Opportunities for the Market Development of Wood-Heating in the East of England

Client:

Forestry Commission East of England Conservancy

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Executive Summary

The East of England has a significant forestry/woodland resource that is in some degree constrained by limited markets, particularly for lower-grade products. This in turn results in substantial under-management, especially in the private sector. At the same time, the UK as a whole is almost unique in northern Europe in not having a developed wood energy sector. Furthermore, large areas of the Region and somewhere between 15% and 25% of heat users do not have access to mains gas, and there are large numbers of fuel poor households in both urban and rural areas without access to affordable warmth. Against this background, the development of woodfuel for heating offers tremendous opportunities and a raft of potential benefits:

- increased renewable energy deployment and reductions in CO_2 emissions
- competitive and affordable energy
- income generation and other benefits for the woodland/forestry sector

This combination of impacts offers a potential 'win-win-win' at every stage of the value chain with benefits for landowners, contractors, end-users and the public at large. At the time of writing, a combination of an increasingly favourable (if hitherto ill-focused) fiscal and regulatory environment and rising market prices for oil and gas has created an opportunity for significant market growth and experience elsewhere has shown that this growth can be both rapid and sustained.

The potential market is not limiting, even if substantially focused on those end-users that do not have access to mains gas. Even a modest 10% market penetration of this element of the overall heating sector could have a tremendous impact in forestry terms, requiring perhaps 300,000 tonnes of woodfuel worth in excess of £15 million per annum. Indeed, this might be set as a long-term 'aspirational' target by 2020, the next key benchmark after 2010 in UK energy policy.

Over this period uptake in the large-scale new building developments projected for the Region will be a key factor alongside inroads into the existing 'non-gas' market. The public sector has a key role in pioneering market development, both as a customer and through facilitation and other market-enabling measures. In this regard, an outline Action Plan was set out in the predecessor to the current report, *Woodfuel in the East of England: prospects and potential.* This report is specifically intended to assist in informing the evolution of the Action Plan into an *Operational Plan* for the period to 2010, these five years will be critical in establishing wood heating as a *bona fide* element of the heating market.

In order to stimulate development, marketing and promotion should be focused on the most likely short-term prospects. These are small to medium-large (up to 5 MW) wood-chip boilers in the public sector, and private farms/estates and 'high load' properties such as rural hotels. At the same time strategically important community heating and wood pellet production should also be actively promoted.

1 Context and Background

1.1 The study

This study has been commissioned by the Forestry Commission East of England Conservancy and funded by the Forestry Commission, the Government Office for the East of England and the East of England Development Agency.

The development of woodfuel is seen as an important strategic opportunity for the Region in terms of its woodland/forestry resource, renewable energy uptake and offset of CO2 emissions, with additional wider benefits for the rural economy. In this context, the work undertaken within the scope of the study is concerned specifically with wood heating[1], and falls into two parts:

- an overview of the market potential for wood heating within the Region, which forms the body of this report; and
- the production of ten Design Studies to facilitate 'pioneer' projects and clusters within the Region. These are summarised in Annex I.

Note: this report is the third in a series dealing with woodfuel development in the Region commissioned or co-commissioned by the Forestry Commission East of England Conservancy [2], and is intended to add to rather than duplicate the previous work. However it can be read in its own right and it offers an updated view of what is a relatively fast-moving policy area. Thus, some of the background and context is re-visited and re-stated herein and, in particular, an updated policy review is provided in Section 3.

The wood-heating sector in the UK is still in its infancy and it is recognised that a number of market barriers must be overcome if the tremendous potential it offers is to be realised. These include a number of factors that must be addressed in concert, including lack of awareness and high capital costs for early adopters[3]. At a UK-wide level, a number of both fiscal and regulatory measures have been developed as a response to these issues and have had a genuine impact in stimulating a significant level of market activity. Furthermore, the sector has been the subject of a number of major reviews over the past few years that seem certain to result in further substantive measures to promote an increased scale and rate of uptake (see Section 3).

However, alongside UK-wide activities, it is also recognised that actions at a Regional level have a key catalytic role in stimulating effective market development. It is in this context that this report and its predecessors have been produced. In addition, a significant step has also been taken within the Region with the appointment of a full-time Biomass Facilitator by Renewables East[4]. Although concerned with the whole of the biomass sector, wood heating

[1] Although the report deals with the development of *wood heating* within the Region, from time to time generic reference is made to *biomass* or to *woodfuel*, within which wood heating is subsumed.
[2] See also *Proving of Woodfuel Harvesting in Undermanaged Woodlands in the East of England*; Forestry Commission East of England Conservancy Dec 2001; and *Woodfuel in the East of England: prospects and potential*; Forestry Commission East of England Conservancy Feb 2003.
[3] For a fuller review of market barriers together with an outline Action Plan, see *Woodfuel in the East of England* ibid.
[4] See http://www.renewableseast.org.uk/news_14.asp.

specifically falls within the compass of the Facilitator, whose role is to engage with key actors within the region and to co-ordinate development in the sector, with the goal of accelerating market deployment of all biomass technologies.

Against this background, the opportunity now properly exists in the East of England to effectively foster the development of wood heating to realise the substantial attendant benefits that would accrue from growth in this sector. A review of key market barriers and an outline Action Plan have already been set out in the predecessor to this report, *Woodfuel in the East of England: prospects and potential* (see footnote 3). This report is specifically intended to define more clearly the market opportunities and to refine the Action Plan into an *Operational Plan* for market enabling in the period through to 2010.

Note: As with its predecessors, the primary focus of this report is woodfuel derived from forestry management practices or primary timber processing (essentially sawmilling), which may in future include pelletised woodfuel (see below). It does not deal substantively with the wood recycling sector, although it is acknowledged that clean[5] recycled material (recovered wood) may be utilised in woodfuel supply chains in appropriate circumstances and may offer a low-cost fuel option, with important caveats relating to fuel quality and the regulatory issues entailed.

Note regarding pelletised fuel

The role of pelletised woodfuel in opening up market segments that cannot effectively be accessed by other wood boiler technologies is well established. This applies particularly to the domestic sector and potentially also to application of wood heating in urban areas where space, fuel delivery and storage logistics are key factors. However, whereas the development of forestry derived woodfuel supply chains can only be triggered by the demand-pull created by boiler installations, any installation of a wood pellet boiler must be predicated on a pre-existing supply of fuel.

Thus, although the same 'chicken-and-egg' issue applies to the development of pellet as to wood-chip applications, it must be addressed differently. At the time of writing wood pellets are beginning to become available in the Region but only on a very limited and *ad hoc* basis, and there are no pellet mills of substance either in the Region or in Great Britain nor is there the required infrastructure for local distribution. The impact that the Balcas plant in Northern Ireland will have is not yet clear[6], although it is likely to facilitate market development; imports via the East coast ports are also a *bona fide* means of addressing immediate market development and are likely in the short to medium term. However, longer-term the development of pelletising capacity in the UK must be seen both as desirable and as an important opportunity for the wood processing sector. The availability of 'indigenous' pellets will undoubtedly increase. Thus pellets are included in the sectoral review provided in Section 5 but it is recognised that this is predicated on the establishment of an effective pellet supply infrastructure.

[5] Untreated and outside the terms of the Waste Incineration Directive, for which see http://www.defra.gov.uk/environment/ppc/wasteincin.
[6] See http://www.balcas.com/articles/biomass.html.

1.2 Why wood - people, economy, environment

The major sources of renewable energy (RE) harness energy from the sun - photovoltaics directly and wind, wave or hydropower indirectly. However, uniquely among renewables, the use of *biomass* is based on harnessing stored solar energy in the form of a fuel, whether woodfuel from forestry and timber processing (the focus of the current report), agricultural by-products such as straw, or dedicated *energy crops* grown specifically as an energy feedstock. This has key implications that give it a far wider range of applications than most RE technologies:

1. Unlike wind and other renewables which can generally be used to generate electricity only, biomass can replace fossil fuels in all three sectors of the energy market:
   - heating and process fuels
   - electricity generation
   - transport fuels

   This opens up the whole of the energy market to penetration by biomass technologies, of which heating and process fuels are the largest single element (approximately 45% by final use across the UK as a whole).
2. Because it is based on using a fuel in some form of prime mover (combustor, gasifier etc.), biomass energy is essentially schedulable, i.e. it can be used on demand, if necessary year-round, and is not dependent on external factors such as weather. This too allows it to be used in a wide range of applications, including heating, where reliability and continuity of energy supply are essential.

Elsewhere in Europe, wood heating is a well-established and thoroughly embedded energy source and, when viewed in a northern European context, the UK's lack of an established sector is striking. However, given an appropriate fiscal and regulatory environment, wood heating has the potential to grow rapidly in the UK and to bring with it a raft of potential benefits. These cut across many different strands and might be said to offer a model of *sustainable development*:

1. Woodfuel is 'carbon lean' and renewable (see Inset 1, below), leading to reductions in emissions of CO^2 by offsetting the use of fossil fuels. Development of wood energy applications therefore contributes to meeting emissions reduction and renewables targets.

2. Woodfuel is a competitive source of energy compared to most fossil fuels such as oil, and even natural gas, and energy from woodfuel used for heating is perhaps the lowest cost of all RE technologies. It therefore has the potential to offer end-users affordable energy at prices that can also be insulated in some degree from increases in fossil fuel prices. This is particularly so in rural or urban fringe areas where natural gas is often unavailable. In addition, money spent on woodfuel is almost by definition spent locally and so retained within the Regional or sub-Regional economy and even, in the context of 'self-supply', within individual rural businesses.

3. Production of woodfuel offers an important diversification opportunity for woodland and timber processing enterprises. It specifically offers a market outlet for the low-grade products that result from all timber harvesting or processing operations: small dimension roundwood (chipwood or pulp) and sawmill co-products (produced either in chipped form or as slabwood). In this regard, the East of England has a substantial woodland resource[7] and the limited and uncertain demand for these products is an acknowledged barrier to development of the sector as a whole. In this context, the 'demand pull' created by a growing wood-energy industry would in turn bring a range of benefits, including:

   - income generation for owners, contractors and processors, and suppliers;
   - employment and job creation ; and
   - increased management and therefore improved quality and value in terms of:
     - future productivity and asset value;
     - habitat value and biodiversity; and
     - sporting and other amenity uses, including improved access.

4. Finally, although not the focus of this report, woody energy crops such as short rotation coppice (SRC) or short rotation forestry (SRF) do have the potential to offer an important diversification opportunity for farmers. The use of clean woody wastes for energy also offers a route for reducing waste disposal costs and removal of significant quantities of material from the waste stream and landfill[8].

Overall, these benefits offer a potential 'win-win-win' for all involved: from landowner to contractor to end-user to the public at large. A combination of an increasingly favourable fiscal and regulatory environment and rising market prices for oil and gas has created an opportunity for significant market growth.

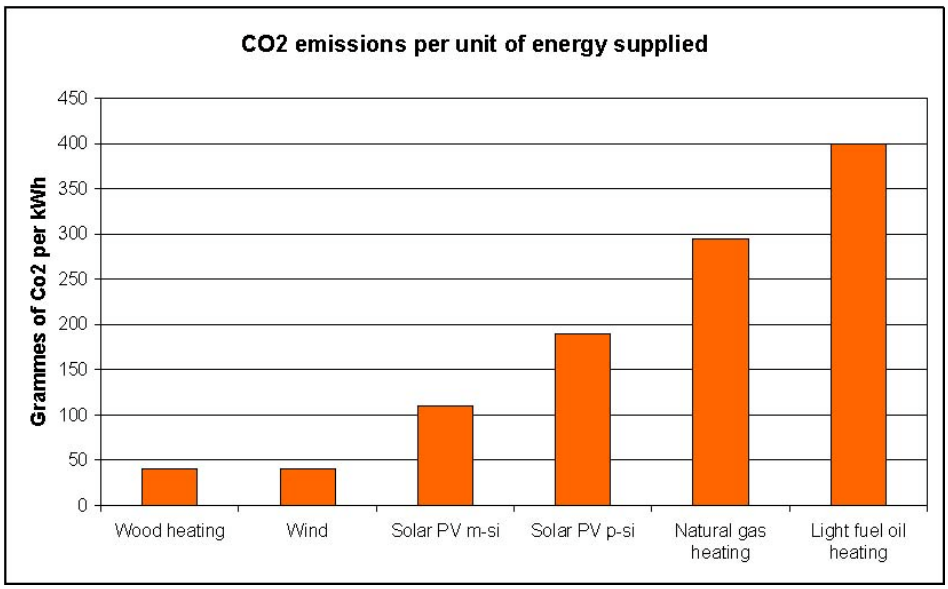
Against this background, biomass is regarded as a key RE technology for the East of England[9] and is specifically being pursued as a priority by Renewables East, the strategic body for the promotion of renewables in the Region. The Forestry Commission also regards Woodfuel development as a key strategic goal both nationally[10] and within the region, where it is a major plank of the Regional Woodland Strategy, *Woodland for Life*[11].

