Forth Energy

Chapter 1

Introduction

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Preface

The issue of climate change is recognised as one of the most serious global challenges facing society today. A group of concerned nations, under the stewardship of the United Nations, have agreed targets to reduce greenhouse gas emissions, commonly referred to as the "Kyoto Protocol". This international effort agreed legally binding targets for reducing greenhouse gas emissions. The Kyoto Protocol runs through to 2012, with firm commitments beyond this time still the subject of debate. At the Copenhagen Climate Change Summit in December 2009, leading developed and developing countries signed the Copenhagen Accord that is backed by a large majority of the world setting out the need to limit the rise in global temperature to 2 degrees Celsius.

The European Commission has introduced several legislative mechanisms to ensure compliance with the Kyoto Protocol and likely future targets. These include the EU Emissions Trading System (EU ETS) and the Renewable Energy Directive[1], the latter requiring all EU countries to meet specified renewable energy targets. This Directive requires 15% of all the UK's energy demand to come from renewable sources by 2020.

The Scottish Government has set a target that 50% of Scottish demand for electricity should be met from renewable sources by 2020, with an interim milestone of 31% by 2011. A target for renewable heat of 11% of the projected 2020 demand has also been set. The development of renewable energy technologies is being strongly encouraged as a means of tackling climate change and promoting the Scottish economy. An aim of the Scottish Government is to realise Scotland's very large renewable potential while safeguarding the environment. The Scottish Government also has a policy of seeking to encourage a mix of renewable energy technologies, with growing contributions from offshore wind, wave, tidal and solar facilities and a greater use of fuel from wood and other energy crops.

In addition, the UK must address the potential future electricity generation gap in the UK, where electricity demand could outstrip supply due to the closure of older capacity on the system, as well as ensuring that the country maintains its security and diversity of energy supply.

Forth Energy, as well as other industry leaders and the Scottish and UK Governments, believe a broad range of technologies need to be deployed to address these challenges. To support this Forth Energy is proposing to construct and operate four Renewable Energy Plants at the Ports of: Grangemouth; Dundee; Leith; and Rosyth. The total renewable electrical output for export from the projects at Grangemouth; Dundee and Rosyth will be 100 MWe each, with the Renewable Energy Plant at Leith generating 200 MWe. The plants will also be capable of exporting renewable heat to nearby heat users.

This Environmental Statement (ES) relates to the proposed Grangemouth Renewable Energy Plant on a site within the Port of Grangemouth. The Renewable Energy Plant will generate renewable electricity and heat from sustainably sourced biomass fuel. It is well sited and will contribute towards the planning and renewable objectives of not only Falkirk Council, but also the national and global initiatives outlined above.

This ES accompanies an application to the Scottish Government for consent under Section 36 of the Electricity Act 1989 for the proposed Renewable Energy Plant. The proposed Renewable Energy Plant is expected to enter into commercial operation by 2015, subject to the granting of all necessary planning and environmental consents and permits.

[1] Directive of the European Parliament and of the Council on the promotion of the use of Energy from Renewable Sources , Commission of the European Communities adopted March 2009

1 Introduction

1.1 Background

1.1.1 Forth Energy is seeking consent under Section 36 of the Electricity Act 1989 to construct and operate the Grangemouth Renewable Energy Plant with a net electrical output of 100 Megawatt (MWe)[2], on a site at the Port of Grangemouth. Sustainably sourced biomass is a recognised source of renewable energy[3] and will be used as a fuel to generate renewable electricity and heat: thereby contributing to the national reduction of emissions of carbon dioxide (CO_2) and contributing to the attainment of national policy objectives which are aimed at the decarbonisation of electricity and heat generation.

1.1.2 This Environmental Statement (ES) records the results and conclusions of the Environmental Impact Assessment (EIA) performed to determine the potential significant impacts (both adverse and beneficial) of the proposed Renewable Energy Plant. It also seeks to identify potential measures to avoid, reduce or compensate for any significant adverse effects and assess residual impacts.

1.2 Forth Energy

1.2.1 Forth Energy is a joint venture formed by Scottish and Southern Energy (SSE) and Forth Ports and has the potential to be Scotland's biggest developer of dedicated renewable power generation facilities. The joint venture is currently progressing renewable energy projects at Forth Ports' sites in Scotland. SSE is the UK's largest renewable energy generator. Forth Ports owns and operates seven commercial ports and manages 280 square miles of navigable waters in Scotland.

1.2.2 Forth Energy believes that the Grangemouth Renewable Energy Plant will be a valuable step in tackling the global challenges of climate change and the national challenges of increasing the amount of energy to be generated from renewable sources. In addition the project contributes to addressing the potential generation capacity shortfall and security of energy supply issues.

1.2.3 This project will also assist SSE in meeting its supplier obligations under the Renewables Obligation[4], ensuring that the company plays a vital part in delivering solutions to the issues and challenges that face society today.

1.3 Grangemouth Renewable Energy Plant

1.3.1 The location of the proposed development is shown within Figure 1.1, with the location of the Section 36 Application boundary shown in more detail in Figure 1.2. The application boundary shown in Figure 1.2 includes:

- the main plant area;
- an area of search for the installation of the cooling water intake (within the Western Channel);
- two alternative infrastructure corridors for the installation of cooling water discharge pipes, ;
- an area of search for the installation of the cooling water outfall (in the vicinity of the River Carron); and
- an infrastructure corridor for the fuel transfer conveyor (along Central Dock Road).

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[2] Gross electricity production will be approximately 118 MWe, with a net export capacity of 100 MWe, the balance of power being used to operate the plant.

[3] The 'UK Renewable Energy Strategy' (UKRES), Department of Energy and Climate Change (DECC) (July 2009)

[4] Renewables Obligation Order 2009

1.3.2 The site is bounded by Central Dock Road and the Western Channel to the north; Central Dock Road to the west; a railway line to the south; and industrial works to the east.

1.3.3 The plant will export up to 100 MWe of renewable electricity to the local electricity network and also, if feasible, renewable heat to local users from the use of up to 1.5 million tonnes per year of biomass fuel (dependent upon calorific value). The plant is being designed to use efficient modern technology satisfying the requirements of BAT (Best Available Technology) including, for example, Fluidised Bed (FB) or pulverised fuel boiler technology, operating within stringent emissions control limits that will be set by the Scottish Environment Protection Agency (SEPA) in accordance with legislation. The plant is intended to operate as a base-load plant, operating continuously except for periods of maintenance.

1.3.4 The site will incorporate fuel storage areas and a power plant area, with fuel being transferred to the storage area and from there to the power plant area via a covered conveyor system. Cooling water infrastructure will also be installed in the impounded dock (i.e. the Western Channel) to provide a supply of cooling water to an evaporative cooling system using mechanical draught cooling structures. This cooling water will be discharged via an outfall in the Carron River. Figure 6.1 shows the proposed layout including open fuel storage, which would be utilised if the fuel used in the Renewable Energy Plant comprises predominantly woodchip. Figure 6.2 shows a layout where the main fuel store comprises silos which would be necessary if the fuel used is predominantly wood pellets. The precise form of fuel to be used (chip or pellet) has yet to be determined as this will require comprehensive and detailed discussions with potential suppliers which can only realistically take place once a consent has been granted.

1.3.5 The construction period for the proposed plant will be approximately 36 months. It is envisaged that during construction the laydown area will be in the location required for fuel storage and also in the area shown as 'reserved space' on the layout drawings (Figures 6.1 and 6.2).

1.3.6 It is expected that the construction workforce will peak at approximately 500 although typical numbers will be of the order of 300 over the three year construction period. An operational workforce of about 40 is anticipated. In addition, the project will also support 10 existing and 21 new port operation staff with respect to fuel handling.

1.3.7 The potential for the plant to increase its efficiency through the supply of steam and/ or hot water to nearby heat users has been investigated. Discussions are ongoing with a number of potential heat users, including Ineos regarding the refinery and petrochemical complex and it is Forth Energy's intention that renewable heat/steam will be supplied to local users where commercially feasible. Should such a user not be identified, however, the proposed plant will, in any case, be designed to include appropriate off-takes to enable steam or hot water to be supplied in the future, should any future local users wish to contract for it. A CHP Feasibility Study has been submitted with this Section 36 Application.

1.3.8 A new onsite 132 kV substation will be built to transform and transmit the electrical output from the plant to the local 132 kV network via a 132 kV underground electrical connection onto the main national transmission network at Bainsford substation. The off-site electrical connection is not within the scope of the Section 36 Application and consequently the EIA. However an indicative route is shown in Figure 6.3 and, wherever possible, the known impacts of the cable are discussed.

1.3.9 Chapter 6 provides further information regarding the proposed development.

1.4 Description of the site and its surroundings

1.4.1 The proposed site at Grangemouth was selected as a suitable site due to the presence of an adjacent operational quay capable of taking suitably sized ships from national or international origins as well as having the infrastructure to receive and discharge large quantities of biomass. Ships of the size required and similar types of cargo are currently being handled routinely at the port. In addition, the site is located within a designated general economic development area, with close road links for deliveries of indigenous biomass

and for ash removal. The availability of a sufficiently large area of land and the availability of an electrical connection were also factors in the site's selection. Also, the industrial area and proximity of other mixed use consumers is considered likely to include potential customers with a demand for steam and/or heat from the generation process of the Renewable Energy Plant. Further information on the site selection process is presented in Chapter 7.

1.4.2 The proposed site is centred on OS National Grid Reference 293500, 682500. It is generally level and covers an area of the order of 18.05 hectares (ha) within the operational area of the Port.

1.4.3 The main plant area is bounded by Central Dock Road and the Western Channel to the north; Central Dock Road to the west; a railway line to the south; and industrial works to the east.

1.4.1 The main plant area is currently used for secondary port activities, to support general cargo activities all of which can be supported in other areas of the port. Grangemouth is the largest container port in Scotland. The Port operates with full marine services and cargo handling activities 24 hours per day, seven days a week. Part of the main plant area is currently occupied by Duncan Adams, a Haulier. The activities associated with this facility will be relocated within the secure Port estate and the site cleared prior to construction commencing. There are small areas of scattered shrubs to the east of this area.

1.4.2 The Carron Dock and Western Channel lie to the north of Central Dock Road. The River Carron runs 100 to 150 m parallel to the docks to the north and the Grange Burn and is located 200 m to the south of the closest site boundary. While the closest shoreline of the Forth Estuary is 100 m to the north of the site (i.e. the southern bank of the River Carron at this location), the River Carron and the docks join the estuary approximately 2.3 km to the north east.

1.4.3 The area surrounding the development site is flat, with the Forth Estuary to the north, the town of Grangemouth to the south, industrial complexes on Earls Road to the west, and the Grangemouth Refinery and petrochemical complexes to the south east and east. To the south west, Grangemouth is bordered by the M9 motorway.

1.4.4 The site is located in an industrial port, with oil and gas import, export and storage located around the Eastern Channel of the port, container storage and handling along the southern around the Grange Dock, and a fish meal plant adjacent to the Western Channel. The warehousing and industrial buildings and plant within the docks are 20 m or more in height. Directly across the Forth Estuary, to the north of the port, is the coal-fired Longannet Power Station, with its 80 m boiler house and stack of 183 m. The general context and character of the port and the character of the estuary at this point is broadly industrial.

1.4.5 The port area is accessed from the A904 Earls Road / Station Road and there is good access to the M9 via junctions 5 and 6. Grangemouth is Scotland's largest container port and has an extensive, security controlled internal road network.

