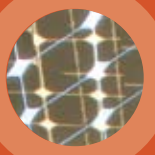
Decentralised Energy

business opportunity in resource efficiency and carbon management


The UK Government's
Business Taskforce on Sustainable Consumption and Production

The BUSINESS TASKFORCE ON SUSTAINABLE CONSUMPTION AND PRODUCTION was convened by Defra and DTI (now BERR) to bring forward proposals on how to help companies adopt more sustainable patterns of consumption and production (SCP) in ways that boost competitiveness and contribute to economic growth.

The Taskforce is approaching this by:

- looking at how government policy can shape the context in which a move to more sustainable production and consumption can be made
- examining evidence from business of the most effective ways to deliver SCP
- identifying tools and skills that will enable business to implement SCP initiatives.

It is led by a small Steering Group whose members are:

Neil Carson,
Chief Executive, Johnson Matthey Plc – Taskforce Chairman

Stewart Davies,
Business Commissioner, Sustainable Development Commission

Gordon Shields,
Chairman, Shields Environmental Plc

Peter Jones,
Director, Development and External Relations, Biffa Waste Services Ltd

Tristan Hillgarth,
Business Development Director, Jupiter International Plc

The main activities of the Taskforce are being undertaken by informal working groups that bring together cross-sectoral business representation to address a theme and come forward with practical recommendations on steps that can be taken by government, business and consumers. These themes include:

- How to unlock barriers to adoption of SCP inside companies?
- What is the potential for business to contribute to uptake of decetralised energy?
- Can a product roadmap approach assist progress towards SCP?
- How does globalisation impact on the business agenda on SCP?

The Taskforce will conclue its work in March 2008.

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Foreword

Concern for the environment has started to reach into every corner of business operations from corporate reputation and brand management to R&D and innovation.

The science of climate change has brought home to business the message that we need to decouple growing economic prosperity from emissions of greenhouse gases – above all CO_2. Yet, as many businesses have discovered, once we start to take a closer look at our carbon footprint we uncover many more questions about the "efficiency" of our operations - how well we manage and account for material resources consumed at different points throughout our supply chains.

These are becoming Board-level issues. As carbon-reduction mechanisms kick in, previously hidden inefficiencies are starting to have a significant financial impact. Public concern about climate change is providing space for competitors to build brand reputation and differentiate products around the carbon intensity of their products and their supply chains. Growing competition for raw materials is becoming an important factor in operational risk management.

We need to decouple growing economic prosperity from emissions of greenhouse gases

All of these drivers point towards the need for radical shifts in the way businesses plan for and use resources if they are to continue to enjoy competitive advantage in domestic and international markets.

Through its working group on **energy transformation** the Business Taskforce on Sustainable Consumption and Production has investigated how, by taking a strategic approach to energy use, resource efficiency and waste management, companies can integrate sustainable consumption and production into their business model. It has focused specifically on the role that **decentralised (distributed) energy** can play in changing perspectives on resource management, carbon and energy efficiency.

The Taskforce has looked at opportunities for business generally and explored as a case study how this is starting to take shape in the **food and food retail sectors**. There is much that business can do on its own using the wealth of new technologies and services available today. But there is also a clear role for Government to help remove barriers to improving resource efficiency and waste management while increasing energy security at the local level. There is no one-size-fits-all formula for addressing these challenges. It is important that government policy is flexible enough to promote a wide range of low-carbon energy solutions.

The emerging energy services sector, which brings together expertise in product and process design, resource management, renewables technologies and decentralised energy generation and distribution, is a vital part of the jigsaw providing a mechanism for acceptable risk management. Government can use extensive PFI programmes to put resource efficiency waste and energy management at the heart of project design and contract delivery so creating a platform for setting standards and raising performance in the energy services sector. And through mechanisms such as Forward Commitment Procurement it can bring forward commercialisation of new low carbon technologies.

The Taskforce recognises that these issues are part of a much larger debate around sustainable consumption and production which concerns the impact of the products and services we make and sell and the way we manage our increasingly global supply chains. Achieving a radical shift to resource efficiency in manufacturing and supply chain operations using carbon and energy as strategic drivers is the key that many businesses need to start this journey.

Peter Jones
February 2008

Decentralised energy: executive briefing

1 The Business Taskforce on SCP recognises that adoption of sustainable consumption and production is both desirable and essential in the 21st century. The idea of a single planet economy sums up the challenge. If replicated worldwide, current patterns of Western consumption and production would, it is estimated, need at least three planets' worth of resources.

2 This calls for a change in the way business uses resources to sustain growth and profitability. Society transforms resources into products, often inefficiently with substantial wastage accompanying each stage in the transformation. **Energy** is required to drive the whole process, indeed energy consumption and energy intensity serve as reliable proxies for, and indicators of, resource inefficiency. Our future production, distribution and consumption of energy will drive progress towards a more sustainable future if we are careful and if we take the right decisions now.

3 **Decentralised energy**, also referred to as distributed energy, is seen by the Taskforce as having a key role to play in the shift to sustainable consumption and production. Covering a wide range of technologies that do not rely directly on the high-voltage electricity transmission network or gas grid, decentralised energy brings a range of business **benefits** including:

- increased conversion efficiency (capture and use of heat generated, reduced transmission losses)
- increased use of renewable, carbon-neutral and low-carbon sources of fuel
- more flexibility for generation to match local demand patterns for electricity and heat
- greater energy security for businesses that control their own generation
- greater awareness of energy issues through community-based energy systems, driving a change in social attitudes and more efficient use of our energy resources

4 Decentralised energy has an established base in the UK although, at less than 10% of generation capacity, its development lags behind Europe and North America. The global share of new generation taken by decentralised power in the world market had increased to 25% by 2006, up from 13% in 2002[1]. Despite the benefits, business uptake of decentralised energy in the UK faces a number of hurdles:

- new disciplines on suppliers and users, for example to achieve supply and demand matching
- large up-front capital costs with payback periods generally beyond 3 years
- complexity of technology for companies who don't see themselves as power generators
- property leasing and management arrangements that focus on short-term cost savings and security of energy supply rather than carbon emissions and energy efficiency
- issues around the technology and economics of grid connection and reverse-metering
- local community acceptance and approval of generation capacity requires,
- new technology suited to the built environment, such as fuel cells, is mostly at pre-commercial stage

1 **Wade** World Survey of Energy (2006)

5 The existing **decentralised energy sector in the UK is diverse** and some solutions are starting to emerge. Delivery of strategic services through entities such as Energy Service Companies (ESCos) is playing a central role in market development. Collective approaches to contracting and managing decentralised energy facilities will enable SMEs as well as larger companies to benefit from this technology. Further action by business, government and wider society could open up many more opportunities for business and society to participate and benefit from a decentralised energy system.

6 A clear road map for implementation of policy on decentralised energy is needed to provide greater certainty for investors. Government leadership in changing behaviours for SCP will also play a vital part in laying the foundations for decentralised energy as part of a low-carbon economy. This means helping **to put carbon management** at the heart of **business models** for example by extending the fiscal and market incentives, currently only available to large energy suppliers and users, to all businesses. It also requires changes in attitudes to waste – in government and business - and an overhaul of the planning process.

7 **Heat supply**, including cooling for air conditioning, needs to be a central component of the decentralised system. The case for investment in many forms of decentralised energy infrastructure rests on the improvements in environmental performance and lifetime cost that all forms of **combined heat and power generation** (CHP) can deliver. Fiscal measures that currently promote renewable electricity alone, need to be modified to recognise rather than discourage this benefit. Extension of Renewable Obligation Certificates to cover heat and ultimately the creation of a Carbon Reduction Certificate will drive these efficiencies.

8 Regulatory measures and the need for greater public accountability around carbon in food processing and retail sectors have fired interest in decentralised energy. Systems using anaerobic digestion (AD) as an integral part of food industry resource management strategy are gaining prominence. Companies along the supply chain, from primary producers to retail and catering companies see efficient use of biogenic materials as part of their **strategy for controlling their carbon footprint**. However, experience in the food sector also flags up challenges to be addressed in relation to business practice and around current restrictions on use of waste materials

9 **The opportunity to integrate waste and energy operations**, for example in small and large-scale CHP, is a valuable feature of the decentralised energy system as it offers real opportunities to improve resource efficiency. Diversion of waste from landfill towards energy recovery is now being encouraged by escalating landfill tax tariffs and by the extended use of tradeable permits for carbon. Energy and waste management needs to be better integrated in government policy in order to **make more effective use of the carbon** embedded in material flowing through the economy. However, expansion of energy from waste (EfW) schemes should go hand-in-hand with measures to ensure optimal conversion efficiency through investment in advanced energy recovery technologies. Measures will also be needed to ensure that EfW systems complement strategies for waste minimisation within the overall context of sustainable consumption and production policy.

10 **Changing procurement practices** in the private and public sectors could provide the engine of growth for decentralised energy. Though many DE technologies are now proven, their capital costs remain high through lack of market demand. Public procurement could be utilised to provide opportunities to demonstrate the benefits of investing in Decentralised energy infrastructure, raising awareness of opportunities for local employment, regeneration and environmental protection. In so doing, market growth would be accelerated and costs brought down, at no risk to the public purse.

11 **Local planning authorities** should play a key part in encouraging uptake of decentralised energy by developers and the construction industry, using the discretion available to them to promote integrated solutions (for example around energy and waste management). Revision and extension of the Merton Rule to encompass low-carbon technologies, as well as building-based renewable energy, should promote investment in and adoption of the most efficient forms of decentralised energy, as should revision of the Building Regulations and the introduction tax relief available for zero- carbon housing.

