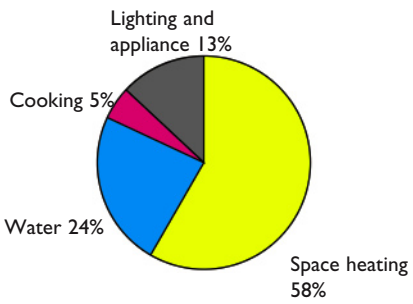
Taking Stock
Fact sheet 4: Energy and Water

Introduction

Energy is fundamental to the life of every region – but the current energy system is disrupting the global climate. This is possibly the greatest single threat to the global environment, a problem for which every nation and every region has to accept some responsibility and work together in a new kind of global order. The ecological footprint (EF) approach has much to offer this agenda. It provides a common platform for comparing energy and infrastructure to other sectors, as well as a direct assessment of the impact of different energy futures and energy strategies on the global environment.

In this factsheet we consider direct energy and water consumed by households and the service sector. Transport energy is considered separately, as is the energy used during the production of goods consumed in the South East, which is termed embodied energy. Direct energy is consumed in the form of electricity, gas, coal, wood and fuel oil. In the UK, there has been a significant shift from solid fuel to natural gas in the 30 years to 2000. A further category of 'direct heat' applies in the few cases of district heating and passive solar energy.

Figure 1: Domestic energy consumption in the South East by end use, 2000



Key facts

Household energy

- Total energy consumed in South East households per year is 75,000 million units (kilo-Watt-hours, kWh), or 9,000 units per person. Three quarters of this is gas.
- This energy supply produces over 2 tonnes of CO_2 per year per person.
- The total ecological footprint of this energy is 4.7 million global hectares, or 0.6 gha per person. This equates to about 9% of the total footprint per person.
- Over half of the energy consumed in homes is for space heating, 18 % is for cooking, lighting and appliances, and most of the remaining 24% is for heating water (See Figure 1).
- The current price of electricity per unit is 4.5 times as much as the price of gas: (7.3p/kWh, compared to 1.6p/kWh)

Services energy

- Total energy consumed in services is 28,000 million units (kWh). Half of this is in gas, a third in electricity, and the rest mainly in oil.
- The total footprint of this energy is over 2 million hectares, or 4% of the total.

Water

- Nationally, about half of all water use is for cooling power stations. Public water supply for households and for services accounts for 30 per cent of consumption.
- Household water consumption in the South East amounts to 165 litres per person per day, or about 60,000 litres per person each year. One third of this goes in flushing of WCs.
- The energy use in the SE water supply system is 860 million units (kWh). Supply to households, and the drainage / sewage system, are each about 40% of the total. Most of the rest goes in leakages.
- The ecological footprint of the SE water supply system is about a sixth of 1% of the total EF per person.

Nearly all the energy produced directly within the region is in the form of electricity, of which 30% is from coal, 25% from gas, and 40% from nuclear. The region imported about one third of its power via the national grid. Electricity supplied only 13% of the total energy demand in the region, but because of the relative inefficiency of power generation and transmission, the primary fuels used to generate electricity were nearly 30% of the total.

Renewable energy supply in the SE region was under the national average, at less than 1% of the total, nearly all of this coming from waste incineration. The SE renewable energy strategy anticipates half of the potential coming from offshore and onshore wind farms, and most of the rest from biomass fuels. The current 'best practicable' target is for renewable energy to supply 6% of the SE production of electricity by 2016. This is considerably lower than the national target to supply 10% by the year 2010.

At present, energy demand is rising slightly, while CO_2 emissions are reducing slowly due to the shift to gas power. A recent report on energy futures foresaw the end of cheap North Sea gas, at a time when most of the world's diminishing fossil fuels reserves will be in the most politically unstable regions. Continued reliance on these reserves may have implications for the reliability and security of energy supplies in the UK.