[7] See *Woodfuel in the East of England* ibid.
[8] See also note on page 2; it should also be noted that demand for recycled fibre from the particleboard industry is already proving a major driver in this respect.
[9] See, among others: *Making Renewable Energy a Reality - Setting a Challenging Target for the Eastern Region*, Go-East on behalf of the East of England Sustainable Development Round Table 2002 – www.sustainability-east.com; *Environmental Prosperity, Business and the Environment in the East of England*, EEDA 2002 -www.eeda.org.uk; *Woodfuel in the East of England: prospects & potential*, Forestry Commission et al 2003; *Woodland for Life*, Forestry Commission 2002 - www.woodlandforlife.net; EEDA corporate development plan 2003-06, - www.eeda.org.uk.
[10] The England Forestry Strategy (EFS) sets out a four-fold role for woodlands and forestry in England, encompassing *forestry for rural development*; *economic regeneration*; *recreation, access & tourism*; and *environment & conservation*. In this context, the development of woodfuel is recognised as providing a number of crosscutting benefits and the EFS draws specific reference to assisting diversification through encouraging the use of woodfuel for energy production. See *England Forestry Strategy – A new focus for England's Woodlands*, Forestry Commission 1999 (www.forestry.gov.uk).
[11] See www.woodlandforlife.net

Inset 1: Woodfuel and combating Climate Change

In January 2004, the Government's Chief Scientific Officer Sir David King warned that …*climate change is the most severe problem that we are facing today, more serious even than the threat of terrorism*…[12], and addressing Climate Change is now firmly on the agenda internationally, nationally and regionally. One of the key mechanisms for achieving reductions in the Greenhouse Gas emissions that drive Climate Change is the large-scale deployment of renewable energy technologies. To this end, a host of regulatory and fiscal measures combined with market forces are providing the catalyst for market development around the world so that, globally, the renewables sector is growing at rates consistently in excess of 20-30% per annum in areas such as wind and solar[13]. In Germany alone, for example, the wind industry employs over 30,000 people directly[14], which might be compared to the residue of just 9,300 now employed in the UK coal industry[15].

Woodfuel is 'carbon lean'. Coal, oil and gas release fossil carbon into the atmosphere when they are burned, whereas sustainably produced woodfuel recycles carbon. The carbon released is that absorbed as the trees grew; it is then reabsorbed by the successor generation of trees. Thus, each successive generation of biomass fuel simply recycles carbon within the Biosphere. There are however some emissions of CO_2 in planting, harvesting, processing and transportation, but replacing fossil fuels with woodfuel will typically reduce emissions by up to 90%.



[12] Article in Science, 9 January 2004
[13] http://news.thomasnet.com/IMT/archives/2004/06/renewable_energ.html
[14] http://www.bwea.com/ref/bweabeaufort.html
[15] http://www.dti.gov.uk/energy/coal/uk_industry/index.shtml

2 Wood Heating: An Emerging Opportunity

Until the late 1990's, the main driver for the nascent biomass sector in the UK was the offtake contracts awarded via the Non-Fossil Fuel Obligation (NFFO) bidding process. These resulted in several large-scale biomass generating facilities being built in the East of England[16], and it is recognised that for the next several years the largest market for woodfuel in the Region will remain the demand created by the FibroThetford electricity generating plant near Thetford in Norfolk[17].

In addition, the author is aware that a number of further generating projects have been mooted within the Region, and one such would certainly have a major impact. However, development of these projects is problematic within the current ROC market context[18] and, while one or more *may* bear fruit in the medium-term, prior experience suggests that the likelihood of success is limited. Similarly, although co-firing of biomass feedstocks into existing coal-fired power plant shows signs of gaining momentum elsewhere in the UK, there is little scope for this in the East of England, which is not home to such any plants[19].

In contrast, alongside the RO driven ROC market, a number of wider fiscal and regulatory instruments are providing the catalyst for much more diversified market development, including wood heating[20]. Alongside rising fossil fuel prices, these provide the context for the potentially rapid development of local, 'embedded' wood heating plants, of which there are an increasing number of 'pioneer sites' across the Region.

Whilst acknowledging the very substantial impact that even a single successful electricity generation project could have, in practice it is likely that the 'bulk' woodfuel market will remain relatively static for the medium term at least. In contrast, the wood heat sector holds out the potential for substantial and solidly founded growth in the medium and long-term. This is very much in line with wider European experience, where growth has been rapid once an appropriate fiscal and regulatory framework is in place[21]. By far the largest proportion of woodfuel is used in local plants providing heating to individual buildings and community heating networks (with some biomass Combined Heat and Power (CHP) in facilities such as paper or board mills and sawmills).

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[16] The FibroWatt plant at Eye, Suffolk, now operating on a mixture of organic wastes; the FibroThetford Plant near Thetford, Norfolk using primarily poultry litter but also using 30 – 50,000 tonnes of woodfuel per annum; and the Elean straw-fired plant at Sutton, Cambs. A number of other plants have been planned and some have come near to fruition (for example, plants at Eye and Corby). However, just the successful plants listed place the East of England far ahead of the other Regions.

[17] One ramification of the existence of the FibroThetford plant in particular is that there is a well-established woodfuel supply chain in the Region. However, this is focused on a relatively small catchment and is almost entirely operated by a single contractor (MI Edwards Engineers at Brandon), utilising mainly forestry residues generated by the Forest Enterprise (FE) estate in Thetford Chase (with some whole-tree thinning material from FE and from the private sector). The set up of the contractor and the nature of the raw material make the material produced generally unsuitable for applications such as use in small-medium sized heating boilers and, while this is an important facet of the Regional 'scene', it is essentially separate altogether from the likely evolution of supply chains to service the wood heating market.

[18] Renewables Obligation Certificates (ROC's) are issued within the terms of the Renewables Obligation (RO) for every unit of electricity generated from allowable renewables. These certificates can be sold separately to the electricity itself, creating an open market for ROC's in their own right. See also Section 3.

[19] For a list of ROC registered plants in the UK, see www.ofgem.gov.uk/ofgem/work/index.jsp?section=/areasofwork/renewableobligation.

[20] Specific relevant measures are set out in Section 3.4

[21] Something that is brought out in the Biomass Task Force *Second Progress Commentary*, March 2005.

Inset 2: Wood heating in Europe

Biomass energy, of which 80% is woodfuel, provides about 7% of the EU's total energy needs. Wood also provides about 10% of the total heat market . Indeed, in those European countries where energy from wood is already integrated into the energy economy, the vast majority of woodfuel is used to generate heat, and countries including Denmark, Sweden, Finland, Austria, Germany, France and Switzerland have generally followed a well-rehearsed path:

Traditional use of woodfuel (logs) in individual properties

- ➔ improved boilers, including introduction of automated wood-chip boilers
  - ➔ addition where appropriate of localised community heating or district heating networks served from central boilerhouses with wood-chip boiler plant;
  - ➔ development of CHP in large process applications (particularly paper mills and similar)
    - ➔ development of pelletised fuel to increase market reach, particularly in the domestic sector
    - ➔ CHP added to district heating networks (still rare)
      - ➔ stand-alone electricity generation and / or co-firing considered (still extremely rare

Overall, biomass derived energy in all its forms represents c.62% of all renewable energy in the EU28; a substantial majority of this is used in highly localised and embedded wood heating plants (total use of wood >100 million m3).

The size of individual heating plants, and therefore fuel requirements, are substantially smaller than electricity generating plants. They are consequently far more readily achievable and can be realised much more quickly with a relatively small capital investment. Moreover, the market for heating and process fuels is actually larger than for electricity in the UK as a whole, accounting for approximately 45% of total energy use. Indeed simply substituting fossil-fuelled with wood-fuelled heating will more than meet 2010 or even 2020 carbon-emission reduction targets.

3 Existing and Emerging Policy Context

The over-arching policy context for the development of wood heating derives from the wider goal of reducing greenhouse gas emissions and, in relation to this, increasing deployment of RE technologies. However, one of the features of biomass as a form of RE and of wood heating in particular is the degree to which it touches on, and is touched by, a raft of wider policy issues and the important synergies that this creates. These are formulated at the international, national and regional levels and include:

- Wider energy policy which, as well as Climate Change, is driven by a number of other elements, including security of supply, alleviation of fuel poverty and competitive markets (see below);
- Rural development policy, especially relating to diversification of land-based enterprises (forestry and agriculture) and economic development or regeneration;
- Waste policies aimed at reducing materials, in particular carbon-based, going to landfill;
- Regional and sub-regional planning policies; and
- Employment and job creation.

A summary of the key policy drivers and recent consultations is provided below, although it is acknowledged that it is not comprehensive, due to the sheer range, diversity and number of policy aspects. This is followed, in Section 3.4, by a review of specific fiscal, regulatory and other instruments that are the main current enabling measures for the development of the wood-heating sector.

Note: this section replicates and updates that provided in Woodfuel in the East of England relating to EU and UK-wide policy, as it is at this level that the major drivers are emerging; it does not seek to re-visit the Regional policy framework.

3.1 European policy

In December 1997, the European Commission adopted a White Paper "*Energy for the Future: Renewable Sources of Energy*"[22] followed in November 2000 by a Green Paper "*Towards a European Strategy for the Security of Energy Supply*"[23]. These papers set an objective to double the share of Renewable Energy Sources (RES) from 5.4% of gross inland energy consumption in 1997 to 12% by 2010.

These targets are promoted under the *Campaign for Take Off*, which incorporates sectoral targets that specifically include 10,000MW_{th} of additional biomass installations and 1,000,000 dwellings to be heated by biomass by 2010[24]. Importantly, it also calls for the support of a range of actors working in partnership to achieve implementation. These include national governments, regional and local authorities, farmers' associations and forest-based

[22] White Paper COM(97) 599
[23] For Green Paper & progress updates see http://www.europa.eu.int/comm/energy_transport/en/lpi_lv_en1.html
[24] See http://www.agores.org/POLICY/COM_STRATEGY/CTO/keyactions.htm

industries, recognising that effective articulation between them is essential to achieving the targets it sets out.

In addition to the above, the EU has enacted two pieces of legislation to deliver the RES 2010 target of 12%: Directive 2001/77/EC to increase renewable electricity generation (RES-E) from 14% in 1997 to 22.5% by 2010 and Directive 2003/30/EC to achieve 5.75% transport biofuels by 2010. Despite these, the Commission Communication on "*The Share of Renewable Energy in the EU*"[25] concluded that further efforts, in particular for biomass, are required to achieve the RES policy objective for 2010. If both targets for RES-E and biofuels are met, then the RES total in 2010 may still only hit 10%. Furthermore, the European Commission has acknowledged that, under current trends, only 18-19% will be achieved for RES-E by 2010. The Commission has consequently launched a *Sustainable Energy - Europe (2005-2008) Campaign*[26] and a *Biomass Action Plan*[27] in an attempt to fill the gap. Feedback from the consultation generated 1300 recommendations for important activities to support biomass/bioenergy markets or applications, from both EU & non-EU countries. These were split evenly between those at the EU and national level. As examples only, the top five mentioned were:

- *"Consider external costs of fossil fuels and benefits of bioenergy in the price formulation, link bioenergy to CO2 trading".*
- *"Harmonise quality standards for bioenergy products…according to the properties of bioenergy products".*
- *"Promote bioheat e.g. via a renewable heat directive".*
- *"Raise awareness about benefits of bioenergy, exchange information".*
- *"Amend Common Agricultural Policy (CAP) regulations, which are seen as a barrier to bioenergy growth"*.

***The Heating Sector – the neglected giant*:** Half the final energy consumption in the EU goes towards heating buildings, domestic water and industrial processes. This is a larger proportion than either transport or the electricity sectors. With European directives to promote renewable electricity and transport fuels already enacted, the renewable heating and cooling sector (via biomass, geothermal, solar thermal etc.) is missing from the policy framework. In April 2005, the European Renewable Energy Council (EREC) together with 40 other organisations made a joint declaration which called for an EU Directive to promote renewable heating and cooling by setting an overall legally binding EU target of 25% by 2020[28]. Currently biomass heat contributes more than 98% of all renewable heat, with the majority coming from

[25] Com(2004) 366 final
[26] "Sustainable Energy Europe (2005-2008)" Campaign at http://www.sustenergy.org
[27] http://europa.eu.int/comm/energy/res/biomass_action_plan/index_en.htm
[28] For EREC *Joint Declaration for a European Directive to Promote Renewable Heating and Cooling* and list of supporting organisations see http://www.erec-renewables.org/#joint

fuel wood in domestic applications, followed by industrial heat from waste and then community heating from biomass.

3.2 UK energy policy

> *"…We need urgent global action to tackle climate change. We are showing leadership by putting the UK on a path to a 60% reduction in its carbon dioxide emissions by 2050. And because the country cannot solve this problem alone, we will work internationally to secure the major cuts in emissions that will be needed worldwide…. This white paper is a milestone in energy policy…".* Tony Blair in February 2003 launching the White Paper "*Our Energy Future – creating a low carbon economy*".

In its *Climate Change Programme*, published in January 2000[29] the UK Government set out a firm commitment both to achieve 20% reductions in CO_2 emissions from 1990 levels by 2010[30] and to generate 10% of electricity from renewable resources within the same period. The Royal Commission on Environmental Pollution report "*Energy – the changing climate*"[31], published in the same year, provided a thorough review of the challenge entailed in addressing our long-term energy needs. This represents an undoubted benchmark not only in the development of RE policy but also in UK energy policy *per se* and was followed by an *Energy Review* published in February 2002 by the Cabinet Office's Policy & Innovation Unit (now the Prime Minister's Strategy Unit)[32]. This highlighted the role that RE has to play both in mitigating Climate Change and in providing energy security in the medium term. It specifically identifies biomass as a key RE technology for the UK.

Between them, the Royal Commission report and the *Energy Review* effectively set the tone for the Energy White Paper "*Our Energy Future – creating a low carbon economy*"[33], published by the UK government in February 2003. The White Paper provides the framework for UK energy policy into the medium and even long-term, and sets out four key strategic goals for UK energy policy:

1. to cut UK carbon dioxide emissions by 60% by 2050 with real progress by 2020;
2. to maintain the reliability of energy markets and security of supply;
3. to promote competitive markets in the UK and beyond; and
4. to ensure that every home is adequately and affordably heated.