1.4.6 The nearest residences to the proposed development are located 200 m to the south of the site boundary. There is a line of trees between these residences and the boundary of the port and another line of trees along the Grange Burn. The north side of the River Carron comprises agricultural fields, with some isolated houses and the small community of Skinflats.

1.4.7 There are a number of recreational facilities in the vicinity of the site, including Falkirk Football Club's stadium approximately 3 km to the southwest, Grangemouth Sports Complex and Grangemouth Sports Stadium approximately 2 km to the south west, and Grangemouth Golf Course, approximately 3 km to the south-south-east.

1.4.8 The proposed development site is adjacent to the Firth of Forth Special Protection Area (SPA) and Firth of Forth Site of Special Scientific Interest (SSSI), with important mudflats at Kinneil to the immediate south of the port and Skinflats to the north. These designated areas support large numbers of nationally and internationally important bird populations.

1.4.9 The site is within Falkirk Council's administrative area, with Fife Council's area on the northern bank of the Forth Estuary.

1.4.10 Further information on the proposed site is included in the baseline description provided in each of the specialist impact assessment chapters (i.e. Chapters 9 to 18).

1.5 Grangemouth Renewable Energy Plant Environmental Statement

1.5.1 The Scottish Government's Energy Consents Unit (SGECU) administers the consenting process under the terms of the Electricity Act 1989 for those seeking consent from the Scottish Ministers for the construction, extension or operation of an electricity generating plant of over 50 MWe in Scotland. "Deemed planning permission" under Section 57(2) of the Town and Country Planning (Scotland) Act 1997 is also sought from the Scottish Minsters alongside the application for consent under Section 36 of the Electricity Act 1989. An overview of the consenting process is presented in Chapter 2 Statutory Context.

1.5.2 This ES has been prepared to accompany the Section 36 Application for the proposals and presents the formal written findings of the EIA, which has been undertaken in accordance with the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000[5] and subsequent amendments (the EIA Regulations). The EIA Regulations state that an EIA is mandatory for a thermal generating station with a heat output of 300 MWth[6] or more.

1.5.3 EIA is a process designed to ensure that new developments, and extensions to existing developments, are located and designed in a way that avoids or minimises environmental impacts. The EIA is therefore a fundamental and integral component of the power station design process. As a result, the project design has evolved during the EIA through the incorporation of the assessment's preliminary and successive findings. An ES addresses the predicted positive and negative significant environmental effects during the construction and operational periods of a development. It is also a requirement to predict the effects during decommissioning, restoration and aftercare operations.

1.5.4 The ES is intended to enable the reader to understand the nature of the proposed development, the steps taken to reduce environmental impacts and to evaluate the likely significant residual environmental effects. The ES therefore acts to aid the decision-making process and to present information in a readily accessible form.

1.5.5 The broad methodology adopted within the EIA is described in Chapter 8. During the EIA, Forth Energy has consulted widely with consultees and stakeholders including SGECU and Falkirk Council. Chapter 3 of this ES outlines the range of consultation activities undertaken, which include the preparation of the scoping request submitted to SGECU in December 2009[7] and also discussions with key consultees.

1.5.6 These discussions have moulded the scope and methodology of the Grangemouth Renewable Energy Plant EIA and ES and have influenced the design and mitigation of the development.

1.5.7 The Grangemouth Renewable Energy Plant ES comprises five separate volumes:

- Volume 1: Non-technical Summary;
- Volume 2: ES Main Text;
- Volume 3: Appendices;

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[5] Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000.

[6] The plant will have a net electrical output of 100 MWe, and a thermal output of 200 MW, with a thermal input of 522 MW. The anticipated overall gross plant efficiency will be 60%.

[7] Grangemouth Renewable Energy Plan, Scoping Report, December 2009

- Volume 4: Transport Statement; and
- Volume 5: Figures.

1.5.8 Information on viewing and purchasing copies of the ES is provided within Appendix A of Volume 3.

1.5.9 The following documents have also been prepared to accompany the Section 36 Application:

- Planning Statement;
- Design Statement.
- Sustainability Statement;
- Combined Heat and Power Feasibility Study;
- Fire Prevention Method Statement; and
- Statement of Participation.

Abbreviations

The following is a list of abbreviations adopted in Chapter 1 Introduction.

AOD	Above Ordnance Datum
EIA	Environmental Impact Assessment
ES	Environmental Statement
ETS	Emissions Trading System
EU	European Union
FB	Fluidised Bed
ha	Hectare
km	Kilometre
kV	Kilovolt
m	Metre
MW	Megawatt
MWe	Megawatt electrical
MWth	Megawatt thermal
OS	Ordnance Survey
SEPA	Scottish Environment Protection Agency
SGECU	Scottish Governments Energy Consents Unit
SPA	Special Protection Areas
SSE	Scottish and Southern Energy
SSSI	Site of Special Scientific Interest

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Chapter 2

The Statutory Context

Contents

2 The Statutory Context

2.1 Introduction

2.1.1 This chapter summarises the relevant legislative context which is applied in seeking the appropriate consents for the proposed development. The principal requirements of the Section 36 and deemed planning consent process are addressed in detail and reference is made to the additional consents and permits that may be required for the construction and operation of the proposed Renewable Energy Plant.

2.2 The Electricity Act 1989

2.2.1 Applications for consent to construct and operate a thermal electricity generation plant are made to the Scottish Government's Energy Consents Unit (SGECU) under the terms of the Electricity Act 1989. The Scottish Ministers have the power to grant or refuse consent under Section 36 of the Electricity Act for those seeking to develop and construct, extend and operate electricity generating stations with a capacity greater than 50 Mega Watt (MW) electrical output located in Scotland.

2.2.2 The Section 36 Application procedures are comprehensive and bring the views of Falkirk Council, local communities and stakeholders, statutory and non-statutory consultees into the overall decision making process.

2.3 The Town and Country Planning (Scotland) Act 1997 as amended

2.3.1 The Section 36 process also provides the opportunity for applicants to seek a direction from Scottish Ministers that "deemed planning permission" be granted under Section 57(2) of the Town and Country Planning (Scotland) Act 1997 as amended. This process runs in tandem with the application for consent under Section 36.

2.3.2 The application of Section 57(2) to the Electricity Act process allows Falkirk Council, as Planning Authority, to suggest conditions to be attached to any subsequent consent, which can be discharged by the Planning Authority in relation to the deemed planning permission aspects of the proposal, should the project be consented.

2.4 The Electricity Works (Environmental Impact Assessment) Regulations 2000

2.4.1 The Environmental Impact Assessment (EIA) Regulations[1] apply to Section 36 Applications and require any development that is considered to have a significant effect on the environment to be subject to an EIA, and that an Environmental Statement (ES) should be submitted with the Section 36 Application. Schedule 1 of the EIA Regulations defines those developments for which an EIA is required and includes development of thermal power stations, such as the Grangemouth Renewable Energy Plant, with a heat output of 300 MW or more[2].

2.4.2 In December 2009, the EIA process commenced through the submission of a Scoping Report[3] seeking a formal 'Scoping Opinion' from the Scottish Ministers with respect to the information to be included within the ES and the methodologies to be used in the EIA. This process informed Forth Energy of the issues which the Scottish Ministers and a number of other stakeholders considered to be the likely significant effects of the proposed development and therefore the topics upon which the ES should focus. The EIA process, which is

[1] Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000, as amended

[2] With an electrical output of 100 MWe, a thermal output of 200 MW, and an anticipated net electrical efficiency of the order of 33%, the thermal input of the proposed plant will be of the order of 522MW

[3] Grangemouth Renewable Energy Plant Scoping Report, December 2009

recorded through the content of this document, has been required to reflect comments received through the Scoping process. Further information on the Scoping Opinion for the Grangemouth Renewable Energy Plant is provided in Section 3.2, Section 8.4 and Appendix B and information on the EIA methodology as a whole is presented in Chapter 8.

2.5 The Consenting Process

2.5.1 At the time of submission for an application under Section 36 of the Electricity Act, the statutory consultees (Falkirk Council, Scottish Environment Protection Agency (SEPA) and Scottish Natural Heritage (SNH)) are consulted through the provision of a copy of the consent application and ES. Falkirk Council will also place a copy of the documentation on their Planning Register together with any related documents, such as a plans showing the land to which it relates and the Scoping Opinions received, so that members of the public may view the ES and make any representations on the application to the Scottish Ministers.

2.5.2 Forth Energy has made the full Section 36 Application, including the ES, available on the project's website[4]. Information on viewing this ES is presented in Appendix A.

2.5.3 The Section 36 process also allows a wide range of non-statutory consultees to consider the information and make their views known to the Scottish Ministers. Forth Energy has issued copies of the application documentation, including the ES and Statement of Participation, to a wide range of non statutory consultees, as noted in Section 3.

2.5.4 Forth Energy has publicised the application through placing public notices for two successive weeks in one or more newspapers available in the locality of the development, a national newspaper and within the Edinburgh Gazette. Public notices will also be placed at a number of locations within the vicinity of the site. This ensures that members of the public and other stakeholders are made aware of the proposed development, are informed as to where they may obtain information on its environmental effects and how to make any representations within 28 days of the date of the second notice appearing in the newspapers.

2.5.5 Falkirk Council officials have indicated that they will be required to report on the application to the Council's Policy and Resources Committee with the Elected Members to be provided with an opportunity to debate the proposals and vote on their acceptability. This position of the Council will then be forwarded to the SGECU. Should the Council decide to submit a statutory objection to the Section 36 Application (which cannot be resolved or dealt with by condition) or where the Scottish Ministers decide to exercise their discretion to do so, a Public Inquiry would be held.

2.5.6 On receipt of the first statutory consultation response, a second public notice will be placed in one or more local newspapers, a national newspaper and the Edinburgh Gazette, again on two successive weeks. This will inform the public that additional information has been received and allows a further 28 days from the date of the second notice for representations to be made.

2.5.7 During their consideration of the proposal, the Scottish Ministers or their statutory consultees may formally request further information from the developer to supplement the information received, in the form of an Addendum to the ES. Should this be the case, the Addendum will also be publicised, permitting further representations from the public and consultees.

2.6 Determination of the Proposals

2.6.1 Once the SGECU has all the relevant representations and views of the local authority, the consultative bodies, non-statutory consultees and the public and has considered the ES and any Addendum, a decision will be taken on whether or not to give consent for the proposed development. The Scottish Ministers can determine the application in one of three ways:

[4] http://www.forthenergy.co.uk

- Consent the proposal as it stands;
- Consent the proposal with conditions; or
- Refuse the proposal.

2.6.2 In addition the Scottish Ministers may direct that planning permission may be deemed to be granted under Section 57(2) of the Town and Country Planning (Scotland) Act 1997, subject to conditions.

2.6.3 A copy of the decision letter and consent, if granted, will be sent to Falkirk Council who will place it on the Planning Register alongside other documents relating to the application. This information will also be sent to the Scottish Ministers' consultative bodies and the non-statutory bodies who were involved in the consultation process.

2.6.4 In arriving at a decision there are a number of key tests that Scottish Ministers will be required to consider in relation to the Electricity Act obligations and the relationship of this to the deemed planning permission.

2.6.5 Under paragraph 3(1) of Schedule 9 to the 1989 Act, an applicant in formulating any relevant proposals:

- "(a) shall have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and
- (b) shall do what he reasonably can to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects."