12 **Collaboration between business and government** to bring public opinion behind decentralised energy is essential to achieve scale up to an effective level of operations. A decentralised energy system will catalyse closer engagement between business and the community around sustainable consumption and production issues. Changing patterns of resource use and infrastructure, and innovation in energy supply to households, businesses and public organisations are expected to bring a shift in emphasis from individual to collective provision.

13 The emerging market for decentralised energy products and services may need to be formally recognised and supported by dedicated **institutional arrangements**. These could range from training and skills development to operating standards, warranty and assurance schemes, and measures to facilitate reliability and connectivity between central, decentralised and micro energy systems.

14 Given the inherent diversity of decentralised energy, the emergent system should be guided by **a route map** that provides a common platform for decision-making based on resources, technologies, sources of expertise and patterns of demand. This will enable suppliers to optimise products and services to meet demand, and customers to make well-informed decisions around energy options.

15 Many strategic issues shape the policy context around decentralised energy – in particular the international energy and climate change agendas. This report presents the insights gathered from the viewpoint of a cross-section of businesses from different parts of UK industry, focussing on experience in the Food Sector. The intention is to provide a platform to **engage more people in business** in considering the role and configuration of the future decentralised energy system. If decentralised energy is to play a real part in the UK energy mix, capacity needs to be developed quickly to meet the expected supply gap which will arise over the next decade as exiisting centralised infrastructure reaches the end of its life. ■

Introduction

As part of its wider remit, the Business Taskforce on Sustainable Consumption and Production (SCP Taskforce) has investigated the potential for business to contribute to the uptake of decentralised energy, including use of combined heat and power (CHP), and the scope this offers to decouple business growth from resource use and environmental impact.

In addressing "Energy Transformation in Business and the Community", the Taskforce recognised the need to engage with a wide range of businesses to scope out where supply of and demand for decentralised energy is mostly likely to come from over the next 10–20 years, and to identify the drivers and barriers from a business perspective.

There is a growing body of expertise around the technical, commercial and governance issues concerning decentralised energy. Through its work on energy transformation, the Taskforce has endeavoured to widen the network of business engagement and shed new light on the potential social, economic and environmental opportunities that decentralised energy holds.

Following an initial scoping exercise, the Taskforce decided to look at the opportunities and barriers for scaling up decentralised energy supply and demand in the food industry, as an exemplar that could identify issues and measures that could also be extended to other sectors as appropriate. From a consumption standpoint, the food and catering supply chain accounts for 20-25 million tonnes of carbon (MtC) emissions a year in the UK, mostly from food production, and is thus an important contributor to UK emissions in its own right. Overall the sector is among the highest in terms of the level of emissions associated with meeting consumer needs. It is also one of the most advanced in terms of its exploration into the opportunities Decentralised Energy might offer.

Through the lens of the food sector the Taskforce set out to identify the potential role decentralised energy can play in addressing energy security needs, in contributing to energy efficiency and sustainable waste management strategies, in creating new employment opportunities and in reducing the carbon footprint of industry.

What is decentralised energy?

There are many different definitions of "decentralised energy". The Government takes a broad view using the term "distributed energy" to refer to the wide range of technologies that do not rely on the high-voltage electricity transmission network or the gas grid. This includes:

- All plants connected to a distribution network rather than the transmission network;
- Small-scale plants that supply electricity to a building, industrial site or community, potentially selling surplus electricity back into a distribution network;
- 'Microgeneration', i.e. small installations of solar panels, wind turbines or biomass/waste burners that supply one building or small community, again potentially selling any surplus;
- Combined Heat and Power (CHP) plants, including:
  - Large CHP plants (where the electricity output feeds into the transmission network but the heat is used locally);
  - Building or community level CHP plants;
- 'Micro-CHP' plants that effectively replace domestic boilers, generating both electricity and heat for the home;
- Non-gas heat sources such as biomass, wood, solar thermal panels, geothermal energy or heat pumps, where the heat is used in just one household or is piped to a number of users in a building or community.

Drawing on this work and consultations with business, the Taskforce has compiled this paper to show how business could better respond to the concept of decentralised energy and its potential role as part of the UK's future energy mix. It looks at the drivers for change and assesses the measures that are needed to deliver this change, and to incentivise business generally to consider decentralised energy in the development of sustainable business models. ■

Carbon and energy in the Food Industry

The Carbon Trust reported (2006)[2] that the food and drinks processing industry is the fourth largest industrial energy user in Britain consuming 3.7 Mt oil equivalent in 2006. Defra's Food Industry Sustainability Strategy (2006)[3] reported that overall, the food industry uses around 14 per cent of energy consumption by UK businesses.

From a consumption standpoint, the food and catering supply chain accounts for 20-25 million tonnes of carbon (MtC) emissions a year in the UK, mostly related to the production of products. Total UK CO_2 emissions in 2005 were 151 MtC[4].

2 **Carbon Trust** Food & Drink Processing (2006)

3 **Defra** Food Industry Sustainability Strategy (2006)

4 **BERR** Energy Trends June 2007; National Statistics (2006)

The opportunity

OVERVIEW

- **Decentralised energy offers the opportunity to reduce the carbon intensity of energy use**
- **An increase in resource efficiency would help improve environmental sustainability**
- **Energy users can benefit from increased energy security and internalisation of carbon costs**
- **Increasing uptake of decentralised energy could create new business opportunities for UK companies**

Resource efficiency and environmental concern

Achieving a shift in resource efficiency in ways that will contribute to decoupling economic growth from environmental impact is central to the Taskforce deliberations. The Taskforce has recognized that there exists a significant opportunity to achieve this with the widespread adoption of decentralised energy in the UK. Additionally the resource efficiency that this can achieve will translate directly into a reduction in the environmental impact of energy generation at both the local and national level. This will occur in two ways:

- reducing the carbon footprint of power generation
- broadening the availability of possible feedstock materials, especially biogenic waste.

Decentralised energy: an environmental opportunity

Energy generation in the UK is responsible for over 50% of total UK CO_2 emissions (37% from centralised power generation and 14% from domestic heat generation from fossil fuels) Over 90% of UK electricity is currently generated in large power stations, and around three quarters of our heat comes from gas fed through a nationwide network. This centralised model delivers economies of scale, safety and reliability. However it is relatively inefficient, with the very best power station only able to achieve an energy efficiency of 50%. A further 9% of the power is then lost during transmission through the distribution network.

A decentralised energy system has many environmental advantages over this situation. Principally, local electricity generation allows us to:

- Capture the heat generated in that process and use it nearby (known as Combined Heat and Power (CHP)). 30%-40% of power station fuel is currently wasted in heat generation and cooling to atmosphere (this also wastes river water, an increasingly valuable resource in the UK).
- Reduce the energy lost in transmission networks (around 9%);
- Increase use of renewable sources of fuel available in the locality, by smaller scale generation;
- Be more flexible to local demand patterns for electricity/heat; and
- Generate a greater awareness of energy issues, driving a change in social attitudes and, in turn, more efficient use of our energy resources.

A DTI (BERR) commissioned report published in 2006 concluded that there could be significant carbon reduction benefits from "distributed" energy (including cost savings to the UK private sector from £1.04 billion to £2.28 billion). WADE (World Alliance for Decentralised Energy) applying their economic model for Distributed Energy to the UK, suggested similar capital savings were possible by 2023, alongside a 14% reduction in total gas usage and 17% reduction in the UK's total CO_2 emissions over the centralized energy scenario, where existing plant is upgraded and replaced as necessary in the next 15 years). In their report "Decentralising Power: An Energy Revolution for the 21st Century" Greenpeace concluded that overhauling our electricity infrastructure and pursuing a decentralised pathway would enable the UK to halve CO_2 emissions from power generation, slashing total UK emissions by more than 15% as well as bringing down energy consumption levels in general by better supply-demand matching.

Regional energy challenges

Compared with the traditional centralised capacity approach, a diversified electricity supply system may offer business more long-term security and control over the environmental footprint of the energy systems they currently use. Regional variations in supply can better reflect demand. For example, in Cornwall population trends and rising domestic consumption will inevitably have an effect on energy demand.

The population of the SW of England grew by 12.5% between 1985 and 2005, faster than any other English region and entirely due to migration[5]. Households in the SW consumed an average of 5,019 kWh of electricity each in 2004, the second highest level in Great Britain and eight per cent higher than the national average[6]. Understanding the behavioural factors underlying these trends is important for energy supply management and for businesses located in this region as pressures on demand and opportunities to meet demand from local generated energy grow.

East Anglia has rising numbers of households and reduced capacity after Sizewell A nuclear power station was taken off line at the end of 2006[7]. Demand could rise further if climate change (and rising prosperity) increase usage of air conditioning systems at home and at work. *The Guardian* (2006)[8] reported that many of the blackouts and brownouts experienced in the US in recent years were blamed on surges in demand from air conditioning. The same trend, though perhaps with less intensity, could be experienced in the United Kingdom.

5 **South West Observatory** State of the South West 2007

6 **South West Observatory** State of the Region's Environmental Information

7 **BBC** Reactors shut down at Sizewell A (December 2006)

8 **The Guardian** "Is it OK to... use our air conditioning?" (June 2006)

What drives business interest in decentralised energy?

