Design and Access Statement

Small Scale Standby Embedded Power Plant
Tofts Lane,
Hunshelf
S36

GreenFrog
Power Limited



Prepared by Green Frog Power Ltd
Date: 20th July 2010

Proposed small-scale standby embedded generating plant and associated parking and connection to National Grid

Design Statement

The site is located within the boundary of the YEDL Tofts Lane Substation compound off Tofts Lane, Hunshelf. The substation compound is located on currently occupied land substation of YEDL. The site is accessed via a private drive with a secure gated entrance on south side of Tofts Lane.

Green Frog Power Ltd have taken a lease on the proposed application site and have agreed with YEDL(Yorkshire Electricity Distribution Ltd) and the National Grid PLC that the site is to be developed as a small-scale standby power generation plant. This kind of power plant is known as 'embedded generation' and is in complete alignment with the Governments 2007 Energy White Paper on future energy policy to encourage green and carbon efficient distributed power. (See Annex 2)

The applicant is contracting with the National Grid to provide standby power when there are periods of shortage in generation on the network. Historically standby power plants are only called up for a few hours per year. For example 2008 – 114hrs, 2009 – 95hrs. These power plants are vital to ensuring continuity of supply as the country moves towards a lower carbon economy. The National Grid have estimated that the network needs to double its standby capacity by 2020 to avoid rolling blackouts. This application is made in response to that requirement.

Embedded Distributed Power (EDP) generation supplies power to the local distribution network at or near the point of use ie: where power is to be used and helps to 'support the network' at times of peak demand avoiding power fluctuations and blackouts. It also does not 'waste' the generated power in transmission losses which occur when power is transmitted over long distances. Nationally transmission losses amount to between 8% and 14%.

EDP is less susceptible to power failure in that when a large power station goes off line all of its output is lost - many thousands of mega watts of power in one event. With distributed power should one station fail to operate only a few mega watts are lost. Hunshelf the subject of this application provides the grid with around 20MW of power.

It is commonly agreed that there will be severe shortage of supply in the foreseeable future as the anticipated recovery in the economy takes place. A number of both nuclear and coal power plants will be coming off line in the near term leaving the power supply of the whole county in a perilous position. (See Annex 3)

It is an important local advantage of this application that in the event of power shortages in the future anyone who is supplied their power through the

Hunshelf substation will not suffer as the proposed embedded power station will be turned on by the National Grid and operate to cover these shortages.

The proposal is for the erection of two purpose built structures to house the generating equipment, each in its own sound proof unit. These generators may operate on either natural gas or diesel. The proposed generators are 41% efficient which compares with 27-35% for open cycle gas turbines and 50%-52% for closed cycle coal power generation. However, when the additional benefits of the savings in transmission losses are factored in this makes this form of generation amongst the very best in carbon efficiency and is considered as Low Carbon technology.

Some of the heat from the engines is also recovered and stored to maintain engine temperature when not operating. Further details of this are given below. Closed Cycle Gas Turbines are not suitable for this standby use as they take several hours to start up and switch off.

The technology proposed is the Best Available Technology (BAT) for the purpose of rapid start standby generation. Further, being connected to the network at the point of use offers demonstrable efficiency improvements of 20% to 33% over non distributed current standby generation. This is without factoring in the 'enablement facility' that this form of generation offers allowing security of supply to wind and other renewable generation. (see Annex 4).

As the proposed large scale extension of the offshore wind generation takes place over the next decade the amount of standby generation must also increase in parallel to support the network when the wind does not blow. In this regard standby power is an essential part of the 'going green' strategy proposed by Ofgem and is seen to enable this process to take place

Our system allows for start up and connection to the national grid within 5 minutes of being called up another essential and important feature of these small scale embedded generation stations. The average time for generation at each call up period is 44 minutes, which averages at only 2.5 call ups per week.

The proposed fuel will be stored in bunded tanks that are located as shown on the site plan in addition there will be smaller double skinned day tanks within the building for each generator. All generators may be operated on natural gas, which is to be drawn from the National Grid gas pipeline in the vicinity of the station. It is important that these embedded stations can operate on a variety of fuel as in future years they will be important in supporting the network during the predicted periods of peak power shortage and uncertainty of gas and oil supplies.

As described above the generators are in their individual sound proof structures designed by our acoustic engineers. At the back of the generator rooms is a service corridor. The service corridor will run the whole length of the building. This corridor will house all the associated fuel supply pipe work

together with the wiring and switch gear needed to control the engines and the supply of power to the local transmission grid.

Access into each individual engine room is made from this corridor. The building is constructed of double skin dense concrete block-work and the external walls and roof are clad in metal profile sheeting to give it the appearance of an agricultural building. The cavity in the walls is filled with thermal insulation. This type of construction has been adopted following consultation and design by our retained acoustic consultants.

The roof and ceiling structures to the individual sound proof units are constructed out of dense concrete block and reinforced concrete beams. This structure is then screeded with a further 100mm concrete screed. The exhaust system and sound baffles are supported on this ceiling structure and the heat exchangers (radiators) needed to maintain the engine temperatures are located externally behind each building as indicated on the site plan.

A Sound Report accompanies this planning application. The construction methods described provide a minimum of 45db (decibels) reduction in airborne sound. The generators themselves are mounted on anti vibration skids that ensure that sound transmission through the structure is minimal.

This combination is designed to ensure that the noise levels from the generating plant are well within recommended allowable noise levels for the site (approximately a decibel rating equivalent to a loud conversation, See accompanying sound report).

Emissions from the generators for all fuel types are given at Annex Five - full emissions data. The use of these engines is well within the requirements of the Environment Agency for this location.

At present there is no employment on the site. However Green Frog Power are proposing to employ 4 full time mobile engineers who will be based at their depot in Hull.

The applicant is currently progressing a number of other similar applications and the associated staff levels across the project anticipate that four full time jobs will be created by each of the stations these jobs will be skilled and highly paid for the region and include :-

- Chemical Engineers
- Mechanical Engineers
- Electrical Engineers
- Accounts Staff
- Fuel Processing Engineers
- Diesel Fitters
- Health and Safety Officers
- Tanker Drivers
- Fork Lift Drivers

- Fuel buyer
- Workshop staff
- Senior Management

This site at Hunshelf will operate as a satellite power plant to the main depot in Hull. However it will be visited on a daily basis by our mobile engineers for general maintenance. Delivery of fuel which will take place as required but never out of normal business hours. Business hours are taken as 9am to 6pm Monday to Friday.

The application is fully supported by YEDL (see letter at Annex 6). As given above this type of embedded generation is ideal as a support to wind and other 'green' power sources. It is the most flexible type of generation as it can be turned on exactly when needed (when the wind stops blowing) which very few other forms of power generation can. Indeed the only types of existing generating equipment that can provide this quick start standby generation are old heavy fuel oil generators that are really inefficient and have poor emissions profiles or open cycle gas turbines that are again much more inefficient (27-35%) and produce power in much larger blocks of 100MW or more. Neither of these options offers the distributed power solution that is the main frame of central government policy in this area.

Landscaping

The proposed development site is to be completely enclosed by a 1.8M high earth bund. A detailed landscape design will be agreed with the Landscape Officer prior to the commencement on site of the project.

Access Statement.

The proposed plant, tanks and associated parking would be constructed using a newly constructed gated access off Tofts Lane, Hunshelf. Tofts Lane is located a short distance off the A616 Whams Road Via Manchester Road and Underbank Lane. The new road will be constructed off this leading to the propose plant. It will be seen that there is plenty of room for the mobile engineers and for the delivery of fuel, which is transported in tankers to park.

The hard-standing and car parking has been designed to enable the fuel delivery tankers to use the new access and for them to enter and leave the site in a forward gear. The tanker will park at the side of the tank bund for easy access to the tanks on the site. (See Annex 8 for our fuel management plan).

The tanker delivery arrangements still enable other car users to enter the site and use the car parking spaces provided.

On standby we require two tanker deliveries during office hours every week. On full-time generation we need, at the most, seven deliveries per week during office hours only.

The installation of the generating equipment within the proposed buildings will be enabled by crane and other specialist equipment this process will only take a few days and will be undertaken by expert approved contractors.

Full details of the buildings and the proposed access details are shown on the application drawings.

Flood Risk Assessment

This site is not affected by the Environment Agency flood map and therefore does not require a Flood Risk Assessment. (See map at Annex 7).

The proposed fuel will be stored in the tanks as shown. A bund will be constructed to accommodate 110% capacity of the largest tank. Details of storage protocol delivery systems and spillage control are outlined within the Fuel Spillage Method Statement (see Annex 8).

Planning Policy as it relates to the application

Please see accompanying document '**Supporting Planning Statement**'
(See Annex One)

Hunshelf STOR Embedded Generation Station

Technical analysis of the proposed site and the 'very special circumstances' arising from this analysis.

1 Overview

Power transmission in the UK since privatisation has become somewhat fragmented. Each region is operated by a different District Network Operator or DNO. In Barnsley this is YEDL Yorkshire Electric Distribution Ltd which is owned by CE Electric a US based holding company.

The power itself is produced by generating companies separately from the DNOs. From the power stations electricity is transmitted at very high voltage 275kVA and 400kVA around the country by the National Grid. From the National Grid it is fed into the district networks at Grid Connection Points GCPs. These GCPs are major substations.

From the GCPs the power is then initially transmitted at 132kVA around the district network on the large pylons with which we are all familiar. At various points the power it 'tapped off' at 'Primary Substations' and from these primary substations it is distributed more locally - say to a city or large town.

Embedded Generation is so called when the generator feeds his power into the network, not directly into the national grid but at some point within the district network. This is where the difficulties lie for embedded generation. The district networks are old and underinvested. Industry experts have estimated that 100s of billions of pounds would be needed across the country to fully update and upgrade the power transmission system in the UK.

The issues that arise when seeking to establish a Point of Connection (POC) for any potential embedded generators are manifold and include but are not restricted to:

Fault Levels The DNO has a statutory requirement to keep the fault levels on any transmission line below predetermined levels. Fault levels are effected by the number of users connect to the line, the type of user eg industrial, residential etc, the equipment faults inherent in the transformers and other transmission equipment and of course the faults caused by any other embedded generator. It is fair to say that the whole of the UK's DNO network is 'stressed' in this regard and it is unusual to find a vacant power line with plenty of 'fault headroom'. The higher the voltage at which connection to the network can be made the less of an influence these inherent faults have for embedded generators. For this reason all of the potential points of

connection identified by the applicant are located at primary substations.

Capacity The district network, as any electrical circuit, has a fixed and limited capacity at any point. That is, the current that can flow through the cables, switches and transformers has a maximum threshold. Switches and busbars located mainly at substations act in the same way as circuit breakers in a domestic home. They have a 'rating' say 400MVA (400 Mega Volt Amps). Many substations have older switches and equipment with ratings far below those of modern equipment and were designed on a power demand estimate of 30 years ago. All of the DNOs have embarked on a program of upgrading this equipment but at present this issue of capacity for embedded generators is a major problem. Further DNOs like to have 'headroom capacity' for new customers to connect to the system, this further restricts the potential points of connection.

Voltage Drop The Distribution Code in the UK allows a 4% maximum voltage drop on any branched line. Voltage drop is a product of the current and the impedance of the circuit in an alternating current arrangement. In layman's terms - increasing the current by installing an embedded station can cause the voltage drop on a line to increase beyond allowable limits. This once again is major issue for DNOs and embedded generators alike. Fortunately as the voltage increases the current drops and so the effects of voltage drop reduce, hence the reason why National Grid transmit at such high voltages and why the embedded generation stations proposed by the applicant are all located at primary substations.

2 How Green Frog have addressed these issues in identifying the potential sites it needs to fulfil its contracts with the National Grid

The applicant Green Frog Power has analysed fully the YEDL and NEDL networks and visited all of the 500 plus primary substations to identify sites where the network can accept embedded generation. This has been done in consultation with YEDL and NEDL engineers and their asset management teams. Of these primary stations only 80 operate at a voltage capable of accepting generation connections at 20MW, further discounting those sites with inherent technical issues leaves less than 40 potential sites throughout the region from Northumberland in the north to Sheffield in the south.

Taking into consideration the total size of the STOR requirements across the UK each DNO is likely to require the development of at least an additional

750MW of capacity, developed from either load management or purpose built facilities as envisaged at Hunshelf.

The choice of Hunshelf is as a result of the issues given above – it is one of the very few places that connection of an embedded STOR station is practical the site has sufficient fault level head room and connectivity to accept this generation. Also due to the decline in the steel industry it is proposed to remove a number of the existing National Grid connections in the area, creating a further potential requirement from YEDL for further system support in the area both over the short and long term. The proposal as envisaged would provide this support if and when needed.

Ideally we have sought to locate these plants in the more industrial areas and indeed have over 60% in such locations. However, for the technical reasons above some of the sites will need to be located at substations in more rural locations. Where this is needed the company have made every effort to minimise any impact on the landscape and it is not to be forgotten that these plants will only operate for around 100 hours per year.

Conclusion

The applicant is proposing to develop an embedded 20MW standby power plant within the YEDL substation compound off Tofts Lane, Hunshelf. Having analysed the district network Hunshelf is one of only a very few sites where embedded STOR generation can practically be accommodated. For these reasons it is considered that the development of the site constitutes the 'very special circumstances' needed to allow the development of this site.

The proposal will generate 4 new full time jobs and will produce electricity which will help support the local grid in that area.

The location has been chosen at the sub-station for the technical reasons outlined in addition this location makes best use of the power produced and avoids long and unsightly overland cables and support columns and in digging up the highways and byways in the local area.

The applicant has spent considerable resource in developing the sound proof generator housings. This building has been designed for this specific purpose it reduces any potential impact to well below permitted levels.

All car parking and deliveries will be on site using the newly constructed gated access off Tofts Lane. During normal operation there will be no permanent staff. However engineers will visit the site on daily basis to check and do general maintenance.

The technology proposed is the Best Available Technology for the purpose of rapid start standby generation and being connected to the network at the point of use offers demonstrable efficiency improvements 22% to 35% over non distributed current standby generation.

The project has been approved by OFGEM, National Grid and YEDL.

Annex 1

(Supporting Planning Statement)



Supporting Planning Statement

Small Scale Standby Embedded Power Plant
Tofts Lane,
Hunshelf
S38 8GY

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Date: 24th June 2010

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1. Background and overview of STOR generation

Background

This document is submitted as part of the application for the development of an embedded STOR power generation plant at Hunshelf near Barnsley. It provides a detailed explanation of STOR (Short Term Operating Reserve), its importance to the National Grid as part of its Essential Infrastructure and to highlight the planning policy as it relates to this type of facility.

STOR is the key method by which the National Grid 'balances' the network – or in simple terms keeps the lights on! The National Grid is charged with operating the network of interconnecting cables that form our power system in an 'efficient and effective' manner.[1] National Grid does not generate power – it is not allowed to under its charter.

Most of our power in the UK is generated at large coal, gas or nuclear power stations. From these the National Grid (NG) distributes the electricity throughout the country to District Network Operators (DNOs), which operate and maintain the local networks. In Barnsley the DNO is YEDL (Yorkshire Electricity Distribution Ltd).

Power is distributed by NG at very high voltages and is 'stepped down' at points in the network known as 'primary substations'. From these primary substations the DNOs distribute the power to the customers. This system has operated since the de-nationalization of the UK's power industry.

The power network is currently facing enormous difficulties with regards to supply. Both Ofgem[2] and National Grid[3] are predicting power cuts from as early as 2013 with a real crisis point being reached in 2017 onwards. How has this occurred?

In 2001 the EU issued the Large Combustion Plants Directive (LCPD), which was designed to dramatically reduce our carbon output as a nation. Under the LCPD most of the older polluting coal power stations are scheduled to close in the next few years. This, coupled with the planned closure of the existing nuclear fleet of power stations, as they reach the end of their active life, has created this very difficult scenario.[4]

Wind power is set to provide a substantial element of our future power needs. This type of power, however, by its very nature, is intermittent and needs to be supported when the wind fails to blow. Wind turbines also fail to work when the wind is too strong. So they need to have back-up, which means STOR. The replacement of old nuclear stations is already well behind schedule – but

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[1] See: National Grid Policy Brief: Operating the system beyond 2020. June 2009.
[2] Ofgem Project Discovery: Energy markets scenario update. February 2010
[3] National Grid: Operating the Electricity Transmission Systems in 2020. June 2009
[4] The Large Combustion Plants Directive 2001/80/EC. October 2001

as importantly the new nuclear stations will each have much larger capacity than their predecessors. That means that when one of them is forced for technical reasons to 'come off line' there is an even larger requirement for supporting reserve power.

What is STOR and why does National Grid need it to balance the network?

During the normal operation of the network by the National Grid the power used by customers is 'balanced' by the power produced by the generating companies. Even at times when the network is not under 'stress', however, the power used is never exactly the same as the power produced. National Grid overcomes this problem by having a constant supply of 'extra power' available at all times, which it uses through a process known as the Balancing Mechanism to ensure that the network is completely in balance. Power cannot be stored.

When an unforeseen demand is put on the network – say by a power station suddenly coming off line for technical reasons – the National Grid controllers have a second line of 'extra power' known as Short Term Operating Reserve or STOR. When called upon by the National Grid the providers of STOR quickly begin to generate and rebalance the system.[5]

National Grid is predicting a doubling of the requirement for Short Term Operating Reserve in the next eight years because of the three factors:

A) The closure of a large number of coal fired power plants which currently provide much of the existing STOR capacity.
B) The advent and planned increase in wind power and other renewable intermittent power sources.
C) The increase in the unit size of proposed new nuclear power stations.

It is to be remembered that STOR is generally only used at times of 'stress' on the network, which are very infrequent – typically less than 100 hours per annum. STOR generation is the last line of defence to prevent serious fluctuations and blackouts.[6]

Local power where it is needed

If the blackouts that energy regulator Ofgem predicts do occur then local businesses will be able to make use of the applicant's power to keep going when others must close down. This is because the applicant's plant is an 'embedded' power station on the local network.

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[5]National Grid: Short Term Operating Reserve; General Description of the Service; 8th May 2009
[6] National Grid: Operating the Electricity Transmission Systems in 2020; Follow Up Report. Feb 2010

Why must these STOR generating stations be located at sub stations?

When power is generated it is usually done so at Low Voltage typically 415V it is then increased in voltage to allow for efficient transmission through the network. This 'stepping up' in voltage is done using transformers – which are generally located at substations.

The applicant has entered into a number of long-term leases with YEDL at their substations for this very purpose and have contracted with National Grid for the next 15 years to provide them with Short Term Operating Reserve power. The completed facility forms part of the UK's overall power transmission network. As such it is deemed Essential Infrastructure and should be considered in planning terms as such.

Unlike most of the UK's Essential Infrastructure, the applicant's project does not involve huge smoke stacks, industrial-sized plant and overhead cables on pylons. This is because the applicant provides small-scale back-up power where it is needed. The buildings have been designed to appear as ancillary agricultural buildings and are entirely contained within the YEDL substation compound. .The compound has already been designated as Essential Infrastructure by the Local Authority.

2. Planning Policy as it relates to the application

a) Planning Act 2008 Part 3 Section 15

This section of the Act sets the application outside that Act as the proposed capacity is far below the 50MW threshold.

Section 15 of the 2008 act - Generating Stations states:-

(1) The construction or extension of a generating station is within section 14(1) (a) only if the generating station is or (when constructed or extended) is expected to be within subsection (2) or (3).

(2) A generating station is within this subsection if—

(a) it is in England or Wales,

(b) it is not an offshore generating station, and

(c) its capacity is more than 50 megawatts.

The application is as stated for a building to house reserve generating equipment for use by the National Grid.

b) Barnsley UDP

Page 326 *BARNSLEY UNITARY DEVELOPMENT PLAN*
Adopted December 2000
Volume 1 - Part II

This section of the UDP sets out the Councils objectives with regards to the essential infrastructure associated with power, water and sewage requirements for the Borough.

Utilities

OBJECTIVES

1. To seek to ensure that infrastructure is provided by the Utility Companies to enable development to proceed in accordance with the reindustrialisation goal of the Council.

The proposed development is an essential part of this infrastructure: Without provision of reserve generation then the power network may be subject in the near future to blackouts and other restrictions.

2. To provide, within the overall policy framework of the Plan, land for infrastructure requirements of Utility Companies.

The large existing sub-station site at Hunshelf has already been defined in the Plan as being part of the land set aside for such infrastructure. Whilst recognising the surrounding 'green belt' definition of the land, it is understood that it's the Boroughs intention that essential infrastructure engineering works within the defined sub-station boundary are an approved use provided that every effort is made to minimise the impact of such works.

UTILITIES POLICIES

General Policy
Policy UTL1

THE PROVISION, REPLACEMENT, OR EXTENSION OF THE UTILITIES INFRASTRUCTURE IN THE BOROUGH INCLUDING WATER SUPPLY, WASTE WATER AND SEWAGE DISPOSAL, ELECTRICITY, GAS AND TELECOMMUNICATIONS WILL BE ENCOURAGED AND SUPPORTED ESPECIALLY WHERE THIS CONTRIBUTES TO THE GOALS OF ECONOMIC RESTRUCTURING AND THE IMPROVEMENT OF THE QUALITY OF LIFE FOR RESIDENTS.

As given above the proposed engineering works will help ensure that the businesses and residents who are fed through the Hunshelf sub-station – one of the major primary substations in the Borough will be protected from the potential power cuts and blackouts predicted by Ofgem and that the proposed works are in keeping with this general policy.

Overhead Power Lines

Policy UTL4

PROPOSALS FOR THE PROVISION OF OVERHEAD POWER LINES OR DEVELOPMENT CLOSE TO EXISTING OR PROPOSED OVERHEAD LINES WILL BE ASSESSED WITH REGARD TO THE FOLLOWING FACTORS:

A) THE EFFECT OF THE TRANSMISSION TOWERS, ASSOCIATED LINES, PLANT AND BUILDINGS ON THE AMENITY OF THE OCCUPIERS OF ANY EXISTING OR PROPOSED DEVELOPMENT

B) THE IMPACT ON VISUAL AMENITY

The applicant requires no new overhead power lines, because the plant is located at the existing substation.
The UDP Further States that:-

8.16 The Council acknowledge the importance of ensuring there is a constant supply of electricity to serve the needs of industry and domestic consumers.

It is to be seen that the proposed engineering works form part of the essential infrastructure needed by National Grid to ensure the continuous supply of power to the residents of Barnsley Metropolitan Borough and as such the local and national policies are at one with the proposed development.

It is also considered that PPS1 is relevant to some extent given that the proposed generation is BAT (Best Available Technology) and as such can be considered as Low Carbon generation in this application of Short Term Operating Reserve. (Please see section 3 below).

PPS1 – Planning and Climate Change December 2007

Tackling climate change is a key government priority for the planning system. This policy sets out how planning should contribute to reducing emissions and stabilising climate change and take into account unavoidable situations. It is noted that planning applications should also consider how well the proposals for their development contribute to the Government's target in their ambition for a low-carbon economy.

PPS1 also states at para 20

".....Also to promote and encourage renewable and low carbon energy generation. Policies should be designed to promote and not restrict renewable and low carbon energy and supporting infrastructure."

"In particular the planning authorities should not require applicants for energy development to demonstrate either the overall need for renewable and low carbon energy and its distribution, nor question the energy justification for why a proposal for such development must be sited in a particular location."

"There is a positive consideration for Local Development Orders to be used to secure renewable and low carbon energy supply systems. LDOs could be used to provide additional permitted development rights across the whole planning authority's area. LDOs could also be used to grant permission for a particular type of development in parts of a planning authority's area."

And

"Planning Authorities should expect a proportion of the energy supply of new development to be secured from decentralised, renewable or low carbon sources."

It is also noted that the new coalition government have recognised the need for 'security of supply' and are developing policies to be contained in their soon-to-be-issued 'National Planning Statement' to cover this area. It is expected that this document will contain specific reference to reserve power generation such as the applicant's.

PPS 22

Section 2.6 of the Guidance to Planning Policy Statement 22 (PPS 22) states that "PPS 22 makes clear that the environmental, economic and social benefits of any proposed scheme should be considered in determining the application". Section 2.7 includes "reducing carbon emissions" as an environmental benefit. However, it is the responsibility of the developer to make these calculations.Please see below for a calculation on carbon emission reduction.