2.6.6 Paragraph 3(2) of the same schedule states that, in considering any relevant proposals for which consent is required under Section 36 of the 1989 Act, the Scottish Ministers shall have regard to:

- "(a) the desirability of the matters in paragraph (a) of sub-paragraph (1) above; and
- (b) the extent to which the person by whom the proposals were formulated has complied with his duty under paragraph (b) of that sub-paragraph."

2.6.7 The approach to the development of the proposed Renewable Energy Plant has by necessity, been required to respect the approach to protecting the surrounding environment and the decision on this Section 36 Application will be required to take into account the matters reported on through the content of this ES.

2.6.8 Section 57(2) of the Town and Country Planning (Scotland) Act 1997 states:

- "On granting consent under section 36 or 37 of the Electricity Act 1989 in respect of any operation or change of use that constitutes development, the Secretary of State [Scottish Ministers] may direct that planning permission for that development and any ancillary development shall be deemed to be granted, subject to such conditions (if any) as may be specified in the direction."

2.6.9 It is important to note that the proposals are being determined by the Scottish Ministers under the Electricity Act and not Town and Country planning procedures. Deemed planning consent is being sought in association with the Section 36 process and as such the determination of the proposals will reflect this procedure.

2.6.10 The determination of this application under the Electricity Act will involve a range of considerations, and specifically the extent to which the proposals can be considered to have addressed the requirements of Schedule 9 of the Act.

2.6.11 The decision on whether or not to grant deemed planning permission under the Town and Country Planning (Scotland) Act 1997 (as amended) will require the Scottish Ministers to take into account all relevant matters, and the role of the Development Plan in this process will be a key aspect. Previous Electricity Act decisions[5]

[5] Ref sections 2.6.1 – 2.6.10 Beauly – Denny Inquiry Report Volume 1

have identified that accordance with the Development Plan is one of a number of relevant material considerations to be taken into account in determining proposals, however this should not be a primary determining factor as in a planning determination under Section 25 of the Town and Country Planning (Scotland) Act 1997 (as amended).

2.7 Other Relevant Consents

2.7.1 In addition to Section 36 Consent and the deemed planning permission, consents and permits under the following Regulations and Acts may be required:

- Pollution Prevention and Control (Scotland) Regulations 2000;
- Water Environment (Controlled Activities) (Scotland) Regulations 2005;
- Coastal Protection Act, 1949;
- Food and Environment Protection Act, 1985;
- Forth Ports Authority (Ports Premises) Byelaws 1983 made pursuant to the Forth Ports Authority Order Confirmation Act 1969;
- Port Authority Order Confirmation Act 1980;
- Harbours Act, 1964;
- Planning (Hazardous Substances) (Scotland) Act, 1997;
- Electricity Generation License, Electricity Act 1989; and
- The Building (Scotland) Act 2003.

2.7.2 The studies included within the ES will form a significant input into the application for a Pollution Prevention and Control (PPC) permit to be submitted by Forth Energy to SEPA under the Pollution Prevention and Control (Scotland) Regulations 2000. The PPC permit application will describe the plant layout, operation, fuels and environmental impacts in more detail than in this ES and will provide the basis for the detailed conditions of the Permit. An application for the PPC Permit will be prepared as the design of the project progresses and will demonstrate that the project applies the principles of 'Best Available Techniques' (BAT), utilising BAT to prevent, and reduce emissions and the impact of the project on the environment as a whole.

2.7.3 The proposed Renewable Energy Plant is a low carbon technology and it is not therefore proposed to design or build the plant to be Carbon-Capture Ready. The plant is also below the 300 MWe European Union threshold[6] for the consideration of Carbon Capture Readiness.

[6] Towards Carbon Capture and Storage: Government's Response to Consultation http://www.berr.gov.uk/files/file51115.pdf

Abbreviations

The following is a list of abbreviations adopted in Chapter 2 The Statutory Context.

BAT	Best Available Technique
EIA	Environmental Impact Assessment
ES	Environmental Statement
MW	Megawatt
MWe	Megawatt electrical
PPC	Pollution Prevention and Control
SEPA	Scottish Environment Protection Agency
SGECU	Scottish Government's Energy Consents Unit
SNH	Scottish Natural Heritage

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Chapter 3

Stakeholder Consultations

Contents

3 Stakeholder Consultations

3.1 Introduction

3.1.1 During the environmental impact assessment (EIA) and early consenting stages, Forth Energy and the EIA team has undertaken extensive consultation with the Scottish Government's Energy Consents Unit (SGECU), Falkirk Council and a large number of stakeholders. This has included:

- Formal scoping consultations;
- Key stakeholder discussions; and
- Public participation.

3.1.2 An overview of these engagement activities is outlined below. A Statement of Participation detailing the community engagement has also been prepared to accompany the Section 36 Application. Forth Energy would like to thank all stakeholders who have taken part in the consultations to-date.

3.2 Formal scoping consultations

3.2.1 In line with best practice for undertaking EIAs, Forth Energy submitted a formal request for an EIA Scoping Opinion to the SGECU in December 2009. This was accompanied by a formal Scoping Report, which outlined the development proposals and provided a description of the site and its vicinity. It also outlined the potential environmental impacts, the proposed EIA methodologies and the structure of the Environmental Statement (ES).

3.2.2 The Scoping Report was distributed to a wide range of stakeholders, who were invited to comment on the proposed EIA methodologies. The statutory consultees consulted by the SGECU during the preparation of the Scoping Opinion comprised Falkirk Council, the Scottish Environment Protection Agency (SEPA), and Scottish Natural Heritage (SNH).

3.2.3 A formal Scoping Opinion was received on 20th April and is presented in Appendix B. In addition, Appendix B includes a table responding to the issues raised and noting where in the Environmental Statement particular issues have been addressed.

3.2.4 In order to involve as many stakeholders as possible, Forth Energy also sent the Scoping Report to a range of non-statutory Consultees, which included those listed in Table 3.1:

Table 3.1: Non-statutory Consultees

Architecture and Design Scotland	Lower Braes Community Council
Association of Salmon Fishery Boards (ASFB)	Marine Scotland
BAA	Maritime and Coastguard Agency
Bainsford, Langlees and New Carron Community Council	National Air Traffic Services (NATS)
BBC	National Grid plc
BT	Network Rail
British Waterways (Scotland)	NHS Forth Valley
Central Scotland Bat Group	Ofcom
Central Scotland Joint Fire and Rescue Service	Renewable Strategy and Onshore Renewables Division- Scottish Government

Civil Aviation Authority (CAA) - Airspace Policy and Safety Regulations	Polmont Community Council
Coal Authority	Ports & Harbours Division – Scottish Government
COSLA	Royal Society for the Protection of Birds (Scotland) (RSPB)
CSS Spectrum / Atkins on behalf of UK Water Industry	Scotland Gas Networks
Defence Estates	Scottish Badgers
Directorate for Climate Change and Water Industry - Scottish Government	Scottish Enterprise – Energy Team
Falkirk Environment Trust	Scottish Power Transmission Ltd
Falkirk Constabulary	Scottish Water
Fife Council	Scottish Wildlife Trust
Forestry Commission Scotland	Scotways
Forth and Tay Navigation Service	STV
Friends of the Earth	Sustainable Development Commission
Grahamston, Middlefield and Westfield Community Council	The Crown Estate
Grangemouth (incl Skinflats) Community Council	Transport Scotland
Greenpeace	West Lothian Council
Health and Safety Executive	Whale and Dolphin Conservation Society
Historic Scotland	WWF Scotland
Linlithgow Angling Club	

3.2.5 The responses from these are also given in Appendix B.

3.3 Key stakeholder discussions

3.3.1 Furthermore, additional meetings and discussions have been held with key stakeholders, including (but not limited to):

- Falkirk Council;
- SGECU;
- SEPA;
- SNH;
- Marine Scotland; and
- Transport Scotland.

3.3.2 The consultation process has proven to be a valuable opportunity to outline the Grangemouth Renewable Energy Plant proposals in more detail and to seek clarifications and further guidance on stakeholder opinion on the project and the scope of the EIA.

3.4 Public Participation

3.4.1 From the outset of this project, Forth Energy has sought to inform local communities of proposals for a Renewable Energy Plant in Grangemouth. Forth Energy has listened to, and where possible, reflected these views in the project's development. Four local Community Councils, Grangemouth; Bainsford, Grahamston, and Polmont Community Council were approached and asked whether they would be interested in finding out more about the proposals. Two further community councils in the local area, Middlefield and Westfield and Lower Braes are not currently operational and therefore were not able to be contacted. A meeting was subsequently held with Grangemouth Community Council in February 2010. During discussion with the community council there was significant support for the principle of renewable energy generation from biomass fuel. There was also an awareness of the benefits that such a project could potentially bring to Grangemouth. However, further detail was requested on;

- The Section 36 application process;
- Fuel supply- type, storage and source;
- Impact of transport to and from the plant on the local road network, particularly in relation to high levels of HGV traffic already perceived in Grangemouth;
- Potential odours from the plant;
- Proximity of the plant to dwellings;
- The possibility that jobs will go to local people; and
- Ash storage and disposal.

All of the above points were addressed with the Community Council and members of the public in attendance at the meeting.

3.4.2 Representatives of the other local community councils declined the offer of a meeting with Forth Energy at this stage.

3.4.3 There has been continued liaison with the community councils and a follow up presentation was held with Grangemouth Community Council in June 2010. Members of Polmont Community Council were also in attendance at this meeting. At this event, Forth Energy provided feedback on the EIA process, the findings of the initial community engagement exercise and on how the proposals have evolved to incorporate local views.

3.4.4 An initial public exhibition was arranged over three days at a vacant shop unit at La Porte Precinct, Grangemouth on the 18th, 19th and 20th February 2010[1]. A series of display boards provided information on the purpose of the project and outlined some early proposals with regard to location, what the plant may look like and the potential benefits that this investment could bring to Grangemouth. Representatives of Forth Energy were on hand for the duration of the exhibition to answer questions on the proposals. This consultation was undertaken early in the development of the project in order to obtain the local community's initial opinions and concerns in order to inform the EIA and project design.

3.4.5 Members of Grangemouth Community Council also attended the public exhibition at La Porte Precinct and provided further comments. These have been considered alongside all other responses to the public engagement event.

3.4.6 Details of the public exhibition and the proposals were publicised in an advertorial and a public notice in the local newspaper, the Falkirk Herald on Thursday 13th February in the week before the public exhibition.

[1] Thursday 18th February 4 pm to 7pm, Friday 19th February 1pm to 5 pm and Saturday 20th February 9 am to 2 pm.

3.4.7 A total of 48 questionnaires were completed and returned over the three days. The results reflected significant support for the principle of locating a renewable energy plant in the Port of Grangemouth.

3.4.8 Specifically, 99 % of visitors who completed a questionnaire supported the principle of renewable energy generation. In addition, 83 % of respondents supported the use of biomass as a source of renewable energy. The remaining 17% of respondents answered "don't know" to this question. 90 % of those responding agreed that the proposed Renewable Energy Plant would bring positive benefits to Grangemouth.

3.4.9 Attendees raised a range of issues which they believed should be considered as the proposals are developed. The most frequent included:

- Visual impact;
- Atmospheric emissions;
- Noise from the plant;
- Fuel supply;
- Road capacity for transportation of fuel; and
- Opportunities for local businesses and jobs.

