

Country status report United Kingdom

By: Nick Barker, AEA

Date: June 2006

Major Changes since the last update

1. POLICY

Extract from DTI web site.

“Our energy future – creating a low carbon economy” defines a long-term strategic vision for energy policy combining our environmental, security of supply, competitiveness and social goals. It builds on the Performance and Innovation Unit's Energy Review, published in February 2002, and on other reports that have looked at major areas of energy policy.

Because energy requires very long term investment we look ahead to 2050 to set the overall context. We set out the challenges we face on the environment, the decline of our indigenous energy supplies and the need to update our energy infrastructure and the policies we need to pursue over the next twenty years and beyond to meet these challenges. As we address these challenges we will have four goals for our energy policy:

- To put ourselves on the path to cut the UK's carbon dioxide emissions by some 60% by about 2050 with real progress by 2020;
- To maintain the reliability of energy supplies;
- To promote competitive markets in the UK and beyond, helping to raise the rate of sustainable economic growth and to improve our productivity, and;
- To ensure that every home is adequately and affordably heated.

The Government has set itself a target of securing 10% of electricity from eligible, renewable sources by 2010. There are four elements to the new strategy in support of renewable energy.

- The Renewables Obligations
- Climate Change Levy Exemption
- Capital Grants and Planting Grants for Energy Crops
- Research and Development Programme.

The Government increased the amount available to support industrially led research and development through the DTI to £19 million per year.”

More recently the following has been announced:

- The Renewables Obligation target has been increased to 15% by 2015.
- A major review of energy policy was launched in January 2006. A consultation has been carried out and analysis is currently being done. A statement on energy policy will be made in early summer 2006.

- The Government has published its response to the Biomass Task Force report. A further capital grant scheme worth for biomass heat and CHP is proposed. <http://www.defra.gov.uk/farm/acu/energy/biomass-taskforce/btfreport-govresponse.pdf>

2. PROGRAMS

The Renewables Obligation

1. The Renewables Obligation means that licensed electricity suppliers will have to provide a specified proportion of their sales from renewable energy in future years. In this way the Government will actively encourage the increased supply of renewables electricity while leaving the choice of technologies to the market. The Government intends that the Obligation will form the framework for the development of renewable energy in this country up until at least 2027.
2. Under the Obligations, electricity suppliers can comply by:
 - buying ROCs from an accredited renewable generator; and / or
 - buying ROCs from other suppliers / traders who have bought more than they need (through the trading of ROCs);and / or, as an alternative to supplying renewable energy, by:
 - paying the regulator the "buy-out price" of (currently) £30/MWh for each unit the supplier is under obligation.

The August 2001 consultation document

<http://www.dti.gov.uk/renewable/consultations.htm> explains how the Obligation is structured and how they will encourage compliance through ROCs rather than the buy-out.

The Renewable Obligation has a number of interesting developments relevant to gasification.

- The definition of biomass has been widened to include all material from plant and animal sources.
- Mixed wastes, containing fossil elements are only eligible if pyrolysis or gasification is used. They are not eligible if they are incinerated. Only the electricity generated from the renewable fraction can be claimed.
- Renewable fractions separated from wastes could be eligible using any technology.
- Co-firing in existing installations is eligible up to 2016 but only if the biomass comprises a certain portion of energy crops after April 2009. See <http://www.dti.gov.uk/energy/renewables/policy/index.shtml>

Climate change levy exemption

From 1st April 2001, a climate change levy has been payable on the use of energy by all non-domestic (industrial, commercial and public sector) customers throughout the UK. The rate for electricity is 0.43p/kWh. Renewable generation (excluding hydro over 10MW) is exempt from the CCL. This means that suppliers who sell eligible renewable electricity to non-domestic customers are exempt from the Climate Change Levy for that supply.

Bio-energy Capital Grants Scheme

Biomass technologies, in particular energy crops, will find it difficult to compete in the short term. Recognising this a series of capital and support grants has been put in place that could bring down the costs of generation (p/kWh) to within the expected price cap.