The White Paper itself indicates that: *"In reducing carbon dioxide emissions, our priority is to strengthen the contribution of energy efficiency and renewable energy sources"*, and, while

[29] For the Climate Change Programme 2000, see http://www.defra.gov.uk/environment/climatechange/02.htm
[30] This is actually ahead of the requirement set out in the *Kyoto Agreement (1997)* which requires the UK government to reduce emissions of greenhouse gases to 12.5% below 1990 levels by 2008-12.
[31] See http://www.rcep.org.uk/newenergy.htm.
[32] See http://www.strategy.gov.uk/work_areas/energy/index.asp.
[33] DTI Energy White paper http://www.dti.gov.uk/energy/whitepaper/

acknowledging that the UK in some degree lags in RE deployment[34], it re-enforces the short-term 10% target by 2010 set in 2000. The implementation of the White Paper is being taken forward by the Sustainable Energy Policy Network (SEPN)[35], a network of Government Departments, Devolved Administrations, Regulators and other key organisations. The second annual report on the White Paper[36] (July 2005) by SEPN highlighted the following progress (key items relevant to biomass only included):

- The Kyoto protocol came into force on 16th February 2005. The UK is already meeting its Kyoto target for 2008-2012 reducing greenhouse gas emissions and current projections show that the UK's emissions of the basket of six greenhouse gases are expected to be about 12.5% below 1990 base levels by the target date.
- *"But there is more to do to meet our domestic goal as set out in the Government's manifesto of achieving a 20% reduction in carbon emissions on 1990 levels by 2010"*: Margaret Beckett, Secretary of State for Environment, Food & Rural Affairs & Alan Johnson, Secretary of State for Trade and Industry. The UK currently has reduced CO_2 ("*carbon*") emissions by about 7.5% from 1990 levels with projections estimating only 14% reduction by 2010. The *Climate Change Programme Review* is planned to get the UK back on track to meeting the goal of 20% reduction.
- Under the UK Presidency of the G8, Climate Change was a key issue at the Gleneagles Summit of G8 Leaders in July 2005. An action plan to promote cleaner technologies including biomass was adopted and an agreement was reached to create a pathway to a post Kyoto accord.
- EU Emissions Trading commenced in January 2005 (see also Section 3.4, below).
- With respect to biomass energy, the second Annual Report highlights the work of the Biomass Task Force under Sir Ben Gill (see also Section 3.3, below).

Although Climate Change is undoubtedly a major driver, the issue of energy security is also at the top of the policy agenda as the geopolitical situation in fossil fuel exporting countries continues to be unstable and the price of fossil fuels has risen rapidly throughout 2004 and 2005. Under section 172 of the Energy Act (2004), the First Annual Report to Parliament on the *Security of Gas and Electricity Supply in Great Britain* was published in July 2005[37]. This highlights the rapidly growing dependence on imported gas, which is forecast to reach 40% by as early as 2010 (until 2005 the UK was a net exporter). (See also Section 4.2).

Energy security and Climate Change are together becoming ever-stronger drivers towards RE and, latterly, biomass heat. The other two pillars of energy policy, the drive towards

[34] In 2003 approximately 3% of the electricity generated in the UK were generated from renewables and waste which places the UK 14th out of EU15.
[35] SEPN web-site www.dti.gov.uk/energy/sepn/index.shtml.
[36] Energy White Paper , Second Annual Report: http://www.dti.gov.uk/energy/sepn/secondannualreport.shtml.
[37] Security of Gas and Electricity Supply First Annual report - http://www.dti.gov.uk/energy/publications/policy

competitive markets and tackling fuel poverty[38] are also relevant in many contexts (e.g. community heating).

UK policy relating specifically to bioenergy

Biomass has figured in a raft of UK policy over a long period, including (in chronological order):

- MAFF published a *National Biomass Energy Strategy* in 1996 that has continued to inform current policy. This identified forest residues, Short Rotation Coppice (SRC) and agricultural residues (principally straw and chicken litter) as the major prospective components of biomass supply chains in the UK. More recently, Defra's *Strategy for Sustainable Farming and Food*[39] refers both to energy crops and to forestry in the context of diversification, noting, "*Biomass products can contribute both to the UK's climate change and renewable energy targets*".
- The DTI publication *New and renewable energy: prospects for the 21st century* represents conclusions drawn in response to a consultation undertaken during 2000[40]. It states that the Government wishes to promote a climate of opportunity and to encourage innovation so that RE, including biomass, can become increasingly cost-effective and competitive with other more traditional sources of energy.
- Biomass features significantly in the various scenarios for the future energy mix developed in the Royal Commission on Environmental Pollution (RCEP) report "*Energy – the changing climate*" referred to earlier. This report noted the potential, but neglected, role of renewable heat, which led to the commissioning of the highly influential RCEP Special Report – "*Biomass as a Renewable Energy Source*"[41] in 2004 (see below).
- The *Renewable Innovations Review*[42] *(Feb 2004)* by the DTI and the Carbon Trust concluded that constraints on the development of biomass energy were related to large scale developments and to immature biomass supply chains. It recommended that Government focus should be on small, regional scale biomass projects. The preferred program for biomass was to "*develop [the] energy crops option and exploit heat markets to kick start fuel [supply] chains*".

3.3 *Recent reports*

Royal Commission

The Royal Commission on Environmental Pollution's (RCEP) special report "*Biomass as a Renewable Energy Source*" published in April 2004 is a thorough analysis of the market

[38] See The Fuel Poverty Strategy Third Annual Progress Report 2005 at http://www.dti.gov.uk/energy/consumers/fuel_poverty
[39] Defra 2002, http://www.defra.gov.uk/farm/sustain
[40] See http://www.dti.gov.uk/renew/ropc.pdf.
[41] Available at http://www.rcep.org.uk/bioreport.htm
[42] See http://www.thecarbontrust.co.uk/carbontrust/about/publications/renewable_innovations_review.pdf

opportunity, costs, challenges and recommendations for biomass energy and is an excellent introduction to the sector. A few of the most important conclusions relating to biomass heat are:

- Sufficient biomass is already available to develop the sector in the form of forestry products, by-products, straw and municipal arisings. The usage of this will bring benefits to farmers and foresters and will divert material from landfill. In the longer term, growth will depend partially on the development of energy crops (e.g. willow and miscanthus), which the report recommends to approach gradually and in a phased manner.
- There is a significant gap in government policy regarding heat production. It highlights that using heat, instead of, or as well as, electrical energy could substantially improve conversion efficiencies from typically around 30% to about 80%.
- Existing government support measures for biomass energy are complex and can conflict with each other. A rationalisation of government policy is strongly recommended.

The key recommendations relating to biomass heat include the following:

- "*The focus should be on establishing the sector through the use of existing, proven technology…the Bioenergy Capital Grants Scheme should be expanded and its guidelines revised to make clear that its main purpose is to support the installation of biomass-based combustion equipment to bring about a large scale expansion of heat-only and CHP generation (power only generation should be excluded on efficiency grounds) from biomass."*
- The scope of biomass as a source for renewable heat needs further investigation, with the potential introduction of a green heat credit system.
- "*Biomass energy should be considered positively in all new-build and retrofit projects. The assumption should be in favour of biomass energy in all projects; construction companies and councils should have to justify any decision not to adopt this option*".

Biomass Task Force

Following this influential report the UK Government commissioned Sir Ben Gill to lead a Government Task Force *(The Biomass Task Force[43])* in October 2004. This Task Force issued its final report in October 2005. With respect to biomass heating, its conclusions build on many of the mian themes of the RCEP report and include the following key recommendations (a selection of the 42 recommendations most relevant to biomass heating); several of which specifically refer to regional actions:

- The government urgently introduce a single capital grant scheme to grant aid all biomass heating boilers and the heat element of biomass CHP. A level of 40% of capex on boilers and infrastructure is proposed for a minimum of 5 years.

- That proactive investment in biomass energy in public buildings is encouraged. Each government department, Regional Development Agency, Government Office and Local Authority should publish ambitious carbon targets for renewable electricity, heat and CHP for 2010 & 2020. This should include schools, hospitals and other buildings in public ownership.
- Government should set targets for renewable heat (primarily from biomass) of 3% by 2010 and 7% by 2015 (against 1% today) across the public and private sectors.
- A number of regulatory barriers should be removed (e.g. buildings regulations revision and requirement to type test individual boilers).
- A second round of the bioenergy infrastructure grant should be introduced.
- The RDAs should work actively in their regions to facilitate the development of the fuel supply infrastructure.
- The Government should consider and report on potential mechanisms to provide long term support to biomass heat including the EU Emissions Trading scheme, Climate Change Levy and Energy efficiency commitment.
- Continuation of the energy crops scheme.
- The Task Force recommended that the Carbon Trust be established as the national focus of knowledge and analysis on biomass energy.

The concept of a Renewable Heat Obligation was reviewed in detail and considered unworkable. At the report launch Lord Bach, Parliamentary Under Secretary, Sustainable Farming & Food warmly welcomed the report and advised that the Government was now bringing together a cross-departmental team under the Secretaries of State for Trade and Industry and Environment, Food and Rural Affairs to develop a plan for taking its recommendations forward. Malcolm Wicks, Energy Minister at the DTI said "*This wide ranging report leaves us in no doubt that biomass has the potential to make a real and lasting contribution toward renewable energy and heat in the UK*."

DTI / DEFRA review

In parallel with the work undertaken by Sir Ben Gill, the DTI and DEFRA jointly commissioned an internal review of renewable heat and the heat component of CHP (including biomass), produced by Future Energy Systems (FES) and published in September 2005[44]. This report recommends that the Government consider giving additional support for wood heating in commercial, industrial, and new build together with major refurbishment of the residential sector. It recommends that this support could include capital grants or heat subsidies similar

[43] See http://www.defra.gov.uk/farm/acu/energy/biomass-taskforce/index.htm for the Biomass Task Force final & interim reports
[44] See ""Renewable Heat and Heat from Combined Heat and Power Plant – Study and Analysis" at http://www.dti.gov.uk/renewables/policy_pdfs/heatreportfinal.pdf.

to the Renewables Obligation. It foresees that it is possible for renewable heat (including biomass) to deliver up to 4.7% of the total UK energy demand by 2020. It does not recommend extending support to the existing residential (standalone) sector due to the high cost of carbon offset achieved, although it does recognise the domestic sector and suggests that it is supported via technology blind support for micro-generation (see also below).

Carbon Trust review

The Carbon Trust published their "*Biomass Sector Review*"[45] in October 2005 at the same briefing as the Biomass Task Force. This presents a detailed analysis of the economics of a wide variety of biomass supply and conversion options. It concludes that when all support mechanisms are removed small-scale biomass heat replacing oil has the most favourable investment returns of all biomass applications examined (including large & small-scale CHP and large & small-scale electricity only). Small heat also has the lowest cost of carbon. Large scale CHP is also attractive with the support of Renewable Obligation Certificates (see Section 3.4). The Trust recommends that the Government consider supporting small biomass heat using capital grants, through the EU ETS and/or using a Renewable Heat Obligation. In addition, the Trust is beginning to scope out a project seeking to accelerate the development of biomass in the UK, focused on the use of biomass for heating at the small scale. A key objective is to build a better understanding of the risks of development and how best to mitigate these across the entire biomass supply chain.

Microgeneration Strategy Consultation

In addition to the above, the DTI have consulted on a *Microgeneration Strategy and Low Carbon Buildings Programme*, which also includes reference to biomass heat. This consultation has informed the development of the Government's strategy for the promotion of microgeneration[46] in Britain, including the development of the low carbon buildings programme that will in turn include biomass heat.

3.4 The current fiscal and regulatory environment

While the policy situation is currently dynamic, the raft of earlier strategies and policies relating to Climate Change and renewable energy have already resulted in a positive policy framework and concrete fiscal and regulatory mechanisms to promote RE technologies, with some specific measures relating to biomass. It is to be hoped that the current consultations and policy developments will create a simpler, stronger and longer-term set of support mechanisms specifically for biomass heat. There is currently however a complex web of measures to provide the drivers for market development of the biomass sector which include:

[45] See www.thecarbontrust.co.uk/carbontrust/about/publications/Biomass%20Sector_FINAL.pdf.
[46] Microgeneration is the production of heat and/or electricity on a small-scale from a low carbon source. Small scale is defined as homes, public sector & small commercial developments. Low carbon refers to either renewable energy generators or technologies with better fuel efficiency than conventional technologies.

- **The Renewables Obligation (RO).** The Renewables Obligation came into force by statutory instrument in April 2002[47]. It obliges all energy supply companies to procure an increasing proportion of renewable energy and is now the principal mechanism for supporting renewable electricity generation in the UK. The mandatory target of electricity generated from renewable sources in England and Wales is 12% by 2010, with an inspirational target of 20% by 2020. Electricity generated from biomass falls within the scope of RE technologies eligible to claim Renewable Obligation Certificates (ROCs) under the RO, although it should be highlighted that the ROCs only apply to renewable electricity (including electricity from renewable CHP) and not heat or cooling. However, the RO is currently being reviewed and there are a number of proposed changes which may have significant impact on the use of biomass for CHP:
  - the RO will allow the increased use of "mixed wastes" and permit biomass fuels to be 90 to 95% pure (rather than the current 98%) – this may encourage the use of recycled timber in CHP projects;
  - the RO will reduce the administrative burden for biomass fuels and permit off-site measurement of biomass fuels;
  - the RO would allow very small generators to pool via agents and thus claim ROCs;
  - the RO will allow electricity used without being put onto the grid to claim the ROC.
- **The EU Greenhouse Gas Emissions Trading Directive[48].** This Directive was agreed in July 2003 and established the framework for trading in Greenhouse gas emissions across the EU and ten accession countries. It is a key long-term tool in the EU's strategy to provide a cost-effective mechanism to meet its Climate Change agreements under the Kyoto protocol. The success of the EU Emissions Trading Scheme (ETS) hinges on the National Allocation Plans (NAPs) which determine how much each country may emit. Member states then set caps on the emissions from their power plants and other energy intensive industries (around 12,000 plants in total throughout the EU). The caps are set in the form of an allocation of allowances, which may then be traded. Each allowance permits the holder to emit one ton of CO_2 per year. The first phase of the EU ETS commenced in January 2005, requiring operators to start monitoring emissions. The approved NAP for the first phase of emissions (2005-2007) was published in May 2005. In the UK, 736 million allowances were allocated to over 1,000 operators. It is anticipated that the UK installations will contribute a reduction of 65 million tonnes of CO_2 (around 8% below their business-as-usual projections) by 2007. In March 2005, the UK Government published a communication document outlining the approach to Phase II of the EU ETS[49].