3.4.10 Following completion of the environmental studies and the initial engineering design of the project, a second public exhibition was held at a vacant shop unit at La Porte Precinct, Grangemouth on Friday 25th and Saturday 26th June. This exhibition provided feedback to the public on the Stage 1 engagement exercise as well as additional information about the proposals. In addition, it provided a further opportunity for the public to comment on the proposals. The exhibition was publicised through;

- An advertisement in the Falkirk Herald on 17th June 2010;
- Distribution of posters in the local area;
- A leaflet mail drop to all households within the Grangemouth postcodes districts (FK2 8, FK3 0, FK3 8, and FK3 9) covering 9,000 households;
- A newsletter sent to previous exhibition attendees and other interested parties;
- Online at Forth Energy's website.

3.4.11 137 visitors attended the exhibition over the two day period, and 72 comment cards were completed. The breakdown of results was as follows:

- 33 respondents (46%) provided positive comments;
- 7 visitors (10%) provided negative comments;
- 19 visitors (26%) did not provide an opinion but asked questions about specific matters where they required further information.

3.4.12 Key positive comments made by respondents are noted as follows:

- The creation of jobs for the local area;
- Creating a sense of pride for Grangemouth as one of the first areas in Scotland to be involved in this type of development; and
- Local businesses being able to benefit from the heat produced by the plant.

3.4.13 Key issues raised were as follows:

- The sustainability of supply of fuel from overseas;

- Environmental Impact of:
  - Emissions
  - Odour
- The advantages for Grangemouth as a result of the development;
- Transport impact; and
- Visual Impact of Grangemouth Renewable Energy Plant.

3.4.14 A detailed Statement of Participation has been prepared to accompany the Section 36 Application, and describes the community engagement process and the responses received from the public.

3.5 Future Consultations

3.5.1 As outlined within Chapter 2 – The 'Statutory Context', on completion of the ES and subsequent submission and registration of the Section 36 Application, Forth Energy will publicise the application. This is to ensure that members of the public and other stakeholders are made aware of the proposed development. The public notice will also outline how interested parties can obtain information on the project, its potential environmental effects and how to make any representations.

3.5.2 Throughout the determination period for the application, Forth Energy will continue to consult with stakeholders to address any queries which they have and to assist the ongoing detailed design of the project.

3.6 Project website

3.6.1 A dedicated project website (www.forthenergy.co.uk) has been established for the four Forth Energy Renewable Energy Plants. The website is regularly updated and will continue to be updated as the project progresses and acts as a resource for the public to find out the most up-to-date information regarding the project and also arrangements for future consultation events. This Environmental Statement, the Statement of Participation, the Planning Statement, the Sustainability Statement, the Combined Heat and Power Feasibility Study and the Design Statement are all available on the website.

Abbreviations

The following is a list of abbreviations adopted in Chapter 3 Stakeholder Consultations.

EIA	Environmental Impact Assessment
ES	Environmental Statement
SEPA	Scottish Environment Protection Agency
SGECU	Scottish Government's Energy Consents Unit
SNH	Scottish Natural Heritage

Forth Energy

Chapter 4

The Need for the Proposed Development

Contents

4 The Need for the Proposed Development

4.1 Summary

4.1.1 There is a strong policy drive to develop sources of renewable energy. The UK has given International and national commitments to address the effects of climate change but it also needs to address its own future electricity generation gap whilst maintaining security and diversity of energy supply.

4.1.2 The proposed Renewable Energy Plant has a strategic fit with the underlying energy requirements of the Falkirk Council area and would be capable of supplying circa 92 % of the area's industrial, commercial and domestic electricity requirements[1]. The Grangemouth Renewable Energy Plant is considered to be a valuable addition to the UK's energy generation portfolio and will assist in securing local and national energy demands.

4.1.3 The Renewable Energy Plant will generate average annual carbon emission savings of 0.16 Mega Tonnes[2] of CO_2e[3] with the life time carbon emission savings of the Grangemouth plant estimated to be approximately 3.2 Mega Tonnes of CO_2e (assuming a 20 year plant life).

4.2 Introduction

4.2.1 This chapter sets out the renewable energy policy rationale for the proposed development. It describes and explains:

- The climate change context; and
- The renewable energy policy context at a European, United Kingdom (UK) and Scottish Government level.

4.3 Climate Change

Causes and Effects

4.3.1 The background to renewable energy policies in the UK has its origins in international concern with regard to the increased production of greenhouse gases (in particular carbon dioxide) and the effect this is having on our climate.

4.3.2 Man made emissions of greenhouse gases, in particular carbon dioxide from the combustion of fossil fuels, are causing the process of climate change by reducing loss of heat from the atmosphere. There is global concern that such actions will cause significant environmental change, in particular relating to the impact on sea levels, altering patterns of temperature and precipitation, and driving increasingly frequent incidents of extreme storminess and drought (e.g. Royal Commission on Environmental Pollution [4] 2000). It is anticipated that such changes would have significant social, health and environmental consequences: this has provided a stimulus for action.

4.3.3 In recent years there have been a number of landmark reports published highlighting the impacts of climate change. The International Energy Agency (IEA), the leading source for medium to long-term energy market

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1 The area requirements figure is net of the Grangemouth Refinery complexes' internal energy requirements.

2 This is based on a grid factor of 0.570 kgCO_2e/kWh, approximate 85% plant availability, 100MWe net output.

3 CO_2e equivalence: Where a processes emissions includes gases other than carbon dioxide, measuring in CO_2e makes reporting simpler. Carbon dioxide is the most common greenhouse gas, but there are five others main greenhouse gases (methane, nitrous oxide, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexachloride) which are covered by the Kyoto Protocol. Carbon dioxide equivalence (CO_2e) is a measure that enables the total impact from all emission sources to be represented in a single number for all the greenhouse gases produced, based upon their individual global warming potential.

4 Royal Commission on Environmental Pollution, 'The Changing Climate' (2000).

projections and analysis, has stated[5] that immediate policy action is required to reduce greenhouse gas emissions and to curb growth in fossil-fuelled energy demand. The challenge for all countries is to put in place a more secure lower carbon energy system without undermining social and economic development.

4.3.4 The Intergovernmental Panel on Climate Change (IPCC) published their Fourth Assessment Report[6] in November 2007 and made it clear that human induced warming of the climate system is unequivocal.

4.3.5 The Stern Review[7] was published in 2007 and is considered to be one of the most comprehensive reviews carried out to date on the economics of climate change. The review states that the dangers of unabated climate change would result in an increase in global temperature and that an increase of 2-3°C would reduce global Gross Domestic Product (GDP) by between 5 and 20%.

International Policy

4.3.6 In response to the prediction of climate change, the international community has taken various steps to promote a strategy to control greenhouse gas emissions. Key conventions such as the Earth Summit (Rio de Janiero, 1992) and the United Nations Framework Convention on Climate Change (Kyoto 1997), to whose protocols the UK is a signatory and to whose requirements the Government has stated it will be bound, resulted in targets being set for the reduction of greenhouse gases.

4.3.7 In October 2006, 'The Ministerial Dialogue on Climate Change, Clean Energy and Sustainable Development' took place in Monterrey, Mexico. One of its aims was to form agreement between the industrialised and developing nations on measures to cut greenhouse gas emissions after the Kyoto Protocol expires in 2012. The principal outcome of the conference was agreement with respect to the urgent need to tackle greenhouse gas emissions coupled with the recognition of the substantial gap between the politics and science of climate change.

4.3.8 International agreements such as Kyoto recognises that the burning of fossil fuels is having an adverse effect on the world's climate and that global measures are required to deal with it.

4.3.9 In December 2009 Denmark hosted the 15th United Nations Climate Change Conference in Copenhagen where the objective was to achieve international commitments and agreements to tackle climate change. Although no legally binding targets for reduction of greenhouse gases were agreed upon, the Copenhagen Accord was developed and includes recognition that global temperature rise should be kept to less than 2°C. The UK, as part of the European Union, has signed up to the Accord, which maintains the existing stance on a 20% reduction in CO_2 emissions by 2020 compared to 1990 levels, with the possibility of moving to a 30% reduction in the event that comparable offers are made by other developed nations.

The Role of Renewable Energy

4.3.10 It is recognised that increasing the role of renewable energy, such as the proposed Renewable Energy Plant, can contribute to achieving greenhouse gas reduction targets by displacing the carbon dioxide emissions from conventional fossil fuel fired generating plant. Biomass is recognised as a form of renewable energy. By operating additional renewable capacity, the need to operate fossil fuelled plant will decrease with a consequent reduction in fuel consumption and associated carbon dioxide emissions.

4.3.11 Renewable energy forms one element of a wider climate change strategy which includes energy efficiency, the development of carbon trading and promotion of more sustainable transport policies and measures.

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5 'World Energy Outlook', Report by the International Energy Agency, (2008).

6 Report by the Inter-Governmental Panel on Climate Change (IPCC), (2008).

7 Undertaken by Sir Nicolas Stern, Head of the UK Government Economic Service and former World Bank Chief Economist, The Stern Review on the Economics of Climate Change, for the UK Government, Cambridge University Press (2007).

4.4 European Policy

4.4.1 In January 2008 the European Commission published the '20 20 by 2020' package[8]. This included proposals for reducing the EU's greenhouse gas emissions by 20% from 1990 levels and increasing the proportion of final energy consumption from renewable sources to 20%. Both targets are to be achieved by 2020.

4.4.2 As part of the 20 20 by 2020 package, a Renewable Energy Directive[9] from the European Commission which requires significant increases in renewable energy production was published in its final form in April 2009 and is legally binding. It contains a mandatory requirement for a 20% share of energy from renewable sources in overall Community energy consumption by 2020.

4.4.3 The UK Government has also published a strategy (DECC, 2009) in order to implement the obligations contained within the EU Renewable Energy Directive: this is referred to further below.

4.4.4 The 20% 2020 target with respect to renewable energy is split between Member States. For the UK, the European Commission's proposals include 16% reduction in UK greenhouse gas emissions by 2020 and for 15% of all energy consumed in the UK to come from renewable sources by 2020.

4.5 United Kingdom Policy

4.5.1 The UK Government retains control of the overall direction of energy policy. Since devolution in 1999, some energy policy issues have been devolved to Scotland such as energy efficiency and renewable energy (including planning consents for the construction and operation of generating plants covered by the Electricity Act 1989).

4.5.2 Encouraging more electricity generation from renewable sources is an important element of both the UK and Scottish Climate Change Programmes[10].

4.5.3 As noted in Section 4.3, the EU Renewable Energy Directive provides the framework for achieving the EU targets. The UK Climate Change Act became law on 26 November 2008 and sets legally binding targets for the UK to achieve an 80% reduction in greenhouse gas emissions by 2050 and reductions on CO_2 emissions of at least 26% by 2020 from 1990 baseline levels.

4.5.4 In this section, reference is made to:

- The UK Biomass Strategy;
- The UK Renewable Energy Strategy;
- The UK Low Carbon Transition Plan;
- The Renewables Obligation.

UK Biomass Strategy (2007)

4.5.5 The UK Biomass Strategy[11] was published in 2007 in parallel with the Government's Energy White Paper[12]. The Strategy defined for the first time the UK Government's policies on biomass for industry, energy and transport in a single document. The strategy stated that biomass will have a central role to play in meeting the

[8] EU Climate Change and Energy Package, European Commission (January, 2008).