ENERGY SECURITY

For many businesses in the food sector, energy security (cost and availability) is already playing a critical part in business sustainability. Over the next 5-10 years market trends and resource issues, among them increasing pressure on fossil fuel supplies, decommissioning of much existing centralised capacity and growing demand, will result in higher prices and the possibility of restricted availability. In large-scale, energy-intensive sectors companies have established systems for energy management that incorporate risks associated with fuel costs and long-term supply. For other companies with less energy intensive operations, exposure to energy security risk will increasingly become a business issue for them as well.

There is a narrow window of time in which to renew and expand existing electricity infrastructure. With it exists a strategic opportunity to make the transition from a centralised to a broader based energy infrastructure that incorporates decentralised power generation. The Taskforce recognises the potential of such a move to offer better long-term supply security and control over the environmental footprint of the energy businesses use. In individual businesses "early adopters" are starting to take advantage of this. However, for the majority of businesses these opportunities are currently outweighed by the issues of having to tie up capital, to make long-term energy commitments and to adopt unfamiliar technologies.

Therefore, the challenge is to get the signals right for business and to reduce these risks. Energy and carbon prices at higher levels would provide stronger economic incentives to explore decentralised energy options from both supply and demand perspectives. Investment in new infrastructure for centralised fuel storage and energy transmission should be evaluated in terms of its capacity to provide adequate buffers in short term energy crises and whether a largely centralised system is cost effective when compared with the decentralised, higher efficiency and lower carbon alternatives now available.

ECONOMIC GROWTH AND BUSINESS OPPORTUNITY

Investment in decentralised energy infrastructure is an opportunity that could deliver economic benefits to the UK in excess of the costs associated with replacement of existing generation capacity.

Business commitments on waste and energy

Many leading businesses have made individual or collective commitments on waste and energy management, and on reducing the carbon footprint of supply chains. By linking such commitments with brand values, these companies are bringing corporate responsibility into mainstream marketing. In 2005 the **Courtauld Commitment**[9] – a voluntary agreement between major retailers and the Waste and Resources Action Programme (WRAP) to work to reduce packaging waste – was agreed to by virtually the entire UK grocery sector (*Asda, Boots, Budgens, the Co-operative Group, Londis, Iceland, Kwik Save, Marks & Spencer, Morrison's, Sainsbury's, Somerfield, Tesco* and *Waitrose*).

The commitment has three broad, shared objectives which the retailers will work on with WRAP to meet. These are:

- design out packaging waste growth by 2008
- deliver absolute reductions in packaging waste by March 2010
- identify ways to tackle the problem of food waste.

The **Carbon Reduction Commitment** (CRC)[10] is a scheme, announced in the Energy White Paper 2007, which will apply mandatory emissions trading to cut carbon emissions from large commercial and public sector organisations (including supermarkets, hotel chains, government departments, large local authority buildings) by 1.1 MtC a year by 2020. The CRC will target emissions from energy use by large organisations whose annual mandatory half hourly metered electricity use is above 6,000 MWh – focusing on those emissions outside the **Climate Change Agreements** (CCAs)[11] and outside the direct emissions covered by the **EU Emissions Trading Scheme** (EU ETS)[12]. In addition, firms with more than 25% of their energy use emissions in Climate Change Agreements would be completely exempt.

9 **WRAP** The Courtald Commitment

10 **Defra** Carbon Reduction Commitment

11 **Defra** Climate Change Agreements

12 **EU Emissions Trading Scheme**

The benefits are available through a range of new business operations:

- Delivery of low carbon, energy efficient solutions to business users.
- Provision of energy generation and supply, maintenance and service contracts through ESCos, enabling users to outsource, thus reducing their resource burden of managing local power generation facilities.
- Development of portfolios of technology and feedstock solutions that can be adapted to local conditions and business models, e.g. the building of biomass production and management capacity to optimise use of short cycle organic carbon as part of sustainable resource-use strategies.
- Facilitation of novel partnerships, for example between developers and energy generators, to establish low carbon, biomass and renewable (e.g. wind) operations at scale on under-utilised land.

CORPORATE RESPONSIBILITY

Some leading businesses have made individual and collective commitments on waste and energy management and on reducing the carbon footprint of supply chains. By linking such commitments with brand values, these companies bring corporate responsibility into mainstream marketing. As a result, for these companies, effective and transparent resource and energy management strategies have become critical tools for brand differentiation and for informing consumers about the environmental footprint of products.

The Taskforce believes a wider adoption of decentralised energy would deliver low-carbon or carbon-neutral sources of energy to more businesses and, in some sectors, would integrate resource and energy management in ways that would provide long-term cost advantages and at lower environmental impact.

Factors that will influence uptake include:

- The extent to which the cost models used to inform capital investment decisions utilise Whole Life Costing principles
- The existence of externally-driven requirements to set public targets and benchmark performance for alternative energy solutions.
- Introduction of standards for measuring the carbon embedded in everything businesses consume.
- The emergence of transparent carbon accreditation systems and tradable permit markets.
- Introduction of measures which impact the split of responsibility for carbon emissions between ownership and lease-holders in rented buildings (e.g. CRC)
- Measures are put in place, to remove real and perceived barriers to business investing in Decentralised Energy technology

New Opportunities for UK Business

The low penetration of decentralised energy operations in the UK coupled with the much higher presence in other European countries is evidence of the business opportunity represented by this sector. Experienced and potential players point to a number of areas where action could be taken to develop the sector more effectively – strengthening business models for decentralised energy and internal business processes that integrate the benefits of decentralised energy.

13 **Oakdene Hollins** Quantification of the potential energy from residuals (EfR) in the UK (2005)

14 **Green Alliance** Manifesto for Sustainable Heat (2007)

15 **ERM** Carbon Balances and Energy Impacts of the management of UK Waste Streams Final report (2006)

Integrated services

Development of a decentralised energy infrastructure also offers companies the opportunity to integrate decentralised energy related services into existing business models where core skills can be extended. In the waste sector for example, diversion of waste from landfill through new recovery technologies is producing a range of feedstocks suitable for CHP systems.

Integration of waste management with local energy supply and demand in infrastructure planning should be a key component in a decentralised energy strategy. A study by Oakdene Hollins (2005)[13] for RPA and ICE found that residual municipal, commercial and industrial wastes could supply up to 17 per cent of UK electricity consumption in 2020. CHP is a sensible, almost inevitable element of a sustainable energy strategy. It converts around 85% of the raw fuel input, compared to the 25–35% efficiency of conventional generation[14]. This reduces CO_2 emissions by 20–40%.

A 2006 study[15] by ERM for Defra undertook a macro-level investigation of the carbon flows, energy and greenhouse gas benefits and impacts associated with alternative management of predominant UK waste streams. Findings confirmed that some materials and management routes show significant potential for greenhouse gas emission and fossil energy demand savings. The largest potential, over and above current recovery efforts, is with regard to:

- energy recovery via anaerobic digestion of agricultural manures/slurries
- energy recovery via combustion of waste wood
- recovery of resources (recycling) and energy (combustion) from waste paper and card
- recycling of non-ferrous metals.

The energy benefits estimated for these materials and management routes equate to a combined saving in the region of 88 to 202 PJ-equivalents per year over the period assessed. This is equivalent to approximately 1–3% of UK energy consumption in 2003.

Discounting the influence of relative material arisings, on a tonne-for-tonne basis the recycling of textiles and plastics and energy recovery via anaerobic digestion of kitchen and green wastes and combustion of crops and other organic wastes also showed significant potential for benefit. Additional benefits would of course spring from using decentralised energy systems – the usual transmission network losses would be eliminated.

STRATEGIC SERVICES:

The Taskforce recognises a central role for businesses such as those in the Energy Service Company (ESCo) sector in the development, growth and uptake of decentralised energy opportunities. Issues such as resource management, project planning and operational management expertise are often critical barriers to adoption of decentralised energy even when the economic case is clear. Through a variety of different models, ESCos have an important part to play in addressing the issue of increased resource management required. They can help with expertise in technology choice and financial budgeting, access to feedstocks, and set up of operating and maintenance contracts especially if decentralised energy is to spread into sectors where energy cost is not currently a business-critical issue. ESCos are the key to creating the business infrastructure necessary to achieve acceptable levels of business risk and to allow the market for decentralised energy products and services to take off in these sectors, thus widespread implementation of Distributed Energy presents a huge opportunity for economic growth in this sector.

COLLECTIVE OPERATIONS:

Different decentralised energy technologies have different levels of modularity. For technologies that are uneconomic below a certain scale, collective partnership approaches to contracting and managing decentralised energy facilities could make them accessible to a wider range of businesses, in particular SMEs. Coordination and delivery of such decentralised energy related operations and services (generation and distribution) could be undertaken on behalf of tenants and leaseholders by business parks, retail centre or other collective management companies.

Collective approaches between producers and users may also be necessary to enable larger operators, such as food processors and retailers the opportunity to reach economic scale in decentralised energy generation. Using biogenic waste streams, where working with the wider community will ensure continuity of adequate feedstock supply year round.

BUSINESS ECONOMIC GROWTH:

In the absence of regulation, market forces have determined business uptake of decentralised energy and its current, low contribution to the UK mix. The Taskforce recognises the dilemma that, for some technologies, more installations are required to bring capital costs down to a level where they become economically self standing in the medium term. This is unlikely to happen in the absence of support from government (but need not be in the form of subsidy). Public and private sector procurement that brings forward capital replacement would increase volumes and deliver economic costs even in early markets for decentralised energy.