[47] See http://www.dti.gov.uk/energy/renewables/policy_obligation/obligation_2002.pdf.
[48] Directive 2003/87/EC of the European Parliament (13/Oct 2003), Official Journal of the European Union 25 October 2003. Further information on the UK Emissions Trading Scheme and EU ETS may be found at the DEFRA web-site http://www.defra.gov.uk/environment/climatechange/trading/index.htm.
[49] See Consultation Paper on the National Allocation Plan for phase 2 of the EU Emissions Trading Scheme http://www.dti.gov.uk/energy/consultations/index.shtml.

- **The Bio-energy Capital Grant Scheme (BeCGS).** The BeCGS was a UK-wide programme funded by the Department of Trade and Industry (DTI) and Lottery Distributor the Big Lottery Fund (formerly New Opportunities Fund)[50]. The scheme, which is closed to new applications, provided grant funding towards the cost of equipment for biomass-fuelled heat, CHP and electricity generating plants under a number of priorities. Although there was a preference for energy crops throughout the scheme, forestry material and agricultural by-products were also identified as eligible fuels. The total funding for the scheme was £66 million to be committed by March 2006 and spent by March 2010. Of this total, £3 million was allocated to small-scale heat. Some of the large electricity generation only projects that have been allocated funding are experiencing problems, which may mean they do not go ahead.

- **The Bio-energy Infrastructure Scheme (BeIS).** The BeIS has been developed on an inter-departmental basis covering the UK to provide support for the development of biomass supply chains[51]. £3.5 million was made available from Defra in 2003 for the UK, with the bidding round closing in May 2005. The purpose of the scheme was to provide grants to farmers, foresters and businesses to help develop the supply chain required to harvest, store, process and supply energy crops and woodfuel to energy end-users. A successful application was made from within the Region to support a Producer Group, Anglia Woodfuels, focused on production of woodfuel for heating plant.

- **Clear-Skies[52] .** Formally the *Community and Household Renewable Energy Scheme,* Clear-Skies was launched in January 2003 with £13.7 million over two years to provide capital support for defined project types (including biomass heating) for the public and non-profit-making sector and for individual householders. Extended to March 2006, the scheme has been very successful but closed to applications in November 2005. Although certain to be replaced in one form or another, it now seems almost inevitable that there will be a hiatus in funding which is clearly undesirable (although funding remains available via the Bio-energy Capital Grant Scheme holders).

- **The Climate Change Levy (CCL).** The CCL came into force in April 2001 and represents a tax on all non-domestic energy use (other than fuel oil, which is covered by pre-existing duty arrangements). Currently CCL rates are set at 0.15 pence/kilowatt-hour (p/kWh) for fuels (coal, gas) and 0.43 p/kWh for electricity. Woodfuel, being renewable, is exempt from the Levy. In addition, a number of industry sectors have negotiated Climate Change Agreements (CCAs) under which they gain up to an 80% reduction in CCL payments for agreeing to binding energy or carbon saving targets[53]. Switching even partly to use of renewable energy can play an important role in helping companies to meet these targets, with tremendous potential value if it thereby secures their CCAs.

[50] See http://www.nof.org.uk/default.aspx?tc=394&tct=1&fc=&fct=30
[51] See http://www.defra.gov.uk/farm/acu/energy/infrastructure.htm.
[52] See http://www.clear-skies.org/.
[53] See http://www.defra.gov.uk/environment/ccl/index.htm.

- **Enhanced Capital Allowances (ECAs).** ECAs represent a tax incentive for investment in efficient 'low carbon technologies' by providing 100% capital allowances in the first depreciation year for approved capital investments made after April 2001[54]. Criteria for registering biomass boiler plant under the scheme are now available for room heaters up to 15KW, for plant rated at less than 300kW thermal output and those between 300KW and 1.5MW. Each boiler type needs to go through separate testing by an approved laboratory and most importantly must define the range of fuels for which it is valid (e.g. wood fuel moisture content, chip size).

- **Planning Policy Statement 22 (PPS22) on Renewable Energy (August 2004)** and its companion *Guide to PPS22* (Dec 2004) is a significant step towards facilitating the delivery of more renewable energy. PPS22 provides a clear and positive policy framework for bringing forward and deciding RE proposals, while acknowledging the need to consult the Planning and Licensing authorities and statutory consultees as early as possible.

  It appears to have limited relevance in the context of most wood heating schemes. Recently in this regard, however, has been the emergence of what may become a key development in planning policy for building integrated RE technologies, such as wood heating, with the establishment of what has come to be termed the *Merton Principal*. This derives its name from the London Borough of Merton, which was the first local authority to set mandatory requirements for on-site RE in new developments in the UK. Their policy is worded "*All new non-residential development above a threshold of 1000 square metres will be expected to incorporate renewable energy production equipment to provide at least 10% of predicted energy requirements*"[55]. While still limited in its scope, the Greater London Authority and the neighbouring county of Surrey have now adopted this principal and it is being seriously considered in other English regions. If adopted, it could become a key driver for wood heating and is particularly relevant to the Region because of the very large-scale of projected new developments.

- **R&D programmes.** Both Defra and, more particularly, the DTI operate R&D programmes to support technical developments in biomass (and other technologies in the case of the DTI). The DTI's *New & Renewable Energy Programme* has now been replaced by the *Technology Programme*[56], which is available to **any** technology, and not specific to renewable energy. Over the period 2005 to 2008, £320 million is available. This is used to co-fund a wide range of projects under twice-yearly calls for proposals, each of which sets out the current range of priorities.

[54] See http://www.eca.gov.uk/etl/homepage.asp.
[55] See http://www.merton.gov.uk/democratic_services/ds-agendas/ds-reports/4875.pdf
[56] See www.dti.gov.uk/technologyprogramme/about.html.

- **Other.** As well as the primary support mechanisms above, substantial funding that has potential relevance to biomass energy schemes is available via a wide range of other schemes including:
  - The **Community Energy Programme,** run by the Energy Saving Trust (EST), aims to deliver a community heating market to the public sector. Only CHP or renewable heat including biomass can provide this heat. This is a potentially important scheme, and has already funded a number of biomass projects. While a further £10 million has been allocated to it, the detail of new priorities has not yet been finalised and the scheme is not currently open to applications (although this is expected to change in the near future)[57].
  - The **English Woodland Grant Scheme** administered by the Forestry Commission provides support for woodland/forestry management[58].
  - The **Carbon Trust** seeks to support innovative and ground breaking projects which reduce emissions of CO_2 and provides R&D funding, soft loans and other finances through a range of schemes. Of these, the Carbon Trust Loan Scheme is specifically applicable to SMEs investing in wood heating, except agricultural or forestry businesses[59].

3.5 Summary

As indicated in the introduction to this Section the policy framework relating to biomass, including biomass heat, is complex and multi-faceted. Such is the number and diversity of relevant policy and related aspects that the review set out above does not purport to be comprehensive. However, one important message does emerge: that, at the time of writing, policy relating to biomass/wood heat is crystallising at a UK level. Existing mechanisms, including grant support, have begun to foster market development. The precise shape of the new measures that seem likely to emerge from the various reviews will be key to establishing the sector as a *bona fide* element not just of RE deployment but, more fundamentally, of the wider heat energy sector. In this regard, the period through to 2010 will be crucial for market development in the wood heat sector and it is specifically in this context that this report should be read.

[57] See http://www.est.co.uk/communityenergy
[58] See http://www.forestry.gov.uk/ewgs
[59] See http://www.thecarbontrust.co.uk/

4 Woodfuel in the Context of the Heat Energy Market in the East of England

4.1 Overview: energy use in the East of England

Although the overall energy flows within the economy are multi-faceted and complex (see Annex II), the energy market can essentially be divided into three elements by final-use:

- electricity
- transport fuels
- heating and process fuels.

Of these, heating and process fuels are of concern to the current report. This is the largest single segment (approximately 45%) and, as the term indicates, it is essentially a fuels market. The main heating fuels are:

- natural gas
- heating oil (28 sec or 35 sec)
- heavier fuel oil grades (MFO, HFO)
- LPG
- coal
- electricity

Detailed data relating to specific fuels use are not readily available on a Regional basis. However, an overall sense of the scale of the heating market can be gained by comparing gas (the dominant heating fuel) with electricity (Table 1):

Table 1 : Gas and Electricity use in East of England

	Domestic		Commercial & industry		All		Sales/consumer - kWh	
	GWh	Consumers	GWh	Consumers	GWh	Consumers	Domestic	Comm & ind.
Gas	36,333	1,776,150	24,242	35,480	60,575	1,811,630	20,456	683,197
Electricity	12,051	2,377,900	14,717	208,300	26,768	2,586,300	5,068	70,643

These figures indicate that the market for gas is approximately 2.25 times the size of that for electricity and, while this cannot be taken to be directly representative of the split between 'heat' and electricity, it does offer a comparison of order of magnitude. It also indicates the extent of the skew inherent in RE policy that has hitherto been dominated by renewable electricity.

Gas vs. other heating fuels

The methodology used to collate and present energy data in the *Digest of UK Energy Statistics* (DUKES[60]) makes it very difficult to assess precisely the split between different fuels

[60] See http://www.dti.gov.uk/energy/inform/dukes/dukes2005/index.shtml

used for heating. However, extrapolating from various of the figures presented in DUKES, it is estimated that gas accounts for about 75% of overall fuel use for heating across both the domestic and industrial sectors. See also discussion and tables in Section 4.2.

4.2 Wood as a heating fuel

Woodfuel can be directly competitive with fossil fuels in a number of market segments, particularly in the context of currently rapid rises in fossil fuel prices, as Table 2 and Figure 2 indicate.

Table 2: Woodfuel equivalent energy costs compared to fossil fuels

Fuel type	Fuel price	Unit	Fuel price	Heat cost	Saving - p/kWh vs.		
			p/kWh	p/kWh	high qual. chip	co-product	pellets
High quality wood-chips	55.00	£/tonne	1.60	1.88			
Sawmill co-product	30.00	£/tonne	1.56	1.89			
Pellets	150.00	£/tonne	3.08	3.52			
Heating oil	32.00	p/litre	3.29	4.39	2.51	2.50	0.87
Natural Gas	1.60	p/kWh	1.60	2.37	0.49	0.48	-1.15
Tanked gas	34.00	p/litre	5.38	7.17	5.30	5.28	3.65
MFO	22.00	p/litre	2.07	2.77	0.89	0.87	-0.76
Coal	80.00	£/tonne	1.03	1.58	-0.29	-0.31	-1.94
Electricity (off peak)	4.00	p/kWh	4.00	4.44	2.57	2.55	0.92
Electricity (peak)	6.50	p/Kwh	6.50	7.22	5.35	5.33	3.70

Notes:

- *High quality wood-chip assumed to be delivered at £55/tonne at 30% moisture content.*
- *Sawmill co-product assumed to be delivered at £30/tonne at 55% moisture content.*
- *Pellets according to Onörm standard delivered at £150 per tonne; the latter is an 'inspirational' figure but believed to be achievable.*
- *Wood boiler seasonal (year-round) efficiencies for well specified plant assumed to be higher than conventional fossil-fuelled plant due to sophisticated combustion controls giving high spot efficiency (>90%) and modulating (load following) capability.*
- *Prices of other fuels indicative only and subject to significant variation according to scale of use, location of user and short-term market fluctuations.*

Clearly, the comparators set out in Table 2 are very sensitive to the fuel costs used, which, as indicated, are subject to considerable variation both through time and between different suppliers and customers. However, while indicative, they do offer an approximation of typical current costs[61]. They show that chipped woodfuel costs less than most fossil fuels at current prices, the only exception being coal, which remains cheap in energy terms but the use of which is inexorably declining and is now very limited in the East of England. Although pellets are significantly more expensive than chipped fuel, if the delivered cost of £150/tonne can be achieved, they would nevertheless be cheaper than the alternative domestic fuels in off-gas rural areas (oil, LPG and electricity).

[61] The natural gas price given is for a 'typical' commercial user, including CCL. Large-scale industrial users may still purchase gas at relatively low costs against which it is difficult for 'virgin' woodfuel to compete; competing with these costs is a specific potential role of recovered woodfuels (e.g. recycled pallets).

The favourable cost comparison is re-iterated in Figure 2, which shows the equivalent 'value' of woodfuel compared to gas at 1.6p/kWh and oil at 28p/l and 32p/l. By way of comparison saw-logs, the highest value conventional forestry product, are currently worth somewhat under £60/tonne ride-side (assumed to be £35/tonne at 55% moisture content, corrected to 30% moisture content).