A further round of the Bio-energy Capital Grants Scheme, focussed on biomass heat and CHP, was launched on 12 April 2006. It will have at least £2 million available for new projects. <http://www.biglotteryfund.org.uk/programmes/renewable/index.htm>

New technologies demonstrator programme

The New Technologies Programme is part of Defra's Waste Implementation Programme (WIP) launched in May this year to deliver the work outlined in the Government's response to the Government's Strategy Unit report 'Waste Not, Want Not'. The WIP has eight work streams, five to be delivered by Defra and three by WRAP (the Waste & Resources Action Programme).

The New Technologies work covers four key areas, including the two funding programmes announced in January 2004. Allocated around £2m, the **Waste Research & Innovation Programme** will address the current lack of funding for R&D projects into new technologies to deal with BMW. On a much larger scale, the **Demonstrator Programme** will provide around. £30m to help to establish new waste treatment technologies that require pilot plants to demonstrate their viability. It is designed to reduce the perceived risk of implementing new technologies that are unproven in the UK and provide accurate technical and economic data.

Compact Power have a contract under this Programme to build a 2MWe unit. A Further unit is proposed in London using Enerkem technology.

RESEARCH AND DEVELOPMENT

Department of Trade and Industry)

The UK New and Renewable Energy Programme is a part of the Technology Programme described below.

The Technology Programme

The government's ten-year Science and Innovation Investment Framework, published in July 2004, reaffirmed the commitment to support businesses investing in new and emerging technologies;

A Technology Strategy Board, comprising mainly experienced business leaders, will identify the new and emerging technologies critical to the growth of the UK economy into which government funding and activities can be directed;

Over the period 2005-2008, £320 million is available to businesses in the form of grants to support research and development in the technology areas identified by the Technology Strategy Board;

In the Spring and Autumn each year, businesses will have the opportunity to compete for funding using two DTI business support products: Collaborative Research and Development and Knowledge Transfer Networks.

Information can be found on <http://www.dti.gov.uk/innovation/tech-priorities-uk/index.html>

Research reports and other publications are available on the web at <http://www.ecdti.co.uk/CGIBIN/priamlnk.cgi?MP=CATSER^GINT65&CNO=1&CAT='EN13'>

The Carbon Trust - Low Carbon Innovation Programme

The Carbon Trust is a body set up by DEFRA to implement carbon saving technologies. It also has R & D activities which it pursues through a series of open calls. Small scale biomass energy is seen as a priority but there is also an interest in larger scale power generation. The Carbon Trust also operates a venture capital scheme that has supported some biomass businesses. www.thecarbontrust.co.uk .

Supergen

Sustainable Power Generation and Supply (Supergen), part of the EPSRC (Engineering and Physical Sciences Research Council) Infrastructure and Environment Programme. This is a programme of basic research that involves the assembly of research consortia from a range of scientific disciplines to tackle the larger challenges of sustainable power generation and supply. Biomass, biofuels and energy crop utilisation is one of four themes for this Programme. Within this theme the potential for power generation systems utilising energy crops and agricultural crops will be examined, and the research is striving for a carbon neutral cycle. Aston University is the lead contractor for this Programme with five further Universities and research institutes and five industrial partners. The work programme comprises six work packages

- Process and techno-economic assessment
- Fuel specification and matching to conversion
- Thermal reactor modelling
- Minimisation of engineering risk
- Co-firing and co-processing biomass
- Network (British Biomass and Bio-energy Forum)

Web site <http://www.supergen-bioenergy.net>

3. R&D Institutes

Industry Research

Mitsui Babcock Technology Centre, Renfrew, Scotland

Mitsui Babcock has played a leading role in the development of environmental technologies, from emissions reduction to clean waste disposal. Their environmental reduction and control systems enable plant to operate within legislative limits – ensuring a cleaner future. The Mitsui Recycling R21 pyrolysis system provides a highly efficient solution to the disposal of municipal solid waste with low emissions, metal recovery and added power generation capability.

Siemens Industrial Turbines Ltd. Lincoln, England

An extensive test facility for gas turbines including a full size test rig for alternative fuels. The services provided by the facility also allow non-power generation work to be undertaken. Investigations of large combustion systems operating at high pressures, high temperatures and with a variety of fuels can be carried out on various rigs contained at the centre.