Measures that would encourage business practice to develop in such a way as to favour decentralised energy include:

- Ensuring business captures the full cost of carbon in its business models. Making it easier to transfer continuing use of assets under leasing arrangements on buildings and commercial facilities, so providing sustainable business opportunities for technology and service companies.
- Increasing transparency around capital and operating costs in published accounts and targeting appropriate incentives towards those who use energy to drive operating efficiency. ■

16 **Biffaward** Food & Drink mass balance (2004)

Drivers for Food Industry uptake of decentralised energy

For the food industry, where there is potential to turn major waste streams into potential energy resources, decentralised energy systems are already becoming an attractive opportunity. A food and drinks sector mass balance study (2004)[16] showed that the UK's food and drinks output of 59 million tonnes per annum (Mtpa) is produced with an accompanying external waste stream of just over 5.8 Mtpa, or about ten per cent of output. Further drivers include:

- widespread operations at a range of scales with a significant overall carbon footprint
- growing consumer pressure to account for carbon in the supply chain
- potential to use decentralised energy as a product or brand differentiator
- increasing vulnerability of food operations to energy security
- major source of biogenic waste adding costs to the supply chain as landfill tax rises
- growing range of energy from waste (EfW) technologies suitable for addressing the mass balance
- opportunities to integrate regional feedstock production, energy production, manufacturing and community use in processing and retail operations.
- importance of heat demand and opportunities to look at decentralised energy for cooling in processing and retail
- emerging examples of sectoral experience with decentralised energy.

CASE STUDY

Food processing and retail sectors – insights for decentralised energy

The food and catering industry contributes about 13% of UK carbon emissions. The industry includes a wide range of activities from agriculture through large and small factories, complex distribution networks and large retail establishments. The industry covers rural areas, where renewable energy sources might be more readily available, and a large number of factories where there is a simultaneous need for electricity and heat, ideal for many forms of distributed generation. Processes used within the food industry have strong analogies with other industrial processes such as edible oil refining, brewing, some dairy processes and sandwich assembly.

Emissions by high-level consumer need[17]

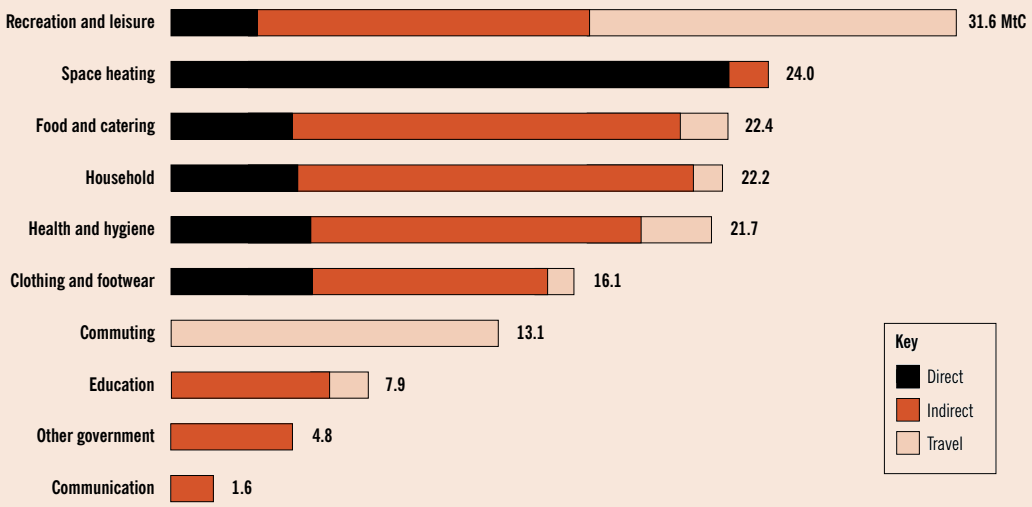


Chart total = 165.4 MtC (excluding 11.0 MtC aviation fuel emissions) **Grand total = 176.4 MtC**

Source: UK Carbon Attribution Model. Centre for Environmental Strategy, University of Surrey (2005). Direct emissions are the emissions associated with the direct consumption of (non-transport related) fossil fuels and electricity in the household. Indirect emissions include the emissions embodied in other goods and services, including energy required to produce the goods and services and the emissions from space heating and lighting by the service and government sectors. Travel-related emissions include emissions from transport fuels and the indirect emissions embodied in transport goods and services.

17 **Carbon Trust** The carbon emissions generated in all that we consume (2006)

Opportunities

A range of technologies are available to the food sector including:

Feedstock production

- Anaerobic digestion of high moisture content biogenic wastes (from farms and food processing)
- Biomass fuels, agricultural wastes and by-products such as woodchips
- Gasification of solid food wastes
- Derived fuels such as diesel oil from plastics using medium temperature pyrolysis and energy crops grown for the purpose (with higher embodied energy) or waste matter

Energy generation

- CHP, scaled to meet the level of demand
- Biomass heating using renewable feedstock
- Wind turbines
- Photovoltaics
- Ground heat pumps
- Use of groundwater as a coolant or as a heat source
- Micro hydro electricity

Contribution from waste

Waste is particularly relevant to the food sector since it can use the various streams of biogenic waste generated along the supply chain. However, the ability to achieve

scale has important bearing on the economics of decentralised energy systems such as CHP that use these materials and feedstocks. Fragmentation of operations between different waste producers needs to be addressed through innovative collaborative partnerships between technology specialists, food companies, other waste producers and potential users (heat and electricity) within a geographic area that optimise scale and efficiency whilst minimising infrastructure and transport costs.

Mechanisms that could assist the take-up of the technologies include:

- Co-locating energy plants to make use of a variety of wastes available in an area
- Using integrated technologies appropriate to the mix of wastes available
- Combining domestic and industrial waste, or wastes from different premises
- Using the existing drainage system as a transport mechanism for collecting/treating organic wastes
- 'Back-hauling' waste from retailers.

Collaborative approaches

It was recognised that more could be done to increase the take up of these opportunities across the food industry generally. Initiatives included the following:

- Collaboration between retailers and developers to introduce decentralised energy onto new developments
- Collaboration between retailers and property owners to introduce decentralised energy into existing properties
- Gaining acceptance of a business model that adequately captures carbon cost
- Developing a menu of decentralised energy technologies to help organisations focus on the best choices
- Downscaling biodigestion technology for use by the potentially many smaller users directly involved in the food supply chain.

Barriers to address in the food sector

As in most other sectors, energy and carbon management are not yet considered core business activities and are generally assigned a low priority from a strategic perspective. Further specific barriers to uptake of decentralised energy from within the food sector were identified:

- Cost and long payback – within the food industry there is a tendency for long payback periods for investment that is not core business
- Planning constraints – fear of delays associated with resolving permissions and discharging conditions are a particular concern for this sector
- Lack of joined up thinking internally within organisations between those managing the energy consumption and those setting capital and operating budgets, and externally with the utility companies in relation to supplying excess energy back into the grid
- The technology-skills gap in supply and maintenance of equipment and downsizing the equipment for smaller operators
- Perceived higher risks relating to the technology and the cost or price of energy
- Disconnect between waste and energy management in corporate procurement processes.

Other barriers of a generic nature relate to:

- Government policy and practice (planning, regulation, fiscal measures, grants and incentives)
- Community attitudes and buy-in
- Capacity to build, install, maintain and operate decentralised energy systems
- Connectivity to distribution networks– alignment between decentralised energy and central grid
- Logistics around fuels and feedstocks. ■

Technology solutions

OVERVIEW

- **The strength of decentralised energy lies in the potential to use diverse feedstocks, to meet different patterns of demand and types of energy need**
- **Different technologies are at varying stages of development maturity and no one choice will be appropriate for every application**

Use of biogenic matter

Biomass (including biogenic waste material) offers enormous potential as an energy feedstock through its suitability for anaerobic digestion and gasification. It is "short-cycle carbon" and is often classified as a "renewable" fuel, as it does not add to the carbon footprint of the generator. From an environmental perspective, there is a need to recognise the constraints on use of virgin biomass for energy production linked to issues such as water availability or land productivity. However, these concerns do not exist for the use of biogenic waste. Not only is "carbon-neutral" energy production possible, but also the reduction in material sent to landfill or general incineration is often of even greater environmental significance to local communities. If the power is generated locally, in a Decentralised energy facility or network, then there is also a significant reduction in the environmental impact of transportation of the waste material.

Use of biogenic waste is starting to make a major contribution to reducing the carbon footprint of sectors including water services and foods. Whilst recognising concerns about locking-in biogenic waste through the expansion of waste to energy systems, more effective integration of resource management operations across sectors should contribute to overall conservation of resources and optimised use of waste for energy by improving feedstock quality.

Building on work such as that of NISP and the Resource Efficiency Knowledge Transfer Network, collaborative partnerships should be used to achieve the necessary scale within an appropriate geographical locale and realise the full potential of AD using solid food wastes from municipal, commercial and industrial sources. This alone could provide UK business and government with the platform to develop a decentralised energy infrastructure benefiting from low infrastructure and transportation costs. Conversion efficiency will be optimised where CHP plays a key part.

Decentralised energy: an array of technologies

There is a broad array of different technologies which can be classed as Decentralised energy, with installations varying in scale from a few watts to tens of megawatts. Some use "renewable" fuels whilst others use fossil fuels but do so in a more efficient manner than conventional power stations.

