modernise facilities and reasonable levels of thermal efficiency. The last element has been focused on avoiding excessive hot and cold temperatures through efficient heating and effective insulation including 200mm of loft insulation. A "Decent Homes Plus" standard is proposed to supercede the current standard for 2010 and is expected to include a greater emphasis on thermal efficiency. The standard does, however, only refer to wall insulation if cavity walls exist, placing limitations on what could be done with solid wall housing (mainly pre 1919 stock). The decent homes standard is also only targeted at Council owned stock and those elements of the private stock deemed to currently fail the standard and occupied by vulnerable households.
Distributed Generation	Electricity generation plant that is connected directly to the distribution networks rather than the high voltage transmission system
District Heating Systems	A system which enables a large number of homes buildings and establishments to receive their heat and hot water from a single source rather than having individual appliances in situ.
Efficiency	The percentage of power that get converted to useful work. A system is 60% efficient converts 60% of the input energy into work
Energy from Waste	Electricity or heat generated from waste including mass burn, pyrolysis and gasification.
Energy Performance of Buildings Directive	This European Directive requires each Member State to establish methods for rating the energy performance of

Term	Definition
	buildings; energy certificates are to be issued when a building is built, sold or rented.
Energy Efficiency Commitment	A legal obligation placed on all domestic energy suppliers to achieve specific energy savings targets through the installation of energy efficiency measures. It is funded by the customers of energy suppliers through their bills. Legally, half of the benefit must go to vulnerable households. Now superseded by the Carbon Efficiency Reduction Target (CERT)
Energy Services Company	A professional company that provides energy end users with energy management services
Fuel Poverty	Households for whom energy costs represent 10% or more of their income.
Feed in Tariffs	A guaranteed price for the supply of renewables
Fuel Cells	A fuel cell is an electrochemical device used to create electricity. Much like a battery, it converts chemical energy to electrical energy. But unlike a typical battery, which holds a limited fuel supply in a sealed container, a fuel cell uses an ongoing supply of fuel to create a continuous flow of electricity. Fuels like natural gas and methane gas are used to produce hydrogen and oxygen. The hydrogen and oxygen are then fed to two terminals in the fuel cell to cause a chemical reaction that produces electricity with heat and water as byproducts.
Greenhouse Gases	The main greenhouse gas emissions considered in this strategy is carbon dioxide which accounts for 85% of emissions from the UK. Emissions of these gases are associated with Green house Effects which gives rise to an increase in the Earth's temperature. Some publications use tonnes of carbon as opposed to tonnes of carbon dioxide. In order to convert between them the difference between the atomic weights of carbon dioxide and carbon molecules in 1 t of C = 44/12 t of CO_2
Heat Grade	A classification of heat sources or heat requirement according to temperature. Up to 50℃ is classified as low grade; medium grade is between 50℃ and 150℃; and high grade heat is over 150℃
Heat Pump	A device to exploit heat differentials. Heat pumps work like refrigerators, moving heat from one place to another. Energy can come into the form of electricity (such as vapour compression) or be thermal energy (absorption heat pumps). Heat pumps can provide space heating, cooling and water heating and exhaust air heat recovery.
Irradiance	**Irradiance**, **radiant emittance**, and **radiant exitance** are radiometry terms for the power of electromagnetic radiation at a surface, per unit area. "Irradiance" is used when the electromagnetic radiation is incident on the surface. "Radiant exitance" or "radiant emittance" is used when the radiation is emerging from the surface.

