GUIDANCE NOTE ON
ENERGY EFFICIENCY AUDITING

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ENVIRONMENTAL PROTECTION AGENCY
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1.0 INTRODUCTION

1.1 Overview

An important element in an energy management system is accurate and up-to-date knowledge of the current energy consumption patterns at a site. An Energy Audit is a practical and valuable way to establish this information. Using this baseline data it is then possible to identify and work towards goals and priorities for future improvement.

The purpose of this guidance note is to provide assistance to Integrated Pollution Control (IPC) licensees to conduct consistent and effective Energy Audits at industrial sites.

1.2 Definitions

1.2.1 Energy Management

Energy management is making the best possible use of the energy consumed by an organisation through the implementation of an energy management system. An energy management system can include *inter alia* relevant policies, procedures, action plans, responsibility chains, training, awareness and motivation, data collection and monitoring systems.

1.2.2 Energy Audit

An Energy Audit is "a study to determine the quantity and cost of each form of energy to a building, process, manufacturing unit, piece of equipment or site over a given period[1]."

The implementation of regular Energy Audits is an important part of a site's energy management system. The results from an Energy Audit can be used by site operators to identify recommendations for energy efficiency improvements at a site. This can include the setting of realistic energy efficiency targets for the site. Once the system of energy management is in place any slippage can be easily identified and acted upon.

1.2.3 Energy Efficiency Improvements

Energy efficiency improvements result in reductions in the energy consumed by a given energy service or level of activity. These reductions are not necessarily associated with technical changes since they can also result from better organisation and management or improved economic efficiency.

[1] Good Practice Guide 316: *Undertaking an Industrial Energy Survey*, UK Energy Efficiency Best Practice Programme

1.2.4 Energy Monitoring

Energy monitoring involves the regular recording of energy consumption and cost, and of the principal variables, such as outside temperature and occupancy, which affect them. It allows essential information on energy performance to be provided at the right time and in a useful form to those responsible for its control.

1.3 Benefits of an Energy Audit

The identification and implementation of recommendations for energy efficiency improvements arising from an Energy Audit can deliver different inter-related benefits to site operators, *viz*.:

- Setting of energy efficiency targets
- Financial benefits in terms of reduced costs or increased profits;
- Operational benefits including improved productivity, comfort and safety, and security of energy supply;
- Environmental benefits such as sustainability, conservation of resources and emissions savings including greenhouse gas reductions.

Environmental benefits are often realised through compliance with environmental legislation or regulatory requirements; for instance:

- The proposed introduction of an energy tax by late 2004 should provide additional motivation to improve energy efficiency.
- Electricity market deregulation and the increased deployment of renewable energy conversion systems have improved accessibility to sustainable energy supplies.

1.4 Implementation

1.4.1 Energy Audits and the Environmental Management Programme

The completion of an Energy Audit and the subsequent implementation of recommendations, as part of a site's Environmental Management Programme, shall be in accordance with the relevant condition(s) in the IPC licence. In addition, the implementation of the recommendations arising from each Audit should be reported in the site's Annual Environmental Report (AER) to the Environmental Protection Agency.

Energy Auditing should be one element in a continuous and cyclical process of energy management. An appropriate frequency for conducting successive Energy Audits should be agreed with the Agency[2].

1.4.2 Monitoring

The accuracy and usefulness of the results from an Energy Audit are dependent on the quality and quantity of input data available for analysis. Therefore, it is good practice to monitor, measure and record details of energy usage on a continuous basis. This can help with the identification of consumption patterns during an Energy Audit as well as ensuring that key personnel at the site have ongoing familiarity with energy usage.

The level and frequency of monitoring will vary between sites and can range from recording details of fuel and electricity 'deliveries' from invoices and bills to detailed metering of thermal and electrical energy flows through different areas and / or systems.

1.4.3 The Energy Auditor

An Energy Audit may be conducted using either in-house expertise or an external Consultant. The Auditor should have the relevant technical expertise and experience to plan and implement the Audit.