Powergen Technology, Ratcliffe

Extensive combustion and power generation test facility

Universities working in this area

Aston University

Cardiff University

Cranfield University

Imperial College

Leeds University

Newcastle University

Queens University Belfast

Sheffield University

University of Manchester Institute of Science and Technology

University of Ulster

4. INDUSTRIES

Biomass Engineering Ltd	Downdraft gasifiers for heating and CHP	www.biomass.uk.com
Eco-trans ltd	Indirectly heated rotary kiln gasifier	http://ecotran.co.uk/
Biomass CHP Ltd, (formerly Exus Energy Ltd)	Downdraft gasifiers for heating and CHP	http://www.biomass-chp.ltd.uk/index.htm
Compact Power Ltd	Indirectly heated gasifier for wastes	www.compactpower.co.uk
ECO2 Ltd	Biomass Power Plant developers	www.eco2.uk.com
GEM	Indirectly heated agitated vessel pyrolyser.	http://www.gem-ltd.co.uk/
ITI Energy	Fixed bed gasifier	www.iti-energy.com
JND Ltd	Indirectly heated rotary kiln gasifier for wastes	www.jnd.co.uk/efw.php
Mitsui Babcock Engineering	Engineering contractors Waste gasification	www.mitsuibabcock.com
Novera Ltd	Novera holds the exclusive licence to the Enerkem gasification technology in	http://www.noveraenergy.com/

	the UK, for MSW applications.	
Rural Generation Ltd	Downdraft gasifiers for heating and CHP	www.ruralgeneration.com
Siemens Industrial Turbines Ltd	Gas turbines	www.siemens.com
Ormrod Diesels	Remanufactured diesel and dual fuel engines for bio-energy.	http://www.ormroddiesels.com
Tenmat	Ceramic and other filters	http://www.tenmat.com
Porvair plc	Ceramic and other filters	http://www.porvair.com/
Madison Filter - Cerafil	Ceramic and other filters	http://www.madisonfilter.com
Finning UK	Suppliers of Caterpillar Engines	www.finning.co.uk
ERG (Air pollution Control) Ltd	Scrubbers and filters	http://www.ergapc.co.uk/
Fairport Engineering	Mechanical handling, SRF pellets and fluff	http://www.orchid-environmental.co.uk/

Contact details can be made available on request

5. R & D PROJECTS

Current biomass R & D projects in the DTI Programme relevant to gasification are;

Next Generation BIGCC, Siemens Industrial Turbines, Lincoln – a £6.9 million project to develop the gas turbines that will be necessary for future applications in biomass and waste gasification. After considerable disruption following the failure of the ARBRE project we are now making some progress with this project. The objectives are to develop burner technology plus a new power turbine design capable of the higher mass flows that we will have with gasification applications.

Fuel Flexibility in Downdraft Gasifiers. Biomass Engineering. Looking at a range of feedstocks with varying physical and chemical properties. This aims are to:

- Demonstrate flexibility of gasifier to handle briquetted materials [REF], chipped material [poplar] and harvested biomass [willow], chipped forestry wastes [log strippings].
- Determine optimal parameters for ceramic filter performance and longevity on producer gas from different feedstocks.
- Confirm environmental compliance by extensive monitoring programme and characterisation of the product, both in-house and by independent companies/laboratories.

Report available shortly.

<http://www.ecdti.co.uk/CGIBIN/priamlnk.cgi?MP=CATSER^GINT65&CNO=1&CAT='EN13'>

250kW downdraft gasification demonstration. Biomass Engineering Ltd. Scale up issues moving from sub 100kWe units. Now in regular operation after many delays largely due to problems connecting to the electricity network and obtaining suitable fuel supplies. '

ECN carried out tar measurements using the IEA/EC tar protocol in June 05 and found production of (problem causing) condensing tars is very low at <20mg/nm³. The very high tar destruction level also meant that the gas CV was typically 5-5.2MJ/Nm³ [LHV basis]. Particulates in the clean gas after the ceramic filter was zero. Report now available.

<http://www.ecdti.co.uk/CGIBIN/priamlnk.cgi?MP=CATSER^GINT65&CNO=1&CAT='EN13'>

All UK Research reports in the Bioenergy area can be found on the above link.

A database of wider biomass research including energy and sustainable biomass materials from all Government departments can be found on <http://aims.defra.gov.uk/>

6. IMPLEMENTATION

The projects below are a selection.