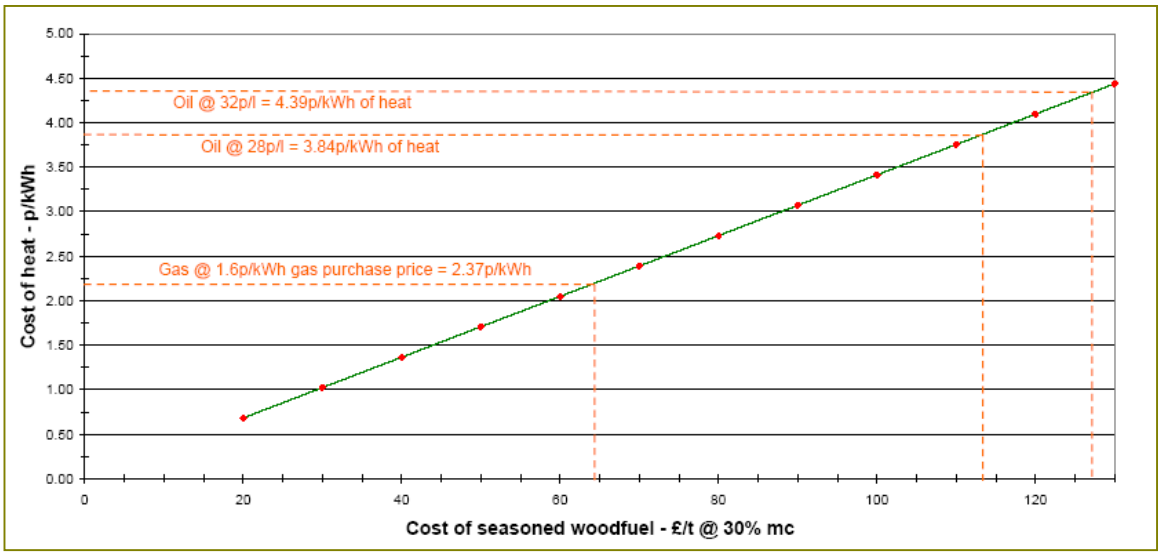


Figure 2. The equivalent energy value of woodfuel.

While this is a powerful message, it is important to note that the cost of heat (in pence per kilowatt-hour) does not translate straightforwardly into a direct comparison with the overall cost of fossil-fuelled heating. These figures relate to the equivalent cost of energy inputs but take no account of capital costs. The latter are a key component in the overall cost of wood fuelled heating, which is based upon a relatively straightforward economic model: capital costs are higher than conventional fossil-fuelled plant but running costs (mainly fuel) are lower, therefore savings on running costs generate a 'payback' on the additional capital. On this basis, the greater the cost differential between woodfuel costs and the competing fuel (oil, gas or others), the greater the potential savings and the greater the amount of capital that can justifiably be 'invested' in the plant.

The savings generated against oil at current prices will produce a viable payback in less than ten years in many instances (with a goal of 3-7 years). It is still, however, difficult to achieve an equivalent payback compared to gas, although large, sustained loads can offer good opportunities.

As indicated above, these comparators are directly subject to wide energy price trends and as fossil fuel costs fluctuate so will the competitiveness of wood heating. At the time of writing, the prices of both gas and oil have been subject to strong price rises for a relatively sustained period, and the price of oil in particular has been highly volatile during 2005, driven by a number of factors. These have pushed oil to prices (over $70/barrel) that are certain to reduce, but the precise shape and timing of future price fluctuations is very difficult to predict with certainty.

In the medium-term, it seems likely that investment in oil refining capacity will ease some of the current intense pressure on prices, and that prices *may* drop back. However, when this will happen and what level of price decay will actually be achieved is uncertain, although a medium term (6-8 years hence) price of *at least* $40 per barrel seems likely[62].

Centrica warns on the cost of gas

UK gas bills may go up for a second time this year because of rising energy costs, British Gas owner Centrica says.

Centrica says no engineers will be affected by the cuts

The company raised bills by almost 6% in January, but then saw its share of the residential gas market fall to 60% by July from 63% a year earlier.

British Gas still has 12.3 million residential gas customers.

Centrica, which said in June that 850 jobs would go at British Gas, warned that the rest of 2004 could prove "even more challenging".

'Forced to follow'

According to chairman Roger Carr, consumer energy prices could prove necessary across the board as a result of rising gas commodiity prices.

"Oil, gas and power prices have risen to levels we have not seen for many years," he said.

With regard to gas prices, which are the dominant element of UK heating costs, the UK gas market has been subject to rapid change over the past several years, driven by two key factors:

1. increasing depletion of indigenous gas reserves (see Inset 3, below). It is estimated that the UK will import up to 40% of gas demand by 2010; and
2. the completion of the first gas inter-connector to Belgium and the ongoing development of new inter-connectors and LNG terminals[63].

The former required that the UK become a gas importer and in so doing (by constructing the inter-connectors) we have become more closely aligned with mainland gas prices. These have been higher than UK prices and have historically shadowed oil prices, although this link

[62] Lord Brown, CEO of BP speaking in the House of Lords 8th June 2005.
[63] Including commissioning of a new Liquefied Natural Gas (LNG) terminal and expansion of the Belgium interconnector in autumn 2005. In the medium term, the new Langeled pipeline will be built from Norway to the UK, as will a new pipeline from the Netherlands, and two new LNG terminals are planned for Milford Haven. See, for example, www.gulf-news.com/Articles/BusinessNF.asp?ArticleID=189214.

may be broken if competition in the gas market becomes the more powerful driver in the long-term.

Overall, the impact of these factors has been increasing consumer prices after a period of reduced prices following liberalisation of the gas market in the 1990s. Between 1990 and 2003, industrial gas prices fell by 28% and, similarly, domestic prices fell by 5.1% between 1998 and 2003. However, although at the time of writing published statistics are not yet available, there were sharp price rises during 2004 that were sustained in 2005.

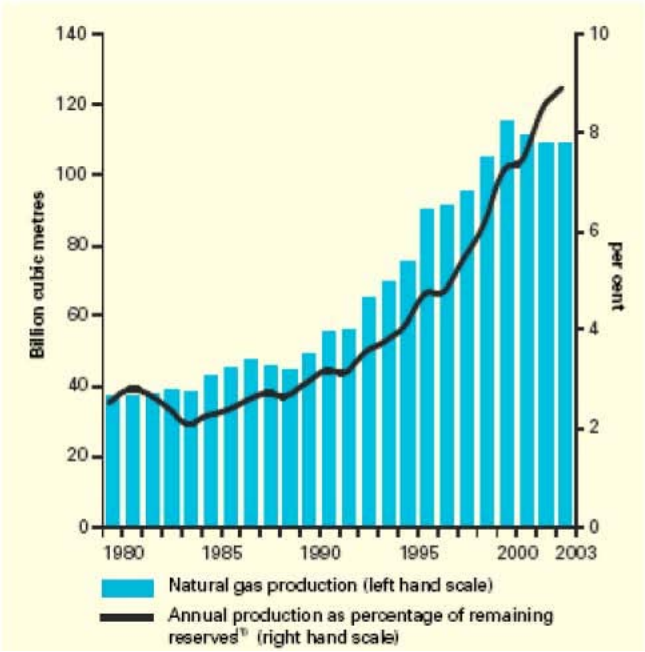
This is echoed in the detailed and considered findings of a House of Lords report published in June 2004[64]. The report considers that the long-term trend towards increasing dependence on imports, not just of the UK but of the EU as a whole (rising towards 70% by 2020), means that "gas prices are likely to rise significantly" over the next 20 years. Overall, the report concludes that while gas supplies will be broadly secure for the next 20 years, this period will be characterised by "increasing volatility in the markets, sharpening international competition for gas, and rising gas prices"

Inset 3: UK gas production

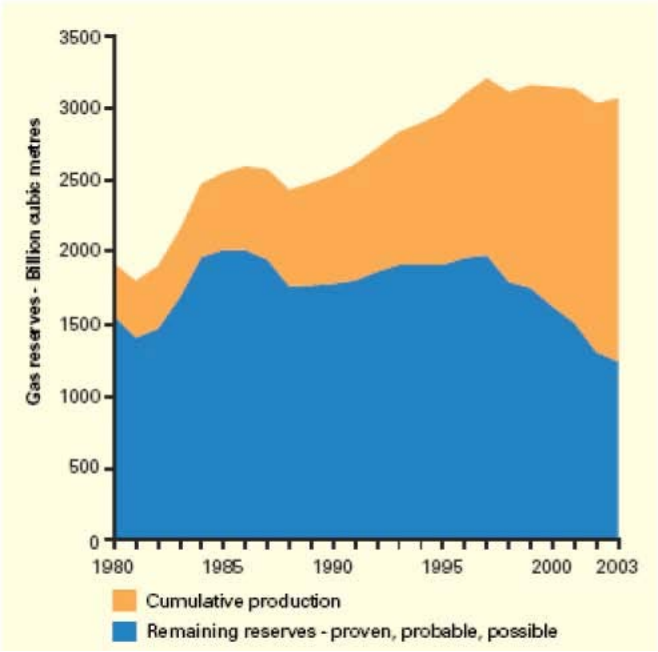
Total UK gas production in the latest period for which statistics are available (third quarter of 2004) was 7.8% lower than the previous equivalent quarter in 2003, reflecting the trend towards declining UK production as reserves are depleted. Related to this, net exports of gas in this period were 53% lower than the 2003 figure and for the first time the UK was a net importer of gas during the winter of 2003/04 (Q4 03 and Q1 04). At the same time, demand for gas from all sectors continued to increase. (Source: DUKES quarterly reports)

UK Energy Sector Indicators 2005 also provides the following analysis:

Gas production and production as a proportion of reserves, 1980 to 2003



Discovered UK gas, cumulative production plus estimates of remaining reserves in present discoveries



[64] Gas: Liberalised Markets and Security of Supply; House of Lords 24th June 2004.

Commentary (from UK ESI 2005):

- Remaining gas reserves have increased slightly since the late 1990s despite large increases in production until after 1999 when revisions to reserves have not full replaced production.
- Revisions to estimates of reserves in 2002 are low due to limited new discoveries and only small extensions to reserves in some existing fields.
- Gas production as a proportion of reserves has more than trebled in the 15 years since 1987.
- In 2002 8.4% of the UK's proven, probable and possible gas reserves were consumed.
- The increase is partly due to some downward revisions to reserves but mostly due to increased production.
- that production of gas will continue at current levels for longer than suggested by these depletion rates. However, these ratios should not be taken as a measure of the future life of these reserves; additional reserves continue to be discovered and it is therefore likely

4.3 Summary

In a public forewarning of the 2005 rises in gas prices given in February, the Chairman of Centrica, Roger Carr, sounded a stern warning that *the era of cheap energy is over.* While firm predictions about energy price trends are always dangerous, it seems likely that the UK will indeed see a steady indexation in energy prices into the medium term.

As well as being subject to global energy price trends, the UK in particular is undergoing a major transformation from being an energy exporter to a net importer of energy (see figure right). This is already having a marked effect on the price of gas, which is the dominant heating fuel and becoming the dominant energy source *per se*[65], and which has been relatively low cost over recent years. Within the heating fuels sector, woodfuel is already competitive in pure energy cost terms and particularly so against the major sources of heating in off-gas areas (most importantly oil). At the time of

Source: UK Energy Sector Indicators 2005 (note: short-term dip in exports in late 1980's due to Piper Alpha accident).

[65] See, for example, *Gas supplies to the UK – a review of the future*; Institute of Physics 2004

writing, the cost differential between woodfuel and gas is still limited, but this seems certain to change in the medium-term, making woodfuel a competitive source of energy across the whole of the heating fuels market.

5 Specific Opportunities for Wood Heating in the East of England

5.1 Introduction

It is essential that promotion and marketing of wood fuelled heating be carefully targeted if successful market penetration is to be achieved. Although there are wider market barriers that have been reviewed elsewhere (see Footnote 3), there are currently two primary constraints on the uptake of wood fuelled heating:

1. The widespread availability, ease of use and, even now, relatively low cost of natural gas; and
2. Physical site constraints on providing a location for the boiler plant and, even more so, on providing for effective woodfuel delivery and storage, which is particularly acute in most urban contexts.

In future both may be partially or even substantially overcome by a combination of factors:

1. rising fossil fuel prices (see above);
2. the development of pelletised woodfuel (for ease of handling and reduced storage); and
3. new and extended community heating networks[66].

All of these factors are touched on elsewhere in this report, with 2 and 3 being specifically identified as important opportunities for development of the sector. However, in the immediate future, the market segments in which wood heating is most competitive and most appropriate are generally energy users in rural or rural fringe areas using heating oil or other relatively more costly fuels. While this represents a limited part of the overall market, it is nevertheless an enormous opportunity. For example, although now somewhat dated, market research commissioned by ETSU in the early 1990's[67] estimated that, in addition to 7.6 million rural dwellings and 240,000 major farm holdings, there were 564,000 rural business and service premises across the UK.

[66] The UK already has significant numbers of community heating networks, mainly in urban areas, and, although the number of households connected to such systems is still relatively limited, the Community Energy Programme in particular is aimed at increasing these numbers and is predicated on the use of either gas CHP or renewable fuels (ie. particularly biomass / woodfuel).

[67] *The Market from Wood Chips from Coppicing: A Report*, FDS Market Research Group Ltd, for ETSU (unpublished), December 1993.