Term	Definition
Insolation	(INcident SOLar radiATION) is a measure of solar radiation energy received on a given surface area in a given time. It is commonly expressed as average irradiance in watts per square meter (W/m^2) or kilowatt-hours per square meter per day ($kW·h/(m^2·day)$), or in the case of photovoltaic's it is commonly measured as kWh/kWp•y (kilowatt hours per year per kilowatt peak rating). The surface may be a planet or a terrestrial object inside the atmosphere, or any object exposed to solar rays.
Irradiance	The solar radiation incident or a surface per unit time. Expressed in watts or kilowatts per square metre.
Jeavon's Paradox	Based on an observation made by William Stanley Jevons, that as technological improvements increase the efficiency with which a resource is used, total consumption of that resource may increase, rather than decrease. It is historically called the Jevons Paradox as it ran counter to Jevons's intuition. In addition to reducing the amount needed for a given output, improved efficiency lowers the cost of using a resource – which increases demand. Overall resource use increases or decreases depending on which effect predominates.
Joint Implementation Protocol	**Joint implementation** (**JI**) is one of three flexibility mechanisms set forth in the Kyoto Protocol to help countries with binding greenhouse gas emissions targets (so-called Annex 1 countries) meet their obligations. JI is set forth in Article 6 of the Kyoto Protocol. Under Article 6, any Annex I country can invest in emission reduction projects (referred to as "Joint Implementation Projects") in any other Annex I country as an alternative to reducing emissions domestically. In this way countries can lower the costs of complying with their Kyoto targets by investing in greenhouse gas reductions in an Annex I country where reductions are cheaper, and then applying the credit for those reductions towards their commitment goal. A JI project might involve, for example, replacing a coal-fired power plant with a more efficient combined heat and power plant. Most JI projects are expected to take place in so-called "economies in transition," noted in Annex B of the Kyoto Protocol.[Currently Russia and Ukraine are slated to host the greatest number of JI projects.
Kinetic Energy	Kinetic energy is the release of potential energy to create motion, ultimately to do work. An example of kinetic energy is the energy carried by wind.
Load Factor	Usually applied to generating plant, load factor is the ratio of the average electrical load to the theoretical maximum load expressed as a percentage. The Load factor is also used to describe the average intensity of usage of energy producing or consuming plant expressed as a percentage of the maximum.
Market Transformation Programme (MTP)	Government supported programme to increase appliance efficiencies.

Term	Definition
MWe	Megawatt electrical
Ofgem	The regulator for Britain's gas and electricity industries. It focuses on making gas and electricity markets work more effectively, regulating monopoly businesses intelligently, securing Britain's gas and electricity supplies and meeting its increased social and environmental responsibilities.
Renewables Obligation	An obligation on all electricity suppliers to supply a specific proportion of electricity from eligible renewable sources (over 1 MWh)
SAP	Standard Assessment Procedure. Calculation of a dwelling's energy use.
Value Added	The value added (to a product or added value of a product) is the increase in value that products as a result of a particular stage of a production process
PUSH	Partnership for Urban South Hampshire
Primary Energy	Primary energy to deliver a given service is the energy converted when a fuel is burned for instance to generate electricity. With the current electricity system, primary energy is roughly three times delivered energy: for each unit of electricity delivered to the consumer, two units are lost in generation and transmission.
Power	Power is the rate at which work is done. The ratio of work and time determines the amount of power used.
Potential Energy	Potential energy is stored energy, waiting to be released. An example of potential energy is the energy embodied in ocean waves, which can be captured through ocean energy technologies to produce kinetic energy.
Renewable Energy	Energy flows that occur naturally and repeatedly in the environment. This includes solar power, wind, wave and tidal power and hydro electricity. Solid renewable energy sources include energy crops and other biomass; gaseous renewables come from landfill and sewage waste.
Renewable Obligation Certificates (ROC)	Eligible renewable generators receive ROCs for each MWh of electricity generated. These certificates can be sold to suppliers. In order to fulfil their obligation suppliers can present enough certificates to cover the required percentage of their output or pay a "buyout price" per MWh for any shortfall. All proceeds from buyout payments are recycled to suppliers in proportion to the number of ROCs they represent.
Thermal Energy	Thermal energy is the use of heat as a source of energy. Thermal energy can be used directly or can be transformed into mechanical energy (using a steam engine), which can then be transformed into electrical energy. Thermal energy is usually measured in British thermal units (Btu).
Thermal Ring Main	A system of pipes taking heat typically in the form ao hot water from an energy production centre to any number of

Term	Definition
	homes or other end users and then returning the cooled water to energy production centre. A thermal ring main is sometimes called a heat network used in a District Heating System. Efficient thermal ring mains depend upon the temperature of the return being significantly lower than the input temperature.
Useful Energy	The net energy provided to a dwelling for space or water heating from a heat source (that is to say the actually delivered multiplied by the boiler efficiency)
Work	Work is the transfer of energy to move an object a certain distance, such as a horse pulling a plow from one side of a field to another. Work is expressed in Joules. The rate at which work is performed is power.
Watt	The rate of energy transfer equivalent to one ampere under an electrical pressure of one volt. One watt equals 1/746 horsepower, or one joule per second. It is the product of voltage and current (amperage). The term "watt" (in addition to the larger measurements of kilowatt and megawatt) is commonly used to describe the capacity of an electric generator. For example, a 1,000-watt photovoltaic system has the capacity to produce 1,000 watts of power at any given time, though it may not consistently produce this much.