Brook Hall Estate, Londonderry. This 100 kWe downdraft gasifier has been generating electricity onto the Northern Ireland grid for the past five years and accumulated over 20,000 hours of operation. The reported load factor is approximately 0.6, which is very close to the design figure. The fuel, short rotation willow coppice, is grown on the farm.

Recently a small micro-turbine has been installed on site and trials are going on to develop this to a commercial concept. Following the failure of the Microturbine company the project is being restructured to use a different turbine and burner system in collaboration with Queens University Belfast.

Contact: Mr. Michael Doran, Rural Generation Ltd, Brook Hall Estate, 66 Culmore Road, Londonderry, Tel: +44 (0) 28 7135 8215,
<http://www.ruralgeneration.com/index.htm>

Blackwater Valley Museum, Northern Ireland.

Exus Energy Ltd, previously known as B9 Energy Biomass Ltd, was trading in Northern Ireland for approximately 8 years before getting into financial difficulties in May 2005. As a company it was at the forefront of developing biomass combined heat and power (CHP) plants. Its early development work was done at the Blackwater Valley Museum site in Benburb, Co Armagh. It was awarded a contract in 1997 to supply renewable electricity, as well as providing heat to the Museum. As a result of this work it was

awarded the contract to supply a biomass CHP plant to the prestigious BEDZED housing development in Croydon, London.

Considerable advances were made with the technology at BEDZED and over 2,000 hours operating experience was achieved on the site before the company ceased trading. The company's main technical difficulty was with the quality of the wood gas, in particular the tar content, which although satisfactory for the conventional diesel engine used at the Blackwater Valley Museum, was not clean enough for the modern gas engine used at BEDZED. In particular, turbo charging and intercooling led to significant engine reliability problems.

As a result of a Company Voluntary Arrangement reached between Exus Energy Ltd and its creditors a new company, called Biomass CHP Ltd, has been formed. Biomass CHP Ltd has acquired the Intellectual Property from Exus Energy Ltd together with the plants at the Blackwater Valley Museum and Kilwaughter Chemical Works in Larne. The company also has a licensing agreement with TSK, a major Japanese engineering company, and they have built a demonstration plant in Japan based on our technology and recently sold their first commercial plant.

Biomass CHP Ltd intends to continue with the development of the technology at its Blackwater Valley Museum plant. This plant has been fitted out with a 200kWe modern gas engine and will be used to demonstrate improved reliability by advanced gas cleaning, in particular tar removal. This programme is expected to take approximately one year to achieve

Compact Power Ltd, Avonmouth. This project has been operating commercially for over 4 years. It processes 800kg of clinical or municipal waste per hour. The waste is first pyrolysed in an externally heated tube. The char residue is steam gasified in a close coupled gasifier with the product gas mixed directly with the pyrolysis gas. The combined gas is then burned in a cyclone burner with the exhaust providing heat for the pyrolysis chamber and a steam boiler. Power is generated from the steam. The unit is a demonstration for larger capacity units in the future that will be built on a modular system with multiple pyrolysis tubes. The emissions performance is exceptionally good because of the good control of the gas combustion process and the high temperature.

The unit shows the potential of gasification in this respect bettering the current EC limits for waste incineration by a very wide margin. Dioxin levels have been measured at less than 0.003ng/nm³. The unit is fully licensed for commercial use by the UK Environment Agency and was included in their annual report as an example of excellence.

Compact Power now have a contract to build a 2MWe demonstration unit firing MSW. Earlier this year they supplied a smaller unit to the UK Royal Navy for disposal of wastes at sea.

Details of these projects can be found on <http://www.compactpower.co.uk>

Novera Energy Ltd. *Sustainable Energy Facility , East London. The facility is designed to gasify 13t/h of Solid Recovered Fuel (SRF); using the Enerkem technology developed in Canada. This will generate approximately 13MW of electricity (subject to the detailed selection of boiler and turbine). The facility will comprise a SRF material handling*

island, a single stream gasification and gas conditioning island, and a single stream power generation island consisting of boiler plant and steam turbine.