5.2 The scale of the opportunity

Highly refined data relating to the segmentation of the heating fuels market is not available. However, using a combination of newly available regional gas use statistics and Census data[68] some useful extrapolations can be made. A summary of key data is presented in the tables set out below:

Table 3: Assessment of woodfuel equivalent energy use by non-gas domestic consumers in the East of England

Number of households in the region	2,232,000	
Households without central heating	114,000	
Number of domestic gas consumers	1,776,000	
Implied number of households using other fuels (inc. electricity)	342,000	
Percentage of total	15	%
Percentage of those with central heating	16	%
Average gas consumption per household	20,500	kWh
Implied total consumption of households using other fuels (inc electricity)	7,000,000	MWh
Equivalent heat consumption @ 75% efficiency	5,250,000	MWh
Woodfuel equivalent (@ 30% mc) Equivalent woodfuel value (@ £55/tonne)	1,800,000 £99,000,000	tonnes

Table 4: Assessment of woodfuel equivalent energy use by non-gas commercial/ industrial energy users in the East of England

Number of commercial and industrial gas users	35,500	
Implied number of businesses using other fuels (inc. electricity) derived from proportion of households	6,500	
Average gas consumption per commercial and industrial user	683,000	kWh
Implied total consumption on businesses using other fuels (inc. electricity)	4,400,000	MWh
Equivalent heat consumption @ 75% efficiency	3,300,000	MWh
Woodfuel equivalent (@ 30% mc) Equivalent woodfuel value (@ £55 / tonne)	1,100,000 £60,500,000	tonnes

Commentary

It is important to note that by drawing on different sources of data, as these tables do, a degree of error in the figures presented is inevitable. Thus, they must be regarded as providing an overview only and are in no way intended to be definitive in their own right. In particular the extrapolated figures for use of 'non-gas' energy include a number of potential sources of error and should be taken as an indication of order of magnitude only.

As a specific caveat, it is noted that in attempting to reconcile them with figures derived from DUKES (Section 4.1), it seems certain that they underestimate the use of 'other fuels', which DUKES would suggest account for nearer 25% of the UK heating market. It is likely that this derives from the Industrial/Commercial sector and therefore Table 4 may not adequately allow

[68] UK Census 2001 (see www.statistics.gov.uk/census2001); *Regional and local gas consumption statistics for 2003,* DTI quarterly *Energy Trends* report, report for December 2004 (see www.dti.gov.uk/energy/inform/energy_trends/index).

for the greater fuels diversity of this sector[69]. Table 3 however is believed to provide a reasonable approximation.

The main implication of this is simply that the non-gas heating market is larger than the figures presented imply, and the immediate opportunity for wood heating is therefore larger. Indeed, notwithstanding the caveats that apply to the precise numbers, the implications of the figures can be set out in bold terms. Specifically, they reinforce the fact that the potential market for wood heating is huge even if focused solely on that sector of the market that uses fuels other than mains gas (suggested as being somewhere between 15 and 25% of the total):

- ~341,777 domestic consumers
- >6,415 commercial consumers
- >2.9 million tonnes of woodfuel equivalent energy use (>4 million tonnes fresh-felled)
- >£160 million equivalent woodfuel value (@ £55/t)

By way of a comparison, the following figures are derived from the executive summary of *The Wood Bank*, the review of the current value of forestry in the Region that informs the Regional Forestry Strategy[70].

- Direct value of forestry: £191 million/annum (including value of non-timber elements such as tourism & game).
- Combined harvestable softwood and hardwood: 470,000 cu m, approximately 420,000 tonnes.

This does not require elaborate analysis since in essence it implies that the potential market size is not limiting, although it does indicate that in a highly evolved market the current forestry resource could become so (confirming the potential longer-term role of energy crops). However, such is the scale of the potential that one message that strongly emerges is the need to clearly focus effort if it is not simply to be dissipated.

Specifically, if the absolute size of the market is not limiting, it becomes particularly important to identify those market segments that offer the potential for substantive early uptake and to direct effort to establishing wood heating in those segments in order that its visibility and profile are raised. In time, market development will naturally broaden but the first priority must

[69] It should also be noted that the number of commercial and industrial energy users captured by the DTI gas use figures at c. 35,000 (implying c. 47,000 total if gas provides for 75% of all users) also falls far short of the total number of businesses in the region, which number c. 150,000. However, only c. 30% of these are companies and fewer than 1% employ more than 250 employees in the Region. Thus, most are not substantive energy users and many may operate from domestic or semi-domestic premises. Thus, it may be assumed that the figures presented above relate only to those organisations that operate premises or processes that are substantive energy users, although it must also be acknowledged that these include public sector organisations as well as companies and that some users may operate over more than one site.

[70] The Wood Bank, Executive Summary Jan 2003, www.woodlandforlife.net

be to achieve an immediate degree of market penetration so that wood heating establishes itself as a viable and well-understood option in the marketplace.

If such efforts are appropriately directed and are concerted, it is possible to have a genuinely substantive impact over the medium-term. In illustrating this, the example of Upper Austria provides an interesting comparator:

Inset 4: Wood heating in Upper Austria

Although the context is in many ways quite different, and it is important not to make over-simplistic assumptions about the degree to which experience may be replicated in the East of England, the development of wood heating in Upper Austria over the past 10+ years certainly offers a striking view of what can be achieved.

Here, a clearly defined strategy for RE development in which wood heating forms a key element has been pursued via an effectively co-ordinated and properly resourced development programme since 1994. The initial target for RE uptake was 25% and by 2002 the actual figure had reached 30%, with biomass providing 14%:

Population:	1,380,000	(E England = 5,420,000)
Area:	11,980 km2	
Forest cover:	41%	(commercial forestry (all Austria) = 86% of total)
	491,180 ha	(E England = 139,112ha = 7.3%)
Modern wood heating systems	15,100	(852MW)
Biomass district heating plants	200	
Wood pellet installations	4,500	
Large pellet producing companies	12	
Companies producing biomass boilers and stoves	15	

Clearly, one difference between Upper Austria and the East of England is the forested area – the former has approximately 3.5 times the area of forestry and a substantially greater forested area *per capita*. However, while important and while it may be that the level of success in Upper Austria cannot be equalled in the East of England, the difference in forest cover is not necessarily *the* fundamental determinant. In this regard it is telling that a wide range of other RE technologies have also been successfully deployed in Upper Austria, including:

- 650,000m^2 of solar collectors (470m2 / 1000 inhabitants; UK <1)
- 600pv plants (2,600kWp)
- >500 small hydro plants
- 17 wind plants (14.4MW)
- >30 biogas plants
- >30 sewage gas plants

These imply that the success in developing wood heating is by no means simply accounted for by the extent of forestry in the region. Other factors are also important, and in particular it must be acknowledged that natural gas is not generally available in Upper Austria, where oil is the main conventional heating fuel. However, overall a key conclusion that emerges from a review of the experience in Upper Austria is the extent to which comprehensive and concerted actions, including a whole range of measures from fiscal intervention to promotion and facilitation, can be effective in stimulating market development.

5.3 Target markets for wood heating: the Opportunities Matrix

Section 5.2 indicated the scale of the market potential for wood heating and reviewed the overall market opportunity. This is elaborated below to provide a review of some of the specific opportunities for the uptake of wood heating in order to provide the basis for focused marketing and promotion.

In *Woodfuel in the East of England*, a number of types of sites/end-uses, all of which are to be found within the region, were identified as offering good potential for uptake based on a number of factors (energy use and costs, other drivers such as Local Agenda 21 and access to woodfuel). These included sites such as process heat users, hospitals and nursing/care homes, rural estates and farms. While this assessment essentially stands, it is refined here by using the concept of an *Opportunities Matrix* to provide a more clearly defined sectoral analysis. Specifically, the market is segmented both by technology and according to end-use, and a review of each is used to provide a two-dimensional summary that highlights the key opportunities.

Classification of end-uses

The breakdown of end-user types is one devised by the author as being appropriate to the context. It is in part derived from the *United Kingdom Standard Industrial Classification of Economic Activities* (UKSIC 92)[71] but is modified to be of more utility in the present context (including the addition of Domestic users). The sectors used are essentially self-explanatory and are set out below:

[71] See www.statistics.gov.uk/methods_quality/sic/contents.asp.

Domestic
private householders - urban
private householders - rural
social housing
housing 'developers' - private sector & social housing providers
Commercial & industrial
public sector - LA's, e.g. schools, offices, leisure facilities
public sector - other, e.g. health / further education / prisons / military
private sector - farms / estates
private sector - horticulture
private sector - offices / light industrial / retail
private sector - mining & quarrying
private sector - utilities
private sector - industrial
private sector - manufacturing (inc food processing)
private sector - other 'poor' load e.g. construction, transport, storage etc
private sector - other 'good' load, e.g. hotels, care homes, residential schools etc.

Classification of technology type / size

The technology used for providing wood heating may be broken down into a number of generic types according to fuel source, which has an immediate bearing on their application. In addition, the question of scale must also be considered in order properly to understand market segmentation. Thus, both elements have informed the technology classification used herein:

1. Log boilers.
2. Pellet central heating boilers (generally for single buildings but with some potential to serve micro-nets[72]).

[72] A common model for the adoption of wood heating elsewhere in Europe is the connection of multiple buildings to a single centralised boiler installation on both a small-scale (often referred to as *micro-nets*) and a larger scale (generally referred to as *District Heating* or, more commonly now, as *Community Heating)*. In the context of a micro-net, the buildings may or may not be within a single ownership. In a micro-net, the central installation may contain more than one boiler (for example a wood boiler alongside

3. Small-medium sized wood-chip boilers, ≤500kW: generally for single buildings/users or micro-nets or small-scale community heating.
4. Medium-large sized wood-chip boilers, 500-5,000kW: providing for a variety of applications, including community heating.
5. Large-scale wood-chip boilers, >5,000kW: generally for large process applications or, potentially, large-district heating. Most viable CHP applications would fall within this category (see also below).

A qualitative review of the key features, constraints and opportunities of each is provided in the review below.

Notes:

- *While CHP is not specifically considered in this report, in theory CHP technologies could conceivably be applied in most contexts otherwise described under Wood-chip boilers. In practice, the most likely application, if there is one, is in the large-scale end-uses, no. 5 above (which is noted in the relevant section).*
- *Conventional log-burning stoves and pellet-fired room heaters are also excluded from this review, although their role in providing supplementary heating as well as an amenity benefit for many households is recognised.*

5.3.1 Log boilers

In common with other wood-fired boilers, current state-of-the art appliances offer a high degree of refinement and efficiency, with less refined but lower cost appliances also available. The 'best' of the currently available log boilers, often referred to as *gasifying boilers*, have a large *log chamber* and closely controlled combustion (generally making use of a lambda sensor to monitor flue gas oxygen levels and thereby optimise the supply of combustion air). Overall, they offer:

- very high efficiency (>90%);
- clean operation (cleaner emissions than an oil boiler);
- minimal and easy maintenance; and
- long burn-periods (up to 20 hours on a single charge of fuel).

a conventional boiler); in the context of community heating or district heating the *energy centre* would certainly contain multiple boilers, and even multiple wood boilers.

Combined with a thermal store known as an *accumulator tank* or *buffer vessel*, well specified systems need lighting just once per day in typical winter weather and are now able to offer a very high level of utility to users. Their high efficiency also means that the total amount of fuel burnt to heat a whole house might be little more than consumed in a large log-burning stove. A household using the East of England average of 20,500kWh per year of gas might use as little as five tonnes of logs per annum.

As an alternative to the full log boiler installation, log-stoves that are specifically optimised as a central heating boiler rather than a room heater are also now available[73]. Although largely intended to be installed alongside a conventional boiler, these perhaps open up the option of affordable wood heating to more households than any of the other technologies. Used for just three hours per day during the heating season, such a stove might replace 30-40% of conventional fuel use in a typical household.

Above: cutaway section through a modern log boiler showing large log chamber.

Below: a contemporary central heating stove fired with logs.

In common with other wood boiler options, space constraints, perceived lack of convenience and capital cost will certainly set a limit on uptake. However, experience elsewhere in Europe shows that logs are still the most commonly used form of woodfuel, and the fuel supply chain is relatively straightforward. Thus, log boilers and central heating stoves are sold in large numbers in Europe (they are the most numerous type of wood boiler installation) and they must be acknowledged as one of the key opportunities for integrating wood heating into individual domestic premises in the Region[74]. Where cost in particular can be addressed, for example via grant schemes but also through other means such as training of local installers to reduce final installed costs, this can represent a good opportunity in otherwise appropriate circumstances, i.e. where space is available and the user is prepared both to source the logs required and to operate the boiler.

[73] More so than traditional stoves with 'back-boilers', which still produce substantially more heat to the room than to hot water.

[74] Although it would be more usual to use a wood-chip or pellet system, it is also possible to use a larger log boiler to heat small micro-nets connecting several properties, such as a terrace of 3 or 4 cottages, and this kind of application should certainly not be ruled out.

Key benefits:

- Low capital cost relative to other wood boiler options: although not 'cheap' (see below), log boilers are inevitably lower cost than chip or pellet systems as they are much simpler.

Above: bundles of 'split log' firewood stacked and seasoning under cover in the yard of a large-scale forestry contractor in Switzerland Here, firewood is a serious enterprise for forestry contractors.

- Relatively straightforward fuel supply chain: logs are already known and understood in the UK and are straightforward to produce, store and handle. While not regarded as a fundamental barrier (and therefore not listed as a constraint below), it is important to recognise that the current market for logs, which is generally based on *ad hoc* purchases for use in small quantities on open fires or in small stoves, is often characterised by questionable quality and high prices. While achievable, a shift in attitude towards logs as a *bona fide* commodity alongside other fuels is required if they are to be produced for sale to third parties as a heating fuel.
- Low cost fuel: related to the above, logs *should* be a relatively low cost fuel when considered in the context of small-roundwood prices and given the relatively simple supply chain steps required to process and deliver *locally*. However, as noted, a shift in attitude such that logs come to be regarded as a commodity and are produced as such, i.e. efficiently and professionally, is required to ensure they represent a cost-effective fuel option. It is of course recognised that in many instances they will be produced on a farm or estate for use on-site, where they are often regarded as 'free'.