The Coalition – Our Program For Government - Energy

- *We will reform energy markets to deliver security of supply and investment in low carbon energy, and ensure fair competition including a review of the role of Ofgem.*
- *We will instruct Ofgem to establish a security guarantee of energy supplies.*

3 Carbon savings

The council is committed to saving carbon and using Best Available Technology. The proposed STOR generation reduces carbon emissions because without STOR reserve power there will either be no wind power or there will be power cuts. To this extent without reserve power the carbon saving offered by wind power would not be realisable.

Wind is inherently unpredictable and if it is too weak or too strong then there is no output. Wind speeds need to rise to around 14 metres per second before a wind turbine hits its output capacity and at over 26 metres per second or so it will cut out.[7]

Moreover, the times of greatest demand are during cold winter days when wind speeds are usually slow. Analysis by National Grid of the five hours of peak electricity demand over each of the past 25 years shows that wind speeds were usually very low at times of most demand on the network.[8]

It is often said that wind turbines need fossil-powered stations to cover for them. To some extent that is true, but the National Grid are highly skilled at predicting both demand and generation capacity. It is only during the peak times at certain times of day or in the event of a generation failure that reserve power is needed - around 100 hours per year. With accurate weather forecasting National Grid requires only one megawatt of STOR to enable ten megawatts of wind capacity.

Using National Grid's forecast data for the extra STOR required to cover for an increase in wind energy we can calculate that for every 77megawatt hours of wind energy generated STOR providers will be called up for one hour on average. Put another way, 1.3% of the energy produced by wind turbines must be provided by a STOR generator such as Green Frog Power's to ensure that there is an acceptable continuity of supply and that the lights do not go off from time to time![9]

Carbon saving

Calculating the carbon saving of STOR is not difficult. The carbon saving from wind-generated power is given as being 0.43 tonnes of carbon per MWh while it is generating. That does not include the necessary STOR diesel–based generation of 1.3%.[10]

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[7] For a typical wind turbine power curve see: National Grid: Operating the Electricity Transmission Systems in 2020; p.16. June 2009. Or any turbine manufacturer's website.
[8] See: National Grid: Operating the Electricity Transmission Systems in 2020; p.35. June 2009
[9] See: National Grid: Operating the Electricity Transmission Systems in 2020; p.29;32. June 2009
[10] RenewableUK: Calculations for wind energy statistics

It can easily be seen that when the carbon savings from wind and the relatively tiny carbon output of the diesel engine are put together, the total saving is almost the same as for intermittent wind: the carbon savings from Green Frog Power's engines are 0.42 tonnes per MW hour when seen as an enabling part of wind energy output. This power can be viewed in the same manner as the small amount of power that wind turbines consume from the Grid to run monitoring security and telecoms functions essential for their operation. Whist remote from the source, a turbine's reserve power is just as essential to its successful operation.[11]

Best Available Technology

When called upon by the National Grid STOR providers such as Green Frog MUST be on line and able to deliver power within a few minutes of receiving an instruction. This requirement restricts the possible types of generating equipment that can be used.

Aside from coal, much of current STOR capacity is provided by turbine engines burning heavy fuel oil. These are extremely inefficient with very poor emissions, so that like coal they are being closed down by the Large Combustion Plant Directive (LCPD). Another major source of existing STOR capacity is open-cycle gas turbines, which burn gasoil (a heavy diesel) in what is effectively (and sometimes in actual practice) a jet engine. These are 25% efficient, meaning they convert 25% of the energy generated by burning fuel into electricity.

Green Frog Power's engines are more than 41% efficient. They are high-technology reciprocating engines. Although used worldwide for power generation they have not been widely used in the UK because power has traditionally been in the hands of the giant generating companies, who have preferred to build a single 1,000-megawatt turbine than set up a number of more efficient plants where the power is actually needed.

Transmission costs are pricy for generators and wasteful of energy. A large proportion of the nation's electricity is lost in power lines – up to 14% of the power generated is lost in this manner. Green Frog Power builds stations close to the end user at the substation, which is only possible because of the small scale of its generators. This saving makes the generating system on a like-for-like basis over 47% efficient. Due to the infrequency of generation

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[11] A diesel generator set, being the best available technology for STOR, produces 0.4 tonnes of carbon dioxide per megawatt hour. So the total emissions on average to enable 100MW of uninterrupted supply of wind will be 1.3% x 100MW x 0.4 tonnes or 0.52 tonnes of carbon dioxide per hour. Of course the 100MW of wind power generated is saving 0.43 tonnes per MWh for the other 98.7% of the time, or just under 43 tonnes per hour in total. Subtracting the carbon dioxide emitted by the STOR generation gives a saving of 42.5 tonnes. So the carbon saving from the engine's use is more than 0.42 tonnes per MW hour of generation and fractionally less than the wind it backs up.

and the intermittency of call up it is not practical to harvest the heat from the engines, which are only running for 100 hours per annum.

Gas, the cleanest fossil fuel, traditionally cannot be used for STOR because the expense of building a top-quality combined-cycle plant has not allowed any headroom in the generating capacity to go on standby. The most modern gas stations can have headroom for standby but the gas-supply system does not allow for it: having a gas pipe with a capacity that is only rarely used is prohibitively expensive in the UK.

That means the Best Available Technology in this application is the engines used by Green Frog Power, and other similar companies that are at the forefront of the new STOR supply.

Annex 2

(White Paper on Energy Policy
Chapter 3)

CHAPTER 3

Heat and Distributed Generation

Most of the UK's electricity and more than two thirds of the UK's gas is supplied through a large nationwide grid. This centralised system has kept down costs through economies of scale and provided secure, cost-effective delivery of energy directly to our homes and businesses. As we seek to reduce the carbon emissions from the electricity and heat we use, it is increasingly clear that technological developments are opening up the possibility of a more decentralised low carbon energy system with local energy supply, ranging from household to community-scale, which could play an important part in our strategy.

3.1 Electricity and heat can be generated locally from renewable sources, making valuable carbon savings. Losses incurred in transmitting centrally-generated electricity to the point of use can be significantly reduced. The costs of transporting heat mean that many of the options for generating heat renewably have to be local. And even where fossil fuels are used, Combined Heat and Power (CHP) can, in the right setting, ensure that these fuels are used more efficiently by capturing and using heat and generating electricity in a single process. A more community-based energy system would also lead to greater individual awareness of energy and its implications for carbon emissions, driving a change in social attitudes and, in turn, greater energy efficiency[63]. The importance of Distributed Energy (DE), and the need for further action was recognised by the Trade and Industry Committee in its recent report[64].

3.2 This chapter:

- sets out the potential benefits of more power and heat being produced locally;
- describes what the Government is already doing to realise this potential;
- sets out the work we are doing to determine a strategy for decarbonising heat;
- summarises the key proposals from the joint DTI/Ofgem Review of Distributed Generation; and
- describes how regional and local activity can help drive progress towards more locally-produced heat and power.

63 Research by the Sustainable Development Commission and the National Consumer Council shows that people moving into homes with built-in renewable energy technologies report far greater awareness of what they can do to reduce their climate impact, and their energy use. Sustainable Consumption Roundtable, May 2006: *I Will If You Will* – http://www.ncc.org.uk/responsibleconsumption/iwill-summary.pdf

64 House of Commons Trade and Industry Select Committee: *Local Energy – Turning Customers Into Producers* First Report of Session 2006-7.

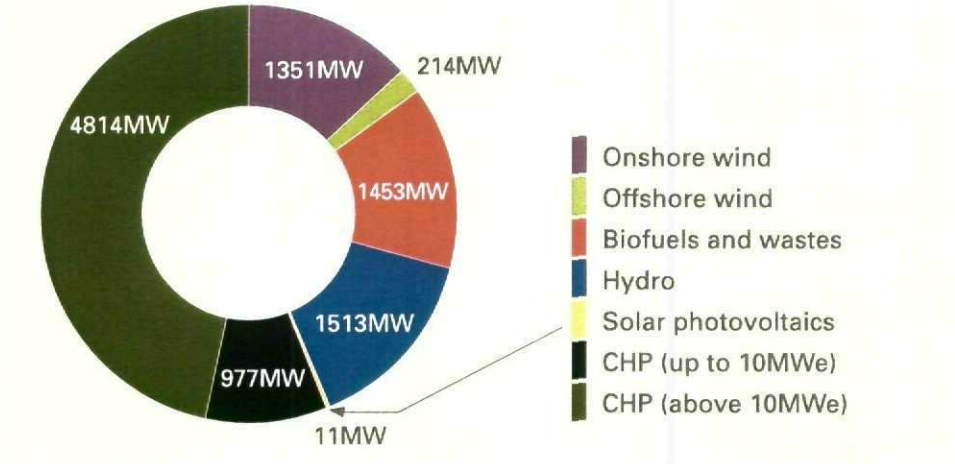
3.3 These measures will help to provide a basis on which decentralised energy can continue to grow alongside investment in the existing, predominantly centralised system.

3.4 The Devolved Administrations have various responsibilities in relation to the matters set out in this chapter. In line with the devolution settlements in Scotland, Wales and Northern Ireland, all proposals in this chapter which touch on devolved matters will be taken forward in accordance with the principles set out in the Memorandum of Understanding.

Distributed Energy (DE): the potential

3.5 The distributed generation of electricity and production of heat are collectively referred to as distributed energy. DE is not all low carbon. However, in this chapter we use the term DE to cover energy that is both local and low carbon. In practice this means some renewable energy, and CHP. DE currently accounts for less than 10% of UK energy supply. The Government wants to provide opportunities for DE to grow by removing barriers and putting the right incentives in place to promote DE where it proves to be cost-effective.

FIGURE 3.1 CURRENT CAPACITY OF CHP AND RENEWABLE GENERATION



Source: DTI, DUKES 2006
Note: Data is not separately collected for Distributed Generation, so this chart covers all CHP and renewable generation. In practice some of the CHP will be connected to the transmission network and some of the renewable generation (particularly wind) will generate electricity that is not used locally.

3.6 In many circumstances, heat and power sourced from DE technologies are more expensive than from the national gas and electricity networks. But, as the value of carbon is increasingly factored in to energy generation costs, and some of the DE technologies become more established, DE's relative costs are expected to improve.

3.7 We worked with WADE[65] to model the costs and benefits to the UK of a greater take-up of Distributed Generation (DG)[66] technologies over the coming twenty years. Modelling of this type is subject to considerable uncertainty.

65 The World Alliance for Decentralized Energy.
66 A definition of DG is provided in paragraph 3.46

It is necessary to develop possible scenarios for the likely future take-up of the different DG technologies and to project costs for each of these technologies over time. On the basis of the scenarios that we have modelled, the relative costs of DG depend upon the balance of a number of factors. On the one hand, fuel costs and carbon emissions are typically lower with an increased penetration of DG. However, CHP is an important component of any feasible DG scenario and offers only limited reductions in fuel use and carbon emissions relative to the most modern gas-fired generation. On the other hand, plant capital costs are typically lower for centralised generation. It is generally believed that transmission and distribution infrastructure costs would be lower with increased DG. However, the location-specific nature of these costs means that it has not been possible to model this effectively.

3.8 Overall our findings suggest that the costs to the UK of some DG technologies may be competitive with the costs of centralised technologies, but that overall system costs are likely to be lower if we retain a framework where DG is a complement rather than an alternative to centralised generation. However, this work is only a starting point and cannot give conclusive results about the relative costs of DG. We will carry out further analysis that incorporates the heat and electricity aspects of a decentralised energy system. Such a model is required to enable more robust conclusions about the relative costs of DG to be drawn.

3.9 The market is best placed to decide which technologies are most effective in supplying the UK's energy whilst also meeting our carbon reduction goals. It is for the Government to ensure that the opportunities for DE are opened up so that it is a viable option for the market to consider. DE is the current main option for increasing the use of renewables for heat generation.

3.10 Our policies on DE will also play a part in the UK's contribution to the EU's climate change and energy policy. In March 2007, the European Council committed the EU to a binding target of reducing greenhouse gas emissions by 20% by 2020 and by 30% in the context of international action. The agreement commits the EU, amongst other things, to a binding target of a 20% share of renewable energies in overall EU consumption by 2020. This applies to heat and electricity, where DE has a key role to play, as well as transport. The Commission has been asked to bring forward detailed proposals for each Member State's contribution to the overall EU renewables target. After a decision has been reached, and each Member State has agreed its contribution, we will bring forward appropriate policies to deliver the UK's share.

3.11 Whilst DE has the potential to reduce carbon emissions, and help security of energy supplies by diversifying the UK's sources of energy, significant growth of DE supply would represent a considerable change from the status quo. The current market and regulatory structures have been designed primarily to meet the needs of large, transmission-connected generators. There are some technical constraints on making DE compatible with the grid, as well as planning issues and other barriers such as upfront costs, and a lack of information about the possibilities available.

TABLE 3.1: EXAMPLES OF LOW CARBON DISTRIBUTED ENERGY TECHNOLOGIES

Technology	Description	Commentary
Total DG	All generating technologies connected to distribution systems	The Energy Networks Association (ENA) reports the total generating capacity connected to distribution networks[67]. At the end of 2006 the total was 12.7GW. However, this does include conventional generators (e.g. small Combined Cycle Gas Turbines (CCGTs) as well as renewable generation
	Distributed Heat Technologies	
Solar water heating	Uses the heat of the sun to produce hot water	The DTI's Microgeneration Strategy[68] reported almost 80,000 UK installations
Heat pumps	Uses the warmth stored in the ground or air, via a cycle similar to that used in refrigerators, to heat water for space heating	The Microgeneration Strategy reported over 500 UK installations
Biomass	Small-scale biomass installations from ~10kW to ~2MW that provide space and water heating by combustion of wood, energy crops or waste	The Microgeneration Strategy reported some 150 pellet boiler installations – likely to be a conservative figure
	Distributed Electricity Generation Technologies	
Solar Photovoltaics (PV)	Panels, often roof-mounted, generate electricity from daylight (not just direct sunlight)	The Microgeneration Strategy reported some 1300 UK installations
Wind	Large wind turbines that convert wind energy directly to electricity	The BWEA[69] reports 140 operational projects (onshore and offshore) having a total capacity of 2065MW

67 http://www.energynetworks.org/spring/engineering/pdfs/DGSG/Connection_Activity_DNOs_Dec2006.pdf
68 http://www.dti.gov.uk/energy/sources/sustainable/microgeneration/strategy/page27594.html
69 http://www.bwea.com/ukwed/index.asp

Micro-wind (<100kW)	Small wind turbines generate electricity – can now be roof-mounted as well as attached to tall masts	It is estimated[70] that there are over 20,000 small wind turbines with a total capacity of 7MW
Micro-hydro	Devices that capture the power of flowing water and convert it to electricity	The Microgeneration Strategy reported some 90 installations
Biomass /waste	Installations range from landfill gas generation stations to large power only facilities approaching 40MW	DUKES 2006 reports that total capacity is approaching 1400MW. See Biomass Strategy for map of installations
Combined Heat & Power Technologies		
Biomass /waste	Installations range from 100kW biomass CHP to ~ 85MWth/20MWe	See Biomass Strategy for map of installations
Micro-CHP, and CHP up to 1MWe	Small devices, usually gas-fired, that produce electricity and capture the waste heat produced as a by-product. CHP used on this scale tends to be for heat and power for a single house or on a community or commercial scale (i.e. a housing estate, or office block)	DUKES 2006 reports 1263 installations having a combined capacity of 206 MWe
CHP from 1MWe – 10MWe	CHP on this scale tends to be large community projects or small industrial applications	DUKES 2006 reports 196 installations having a combined capacity of 771 MWe
CHP over 10MWe	CHP on this scale tends to be large gas-turbine industrial applications that require a substantial heat load on a continuous basis	DUKES 2006 reports 75 installations having a combined capacity of 4814 MWe

70 By AEA Energy and Environment: see http://www.restats.org.uk

3.12 The DE challenge is therefore to make sure that new market opportunities are identified, that the market and regulatory environment is "user-friendly" for smaller participants, that potential barriers are identified and addressed, and that genuine market failures are resolved.

3.13 The Foresight Sustainable Energy Management and the Built Environment project, also referred to in chapter 2, will consider the long-term impacts of more decentralised ways of generating low carbon heat and electricity, and their interaction with current energy systems. This will include looking at the long-term potential and challenges of distributed generation, and its role and relationship with centralised generation. The work will examine the critical uncertainties, map possible future directions and test the policy implications, and will report in summer 2008.

3.14 There are a number of measures we can take in the short-term, as well as a range of existing policies, which will help support the take up of DE. The energy efficiency policies set out in chapter 2 will also drive investment in DE as, increasingly, take-up of the most cost-effective energy saving measures, such as insulation, will have been exhausted.

Existing and recent Government measures

3.15 Existing policies which will stimulate the take-up of DE include particularly:

- the zero carbon new homes policy;
- support for renewables, microgeneration and CHP; and
- public sector leadership.

Zero carbon new homes

3.16 The Government's drive towards zero carbon homes will increase demand for DE. In *Building a Greener Future*[71] the Government proposed that all new homes in England should be zero carbon from 2016. A firm decision on this timetable will be announced later this year. By 2016, if we meet our housing supply ambitions, there will be an additional 200,000 homes every year, the majority of which will be newly-built, zero carbon homes. This will include homes which will use DE sources of energy.

Support for renewables, microgeneration and CHP

3.17 Government has also taken a number of steps to promote some of the specific DE technologies. The proposed changes to the Renewables Obligation, set out in chapter 5, will boost support for renewable Combined Heat and Power (CHP), including the recovery of energy from waste and some types of microgeneration technologies. Defra's Waste Strategy, published in May 2007, sets out our broader policy on improving the recovery of energy from waste, which will also boost DE.

3.18 A number of incentives are available for people looking to invest in microgeneration technologies for their home, school, community, or business. They are available under:

- Warm Front Programme (and its equivalents in the Devolved Administrations);

71 http://www.communities.gov.uk/pub/173/BuildingaGreenerFutureTowardsZeroCarbonDevelopment_id1505173.pdf

- Low Carbon Buildings Programme; and
- Enhanced Capital Allowance Scheme.

3.19 The Low Carbon Buildings Programme will provide £86 million of grant funding for microgeneration installations in homes, communities, public and private sectors to 2009. This includes the additional £6 million[72] announced by the Chancellor in Budget 07 to fund householder installations only as a final tranche of funding for Phase One of the programme. Following this new funding and the high demand for the householder stream of the programme we have redesigned it – details can be found at www.lowcarbonbuildings.co.uk

3.20 Fiscal incentives are also important. A reduced VAT level of 5% is applicable to the installation of most microgeneration technologies. The list of applicable technologies was lengthened with the addition of ground-source heat pumps, air-source heat pumps and micro-CHP in the 2004 and 2005 Budgets. As announced in the December 2006 Pre-Budget Report, legislation in the Finance Bill 2007 will ensure that, where private householders install microgeneration technology in their home for the purpose of generating power for their personal use, any payments they receive from the sale of surplus power or Renewable Obligation Certificates to an energy company are not subject to income tax.

3.21 CHP benefits from a range of existing policies, including exemption from the Climate Change Levy and Business Rates. In addition, incentives for CHP have been improved by fully rewarding its carbon saving in the EU Emissions Trading Scheme (ETS) Phase II, which begins on 1 January 2008.

Public sector leadership

3.22 The public sector has a role to play in promoting DE. The Government has committed to carbon emission reduction targets[73] and its office estate becoming carbon-neutral by 2012. We will publish a report on ways in which local authorities can contribute to our climate change objectives, including by increasing levels of DE, by August 2007.

3.23 The Carbon Trust has allocated £10 million to Partnership for Renewables which provides support for public sector organisations wanting to invest in DE. It plans to have 500MW of renewable energy projects, primarily 3-5MW wind turbine projects, constructed or under development within the next five years by attracting private sector investment of up to half a billion pounds.[74]

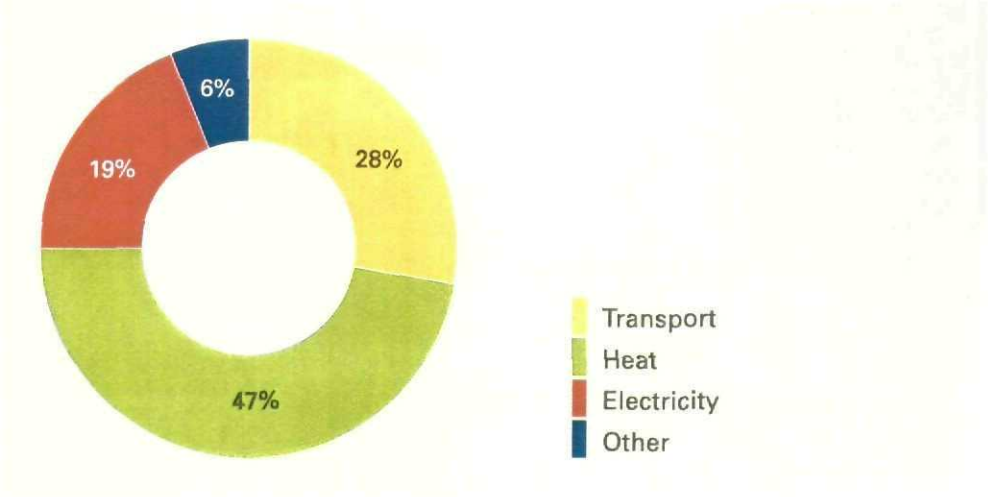
Heat

3.24 Decarbonising heat, by more DE and other means, is important as heat accounts for around 47% of the UK's total carbon emissions (including emissions from electrical heating) – equivalent to 71 million tonnes of carbon (MtC) in 2005.[75] Generating heat uses around half of the UK's total energy consumption by end-use. Nearly three quarters of that energy is used for

72 This £6 million takes the total level of funding available to householders to £18 million.
73 Commitments announced in June 2006 (and repeated in the March 2006 Sustainable Procurement Action Plan) aim to reduce carbon emissions from Government offices by 30% by 2020, relative to 1999/2000 levels.
74 www.carbontrust.co.uk/commercial/enterprises/pfr.htm
75 UK NAEI (2005).

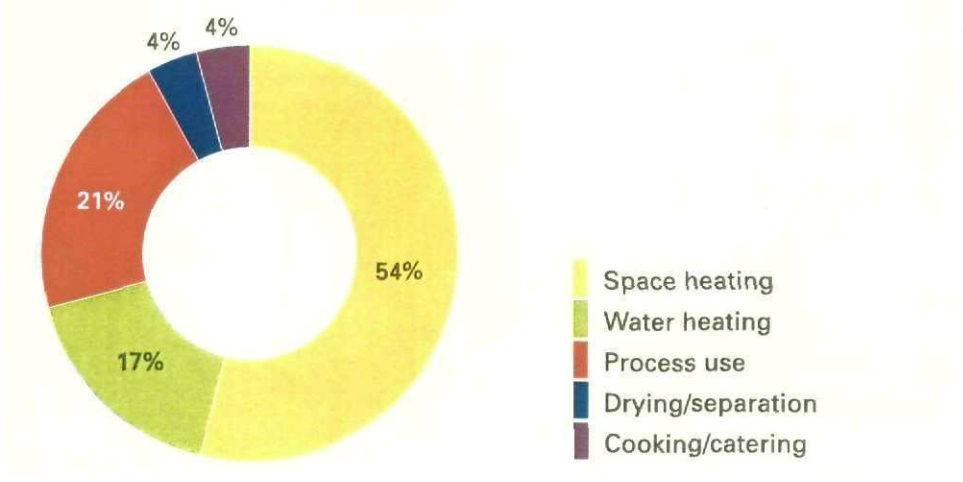
space and water heating, primarily in the domestic sector and to a lesser extent in the commercial and public sectors. The remainder is used by industry as an input to a wide range of processes; a small proportion is also used for cooking. The vast majority of heat demand in the domestic, commercial and public sectors is met by gas supplied through the gas distribution network;[76] industry tends to use a mix of heating fuels. Gas can be converted to useful heat at over 90% efficiency in modern condensing boilers.

FIGURE 3.3 CARBON DIOXIDE EMISSIONS BY SECTOR, 2005



Source: Defra
Note 1: Heat emissions comprise 35% direct emissions from heat and 12% indirect emissions from electricity used to generate heat.
Note 2: other emissions include those from non-fuel combustion, agricultural and industrial emissions which do not relate to heat and electricity.

FIGURE 3.4 HOW HEAT FOR ENERGY IS USED



Source: DTI

76 Some 77% of UK homes have gas central heating (2004 figures).

3.25 There are three options for reducing emissions from heating:

- reduce the absolute demand for heating by improving energy efficiency. The largest and most cost-effective carbon savings in the short-term will therefore come through improved energy efficiency, supported by the energy saving measures in chapter 2;
- make more use of CHP, which is covered later in this chapter; and
- increase the proportion of heat generated through less carbon-intensive technologies (see detail below on renewable heat and biomass), including producing heat from low-carbon electricity.