[9] Directive 2009/28/EC of the European Parliament and of the Council on the Promotion of the use of Energy from Renewable Sources (2009).

[10] The UK Climate Change Programme (March 2006) & The Scottish Climate Change Programme, 'Changing our Ways' (November 2006).

[11] Department for Environment, Food and Rural Affairs (DEFRA), May 2007.

[12] The Energy White Paper, Meeting the Challenge (May, 2007).

EU target of 20% renewable energy consumption by 2020. The Government strategy for biomass is intended to:

- Realise a major expansion in the supply and use of biomass in the UK;
- Facilitate the development of a competitive and sustainable market and supply chain;
- Promote innovation and low carbon technology developments where biomass can deliver relatively higher energy yields;
- Facilitate a shift towards a bio-economy through sustainable growth and development of biomass use for fuels and renewable materials;
- Maximise the potential of biomass to contribute to the delivery of climate change in energy policy goals; and
- To reduce CO_2 emissions, and achieve a secure, competitive and affordable supply of fuel.

4.5.6 The delivery of the Strategy "*will require a major expansion of biomass use and sustainable supply*" (page 5). The Government makes it clear that the import of biomass feedstock will continue to play a significant role in meeting UK energy needs and in particular in meeting the demand for biomass that the strategy will create.

4.5.7 In terms of biomass for energy, the Strategy emphasises the Government wishes to increase the use of biomass as an energy source. It states that biomass is an important tool for tackling climate change as well as offering new commercial opportunities, (para 2.1).

4.5.8 In term of electricity generation, reference is made in the Strategy at Section 3.9 to the Renewables Obligation (referred to further below). It is highlighted that biomass has an important role to play in achieving the UK renewable electricity generation targets, both through co-firing and the use of dedicated biomass generation.

4.5.9 The contribution that biomass can make to renewable heat (and cooling) is also set out in the Strategy. It states that renewable heat, partly but not entirely, sourced from biomass (as of 2007) only accounted for approximately 1% of heat supply in the UK. Imported biomass is also highlighted as playing a part in the development and expansion of the biomass heat sector.

4.5.10 The Strategy makes a cross reference to the Scottish 'Biomass Action Plan' which was published in March 2007 and this is referred to in more detail below.

UK Renewable Energy Strategy (2009)

4.5.11 In light of the significant increase in renewable energy required by the EU Renewable Energy Directive, the UK Renewable Energy Strategy (UKRES) was issued by the Department of Energy and Climate Change (DECC) in July 2009.

4.5.12 The UKRES aims to implement the obligations contained within the EU Renewable Energy Directive and to thereby result in a significant increase in the contribution that renewable energy makes to energy generation in the UK. The UKRES sets out the Government's comprehensive action plan for delivering the 'renewables revolution'. The document sets out the balance of fuels and technologies that is most likely to achieve this challenging goal and the strategic role that the UK Government will adopt and the specific actions intended to lead delivery.

4.5.13 The UKRES states that the UK needs to radically increase the use of renewable electricity. The document sets out the means by which the UK can meet the legally binding target of 15% of energy consumption from renewable sources by 2020. This will mean a seven-fold increase in the share of renewables in little more than a decade.

4.5.14 The UKRES sets out interim targets leading up to 2020. Paragraph 2.36 of the UKRES states that there needs to be sufficient progress made each year to remain on track to achieve the 2020 target. Under the Renewable Energy Directive, the UK interim targets for renewables in the energy mix are as follows:

- 4% in 2011-12;
- 5.4% in 2013-14;
- 7.5% in 2015-16;
- 10.2% in 2017-18.

4.5.15 The UKRES highlights (paragraph 2.38) that the earliest interim target (2011-12) will be the most challenging.

4.5.16 The UKRES states that 30% of electricity should be generated from renewables in the UK by 2020, which would be up from approximately 5.5% in 2009. This is expected to come from a range of renewable technologies. Bioenergy used in electricity production is expected to make an important contribution of approximately 22% of renewable electricity generation (7% of total electricity demand[13]). In terms of the increased deployment of renewable heat, 12% of heat demand should be generated from renewable sources by 2020[14].

4.5.17 The UK Government is committed to ensuring that the appropriate regulatory and financial frameworks are in place to enable the market to deliver the required increase in renewable energy. In terms of financial support, the Strategy sets out a framework of long term, comprehensive and targeted financial support. The Renewables Obligation (RO) is to remain the key mechanism for incentivising renewable electricity and Scottish and Southern Energy (SSE) is subject to the RO. The RO is to be expanded and extended to ensure it can deliver approximately 30% renewable electricity by 2020.

4.5.18 The UKRES is expected to deliver significant environmental benefits, in particular by contributing to global action against climate change. It recognises that there will also be some pressures on the local environments and natural heritage from new infrastructure provision.

4.5.19 In terms of economic and employment opportunities, these are highlighted and the aspiration is for the UK to be at the forefront of global competition in the low carbon economy. The Government estimates that the Strategy will:-

- Put the UK on a path towards decarbonising the production of energy in the UK, alongside nuclear and carbon capture and storage.
- Contribute to the security of energy supplies in the UK through reducing demand for fossil fuels of around 10% and gas imports by between 20 – 30% against forecast use in 2020.
- Bring outstanding business opportunities and enable the UK to restructure into a low carbon economy, providing around £100 billion of investment opportunities and contribute to the creation of up to 0.5 million more jobs in the UK renewable energy sector.

4.5.20 The UKRES is also intended to tackle climate change, reducing the UK's emissions of carbon dioxide by over 750 million tonnes between now and 2030. It will also promote the security of the UK's energy supply, reducing overall fossil fuel demand by around 10% and gas imports by 20–30% against what they would have been in 2020.

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[13] The UKRES notes that this estimate is modelled on dedicated biomass, co-firing, landfill gas and energy from biomass waste electricity and CHP plant incentivised under the Renewable Obligation (RO).

[14] UKRES, para 2.7.

4.5.21 The UKRES highlights that there is a need to use more sustainable bioenergy and that the supply and use of biomass for heat and power needs to be increased significantly.

4.5.22 Paragraph 53 of the document makes it clear that the UKRES is an integral part of the Government's overall UK Low Carbon Transition Plan (referred to in the following paragraphs).

4.5.23 Section 6 of the document states that the Devolved Administrations have a leadership role to undertake. The UKRES as a whole is published by the UK Government and the policies to meet the 2020 targets will be taken forward in England, Scotland and Wales, Great Britain or on a UK – wide basis as appropriate and in accordance with each devolution arrangement. The UKRES makes it clear that there has been close engagement with the Devolved Administrations in developing the Strategy and that this close working will continue in implementing the policies set out in the UKRES. This will include the development of the UK National Action Plan to facilitate meeting the 2020 targets. The document makes it clear that each of the Devolved Administrations is setting out its own plan to increase renewable energy use and that "*the UK Government and the Devolved Administrations are working together to ensure that our plans are aligned"* (UKRES, para 8.18).

The UK Low Carbon Transition Plan (2009)

4.5.24 Along with the UKRES, the UK Government published the UK Low Carbon Transition Plan, as a White Paper in July 2009.

4.5.25 The White Paper sets out the UK's first ever comprehensive low carbon transition plan to 2020. The plan seeks to deliver greenhouse gas emission cuts of 18% on 2008 levels by 2020 (and over a third reduction on 1990 levels).

4.5.26 The White Paper emphasises that the UK will need to drive major changes to the way energy is used and supplied (page 5). It seeks to ensure that the UK will get 40% of electricity from low carbon sources by 2020, with policies to produce approximately 30% of UK electricity from renewables by 2020, by substantially increasing the requirement for electricity suppliers to sell renewable electricity.

4.5.27 The White Paper explains that the UK Government has put in place the worlds first legally binding target to cut carbon emissions by 80% by 2050 (as required by the Climate Change Act 2008) and it has set five year 'carbon budgets' to 2022 to 'keep the UK on track' and which provide a clear pathway for reducing emissions in the future (page 6). The White Paper sets out for the first time how these budgets will be met.

4.5.28 The White Paper explains that carbon budgets are a limit on the total quantity of greenhouse gas emissions over a five year period. They are intended to reflect the fact that the UK's overall contribution to reducing global greenhouse gas emissions is determined by emissions into the atmosphere over time, not by meeting specific targets in specific years. The carbon budgets will provide an opportunity for scrutiny by reporting each year on progress and will ensure that the policy framework for the UK is guided by an evidence base.

4.5.29 In terms of carbon savings to 2020, the Government announced the first three budgets, covering the periods 2008 – 12, 2013 -17 and 2018 – 22 in April 2009. The White paper states that the carbon budgets will be challenging. The final budget period centred on 2020 requires a 34% cut on 1990 levels.

4.5.30 The White Paper refers to 'transforming our power sector' and states that the Transition Plan, along with wider policies, will result in some 40% of electricity coming from low carbon sources by 2020 (Summary, page 4). Sources will include renewables, nuclear and fossil fuel coal generation plants fitted with carbon capture and storage technology.

Renewables Obligation and Renewable Heat Incentive

4.5.31 The Renewables Obligation[15] (RO) is a Government mechanism designed to incentivise the production of renewable electricity. The wider powers of the RO, enabling the creation of an obligation on suppliers, are reserved to the UK Government, however, the Scottish Government has devolved powers which enable it to deliver the RO in Scotland.

4.5.32 Electricity supply companies (Suppliers) are required to supply annually, an increasing percentage of the energy supplied to customers from eligible renewable sources. To demonstrate that renewable energy has been supplied to customers, suppliers have either to surrender Renewable Obligation Certificates (ROCs) or alternatively they can pay a 'buy out' fee. Any buyout fees collected are re-distributed to the Generators of renewable energy in relation to their share of the total annual renewable energy volume produced.

4.5.33 ROCs are issued monthly to generators of renewable energy and these ROCs can be bought by, and sold to, anyone.

4.5.34 To avoid paying the buyout fee, Suppliers are encouraged to either generate their own renewable electricity to get ROCs directly or to purchase ROCs from others who have generated the renewable electricity.

4.5.35 Technologies that are currently eligible for ROCs are: biomass; onshore wind; offshore wind; new hydro; refurbished hydro; solar photovoltaic; wave and tidal; private micro hydro; and landfill gas generators.

4.5.36 Due to the introduction of banding of the RO in the New Orders on 1 April 2009, the focus of the RO has been radically altered and is no longer technology neutral. Banding has been introduced to give increased incentives to developing renewable technologies resulting in some technology bands receiving more ROCs, while those in others receive less.

4.5.37 Biomass generation has benefited from banding and currently receives 1.5 ROCs per MWh for producing electricity and an extra ½ ROC, i.e. a total of 2.0 ROCs per MWh, if it can deliver a minimum qualifying level of heat as well as power i.e. the plant is considered to be a [Good Quality] Combined Heat and Power plant (GQCHP).

4.5.38 It is currently proposed by the Government's Department of Environment and Climate Change (DECC) under powers granted to them in the Energy Act 2008, to remove the additional incentive (extra ½ ROC) for supplying a qualifying level of heat (GQCHP) from the RO and to establish a separate incentive mechanism for heat alone. This new mechanism is being called the Renewable Heat Incentive (RHI)[16]. The features of this new RHI mechanism are still being developed and are expected to be introduced in April 2011.

4.5.39 Based on present customer levels, SSE's current renewable obligation equates to approximately 11 TWh (Terawatt hours) or the output from approximately 2,000 MW of renewable generation[17].