Key constraints:

- Requirement for daily attendance: although a well-specified log boiler should require filling and lighting just once per day during normal winter heating conditions, even this is sufficient to deter many users and it will always remain a constraint on uptake. The smaller 'stove boilers' require yet more regular attendance and substantially rely on users who desire the 'amenity' benefit of having such an appliance - running it, for example, in the evenings when they are willing or able to attend it (although this is a significant market and should not be underestimated).
- Space for 'full' log boilers: the full-scale log boilers have a significant space requirement (at least 2 x 3m including space for a buffer tank) and can only be accommodated in a large utility room or outbuilding; they cannot be accommodated in a living space. Outside space is also required for log storage.

- Capital cost relative to conventional boilers: although the lowest cost wood boiler option, log boiler installations are still expensive compared to conventional boilers. While they may be cost-effective in many instances due to their relatively low running costs, this high capital cost will deter some users *per se*, while for others it may or may not deter them but it can be a more fundamental barrier if they do not have access to sufficient capital.

Review by market segment: Log boilers

Sector	Applicability
Domestic	
Private householders	Potentially good application for stove boilers in rural areas, and even some application in urban areas alongside conventional boilers; some application for full log boilers in rural properties although cost, space constraints and attendance requirements will limit uptake other than where fuel is available on-site (see also Farms & Estates, below).
Social housing	Limited application, stove boilers only if any.
Housing 'developers' - private sector & social housing providers	Limited application, stove boilers only if any.
Commercial & industrial	
Public sector - LA's, e.g. schools, offices, leisure facilities	Very limited application, although can conceivably be considered for very small loads such as small rural primary schools and village halls if attendance requirements can be provided for[75].
Public sector - other, e.g. health / further education / prisons / military	Not suitable.
Private sector - farms / estates	Good opportunity offering potential for significant uptake.
Private sector - horticulture	Not suitable.
Private sector - offices / light industrial / retail	Not suitable.
Private sector - mining & quarrying	Not suitable.
Private sector - utilities	Not suitable.
Private sector - industrial	Not suitable.
Private sector - manufacturing (inc food processing)	Not suitable.
Private sector - other 'poor' load e.g. construction, transport, storage etc	Not suitable.
Private sector - other 'good' load, e.g. Hotels, care homes, residential schools etc	Limited application due to lack of automation although may occasionally be an option for relatively small loads, e.g. small rural hotels

[75] The author is aware that a log boiler is currently planned for a small primary school in a village in rural Cumbria where attendance of the boiler and fuel supply would be provided by a neighbouring farm.

5.3.2 Pellet central heating boilers

The level of refinement of the latest generation of pellet boilers means that they can now provide a degree of utility or 'user-friendliness' almost akin to a conventional oil or LPG boiler. Typical features include:

- Sophisticated combustion controls to give high efficiency (>90%) and very clean emissions.
- Automatic ignition so that they respond to the heating demand without user intervention.
- Modulating controls to allow them to follow the heat demand of the building and maintain maximum year-round efficiency.
- Automatic cleaning and de-ashing to give minimal maintenance requirements (emptying of the ashbin fortnightly or even monthly and an annual service).
- A 'menu' of fuel delivery, storage and handling options to suit a wide variety of circumstances.

Thus, they are a key technology for achieving market penetration where log or wood-chip systems are either inappropriate or unfeasible, and experience in Austria testifies to the fact that once a supply infrastructure is in place very rapid market growth can occur (see Inset 4, above)[76]. Indeed, the smallest appliances are room-standing stoves designed as fully capable central heating boilers (with up to 85% of the heat produced going into the hot water). These appliances could be installed in many houses where the larger dedicated boilers are not an option, opening up a large part of the residential market to penetration by this technology (including social housing).

As well as individual domestic premises, pellet boilers can be used in micro-nets and for smaller 'commercial' heat loads, such as small schools or hotels, where their convenience in particular can be attractive and where they may overcome issues such as lack of space or access.

[76] In Upper Austria 4 years ago 30% of newbuild houses had oil boilers and 5% had pellet boilers; last year these figures had reversed so that 30% of new houses had pellet boilers and 6% oil boilers (personal communication Gerhard Selinger, Rika Metallwarenges.m.b.H, Austria).

Key benefits:

The main benefits of pellet boilers derive from the properties of the fuel:

- Flexibility of fuel delivery and storage arrangements (very often, deliveries are made using a vehicle akin to an oil tanker and pellets blown into store).
- Much smaller fuel storage requirements (if sufficient space is available for pellet storage, it is quite possible that one or two deliveries are all that is required to provide fuel throughout a year).
- High degree of utility of appliances and high degree of reliability due to uniformity of fuel.

There is some capital cost saving compared to wood-chip plant due to lighter construction.

Key constraints:

- Currently immature fuel supply chains: although wood pellets are now becoming available in the Region for the first time, availability remains limited and somewhat *ad hoc* and in particular the local distribution infrastructure that is required for large-scale uptake is still missing. The main result of this is that consumer confidence is limited and prices are higher than they would be in a mature market (see also below). It should be noted that, although currently a constraint, this situation can change very quickly, and certainly if a pellet mill were to be constructed in mainland UK it would stimulate significant market acceleration.

  Note: it is only the lack of effective supply infrastructure that prevents a higher priority being given to pellet applications in the table over.

- Site constraints: although more compact than wood-chip boiler installations, space, both for the boiler itself and for fuel storage, is still a limiting factor in locating a pellet boiler in many premises (although the stove boilers can overcome this in appropriate circumstances).
- Capital cost: the cost of pellet boiler plant is substantially higher than that of conventional boilers, particularly domestic boilers, and the more limited fuel cost savings that accrue from using pellets (below) result in longer 'paybacks' than for other fuels.

A contemporary central heating stove fired with pellets.

- Fuel cost: the cost of pellets is significantly higher than that of logs or wood-chips. This is exacerbated in the short-term by immature supply chains, but even in the longer term the savings compared to fossil fuels will always be less compared to log or chip boilers and 'paybacks' relatively longer.

Table 5: Review by market segment for pellet boilers

Sector	Applicability
Domestic	
Private householders	Acknowledging constraints identified above, potentially key technology for achieving market penetration in the domestic sector in rural / off-gas areas.
Social housing	Similarly important option for achieving market penetration of social housing in rural areas; providers have potential role to play in developing local distribution infrastructure for their tenants.
Housing 'developers' - private sector & social housing providers	As above, important technology for residential developments, although wood-chip fired community heating is obvious option in many circumstances.
Commercial & industrial	
Public sector - LA's, e.g. schools, offices, leisure facilities	Good opportunity to meet requirements of premises that are unsuited to wood-chip boilers, for example due to space constraints.
Public sector - other, e.g. health / further education / prisons / military	Limited opportunities particularly as heat loads are generally relatively larger than above.
Private sector - farms / estates	Opportunity in line with that for private householders, above, but not relevant for on-site fuel production, which is prime driver in separating out this sector.
Private sector – horticulture	Limited opportunities.
Private sector - offices / light industrial / retail	Limited opportunities.
Private sector - mining & quarrying	Not suitable.
Private sector – utilities	Not suitable.
Private sector – industrial	Not generally suitable.
Private sector - manufacturing (inc food processing)	Not generally suitable.
Private sector - other 'poor' load e.g. construction, transport, storage etc	Not suitable.
Private sector - other 'good' load, e.g. Hotels, care homes, residential schools etc	May be good option where wood-chip not feasible/appropriate.

5.3.3 Wood-chip boilers

Driven by growing and dynamic markets such as Austria, wood-chip boilers have undergone a step change in quality, utility and efficiency over the last ten years. Small to medium sized boilers (up to 500kW) in particular now offer a range of features and a degree of sophistication that allows for essentially unattended operation and open the way for use in a wide variety of contexts. Plant is also available to suit every use or application, from Low Pressure Hot Water (LPHW) for central heating, to steam or thermal oil boilers for process applications and even CHP. With the use of absorption chillers it is also possible to provide cooling from wood boiler plant, and by linking multiple premises together via heat mains, 'micro nets' or 'community heating' networks can bring wood heating to third party users and to whole communities.

Table 6: Leading features of contemporary wood boilers

Feature	≤500kW	>500kW
Efficiency & emissions	Sophisticated combustion controls, generally using lambda sensors, give very high efficiency (>90%) and clean emissions.	Also have sophisticated combustion controls; marginally lower efficiencies in some instances, e.g. due to difficulty / cost of achieving same level of insulation in large plant, wetter fuel and larger fuel inventories.
Modulation	Yes, typically 30-100% MCR.	Yes, typically 30-100% MCR.
Self-cleaning (heat exchanger tubes)	Generally available on state-of-the-art boilers (standard on best plant), although not standard or even available on less sophisticated plant, particularly ≤100kW.	Generally available but often an option as more likely to be located in attended plant rooms / boilerhouses where same level of automation is less essential.
Auto de-ashing	Generally available on all boilers and standard on best plant.	Available and generally provided on all boilers; required on large (multi MW) plant due to volume of ash produced.
Fuel tolerance	Generally small ≤100kW) boilers require relatively high quality fuel, typically Onörm standard W30:G30. More tolerant boilers (W50:G50) available at larger sizes but not universal.	Although has cost implications, can generally be specified according to fuel quality available, including very wet fuels and coarse/shredded fuels if required. May still be issues with burning >60% mc (W60) fuels on all but very large boilers.
Auto ignition	Generally available on state-of-the-art boilers (standard on best plant), although not standard or even available on less sophisticated plant, particularly <100kW.	Available on some plant up to about 1MW but relatively uncommon and does not generally allow for unattended lighting.
Other	Weather compensating heating system controls available on best plant; also remote monitoring and control.	Wider variety of fuel handling/ receptions options generally 'affordable'; steam plant also available, although significantly more expensive than LPHW.

Key benefits:

- Utility: the level of sophistication and automation of the best of the latest generation of wood boilers at every scale offers users a very high degree of utility and makes wood boilers a *bona fide* boiler plant option where other constraints can be overcome.
- Low cost fuel: appropriately produced/sourced and given appropriate delivery/reception arrangements, wood-chips can be a very competitive source of energy and warrant the relatively high level of investment entailed (see Table 2 above).

Key constraints

- Site constraints: the need to accommodate large plant and appropriate woodfuel reception and storage facilities is a primary constraint on many sites and also impacts on the overall cost of an installation.
- Immature fuel supply chains: although roundwood from forestry and sawmill co-product are produced and traded in large quantities in the UK, quality controlled woodfuel is not produced in significant quantities. The lack of established supply chains is currently a significant hand-break on faster development (although it is not regarded as a longer-term bar to widespread uptake). The more demanding requirements of small (≤100kW) boilers make this issue particularly acute at the smaller scale.
- Capital cost: although cost-effective in many circumstances, and there is a strong cost-decay with size, the initial cost of wood-chip boiler plant is substantially higher than that of conventional boilers, particularly when all of the associated costs, such as civils and building works, are taken into account. Community heating installations in particular have to bear very substantial additional infrastructure costs.

Table 7: Review by market segment for small-medium wood-chip boilers (≤500kW)

Sector	Applicability
Domestic	
Private householders	Limited application in individual domestic premises due to cost & site constraints.
Social housing	Limited application in individual domestic premises due to cost & site constraints HOWEVER can be opportunities to retrofit micro-nets or community heating rural areas *or* to retrofit wood boilers to existing community heating installations in urban areas (though later not common in E. of England).
Housing 'developers' - private sector & social housing providers	Limited application in individual domestic premises due to cost & site constraints; HOWEVER good opportunity for micro-nets or community heating in newbuild developments, particularly if appropriate planning tools are put in place. Potentially key opportunity given growth targets in E. of England.
Commercial & industrial	
Public sector - LA's, e.g. schools, offices, leisure facilities	Key opportunity to pioneer and roll-out the technology due to more immediate impact of policies on Climate Change etc on public sector.
Public sector - other, e.g. health / further education/ prisons/ military	Key opportunity to pioneer and roll-out the technology due to more immediate impact of policies on Climate Change etc on public sector and also due to high load factors on many such sites.
Private sector - farms / estates	Key opportunity due to tie-up between high energy costs (oil, lpg) in rural areas and ability to produce own woodfuel and add value to forestry products.
Private sector - horticulture	Good opportunity in this sector but often/generally larger plant.
Private sector - offices / light industrial / retail	Can be opportunities in newbuild in particular but limited imperative at present.
Private sector - mining & quarrying	Not suitable.
Private sector - utilities	Not suitable.
Private sector - industrial	Can be opportunities in this sector but for larger plant.
Private sector - manufacturing (inc food processing)	Can be opportunities in this sector but for larger plant.
Private sector - other 'poor' load e.g. construction, transport, storage etc	Not suitable.
Private sector - other 'good' load, e.g. hotels, care homes, residential schools etc	Key opportunity to pioneer and roll-out the technology, particularly in rural / off-gas areas due to high load factors.