Permits have been applied for and full details can be obtained from <http://www.sustainablelondon.co.uk/index.htm>

DEMONSTRATION AND PILOT PROJECTS

To be included in the list the project has either firm grant offer, be fully permitted or have hardware on the ground.

	Owner/ Location	Type of Gasifier	Fuel	Gas Use	Plant size	Status	Support
1	Enniskillen College / Northern Ireland	Downdraft	SRC	Dual Fuel Engine	100kWe	Closed	
2	Rural Generation Ltd. Northern Ireland	Downdraft	SRC	Dual Fuel Engine	100kWe	Operating.daily on a commercial basis 20k hours	NI NFFO Reg. Dev Fund
3	<i>Biomass CHP Ltd</i> Blackwater Valley Northern Ireland	Downdraft	SRC	SI Engine	204kWe	Rebuild with new gas cleaning & SI engine	NI NFFO Reg. Dev Fund
4	<i>Biomass CHP Ltd</i> Beddington ZED, London	Downdraft	Waste wood	Spark ignition engine	120kWe	Started March 2003 5000 +Hours. Status unclear	Private. Charity
5	<i>Biomass CHP Ltd</i> Kilwaughter, Northern Ireland	Downdraft	Wood	Spark ignition engine	300kWe	Commissioning. Status unclear	Private RO Certificates
6	Biomass Engineering. Warrington, England	Downdraft/	Waste wood / various Leather and meat processing wastes	SI Engine Micro turbine Heat	80kWe	2000, Operating as test unit	UK Local Gov. and Private DTI Programme
7	Biomass Engineering Ecos Millenium centre Balymena NI	Downdraft	Coppiced Willow	SI Engine	60kWe CHP	Operating	Reg Dev fund
8	Biomass Engineering Ltd Mossborough Hall Farm	Downdraft	Willow and other woods	SI Engine	250kWe	Operating	DTI R & D
9	<i>Biomass Engineering Ltd Culceth</i>	<i>Downdraft</i>	<i>Wood</i>	<i>SI Engine</i>	<i>150kWe</i>	<i>Operating Nov 05</i>	<i>Private</i>
10	<i>Biomass Engineering Ltd Stoke</i>	<i>Downdraft Modules</i>	<i>Waste wood</i>	<i>SI Engine</i>	<i>3 MWe</i>	<i>Design and construct commission Jan 07</i>	<i>Private</i>
11	<i>Biomass Engineering Ltd Jepsons</i>	<i>Downdraft</i>	<i>Waste wood</i>	<i>SI Engine</i>	<i>80kWe</i>	<i>Operating</i>	<i>Private</i>
12	Avonmouth 1	Indirect/ Compact Power	Municipal, Industrial and clinical waste	Steam Boiler	1 MWth	Continuous commercial operation since 2001	Private
13	Avonmouth 2	<i>Indirect/ Compact Power</i>	<i>Municipal, waste</i>	<i>Boiler & steam turbine</i>	<i>2MWe</i>	<i>Detail design</i>	<i>Private</i>
14	Graveson Environmental South Wales	Indirectly heated agitated vessel	Wastes	Engine	250kW?	2000 Pilot trials	Private
15	Charlton Energy	Eco-tran ltd, indirectly heated rotating kiln	Energy crops, Ag & forestry residues	IC Engines	7 MWe	Detail design	DTI Capital Grants Scheme
16	Winbeg 1.	FERCO	Energy crops, Ag & forestry residues	GTCC	22MWe	Failed permitting. Uncertain status	DTI Capital Grants Scheme
17	Corpach, Fort William, Scotland	Indirectly heated kiln	Forestry residues	GTCC CHP	15 MWe	Design & Permits	DTI Capital Grants Scheme
18	Banham Power	Uncertain	Poultry litter	3 x Recip engines	5.4 MWe	Design and construction	Private
19	Sustainable Energy Facility , East London	Enerkem fluid bed	Solid recovered fuel	Boiler & steam turbine	13 MWe	Design & Permits	Waste Innovation Programme. Private
20	<i>ITI Energy Ltd</i>	<i>2 stage downdraft</i>	<i>Solid recovered fuel</i>	<i>SI Engine</i>	<i>1MWe</i>	<i>Demonstration</i>	<i>Private</i>

(Additions June 2006 in italics)