3.26 DE has the potential to reduce the carbon content of both electricity and heat. However, there are some key differences between heat and electricity which dictate different policy approaches. For example:

- heat has to be produced relatively close to its point of use (in contrast with electricity which can travel great distances without substantial loss);
- renewable heat technology currently requires a distributed approach, whereas large scale renewables are already an option for reducing the carbon content of electricity;
- affordable heat is a critical part of the fuel poverty agenda; and
- electricity cannot easily be stored[77] whilst heat can.

3.27 Many current policies contribute to reducing carbon dioxide emissions from heat – for example the EU ETS, the Climate Change Levy, tax incentives for CHP and the Energy Efficiency Commitment[78] (EEC) all contribute to reduced carbon emissions from heat. In addition, policies such as the Warm Front programme to tackle fuel poverty helps to reduce emissions. However, the Government recognises the value of considering the heat sector in a holistic and focussed way and exploring the scope for further reductions in carbon emissions from this sector.

The Government will conduct further work into the policy options available to reduce the carbon impact of heat and its use in order to determine a strategy for heat. The work will look at the full range of policy options, including the range of existing policy mechanisms such as the EU ETS.

Renewable heat

3.28 Renewable heat is a potentially important means of reducing carbon emissions. The Government is committed, through the Climate Change and Sustainable Energy Act 2006, to promote the use of renewable heat. Renewable heat will also need to play its part in contributing to the UK's share of the EU renewable energy targets. Renewable heat is already competitive in some circumstances and benefits from capital grant support; it is also incentivised through EU ETS, in some cases.[79]

77 While electricity storage technologies are available, costs and technical constraints mean they are not widely used. Further developments may make storage a viable power system option in the future.

78 The new name for EEC Phase 3 will be the Carbon Emission Reduction Target (CERT)

79 Capital grant support for renewable heat and renewable CHP has been provided through the DTI/Big Lottery Fund Bioenergy Capital Grants Scheme and Clear Skies Initiative. There is currently support available through the Low Carbon Buildings Programme, and a new round of the Bioenergy Capital Grants Scheme, funded by Defra, has recently closed.

3.29 However, the renewable heat market has been slow to develop,[80] and currently less than 1% of UK heat demand is supplied from renewable sources. A 2005 report by Future Energy Solutions[81] said that, by 2010, 1.8% of UK heat demand – rising to 5.7% by 2020 – could be produced from the range of renewable heat sources. The initial results of a draft Ernst & Young study, commissioned by DTI and Defra, indicate that renewable heat could provide significant carbon savings. They also find that various market failures exist, including the limited application and effectiveness of carbon pricing in this sector, which have slowed its development. This analysis is at a very early stage. The Government will continue to develop its thinking in this area.

3.30 The Government-appointed Biomass Taskforce, in its October 2005 report,[82] indicated that the proportion of UK heat demand supplied from renewable sources could rise to 3% by 2010 and 7% by 2015, provided a range of barriers were addressed, including:

- the lack of a carbon price;
- low investor confidence;
- lack of awareness in the construction and supply sectors; and
- fragmented supply chains.

3.31 In its response to the Biomass Task Force, the Government committed to producing a Biomass Strategy,[83] which is published alongside this White Paper. It brings together current Government policies on biomass and is summarised in Box 3.1. It provides a coherent framework for the development of biomass.

BOX 3.1 SUMMARY OF THE BIOMASS STRATEGY

The strategy identifies significant potential to increase the domestic supply of biomass, through the more efficient utilisation of agricultural land, unmanaged woodland and waste. Our analysis shows a hierarchy of use in terms of cost of carbon saving, with biomass heating as the most cost efficient use for energy. The Strategy is intended to realise a major expansion in the supply and use of biomass by:

- providing targeted support in key areas such as expansion of energy crops and biomass heat installations, through direct grants and other measures such as the schools building programme;
- sourcing an additional 1 million tonnes of wood from unmanaged woodlands;
- increasing land used for production of perennial energy crops by some 350,000 hectares;
- increasing the utilisation of organic waste materials; and
- stimulating technology development.

80 The main available renewable heat options are distributed: microgeneration (solar thermal, heat pumps) and biomass (still expensive on a small scale) for residential use, and larger biomass for commercial and industrial installations.

81 http://www.dti.gov.uk/energy/sources/renewables/policy/renewable-heat/page15963.html

82 http://www.defra.gov.uk/farm/crops/industrial/energy/biomass-taskforce/pdf/btf-finalreport.pdf

83 http://www.defra.gov.uk/environment/climatechange/index.htm

Combined Heat and Power (CHP)

3.32 CHP is a potentially carbon-efficient technology which captures the heat generated as a by-product in electricity generation. Typically the process is fired by fossil fuels, though biomass CHP is growing in importance. CHP installations vary in size from micro-CHP installations, an alternative to the domestic boiler, through community schemes generating heat for housing developments and office buildings, to industrial sites equal in size to a medium-sized power station.

3.33 The carbon savings from generating electricity in CHP installations, and making use of the heat for either heating or cooling processes, depend on many site-specific factors, including the size of the scheme and the nature of its heat load. Indicative carbon efficiencies are illustrated in Table 3.2.

TABLE 3.2: CARBON SAVINGS OFFERED BY GOOD QUALITY CHP[84] RELATIVE TO THE SEPARATE PRODUCTION OF HEAT AND POWER FROM GAS[85]

Size of installation	up to 1 MWe	1-50 MWe	over 50 MWe
Efficiency savings	18-30%	7-21%	10-23%

3.34 The more consistent the demand for heat throughout the day, the more economic CHP can be. Hence the best sites for CHP are industrial sites in continual operation. Community-scale projects are most effective where a range of different heat and cooling demands (residential flats, office blocks, municipal buildings) are aggregated within the system to ensure broadly constant overall demand. However, the costs of generating electricity using CHP are often higher than for standard centralised generation, even though there is a financial return for the heat that can be sold.

3.35 Therefore, in recognition of the carbon savings Good Quality CHP offers, Government has introduced a number of support measures to encourage development of such schemes, including:

- exemption from the Climate Change Levy;
- Business Rates exemption;
- full reward for the carbon saving of CHP under the allocations for EU ETS Phase II, which will inform our thinking for Phase III;
- Enhanced Capital Allowances for power stations and equipment; and
- Renewable Obligation Certificate (ROC) eligibility for the biomass element of fuel used in energy from waste plants that utilise CHP, as explained in chapter 5.

84 Good Quality CHP denotes those schemes that meet the energy efficiency criteria prescribed by the UK's CHP Quality Assurance Programme (CHPQA). Such schemes are entitled to certain financial benefits. Further information on the programme can be found at www.chpqa.com.

85 Source: data from the CHPQA programme on a "best available technology" basis. The range reflects the use of a range of technology types at the margins of the size boundaries and the use of alternative counterfactuals for the efficiency of a gas plant.

3.36 In addition to these measures to make CHP more financially attractive, Government has taken steps to increase awareness of the opportunities for CHP amongst users of heat. Since the publication of the Energy Review Report, DTI has published revised guidance for power station developers which includes industrial heat maps. We will work to develop those heat maps with Regional Development Agencies (RDAs) and local authorities.

3.37 Defra will work with local authorities on guidance to ensure that anyone replacing a mid-sized furnace as part of a boiler plant (over 400kW) is aware of the potential for CHP. In addition, the proposals announced here on export reward, market and licensing arrangements and connections will potentially improve the economics of CHP schemes.

Microgeneration Strategy

3.38 In March 2006, Government published the Microgeneration Strategy: *Our Energy Challenge: Power from the People.*[86] It aims to create conditions under which microgeneration becomes a viable source of energy generation for homes, communities and businesses. Actions to address the constraints on the uptake of microgeneration are summarised below.

Cost constraints

3.39 The costs of installing microgeneration technologies are relatively high. The aim of the Government's £86 million Low Carbon Buildings Programme, launched in 2006, is to demonstrate the potential of microgeneration technologies, and also stimulate the market by demonstrating their potential and providing grants to householders, public, not for profit and commercial organisations across the UK to cover installation cost. The aim of the programme is to drive up demand for microgeneration which in turn will lead to price reductions, making it more accessible across the board.

3.40 Further financial incentives include:

- rewarding the export of excess electricity, as discussed later in this chapter
- benefits associated with Renewable Obligation Certificates (ROCs), Climate Change Renewables Levy Exemption Certificates (LECs) and Renewable Energy Guarantees of Origin (REGOs). Clear guidance outlining the benefits of each and explaining how to obtain these will be published shortly. A typical domestic microgenerator would generate renewable electricity with a ROC value of around £40 at current market prices. However, as the Renewable Obligation was designed to support large-scale renewable generation, it has been difficult for householders to access this value. The changes to the Renewable Obligation introduced in April 2007, which are set out in chapter 5, are designed to remedy this.

86 http://www.dti.gov.uk/energy/sources/sustainable/microgeneration/strategy/page27594.html

Technical constraints

3.41 We are addressing a number of technical constraints to make it easier for microgenerators to connect to the grid. The smallest[87] microgenerators no longer need to obtain permission to connect to the network, and new wiring regulations will be published in January 2008 that will make it easier to connect microgenerators into existing electrical installations. DTI is working in partnership with Ofgem, energy supply companies and Distribution Network Operators (DNOs)[88] to ensure that network and market systems are able to cope with growing demand for microgeneration.

3.42 As discussed in chapter 2, smart metering is key to the overall development of the energy market and in particular allowing more sophisticated import and export tariffs to be introduced. It is important that smart meters interact intelligently with microgeneration.

Regulatory constraints/opportunities

3.43 The Microgeneration Strategy highlighted the role of Planning and Building Regulations. We are using these policies to support microgeneration. For example, the Code for Sustainable Homes was published in December 2006 along with the consultation on the move towards all new homes being zero-carbon by 2016.

3.44 We believe that the planning regime should be more supportive of microgeneration and, as a first step, we are committed to extending permitted development rights for householders which will mean that, under certain circumstances, planning permission would not be needed before installing microgeneration on a home.[89] This change will take effect in autumn 2007. Government is also considering how a similar approach could be extended to other buildings, for example, relating to agricultural and other commercial uses.

Development of the microgeneration industry

3.45 As well as addressing these constraints, the Microgeneration Strategy aims to help development of microgeneration technologies, in the following ways:

- a map of funding available for microgeneration R&D has been published on the DTI website to point companies to major funding sources in the UK[90];
- a route-map of all technologies is being developed by DTI and industry to address the specific challenges faced by each individual technology;
- DTI is working with the Sector Skills Councils to ensure the skills base develops to support the levels of demand in manufacturing, installing and maintaining microgeneration technologies;
- the Microgeneration Strategy recognises the importance of educating children in energy efficiency through their schools. Schools can access funding through the Low Carbon Buildings Programme; and
- working with industry to move away from grants-based funding to a more sustainable model.

87 The ENA's Engineering Recommendation G83/1 allows this approach for generators up to 16A/phase. This approach applies up to a total generation capacity of around 4kW (micro-wind turbines and domestic CHP units are typically 1kW devices).

88 A DNO is an entity licensed to distribute electricity through cables and has a duty to provide connections to premises.

89 http://www.communities.gov.uk/index.asp?id=1508888. The Communities and Local Government consultation period closes on 27 June 2007.

90 http://www.dti.gov.uk/energy/sources/sustainable/microgeneration/strategy/implementation/page36314.html

Distributed Generation (DG) Review

3.46 Beyond this range of existing measures, the Energy Review Report in July 2006 announced a joint DTI/Ofgem Review of the specific barriers to DG (including CHP). DG refers specifically to those decentralised technologies which generate electricity, and are connected to the distribution grid, as well as transmission-connected CHP[91]. The full DG Review Report is published separately alongside this White Paper[92].

3.47 The UK energy market was established to meet the needs of large centralised generation. Aspects of the system disadvantage smaller players, such as distributed generators, particularly those involved in community generation projects. The system was also generally designed for one-way flow of electricity from large power stations, through the high-voltage transmission grid and into distribution networks across the country, rather than the sharing of electricity around sites within a distributed, more community-based network.

3.48 Some decentralised technologies (such as wind and solar) generate electricity intermittently, whilst CHP schemes primarily respond to the demand for heat rather than electricity. Consequently, the output of distributed generators often does not exactly match the electricity demand profile of particular consumers. As electricity cannot easily be stored, DG therefore requires the ability to both import from and export to the distribution network.

3.49 We consulted widely as part of the review. Key barriers to DG, identified by interested parties, were:

- **Cost** – DG technologies tend to have relatively high capital costs, being largely non-mass produced. The rewards for exporting excess electricity produced by distributed generators are seen as small and difficult to access. More generally, the true cost of carbon is not yet fully reflected in the price of electricity, which disadvantages lower carbon technologies.
- **Lack of reliable information** – there was a low awareness of DG options amongst potential consumers; grants and rewards such as ROCs were perceived as being hard to access; and the lack of a comprehensive accreditation scheme for suppliers and installers put people off untried technologies.
- **Electricity industry issues** – due to the nature of the existing network structure, it could be hard for small generators to connect to the centralised system, and the DNOs did not approach the connection of distributed generators in a sufficiently positive way. The cost to suppliers of rewarding small generators for exporting their excess electricity was a further disincentive to the industry.
- **Regulatory barriers** – the difficulties of getting planning permission for DG technologies was raised, especially in the context of community developments and new housing, where the associated costs and delays acted as a disincentive.

91 Most centrally-generated electricity is transported via the high-voltage transmission grid, only stepping down onto the lower voltage distribution grid to complete its journey from the power station to the customer. Transmission-connected CHP is included because the heat will be used locally.

92 http://www.dti.gov.uk/energy/whitepaper

3.50 In the context of Government's overall energy policy goals, we believe that any action to address these barriers should:

- stimulate take up of cost-effective, low-carbon forms of distributed generation;
- provide a means of enabling distributed generators to realise a reasonable economic value from their schemes;
- reduce complexity involved in setting up as a distributed generator. Requirements on these smaller players should be proportionate to their size and the use they make of the wider public network; and
- encourage, where possible, further development of DG within the licensed framework, rather than outside of it.

3.51 In light of these principles, the Government proposes a four-point package of measures as set out below.

Improving information and awareness

3.52 There is a lack of comprehensive and user-friendly information on DE. Some help (including from Government) is available to support householders, local authorities and developers to implement DE solutions, but the information is patchy or located in a variety of places. In some cases the required information does not exist.

3.53 Chapter 2 sets out the Government's strategy for getting citizens more engaged in combating climate change and advising them on how to reduce their carbon footprint. Defra launched a communications campaign in April to promote their "Act on CO_2" brand, including a CO_2 calculator. A key aim of this campaign is to encourage behaviour change and get the general public to take steps to reduce their carbon emissions.

3.54 As part of this, we intend to improve the provision of information and advice on DE, including:

- providing information about different technologies and how they work in the household, alongside the advice to households on energy efficiency set out in chapter 2;
- ensuring the availability of guidance on the potential benefits of microgeneration including how to maximise the financial benefits (grants, access to ROCs, export reward); and
- providing information for local authorities and developers on how to use DE to help achieve their emission reduction goals, including the role of planning policy, information on specific technologies, the role of Energy Service Companies and other financing options. We are considering how we could improve the advice and support available to the Core Cities and Local Authorities to help them deliver key opportunities for carbon abatement, including DE and innovative programmes of support for householders. DTI, Defra and CLG will jointly publish a report by August 2007 to help local authorities[93] meet our climate change objectives including by increasing levels of microgeneration and DE.

93 Local authorities in England and Wales will be under a statutory duty to have regard to this report in exercising their functions.

3.55 In addition to the provision of information we will improve confidence by introducing a microgeneration certification scheme covering products, installers and manufacturers. This will provide consumers with independent certification of microgeneration products and services, and a route for complaints. A pilot scheme[94] covering product installation, and a Code of Practice, opened for the transition phase in May 2007, building on the existing Clear Skies and Solar PV accreditation schemes. It will be supported by DTI initially, with the objective of the industry taking the responsibility for it in due course.

We will ensure that this improved information on DE provides a comprehensive picture of all the options, costs and benefits to help accelerate the take up of DE. We will keep under review the need for further measures.

More flexible market and licensing arrangements

3.56 Licences are required for the generation, distribution and supply of electricity,[95] though in some circumstances exemptions are applicable[96]. Licensed parties have to comply with a range of licence conditions to ensure, amongst other things, the safe distribution and supply of electricity, and to provide consumer protection. Licences also require the licensee to be a party to relevant industry codes, which are technically complex and therefore require significant expert resource to understand and comply with; the kind of resource that the smaller distributed generators do not have.

3.57 The wholesale electricity market was established around a centralised model. Therefore, the complexities and associated costs facing small generators in fully participating in this market, and the obligations that suppliers have to meet to trade across public networks, are significant discouragements to DG. Those that have established DG schemes have reported that success has come from finding solutions in spite of the system, rather than because of it.

3.58 For example, the Woking Borough Council DG scheme uses a private network, making full use of the licensing exemptions framework, to avoid the costs and complexities. Exemptions take enforcement of issues related to consumer choice, protection and safety largely outside of the remit of the regulator; on a small scale this has minimal impact on the market. However, in the future, as we hope to move towards increased levels of DG across the country, Government is committed to improving the market opportunities so that DG can flourish inside the licensed framework.

94 http://www.ukmicrogeneration.org.uk

95 Apart from transmission connected CHP schemes, for the majority of DG schemes transmission licences are not applicable.

96 The Electricity (Class Exemptions from the Requirement for a Licence) Order 2001 provides for those that generate, distribute or supply specified, smaller amounts of electricity to remain exempt from the need to be licensed. Most DG schemes fall inside the exemption limits for generation. Such an unlicensed generator who supplies up to 5MW in aggregate, of which no more than 2.5MW is supplied to domestic consumers, can supply electricity across public networks, therefore making use of both the generation and supply exemptions framework.

3.59 Ofgem has proposed fundamental simplifications to the existing supply licence, and implementation of the modified licence is planned for June 2007 this year. It will contain half the number of standard conditions and will set out simpler, clearer obligations. It will retain only those obligations necessary for the energy market to function properly and to protect the interests of customers, especially those who are vulnerable. However, there is a requirement for a broader review of industry arrangements, including those relating to energy trading, to facilitate DG.

To address these barriers DTI and Ofgem will consult later in 2007 on options for more flexible market and licensing arrangements for distributed low-carbon electricity within the licensed framework, to be implemented by the end of 2008.

3.60 One important future model for delivering DG is the Energy Services Company (ESCo). The Government will be taking forward further work to examine the potential role of ESCos and ways in which we can support their development. Box 3.2 explains the concept and summarises current government action in this area.

BOX 3.2 ENERGY SERVICE COMPANIES (ESCOS)

An ESCo is a company that provides a customer with energy supply solutions (such as heating and lighting) rather than simply gas and electricity. An ESCo could provide a customer with a combination of energy-saving advice and equipment, renewable generation, planned maintenance, fuel and finance. Government recognises that ESCos offer a useful model for market delivery of its energy objectives, as they can bring together different areas of expertise, skills and investment to facilitate the cost-effective development and implementation of distributed energy systems.

Government's role in providing the framework to enable ESCos to develop involves:

- providing the right incentives through the development of efficient energy and carbon markets;
- removing barriers, such as addressing poor quality information on energy consumption through improved billing and metering. Ofgem has proposed the removal of the 28-day rule as part of its Supply Licence Review, and this has already been subject to extensive consultation. This Review will enable suppliers and consumers to reach longer-term agreements and facilitate the energy services approach;
- addressing lack of awareness and expertise by providing information and encouraging the sharing of experience among public sector, utility, corporate and financial stakeholders;
- overcoming risk and uncertainty by setting a standard framework for processes (such as contracts) and facilitating accreditation; and

BOX 3.2 continued

- ensuring competitive market conditions by making it easier for new market entrants while maintaining service standards.

Following the commitment in the Local Government White Paper, we will continue to work with the Core Cities to identify opportunities for low-carbon energy services, where developing a relationship with an ESCo could lead to better delivery of carbon emissions reduction. We will also work with the British Council of Shopping Centres to take forward the option of DG in new shopping centre developments.

Clearer export rewards for smaller generators

3.61 Many distributed generators produce more electricity than they need. This excess electricity can be sold ("exported") to suppliers in order to earn some extra income for the generator and supply a small amount of electricity to the system.

3.62 Suppliers are not currently required to make an offer for exported electricity. Most suppliers do now offer tariffs, but few of these tariffs are widely advertised and the terms vary considerably between suppliers. This makes it difficult for customers to determine which tariff will best meet their circumstances.

3.63 The tariffs available generally offer a lower price for exported electricity than the retail price for imported electricity. This reflects the expected difference between wholesale and retail price in any market, including the cost of transporting the exported electricity to a customer and the transaction costs for the supplier. In many situations where traded volumes are small it is, in fact, uneconomic (at present) for suppliers to purchase this electricity.

3.64 Transparency of prices offered by each supplier for exported electricity in a simple and easy to understand format is the first step to addressing this barrier.

All six major energy suppliers have now committed to publishing easily accessible export tariffs.

3.65 There are a number of technical changes that would help suppliers to cut their administration costs, thus making it more cost-effective to offer a tariff for exported electricity. We welcome the engagement of industry thus far on these changes, and will continue to work with them to progress this work.

3.66 We will keep under review whether it is necessary to use the powers granted under The Climate Change and Sustainable Energy Act 2006,[97] which allows Government, from August 2007, to vary supply licences to require suppliers to offer to acquire electricity exported by their customers. Our decision will be informed by Ofgem's work, announced in Budget 2007, to examine how green homes could benefit more from prices paid for electricity exported to the network, and how the market for rewarding microgenerators develops.

Facilitating connections for distributed generators

3.67 Distributed generators can range in size from a few KW to 100 MW or sometimes more. The smallest microgenerators no longer need permission from a DNO to connect to the distribution network – they can simply connect and inform the DNO that they have done so[98]. Generators above this limit, however, need to go through a more onerous process and several responses to the DG Call for Evidence[99] suggest that DNOs could make the connection process quicker and easier for their customers. In line with the Government's desire for DG to compete on a level playing field with conventional generation, the Government believes that it is important that distributed generators can connect to the grid easily and efficiently.

3.68 There is no evidence of fundamental technical barriers to connection for DG[100]. Instead the process for connection needs to be simplified for DG to make it more accessible and cost-effective. We recognise the significant progress that has been made in addressing barriers, much of it through the Energy Networks Strategy Group (ENSG) co-chaired by DTI and Ofgem.

3.69 However, more is needed to ensure that DG can play its full part. The Government welcomes Ofgem's initiatives to:

- extend cost-reflective charging to the distribution network. This benefits local generation because it potentially allows credits to generators where they provide benefits to the network;
- extend its Innovation Funding Incentive to the end of the next price review period (likely to be 2015) and to extend eligibility for Registered Power Zones to generation connected in the next five years;
- allow developers of DG a choice of connection provider
- review during 2008, as part of the next price control review, the incentives and investment drivers for DNOs to connect DG; and
- review how the DNOs' Long-Term Development Statements can be made more useful to distributed generators.

3.70 More broadly, it will be important for network operators to invest in the light of these longer-term developments. We have funded work on long-term scenarios through the ENSG and we welcome Ofgem's plans to undertake long-term analysis (see chapter 5). Taken together, these connections

97 Sections 7 and 8, Climate Change and Sustainable Energy Act 2006: http://www.publications.parliament.uk/pa/cm200506/cmbills/017/2006017.pdf

98 See footnote 87

99 http://www.dti.gov.uk/energyreview/implementation/distributed-energy/page35076.html

100 http://www.dti.gov.uk/files/file31648.pdf: Econnect carried out a study of the network reinforcement costs for increasing DG penetration. It found that almost 20% penetration of microgeneration could be accommodated without network reinforcement, but that for larger DG power stations, average reinforcement costs will rise from current levels. More details are in the DG Review Report.

measures should better facilitate the connection of DG to distribution networks. This will increase incentives for DG and increase the possibility for DG to compete alongside centralised generation to supply GB's electricity needs.

3.71 The Ofgem-chaired Transmission Arrangements for Distributed Generation Group (TADG) is currently considering the interaction between DG and the transmission system, and plans to report its findings later this month. Many respondents to the Call for Evidence were concerned that this work could be detrimental to DG, by eroding the "embedded benefits" that reward DG for the network benefit it brings. The Government would not want to see additional barriers erected to DG. However, charges should be cost-reflective, with charges being proportionate to the costs imposed, and with parties appropriately rewarded for any benefit contributed. In general, the Government believes that the burden of regulation on a distributed generator should be proportionate to its use of the network.