The advantages of using in-house expertise include familiarity with the site, its operations and its personnel, freedom of access to the site and flexibility in timing. The advantages of using a Consultant include independence, breadth of relevant knowledge, technical expertise, resource availability and the benefits of a fresh perspective of the site.

With either of the above options, the operator should nominate a Project Coordinator with ultimate responsibility for the completion of the Audit. If the Audit is being conducted in-house, the Project Coordinator and Auditor could be the same person.

1.4.4 Additional Information

Appendix I contains a list of sources of additional information on energy management, Energy Auditing and industrial energy efficiency.

[2] It may be appropriate to conduct successive Energy Audits at a greater frequency than that agreed with the Agency in exceptional circumstances; for example if site operators suspect that there may be significant changes to consumption profiles due to changes in product mix or shift operations.

2.0 AUDIT PROCESS

2.1 Preparation

2.1.1 Responsibilities

The Project Coordinator should undertake the following work elements or assign them to one or more appropriately qualified members of site personnel:

- Selection of Auditor;
- Compilation of input data for Auditor;
- Coordination of site visit(s) for Consultant (if relevant);
- Coordination of input, including suggestions for recommendations for improvements, from relevant site personnel;
- Assessment of implications of Audit findings in the context of site operations;
- Integration of Audit recommendations into Environmental Management Programme;
- Implementation of Audit recommendations and monitoring of results.

2.1.2 Scope of Audit & Audit Programme

The Project Coordinator and Auditor should agree on a scope for the Audit which should include the site areas, systems and activities to be assessed. The Project Coordinator shall consult with the Agency on the nature and extent of the Audit and shall develop an Audit Programme to the satisfaction of the Agency. The Audit Programme shall be submitted to the Agency in writing at least one month before the Audit is to be carried out.

2.1.3 Input Information

Before commencing the Audit, the designated person should compile a comprehensive set of existing site and energy data as inputs to the Audit process. The data should include:

- Reports from previous Energy Audits (if available);
- Site plans, building layout drawings and inventories of major plant and equipment;
- At least 12 months of electricity and fuel consumption data;

- Details of activity, occupancy and / or production levels for the same period as the energy consumption data.
- Details of weather conditions during the period, if available.

2.2 Execution

2.2.1 Energy Management System

According to Sustainable Energy Ireland[3], "typically a company can save 2 or 3% of its energy through improving its energy management systems". The Auditor should review the site's energy management system, if one exists, against best practice and make recommendations for improvement. Site operators should strive to develop their energy management systems on a prioritised basis as part of a continuous and cyclical process of improvement.

This can be done by identifying the level of development of different elements of the site's energy management system on the energy management matrix included in Appendix II. Level 4 of the matrix represents Best Practice in the field. However, this level of development may not be appropriate for all sites.

2.2.2 Energy Consumption

The Auditor should consider each of the energy systems at the site in a rigorous and thorough manner. A checklist of items that should be investigated in the course of an Energy Audit at a typical site is included in Appendix III. The degree of analysis committed to each item should depend on that item's relative importance in terms of energy consumption on the site. Not all of the items included in Appendix III are relevant to all sites. Furthermore, the checklist is not exhaustive and Auditors on some sites may identify additional areas for assessment. Appendix III also contains a list of reference documents with relevant information for auditing different industrial energy systems.

The Auditor should assess the current performance of each energy system and evaluate the potential for improvements in terms of energy savings, emissions savings, cost savings and payback.

[3] Energy Audit Template of Sustainable Energy Ireland's Negotiated Agreements Pilot Programme

3.0 ANALYSIS

3.1 Evaluation of Energy Performance

3.1.1 Energy Performance and Site Activity

Auditors should assess energy performance in the context of site activity and develop appropriate Energy Performance Indicators for the entire site and / or individual energy systems. These indicators provide a means to quantify energy costs and consumption against important parameters, including production. The parameters upon which useful indicators may be based can vary greatly from site to site[4]. They could include number of 'widgets' produced, tonnes / litres of product produced, reactor-hours of processing, production man-hours, site occupancy or degree days[5].