Table 8: Review by market segment for medium-large wood-chip boilers (500 – 5,000 kW)

Sector	Applicability
Domestic	
Private householders	Not suitable.
Social housing	Can be good opportunities to retrofit community heating *or* to retrofit wood boilers to existing community heating installations in urban areas (though later not common in E. of England); generally towards the lower end of this size range.
Housing 'developers' - private sector & social housing providers	Potentially key opportunity for community heating in newbuild developments, particularly if appropriate planning tools are put in place.
Commercial & industrial	
Public sector - LA's, e.g. schools, offices, leisure facilities	Key opportunity to pioneer and roll-out the technology due to more immediate impact of policies on Climate Change etc on public sector; generally towards lower part of size range.
Public sector - other, e.g. Health, further education, prisons & military	Key opportunity to pioneer and roll-out the technology due to more immediate impact of policies on Climate Change etc on public sector and also due to high load factors on many such sites.
Private sector - farms / estates	Key opportunity but generally smaller plant.
Private sector - horticulture	Good opportunity in this sector due to large loads, particularly where off-gas.
Private sector - offices / light industrial / retail	Can be opportunities in newbuild in particular but limited imperative at present.
Private sector - mining & quarrying	Not suitable.
Private sector - utilities	Not suitable.
Private sector - industrial	Can be good opportunities in this sector but limited imperatives at present.
Private sector – manufacturing (inc food processing)	Can be good opportunities in this sector but limited imperatives at present.
Private sector - other 'poor' load e.g. construction, transport, storage etc	Not suitable.
Private sector - other 'good' load, e.g. Hotels, care homes, residential schools etc	Key opportunity to pioneer and roll-out the technology due to high load factors, although generally towards the lower end of this size range or smaller.

Table 9: Review by market segment for large wood-chip boilers (>5000kW)

Sector	Applicability
Domestic	
Private householders	Not suitable.
Social housing	Not suitable – heat loads too small other than in exceptional circumstances.
Housing 'developers' - private sector & social housing providers	Potentially key opportunity for community heating in newbuild developments, particularly if appropriate planning tools are put in place. Size of some proposed developments could require plant in this size range, although opportunities will be limited in no. Possibly one of few opportunities (if there are any) for CHP.
Commercial & industrial	
Public sector - LA's, e.g. schools, offices, leisure facilities	Not suitable – heat loads too small.
Public sector - other, e.g. health / further education / prisons / military	Not generally suitable – heat loads too small other than in exceptional circumstances (e.g. very large hospital or prison)
Private sector - farms / estates	Not suitable.
Private sector – horticulture	Not generally suitable – heat loads too small and too 'peaky' other than on exceptionally large sites.
Private sector - offices / light industrial / retail	Not suitable – heat loads generally too small other than exceptionally large developments and limited imperative at present.
Private sector - mining & quarrying	Not suitable.
Private sector – utilities	Not suitable.
Private sector – industrial	Can be opportunities in this sector for large process applications, although limited opportunities in the East of England.
Private sector - manufacturing (inc. food processing)	Can be opportunities in this sector but limited imperatives at present.
Private sector - other 'poor' load e.g. construction, transport, storage etc	Not suitable.
Private sector - other 'good' load, e.g. Hotels, care homes, residential schools etc	Not suitable.

5.3.4 Opportunities Matrix

Based on the sectoral reviews provided on the pages above, an overall *Opportunities Matrix* has been synthesised and is set out below:

Table 10: Opportunities matrix

Sector	Log boilers	Pellet boilers (inc small networks)	Small-medium wood-chip boilers (≤500kW)	Medium-large wood-chip boilers (500kW- 5,000 kW)	Large wood-chip boilers (>5,000 kW) inc. CHP
Domestic					
private householders					
social housing					
housing 'developers' - private sector & social					
Commercial & industrial					
public sector - LA's, e.g. schools, offices					
public sector - other, e.g. health / further					
private sector -farms / estates					
private sector - horticulture					
private sector - offices / light industrial / retail					
private sector - mining & quarrying					
private sector - utilities					
private sector industrial					
private sector - manufacturing (inc food processing)					
private sector - other 'poor' load e.g. construction, transport, storage					
private sector - other 'good' load, e.g. hotels, care homes, residential schools					

Good market opportunity - highest priority

A level of market penetration possible but either cost or other market barriers will limit impact or niche opportunity

Unlikely to achieve significant market penetration due to technical issues, costs or other barriers

6 Conclusions

The next five years to 2010 will be critical in establishing wood heating as a *bona fide* element of the heating market and a number of key "headline" issues are summarised below:

The market

1. The scale of market opportunity is huge and, notwithstanding a number of genuine market-barriers, is not limiting *per se.*

2. In pure market terms, the sector that is most immediately open to penetration by wood heating is the 'non-gas' fuels sector (oil, LPG etc.), primarily in rural or rural fringe areas, where wood is already becoming an increasingly competitive fuel. This should certainly inform marketing and promotion towards sectors such as farms/estates, and 'high load' properties such as rural hotels that are highlighted in the Matrix (Table 10). However, while offering an immediate and ready target for uptake, the opportunity is by no means limited to this sector. For example, high load factor sites using gas might also be targeted.

3. The public sector is also a key market, including not just local authorities but also health, education, prisons and the military, many of which offer high load factor opportunities, and indeed the Forestry Commission as the fuel resource is readily available and they could provide a good exemplar. Within the public sector, the major investment in public sector buildings that will be made via the PFI over the coming decade should certainly be addressed in formulating future actions if this is not to be a wasted opportunity.

4. From a strategic perspective, the role of both small-scale micro-nets and larger-scale community heating in bringing wood heating to both third party heat users and large numbers of users must be acknowledged and addressed. Although limited in the East of England, there are some opportunities for retro-fit installation and refurbishment of existing social housing may be an important niche in this respect. However, the major opportunity lies in the development of community heating applications in a newbuild context, which in turn immediately raises the issue of developing appropriate planning tools.

5. Although undoubtedly far fewer in number, the role of large-scale commercial/industrial applications cannot be ignored, although market drivers (including wider fiscal/regulatory measures) will be more important than facilitation or other non-financial measures in this sector.

Technology

6. The role that all technologies have to play in a developed market, including log boilers at one end and large-scale wood-chip plant in large community heating or process applications at the other, should be acknowledged in framing future actions.

Fuel supply

7. Given likely and realistic growth targets, the scale of the existing forestry resource is very unlikely to prove limiting in the short-medium term (to 2010).

8. In the short-term, the lack of established wood-chip supply chains is certainly inhibiting faster uptake and there is a clear rationale for facilitating supply-chain development as a short-term action. However, in the longer-term, demand pull from a growing sector will certainly remove this barrier.

9. The role that pellets can play in opening up market opportunities otherwise unsuited to woodfuel is a very real one, but this is predicated on the development of an effective supply infrastructure. It is only the lack of such an infrastructure that prevents a higher priority being given to pellet applications in the Opportunities Matrix (Table 10). Efforts should be made to improve the supply-side for pellets. In the East of England, while pellet manufacture might be a long-term aspiration, in the short-medium term this will particularly relate to fostering effective local distribution infrastructure.

10. Although not the focus of this report, wood energy crops such as SRC or SRF do have the potential to offer a diversification opportunity for farmers and to expand the biomass resource in the longer-term. The use of clean woody wastes for energy also offers the potential for developing a low-cost fuel supply for large, cost-sensitive users and for taking significant quantities of material out of the waste stream and from landfill.

Market enablement

11. At present, the wood-heating sector is in its very earliest days and lacks a properly functioning market in the UK as a whole. In the short-term, market development, and therefore demand, is inhibited by limited market awareness so promotion and marketing are essential.

12. In this regard, the role of the public sector in both facilitating and pioneering (as a customer) market development is without doubt key and an essential priority for action.

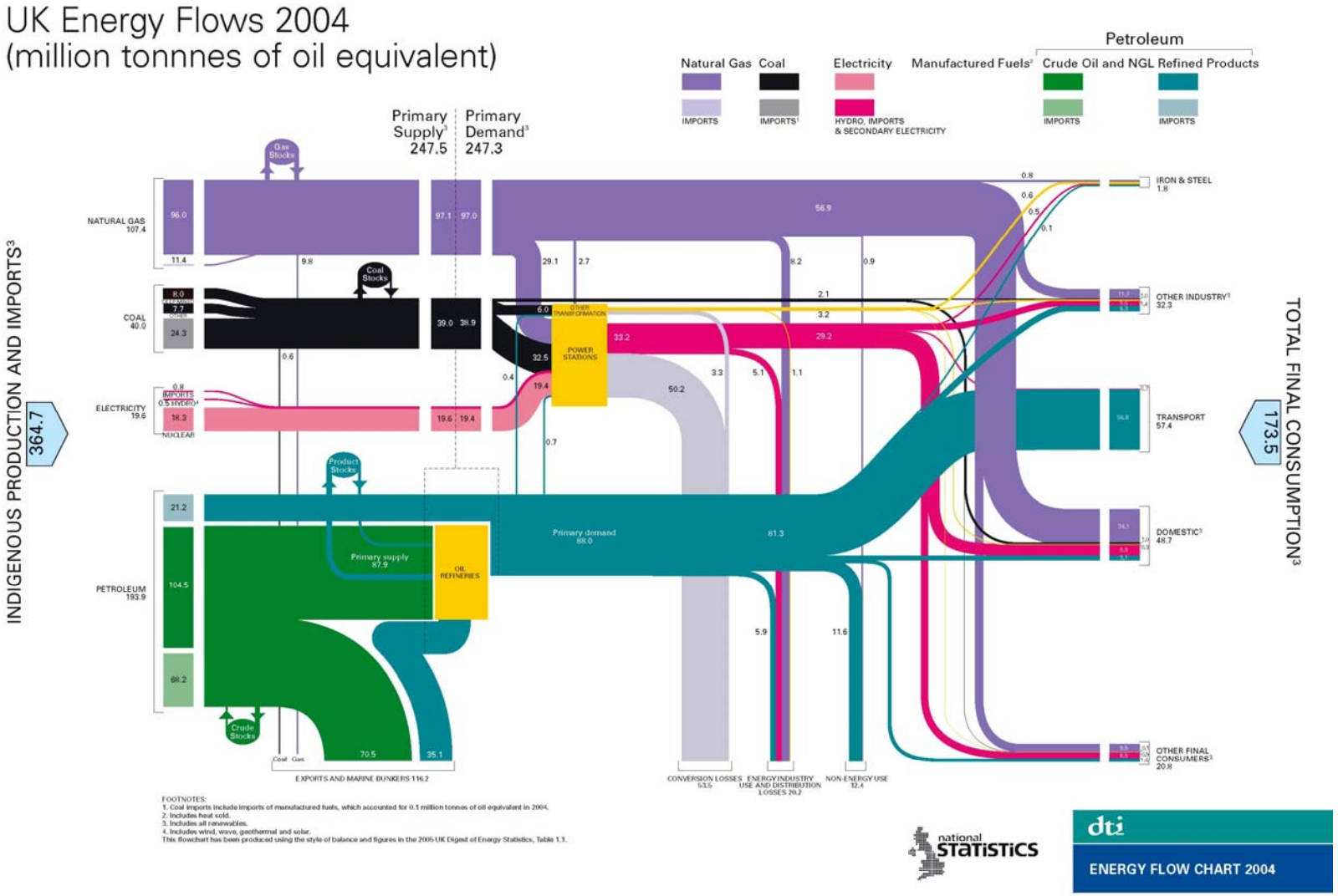
13. In order to achieve initial take-off, marketing and promotion should be focused on the most likely short-term prospects. As highlighted in the Opportunities Matrix these are small to medium-large (up to 5 MW) wood-chip boilers in the public sector, farms/estates and ‘high load’ properties such as rural hotels. At the same time, strategically important sectors such as community heating and wood pellets should also be actively promoted.

14. Finally, the role of the planning system in stimulating demand requires a proper and substantive review. In particular, the question of setting mandatory planning requirements, as for example established in the Merton Principal, is important and has the potential to act as an extremely powerful driver.

ANNEX I: Summary of Design Studies

Site	Description	Client	Wood boiler description	Size of boiler	Installed / due to be installed
Wickham Market School, Suffolk	Primary & middle school	Suffolk County Council	Automatic wood-chip in basement boiler room	150kW	Stalled due to lack of funding
Green Light Trust nr Bury St. Edmonds, Suffolk	Barn conversion to offices	Green Light Trust	Log-fired boiler	15kW	Feb 06
Bayfield Hall, nr Holt, Norfolk	Large private house with letting flats	Mr. Roger Combe	Automatic wood-chip in boiler room service courtyard	60kW	Sept 04
The Lowes, nr Holt, Norfolk	Barn conversion to high quality holiday lettings	Mr. Nicholas Detterding	Automatic wood-chip in dedicated boilerhouse with sunken fuel store	100kW	Apr 05
Sheringham Park, Norfolk	New visitor facilities in barn conversion	The National Trust	Automatic wood-chip boiler in plant room	30kW	Aug 04
Westley Bottom, nr Bury St Edmonds, Suffolk	New offices in barn conversion	The National Trust	Automatic wood-chip in plant room	60kW	Oct 04
Thames Chase Forest Centre nr Upminster, Essex	New visitor facilities and offices	Thames Chase Community Forest	Automatic wood-chip boiler in separate boilerhouse	40kW	During 2006
Polehouse Nursery, Martham, Norfolk	Large glasshouse	The Broads Authority and Mr. Peter Wenzak	Automatic wood-chip boiler in dedicated new-build boilerhouse	1500kW	During 2006
Doggetts Farm, Stradbroke, Suffolk	Refurbishment of large farmhouse	Mr. Ted Ridge	Log-fired boiler in garage	20kW	Jan 06
Cookley & Walpole Primary School	Replacement of life-expired oil boiler in primary school	Suffolk County Council	Automatic wood-chip boiler in existing boilerhouse	60kW	Aug 06

ANNEX II: UK Energy Flows 2004[77]



[77] Source http://www.dti.gov.uk/files/file11248.pdf