Policy background

The long-term target is for the UK and the SE region to move towards the internationally advised target of 60% reduction in CO_2 emissions by the year 2050. The key question in achieving a Factor Four reduction is whether this is going be achieved by greatly expanded renewable energy, greatly improved efficiency, or a new set of nuclear power plants.

The net effect of these policy and market trends is expected to be quite rapid changes in the structure of energy production in the UK. The DTI Energy White Paper sketches out a powerful scenario for the energy system in 2020, which it maintains is on the path towards the recommended 60% cut in 2050:

"We envisage the energy system in 2020 being much more diverse than today. At its heart will be a much greater mix of energy, especially electricity sources and technologies, affecting both the means of supply and the control and management of demand". For example:

- Much of our energy will be imported, either from or through a single European market embracing more than 25 countries.
- The backbone of the electricity system will still be a market-based grid, balancing the supply of large power stations. But some of these will be offshore marine plants, including wave, tidal and windfarms. Smaller onshore windfarms will also be generating. Backup capacity will be needed when weather conditions reduce or cut off these sources.

- There will be much more local generation, in part from medium to small local/community power plant, fuelled by locally grown biomass, locally generated waste, wind or possibly wave power. These will feed local distributed networks, which can sell excess capacity into the grid. Plant will also increasingly generate heat for local use (See Woking Borough Council case study).
- There will be much more micro-generation, for example from CHP plant, fuel cells in buildings, or photovoltaics. This will also generate excess capacity to be sold into local networks.
- Energy efficiency improvements will reduce demand overall, despite new demand for electricity, for example for digital television and more computers. Air conditioning may become more widespread.
- New homes will be designed to need very little energy and will perhaps even achieve zero carbon emissions. The existing building stock will increasingly adopt energy efficiency measures and some will use solar water heating and/or photovoltaic power generation.
- Gas will form a large part of the energy mix as the savings from more efficient boiler technologies are offset by demand for gas for CHP (which in turn displaces electricity demand).
- Coal fired generation will either play a smaller part than today in the energy mix or be linked to CO_2 capture and storage (if that proves technically, environmentally and economically feasible).

Possible future scenarios

In the full Taking Stock Project Report we consider four scenarios for each sector, ranging from high growth (Factor 0) through business as usual (Factor 1) to low growth (Factor 2) and finally a 'Factor Four' scenario which represents a more sustainable alternative involving more efficient use of resources and a reduced ecological footprint. The Factor Four scenarios are designed to achieve a 40% reduction in EF by 2020, and a 75% reduction by 2050, in line with the 'halving resource use – doubling efficiency' targets first set out in the book Factor Four published in 1997.

Key energy scenario indicators include:
• Energy demand from services building stock.
• Energy demand from household building stock.
• Renewable energy supply from the region.
• Heat supplied directly, e.g. from passive solar.
• Combined heat and power, generally co-generation with district heating.
• Energy recovery from waste, through incineration and other technologies.

Water scenario trends and drivers have been simplified to reflect the relatively small contribution of the water system in the total footprint calculation. They include:
• Household water demand / m2: A combination of lifestyle factors, particularly garden and car use: and technology factors on the efficiency of appliances and sanitary equipment.
• Leakage: This is basically related to the investment in new and replacement pipework.
• Regional supply balance: The proportion of the total demand met from within, or imported to the region.

Possible future scenarios

High growth scenario (F-0)

In a scenario of rapid economic growth, the energy and water utilities are shifted more than ever to a free market, supplier dominated industry. New supplies are opened up and globalised with large scale technology. This sees continuing growth at 1% per year in the EF of the regional energy supply, resulting in a 60% increase by 2050.

Business as usual scenario (F-1)

Current trends continue, combining the government's aspirations in the Energy White Paper, with the realities of a globalised industry. Offshore carbon sequestration appears to be the ultimate technical fix, enabling fossil fuel production to continue while stocks last. The result is an EF which changes little between now, 2020 and 2050.