There are a number of publications that allow a company to develop Energy Performance Indicators and to compare themselves to companies from a similar industrial sector. Appendix I – 'Additional Sources of Information' should be referred to.

Once appropriate performance indicators have been developed for a site, they can be tracked over time to give a useful overview of energy consumption patterns.

3.1.2 Benchmarking

Auditors should endeavour to benchmark energy performance against other sites in the operator's organisation, in the same industry sector or in a comparable sector. There is a considerable amount of information available to compare sites. The reference documents in Appendix III should be referred to.

3.2 Audit Recommendations

3.2.1 Identification of Recommendations

The Auditor should identify a set of recommendations for improving the energy performance of the site. Before preparing the final report the Auditor and Project Coordinator should strive to confirm the technical feasibility of each recommendation. Alternatively, studies to investigate the technical feasibility of specific actions may be included as recommendations. Recommendations could include:

- Modification or replacement of existing plant and / or equipment;
- Modification of operational procedures;

[4] It may be difficult to develop useful Energy Performance Indicators for complex, multi-product sites.

[5] ECG 18 *Benchmarking Tool for Industrial Buildings – Heating and Internal Lighting*, available from www.actionenergy.org.uk, includes a methodology for normalising energy consumption due to differences in occupancy and weather.

- Review of maintenance and other activities that affect the efficient use of energy;
- Additional investigations of potential energy saving measures for specific plant or processes;
- Commitment to ongoing training and information dissemination to increase awareness among staff.

For many companies, the first step in improving energy management on site is to simply measure and benchmark boiler combustion efficiency. This benchmark can be used to assess boiler performance and energy efficiency in subsequent years following modification etc.

When identifying and examining recommendations for improving the energy performance of the site, the feasibility of incorporating cleaner production techniques should also be investigated.

3.2.2 Evaluation of Recommendations

The Auditor should determine the savings and costs associated with each recommendation identified during the Audit. The savings should be expressed for each recommendation in terms of:

- Actual energy saved in kWh or GJ by determining a change in a specific parameter; for example temperature, running time or installed power.
- Annual greenhouse gas emissions savings in terms of tonnes of CO_2 by using the fuel and electricity conversion factors set out in Appendix IV.
- Cost in Euro of energy saved by using the site's invoice data for different energy streams.

For each recommendation, the costs should be expressed in terms of:

- The capital expenditure required for implementation.
- The simple payback period, *P*, by dividing the capital expenditure for each recommendation, *C*, by the difference between the annual incremental savings, *S*, and the annual incremental operational costs, *O* (if any), as follows –

$$P = C/(S - O) \quad \text{years.}$$

- Capital cost per tonne of annual CO_2 emissions savings.

It may be useful to divide the recommendations into three cost categories, *viz*.: no / low cost; medium cost; high cost. The cost thresholds that define the categories can vary between different sites though they usually reflect the different levels of authority required to approve expenditure. For further information on the financial aspects of energy management, Appendix I should be referred to.

3.2.3 Overlap

The Auditor should identify, and where possible quantify, any interdependency between the recommendations identified as part of the Audit. Overlap may exist in the predicted levels of energy savings associated with different recommendations whereby the combined savings from implementing two recommendations may be less than the sum of the savings from each measure implemented independently. An example would be the annual savings associated with improving the insulation on a boiler shell and with reducing the running hours of the boiler.

3.2.4 Implementation of Recommendations

The Project Coordinator should ensure that:

- The Audit findings are brought to the attention of, and considered by, appropriate site management;
- A final list of recommendations is selected for implementation;
- The final list of recommendations is included in an implementation programme in which each recommendation is allocated a specific target date, sufficient resources and a specific individual responsible for its completion;
- The final recommendations are incorporated as targets into the site's Environmental Management Programme;
- The performance of the implemented recommendations are monitored, recorded and incorporated as inputs into the next Energy Audit.