Driving demand for DE at local and regional level

3.72 Local authorities and regions have a key role to play in facilitating the development and uptake of DE – as community leaders, through their knowledge of local opportunities, and through their powers and responsibilities for planning and regeneration. Some local authorities and regions are already at the cutting edge of efforts to develop DE schemes in the UK. Government has taken steps to support this drive for low carbon energy generated locally, particularly in its planning and development policy. Government has made it clear that it expects all planning authorities to make full use of the positive approach to renewables set out in Planning Policy Statement 22 on Renewable Energy.

3.73 Chapter 2 sets out the additional measures that the Government is taking to improve energy efficiency and reduce the carbon footprint of the built environment. The Government's ambition is that all new housing development in England should, by 2016, be zero carbon, and has consulted on a timetable for moving towards that standard[101]. The measures to support the move towards zero carbon homes and development, and thereby stimulate demand for DE include in particular:

- the draft Planning Policy Statement: Planning and Climate Change which expects planning to be a positive force for change by helping to create an attractive environment for innovation and for the private sector to bring forward investment in renewable and low carbon technologies;
- measures to improve the energy performance of Building Regulations so that over time all new homes meet the energy and carbon standards set out in the Code for Sustainable Homes;
- time-limited stamp duty exemption for new zero carbon homes[102]; and

101 http://www.communities.gov.uk/pub/173/BuildingaGreenerFutureTowardsZeroCarbonDevelopment_id1505173.pdf

102 From 1 October 2007, all new zero-carbon homes costing up to £500,000 will pay no stamp duty, with zero-carbon homes costing in excess of £500,000 receiving a reduction in their stamp duty bill of £15,000. The exemption will be time-limited for 5 years until September 2012, with the Government considering the case for an extension before then. For further details see Budget Note 26 in http://www.hm-treasury.gov.uk/media/757/0A/bud07_budgetnotes_381.pdf

- low to zero-carbon demonstration projects – notably the Carbon Challenge and the Thames Gateway study. In the Thames Gateway, CLG will be supporting the development of decentralised energy projects in specific locations such as Barking, and by working with English Partnerships to develop a portfolio of energy projects that a future ESCo could take forward.

3.74 The English Regions, particularly through the RDAs with their role in supporting sustainable economic development, regeneration and innovation, will play an important role in identifying and securing opportunities for distributed energy. As well as their role in helping developers identify potential customers for heat, RDAs will act to support innovative energy financing and delivery models in their regions. RDAs will also support the development of DE projects (such as anaerobic digestion plants) for example, by supporting the development of energy supply chains and skills, and by ensuring regeneration projects meet high standards of carbon efficiency.
This is covered in more detail in chapter 9.

Next steps

3.75 The measures in this chapter should substantially improve the environment for DE in the UK. The measures to promote lower carbon developments will drive demand for decentralised heat and electricity generation. Meanwhile,
a number of barriers to DE projects are being removed, making DE a more realistic alternative to the traditional, centralised approach.

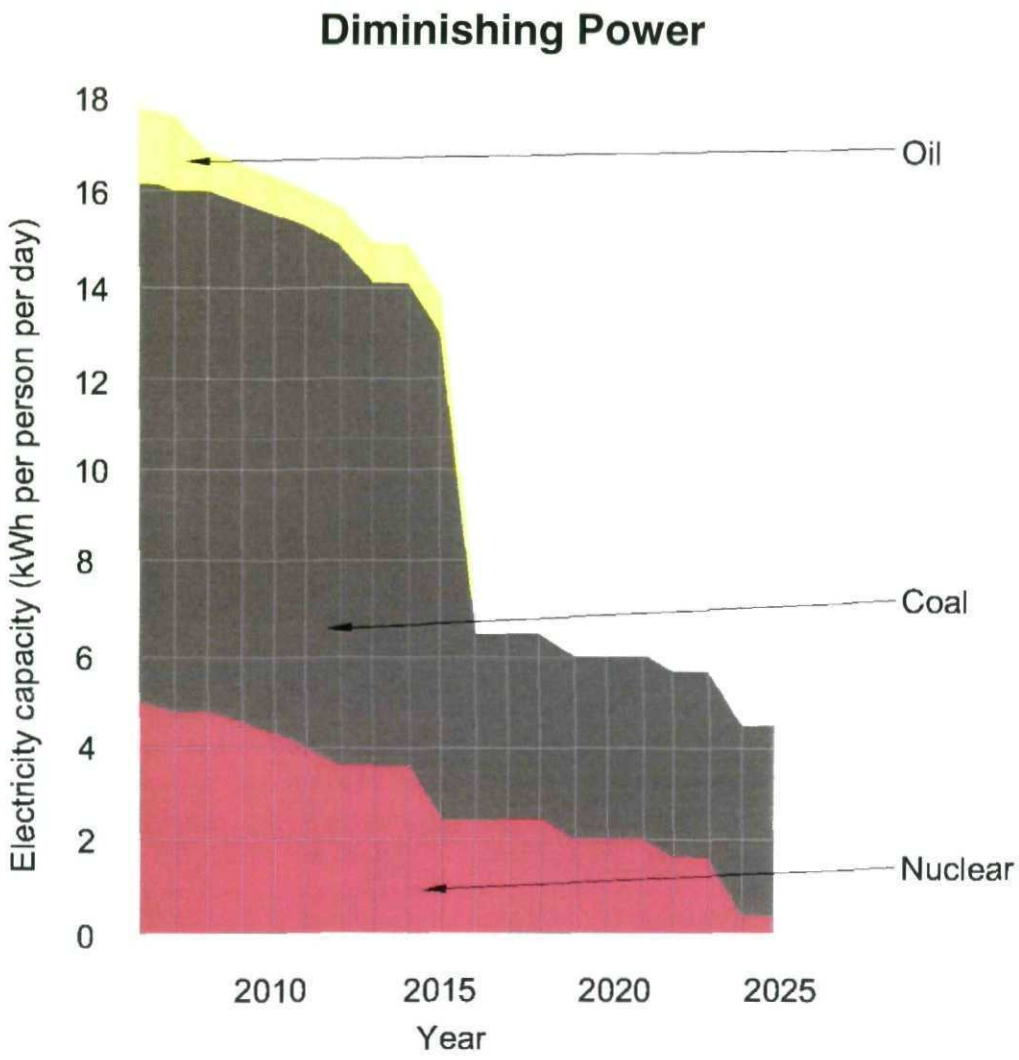
3.76 It is for the market to decide on the best mix of technologies but we are committed to ensuring that DE solutions have a real opportunity to compete. We are establishing a new Distributed Energy Unit within the DTI to monitor the development of markets for these technologies, to drive the implementation of these measures and to ensure that any further barriers to DE that may be identified are addressed. Our further work will take account of the impact of these measures and proposals for implementing the EU renewables target, as they are developed over the next few years.

Distributed Energy Summary of Measures

- **to remove barriers and encourage more widespread deployment of distributed generation we are bringing forward a package of measures, including:**
  - **information, and guidance on options in distributed generation;**
  - **more flexible market and licensing arrangements for distributed, low-carbon electricity supply, within the licensed framework, to be implemented by end 2008;**
  - **more clarity on the terms offered by energy suppliers to reward micro-generators for the excess electricity they produce and export; and**
  - **making it easier to connect to and use the distribution network.**
- **these measures will support the drive for distributed energy from the Government's move to zero carbon homes;**
- **we are conducting further work into policy options to reduce the carbon impact of heat, including reviewing the impact of the range of existing mechanisms;**
- **we are publishing the UK Biomass Strategy to maximise the supply and use of biomass – wood, energy crops, waste, and more – in the production of sustainable energy; and**
- **we are continuing to take forward implementation of the Microgeneration Strategy, announced last year, including making it easier to get planning permission and providing funding to help meet the costs of installation.**

Annex 3

(UK Power Stations Closures)



Uk power station closures, as projected by energy company EDF

Annex 4

(Supply of STOR assessment)



An assessment of the long-term supply of STOR in the UK and how the Green Frog Power model acts as an Enabling Technology to other Intermittent Renewables in this regard.

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1 **What is STOR and why is it important for our low carbon future and security of supply?**

2 **The technical constraints in delivering STOR to the National Grid.**

1 What is STOR and why is it important for our low carbon future and security of supply?

STOR (Short Term Operating Reserve) is the term used by the National Grid to define its requirements for standby generation at times of 'stress' or demand pressure on the National Grid – STOR is what keeps the lights on when things don't quite go to plan. It is part of a larger process used by the National Grid to balance the demand and supply on the network.

The requirement for STOR capacity has been calculated to double in the coming decade from 4GW to 8GW (National Grid 'Future Balancing Services Requirements: Response' 2009).

This is set against a potential current trend and market research which indicates that volumes tendered into the STOR market under current tendering regimes over this same period will actually fall.

This increased requirement for STOR is as a result of three main factors :-

- The increased reliance on renewable energy, notably wind which is in itself unpredictable. A larger portion of the overall capacity of the network is not certain – when the wind does not blow! This needs to be covered by STOR.
- The proposed increase in size of the next generation of nuclear power plants from 1.2MW to 1.8MW each has a similar demand increase: In the event of one of these new generation stations coming off line a larger amount of power is lost that must be covered by STOR generation.
- The general predicted increased use of power. This is not so certain as different models predict both rises and reductions in overall power usage in coming years. In this analysis we have opted for the figures produced by the National Grid's analysis of the 'Gone Green Scenario' which shows a slight overall fall in demand from 60,000 MW 2009/10 to 58,700 MW 2025/26.
- There is also a large interim demand to be covered as many of our existing coal and nuclear power plants are due to come off line in the next decade before the full benefits of the renewables have time to be developed.

Government Figures released by the DTI in its Energy White Paper – Meeting the Energy Challenge (p129) states that a total of 22.5 GW of generating capacity will be gone by 2020. By 2025 there will be further coal plant closures and just one of our existing nuclear power stations will still be working. This represents almost 50% of our existing capacity.

The main requirement of STOR generation is that it is available onto the network within 6 minutes of a 'call up' by the National Grid. Green Frog Power have developed a technology that is able to do this. It is the most efficient technology available to fulfil this requirement. In so doing we are able to 'support' the other renewable technologies and allow them to proliferate without fear of an under supply (blackouts) on the network.

Both main political parties have identified standby generation as core to their future energy plans. The Department of Energy and Climate Change DECC are quoted as saying "On the issue of ageing power stations, doing nothing will mean losing our ability to supply enough electricity at times of peak demand, especially when other factors – like unusually cold weather - put the grid under additional strain.' In July 2009 DECC published a forecast showing that 'expected energy unserved' (blackouts) would rise from almost nothing today to 3,000 MW by 2017.

The Chief executive of Ofgem said in February of this year "In 2017 we get to the really sweaty-palm moment in terms of possible shortages. It is the scale of the collapse from 2013 up until 2017 that is profound and worrying."

In summary then standby generation or STOR is an essential tool used by the National Grid to balance the supply and demand side of the network. Greater reliance on intermittent renewable generation requires a greater level of standby generation. It follows therefore that STOR generation is an essential enabling technology to the intermittent renewable generators.

In order to evaluate the level of this enablement we have again used the Ofgem / National Grid 'Gone to Green Scenario' . Please see below:

Positive Reserve Requirements per Annum - Gone Green Scenario

The table below details the average value of STOR required under the Gone Green Scenario

	Installed Capacity MW						Wind Forcast Error (rmse) % of capacity	Predicted STOR requirement MW
Year	Wind	Nuclear	Coal	Gas	Other	Total Demand		
2009/10	2,400	10,400	28,400	27,500	10,500	60,000	10.00%	4,300
2010/11	3,200	9,400	28,400	29,300	10,500	60,100	10.00%	4,400
2011/12	4,200	9,400	28,400	30,100	10,900	59,600	9.56%	4,501
2012/13	6,300	9,400	27,400	31,600	11,100	59,900	9.12%	4,727
2013/14	8,100	9,400	25,400	31,600	11,000	60,100	8.68%	4,889
2014/15	9,800	9,400	24,300	32,500	10,900	60,400	8.22%	5,027
2015/16	11,300	9,400	23,100	33,800	7,900	60,400	7.78%	5,119
2016/17	13,500	7,100	23,100	33,200	8,000	60,300	7.34%	5,261
2017/18	16,200	7,100	22,700	34,400	8,100	60,200	6.90%	5,420
2018/19	20,700	6,000	20,800	34,200	9,000	60,100	6.46%	5,695
2019/20	24,700	5,300	19,800	34,200	9,500	59,900	6.00%	6,878
2020/21	29,400	6,900	19,800	34,200	8,800	59,600	6.00%	7,223
2021/22	30,400	6,900	19,800	33,100	8,900	59,400	6.00%	7,290
2022/23	31,400	8,600	16,800	33,700	9,200	59,200	6.10%	7,402
2023/24	32,300	8,600	16,800	34,400	9,300	59,000	6.20%	7,508
2024/25	33,300	9,700	15,800	32,700	9,700	58,800	6.30%	7,619
2025/26	34,200	9,700	13,900	30,900	11,000	58,700	6.40%	7,734

rmse = Root Mean Square Error
* Actual

Calculating the enablement value of STOR to wind generation

If we assume that all of the existing STOR providers remain as such for the next 15 years then new providers will be needed of 3,434MW. This will enable the development of an additional 31,800 MW of wind power.

As nuclear generation under this scenario remains constant with a slight fall of 700MW and existing coal is replaced by clean coal and wind. It is relatively simple to calculate:

2010

STOR requirement /MW of total capacity	0.072 MW
Therefore STOR requirement total for wind generation	**172** MW

2025

STOR requirement /MW of total capacity	0.132 MW
Therefore STOR requirement total for wind generation	**4,506** MW
STOR requirement increase for wind generation	**4,334** MW
To enable additional wind generation to replace existing coal generation	**31,800** MW

Produced with kind premission of Ofgem and National Grid

It must be accepted that any such analysis over such a long time frame is to a certain extent subjective. However, it cannot be argued that increased STOR capacity is a prerequisite of any intermittent renewable generation on the network.

The use of highly efficient fast start engines running for only 150 hours per annum is the most efficient available technology to fill this essential role in securing the UK's power supplies as the transition to a low-carbon economy takes place over the next two decades.

2 The technical constraints in delivering STOR to the National Grid.

In order to be responsive and fulfil the requirements to the National Grid new entrants to the STOR market need to be able to provide efficient and reliable generation within 6 minutes of call up. This in and of itself presents a number of technical constraints.

Currently only open cycle gas turbines (OCG) and reciprocating engines (gensets) are able to do this from a standing start, i.e. from start up to delivery of synchronised power being delivered into the network.

OCG is some 12-30% less efficient than a genset in terms of power produced per unit of fuel. It is very much louder and is far less flexible in capacity as units tend to start at 25MW whereas gensets can be anything from 0.25MW upwards.

Using the Green Frog Power system, smaller generation can be connected to the network at 11KVA and below ie at the point of delivery. This avoids the large cable and other transmission losses that are associated with large power stations.

Conclusion

Until there is a breakthrough in non intermittent green energy or people are prepared to accept power cuts it is essential to have back-up for wind power. The greenest and simplest back-up is provided by reciprocating engines, with 100 years of proven history. This enabling technology is low carbon and provides the flexibility to allow the proliferation of wind and other intermittent generation.

Annex 5

(Engine Emissions data)

GAS GENERATOR SET

CATERPILLAR®

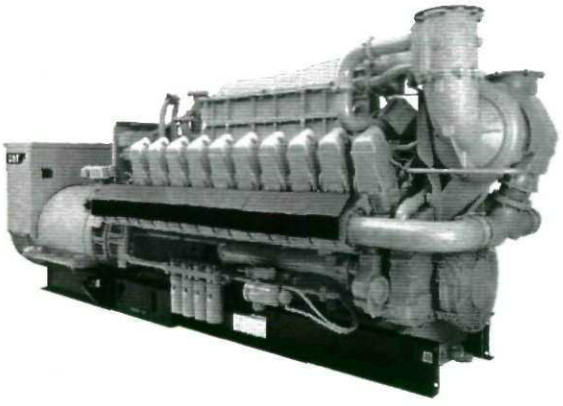


Image shown may not reflect actual package

NATURAL GAS CONTINUOUS 1950 ekW 2438 kVA 50 Hz 1500 rpm 400 Volts

Caterpillar is leading the power generation market place with power solutions engineered to deliver unmatched performance, reliability, durability and cost-effectiveness.

BENEFITS

EMISSIONS

- Meets most worldwide emissions requirements down to 250 mg/Nm³ NOx level without after treatment

FULL RANGE OF ATTACHMENTS

- Wide range of bolt-on system expansion attachments, factory designed and tested
- Flexible packaging options for easy and cost effective installation

PROVEN SYSTEM

- Fully prototype tested
- Field proven in a wide a wide range of applications worldwide
- Certified torsional vibration analysis available

WORLDWIDE PRODUCT SUPPORT

- Caterpillar dealers provide extensive post sales support including maintenance and repair agreements
- Caterpillar dealers have over 1,600 dealer branch stores operating in 200 countries
- The Cat® S·O·S℠ program cost effectively detects internal engine component condition, even the presence of unwanted fluids and combustion by-products

CAT® G3520C GAS ENGINE

- Robust high speed block design provides prolonged life and lower owning and operating costs
- Designed for maximum performance on low pressure gas fuel supply
- Simple open chamber combustion system for reliability and fuel flexibility
- Leading edge technology in ignition system and air/fuel ratio control for lower emission and engine efficiency
- One electronic control module handles all engine functions: ignition, governing, air/fuel ratio control and engine protection
- Island Mode feature improves engine's capability to handle electrical loading and unloading

CAT SR4B GENERATOR

- Designed to match performance and output characteristics of Caterpillar gas engines
- Industry leading mechanical and electrical design
- High efficiency

CAT EMCP II+ CONTROL PANEL

- Simple user friendly interface and navigation
- Digital monitoring, metering and protection setting
- Fully featured power metering and protective relaying
- UL 508A Listed
- Remote control and monitor capability options

CONTINUOUS 1950 ekW 2438 kVA
50 Hz 1500 rpm 400 Volts

CATERPILLAR®

FACTORY INSTALLED STANDARD & OPTIONAL EQUIPMENT

System	Standard	Optional
Gas Engine Control Module (GECM)	• Fuel/air ratio control • Start/stop logic: gas purge cycle, staged shutdown • Engine Protection System: detonation sensitive timing, high exhaust temperature shutdown • Governor: Transient richening and turbo bypass control • Ignition • Island Mode Feature — *additional engine control module,* new software and engine sensores	
Air Inlet	• Two element, single-stage air cleaner with enclosure and service indicator	• Air cleaner with precleaner • Mounting stand
Control Panel	• EMCP II+	• Local alarm module • Remote annunciator • Communications module (PL1000T, PL1000E) • Synchronizing module • Engine failure relay
Cooling	• Engine driven water pumps for jacket water and aftercooler • Jacket water and SCAC thermostats • ANSI/DN customer flange connections for JW inlet and outlet Cat flanges on SCAC circuit	• Coolant level drain line with valves, fan with guard • Inlet/Outlet connections
Exhaust	• Dry exhaust manifolds, insulated and shielded • Center section cooled turbocharger with Cat flanged outlet • Individual exhaust port and turbocharger outlet wired to • Integrated Temperature Sensing Module (ITSM) with GECM providing alarms and shutdowns	• Flange • Exhaust expander • Elbow • Flexible fitting • Muffler and spark-arresting muffler with companion flanges.
Fuel	• Electronic fuel metering valve • Throttle plate, 24V DC actuator, controlled by GECM • Fuel system is sized for 31.5 to 47.2 MJ/Nm³ (800 to 1200 Btu/cu ft) dry pipeline natural gas with pressure of 10.2 to 34.5 kPa (1.5 to 5 psi) to the engine fuel control valve	• Fuel filter • Gas pressure regulator • Gas shutoff valve, 24V, ETR (Energized-To-Run)
Generator	• SR4B generator, includes: Caterpillar's Digital Voltage Regulator (CDVR) with 3-phase sensing and KVAR/PF control Reactive droop Bus bar connections Winding temperature detectors Anti-condensation space heater	• Medium and high voltage generators and attachments • Low voltage extension box • Cable access box • Air filter for generator • Bearing temperature detectors • Manual voltage control • European bus bar
Governing	• Electronic speed governor as part of GECM • Electronically-controlled 24V DC actuator connected to throttle shaft.	• Woodward load sharing module
Ignition	• Electronic Ignition System controlled by GECM • Individual cylinder Detonation Sensitive Timing (DST)	
Lubrication	• Lubricating oil • Gear type lube oil pump • Oil filter, filler and dipstick • Integral lube oil cooler • Oil drain valve • Crankcase breather	• Oil level regulator • Prelube pump • Positive crankcase ventilation system
Mounting	• 330 mm structural steel base (for low and medium voltage units) • Spring-type anti-vibration mounts (shipped loose)	
Starting/Charging	• 24V starting motors • Battery with cables and rack (shipped loose) • Battery disconnect switch • 60A, 24V charging alternator (standard on 60 Hz 1,800 rpm only)	• Charging alternator • Battery charger • Oversized battery • Jacket water heater
General	• Paint — Caterpillar Yellow except rails & radiators • Damper guard • Operation and Maintenance Manuals • Parts Book	• Crankcase explosion relief valve • Engine barring group • EEC D.O.I and other certifications

CONTINUOUS 1950 ekW 2438 kVA

50 Hz 1500 rpm 400 Volts

CATERPILLAR®

TECHNICAL DATA

Generator Set — 1500 rpm/50 Hz/400 Volts		DM 5831	DM 5833	DM 5835	DM 5837
G3520C Gas Generator Set					
Emission level (NOx)	mg/Nm³	447	221	464	230
Aftercooler SCAC (Stage 2)	Deg C	54	54	32	32
Package Performance (1)					
Power Rating @ 0.8 pf (with 2 water pumps and without fan)	ekW Continuous	1950	1950	1950	1950
Power Rating @ 0.8 pf (with 2 water pumps and without fan)	kVA Continuous	2438	2438	2438	2438
Power Rating @ 1.0 pf (with 2 water pumps and without fan)	ekW Continuous	1977	1977	1977	1977
Electric Efficiency @ 1.0 pf (ISO 3046/1) (2)	%	39.5	38.6	39.4	38.6
Mechanical Power (with 2 water pumps and without fan)	bkW	2026	2026	2026	2026
Fuel Consumption (3)					
100% load without fan	Nm³/hr	507	517	507	519
75% load without fan	Nm³/hr	391	399	393	403
50% load without fan	Nm³/hr	275	281	277	284
Altitude Capability (4)					
At 25° C (77° F) ambient, above sea level	M	350	350	360	222
Cooling System					
Ambient air temperature	Deg C	25	25	25	25
Jacket water temperature (Maximum outlet)	Deg C	99	99	99	99
Exhaust System					
Combustion air inlet flow rate	Nm³/min	147	152	147	152
Exhaust stack gas temperature	Deg C	466	470	452	460
Exhaust gas flow rate	Nm³/min	156	161	156	161
Exhaust flange size (internal diameter)	mm	304.8	304.8	304.8	304.8
Heat Rejection (5)					
Heat rejection to jacket water and oil cooler and AC — Stage 1	kW	1017	1044	989	1000
Heat rejection to AC — Stage 2	kW	157	165	228	233
Heat rejection to exhaust (LHV to 25° C)	kW	1749	1822	1708	1814
Heat rejection to exhaust (LHV to 120° C)	kW	1268	1319	1214	1287
Heat rejection to atmosphere from engine	kW	138	138	138	138
Heat rejection to atmosphere from generator	kW	62.4	62.4	62.4	62.4
Generator					
Frame		828	828	828	828
Temperature rise	Deg C	105	105	105	105
Motor starting capability @ 30% voltage dip (6)	skVA	4557	4557	4557	4557
Lubrication System					
Standard sump refill with filter change	L	541	541	541	541
Emissions (7)					
NOx @ 5% O_2 (dry)	mg/Nm³	447	221	464	230
CO @ 5% O_2 (dry)	mg/Nm³	1021	953	979	966
THC @ 5% O_2 (dry)	mg/Nm³	2414	2586	2705	3040
NMHC @ 5% O_2 (dry)	mg/Nm³	363	388	406	456
Exhaust O_2 (dry)	%	9.2	9.4	9.5	9.8

CONTINUOUS 1950 ekW 2438 kVA

50 Hz 1500 rpm 400 Volts

CATERPILLAR®

TECHNICAL DATA

Generator Set — 1500 rpm/50 Hz/400 Volts		DM 5830	DM 5832	DM 5834	DM 5836
G3520C Gas Generator Set					
Emission level (NOx)	mg/Nm³	447	221	459	228
Aftercooler SCAC (Stage 2)	Deg C	54	54	32	32
Package Performance (1)					
Power Rating @ 0.8 pf (with 2 water pumps and without fan)	ekW Continuous	1950	1950	1950	1950
Power Rating @ 0.8 pf (with 2 water pumps and without fan)	kVA Continuous	2438	2438	2438	2438
Power Rating @ 1.0 pf (with 2 water pumps and without fan)	ekW Continuous	1977	1977	1977	1977
Electric Efficiency @ 1.0 pf (ISO 3046/1) (2)	%	39.5	38.6	39.4	38.5
Mechanical Power (with 2 water pumps and without fan)	bkW	2026	2026	2026	2026
Fuel Consumption (3)					
100% load without fan	Nm³/hr	507	517	508	520
75% load without fan	Nm³/hr	391	399	394	403
50% load without fan	Nm³/hr	275	281	278	285
Altitude Capability (4)					
At 25° C (77° F) ambient, above sea level	M	250	250	357	221
Cooling System					
Ambient air temperature	Deg C	25	25	25	25
Jacket water temperature (Maximum outlet)	Deg C	90	90	90	90
Exhaust System					
Combustion air inlet flow rate	Nm³/min	148	152	147	152
Exhaust stack gas temperature	Deg C	454	458	451	458
Exhaust gas flow rate	Nm³/min	157	161	156	161
Exhaust flange size (internal diameter)	mm	304.8	304.8	304.8	304.8
Heat Rejection (5)					
Heat rejection to jacket water and oil cooler and AC — Stage 1	kW	1080	1110	1044	1057
Heat rejection to AC — Stage 2	kW	128	135	198	202
Heat rejection to exhaust (LHV to 25° C)	kW	1727	1800	1705	1810
Heat rejection to exhaust (LHV to 120° C)	kW	1230	1279	1207	1279
Heat rejection to atmosphere from engine	kW	125	125	125	125
Heat rejection to atmosphere from generator	kW	62.4	62.4	62.4	50
Generator					
Frame		828	828	828	828
Temperature rise	Deg C	105	105	105	105
Motor starting capability @ 30% voltage dip (6)	skVA	4557	4557	4557	4557
Lubrication System					
Standard sump refill with filter change	L	541	541	541	541
Emissions (7)					
NOx @ 5% O_2 (dry)	mg/Nm³	447	221	459	228
CO @ 5% O_2 (dry)	mg/Nm³	1030	961	968	955
THC @ 5% O_2 (dry)	mg/Nm³	2680	2872	2755	3089
NMHC @ 5% O_2 (dry)	mg/Nm³	402	431	414	464
Exhaust O_2 (dry)	%	9.4	9.6	9.4	9.7

CONTINUOUS 1950 ekW 2438 kVA

50 Hz 1500 rpm 400 Volts

CATERPILLAR®

DEFINITIONS AND CONDITIONS

(1) Continuous — Maximum output available for an unlimited time.