Possible future scenarios

Low growth scenario (F-2)
In a scenario of market failure and environmental hazards, the current consumption levels in the affluent SE fall with severe social and environmental costs. Climate change becomes increasingly disruptive, leading to water shortages and increasing demand for power, but unstable supply means prices rise rapidly, causing hardship for the less wealthy. As a result of this disruption and economic stagnation energy use, carbon emissions and the total EF reduce by about 1.5% per year.

Factor Four scenario (F-4)
The Factor 4 scenario represents an aspirational mix of best practices, including those on demand, infrastructure and supply sides. An integrated energy-climate strategy will seek opportunities to combine employment, environmental gains and social objectives, and emphasis will be given to energy from renewables and more efficient use of water. Combined heat and power (CHP) will be a major provider in urban areas, being built into public and commercial developments, and ultra low energy building designs will be used. Energy services companies will mediate between suppliers, distributors and users. The result is a reduction in carbon emissions and EF of 35-40% by 2020, and 75% by 2050.

Policy implications

Regional policy has had very little engagement with energy issues since the setting up of the Central Electricity Generating Board (CEGB) and the national grid, in stages since the 1900s, and the phasing out of town gas in the 1960s. There is now a resurgence in the light of aspirations for renewable energy sources. However this is focused on regional planning, which is significant, but only part of a bigger picture which includes investment and market signals for utilities, co-generation, and energy efficiency in buildings.

To achieve anything like the Factor 4 scenario above, a much more pro-active regional energy strategy is needed than currently exists, and it will need to operate at sub-regional and urban level. It will achieve best practice in new development and conversions by bringing together institutions and financial mechanisms needed to steer developers, financiers, utilities, designers, contractors and building managers into a low-energy mode of practice. At the same time it will seek win-win economic and social opportunities from this agenda. Key factors will include:

- Supply side: Combined heat and power.
- Supply side: Expanding generation from renewables.
- Demand side: Households - Aggressive energy efficiency policies for new development, also for regeneration and rehabilitation of existing stock.
- Demand side: Commercial - Pro-active partnership arrangements on the energy services model, at an urban or sub regional scale.
- Increases in water efficiency, reduced leakages plus water collection and re-use.

For further details of our findings on energy/water see the full Project Report at **www.takingstock.org**

Case Study - Woking Borough Council Energy Services

Over the past 11 years Woking Borough Council has implemented a series of sustainable energy projects, including the UK's first small-scale combined heat and power (CHP) heating and heat fired absorption cooling system; the first local authority direct supply residential CHP and renewable energy systems; the largest domestic integrated photovoltaic/CHP installations; the first local sustainable community energy system; the first fuel cell CHP system; and the first public/private joint venture Energy Services Company (ESCO). These have resulted in savings of nearly £4.9 million for the Council, and further savings for householders and businesses in the Borough. Woking is recognised as the most energy efficient local authority in the UK, and gained the Queen's Award for Enterprise: Sustainable Development 2001, the only local authority to have achieved this.

The table shows the savings achieved in Woking, and a rough estimate of potential savings in the South East based on numbers of households. Woking now has a Climate Change Strategy with the key target to achieve an 80% reduction in Woking's CO_2 equivalent emissions of it's 1990 level by 2090, in line with the Royal Commission on Environmental Pollution's national targets.

For more information see full case study on Taking Stock website www.takingstock.org

Category	Savings over 11 years – Woking since 1990/91	% saving	Potential savings over 11 years – South East
Energy consumption savings	170,170,665 KWh	43.8% saving	14,413.5 GWh
Carbon dioxide CO_2 emissions savings	96,588 tonnes	71.5% saving	8,181,000 tonnes
Nitrogen oxides NO_x emissions savings	319.1 tonnes	68 % saving	27,000 tonnes
Sulphur dioxide SO_2 emissions savings	976.6 tonnes	73.4 % saving	82,700 tonnes
Water consumption savings	340,011,000 litres	43.8% saving	28,799,000 m^3
Savings in energy and water budgets	£4,889,501	34.3% saving	£414,141,000

Project Partners

Project Funders