4.0 REPORTING

Two reports should be prepared for each Energy Audit, *viz.*:

- Main Report for site use;
- Summary Report for submission to the Agency as part of the Annual Environmental Report.

4.1 Main Report

The layout and style of the Main Report is at the discretion of the Auditor. However, it should be presented in a clear, concise and logical format. Large tables, data sets, plots, diagrams, equipment documentation, policy statements and any sampling, testing or calibration reports should be included in Appendices only. The report should include *inter alia*:

- Overview of the activities at the site and the main energy consumers;
- Details of the timing of the Audit with respect to weather and site production / occupancy levels;
- Details of the period covered by the Audit;
- Details of the scope of the Audit including the areas, systems and activities assessed;
- The status of the energy management system at the site;
- The current energy performance of the site and of each of the energy systems assessed in the Audit;
- The Audit recommendations quantified in terms of energy and emissions savings and payback period.

4.2 Summary Report

The operator of an IPC licensed site is required to submit a summary report on the Energy Audit to the Agency. This report shall include:

- 'Table 1' setting out the consumption of different energy streams at the site.
- 'Table 2' setting out the final list of Audit Recommendations that have been incorporated into the implementation programme. For each recommendation the table shall include a description of the measure, the predicted energy savings, emissions savings and payback period, the target date and the title of the person or function responsible for implementation.
- A maximum of two pages of text including:
  - an overview of the status of the energy management system at the site;
  - any energy performance indicators calculated for the site for the Audit period and previous periods (see section 3.1.1).
  - a summary of the implications of Audit findings.

Suggested layouts for the two tables are given in Appendix V.

Appendix I - Sources of Information

Sustainable Energy Ireland

Sustainable Energy Ireland is Ireland's national energy authority. The Authority promotes and assists environmentally and economically sustainable use of energy and runs a number of initiatives in the industrial sector including the Large Industry Energy Network.

Web: www.sei.ie, contact: info@sei.ie

Action Energy (UK)

Action Energy is an initiative of the British Government to promote the efficient use of energy. The Action Energy website contains links to, and ordering information for, a wide selection of documents on different aspects of energy management, Energy Auditing, industrial energy efficiency, energy performance indicators and the financial aspects of energy management.

Appendix III includes references to Action Energy documents of relevance to specific energy systems. Other, general documents available from Action Energy include:

- GPG 69 *Investment Appraisal for Industrial Energy Efficiency*
- GPG 87 *The Pharmaceutical Industry*
- GPG 165 *Financial Aspects of Energy Management in Buildings*
- GPG 316 *Undertaking an Industry Energy Survey*

Web: www.actionenergy.org.uk

Other Sources of Information on Energy Management

- International Energy Agency Demand-Side Management Programme - http://dsm.iea.org/
- New Zealand Energy Efficiency and Conservation Authority - http://www.eeca.govt.nz/
- Sustainable Energy Authority Victoria – Developing an Energy Management System - http://www.seav.vic.gov.au/advice/business/energy_management/index.html

- The Australian Greenhouse Office -Setting Up an Energy Management Programme - http://www.greenhouse.gov.au/lgmodules/wep/setting_up/index2.html
- US Energy Star Program - http://www.energystar.gov/index.cfm?c=industry.bus_industry
- US Federal Energy Management Program - http://www.eere.energy.gov/femp/