Ratings are based on pipeline natural gas having a Low Heat Value (LHV) of 35.6 MJ/Nm³ (905 Btu/cu ft) and 80 Caterpillar Methane Number. For values in excess of altitude, ambient temperature, inlet/exhaust restriction, or different from the conditions listed, contact your local Caterpillar dealer.

(2) Efficiency of standard generator is used. For higher efficiency generators, contact your local Caterpillar dealer.

(3) Ratings and fuel consumption are based on ISO3046/1 standard reference conditions of 25° C (77° F) of ambient temperature and 100 kPa (29.61 in Hg) of total barometric pressure, 30% relative humidity with 0, +5% fuel tolerance.

(4) Altitude capability is based on 2.5 kPa air filter and 5.0 kPa exhaust stack restrictions.

(5) Heat Rejection — Values based on nominal data with fuel tolerance of ±2.5% and 2.5 kPa inlet and 5.0 kPa exhaust restrictions.

(6) Assume synchronous driver

(7) Emissions data measurements are consistent with those described in EPA CFR 40 Part 89 Subpart D & E and ISO8178-1 for measuring HC, CO, PM, NOx. Data shown is based on steady state engine operating conditions of 25° C (77° F), 96.28 kPa (28.43 in Hg) and fuel having a LHV of 35.6 MJ/Nm³ (905 Btu/cu ft) and 80 Caterpillar Methane Number at 101.60 kPa (30.00 in Hg) absolute and 0° C (32° F).

Emission data shown is subject to instrumentation, measurement, facility, and engine fuel system adjustment.

CONTINUOUS 1950 ekW 2438 kVA

50 Hz 1500 rpm 400 Volts

CATERPILLAR®

DIMENSIONS

Package Dimensions		
Length	6443.7 mm	253.69 in
Width	1996.4 mm	78.60 in
Height	2254.0 mm	88.74 in
Approx. Shipping Weight	18 350 kg	40,455 lb

Note: Do not use for installation design.
See general dimension drawings
for detail (Drawing # 234-3559).

Performance Number: DM5830
DM5831
DM5832
DM5833
DM5834
DM5835
DM5836
DM5837

Feature Codes: 520GE04
520GE05
520GE07
520GE08

Generator Arrangement: 144-1830

Source: U.S. Sourced

LEHE0005-00 (11-08)

www.cat-electricpower.com

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DIESEL GENERATOR SET

CATERPILLAR®



Image shown may not reflect actual package.

STANDBY
2000 ekW 2500 kVA
50 Hz 1500 rpm 400 Volts

Caterpillar is leading the power generation marketplace with Power Solutions engineered to deliver unmatched flexibility, expandability, reliability, and cost-effectiveness.

FEATURES

FUEL/EMISSIONS STRATEGY
- Low Emissions

FULL RANGE OF ATTACHMENTS
- Wide range of bolt-on system expansion attachments, factory designed and tested
- Flexible packaging options for easy and cost effective installation

SINGLE-SOURCE SUPPLIER
- Fully prototype tested with certified torsional vibration analysis available

WORLDWIDE PRODUCT SUPPORT
- Caterpillar® dealers provide extensive post sale support including maintenance and repair agreements
- Caterpillar dealers have over 1,600 dealer branch stores operating in 200 countries
- The Cat® S•O•S℠ program cost effectively detects internal engine component condition, even the presence of unwanted fluids and combustion by-products

CAT 3516B-HD TA DIESEL ENGINE
- Reliable, rugged, durable design
- Field-proven in thousands of applications worldwide
- Four-stroke-cycle diesel engine combines consistent performance and excellent fuel economy with minimum weight

CAT SR5 GENERATOR
- Matched to the performance and output characteristics of Caterpillar engines
- Industry leading mechanical and electrical design
- Industry leading motor starting capabilities
- High Efficiency

CAT EMCP 3 SERIES CONTROL PANELS
- Simple user friendly interface and navigation
- Scalable system to meet a wide range of customer needs
- Integrated Control System and Communications Gateway

STANDBY 2000 ekW 2500 kVA

50 Hz 1500 rpm 400 Volts

CATERPILLAR®

FACTORY INSTALLED STANDARD & OPTIONAL EQUIPMENT

System	Standard	Optional
Air Inlet	• Single element canister type air cleaner • Service indicator	• Dual element & heavy duty air cleaners (with pre-cleaners) • Air inlet adapters & shutoff
Exhaust	**• Dry exhaust manifold** **• Flanged faced outlets**	**• Mufflers and Silencers** **• Stainless steel exhaust flex fittings** **• Elbows, flanges, expanders & Y adapters**
Fuel	• Secondary fuel filters • Fuel priming pump • Flexible fuel lines • Fuel cooler* *Not included with packages without radiators	• Water separator • Duplex fuel filter
SR5 Generator	**• Class H insulation** **• CAT digital voltage regulator (CDVR) with KVAR/PF control, 3-phase sensing** **• Reactive droop**	**• Premium & oversize generators** **• Winding temperature detectors** **• Anti-condensation heaters**
Power Termination	• Bus bar (NEMA and IEC mechanical lug holes) -right side standard • Top and bottom cable entry	• Circuit breakers, UL listed, 3 pole with shunt trip,100% rated, choice of trip units, manual or electrically operated (low voltage only) • Circuit breakers, IEC compliant, 3 or 4 pole with shunt trip (low voltage only), choice of trip units, manual or electrically operated • Shroud cover for bottom cable entry • Power terminations can be located on the left and/or rear as an option. Also, multiple circuit breakers can be ordered (up to 2)
Governor	**• ADEM™ 3**	**• Load share module**
Control Panels	• User Interface panel (UIP) - rear mount • EMCP3.1 Genset Controller • Voltage and Speed adjust • AC&DC customer wiring area (right side) • Reactive droop • Emergency Stop Pushbuttom	• EMCP3.3 • Option for right or left mount UIP • Local & remote annunciator modules • Load share module • Discrete I/O module • Generator temperature monitoring & protection
Lube	**• Lubricating oil and filter** **• Oil drain line with valves** **• Fumes disposal** **• Gear type lube oil pump**	**• Oil level regulator** **• Deep sump oil pan** **• Electric & air prelube pumps** **• Manual prelube with sump pump** **• Duplex oil filter**
Mounting	• Structual steel tube • Anti-vibration mounts (shipped loose)	• Isolator removal Spring-type isolator, zone 4
Starting/Charging	**• 24 volt starting motor(s)** **• Batteries with rack and cables** **• Battery disconnect switch**	**• Battery chargers (10&20AMP)** **•45 amp charging alternator** **• Oversize batteries** **• Ether starting aid** **• Heavy duty starting motors** **• Barring device (manual)** **• Air starting motor with control & silencer**

STANDBY 2000 ekW 2500 kVA

50 Hz 1500 rpm 400 Volts

CATERPILLAR®

SPECIFICATIONS

CAT GENERATOR

Caterpillar Generator

Frame size..... 1844
Excitation..... Permanent Magnet
Pitch..... 0.6667
Number of poles..... 4
Number of bearings..... 2
Number of leads..... 6
Insulation..... UL 1446 Recognized Class H with tropicalization and antiabrasion
IP Rating..... IP23
Alignment..... Closed Coupled
Overspeed capability - % of rated..... 150
Wave form..... 003.00
Paralleling kit/Droop transformer..... Standard
Voltage regulator.3 Phase sensing with selectible volts/Hz
Voltage regulation..... Less than +/- 1/2% (steady state)
Less than +/- 1% (no load to full load)
Telephone Influence Factor..... Less than 50
Harmonic Distortion..... Less than 5%

CAT DIESEL ENGINE

3516B-HD, V-16, 4-stroke-cycle watercooled diesel

Bore - mm..... 170.00 mm (6.69 in)
Stroke - mm..... 215.00 mm (8.46 in)
Displacement - L..... 78.08 L (4764.73 in^3)
Compression ratio..... 15.5:1
Aspiration..... TA
Fuel system..... Electronic unit injection
Governor type..... ADEM3

CAT EMCP CONTROL PANEL

- EMCP 3.1 (Standard)
- EMCP 3.2 / EMCP 3.3 (Option)
- Single location customer connector point
- True RMS AC metering, 3-phase
- Controls
  - Run / Auto / Stop control
  - Speed adjust
  - Voltage Adjust
  - Emergency Stop Pushbutton
  - Engine cycle crank
- Digital Indication for:
  - RPM
  - Operating hours
  - Oil pressure
  - Coolant temperature
  - System DC volts
  - L-L volts, L-N volts, Phase amps, Hz
  - ekW, kVA, kVAR, kWhr, %kW, PF (EMCP 3.2 / 3.3)
- Shutdowns with common indicating light for:
  - Low oil pressure
  - High coolant temperature
  - Low coolant level
  - Overspeed
  - Emergency stop
  - Failure to start (overcrank)
- Programmable protective relaying functions: (EMCP 3.2 & 3.3)
  - Under and over voltage
  - Under and over frequency
  - Overcurrent (time and inverse time)
  - Reverse power (EMCP 3.3)
- MODBUS islolated data link, RS-485 half-duplex (EMCP 3.2 & 3.3)
- Options
  - Vandal door
  - Local annunciator module
  - Remote annunciator module
  - Input / Output module
  - RTD / Thermocouple modules
  - Monitoring software

STANDBY 2000 ekW 2500 kVA

50 Hz 1500 rpm 400 Volts

CATERPILLAR®

TECHNICAL DATA

Open Generator Set - - 1500 rpm/50 Hz/400 Volts	DM7973	
Low Emissions		
Coolant to aftercooler		
Coolant to aftercooler temp max	30 ° C	86 ° F
Generator Set Package Performance		
Genset Power rating @ 0.8 pf	2500 kVA	
Genset Power rating with fan	2000 ekW	
Fuel Consumption		
100% load with fan	542.7 L/hr	143.4 Gal/hr
75% load with fan	409.7 L/hr	108.2 Gal/hr
50% load with fan	273.4 L/hr	72.2 Gal/hr
Cooling System[1]		
Engine coolant capacity	233.0 L	61.6 gal
Inlet Air		
Combustion air inlet flow rate	178.8 m³/min	6314.3 cfm
Exhaust System		
Exhaust stack gas temperature	511.1 ° C	952.0 ° F
Exhaust gas flow rate	487.6 m³/min	17219.4 cfm
Exhaust flange size (internal diameter)	203.2 mm	8.0 in
Exhaust system backpressure (maximum allowable)	6.7 kPa	26.9 in. water
Heat Rejection		
Heat rejection to coolant (total)	662 kW	37648 Btu/min
Heat rejection to exhaust (total)	2228 kW	126706 Btu/min
Heat rejection to aftercooler	629 kW	35771 Btu/min
Heat rejection to atmosphere from engine	153 kW	8701 Btu/min
Heat rejection to atmosphere from generator	87.7 kW	4987.5 Btu/min
Alternator[2]		
Motor starting capability @ 30% voltage dip	6537 skVA	
Frame	1844	
Temperature Rise	125 ° C	225 ° F
Lube System		
Sump refill with filter	401.3 L	106.0 gal
Emissions (Nominal)[3]		
NOx mg/nm3	1813.3 mg/nm³	
CO mg/nm3	462.8 mg/nm³	
HC mg/nm3	48.7 mg/nm³	
PM mg/nm3	42.3 mg/nm³	

[1] For ambient and altitude capabilities consult your Caterpillar dealer. Air flow restriction (system) is added to existing restriction from factory.

[2] Generator temperature rise is based on a 40° C (104° F) ambient per NEMA MG1-32.

[3] Emissions data measurement procedures are consistent with those described in EPA CFR 40 Part 89, Subpart D & E and ISO8178-1 for measuring HC, CO, PM, NOx. Data shown is based on steady state operating conditions of 77°F, 28.42 in HG and number 2 diesel fuel with 35° API and LHV of 18,390 btu/lb. The nominal emissions data shown is subject to instrumentation, measurement, facility and engine to engine variations. Emissions data is based on 100% load and thus cannot be used to compare to EPA regulations which use values based on a weighted cycle.

STANDBY 2000 ekW 2500 kVA

50 Hz 1500 rpm 400 Volts

CATERPILLAR®

RATING DEFINITIONS AND CONDITIONS

Meets or Exceeds International Specifications: AS1359, CSA, IEC60034-1, ISO3046, ISO8528, NEMA MG 1-22, NEMA MG 1-33, UL508A, 72/23/EEC, 98/37/EC, 2004/108/EC

Standby - Output available with varying load for the duration of the interruption of the normal source power. Average power output is 70% of the standby power rating. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year. Standby power in accordance with ISO8528. Fuel stop power in accordance with ISO3046. Standby ambients shown indicate ambient temperature at 100% load which results in a coolant top tank temperature just below the shutdown temperature.

Ratings are based on SAE J1349 standard conditions. These ratings also apply at ISO3046 standard conditions. **Fuel rates** are based on fuel oil of 35° API [16° C (60° F)] gravity having an LHV of 42 780 kJ/kg (18,390 Btu/lb) when used at 29° C (85° F) and weighing 838.9 g/liter (7.001 lbs/U.S. gal.). Additional ratings may be available for specific customer requirements, contact your Caterpillar representative for details. For information regarding Low Sulfur fuel and Biodiesel capability, please consult your Caterpillar dealer.

STANDBY 2000 ekW 2500 kVA

50 Hz 1500 rpm 400 Volts

CATERPILLAR®

DIMENSIONS

Package Dimensions		
Length	**6358.6 mm**	**250.34 in**
Width	**2286.0 mm**	**90 in**
Height	**2342.0 mm**	**92.2 in**
Weight	**17 332 kg**	**38,210 lb**

NOTE: For reference only - do not use for installation design. Please contact your local dealer for exact weight and dimensions. (General Dimension Drawing #3274640).

Performance No.: DM7973

Feature Code: 516DE5H

Gen. Arr. Number: 3111142

Source: U.S. Sourced

June 08 2009

14155139

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Annex 6

(Letters of support)

CE Electric UK

Date: 04/12/2009

CE Electric UK
98 Aketon Road
Castleford
WF10 5DS

Tel: 01977 605661
Fax: 01977 605811

Mr Mark Jones
Green Frog Power Ltd
Unit 4
Trillennium
Gorsey lane
Coleshill
Birmingham
B46 1JU

Dear Mr Jones

Development of Small Scale Stor Generation Facilities

Following on from our recent meeting, with regard to the develoment of the above I can clarify our current position.

I understand you are submitting planning applications for developments within our existing Primary land holdings, with proposals for connection in to the YEDL Distribution Network.

YEDL has no objections to your proposals and fully supports the development generation of all types and will contribute what ever assistance is required within the remit of our Operting License.

As you are aware the Stor service is used by National Grid not only to provide short time reserve, but without this facility the future development of Green Generation will be compromised as the Stor servcie is also used to balance requirement when some forms of green power which rely on natural resources are not operting at there full capacity.

I wish you ever success in your development and will, as always provide any support that is appropriate.

If you require any further assitance please feel free to contact me accordingley.

Yours sincerely

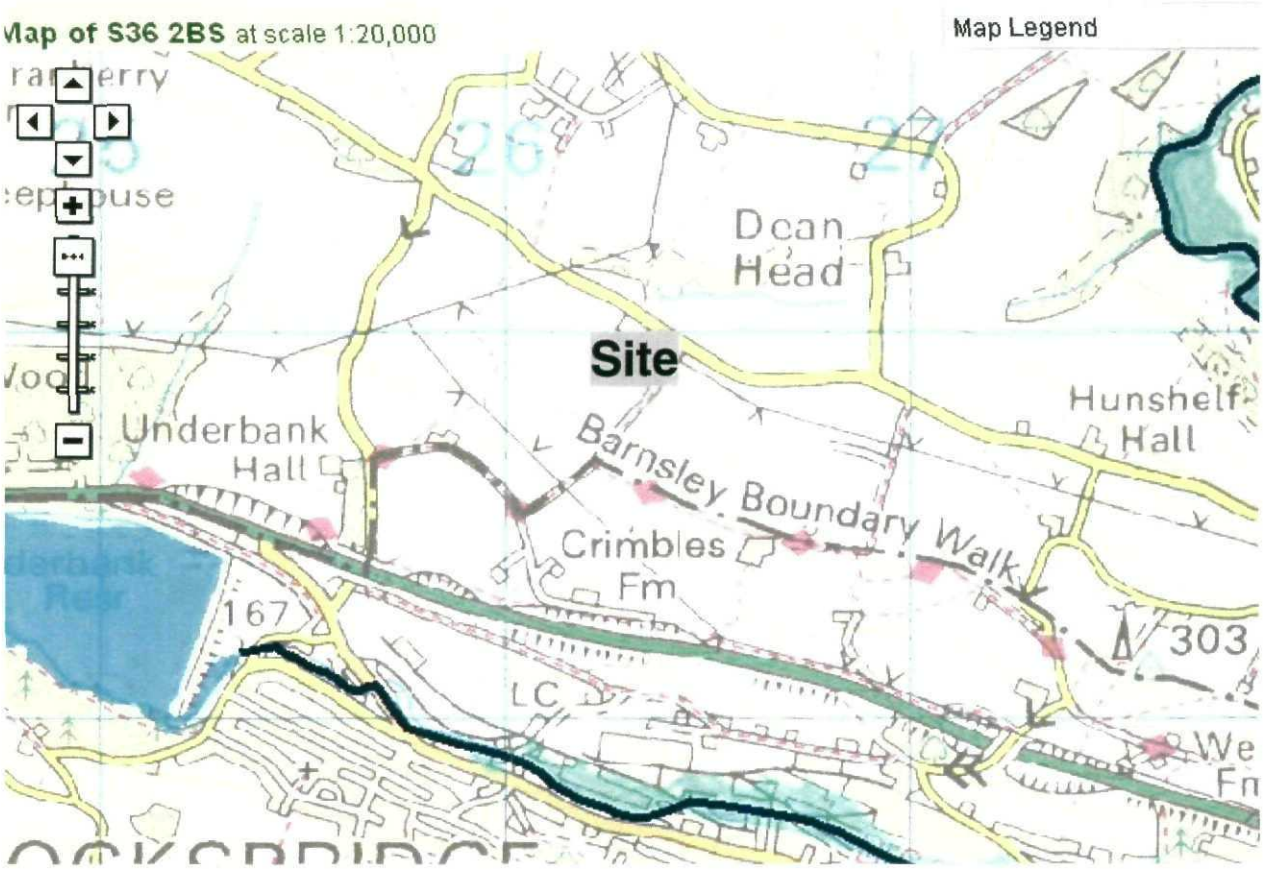


HOWARD KIRKE
MARKET DEVELOPMENT MANAGER
CE ELECTRIC UK

Annex 7

(Flood Risk Map)

Tofts Lane, Hunshelf, Flood Risk Map



Annex 8

(Fuel Spillage Action Plan)

Action Plan
For Fuel Spillages



Prepared by Green Frog Power Ltd
Date: 28th September 2009
Revision A dated 8th march 2010

Potential releases to the land and surface water from the installation have been identified as:

- Accidental spillage during delivery
- Accidental spillage during the movement around the site
- Migration of spilled or leaked material in rain water.

The following summarises the measures to be implemented to minimise releases to land or surface water.

General

The surface water drainage system at the site will be connected to an interceptor before discharging to the main public sewer or local watercourse. This interceptor will be fully overhauled and cleaned prior to the delivery of any DERV to the storage tanks on site.

All tanks will be designed and installed according to the appropriate British Standards and CIRIA Standards. Risk analysis has shown that there is unlikely to be failure of more than one tank without a deliberate act of malice. The tanks bund wall therefore has been designed to contain a minimum of 110% of the largest single tank volume. The structure has been designed to be impervious to the liquids that will be stored.

- **Accidental spillage during delivery**

The loading and unloading of fuel deliveries will be monitored at all times by at least one member of staff in addition to the delivery driver. These staff members will be fully trained in the safe operation of all the equipment involved and aware of the detailed action plan protocol in the event of a spillage. Specialist dry absorbent media would be on hand and used to soak up any spills and dispose of them appropriately off-site waste.

During normal operation, surface water from hard standing areas will be collected via a network of gullies, channels and drains, which will be channelled to the interceptor. To avoid contamination of this water with fuel/oil at accidents of loading/unloading the drains, the loading bays will be closed during loading/unloading procedures.

Hard standing will be tarmac for driveways, and concrete for delivery bays. Along the hard standing areas at the loading bays there will be a watertight kerb, of approximately 100mm in height, to prevent migration of accidental spills beyond the installation boundary.

Site personnel under strict management protocols would deal with minor spillages on to hard standing areas in order to prevent the spill reaching the drainage system. Dry absorbent material will be used to soak up minor spills and this material would then be removed off-site and treated as special waste under current waste handling legislation

- **Accidental Spillage During movement around site.**

In all plant and storage areas, rainwater on the site will be regarded as surface water and collected via a simple piped drainage system and discharged via the interceptor on the site. All roof drainage will be discharged directly into the surface water sewer so as not cross contaminate with hard standing surface water.

All plant areas will have separate sumps for maintenance. Before discharging the content of these sumps to the sewer system they will be inspected by staff and where required the contents of the sump would be pumped to IBC containers for appropriate disposal off site. The emptying of the sumps is manually controlled by staff.