Decentralised energy in London

The Mayor of London's report *Powering London into the 21st Century*[18] pursues the application of decentralised energy to achieve projected energy demand and carbon dioxide (CO_2) emission targets by 2025. This report concludes that by 2025 CO_2 emissions from London could be cut by 27.6% through adopting a low decentralised energy programme. The same broad conclusions were reached by the sister report (also prepared by Greenpeace) for Edinburgh (2006)[19].

COMBINED HEAT AND POWER (CHP) TECHNOLOGY

This is where the heat generated by electricity production is captured and used to generate more electricity or distributed via a heat network, is currently utilised at about 1,500 sites in the UK. Technologies such as gas turbines or gas-driven reciprocating engines have been available for decades for this application and are used around the world widely at a variety of scales.

In the UK, most of the CHP energy is generated by a few large gas-turbine generators in the chemicals and refining sectors (83% of capacity is in 75 >10MWe installations), whilst the remainder are small gas turbine CHP installations e.g. in small community heating schemes, hospitals and universities. An increase in installations was seen with the introduction of the Climate Change Levy but in the ten years since then CHP capacity in the UK has remained flat at 7% of total electricity generating capacity.

One of the reasons behind this disappointing history relates to the limited sites that are suitable for installation of these long-standing technologies. For CHP to deliver a higher proportion of heat and power

18 **Mayor of London's report** Powering London into the 21st century

19 **City of Edinburgh Council** Powering Edinburgh into the 21st century

demand more installations within population centres will be required. Conventional building-based CHP technology (for example gas turbines and reciprocating engines) has a number of features that can limit its suitability in many urban applications. Although significant improvements continue to be made such technologies can be relatively inflexible in handling variations in power/energy demand (poor turndown), can be noisy, and still require significant planned maintenance (downtime).

Newer technologies, (such as Stirling engines or Fuel Cell CHP) can provide alternative solutions that are less limited by these constraints, and can deliver CHP efficiencies (80-90%) even in the most dense population centres. However, some of these less mature technologies have remained pre-commercial for several years as a result of high costs (from low volumes rather than intrinsic cost structures) and from the conservatism of energy providers and users. Help from government in the form of regulation, fiscal measures or public procurement will be required to increase penetration of urban CHP and these are considered later.

MICROGENERATION TECHNOLOGY

In 2004 there were ~82,000 Microgeneration installations in the UK which fall into 3 technology categories

- Renewable electricity: solar photovoltaics, micro-wind turbines
- Renewable Heat: Solar thermal and geothermal systems are also used to generate heat directly
- Low Carbon micro-CHP systems: small gas engines, stirling engines, fuel cells

A DTI (BERR) study has confirmed the "irrational" buyer behaviour seen in many other capital goods markets: the order of prevalence of different technology choices is not related to the expected payback period, but is determined by the upfront installation costs. In 2005, solar water heating accounted for over 95% of micropower installation despite taking almost the longest to break even (only Solar PV is worse). It does however have one of the lowest upfront costs.

Decentralised Energy in Europe

The decentralised energy sector has established a base in the UK although its development lags behind Europe and North America. The global share of new generation taken by decentralised power in the world market has increased to 25% by 2006, up from 13% in 2002[20]. Half of Denmark's electricity and almost 40 per cent of the Netherlands' is generated by decentralised energy systems. Its use is widespread and mainstream in many other European countries, including Sweden, Germany, Austria, Finland, Italy and Spain.

In Denmark a strategy of decentralised energy focused on district heating and improving efficiency in housing means that while final energy consumption for space heating has fallen by over 15 per cent, the actual floor space heated has increased by over 20%. The Netherlands increased its use of CHP so successfully that in the period from 1985 to 1995 it grew to be the biggest single source of generation in Holland and will continue to grow. According to a review by the Dutch government, CHP also played the most significant role of any policy instrument in reducing CO_2 emissions in the Netherlands in the period 1990-2000 and was also the most cost efficient policy instrument for reducing emissions.

RENEWABLE ENERGY TECHNOLOGY

The range of Renewable energy technologies is wide and encompasses both larger CHP and microgeneration technologies. Technolgies that directly use the earth's natural forces of wind, wave, gravity as well as solar power are central to renewable options. Existing renewable generation plant is generally connected into the national grid and owned by large power generators.

For those renewable power installations that generate heat, including the co-generated heat generated at renewable power installations gives a total energy production that is equivalent to the UK saving 4.6 million tones of oil per year (90% of which is electricity generation). Table 4 gives a breakdown of Renewable Energy Generation in the UK in 2005. ■

Renewable Generation in the UK in 2005 by source[21]

Renewable Energy Type		Number of sites under RNO	Average capacity per site (MW)	% of total Renewable electricity generated	% of total oil saved	Elec:heat usage ratio
Wind	Onshore	92	2.3	15	5	1:0
	Offshore			2	0.8	1:0
Solar	Photovoltaics	–	micro	0.05	0.02	1:0
	Active solar heating			0	0.7	0:1
Hydro	Small scale	62	0.7	3	0.9	1:0
	Large scale			27	9	1:0
Biofuels	Landfill gas	218	2.2	25	33	100:1
	Sewage sludge digestion	21	1.1	2	4	3:1
	Municipal solid waste	37	11	6	11	13:1
	Co-firing with fossil fuels	–	–	15	20	1:0
	Other (wood burning, farm waste...)	9	15	5	15	0.8:1
Geothermal Aquifiers		–	micro	0	0.02	0:1

21 **BERR**
Digest of UK Energy Statistics (DUKES) (2006)

Energy recovery option profiles[22]

Recovery Option	Conversion efficiencies	Typical scale (ktpa)	Carbon Savings (for MSW)	Plant size/capital/gate fees (2006/07)
Incineration	20-28% (electricity) 70% (CHP)	100–500	232 kg CO_2/t With CHP, there should be a net carbon benefit	1. 100 ktpa: £64.7 million £78.4/t 2. 200 ktpa: £104.7 million £58.5/t 3. 400 ktpa: £149.1 million £37.8/t
Anaerobic Digestion	30-35% (electricity) 80% (CHP)	<250	430 kg CO_2/t (electricity only)	1. 20 ktpa: £7.3 million £65.4/t 2. 50 ktpa: £14.7 million £52.5/t 3. 150 ktpa: £28.8 million £37.9/t
RDF or SRF from MBT	Energy loss in the separation of waste 15-20%	50–250	570 kg/t If dry recyclables or biodegradables are removed prior to the MBT-RDF, benefits are less	1. 50 ktpa: £29.4 million £98.8/t 2. 100 ktpa: £44.4 million £79.3/t 3. 200 ktpa: £67.1 million £65.3/t
Pyrolysis	30% (electricity) 70% (CHP)	<10–225	No data	1. 30 ktpa: £21.7 million £93.6/t 2. 100 ktpa: £27.9 million £69.2/t 3. 150 ktpa: £67.2 million £51.56/t
Gasification			524 kg CO_2/t	

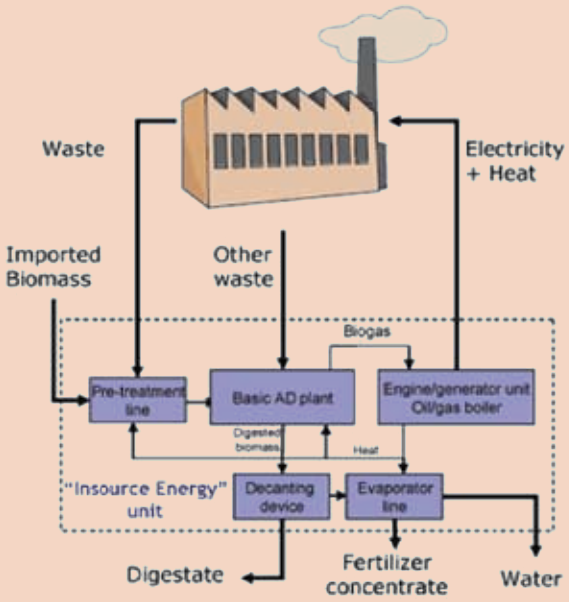
22 **Defra**
Waste Strategy 2006

ERM
Carbon balances & energy impacts of the management of UK wastes (2006)

InSource Energy

InSource Energy[23] is a new business created by Carbon Trust Enterprises Limited. In September 2007 Scottish and Southern Energy plc invested £2.7 million to acquire a 40 per cent stake in InSource Energy plus up to a further £10 million to fund the company's projects as it enters its next phase of development. It is an energy and waste management business that provides tailored, on-site solutions for food and drink manufacturers in the UK, through the provision of various technologies, such as biomass boilers and anaerobic digestion coupled with combined heat and power (CHP) units. Insource Energy reduces waste and energy costs and saves carbon[24].

InSource Energy can finance, develop, build, own and operate energy and waste systems. It is not linked to any technology provider; but provides an independent service that utilises the best available technology and the best suppliers to meet customers' specific requirements. A tailored solution for a food and drink manufacturer might be as illustrated.



23 **The Carbon Trust** In Source Energy (2007)

24 **The Carbon Trust** (2007)

Biogen and Bedfordia Farms: energy from biogenic waste

Installed at Befordia Farms in Bedforshire, in conjunction with a pig finishing unit, the plant generates over 1MW of electricity from CHP engines driven by gas from the plant.