4.5.40 In 2009 SSE surrendered 3.2 TWh of ROCs which is equivalent to 17% of the total ROCs produced in the UK. The remainder of the obligation was met by paying the buy-out fee[18].

Security and Diversity of Supply

4.5.41 In addition to the need for new renewable energy generation to reduce emissions of greenhouse gases, the UK also requires new electricity generating plant to ensure the future security of supply. The UK Low Carbon

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15 Renewable Obligation (Scotland) Order 2002 (as amended).

16 Energy Act 2008.

17 Assuming a generation load factor of 60%.

18 Renewable Obligation: Annual Report, 2008/09 Ref 32/10 (8 March 2010).

Transition Plan[19], referred to above, anticipates that by 2018 about sixteen power plants (equating to 18 Gigawatt (GW), i.e. about 25% of the current installed capacity) will have closed.

4.5.42 With the current and planned closures of this large number of power plants, a significant number of new power plants is required to ensure energy security. The UK will therefore need rapid and substantial investment in new generation capacity to replace these closures.

4.5.43 The need to secure the UK's energy supply is a key theme of government energy policy as the UK's indigenous energy production declines and diversity in fuel sources is recognised as an important contributor to security of supply. A diverse mix of low carbon technologies helps deliver energy security by reducing the risk of problems that may arise with one type of technology or fuel. The Grangemouth Renewable Energy Plant contributes to this policy objective through the large scale use of renewable fuel.

4.6 Scottish Government Policy

4.6.1 In this section, reference is made to:

- The Scottish Government Renewable Energy and Heat Targets;
- The Biomass Action Plan for Scotland;
- The Renewable Heat Action Plan for Scotland;
- The Climate Change (Scotland) Act 2009;
- The Scottish Climate Change Delivery Plan;
- The Scottish Renewables Action Plan; and
- Towards a Low Carbon Economy for Scotland: Discussion Paper.

Renewable Energy and Heat Targets

4.6.2 In Scotland, policy and commitment generally reflects that of the UK Government. The Scottish Government has set a target that 50% of gross electricity consumption should come from renewable sources by 2020, with an interim milestone of 31% by 2011[20].

4.6.3 In common with the rest of the UK, a significant amount of developer activity to date has been in relation to onshore wind. However, the introduction of banding to give different levels of support through the Renewable Obligation (RO) for different renewable technologies seeks to widen the range of technologies, such as biomass, being brought forward for deployment.

4.6.4 The development of renewable energy technologies is being strongly encouraged as a means of tackling climate change and promoting the Scottish economy. An aim of the Scottish Government is to realise Scotland's very large renewable potential while safeguarding the environment. The Scottish Government has a policy of seeking to encourage a mix of renewable energy technologies, with growing contributions from offshore wind, wave, tidal and solar facilities and a greater use of biomass[21].

4.6.5 The Scottish Government's target in relation to renewable heat is that 11% of heat demand should be generated from renewable sources by 2020. It is important to note that the 50% and 11% targets for 2020 are

[19] Low Carbon Transition Plan (DECC, 2009), page 73.

[20] Renewables Action Plan, page 13, The Scottish Government (2009).

[21] National Planning Framework 2 for Scotland, paragraph 145, The Scottish Government, (2009).

indicative interim ambitions, which will need to be exceeded as the Government is seeking a decarbonisation of electricity supply by 2030 and a largely decarbonised heat sector by 2050[22].

Biomass Action Plan for Scotland (2007)

4.6.6 The 'Biomass Action Plan for Scotland' was produced by the Scottish Executive in March 2007. The aim of the Action Plan is to set out a co-ordinated programme for the development of the biomass sector in Scotland "*to ensure that Scotland's biomass resource is properly supported and exploited and that it delivers additional economic benefits whilst making a contribution to the ambitious targets for emissions reduction set out in 'changing our ways' Scotland climate change programme".*

4.6.7 The Plan, for the first time, sets out a programme for the co-ordinated development of the biomass sector in Scotland. Key aims (paragraph 2.2) of the Action Plan are:-

- To provide a focus for a strategic co-ordinated approach to developing biomass for energy production across the heat, electricity and transport sectors;
- To identify roles and responsibilities for Government, industry and public stakeholders to develop a vibrant bio-energy industry in Scotland; and
- To identify future actions and gaps.

4.6.8 The Plan states (paragraph 3.3) that Scotland has the potential to be the renewable powerhouse of Europe. In supporting a diverse of mixture of clean energy, the Government's focus is on those renewable technologies yet to establish a significant foothold in Scotland, including biomass, marine and hydrogen.

4.6.9 The Plan states that the Government will be focusing on expanding the renewable heat market through the development of a Renewable Heat Strategy (referred to later in this section) and the implementation of the Scottish Biomass Support Scheme.

4.6.10 Section 6.1 of the Plan states that Scotland has enormous renewable electricity generation capacity, with biomass one of a number of potential sources alongside wind, wave, tidal and the existing hydro resource. It states that biomass can help increase that diversity with the added value that biomass generation can provide a controllable base load, enhancing security of supply.

4.6.11 It notes that electricity generation through co-firing is currently the largest user of biomass in Scotland, although proposals for purpose built biomass plants are emerging.

4.6.12 The Plan is intended to provide a focus for the public and private sectors to maximise the opportunities for growth, employment and sustainability offered by the expansion of a biomass sector. It sets out a framework to take forward and expand the supply and use of biomass for heat, electricity and transport.

The Renewable Heat Action Plan for Scotland (2009)

4.6.13 The Renewable Heat Action Plan (RHAP) for Scotland was published in 2009[23]. It seeks to promote the growth of the sector in advance of the main market mechanism, the UK wide Renewable Heat Incentive[24] (RHI) which is due to launch in April 2011. The RHAP sets out a framework for activity across a wide range of areas, which will contribute to meeting the Government's 2020 heat target.

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[22] The 'Renewables Action Plan', page 9, The Scottish Government (June 2009).

[23] Renewable Heat Action Plan for Scotland: a plan for the promotion of the use of heat from renewable sources, The Scottish Government (2009).

[24] The RHI is seen as the main mechanism to accelerate the rapid growth needed to reach the Scottish, UK and EU renewable energy targets.

4.6.14 The RHAP states that renewable heat will play a key role in helping to address both climate change and renewable energy ambitions. It sets out the strategic context in terms of climate change and notes that the Scottish Government's Climate Change Delivery Plan sets out strategic options for the delivery of future emissions cuts. The Delivery Plan (referred to below) identifies four transformational outcomes which are needed to be substantially delivered by 2030 for Scotland to be on the correct pathway to meet the 2050 target. One of these outcomes relates to renewable heat:

"A largely de-carbonised heat sector by 2050 with significant progress by 2030 through a combination of reduced demand and energy efficiency, together with a massive increase in the use of renewable of low carbon heating".

4.6.15 The RHAP states that alongside the ambitious emissions reduction targets, Scottish Ministers have made a commitment to delivering 10 energy pledges which will be a key driver to meeting Scotland's targets of 20% of total energy use from renewable sources by 2020. To assist in reaching this target, it is proposed that 11% of heat use will be from renewable sources.

4.6.16 Energy Pledge 2 is as follows:

"We will aim to build a commercially viable, diverse renewable heat sector in Scotland to deliver benefits to the wider public, through the implementation of our Renewable Heat Action Plan. This commitment is reflected in the Climate Change (Scotland) Act which requires the Scottish Ministers to produce and publish a plan for the promotion of the use of heat from renewable sources".

4.6.17 The RHAP refers to the UK context and notes that the Scottish Government is working with the UK Government to play its part in meeting the EU Renewable Energy Directive (adopted 2009). As stated in Section 1.3, the Directive requires the UK to achieve 15% of energy use from renewable sources by 2020. Scotland, in setting a 20% target, has aimed proportionally higher than the required contribution for the UK as a whole.

4.6.18 In terms of targets, Scotland has committed to achieve a headline target of 20% of total Scottish energy use from renewable sources by 2020. This is made up of a contribution of electricity (50% of gross electricity consumption), transport (10% for renewable transport) and heat (11% of heat usage to be met from renewable sources).

4.6.19 Paragraph 4.2 of the RHAP highlights that achieving the renewable heat target will also be critical to achieving the statutory targets set in the Climate Change (Scotland) Act 2009.

4.6.20 The target for renewable heat in 2020 has been set at 6,420 GWh (or 2.07 GW of installed capacity), which is forecast to be in the region of 60,089 GWh (60.1 TWh) by 2020. The current level for renewable heat usage is approximately 1.4% (of projected 2020 demand).

4.6.21 The RHAP sets out a vision for 2020 (paragraph 5.2) which is:

"To build a commercially viable, diverse and renewable heat industry in Scotland in support of our 2020 renewable energy target and help tackle climate change. In doing so, to maximise the contribution of sustainable biomass to meet renewable heat target and reduce carbon emissions".

4.6.22 The 11% target by 2020 will be met by various means including a substantial increase in the uptake of heat from a range of bio-energy sources across the domestic, commercial and industrial sectors.

The Climate Change (Scotland) Act (2009)

4.6.23 The Climate Change (Scotland) Act 2009 received Royal Assent on 4th August 2009[25]. It introduced ambitious, world leading legislation to reduce emissions. Part 1 of the Act sets the statutory framework for greenhouse gas emission reductions in Scotland by setting an interim 42% reduction target for 2020 and an 80% reduction target for 2050, from 1990 emission levels.

4.6.24 Reductions in greenhouse gas emissions from energy generation are a key component to achieve the above targets. The Act places a statutory requirement on the Scottish Ministers to set appropriate levels for energy generation to contribute to meeting the targets. Annual targets for the years 2010 – 2022 require to be set out by the Scottish Ministers no later than 1 June 2010.

Scottish Climate Change Delivery Plan (2009)

4.6.25 The Scottish Government issued the Climate Change Delivery Plan[26] in June 2009. The Delivery Plan sets out actions that can be delivered over the next decade and beyond, in order to achieve the targets that Parliament has laid down in the Climate Change (Scotland) Act 2009. The Plan makes it clear that the drive to reducing the impact of climate change will have a range of positive benefits for Scotland including economic opportunities in biomass and renewable heat[27].

4.6.26 The Plan identifies five transformational outcomes which need to be substantially delivered by 2030 to put Scotland on the correct pathway to the 2050 target, which include, *inter alia*:

- A largely decarbonised electricity generation sector by 2030, primarily using renewable sources for electricity generation with other electricity generation from fossil fuelled plants utilising carbon capture and storage;
- A largely decarbonised heat sector by 2050 with significant progress by 2030 through a combination of reduced demand and energy efficiency, together with a massive increase in the use of renewable or low carbon heating.

4.6.27 The Delivery Plan identifies key sectors of the economy for abatement and identifies the high level measures required in each sector to deliver greenhouse gas emission targets.

4.6.28 The Plan confirms that the key milestone is that by 2020 more than 50% of electricity should be generated from renewable sources and that the 2020 target equates to an electricity generation level of some 8.4 GW of installed renewables capacity. The Plan makes it clear that the requirement on the UK to meet EU renewable targets by 2020, equating to 15% of all energy use from renewable sources, will lead to strong demand from elsewhere in the UK for Scottish renewable electricity.