Under normal working conditions, rainwater collected within the tank bund would be regarded as clean. In order that there is an additional safeguard against any spillage reaching the sewer system, the bund will have no direct connection to the sewer system. The base of the bund area will be laid out with a slight slope to direct rainwater towards a sump. A manually operated pump will be located in the sump. An inspection of the bund will be made weekly by the mobile engineers to record water levels. In addition, any excess collected liquid would signal an alarm prompting investigation by site personnel. After taking samples and analysing the rainwater of the bund, the contents would be pumped to the surface water drainage system or watercourse, if it is free from contamination.

For minor spills in the tank bund, the procedures are similar to that in the hard standing areas. Dry absorbent media would be used to soak up spills and dispose of them appropriately off-site waste. Spills undetected at source will be retained by the bund wall and collected in the sumps. It will then be detected by the testing regime prior to pumping and treated appropriately.

In the event of a failure of this nature, the liquid within the bund walls would be pumped out into tankers and the area cleaned as per the management plan. Simultaneously, the alarm system would be activated and staff would isolate the on-site drainage and contain any further contamination.

- **Migration of spilled or leaked material in rain water.**

The above protocols are designed to manage any spillage at the site of a substantial nature. Small scale contamination such as splashes and drips when refilling of tanks and during deliveries will be dealt with by staff at the time. The final safeguard of the migration of minor spilled or leaked materials in rainwater is the on site interceptor which is designed to deal with such materials and will be operated and maintained in accordance with manufactures specifications.

Fuel Proof experts in fuel storage equipment

Chat With Fuel Proof Support
Offline

Product range

Static Bunded Fuelstores
Static Bunded Fuelcubes
Bunded Generator Tanks
Bulk Diesel Storage tanks
Highway Tow Diesel Bowsers
Site Tow Diesel Bowsers
Bunded Waste Oil Tanks
Aviation Fuel Storage

Fuel Dispensing Equipment

Water Storage Equipment

Product quick finder

Fuel pumps

Contact information

Tel: +44 (0)1524 850685
Fax: +44 (0)1524 859681
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Fuel storage equipment | Bulk tanks > Vertical Bulk Diesel Tanks

get a quote click here

Vertical **Bulk diesel tanks**





High security bunded diesel storage equipment

View image gallery | Back to bulk tanks page

Key features

- All steel construction and lockable doors for high security
- Vertical design reduces footprint - ideal for storing fuel in areas with limited space
- Low cost and quick to install - tanks are self-supporting and do not require any civils work prior to installation

Product range & technical details

Capacity (litres/gallons)	Length (mm)	Width (mm)	Height (mm)	Empty weight (kg)	Full weight (kg)
5200 (1140)	2050	2500	2248	1050	5574
10000 (2200)	3000	2300	3200	2800	11500
12500 (2750)	3200	2500	3270	3150	14025
18000 (3950)	3700	3000	3270	3875	19535

Product information
Vertical, cylindrical bulk diesel tanks in capacities from 5,200 litres (1,140 gallons) to 18,000 litres (3,950 gallons). Heavy duty double cylinder design with an all-steel construction. Large fuel cabinet provides access to tank connections and dispensing equipment. Fully bunded and pressure tested inner tanks; built in accordance with the latest environmental regulations. **For use with diesel and gas oil.**

Standard specification

- Double vertical cylinder design with all-steel construction
- Fully bunded tank in accordance with environmental regulations
- Pressure tested inner tank
- Bolted inspection hatch for cleaning and inspection

Fuel Proof™ experts in fuel storage equipment

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Offline

Product range

Static Bunded Fuelstores
Static Bunded Fuelcubes
Bunded Generator Tanks
Bulk Diesel Storage tanks
Highway Tow Diesel Bowsers
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Aviation Fuel Storage

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Industrial **Bulk diesel tanks**





High security bunded diesel storage equipment

Key features

- Double cylinder design with dished ends; constructed from 5mm & 6mm steel
- Heavy duty construction and lockable door for security
- Quick to install - tanks are self-supporting and do not require any civils work prior to installation

Product range & technical details

Capacity (litres/gallons)	Length (mm)	Width (mm)	Height (mm)	Empty weight (kg)	Full weight (kg)
19,000 (4,175)	9800	2570	3295	3834	17434
25,000 (5,495)	9800	2780	3295	5269	21250
30,000 (6,595)	8400	2500	3000	6297	31797
36,000 (7,912)	8400	2500	3000	6297	31797
42,000 (9,230)	9500	2700	3150	7644	41644
50,000 (10,990)	11500	2700	3150	-	-
60,000 (13,155)	13500	2700	3150	-	-

Product description

Heavy duty horizontal bulk diesel tanks in capacities from 10,000 litres (2,195 gallons) to 60,000 litres (13,185 gallons). Heavy duty double cylinder design with dished ends, constructed from 5mm & 6mm steel. Large fuel cabinet provides access to tank connections and dispensing equipment. Fully bunded and pressure tested inner tanks; built in accordance with the latest environmental regulations. **For use with diesel and gas oil.**

Standard specification

- For the storage of **diesel**, **gas oil** or **kerosene**
- Double skin horizontal cylinder design with all-steel construction – 6mm
- 6mm S275 mild steel spun metal dished tank ends
- 110% bund capacity
- 2 point lifting eyes, empty lift only
- Sturdy cradle base with transport tie down points
- Suction line dip tube for fuel delivery - 1" with anti-siphon valve
- 2" BSP fill point
- 2" offset fill pipe

Landscape & Visual Impact Assessment



Proposed small scale standby embedded power plant

Tofts Lane, Hunshelf, Barnsley, S36 2BS

July 2010

Revision A

Produced for:

GreenFrog

by:

Encon Associates Limited
Kestrel Business Centre
Colwick
Nottingham
NG4 2JR

A1403

Date of Report:	July 2nd 2010
Report Reference:	A1403 Revision A (20.07.10)
Issued by:	MJB
Checked by:	GLM

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B - Field Survey Forms

C - Results of Visual Assessment

1 INTRODUCTION

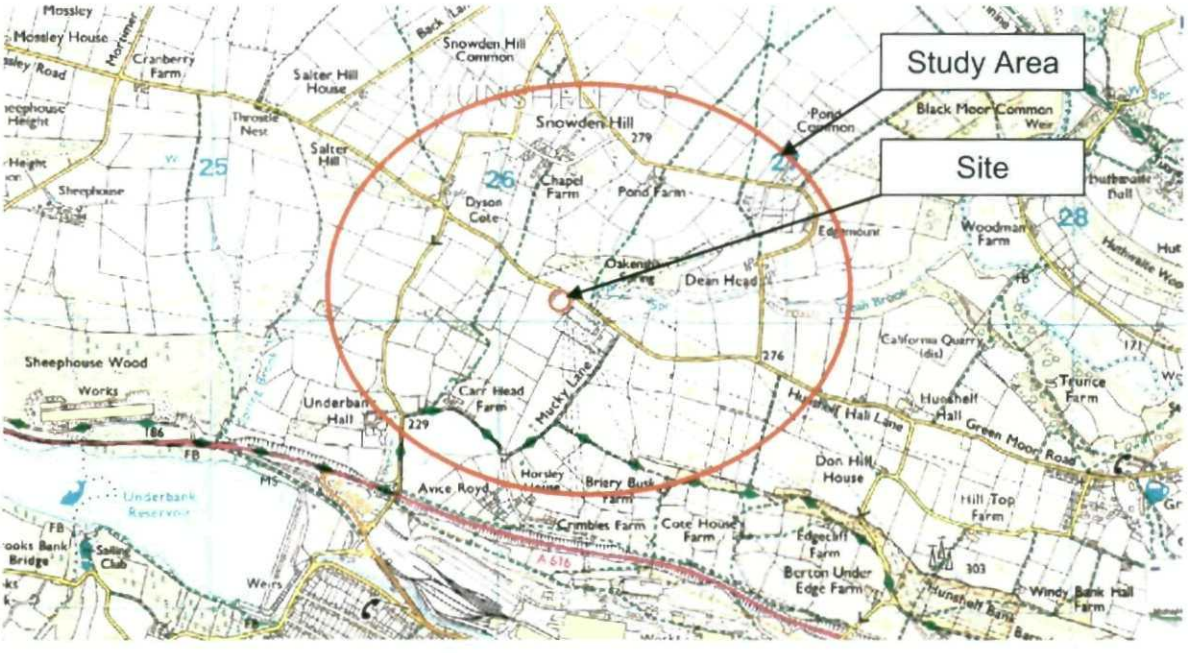
1.1 Encon Associates were commissioned by Mr David Sheppard of Green Frog Power in response to the Local Authorities request for "a landscape and visual impact assessment" in support of their planning application to construct a small scale standby embedded power plant adjacent to the existing YEDL Tofts Lane Substation compound at Hunshelf.

1.2 This Report provides an assessment of the visual impact of the proposed development, with particular emphasis on the view of the new unit and its potential impact on the surrounding area. Whilst this report does not constitute a full Environmental Impact Assessment, the Report seeks to follow the principles of the guidance published by The Landscape Institute and the Institute of Environmental Assessment for "Guidelines for Landscape and Visual Impact Assessment".

1.3 This report seeks to assess the visual impact of the proposals as well as any impacts on the existing landscape of the area to inform the design for any mitigation required in the form of new landscaping and planting.

2 DESCRIPTION OF SITE AND SURROUNDING AREA

The site is located at Hunshelf near to the town of Stocksbridge, in South Yorkshire (see below) and is within the unitary boundary of Barnsley.



2.1 The application site is located within the boundary of the Yorkshire Electricity Distribution Ltd (YEDL) Tofts Lane Substation compound off Tofts Lane, Hunshelf. The substation compound is located on currently occupied substation land of YEDL which is accessed via a private drive with a secure gated entrance on south side of Tofts Lane.

2.2 The existing site layout and location of the application site is shown in Diagram 1 overleaf.

Diagram 1 - Existing Site Layout



2.3 Green Frog Power Ltd have taken a lease on the proposed application site and have agreed with YEDL (Yorkshire Electricity Distribution Ltd) and the National Grid PLC that the site is to be developed as a small-scale standby power generation plant. This kind of power plant is known as 'embedded generation' and is in complete alignment with the Governments 2007 Energy White Paper on future energy policy to encourage green and carbon efficient distributed power.

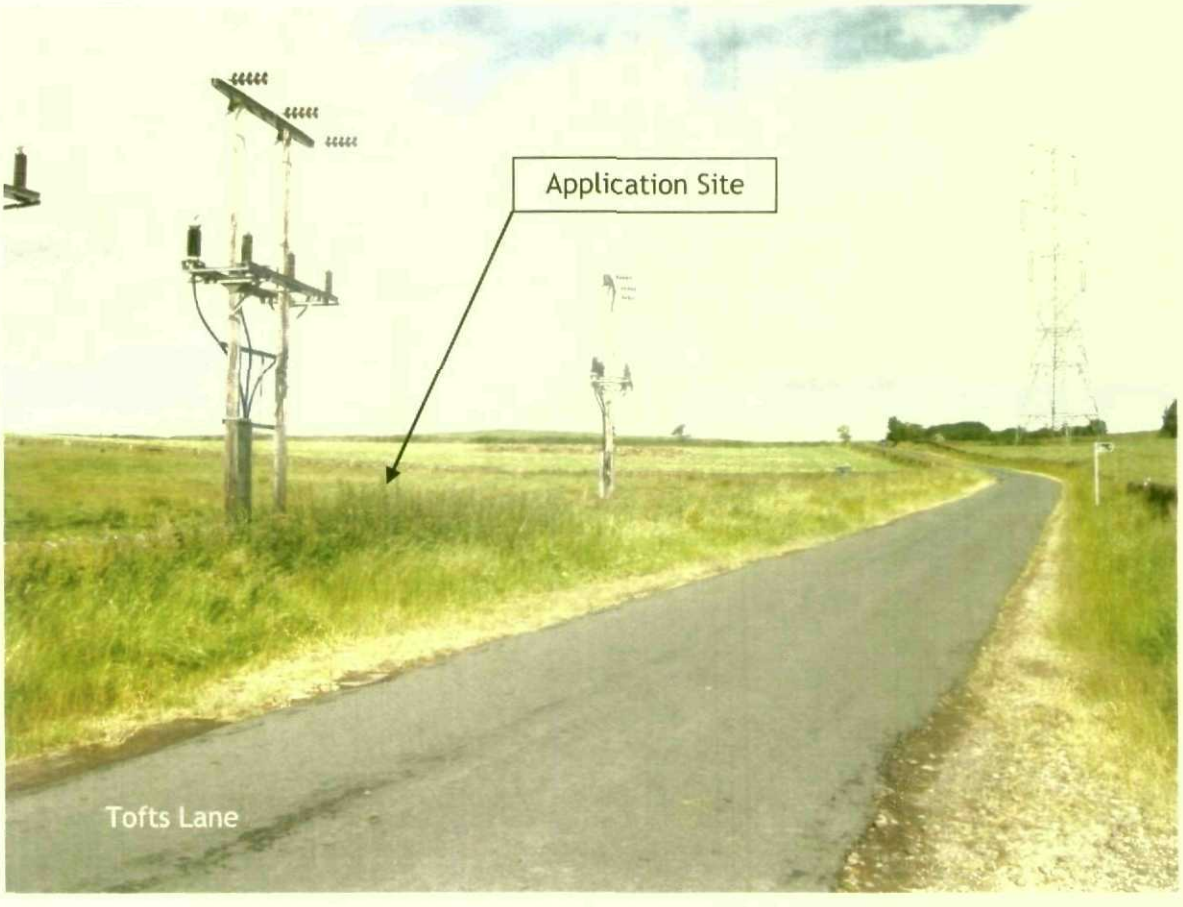
2.4 The site is located in a predominantly rural area consisting of farms and farm land. The closest farm buildings are 700m from the existing site entrance at the junction of Tofts Lane

and Underbank Lane. The closest residential settlement is located on Dean Head Lane, which is 900m from the application site (see aerial photograph below)



2.5 The site represents a rural location within land historically and currently used for agriculture/grazing. Topography of the area is such that the site is located on the mid slope of a large valley and is set lower than the majority of the surrounding land north of the site, with the high ground consisting of Snowden Hill, with the lower ground of Stocksbridge and the valley bottom to the south of the site, including Underbank Reservoir. Tofts Lane which runs from north-west to south-east gently falls from 308m AOD in the west to 280m AOD in the east. The site is situated at a general level of 285m AOD, some 10 - 20m lower than the surrounding hillside to the north and approximately 100m above the valley bottom to the south which it at a level of approximately 180m AOD.

2.6 The site is located off a quiet country lane and is surrounded by farmland/grazing land.



View of Tofts Lane looking west with the application site on the south of the road

2.7 The existing character of the area is dictated by the strong lines of field boundaries, dry stone walls, tree-belts, blocks of trees and hedgerows alongside most of the lanes surrounding the site. The photograph below is typical of Tofts Lane adjacent to the application site.



View from Tofts Lane looking east towards the site

2.8 The wider context of the site is an undulating framework of fields and hedgerows interrupted by small areas of woodland, grass embankments, many of them grazed by livestock, and individual hedgerow trees. There are a small number urban areas in the vicinity of the site. Stocksbridge and Deepcar approximately 1 mile to the south, Penistone to the north approximately 1.5 miles from the site and Thurgoland which is approximately 2 miles to the east. The west of the site has no urban areas in proximity of the site and consists mainly of moorland and the upper Derwent Valley with isolated settlements, with the Pennines further west from the site. The closest urban area to the west is Glossop which is approximately 20 miles further west across the Pennines.

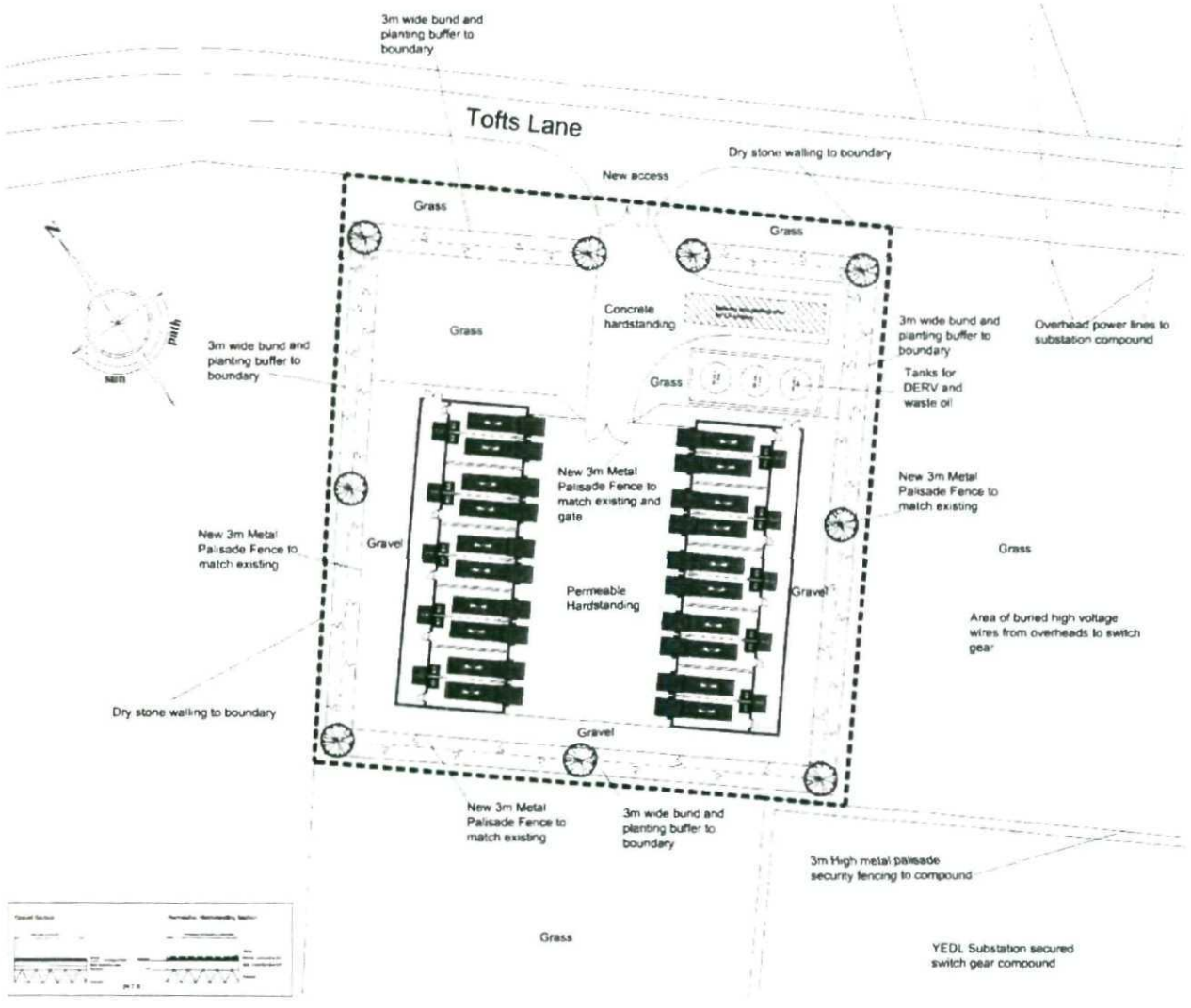
2.9 The existing landscape features of the surrounding area, along with views towards the site have been recorded and are appended to this report to show the context of the site with its surroundings.

3 PROPOSALS

3.1 The Development proposed is the erection of two purpose built structures to house the generating equipment for the standby power plant each within its own sound proof unit. The proposed fuel for the generator will be stored in "bunded tanks". In addition there will be smaller double skinned day tanks within the building for each generator.

3.2 The proposed plant, tanks and associated parking is to be constructed using a newly formed gated access off Tofts Lane which is just a short distance off the A616 Whams Road Via Manchester Road and Underbank Lane. The new access will be constructed from the existing lane leading to the proposed plant. The hard-standing and car parking has been designed to enable the fuel delivery tankers to use the new access and for them to enter and leave the site in a forward gear. The tanker will park at the side of the tank bund for easy access to the tanks on the site. The tanker delivery arrangements still enable other car users to enter the site and use the car parking spaces provided. The proposals are shown on the site plan (see Diagram 2 overleaf).

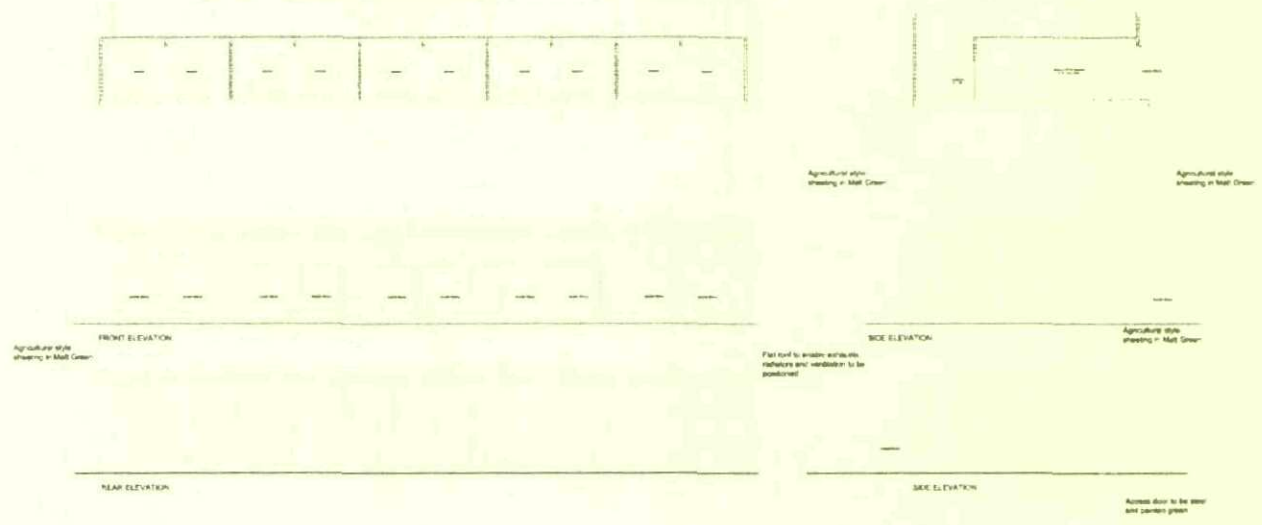
Diagram 2 - Proposed Site Layout



3.3 It is also proposed to completely enclose the site with a 1.8m high earth bund. This is to be planted with a mix of native species of trees and shrubs to screen the development. The detailed landscape design will be designed based on the findings of this report and is provided separately on proposal plans.

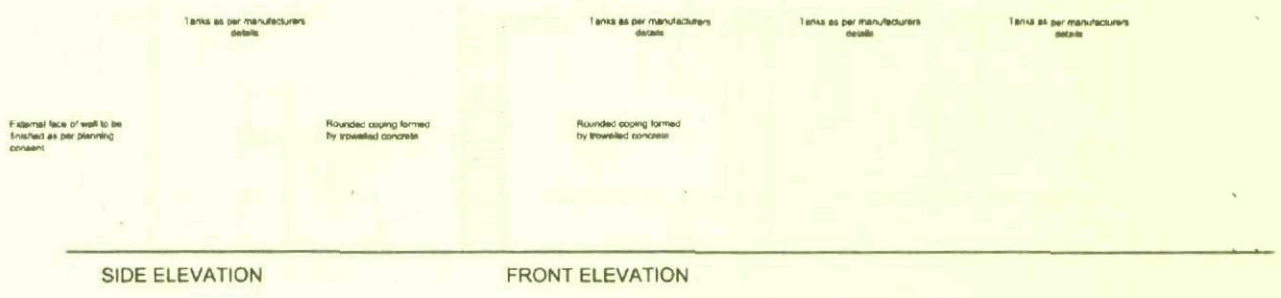
3.4 The elevations below show the appearance of the structure of the generator building:

Diagram 3 - Elevations of Proposed Building



3.5 The elevation below shows the arrangement for the fuel tank bund within the compound:

Diagram 4 - Tank Bund Detail



4 VISUAL ASSESSMENT

4.1 The site was visited on Friday 2nd July 2010 to carry out a visual assessment of the area in order to determine the impact on the visual setting of the proposed development and the existing landscape context.

4.2 The process takes the form of a review of the existing landscape and visual appearance of the context of the site as a 'baseline study'. The data collected forms the basis against which a review of the magnitude and the significance of the predicted landscape and visual impacts of the development can be assessed.

4.3 The purpose of the baseline study is to record and analyse the existing character, quality, enhancement potential and sensitivity of the landscape and visual resources in the vicinity of the proposed development.