TECHNOLOGY:
The plant processes 230 m^3 of pig slurry and 575 t/week food waste, generating up to 1 MW electricity. The slurry and food waste are blended and heated to 70ºC (using waste heat from the CHP engines) to kill pathogens. The sterile mix is pumped to anaerobic digesters, where the mix degrades to produce methane and a nutrient-rich liquid waste suitable for use as a fertiliser. The gas is burnt in engine generators and electricity is exported to the grid.

REPLICABILITY:
Bedfordia Farms hope that ten such plants can be built within five years. The system is now proven in the UK where it is estimated that 120 Mtpa of similar slurry is produced, and a further 30 Mtpa in food waste. This plant will utilise 12,000 m^3 pa slurry and 30,000 tpa of food waste which requires quite a large farming operation (3,000 cows or 5,000 pigs). The success of the plant also rests upon the availability of food waste to enrich the slurry, so the plant should be installed near a large food factory or a centre of population. The final fertiliser by-product has a much lower odour than raw slurry at the land spreading stage and the plant has odour-control equipment installed. The use of food waste necessarily involves the use of trucks to transport the waste to the site, but at the scale shown this represents only four trucks per day.

IMPACT:
The economics of this system benefit from a range of income streams including waste disposal fees, Renewable Obligation Certificates (ROCs) and the sale of electricity.

UTC Power and Verizon

Fuel Cell Technology has several features that make it suitable for use in installations that are unsuited to conventional CHP technology (e.g. in office or other developments in the urban environment). UTC Power manufacture a 200 kWe unit which is commercially available. UTC have installed over 260 of these units worldwide and they have so far generated over 1.3 billion kWhr of commercial power. The units are powered by methane, which may either come from natural gas or renewable sources such as waste treatment plants. They offer 80-90 % fuel efficiency and 38-41% electrical efficiency with the by-product heat used for both heating and cooling. The very high reliability of the fuel cell means that these units provide a backup power function as well as being a source of baseload energy.

COMMERICAL INSTALLATION:
Verizon is an office–based telecommunications company who who chose to install a PAFC in 2005 to achieve for maximum energy security and power efficiency at their call switching centre in Garden City, Long Island New York. The 7 x 200 kW units (1.4MWe) provide tri-generation power (electricity, heat & cooling) for 292,000 square foot office space housing 900 employees. This installation also provides a backup power function for the New York area air traffic control system.

ENVIRONMENTAL BENEFIT:
The emissions Savings over conventional power generation are substantial. The PAFC system saves enough electricity to light 1,150 homes and has reduced Verizon's carbon footprint by ~ 5000 tonnes per year, the same environmental benefits as planting 1,150 acres of forest . Additionally, NOx emissions of 18 tonnes p.a. have been made, equivalent to removing 1,020 cars from the roadways per year.

COSTS

	Verizon	Conventional CHP
Power rating	**1.4 MWe+2.1MWth**	**2.9kWe+2.7kWth**
Energy Cost Savings	£340k p.a.(actual saving)	£600k p.a.
Capital Cost	~£400k per unit	£4.4M (15 year lease)
Operating Cost	£150k (1st year)	£300k p.a

The high capital costs are a result of the very small market size; significant cost reductions are forecast, and more importantly, as a result of planned investments by UTC and its supply chain to design costs out of the system. However, a higher degree of certainty for market demand is required for businesses to justify these investments.

Barriers

OVERVIEW

- **Uptake of decentralised energy, at 7% (flat for several years) of total UK capacity is low compared with some other European countries.**
- **Financial (capital cost and risk) considerations, as well as operating system, decision making and infrastructural legacies are barriers to the up take of decentralised energy**
- **Decentralised energy solutions also face a range of non-financial barriers to widespread adoption**

Proven technology but barriers remain

Most of the technologies outlined in the previous section are well established. However, their uptake in the UK remains small:

- Renewable energy accounted for 4% of the total electricity generated in the UK in 2005
- Combined Heat and Power plants (capturing the heat from electricity generation) provides about 7%.
- Less than 0.5% of our electricity currently comes from microgeneration (defined as < 50kW units)

The UK government has targets to increase penetration:

- Renewable energy to rise to 15% generation capacity by 2020
- Installation of CHP DE capacity to rise to 10GWe by 2010 (currently 5.7GWe or 7% of total capacity)
- Microgeneration to provide 30–40% of the UK's electricity needs and help reduce annual household carbon emissions by 15% by 2050

Examination of the issue has led the Taskforce to conclude that relying on existing market forces will not result in business adoption of decentralised energy at the scale required to meet any of these UK targets. The remainder of this report explores why business has been reluctant to invest in Decentralised Energy technology and what needs to change to enable us to meet these targets.

Barriers to progress

FINANCIAL CONSIDERATIONS

A fundamental prerequisite for any decentralised energy project is that of "getting the economics right". The cost model for decentralised energy must show an appropriate return if investment in new technologies and operating procedures is to even be considered. Whilst many potential projects are already viable, contributors to the Taskforce have stressed four areas where action could be taken to further strengthen the economic case and increase penetration of such schemes:

Financial costs: businesses are looking for new products from the financial services sector that will encourage investment in low carbon, renewables and energy alternatives. In particular they are looking for products that will help balance the high, upfront capital costs associated with new technologies with lower operating costs, spreading them out over the life of such investments. Such initiatives may need to go hand in hand with changes in accounting methods to support adoption of whole life costing (WLC) approaches. The lack of comparable capital and operating cost data for different technology options to employ in WLC models was also cited as a major hurdle.

Buying and selling energy back: Decentralised energy producers, especially smaller ones, often struggle to justify an installation without the ability to sell surplus electricity back to the grid at a reasonable price. Prices for buy back should be closer to commercial tariffs, as in other European markets, rather than at the lowest wholesale rate. This change could be helped through adoption of a system for buy back which accounts for and differentiates according to carbon emissions and other environmental impacts arising from the energy source.

Long Term Feedstock costs: Costs associated with feedstocks are also a critical factor in making an economic decision to opt for certain decentralised energy solutions. New financial tools, such as the possibility to fix feedstock prices over the long term for waste to energy projects can alleviate this concern. In these cases the ability to balance local feedstock supply with demand from decentralised energy producers is also essential and needs to be clearly recognised in project planning.

Capital Renewal: Some decentralised energy providers argue that to build decentralised infrastructure at the scale needed in the timeframe available will require measures to accelerate capital renewal in business and in the wider built environment. This view is tempered by voices from business who are considering investing in decentralised infrastructure, whose business models generally require low rates of capital renewal on their investments. Businesses may need incentives to accommodate different financial models for decentralised energy activities that operate on different business cycles and payback periods from core activities.

Fuel Costs: short term price fluctuations, variations in the cost/price model used to value certain classes of fuel (e.g. waste derived fuels avoiding landfill tax) and the lack of comparable cost/conversion efficiency data across different fuels and feedstocks are an issue for potential business users, especially when distributed energy technology choices may lock companies into a fuel option for the life of the equipment

Market: given that the existing decentralised energy sector is dependent on a degree of fiscal incentive (i.e. ROCs), providers express concern about the long-term sustainability of demand, and potential business customers express concern about long term value-for-money. The absence of a clear market framework for the components of a decentralised energy value chain imposes high levels of uncertainty for companies operating at all stages.

Ownership and Management Issues

The Taskforce has probed experience of decentralised energy with companies operating in and alongside the food processing and retail sectors. A fundamental concern identified by companies at all stages of the supply chain was how and where risk is owned and managed in a decentralised system. Similar concerns were evident in conversations with companies from the construction and waste sectors.

Energy Management is not generally a Boardroom issue in all but the most energy-intensive industries. Businesses often rent their premises from large property companies and have little control over their energy supply, and may thus also take little interest as it comes as part of the rental package". Leasing and management arrangements generally focus on short-term cost savings and security of energy supply rather than carbon emissions and energy efficiency. Even in companies who own their own premise, energy management has been a relatively small part of operating costs, has not traditionally been treated as a strategic issue, and thus usage is influence by many players around the organisation. Making energy management a strategic function that can sit inside or outside a business (alongside HR, ICT and logistics) such that it has visibility at the relevant decision making level may help provide the resource capable of initiating change.

Feedstocks: Reliability of feedstock supplies for biomass or waste decentralised energy is also perceived as a greater risk, potentially imposing higher costs over all as a result of supply disruption than irregularities arising from the existing centralised supply. Furthermore there is uncertainty whether appropriate feedstock supplies (e.g. from biomass or waste derived fuels) will be available throughout the life of the decentralised energy equipment

Technology and equipment: although many decentralised energy technologies use proven technology, there is a common misconception by those unfamiliar with it that the sector is characterised by intrinsically unproven, expensive and risky technologies. The lack of comparable performance data and concerns about the long-term commercial viability of technology supply companies (availability of ongoing service and maintenance support) was cited as a major concern for potential investors. A robust system of technology validation and performance rating will thus be an essential component in any policy that sets targets and incentives for installing decentralised energy capacity.