Appendix II - Energy Management Matrix

Level	Energy Policy	Organising	Motivation	Information Systems	Marketing	Investment
Level 4	Energy policy, action plan and regular review have commitment of top management as part of an environmental strategy	Energy management fully integrated into management structure. Clear delegation of responsibility for energy consumption.	Formal and informal channels of communication regularly exploited by energy manager and energy staff at all levels.	Comprehensive system sets targets, monitors consumption, identifies faults, quantifies savings and provides budget tracking.	Marketing the value of energy efficiency and the performance of energy management both within the organisation and outside it.	Positive discrimination in favour of 'green' schemes with detailed investment appraisal of all new-build and refurbishment opportunities.
Level 3	Formal energy policy, but no active commitment from top management.	Energy manager accountable to energy committee representing all users chaired by a member of the managing board.	Energy committee used as main channel together with direct contact with major users.	M&T reports for individual premises based on sub-metering, but savings not reported effectively to users.	Programme of staff awareness and regular publicity campaigns.	Same pay back criteria employed as for all other investment.
Level 2	Un-adopted energy policy set by energy manager or senior departmental manager.	Energy manager in post, reporting to ad-hoc committee, but line management and authority are unclear.	Contact with major users through ad-hoc committee chaired by senior departmental manager.	Monitoring and targeting reports based on supply meter data. Energy unit has ad-hoc involvement in budget setting.	Some ad-hoc staff awareness training.	Investment using short-term payback criteria only.
Level 1	An unwritten set of guidelines	Energy management is the part-time responsibility of someone with limited authority or influence	Informal contacts between engineer and a few users.	Cost reporting based on invoice data. Engineer compiles reports for internal use within technical department.	Informal contacts used to promote energy efficiency.	Only low cost measures taken.
Level 0	No explicit policy	No energy management or any formal delegation of responsibility for energy consumption	No contact with users.	No information system. No accounting for energy consumption.	No promotion of energy efficiency.	No investment in increasing energy efficiency in premises.

Taken from the Energy Audit Templates of Sustainable Energy Ireland's Pilot Programme on Negotiated Energy Agreements

Appendix III – Energy Audit Check List

The following is a checklist of items that should be investigated in the course of an energy Audit at an IPC licensed site. Not all of the items included in Appendix III are relevant to all sites. Furthermore, the checklist is not exhaustive and Auditors on some sites may identify additional areas for assessment.

Additional details of energy efficiency measures for different energy systems may be found in the supporting documentation referenced at the end of each section. These references are taken from the Energy Audit Templates of Sustainable Energy Ireland's Negotiated Energy Agreement Pilot Programme. The supporting documentation is produced by the UK's Action Energy programme and can be downloaded or ordered from www.actionenergy.org.uk.

Energy Inputs	
Checks	Check usage, cost, storage facilities for oil, gas, solid fuel. Check potential for alternative supply contracts. Check potential for use of alternative fuels. Check electricity usage, cost, supply and load patterns. Check potential for alternative supplier or tariff structure. Check potential for power factor correction.
Reference Documents	

Buildings	
Checks	Check location, orientation, exposure, size, shape, age of individual buildings. Check floor areas and floor layouts. Check building uses; occupancy patterns; occupancy rates. Check building fabric with respect to insulation standards, glazing standards, air infiltration.
Reference Documents	GPG 303 *The Designers Guide to Energy Efficient Industrial Buildings*; GPG 316 *Undertaking an Industrial Energy Survey*.

Energy Conversion Plant (Fired)	
Checks	Check make, type, rating, age of individual boilers and burners. Check physical condition; servicing records. Check fuel consumption data for individual plants. Check usage patterns; demand; control. Check combustion efficiencies over firing range. Check seasonal efficiencies. Check insulation standard, condition and suitability. Check potential for load reduction. Check potential for boiler replacement and improvement of control system.

Energy Conversion Plant (Fired)	
Reference Documents	ECG 66 *Steam Generation Costs*; GPG 30 *Energy Efficient Operation of Industrial Boilers*; FEB 14 *Economic Use of Oil-Fired Boiler Plant*; FEB 15 *Economic Use of Gas-Fired Boiler Plant*; FEB 17 *Economic Use of Coal-Fired Boiler Plant*; FEB 19 *Process Plant Insulation and Fuel Efficiency*; GPG 316 *Undertaking an Industrial Energy Survey*.