4.4 A photographic record has been produced to illustrate the extent to which the application site can be viewed from the surrounding accessible land ie public footways, tracks, roads, etc.

4.5 The photographs taken are 35mm 'human eye' perspective with no zoom applied in order to represent as close as possible the actual views of the site.

4.6 The results of the Baseline Study are appended at the back of this report.

5 RESULTS

5.1 The results of the Baseline Study have been extracted from the Field Survey exercise carried out on the 2nd July 2010 and have been appended to the back of this report. The results are summarised below:

5.2 View of the Site

The visual survey was carried out along Pond Common Lane, round Sharpe Royd Nook, up Dean head Lane, right onto Tofts Lane (including the adjacent public footpaths), down Underbank Lane, along Hunshelf Road, up Mucky Lane, and finally back onto Tofts Lane. It was assessed that this route would most likely provide the greatest visibility of the application site.

5.3 A total of 16 viewpoints were examined to determine the extent to which the site is visible from the surrounding area. Away from Tofts Lane, the visibility of the site was very limited with views of the site mainly obscured by the topography and existing hedgerows and mature trees.

5.4 The site becomes visible from the vantage point of the public footpath which crosses grazing land rising towards Chapel Farm to the north of the site. This elevated position enables views across the broad valley. However, in the vast majority of locations, the site was either considerably or partially obscured by existing hedgerows and wooded areas in the foreground or the topography of the land between the view point and the site.

The development site is fully or almost fully, visible in 31% of the view points. The site can be partially seen from 19% of the view points and cannot be seen at all in 50% of the view points.

5.3 Description

The most common description of the site is one of gently undulating, rolling, broad valley topography, rural character with strong field patterns defined by dry stone walls and or hedgerows with isolated trees

5.4 Landcover and landscape elements

The most common landscape elements in view, ie those which appear in more than 50% of the views, were as follows:

Masts/poles	50%
Pylons	94%
Walls	94%
Hedges	56%
Field pattern	94%
Isolated trees	88%
Road	63%

Trees and fields are the main features of this landscape, with the existing substation appearing in 31% of the view points.

5.5 Landform

The most common category to describe the landform, ie those which best described the topography in more than 50% of the views were:

Undulating	50%
Hills	50%
Broad valley	100%

The topography is therefore one of undulating, hills which takes the form of a broad valley.

5.6 Aesthetic factors

The following best describes the landscape for each of the categories (as per the % results appended)

BALANCE:	harmonious and balanced
SCALE:	medium to large
ENCLOSURE:	open and exposed, with some enclosure
TEXTURE:	textured, with some smooth elements
COLOUR:	colourful, with some muted elements

DIVERSITY:	simple with some diversity
MOVEMENT:	peaceful with some remote activity
UNITY:	unified with some interruption and fragmented elements
FORM:	combination of straight and curved, with some sinuous and angular form
SECURITY:	mainly safe and comfortable with an element of unsettling
STIMULUS:	generally interesting landscape with some minor bland parts
PLEASURE:	pleasant with some minor unpleasant part

5.7 Landscape condition

The overall condition of the landscape is Good and is mainly described as a managed agricultural landscape with well maintained dry stone walls and hedgerows and strong woodland blocks with isolated trees around field boundaries.

Most Appropriate Management Strategy:

Conservation:	Maintain rural character and boundary walls/fences/hedgerows
Restoration:	None required
Reconstruction:	None required

5.8 Ability to Accommodate Change

A strong landscape structure provides an ability to absorb development to a certain extent, but the introduction of alien built forms would significantly influence the character and quality and would need to be designed to blend in with the existing character of the area.

Any development would need to be strongly connected with the existing built form in the locality namely the existing sub-station and the surrounding farm and agricultural buildings. The strong landscape features eg blocks of woodland and the rolling topography of the broad valley with isolated trees would help to integrate the development within the rural setting of the area.

6 SUMMARY OF IMPACT

6.1 The site is not fully visible in 50% of the viewpoints surveyed and is only fully visible in less than a third. Within the remaining viewpoints, the site is partially visible and is obscured by the character of the rolling topography and blocks of isolated trees, field boundaries and hedgerows.

6.2 Whilst assessing the extent to which the site is visible, consideration needs to be given to the time of year in which the survey has been carried out ie during the summer months. The tree species in this area are almost exclusively deciduous and at this time of year they are in leaf. During the winter months the deciduous trees will lose their foliage, which may result in some views of the site becoming more visible. However, the screening ability of

the existing trees in the area is only a small factor, with the topography being the main element to obscure the views of the site from the surrounding areas and so the fall of leaf will only have a minor effect on increasing the views.

6.3 The landscape of the area is good quality, rural countryside. The area has high aesthetic qualities which are harmonious and balanced and of a medium to large scale. The landscape has a sense of enclosure offered by the strong field patterns bounded by dry stone walls and yet has an open, almost exposed feeling. It has a textured, colourful appearance, although muted from some viewpoints.

6.4 The diversity of the landscape is simple with some diverse elements and is peaceful and unified. The form is generally straight and curved with some sinuous lines and on the whole feels safe. It is an interesting and pleasant landscape. The landscape has a robustness that is strong enough to accommodate development that is formed to emphasise the existing characteristics of the area ie: strong field boundaries, clumps of woodland, hedgerows, rolling topography with isolated trees.

6.5 Careful consideration of the boundary to the site in the form of a new soil bund with some planting including isolated trees instead of a continuous screen of tree planting would help to blend the proposals within the landscape. The location of the fencing is also important and by positioning the fencing within the proposed screen bund, this will reduce the visual impact of the steel fencing by obscuring the view with the bund in front of it.

6.6 Consideration is also needed for the configuration of the fuel storage which has a potentially high impact. The proposed fuel tanks and associated access steps currently stand higher than the level of the building. Their impact could be reduced by lowering the tanks either by laying them on their side rather than having them up right or an even better solution would be to bury them underground (depending on whether this is a viable option which can be economically and safely designed by the engineers)

7 CONCLUSION

71. This report has been produced in response to the Local Authorities request for "a landscape and visual impact assessment" in support of a planning application to construct a small scale standby embedded power plant adjacent to the existing YEDL Tofts Lane Substation compound at Hunshelf.

7.2 The Report provides an assessment of the visual impact of the proposed development, with particular emphasis on the view of the new unit and its potential impact on the surrounding area. Whilst this report does not constitute a full Environmental Impact Assessment, the Report seeks to follow the principles of the guidance published by The Landscape Institute and the Institute of Environmental Assessment for "Guidelines for Landscape and Visual Impact Assessment".

7.3 The results of this report should be used as a strategy for the design of the layout proposals including landform, building orientation, screening and landscaping, the main suggestions are to locate the screen bund on the outside of the fencing to obscure and soften the appearance of the fencing and also to lower the height of the fuel tanks by rotating them

onto their sides or by burying underground. Landscaping details have been provided on the Proposed Landscaping Plan (drawing number A1403-01) and should be read in conjunction with this report.

Signed for and on behalf of Encon Associates Limited

M. J Bentley

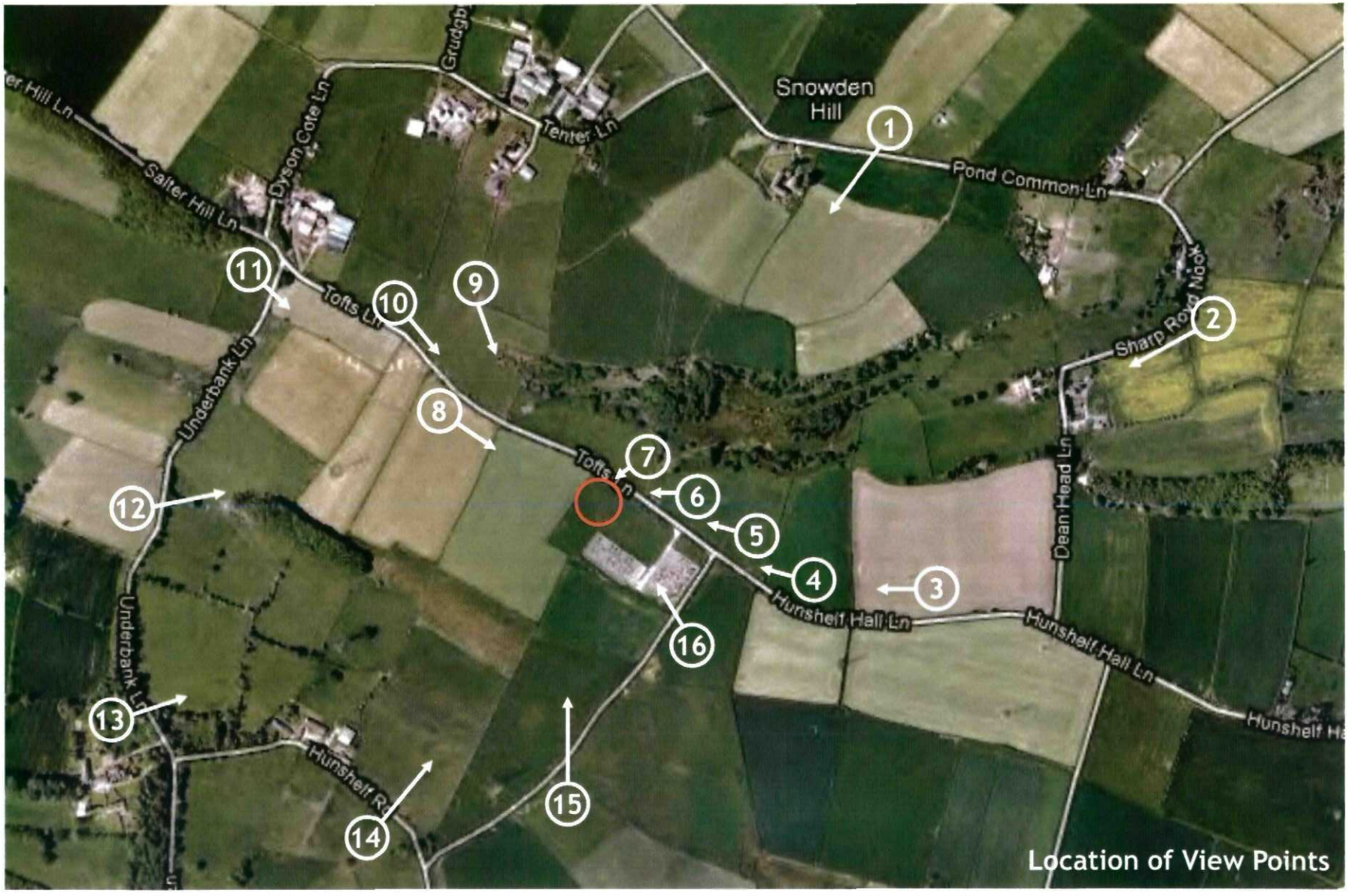
Mark Bentley BA (Hons), Dip LA, MCIHT

Landscape Architecture Division

Date: 14th July 2010

APPENDIX A

Location of Viewpoints


Snowden Hill
Pond Common Ln
Tenter Ln
Dyson Cote Ln
Salter Hill Ln
Tofts Ln
Underbank Ln
Sharp Royd Nook
Dean Head Ln
Hunshelf Hall Ln
Hunshelf Hall Ln
Hunshelf Ha
Underbank Ln
Hunshelf R
1
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Location of View Points

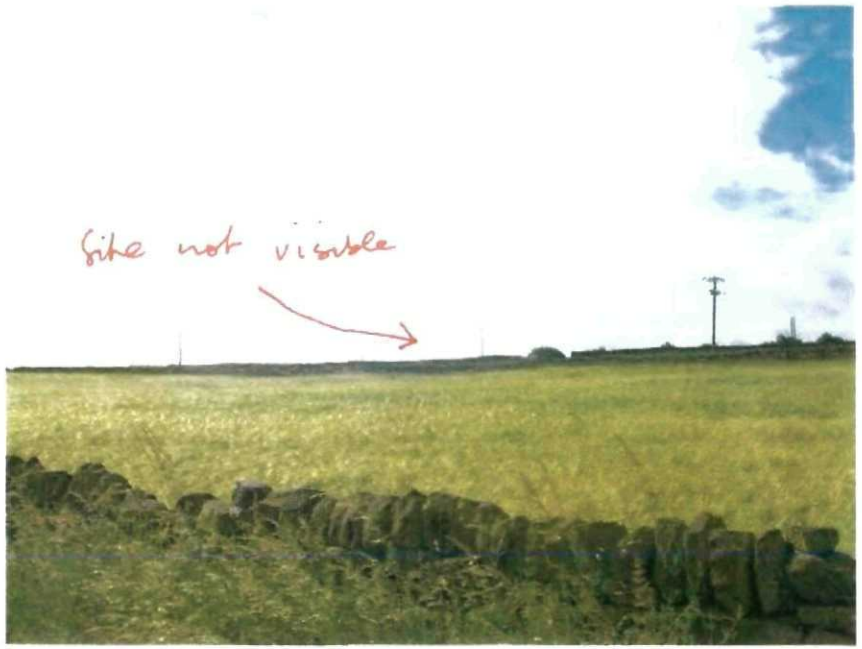
APPENDIX B

Field Survey Forms

FIELD SURVEY FORM

View No: 1 Location: Pond Common Ln Date: 2/7/10 Surveyor: MB

Annotated View:



Brief Description:

View from Pond common Lane which is elevated from the site which is obscured by the topography

Landcover and landscape elements:

Farm buldings	walls	woodland	river	footpath
Churches	fences	plantation	stream	track
Masts/poles	hedges	isolated trees	lake	road
Pylons	banks	tree clumps	reservoir	motorway
Industry	shelterbelt	hedgerow trees	pond	railway
Vernacular buildings	field pattern	parkland	canal	
Settlement	arable	scrub	waterfall	
Built-up	pasture	marsh	beach	
Mineral working	orchards		dune	
Ruins			mudflat	

Landform:

Flat	plain	coast
Undulating	rolling lowland	estuary
Rolling	plateau	broad valley
Steep	hills	narrow valley
Vertical	scarp	deep gorge
	Cliff	

Aesthetic factors:

BLANCE:	harmonious	balanced	discordant	chaotic
SCALE:	intimate	small	medium	large
ENCLOSURE:	confined	enclosed	open	exposed
TEXTURE:	smooth	textured	rough	very rough
COLOUR:	monochrome	muted	colourful	garish
DIVERSITY:	uniform	simple	diverse	complex
MOVEMENT:	remote	vacant	peaceful	active
UNITY:	unified	interrupted	fragmented	chaotic
FORM:	straight	angular	curved	sinuous
SECURITY:	comfortable	safe	unsettling	threatening
STIMULUS:	boring	bland	interesting	invigorating
PLEASURE:	offensive	unpleasant	pleasant	beautiful

Landscape Condition:

Arable fields in good condition

Most Appropriate Management Strategy:

Conservation:
Preserve the arable maintenance

Restoration:
–

Reconstruction:
–

Ability to Accommodate Change:

Some built form in the area, but largely rural with limited ability to accommodate change

FIELD SURVEY FORM

View No: 2 Location: Sharpe Royd Nook Date: 2/7/10 Surveyor: MB

Annotated View:



Brief Description:

View from Sharp Royd Nook towards Toffs Lane. The site is not visible from here

Landcover and landscape elements:

Farm buildings	walls	woodland	river	footpath
Churches	fences	plantation	stream	track
Masts/poles	hedges	isolated trees	lake	road
Pylons	banks	tree clumps	reservoir	motorway
Industry	shelterbelt	hedgerow trees	pond	railway
Vernacular buildings	field pattern	parkland	canal	
Settlement	arable	scrub	waterfall	
Built-up	pasture	marsh	beach	
Mineral working	orchards		dune	
Ruins			mudflat	

Landform:

Flat	plain	coast
Undulating	rolling lowland	estuary
Rolling	plateau	broad valley
Steep	hills	narrow valley
Vertical	scarp	deep gorge
	Cliff	

Aesthetic factors:

BLANCE:	harmonious	balanced	discordant	chaotic
SCALE:	intimate	small	medium	large
ENCLOSURE:	confined	enclosed	open	exposed
TEXTURE:	smooth	textured	rough	very rough
COLOUR:	monochrome	muted	colourful	garish
DIVERSITY:	uniform	simple	diverse	complex
MOVEMENT:	remote	vacant	peaceful	active
UNITY:	unified	interrupted	fragmented	chaotic
FORM:	straight	angular	curved	sinuous
SECURITY:	comfortable	safe	unsettling	threatening
STIMULUS:	boring	bland	interesting	invigorating
PLEASURE:	offensive	unpleasant	pleasant	beautiful

Landscape Condition:

Well maintained fields and walls

Most Appropriate Management Strategy:

Conservation:

Maintain existing quality

Restoration:

—

Reconstruction:

—

Ability to Accommodate Change:

Site not visible from here. Built form existing in this area.

FIELD SURVEY FORM

View No: 3 Location: Tofts Lane Date: 2/7/10 Surveyor: MB

Annotated View:



Brief Description:

View from Tofts Lane showing the site obscured by topography and isolated trees

Landcover and landscape elements:

Farm buldings	walls	woodland	river	footpath
Churches	fences	plantation	stream	track
Masts/poles	hedges	isolated trees	lake	road
Pylons	banks	tree clumps	reservoir	motorway
Industry	shelterbelt	hedgerow trees	pond	railway
Vernacular buildings	field pattern	parkland	canal	
Settlement	arable	scrub	waterfall	
Built-up	pasture	marsh	beach	
Mineral working	orchards		*dune*	
Ruins			*mudflat*	

Landform:

Flat	plain	coast
Undulating	rolling lowland	estuary
Rolling	plateau	broad valley
Steep	hills	narrow valley
Vertical	scarp	deep gorge
	Cliff	

Aesthetic factors:

BLANCE:	harmonious	balanced	discordant	chaotic
SCALE:	intimate	small	medium	large
ENCLOSURE:	confined	enclosed	open	exposed
TEXTURE:	smooth	textured	rough	very rough
COLOUR:	monochrome	muted	colourful	garish
DIVERSITY:	uniform	simple	diverse	complex
MOVEMENT:	remote	vacant	peaceful	active
UNITY:	unified	interrupted	fragmented	chaotic
FORM:	straight	angular	curved	sinuous
SECURITY:	comfortable	safe	unsettling	threatening
STIMULUS:	boring	bland	interesting	invigorating
PLEASURE:	offensive	unpleasant	pleasant	beautiful

Landscape Condition:

Well maintained fields and boundary walls

Most Appropriate Management Strategy:

Conservation:

Maintain existing quality

Restoration:

—

Reconstruction:

—

Ability to Accommodate Change:

The site is obscured from this location and therefore change could be accommodated if the screening elements are retained / enhanced

FIELD SURVEY FORM

View No: 4 Location: Tofts Lane Date: 2/7/10 Surveyor: MB

Annotated View:



Brief Description:

View down Tofts Lane showing isolated trees in the foreground with the site on the left

Landcover and landscape elements:

Farm buldings	walls	woodland	river	footpath
Churches	fences	plantation	stream	track
Masts/poles	hedges	isolated trees	lake	road
Pylons	banks	tree clumps	reservoir	motorway
Industry	shelterbelt	hedgerow trees	pond	railway
Vernacular buildings	field pattern	parkland	canal	
Settlement	arable	scrub	waterfall	
Built-up	pasture	marsh	beach	
Mineral working	orchards		dune	
Ruins			mudflat	

Landform:

Flat	plain	coast
Undulating	rolling lowland	estuary
Rolling	plateau	broad valley
Steep	hills	narrow valley
Vertical	scarp	deep gorge
	Cliff	

Aesthetic factors:

BLANCE:	harmonious	balanced	discordant	chaotic
SCALE:	intimate	small	medium	large
ENCLOSURE:	confined	enclosed	open	exposed
TEXTURE:	smooth	textured	rough	very rough
COLOUR:	monochrome	muted	colourful	garish
DIVERSITY:	uniform	simple	diverse	complex
MOVEMENT:	remote	vacant	peaceful	active
UNITY:	unified	interrupted	fragmented	chaotic
FORM:	straight	angular	curved	sinuous
SECURITY:	comfortable	safe	unsettling	threatening
STIMULUS:	boring	bland	interesting	invigorating
PLEASURE:	offensive	unpleasant	pleasant	beautiful

Landscape Condition:

Well maintained fields and boundary walls

Most Appropriate Management Strategy:

Conservation:

Maintain the existing quality of arable/pasture

Restoration:

—

Reconstruction:

—

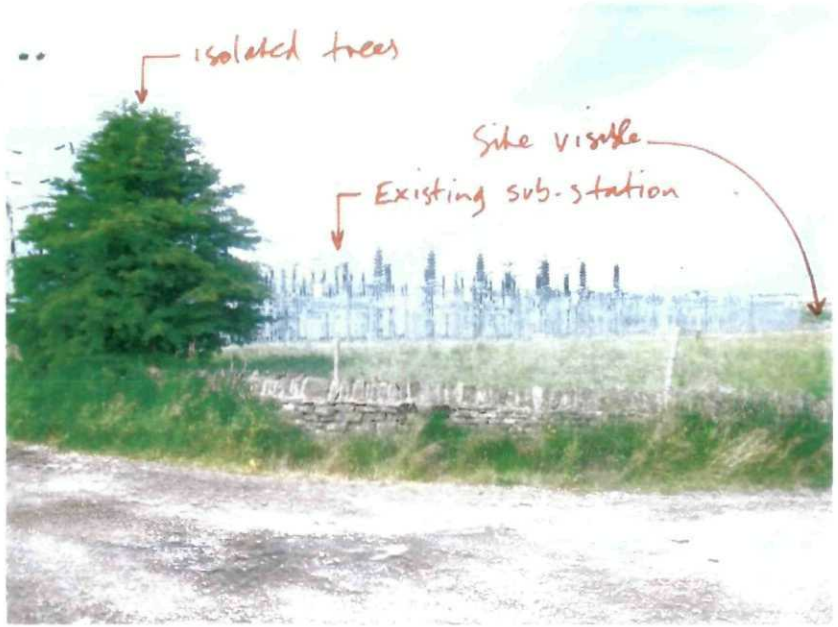
Ability to Accommodate Change:

Despite rural nature, the existence of the sub-station would help the inclusion of additional structures as it would be in keeping with the existing features

FIELD SURVEY FORM

View No: 5 Location: Mucky Ln Date: 2/7/10 Surveyor: MB

Annotated View:



Brief Description:

A view from the junction of Mucky Lane and Tofts Lane showing the existing plant

Landcover and landscape elements:

Farm buldings	walls	woodland	river	footpath
Churches	fences	plantation	stream	track
Masts/poles	hedges	isolated trees	lake	road
Pylons	banks	tree clumps	reservoir	motorway
Industry	shelterbelt	hedgerow trees	pond	railway
Vernacular buildings	field pattern	parkland	canal	
Settlement	arable	scrub	waterfall	
Built-up	pasture	marsh	beach	
Mineral working	orchards		dune	
Ruins			mudflat	

Landform:

Flat	plain	coast
Undulating	rolling lowland	estuary
Rolling	plateau	broad valley
Steep	hills	narrow valley
Vertical	scarp	deep gorge
	Cliff	

Aesthetic factors:

BLANCE:	harmonious	balanced	discordant	chaotic
SCALE:	intimate	small	medium	large
ENCLOSURE:	confined	enclosed	open	exposed
TEXTURE:	smooth	textured	rough	very rough
COLOUR:	monochrome	muted	colourful	garish
DIVERSITY:	uniform	simple	diverse	complex
MOVEMENT:	remote	vacant	peaceful	active
UNITY:	unified	interrupted	fragmented	chaotic
FORM:	straight	angular	curved	sinuous
SECURITY:	comfortable	safe	unsettling	threatening
STIMULUS:	boring	bland	interesting	invigorating
PLEASURE.	offensive	unpleasant	pleasant	beautiful

Landscape Condition:

Good

Most Appropriate Management Strategy:

Conservation:
Maintain grassland

Restoration:
—

Reconstruction:
—

Ability to Accommodate Change:

Extension to the existing power station could be accomodated

FIELD SURVEY FORM

View No: 6 Location: Tofts Lane Date: 2/7/10 Surveyor:

Annotated View:



Brief Description:

A view up Tofts Lane with the existing plant on the left and the application site

Landcover and landscape elements:

Farm buildings	walls	woodland	river	footpath
Churches	fences	plantation	stream	track
Masts/poles	hedges	isolated trees	lake	road
Pylons	banks	tree clumps	reservoir	motorway
Industry	shelterbelt	hedgerow trees	pond	railway
Vernacular buildings	field pattern	parkland	canal	
Settlement	arable	scrub	waterfall	
Built-up	pasture	marsh	beach	
Mineral working	orchards		dune	
Ruins			mudflat	

Landform:

Flat	plain	coast
Undulating	rolling lowland	*estuary*
Rolling	plateau	broad valley
Steep	hills	narrow valley
Vertical	scarp	deep gorge
	Cliff	

Aesthetic factors:

BLANCE:	harmonious	balanced	discordant	chaotic
SCALE:	intimate	small	medium	large
ENCLOSURE:	confined	enclosed	open	exposed
TEXTURE:	smooth	textured	rough	very rough
COLOUR:	monochrome	muted	colourful	garish
DIVERSITY:	uniform	simple	diverse	complex
MOVEMENT:	remote	vacant	peaceful	active
UNITY:	unified	interrupted	fragmented	chaotic
FORM:	straight	angular	curved	sinuous
SECURITY:	comfortable	safe	unsettling	threatening
STIMULUS:	boring	bland	interesting	invigorating
PLEASURE:	offensive	unpleasant	pleasant	beautiful

Landscape Condition:

Good

Most Appropriate Management Strategy:

Conservation:

Maintain grass areas within Plant area

Restoration:

–

Reconstruction:

–

Ability to Accommodate Change:

Good ability for change within proximity of existing Power Plant

FIELD SURVEY FORM

View No: 7 Location: Tofts Ln Date: 2/7/10 Surveyor: MB

Annotated View:



Brief Description:

The site is clearly visible from Tofts Lane

Landcover and landscape elements:

Farm buldings	walls	woodland	river	footpath
Churches	fences	plantation	stream	track
Masts/poles	hedges	isolated trees	lake	road
Pylons	banks	tree clumps	reservoir	motorway
Industry	shelterbelt	hedgerow trees	pond	railway
Vernacular buildings	field pattern	parkland	canal	
Settlement	arable	scrub	waterfall	
Built-up	pasture	marsh	beach	
Mineral working	orchards		dune	
Ruins			mudflat	

Landform:

Flat	plain	coast
Undulating	rolling lowland	estuary
Rolling	plateau	broad valley
Steep	hills	narrow valley
Vertical	scarp	deep gorge
	Cliff	

Aesthetic factors:

BLANCE:	harmonious	balanced	discordant	chaotic
SCALE:	intimate	small	medium	large
ENCLOSURE:	confined	enclosed	open	exposed
TEXTURE:	smooth	textured	rough	very rough
COLOUR:	monochrome	muted	colourful	garish
DIVERSITY:	uniform	simple	diverse	complex
MOVEMENT:	remote	vacant	peaceful	active
UNITY:	unified	interrupted	fragmented	chaotic
FORM:	straight	angular	curved	sinuous
SECURITY:	comfortable	safe	unsettling	threatening
STIMULUS:	boring	bland	interesting	invigorating
PLEASURE:	offensive	unpleasant	pleasant	beautiful

Landscape Condition:

Good

Most Appropriate Management Strategy:

Conservation:

Maintain the arable fields

Restoration:

–

Reconstruction:

–

Ability to Accommodate Change:

Some ability for change adjacent to existing power plant if sympathetically done

FIELD SURVEY FORM

View No: 8 Location: Tofts Lane Date: 2/7/10 Surveyor: MB

Annotated View:



Brief Description:

Clear view of the application site in the foreground of the existing plant

Landcover and landscape elements:

Farm buldings	walls	woodland	river	footpath
Churches	fences	plantation	stream	track
Masts/poles	hedges	isolated trees	lake	road
Pylons	banks	tree clumps	reservoir	motorway
Industry	shelterbelt	hedgerow trees	pond	railway
Vernacular buildings	field pattern	parkland	canal	
Settlement	arable	scrub	waterfall	
Built-up	pasture	marsh	beach	
Mineral working	orchards		dune	
Ruins			mudflat	

Landform:

Flat	plain	coast
Undulating	rolling lowland	estuary
Rolling	plateau	broad valley
Steep	hills	narrow valley
Vertical	scarp	deep gorge
	Cliff	

Aesthetic factors:

BLANCE:	harmonious	balanced	discordant	chaotic
SCALE:	intimate	small	medium	large
ENCLOSURE:	confined	enclosed	open	exposed
TEXTURE:	smooth	textured	rough	very rough
COLOUR:	monochrome	muted	colourful	garish
DIVERSITY:	uniform	simple	diverse	complex
MOVEMENT:	remote	vacant	peaceful	active
UNITY:	unified	interrupted	fragmented	chaotic
FORM:	straight	angular	curved	sinuous
SECURITY:	comfortable	safe	unsettling	threatening
STIMULUS:	boring	bland	interesting	invigorating
PLEASURE:	offensive	unpleasant	pleasant	beautiful

Landscape Condition:

Good

Most Appropriate Management Strategy:

Conservation:

Maintain the existing arable land where poss

Restoration:

–

Reconstruction:

–

Ability to Accommodate Change:

Some ability adjacent to the existing power plant.

FIELD SURVEY FORM

View No: 9 Location: Public footpath (off Toffts Ln) Date: 2/7/10 Surveyor: MB

Annotated View:



Brief Description:

Application site visible adjacent to the existing power station

Landcover and landscape elements:

Farm buildings	walls	woodland	river	footpath
Churches	fences	plantation	stream	track
Masts/poles	hedges	isolated trees	lake	road
Pylons	banks	tree clumps	reservoir	motorway
Industry	shelterbelt	hedgerow trees	pond	railway
Vernacular buildings	field pattern	parkland	canal	
Settlement	arable	scrub	waterfall	
Built-up	pasture	marsh	beach	
Mineral working	orchards		dune	
Ruins			mudflat	

Landform:

Flat	plain	coast
Undulating	rolling lowland	estuary
Rolling	plateau	broad valley
Steep	hills	narrow valley
Vertical	scarp	deep gorge
	Cliff	

Aesthetic factors:

BLANCE:	harmonious	balanced	discordant	chaotic
SCALE:	intimate	small	medium	large
ENCLOSURE:	confined	enclosed	open	exposed
TEXTURE:	smooth	textured	rough	very rough
COLOUR:	monochrome	muted	colourful	garish
DIVERSITY:	uniform	simple	diverse	complex
MOVEMENT:	remote	vacant	peaceful	active
UNITY:	unified	interrupted	fragmented	chaotic
FORM:	straight	angular	curved	sinuous
SECURITY:	comfortable	safe	unsettling	threatening
STIMULUS:	boring	bland	interesting	invigorating
PLEASURE:	offensive	unpleasant	pleasant	beautiful

Landscape Condition:

Good grazing land well maintained

Most Appropriate Management Strategy:

Conservation:
Maintain the rural landscape/farmland

Restoration:
—

Reconstruction:
—

Ability to Accommodate Change:

Rural setting could not stand change unless located with existing features such as the power plant as this could be interpreted more easily

FIELD SURVEY FORM

View No: 10 Location: Tofts Lane Date: 2/7/10 Surveyor: MB

Annotated View:



Brief Description:

The site is almost visible as the land rolls down the broad valley

Landcover and landscape elements:

Farm buildings	walls	woodland	river	footpath
Churches	fences	plantation	stream	track
Masts/poles	hedges	isolated trees	lake	road
Pylons	banks	tree clumps	reservoir	motorway
Industry	shelterbelt	hedgerow trees	pond	railway
Vernacular buildings	field pattern	parkland	canal	
Settlement	arable	scrub	waterfall	
Built-up	pasture	marsh	beach	
Mineral working	orchards		dune	
Ruins			mudflat	

Landform:

Flat	plain	coast
Undulating	rolling lowland	estuary
Rolling	plateau	broad valley
Steep	hills	narrow valley
Vertical	scarp	deep gorge
	Cliff	

Aesthetic factors:

BLANCE:	harmonious	balanced	discordant	chaotic
SCALE:	intimate	small	medium	large
ENCLOSURE:	confined	enclosed	open	exposed
TEXTURE:	smooth	textured	rough	very rough
COLOUR:	monochrome	muted	colourful	garish
DIVERSITY:	uniform	simple	diverse	complex
MOVEMENT:	remote	vacant	peaceful	active
UNITY:	unified	interrupted	fragmented	chaotic
FORM:	straight	angular	curved	sinuous
SECURITY:	comfortable	safe	unsettling	threatening
STIMULUS:	boring	bland	interesting	invigorating
PLEASURE:	offensive	unpleasant	pleasant	beautiful

Landscape Condition:

Good

Most Appropriate Management Strategy:

Conservation:
Maintain fields

Restoration:
-

Reconstruction:
-

Ability to Accommodate Change:

Some ability for change if sensitively done.

FIELD SURVEY FORM

View No: 11 Location: Tofts Lane Date: 2/7/10 Surveyor: MB

Annotated View:



Brief Description:

Slightly elevated view looking down the lane and the broad valley

Landcover and landscape elements:

Farm buldings	walls	woodland	river	footpath
Churches	fences	plantation	stream	track
Masts/poles	hedges	isolated trees	lake	road
Pylons	banks	tree clumps	reservoir	motorway
Industry	shelterbelt	hedgerow trees	pond	railway
Vernacular buildings	field pattern	parkland	canal	
Settlement	arable	scrub	waterfall	
Built-up	pasture	marsh	beach	
Mineral working	orchards		dune	
Ruins			mudflat	

Landform:

Flat	plain	coast
Undulating	rolling lowland	estuary
Rolling	plateau	broad valley
Steep	hills	narrow valley
Vertical	scarp	deep gorge
	Cliff	

Aesthetic factors:

BLANCE:	harmonious	balanced	discordant	chaotic
SCALE:	intimate	small	medium	large
ENCLOSURE:	confined	enclosed	open	exposed
TEXTURE:	smooth	textured	rough	very rough
COLOUR:	monochrome	muted	colourful	garish
DIVERSITY:	uniform	simple	diverse	complex
MOVEMENT:	remote	vacant	peaceful	active
UNITY:	unified	interrupted	fragmented	chaotic
FORM:	straight	angular	curved	sinuous
SECURITY:	comfortable	safe	unsettling	threatening
STIMULUS:	boring	bland	interesting	invigorating
PLEASURE:	offensive	unpleasant	pleasant	beautiful

Landscape Condition:

Good condition, grass verges overgrown but in keeping with rural setting

Most Appropriate Management Strategy:

Conservation:

Maintain farmland

Restoration:

—

Reconstruction:

—

Ability to Accommodate Change:

Close to other settlements in the area could stand some change

FIELD SURVEY FORM

View No: 12 Location: Underbank Ln Date: 2/7/10 Surveyor: MB

Annotated View:



Brief Description:

Rural farmland with isolated trees on field boundaries

Landcover and landscape elements:

Farm buldings	walls	woodland	river	footpath
Churches	fences	plantation	stream	track
Masts/poles	hedges	isolated trees	lake	road
Pylons	banks	tree clumps	reservoir	motorway
Industry	shelterbelt	hedgerow trees	pond	railway
Vernacular buildings	field pattern	parkland	canal	
Settlement	arable	scrub	waterfall	
Built-up	pasture	marsh	beach	
Mineral working	orchards		dune	
Ruins			mudflat	

Landform:

Flat	plain	coast
Undulating	rolling lowland	estuary
Rolling	plateau	broad valley
Steep	hills	narrow valley
Vertical	scarp	deep gorge
	Cliff	

Aesthetic factors:

BLANCE:	harmonious	balanced	discordant	chaotic
SCALE:	intimate	small	medium	large
ENCLOSURE:	confined	enclosed	open	exposed
TEXTURE:	smooth	textured	rough	very rough
COLOUR:	monochrome	muted	colourful	garish
DIVERSITY:	uniform	simple	diverse	complex
MOVEMENT:	remote	vacant	peaceful	active
UNITY:	unified	interrupted	fragmented	chaotic
FORM:	straight	angular	curved	sinuous
SECURITY:	comfortable	safe	unsettling	threatening
STIMULUS:	boring	bland	interesting	invigorating
PLEASURE:	offensive	unpleasant	pleasant	beautiful

Landscape Condition:

Good

Most Appropriate Management Strategy:

Conservation:
Maintain farmland

Restoration:
–

Reconstruction:
–

Ability to Accommodate Change:

Open, rural area less able to accommodate change.

FIELD SURVEY FORM

View No: 13 Location: Underbank Ln Date: 2/7/10 Surveyor: MB

Annotated View:



Brief Description:

Shady lane with well established trees forming a 'tunnel' effect over the road

Landcover and landscape elements:

Farm buldings	walls	woodland	river	footpath
Churches	fences	plantation	stream	track
Masts/poles	hedges	isolated trees	lake	road
Pylons	banks	tree clumps	reservoir	motorway
Industry	shelterbelt	hedgerow trees	pond	railway
Vernacular buildings	field pattern	parkland	canal	
Settlement	arable	scrub	waterfall	
Built-up	pasture	marsh	beach	
Mineral working	orchards		dune	
Ruins			mudflat	

Landform:

Flat	plain	coast
Undulating	rolling lowland	estuary
Rolling	plateau	broad valley
Steep	hills	narrow valley
Vertical	scarp	deep gorge
	Cliff	

Aesthetic factors:

BLANCE:	harmonious	balanced	discordant	chaotic
SCALE:	intimate	small	medium	large
ENCLOSURE:	confined	enclosed	open	exposed
TEXTURE:	smooth	textured	rough	very rough
COLOUR:	monochrome	muted	colourful	garish
DIVERSITY:	uniform	simple	diverse	complex
MOVEMENT:	remote	vacant	peaceful	active
UNITY:	unified	interrupted	fragmented	chaotic
FORM:	straight	angular	curved	sinuous
SECURITY:	comfortable	safe	unsettling	threatening
STIMULUS:	boring	bland	interesting	invigorating
PLEASURE:	offensive	unpleasant	pleasant	beautiful

Landscape Condition:

Good

Most Appropriate Management Strategy:

Conservation:

Maintain field patterns and hedgerow trees

Restoration:

–

Reconstruction:

–

Ability to Accommodate Change:

Some buildings in the area would help to integrate any new development

FIELD SURVEY FORM

View No: 14 Location: Hunshelf Rd Date: 2/7/10 Surveyor: MB

Annotated View:



Brief Description:

Strong field patterns in this view

Landcover and landscape elements:

Farm buildings	walls	woodland	river	footpath
Churches	fences	plantation	stream	track
Masts/poles	hedges	isolated trees	lake	road
Pylons	banks	tree clumps	reservoir	motorway
Industry	shelterbelt	hedgerow trees	pond	railway
Vernacular buildings	field pattern	parkland	canal	
Settlement	arable	scrub	waterfall	
Built-up	pasture	marsh	beach	
Mineral working	orchards		dune	
Ruins			mudflat	

Landform:

Flat	plain	coast
Undulating	rolling lowland	estuary
Rolling	plateau	broad valley
Steep	hills	narrow valley
Vertical	scarp	deep gorge
	Cliff	

Aesthetic factors:

BLANCE:	harmonious	balanced	discordant	chaotic
SCALE:	intimate	small	medium	large
ENCLOSURE:	confined	enclosed	open	exposed
TEXTURE:	smooth	textured	rough	very rough
COLOUR:	monochrome	muted	colourful	garish
DIVERSITY:	uniform	simple	diverse	complex
MOVEMENT:	remote	vacant	peaceful	active
UNITY:	unified	interrupted	fragmented	chaotic
FORM:	straight	angular	curved	sinuous
SECURITY:	comfortable	safe	unsettling	threatening
STIMULUS:	boring	bland	interesting	invigorating
PLEASURE:	offensive	unpleasant	pleasant	beautiful

Landscape Condition: Good

Most Appropriate Management Strategy:

Conservation:

Maintain existing field patterns

Restoration:

—

Reconstruction:

—

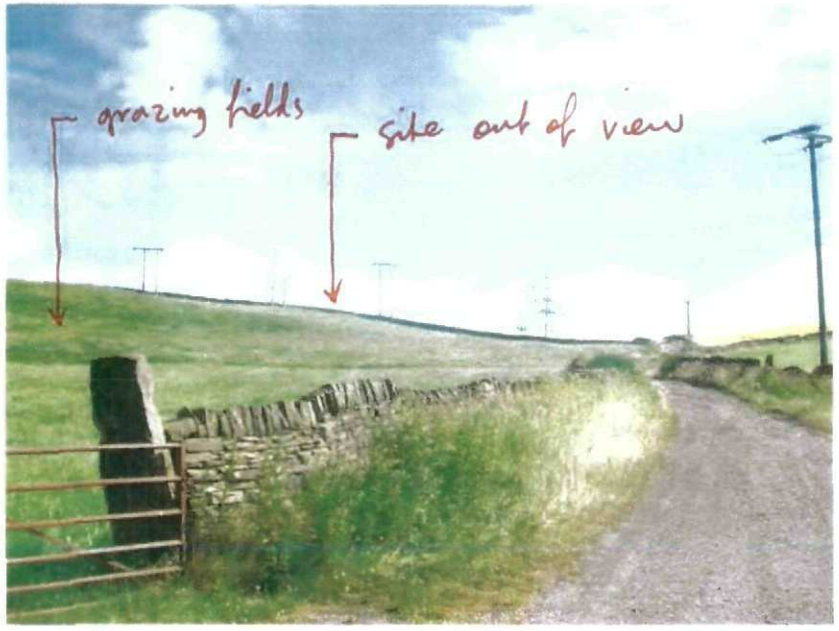
Ability to Accommodate Change:

Medium. Possibly add built structures to this area. Farm buildings adjacent here would be in keeping

FIELD SURVEY FORM

View No: 15 Location: Mucky Lane Date: 2/7/10 Surveyor: MB

Annotated View:



Brief Description:

Rolling arable/grazing fields dominate the view
No sign of the power plant other than pylons

Landcover and landscape elements:

Farm buildings	walls	woodland	river	footpath
Churches	fences	plantation	stream	track
Masts/poles	hedges	isolated trees	lake	road
Pylons	banks	tree clumps	reservoir	motorway
Industry	shelterbelt	hedgerow trees	pond	railway
Vernacular buildings	field pattern	parkland	canal	
Settlement	arable	scrub	waterfall	
Built-up	pasture	marsh	beach	
Mineral working	orchards		dune	
Ruins			mudflat	

Landform:

Flat	plain	coast
Undulating	rolling lowland	estuary
Rolling	plateau	broad valley
Steep	hills	narrow valley
Vertical	scarp	deep gorge
	Cliff	

Aesthetic factors:

BLANCE:	harmonious	balanced	discordant	chaotic
SCALE:	intimate	small	medium	large
ENCLOSURE:	confined	enclosed	open	exposed
TEXTURE:	smooth	textured	rough	very rough
COLOUR:	monochrome	muted	colourful	garish
DIVERSITY:	uniform	simple	diverse	complex
MOVEMENT:	remote	vacant	peaceful	active
UNITY:	unified	interrupted	fragmented	chaotic
FORM:	straight	angular	curved	sinuous
SECURITY:	comfortable	safe	unsettling	threatening
STIMULUS:	boring	bland	interesting	invigorating
PLEASURE:	offensive	unpleasant	pleasant	beautiful

Landscape Condition: Good
well maintained fields and walls. Lane has lots of pot holes!

Most Appropriate Management Strategy:

Conservation:
Maintain existing fields for grazing

Restoration:
-

Reconstruction:
-

Ability to Accommodate Change:

Low. Any addition to this area would not be in keeping and change could not easily be accommodated

FIELD SURVEY FORM

View No: 16 Location: Mucky Lane Date: 2/7/10 Surveyor: MB

Annotated View:



Brief Description:

Dry stone wall in foreground, power plant dominating the view. Woodland in background

Landcover and landscape elements:

Farm buldings	walls	woodland	river	footpath
Churches	fences	plantation	stream	track
Masts/poles	hedges	isolated trees	lake	road
Pylons	banks	tree clumps	reservoir	motorway
Industry	shelterbelt	hedgerow trees	pond	railway
Vernacular buildings	field pattern	parkland	canal	
Settlement	arable	scrub	waterfall	
Built-up	pasture	marsh	beach	
Mineral working	orchards		dune	
Ruins			mudflat	

Landform:

Flat	plain	coast
Undulating	rolling lowland	estuary
Rolling	plateau	broad valley
Steep	hills	narrow valley
Vertical	scarp	deep gorge
	Cliff	

Aesthetic factors:

BLANCE:	harmonious	balanced	discordant	chaotic
SCALE:	intimate	small	medium	large
ENCLOSURE:	confined	enclosed	open	exposed
TEXTURE:	smooth	textured	rough	very rough
COLOUR:	monochrome	muted	colourful	garish
DIVERSITY:	uniform	simple	diverse	complex
MOVEMENT:	remote	vacant	peaceful	active
UNITY:	unified	interrupted	fragmented	chaotic
FORM:	straight	angular	curved	sinuous
SECURITY:	comfortable	safe	unsettling	threatening
STIMULUS:	boring	bland	interesting	invigorating
PLEASURE:	offensive	unpleasant	pleasant	beautiful

Landscape Condition: Good

Well maintained dry stone wall, arable fields

Most Appropriate Management Strategy:

Conservation:

Maintain rural character and field boundaries

Restoration:

—

Reconstruction:

—

Ability to Accommodate Change: High

Existing power plant highly visible. Additional power plant proposed will be in keeping with the adjacent use, although an alien use for the rural location

APPENDIX C

Results of Visual Assessment

RESULTS OF VISUAL ASSESSMENT

Is the Site visible from view point?

View Point	No	Partially	Yes
1	✓		
2	✓		
3		✓	
4		✓	
5			✓
6			✓
7			✓
8			✓
9			✓
10		✓	
11	✓		
12	✓		
13	✓		
14	✓		
15	✓		
16	✓		
Total:	8	3	5
%	50%	19%	31%

Description:

The most common description of the area is of arable or grazing fields and tree clumps with an undulating, broad valley topography, rural character with strong field patterns and drystone walls with occasional hedgerows and isolated trees. The existing sub-station is visible and/or partially visible in 50% of the view-points assessed.

Most common landcover and landscape elements in view:

Farm buldings 12%	walls 94%	woodland 44%	river	footpath 19%
Churches	fences 44%	plantation	stream	track 44%
Masts/poles 50%	hedges 56%	isolated trees 88%	lake	road 63%
Pylons 94%	banks 44%	tree clumps 25%	reservoir	motorway
Industry 25%	shelterbelt 6%	hedgerow trees 25%	pond	railway
Vernacular buildings 6%	field pattern 94%	parkland	canal	
Settlement 6%	arable 19%	scrub	waterfall	
Built-up	pasture 38%	marsh	beach	
Mineral working	orchards		dune	
Ruins			mudflat	

Landform:

Flat 25%	plain 6%		coast
Undulating 50%	rolling lowland	19%	estuary
Rolling 38%	plateau 19%		broad valley 100%
Steep 6%	hills 69%		narrow valley
Vertical	scarp		deep gorge
	Cliff		

Aesthetic factors:

BLANCE:	harmonious 50%	balanced 31%	discordant 13%	chaotic 6%
SCALE:	intimate 6%	small	medium 44%	large 50%
ENCLOSURE:	confined 6%	enclosed 6%	open 69%	exposed 13%
TEXTURE:	smooth 25%	textured 63%	rough 6%	very rough
COLOUR:	monochrome 13%	muted 38%	colourful 50%	garish
DIVERSITY:	uniform	simple 81%	diverse 19%	complex
MOVEMENT:	remote 13%	vacant	peaceful 75%	active 13%
UNITY:	unified 50%	interrupted 38%	fragmented 13%	chaotic
FORM:	straight 38%	angular 13%	curved 38%	sinuous 13%
SECURITY:	comfortable 31%	safe 44%	unsettling 25%	threat
STIMULUS:	boring	bland 6%	interesting 94%	invigorating
PLEASURE:	offensive	unpleasant 6%	pleasant 94%	beautiful

Landscape Condition:

The overall condition of the landscape is *Good* and is mainly described as a managed agricultural landscape with well maintained dry stone walls and hedgerows and strong woodland blocks with isolated trees around field boundaries.

Most Appropriate Management Strategy:

Conservation: Maintain rural character and boundary walls/fences/hedgerows

Restoration: None required

Reconstruction: None required

Ability to Accommodate Change:

A strong arable/rural character with little or no built form in the surrounding area although in the immediate vicinity there is the existing sub-station which therefore provides for some ability to accommodate change in proximity to the existing buildings.