Technical Expertise: moving away from the centralised energy generation and distribution model raises a range of questions around regulation of energy generation and distribution (planning consent, health and safety etc) and the ownership and management of distribution infrastructure, (installation of dedicated pipes and wires) connectivity rules, automatic switch substation communications protocols. Competence to manage these issues generally lies outside core business capability in those sectors that would otherwise benefit from installing some local generation capacity. The timescales and complexity involved in dealing with local authority planning processes for installation pre-approval have proven to be difficult to align with financial decision-making cycles for non-core business activity. ■

Implications of decentralised energy for business in society

OVERVIEW

- **Political leadership and investment in public education has a critical role to play in paving the way for decentralised energy solutions to be accepted by local communities**
- **Collective and communal approaches to service provision are called for but will require significant behaviour change and closer relationships between business and the community**
- **Local planning processes must be mobilised to enable the benefits to business and society to be realised.**
- **Investment in public education, engagement and capacity building will play an essential part in building local buy-in**

Development and planning

Development and planning processes are the principal vehicles through which business and the community will engage on decentralised energy projects. Negotiating the existing planning process is currently considered a major hurdle to businesses even once they are committed to investment in decentralised energy For example, for biomass systems, strategic, supply-side and demand-side factors need to be addressed through the integration of policies on cost reduction, resource use, waste, energy and agriculture, recognising the close inter-relationship between the sectors from an SCP perspective.

Political vision and leadership are already promoting update of decentralised 'renewable' and low carbon energy in London, via changes to the planning process, and political leadership is expected to hold the key to development of this sector in all regions around the country through application of approaches similar to a broadened Merton Rule.

STRATEGIC FACTORS

Local planning authorities need to be open to new ideas from business and ready to accelerate permissions and discharging conditions to foster the uptake of new approaches. They should use the scope they have to adapt the application of planning regulations to promote innovation in collective and integrated energy solutions. The planning process could also be employed in ways that encourage all new energy provision to prioritise use of locally available feedstocks, such as waste, wind, solar and biofuels, and using the most efficient conversion technologies such as CHP.

PRIMING THE SUPPLY SIDE

Major projects led by the public sector provide opportunities to raise the visibility of decentralised energy options as realistic alternatives to conventional approaches. Through clear commitments and bold, binding targets on energy efficiency and carbon emissions, public procurement can influence developers and bring the market for decentralised energy technologies up to scale. Forward Commitment Procurement is a powerful tool that can also bring forward the commercialisation of new technologies without increasing costs or risk from those public or private bodies investing in new plant.

CREATING LOCAL DEMAND PULL

Development and planning processes can also stimulate demand pull for decentralised energy supply and technology. For example:

- New building and development applications should provide proposals on carbon footprint management over the whole life of the facility. Developers should be required to take ownership of the carbon footprint and responsibility for ensuring implementation of the proposed sustainable energy solutions rather than passing this on to contractors and builders.
- The contractual treatment of project risk between developers, designers, contractors and builders currently blocks the introduction of new technologies

into many developments. Planning processes that require decentralised energy installations or policies that underwrite their adoption are required, e.g. implementation of the Merton Rule.

- Clear targets should be set for new non-residential buildings to ensure energy use and emissions are maintained below a pre-determined level as prescribed in the Building Regulations
- Mechanisms should be put in place to engage tenants, leaseholders and future owners with the use of low carbon technology in buildings they occupy.

MANAGING COSTS AND BENEFITS

The development of a decentralised energy infrastructure is expected to require new measures to assess the impact on communities and society in areas such as:

- Establishing a dedicated health and safety framework – for example around the use of new fuels or changes in the scale of operations associated with new fuels – where appropriate this should build on established practice in existing operations.
- The aesthetic impact of decentralised energy facilities, and the choice of technology used, can have either positive or negative implications. Negative impacts should be weighed carefully against other aspects, recognising for example the environmental advantages of locating facilities close to feedstock supplies and the economic gains from using land with low amenity value for large scale renewables.
- The employment implications of a shift to a decentralised infrastructure in which facilities are located closer to high population areas away from rural areas with higher unemployment levels.
- New metrics of the long-term value from investment in decentralised energy that are more economically robust than existing SRI measures.

Public Attitudes

A major hurdle to the scale up of decentralised energy is existing behaviours and attitudes in business and society generally. For decentralised energy to achieve its full scale and potential in the UK business and government will need to swing public opinion behind the changes this will entail in service, infrastructure landscape and amenities. Decentralised energy may require a transformation in attitudes in favour of more collective and communal forms of service provision in place of the current individualised infrastructure and energy delivery mechanisms. Sustained and open communications to inform, educate and engage the public are essential to lower planning hurdles to capacity building around new decentralised energy technologies and services.

Food waste and energy efficiency in London

The UK food sector, and the supply chain associated with it, exemplifies the opportunity that exists to use decentralised energy as part of a low-carbon, energy efficiency strategy. The Mayor's *London Food Strategy* (2006)[25] noted that for London as elsewhere, the food system has significant environmental impacts. The 2002 *City Limits*[26] report estimated that food is responsible for 41% of London's "ecological footprint"; while food preparation, storage and consumption account for 10–20% of the average household's environmental impact. The *London Food Strategy* suggested that close to half of human impact on the environment is directly or indirectly related to the operation of the food system as a whole.

Experience in the food sector also reveals the challenges that need to be addressed both from the perspective of internal business practice and in terms of current restrictions on use of waste materials. The potential for systems using anaerobic digestion (AD) to become an integral part of a food industry resource management strategy is gaining prominence. Businesses across the supply chain, from primary producers to retail and catering companies are recognising the opportunity to use biogenic materials as part of their strategy for controlling their carbon footprint

What is the Merton Rule?[27]

The 'Merton Rule' is the planning policy, pioneered by the London Borough of Merton, which requires the use of renewable energy onsite to reduce annual carbon dioxide (CO_2) emissions in the built environment. Following the publication of Planning Policy Statement 22 (PPS22), Planning Guidance on Renewable Energy, issued by the Office of Deputy Prime Minister in 2004, the London Borough of Merton was the first to formalise the governments renewable energy targets in its adopted UDP, setting the target for the use of onsite renewable energy to reduce annual CO_2 emissions for all new major developments in the borough by 10%.

The first project to comply with this target – ten light industrial units – was completed in June 2005 at Willow Lane, Mitcham, (above) using micro turbines and solar PV to meet the requirement. Croydon were quick to follow Merton's lead, and their first project designed to reach a '10% target' was completed in July 2005. North Devon has chosen to demand 15% CO_2 reduction from renewables and Kirklees Council have proposed that by 2011, 30% of energy consumption in every one of its new buildings is from renewable sources. This is a trend that has drawn increasing interest from local authorities across the UK, with over 75 councils already drawing up policies.

25 **Defra** Securing The Future (2005)

26 **GLA** Mayor's London food strategy (2006)

27 **The Merton Rule**

Messages and approaches to communication should:

- Explain how decentralised energy can bring a range of community benefits: local independence, energy security, lower carbon emissions, reduced business vulnerability to peak draw from the grid, new job opportunities in fuel production, technology supply and energy service sectors.
- Show that decentralised energy can enable people and communities to make a contribution to tackling climate change and to reducing other environmental impacts associated with resource use and energy consumption.
- Address public perceptions about proven decentralised energy technologies such as large CHP or biomass fuels that tend to be "locked in the past".
- Generate public dialogue around the newly emerging local solutions – renewables, waste to energy and other low carbon solutions.
- Showcase early and established technologies through complementary decentralised energy and CHP demonstrator projects. The creative business park model can be an effective tool for building awareness, insight and knowledge, and for generating momentum towards adoption.

Provide public sector leadership and raise awareness about whole-life approaches to development and construction. A grounding in energy services needs to be included as part of professional development for all senior local government officials in order for them to provide the necessary leadership. ■

Decentralised energy – community engagement.

The UK government's review of energy requirements[28] (in the context of maintaining energy security and reducing impact on climate change) tackled a principal SCP goal of reducing environmental damage. The review concluded that *"the starting point is for all of us to save energy; the challenge is to secure the heat, light and energy we need... in a way that cuts the amount of oil, gas and electricity we use"*, addressing the key SCP objective of using less resources.

Policies proposed by the review are estimated to deliver by 2020 a saving of 6–9 MtC (million tonnes of carbon), around 4–6% of total 2005 emissions, on top of the 12 MtC saving by 2010 that are projected to come from the policies announced in the 2006 Climate Change Programme[29].

A key tenet of these proposals was a call to encourage and support the local generation of power in Britain. There is significant potential in the future to use small scale local generation to provide affordable and reliable energy. This is important both for limiting UK dependence on imported gas and for tackling climate change.

SERA[30] notes that decentralised energy systems place generation at the heart of the community and allows the risk of investing in infrastructure and the savings in terms of reduced energy bills and CO_2 emissions to be shared fairly between households and energy providers. In Southampton and Woking, for example, there are off-grid networks of CHP and local renewables (wind, solar and heat pumps). Such schemes have replicated models used in other European countries to provide a practical demonstration of the major benefits that decentralised power coupled with Piped Hot water heating systems can provide. Woking's not-for-profit Thamesway Limited succeeded in reducing the areas carbon emissions by 77% between 1990 and 2004. Such schemes also increase competition of supply helping to continue to secure affordable energy, and increase energy security as they maximise the sources of supply.