Refrigeration Plant	
Checks	Check make, type, rating, age of equipment. Check physical condition; servicing records. Check energy input versus refrigeration output. Check usage patterns; demand; control. Check insulation standard, condition and suitability. Check potential for reducing refrigeration demand. Check potential for heat recovery.
Reference Documents	GPG 316 *Undertaking an Industrial Energy Survey*.

Distribution Systems	
Checks	Check leaks and losses in hot water distribution systems. Check leaks and losses in chilled water distribution systems. Check leaks and losses in steam distribution systems. Check leaks and losses in thermal fluid distribution systems. Check leaks and losses in compressed air distribution systems. Check imbalances between supply and end use, e.g. from meters. Check insulation standard, condition and suitability. Check potential for reducing flow rates in piping and ducting systems. Check potential for rationalisation of piping and ducting systems. Check steam trap operation. Check condensate return and potential for additional recovery. Check flash steam and potential for additional recovery. Check loadings and efficiencies of transformers. Check potential for rationalisation of electrical distribution system.
Reference Documents	ECG 67 *Steam Distribution Costs*; GPG 197 *Energy Efficient Heat Distribution*; ECG 66 *Steam Generation Costs*; GPG 30 *Energy Efficient Operation of Industrial Boilers*; FEB 19 *Process Plant Insulation and Fuel Efficiency*; GPG 316 *Undertaking an Industrial Energy Survey*.

Space Heating	
Checks	Check type of heating system installed. Check running hours in relation to occupancy. Check heating regime in relation to occupancy. Check actual versus temperature design comfort conditions. Check heating load. Check position, operation and condition of heat emitters. Check position, operation, settings, condition of existing controls. Check need for additional controls- time, temperature, zone, etc.
Reference Documents	ECG 18 *Benchmarking Tool for Industrial Buildings – Heating and Internal Lighting*; GPG 316 *Undertaking an Industrial Energy Survey*.

Air Conditioning & Ventilation	
Checks	Check type of system(s) installed. Check air conditioning / ventilation regime in relation to occupancy. Check actual versus design comfort conditions. Check heating / cooling and ventilation loads. Check position, operation and condition of system equipment. Check position, operation, settings, condition of existing controls. Check need for additional controls. Check leaks and losses in conditioned air distribution systems.
Reference Documents	GPG 257 *Energy Efficient Mechanical Ventilation Systems*; GPG 197 *Energy Efficient Heat Distribution*; GPG 291 *A Designers Guide to the Options for Heating and Cooling*; GPG 316 *Undertaking an Industrial Energy Survey*.

Domestic Hot Water	
Checks	Check make, type, rating, storage capacities of hot water heaters. Check water delivery temperatures and controls. Check flow rates and flow control at outlets. Check insulation standard and condition. Check potential to use an alternative heating source.
Reference Documents	GPG 197 *Energy Efficient Heat Distribution*; GPG 291 *A Designers Guide to the Options for Heating and Cooling*; GPG 316 *Undertaking an Industrial Energy Survey*.

Process Heating & Cooling	
Checks	Check type of system(s) installed. Check actual versus design conditions Check heating and cooling loads. Check condition and operation of system equipment. Check position, operation, settings, condition of existing controls. Check need for additional controls. Check other methods of saving.

Process Heating & Cooling	
Reference Documents	GPG 215 *Advanced Process Control*; GPG 66 *Rotary Drying in the Chemical Industry*; GPG 185 *Spray Drying*; GPG 243 *Drying of Particulate Solids*; FEB 19 *Process Plant Insulation and Fuel Efficiency*; GPG 253 *A Managers Guide to Optimising Furnace Performance*; GPG 316 *Undertaking an Industrial Energy Survey*.

Electrical Power	
Checks	Check rating, loading of individual motors. Check rating, loading of non -motive electrical equipment, e.g. processing and production equipment. Check running hours. Check potential for improved load matching, e.g. fans and pumps. Check potential for using variable speed drives. Check potential for load reduction. Check potential for control of demand surges. Check potential for switching to night operation. Check for unnecessary running at weekends.
Reference Documents	GPG 2 *Energy Savings with Motors and Drives*; GPCS 170 *Variable Speed Drives in a Chemical Plant*; GPG 316 *Undertaking an Industrial Energy Survey*.