The Scottish Renewables Action Plan (2009)

4.6.29 The Scottish Government issued the Renewables Action Plan (RAP) in June 2009. This identifies what needs to happen in the renewables sector in order to achieve Government objectives and it focuses on actions needed over the immediate 24 month period. It is intended to be a "*live document – a portal for the development of the sector, subject to ongoing input and revision as new opportunities arise, as technology moves forward, and as new requirements become apparent*". (RAP, Executive Summary, page 5).

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[25] The Climate Change Act 2008 became law in the UK on 26th November 2008. It makes it the duty of the Secretary of State to ensure that the net UK carbon account for all six Kyoto greenhouse gases for the year 2050 is at least 80% lower than the 1990 baseline.

[26] Climate Change Delivery Plan 'Meeting Scotland's Statutory Climate Change Targets', The Scottish Government, (June 2009).

[27] Climate Change Delivery Plan (2009), para 1.6.

4.6.30 The RAP refers to the imperative for action to address climate change (demonstrated by Scotland's world leading carbon reduction target of 42% (see the reference to the Climate Change (Scotland) Act above) is driving development across a host of policy interests. It makes reference to the Scottish Government's commitment to achieve a headline target of 20% of total Scottish energy use coming from renewable sources by 2020. Specific targets include 50% of electricity demand and the RAP sets out the framework for action in the specific area of renewable energy.

4.6.31 Key objectives are summarised as follows:

- To establish Scotland as a UK and EU leader in the field of renewable energy;
- To ensure maximum returns for the Scottish domestic economy; and
- To meet targets for energy from renewables, and for emissions reductions, to 2020 and beyond; (RAP, Executive Summary, page 5).

4.6.32 The RAP refers to Scottish and UK structures and makes it clear that the Scottish Government is continuing to engage very closely with the UK Government on the shape and scope of renewable energy legislation and the financial incentives which they create. There is reference to the Renewables Obligation (RO) mechanisms and the RAP states that Scottish Government is working with "*UK colleagues on the further changes to the RO required to align it with the demands of the EU 20% target*…." (page 17).

4.6.33 Section 4 of the RAP highlights that each of the technology sectors will have its own part to play in helping Scotland meet its energy targets "*and ministers are committed to a diverse renewables mix to maximise the scope to match supply with demand and to enhance security of supply"* (page 20).

4.6.34 In terms of energy consents and planning, actions include the need to:

- Create a supportive planning landscape;
- Ensure the planning and consenting regimes better support investment in renewables in Scotland; and
- Continue to work with Local Planning Authorities to develop their strategic locational guidance in line with Planning Advice Note 45 'Renewable Energy' and to ensure that the planning system produces decisions that are efficient, transparent, consistent and timely (page 37).

4.6.35 Each renewable technology is referred to in the Annex to the RAP and with regard to bioenergy the vision is expressed as: "*To maximise the contribution of sustainable biomass to meet renewable heat and electricity targets, and reduce carbon emissions*" (RAP, page 64). The 'headline ambitions' of the Government with regard to bioenergy are:

- Substantial growth of bioenergy potential in Scotland in harmony with environmental and air quality obligations;
- Substantial increase in the uptake of heat from a range of bioenergy sources across the domestic, commercial and industrial sectors.

Towards a Low Carbon Economy for Scotland: Discussion Paper (2010)

4.6.36 The Scottish Government issued the report entitled 'Towards a Low Carbon Economy for Scotland' in March 2010. It highlights that in addition to the statutory imperative of reducing emissions, as required by the Climate Change (Scotland) Act, there are important economic and social reasons for starting the process of a transition to a low carbon economy now, with commitment and urgency. The Foreword to the Report states that "*Scotland has an opportunity to become a world leader in the low carbon economy*". The report has been prepared to provide a Scottish focus to low carbon related activity and to complement activity at the UK level (i.e. the Low Carbon Transition Plan, July 2009 – referred to in Section 1.4).

4.6.37 The report sets out the Scottish Government's plans to move towards a low carbon economy in Scotland, as part of the overarching Government Economic Strategy[28]. The drivers of a low carbon transition are set out, including sustainable economic growth, emission reduction targets, energy supply and demand, carbon price, legislation and energy security. In terms of energy security, the report states (page 11): "*Securing the low carbon transition must include maintaining effective supply and affordability of energy at the same time as migrating to low carbon fuels, such as biomass, shifting our emphasis to renewable generation…..*"

4.6.38 The report refers in some detail to the economic opportunities presented by the transition to a low carbon economy. It estimates that concerted action combined with an expanding global market could increase low carbon employment in Scotland to around 130,000 by 2020 By the end of 2008, all low carbon sectors in Scotland supported some 70,000 jobs therefore there is the potential for some 60,000 new jobs. Furthermore, the report highlights that meeting Scotland's renewable electricity and heat targets will alone provide up to £15 billion worth of investment opportunities.

4.7 Land Use Planning Policy

4.7.1 Chapter 5 sets out the relevant land use planning policy context for the proposed development in terms of the statutory Development Plan, national planning policy and other relevant guidance.

4.7.2 As explained in Chapter 5, on a national level, the National Planning Framework 2 (NPF) for Scotland provides the strategic spatial policy framework to guide the development of Scotland to 2030. The NPF was given a statutory recognition within the Planning Etc (Scotland) Act 2006 and includes policy on renewable energy.

4.7.3 Scottish Planning Policy (SPP) provides the Scottish Government's national planning policies. It addresses various topics, including renewable energy.

4.8 Conclusion

4.8.1 There is a strong policy drive at a European, UK and Scottish level to continue to develop renewable energy. International and national commitments have been made to address the effects of climate change and to achieve greater security in the domestic supply of energy.

4.8.2 In summary, these latest European and UK Government policies establish a strategic need for renewable energy provision in the UK to assist in tackling climate change. Furthermore, the UK needs to address the potential future electricity generation gap in the UK, where electricity demand could outstrip supply due to the closure of older capacity on the system, as well as ensuring that the country maintains its security and diversity of energy supply. The Renewable Energy Plant is considered to be a valuable addition to the UK's energy generation portfolio and will assist in securing the UK's energy supply system.

4.8.3 The proposed Grangemouth Renewable Energy Plant would have significant advantages compared to other renewable technologies such as wind power, hydroelectric, solar and photovoltaics, which, whilst being valuable sources of renewable energy, are intermittent in nature.

4.8.4 The degree of intermittency is commonly referred to as the 'load factor[29]'. The Grangemouth Renewable Energy Plant's design load factor is approximately 95% which will assist the National Grid in balancing short term electricity supply with demand and maintaining the integrity of the national electricity transmission system.

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[28] The Scottish Government Economic Strategy (2007).

[29] The Load Factor is calculated by dividing the amount of electricity that a plant produces over a year by the amount of electricity it could have produced if it had run at full power over that same period.

4.8.5 Forth Energy believes a broad range of technologies need to be deployed to address these challenges in relation to renewable energy and climate change. To support this, Forth Energy is proposing to construct and operate the Renewable Energy Plant at the Port of Grangemouth. The total renewable electrical output for the site will be up to 100 MWe. The plant will also have a capacity of 200MWth and will be capable of exporting renewable heat to nearby users.

4.8.6 The proposed development will make a direct contribution to achieving renewable energy generation and renewable heat deployment targets thereby implementing Government policy at the UK and Scottish levels which encourages more electricity generation and heat usage from renewable sources.

4.8.7 In terms of electricity generation, the proposed Renewable Energy Plant has a strategic fit with the requirements of the Falkirk Council area, i.e. it will be large enough to supply almost all of the area's[30] (industrial, commercial and domestic) electricity requirements, circa 92 %.

4.8.8 In terms of annual carbon emission savings, the average annual savings for the Renewable Energy Plant in 2015 would be 0.16 Mega Tonnes[31] of CO_2e.

4.8.9 In terms of life time carbon emission savings, taking into account the reduction in carbon in the UK grid, the savings over the life time of the Grangemouth plant are estimated to be approximately 3.2 Mega Tonnes of CO_2e over the lifetime of the plant (assuming the plant life is 2015 to 2035).

4.8.10 The electricity and heat produced by the Grangemouth Renewable Energy Plant would therefore contribute positively to the policy objectives outlined above over the plant's lifetime by producing renewable electricity and heat and thereby reducing greenhouse gas emissions from UK power generation.

[30] The area requirements figure is net of the Grangemouth Refinery complexes' internal energy requirements.

[31] This is based on a grid factor of 0.570 kgCO2e/kWh, approximate 85% plant availability, 100MWe net output.

Abbreviations

The following is a list of abbreviations adopted in Chapter 4 'The Need for the Proposed Development'.

CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DECC	Department of Energy and Climate Change
EU	European Union
GQ CHP	Good Quality Combined Heat and Power
GW	Gigawatt
GWh	Gigawatt hour
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
MW	Megawatt
MWe	Megawatt electrical
MWh	Megawatt hour
MWth	Megawatt thermal
NPF2	National Planning Framework 2
RAP	Renewables Action Plan
RHAP	Renewable Heat Action Plan
RHI	Renewable Heat Incentive
RO	Renewables Obligation
ROC	Renewables Obligation Certificate
SGECU	Scottish Government's Energy Consents Unit
SSE	Scottish and Southern Energy
SPP	Scottish Planning Policy
TW	Terawatt
TWh	Terawatt hour
UK	United Kingdom
UKRES	United Kingdom Renewable Energy Strategy

Forth Energy

Chapter 5

Planning Policy Context

Contents

5. Planning Policy Context

5.1 Introduction

5.1.1 This chapter describes the planning policy framework applicable to the proposed Grangemouth Renewable Energy Plant and includes a description of relevant material considerations, such as national planning policy and guidance, emerging Development Plan policy, Supplementary Planning Guidance (SPG) and other Council policies. Material considerations also include national renewable energy policy which has been referred to within Chapter 4 'The Need for the Proposed Development'.

5.1.2 The application is submitted under the terms of Section 36 of the Electricity Act 1989 and Section 57 of the Town and Country Planning (Scotland) Act 1997 (as amended), as the electricity generation capacity of the proposed development exceeds 50 MWe. In considering the application under Section 36 of the Electricity Act 1989 the Scottish Ministers must also fulfil the requirements of paragraph 3 to Schedule 9 of that Act. If Section 36 consent is granted then the Scottish Ministers may also direct that planning permission for the proposed development is deemed to be granted. This is referred to in more detail within Chapter 2 'The Statutory Context'.

5.1.3 It is important to note that this chapter does not include an assessment of the proposed development's accordance with the statutory Development Plan and other material considerations. This would involve a degree of subjective interpretation, which is contrary to advice on ES preparation, including good practice guidance on EIA, which states that discussions of planning policy in an ES should be objective. Direct references to other ES Chapters are included within this Chapter to illustrate where the environmental information relevant to particular Development Plan policies can be sourced. The key relevant policies from the Development Plan are directly quoted below and where a policy is of limited relevance only the part of the policy of relevance is quoted.

5.1.4 It should be noted that the Applicant has also submitted a separate Planning Statement in support of the Section 36 Application, which considers, in detail, the relevant provisions of the Development Plan, national planning policy, renewable energy policy and other material considerations in the context of the proposed development. The Planning Statement also provides conclusions on the acceptability of the proposed development in policy terms. The Planning Statement does not form part of the ES.

5.2 The Development Plan

Policy Context

5.2.1 The proposed development site lies within the administrative area of Falkirk Council. The statutory Development Plan is as follows:-

- The approved Falkirk Council Structure Plan (2007), and
- The adopted Grangemouth Local Plan (1985, 2nd Alteration 1990).