28 **BERR** Meeting the energy challenge (2007)

29 **Defra** Climate Change – the UK Programme 2006

30 **SERA** Submission to the DTI Energy Review (2006)

5 The policy context

OVERVIEW

- **A combination of regulation, behaviour change and fiscal measures will be needed to deliver a well-integrated system that benefits society**
- **Investments in energy are long-term commitments. A structured long-term policy framework is necessary for businesses to choose decentralised energy solutions**
- **Capital costs for immature decentralised energy solutions are still high. Public sector procurement is an important tool to accelerate uptake of decentralised energy services through building early market scale and aising awareness of alternatives to conventional approaches**

Behaviour change

A sense of urgency regarding the need to move the UK energy portfolio away from carbon- intensive energy generation is required across government, businesses and individuals. To achieve a sustainable balance between energy supply and demand in the UK Government should implement policy that:

- Focuses on changing behaviour and attitudes – and lets business provide the solutions.
- Encourage business models that place energy management as a core function within companies through changing those elements that currently maintain the status quo (tax structure, accounting practice, safety standards, procurement practice).

Long- term Policy framework

The priority for business is to have a policy framework in place that provides sufficient certainty for long-term investment planning.

- Regulations should be phased over sufficiently long timescales to provide certainty for business investment. For example, pricing in the cost of carbon requires that carbon trading regulations be clearly laid out over a 15 or 20-year timeframe rather than the current five-yearly cycle.
- Similarly, longer term policy around energy and resource management should be developed so it can effectively drive investment decisions for R&D, capital expenditure and formatio of new business opportunities. This should be done in such a way that outcomes (low carbon, energy efficiency etc) are targeted rather than specific technology solutions.
- The separation of responsibility for electricity generation above and below 50MW capacity between BERR and Defra should be ended and governance of energy supply integrated
  - innovation policy
  - CHP regulations
  - energy efficiency obligations

Incorporating these approaches in a coherent overarching policy framework should encourage a system to emerge that offers a diversity of technical solutions and approaches while minimising cost and overcoming the skills and other capacity constraints.

Public procurement

There are a number of ways Government can use its procurement strategy to influence the climate and conditions for developing a decentralised energy system:

- The public sector should lead by example in developing and using inclusive (Whole Life) cost models over longer budgeting cycles (more than six years) to demonstrate how capital and operating expenditure, costs and benefits can be brought into balance.
- Government spend on construction (£22.3bn in 2003–4)[31] has a major part to play in influencing the supply chain to bring down entry costs for decentralised energy. Use of Forward Commitment

31 **Defra** Procuring the future (2006)

Procurement models by government will bring forward the commercialisation of newer technologies, by building market scale, at no financial or technological risk to the public purse

- Public sector organisations and local authorities drawing up major PFI agreements should be required to include assessment of the potential to use decentralised energy for power, heating and cooling. Where appropriate these should become demonstrator projects for decentralised energy.
- Benchmarks and performance ratings for comparable public sector facilities, such as development zones and universities, should be agreed and published. Based on this experience Government should set binding targets for decentralised energy uptake in the public sector more widely.
- Before the cost of carbon starts to kick in, show business how new plant can contribute to managing the carbon budget.

Grants and Fiscal measures

Increased uptake of low carbon decentralised energy would be encouraged by actions such as:

- Use capital grants for investment, tax rebates, and building code adjustments. Set minimum standards for renewable content of energy from the grid along with E-efficiency in products and equipment.
- Simplify and extend access to the current portfolio of incentives (ROCs, LECs, Carbon Credits) to ensure the UK reaches its full potential for renewables and low carbon decentralised energy.
- Modify the existing portfolio of incentives to ensure electricity, heat and cooling generation capacity are treated equally and all providers are required to take an integrated approach to maximise resource efficiency
- Provide more grants particularly for smaller enterprises. Improve the grant system and other financial mechanisms such as loans, underwriting output and support for retrofitting equipment, to shorten the capital renewal cycle.
- Shift the tax system to a carbon base

Planning and regulation

The removal of planning hurdles is a frequently mentioned step for Government to take to liberate the market for renewables and to develop decentralised energy services. This can be achieved by positive measures to encourage their use.

- Encourage revision and extension of the Merton Rule in ways that encourage incorporation of appropriate low carbon technologies in new building projects.
- Raise planning operations (planning consents, permits etc) to a higher strategic level commensurate with the scale of opportunity represented by decentralised energy. Government should recognise that local authorities may not have sufficient discretion or scope of responsibility to make fully informed assessments of the potential of substantial decentralised energy investments.
- Improve synchronisation of decision-making between Local Authorities and the Environment Agency.
- Remove or reduce the delays caused by the public consultation process that are currently required for some decentralised energy installations. These are a disincentive to business making a move away from conventional approaches to energy management.
- Ensure that smaller decentralised energy generators have the right to sell electricity back to the grid at a reasonable price (or allow them to by-pass centralised utilities and distributors to become retailers).

Waste

Business and Domestic Waste is an important potential feedstock for decentralised energy generation. There is a need to join up the whole waste chain from its generation, which is controlled by manufacturers and retailers, through product and packaging design, right through to its ultimate fate. First, to ensure that its generation is minimised and secondly that what remains is viewed as a potential feedstock for other processes, in particular local energy generation. The market framework is set by Government who should:

- Use increased landfill taxes to make alternative uses, such as decentralised energy, cost competitive with conventional generation.
- Review definitions of waste to allow effective use of high calorific and biogenic material in the energy system. These should be updated in the light of new understanding about materials mass balances to ensure that waste recovery definitions are appropriate for the current technical capability.
- Ensure that high-calorific and energy-rich biomass is treated by local government and business as an important community resource and is recovered from waste for local power generation
- Ensure all EfW consents must be CHP to avoid lock-in to large-scale systems that produce more heat than can be used locally.
- Join up BERR and Defra work on energy and waste.

Resource management should be integral and integrated into both policy areas.

- Lobby for the modification the EU Waste Incineration Directive to ensure that gas from pyrolysis does not get caught in such a way as to prevent its use in decentralised energy

Support services to be developed

- Bring forward a transparent system of carbon accounting based on PAS2050 to achieve meaningful, consistent and comparable reporting and inform investment and customer choice.
- Develop reliable accreditation for renewables and decentralised energy technologies and services.
- Tackle the skills shortage in renewables, decentralised energy, sustainable building and heating systems.
- Provide more security for decentralised energy supply and service companies by underwriting the take up of the heat output of CHP plant.
- Support the development of one-stop shops on decentralised energy technology so that potential users find it easier to identify the appropriate technology for their business.
- Remove the barriers to selling surplus power to network operators.
- Protect small generators from network disruptions that prevent them from supplying power during grid shutdowns.

Mapping the decentralised energy system

A decentralised energy system map for the UK would provide a dynamic framework that will enable suppliers to optimise the delivery of products and services and customers to make well-informed choices from the range of decentralised energy options by providing a common platform for decision-making along the decentralised energy supply chain:

- A UK-wide strategic map for management of energy generation would include a detailed picture of feedstock availability, electricity, heat and cooling usage.
- The map should overlay resources with available technologies, centres of expertise, areas for skills and capacity development.
- This map should be used in public education programmes to increase community understanding and acceptance of new energy solutions linked to carbon reduction and climate change priorities. ■

APPENDIX A

Food industry consultation – overview of activity undertaken by the Taskforce

In line with its remit to bring forward proposals on business adoption of SCP that support business success and economic growth, the Taskforce decided to investigate the opportunities for decentralised energy through the lens of one or more sectors with potential for growth, an expanding environmental footprint and continuing operations in the UK. The criteria used to prioritise sectors that should be investigated included:

Technology/technical factors

- High over all energy use in varied production processes
- Levels of waste, in particular biomass, generated along the supply chain
- Importance of energy security to product quality
- Availability of appropriate technologies to work with existing business models
- Importance of heat in energy demand

Socio-political factors

- Potential to balance supply and demand locally
- Geographic link to fuel sources
- Structure of local employment and capacity to redeploy
- Local planning climate – awareness and leadership from community leaders and public authorities
- Scope and capacity to integrate operations locally
- Readiness to change business models and ways of working
- External pressure for change targeted at a sector

Economic factors

- Industry structure and scale of operating units
- Expected impact of future carbon measures on business models
- Rate of capital investment and renewal – payback periods
- Location of main production and other commercial operations.

Against this range of criteria a cross-section of business representatives rated the food processing and retail sector as having a potentially strong interest in the development of decentralised energy system:

- Widespread operations at a range of scales with a significant over all carbon footprint – growing consumer pressure to account for carbon in the supply chain – potential product or brand differentiator.
- Increasing vulnerability of food operations to energy security – high value product losses can impact heavily on profitability.
- Major source of biogenic waste which is adding costs to the supply chain as landfill tax rises.
- Growing range of waste to energy technologies suitable for addressing the food sector mass balance.
- Opportunities to integrate regional feedstock production, energy production, manufacturing and community use in processing and retail operations.
- Heat demand is important in food processing and there are opportunities to look at decentralised energy for cooling in processing and retail.
- Emerging examples of sectoral experience with decentralised energy.

With the aim of informing broader deliberations on the role that decentralised energy can and should play in sustainable consumption and production strategy, the Taskforce initiated a short review of the food sector which sought to:

- Develop an overarching view of the action one sector could take to manage its carbon footprint through an integrated approach to energy use along the value chain.
- Draw out lessons on how to change business and government mindsets on energy infrastructure and the new business opportunities that decentralised energy offers.
- Provide guidance on areas where general awareness and capacity building is needed.
- Identify key policy measures to support business uptake.

A workshop focused on the food industry, involving representatives from across the food sector try together with energy suppliers and business support organisations. A short follow-up survey with food sector practitioners generated sector-specific and generic observations. The findings from this research have been incorporated in the main body of this report.

APPENDIX B

Acknowledgements

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APPENDIX C

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