Lighting	
Checks	Check type of lighting system. Check lighting loads; lighting levels. Check condition, siting, switching of existing luminaires. Check need for additional switching controls. Check lamp replacement procedures. Check potential for greater use of daylight. Check frequency of cleaning
Reference Documents	ECG 18 *Benchmarking Tool for Industrial Buildings – Heating and Internal Lighting*; GPG 158 *Energy Efficiency in Lighting in Industrial Buildings*; GPG 199 *Energy Efficient Lighting – a Guide for Installers*; GPG 316 *Undertaking an Industrial Energy Survey*.

Compressed Air	
Checks	Check make, type, rating, age of system equipment. Check physical condition; servicing records. Check usage patterns; demand control. Check condition of air intake and filters. Check air intake temperature.
Reference Documents	FEB 4 *Compressed Air and Energy Use*; GPG 126 *Compressing Air Costs*; GPG 216 *Energy Savings in the Filtration and Drying of Compressed Air*; GPG 214 *Energy Savings in the Selection Control and Maintenance of Air Compressors*; GPG 316 *Undertaking an Industrial Energy Survey*.

Industrial Gases	
Checks	Check make, type, rating, age of system equipment. Check physical condition; servicing records. Check usage patterns; demand control. Check if the gas provided is to a higher purity than that required by the process, and hence can energy be saved by using gas produced to a specification closer to the requirements.
Reference Documents	GPG 90 *Efficient use of Industrial Gases*.

Waste	
Checks	Check potential for heat recovery from aqueous effluent. Check potential for heat recovery from emissions to atmosphere. Check potential for heat recovery from solid waste.
Reference Documents	GPG 141 *Waste Heat Recovery*; GPG 89 *Compact Heat Exchangers*; GPG 316 *Undertaking an Industrial Energy Survey*.

Appendix IV – Fuel to Carbon Conversion Factors

Fuel	Conversion Factor		
	t C/TJ	t CO_2/TJ	g CO_2/kWh
Coal	24.60	90.20	324.72
Peat	29.57	108.42	390.32
Briquettes	29.57	108.42	390.32
Gasoline	18.90	69.30	249.48
Kerosene	19.47	71.39	257.00
Fuel Oil	20.73	76.01	273.64
LPG	17.37	63.69	229.28
Gasoil	19.99	73.30	263.87
Natural Gas	14.98	54.93	197.74
Town Gas	15.00	55.00	198.00
Electricity	-	-	775.77
Hydro	-	-	-
Other Renewable Energy	-	-	-

Notes:

t – tonne
C – Carbon
TJ – Terajoule
CO_2 – Carbon Dioxide
g – gram
kWh – kilowatt hour

Source: EPA

Appendix V – Data for Inclusion in Summary Report

Table 1 - Site Energy Usage

			Period:
Energy Stream	**Annual Quantity**	**Units**	**Comments**
Electricity Consumed Onsite		kWh	
Electricity Imported		kWh	
Electricity Generated Onsite (CHP sites only)		kWh	
Electricity Exported Offsite (CHP sites only)		kWh	
Natural Gas Total		kWh (Gross CV)	
Natural Gas for CHP		kWh (Gross CV)	
Gasoil		litre	
LPG		litre	
Light Fuel Oil		litre	
Medium Fuel Oil		litre	
Heavy Fuel Oil		litre	
Other – please specify			

Table 2 - Energy Audit Recommendations

Ref	Date	Recommendation	Investment Cost Category[6]	Payback Period	Predicted Annual Energy Savings		Annual CO_2 Emissions Savings	Target Completion Date	Respons-ibility	Comments
				[Year]	[kWh]	[€]	[Tonne]			

[6] Either no / low cost, medium cost, high cost