5.2.2 The Falkirk Council Local Plan was finalised in 2007. The Local Plan Inquiry ended in the summer of 2009 and the Reporter's recommendations were published in March 2010. These recommendations were considered and ratified by the Falkirk Council Committee on 15th June 2010. The Finalised Draft Local Plan is expected to be formally adopted in the late Autumn of 2010. It is currently a material consideration in the determination of any planning application in the Plan area and is given significant weight by the Council in contrast to the adopted Local Plan which is very dated.

5.2.3 Given the advanced status of the emerging Local Plan, it is considered that the provisions of the Finalised Draft Falkirk Council Local Plan 2007 should be given greater weight than the adopted Local Plan. Where appropriate we have taken into account changes to the Finalised Draft Local Plan as published arising out of

pre-inquiry modifications and the recommendations of the Inquiry reporter which were recently ratified by the Council.

5.2.4 The Planning etc (Scotland) Act 2006 introduced, among other things, a revised Development Planning system. For the City Regions only, Structure Plans are to be replaced with Strategic Development Plans (SDP). There is no SDP to be prepared for the Falkirk Council area. All Local Plans are to be replaced with Local Development Plans (LDP) and Falkirk Council has indicated that the Main Issues Report (MIR) for the LDP will be published for consultation early 2011. The MIR is the first formal stage of plan preparation.

5.3 The Development Plan Aims and Objectives

Falkirk Council Structure Plan (2007)

5.3.1 The Falkirk Council Structure Plan provides the strategic land use policy for the Falkirk Council administrative area. The Structure Plan sets out a development strategy within Chapter 2 and the strategy is expressed in the plan as follows:

"To achieve this vision of a positive future for the area, the Council believes that a strategy of carefully managed growth which benefits all its communities must be pursued over the period of the Structure plan. Therefore, the strategy:

- *Provides for population and economic growth, so that the vitality of and profile of the area as a whole is maintained and strengthened.*
- *Distributes growth amongst the different settlements, having regard to their physical and environmental capacity and social and economic needs, in order to ensure their future viability and a healthy level of self-containment.*
- *Promotes major strategic economic development at selected mixed use development opportunities, which are, or can be made, easily accessible by public transport and will stimulate economic growth in jobs and competitiveness.*
- *Identifies, protects and enhances the area's key environmental assets, requiring a new development to conserve these assets and to attain a consistently higher level of design quality that has hitherto been achieved in the area.*
- *Ensures that growth is realistic and achievable, social and physical infrastructure requirements having been assessed and mechanisms for securing their provision put in place." (paragraph 2.28, page 10).*

5.3.2 The strategy and policies of the Structure Plan have been built around four strategic themes, which are:

6. **Economic Prosperity;**
7. **Sustaining Communities;**
8. **Environmental Quality; and**
9. **Sustainable Transport.**

5.3.3 The implications of these themes for the Council's strategy is set out in the plan, and the key points of relevance to the proposed Renewable Energy Plant are summarised as follows:

Economic Prosperity

"At present, the area is vulnerable to further job losses in the manufacturing sector and an increase in out-commuting. Further job creation is necessary to encourage in-migration and a more robust and diversified economy." (paragraph 2.32, page 12).

5.3.4 The strategy identifies a number of objectives, including the following items of relevance:

- "Concentrate new employment generating development on the major strategic development opportunities, taking advantage of their excellent accessibility and market attractiveness…….
- Continue to support and provide for the expansion of the Grangemouth chemicals sector, subject to continuing improvements in environmental and safety performance……." (paragraph 2.32, page 12)

Environmental Quality

5.3.5 *"The area is endowed with a range of environmental assets of national and local importance which require to be protected. Whilst a growth strategy has potentially adverse implications for these assets, the investment which comes with it can be a means to achieve environmental enhancements."*

5.3.6 It is identified that the strategy will seek to:

- *"Identify and apply appropriate levels of protection to landscape, ecological and heritage assets within the area.*
- *Require a high standard of design and quality in new development, with particular attention paid to visual, landscape, accessibility, community safety and substantial factors." (paragraph 2.34, page 13)*

Sustainable Transport

5.3.7 It is identified that the strategy will:

- "Seek to locate new development in locations which minimise the number and length of car trips.". (paragraph 2.35, page 13)

5.3.8 The strategy has the following implications for Grangemouth:

5.3.9 *"In Grangemouth, development will focus on the vacant land at the docks which is identified as a mixed use strategic development opportunity. This will include the expansion of the town centre, further port related development and potentially, leisure uses associated with the Millennium Link. ……...Any development will have to be carefully planned to balance the need to meet health and safety requirements, safeguard the existing chemical and petrochemical industries, safeguard the operation of the docks and ensure no adverse impact on the Firth and Forth Special Protection Area…...." (paragraph 2.41, page 14).*

Grangemouth Local Plan (1985, 2nd Alteration 1990)

5.3.10 The four main 'needs' on which the Local Plan should concentrate are identified as:

1. **the need to provide more jobs in Grangemouth to reduce unemployment;**
2. **the need to broaden the types of job and industry away from dependence on petrochemicals and 3 major companies;**
3. **the need to try to mitigate the impact of industry with major hazard installations; and**
4. **the need to monitor and control the effects of water pollution.**

5.3.11 These identified needs are addressed through the policies and proposals of the Local Plan.

5.3.12 The Local Plan strategy seeks to reduce population decline and generate employment growth whilst recognising the policy and physical challenges faced in this locality (paragraph 2.2, page 3).

Finalised Draft Falkirk Council Local Plan (2007)

5.3.13 The Plan identifies four primary objectives in implementing the Structure Plan strategy. In the Plan, Table 2.1 (page 10) identifies what are termed as the primary and secondary objectives of the Local Plan. These are set out in the following table 5.1 below:

Table 5.1: Local Plan Primary and Secondary Objectives

SUSTAINABLE GROWTH IN ALL OUR COMMUNITIES	
ENVIRONMENTAL QUALITY	**SUSTAINING COMMUNITIES**
Effect a significant improvement in the quality of the built and natural environment in the area • Improve design quality and standards • Enhance the environment and image of the area • Protect and enhance our natural heritage, with countryside and Green Belt, urban greenspace, landscape resources, biodiversity, woodland, watercourses and the coast promoted as an integrated and accessible Green Network • Ensure that mineral extraction is environmentally sensitive, in terms of where it is permitted, how it is carried out and the effectiveness of restoration.	**Sustain the viability and quality of life of each individual community within the area** • Meet housing growth targets in sustainable locations, and ensure growth is balanced and meets housing need • Create and maintain residential amenity • Achieve quality community infrastructure in association with growth, with particular emphasis on safeguarding and improving existing facilities, and securing appropriate developer contributions.
ECONOMIC PROSPERITY	**SUSTAINABLE TRANSPORT AND INFRASTRUCTURE**
Promote a stronger and more diverse local economy building on the area's locational and other strategic assets • Promote the Strategic Development Opportunities as key drivers of regeneration and job creation • Enable and safeguard land for business growth in sustainable locations • Create and maintain vital and viable town, district and local centres • Promote the leisure and tourism sector with emphasis on the canal corridor • Manage risk from major hazards, with a balance achieved between health and safety aspects and regeneration needs.	**Create an integrated network of transport and other physical infrastructure which supports sustainable development goals** • Promote sustainable transport choices to reduce car travel • Develop a safe and efficient transport network • Promoting sustainable drainage practices and reducing flood risk • Minimise the environmental impact of other forms of essential infrastructure, such as telecommunications • Support sustainable waste management • Develop the area's renewable energy potential.

5.4 The Development Plan: Key Policies

5.4.1 The key Development Plan policies which are considered relevant to the assessment of the proposed development have been identified, and are listed in Table 5.2 below.

Table 5.2: Relevant Development Plan Policy

Policy Topic	Structure Plan	Local Plan	Finalised Draft Local Plan
Renewable Energy	Policy ENV.13: General Principles for Renewable Energy		ST20 Renewable Energy Development
Design	Policy ENV.7: Quality of Development		EQ1 Sustainable Design Principles
			EQ22 Landscape and Visual Assessment
Land Use	Policy ECON.1: Strategic Development Opportunities	Policy Grangemouth One: Urban Limit	EQ28 The Coastal Zone
	Policy ECON.2: Strategic Development Opportunities – Development Criteria	Policy Grangemouth Two: Development within the Urban Area	EP1 Strategic Development Opportunities
		Policy Grangemouth Four: Safeguarding Zone	EP2 Land for Business and Industrial Use
		Policy Grangemouth Seven: Major Hazard Consultation Zones	EP4 Business and Industrial Development within the Urban and Village Limits
			EP18 Major Hazards
Natural Heritage	Policy ENV.3: Nature Conservation	Policy Grangemouth Fifteen: Ecological Sites	EQ24 Ecological Sites and Features
			EQ25 Biodiversity
			EQ27 Watercourses
Built Heritage	Policy ENV.5: Built Environment and Heritage	Policy Grangemouth Twenty Seven: Ancient Monuments	EQ16 Sites of Archaeological Interest
Transport	Policy TRANS.3: Transport Assessment		ST7 Transport Assessments
	Policy TRANS.4: Freight Operations		ST9 Managing Freight Transport
Flooding and Drainage	Policy ENV.4: Coastal Planning and Flooding		ST12 Flooding
	Policy ENV.15: Water Quality		
Other Policies	Policy COM.5: Developer Contributions		
	Policy ENV.14: Air Quality		

5.5 Renewable Energy Policy

Structure Plan

5.5.1 **Policy ENV.13 'General Principles for Renewable Energy' states**:

5.5.2 *"Proposals for the generation of energy from renewable sources will generally be supported subject to an assessment of individual proposals in relation to Structure Plan Policies ENV.1-ENV.7. The council will work in partnership with other agencies to set out, in the local plan, the criteria for the location and design of renewable energy developments." (page 54)*

Adopted Local Plan

5.5.3 There are no specific polices within the adopted Local Plan relating to renewable energy.

Finalised Draft Local Plan

5.5.4 In 2003, Falkirk Council carried out a study on the renewable energy potential in the Council area and focussed on wind, hydro, biomass and geothermal. Their findings suggested that wind and biomass may have some potential on a commercial scale. Within the Plan, Policy ST20 'Renewable Energy Development' indicates that the Council will operate a presumption in favour of renewable energy development.

5.5.5 **Policy ST20 'Renewable Energy Development'** states:

"The Council will support development required for the generation of energy from renewable sources, and the utilisation of renewable energy sources as part of new development, subject to assessment of proposals against other Local Plan policies. Renewable energy development will be viewed as an appropriate use in the countryside where there is an operational requirement for a countryside location." (page 79).

5.6 Design Policy

Structure Plan

5.6.1 **Policy ENV.7: 'Quality of Development'** states that:

"Priority is attached to the achievement of high standards of design in all new development. Proposals for development which would have significant visual and physical impact on a site and its surroundings must be accompanied by a "design concept statement" incorporating the relevant factors outlined in Schedule ENV.7 which sets out how design principles have been addressed and how quality objectives will be achieved.

Local Plans and Supplementary Planning Guidance will provide detailed guidance on how significant impact will be assessed and the details to be included in such design concept statements." (page 50)

Adopted Local Plan

5.6.2 There are no specific policies within the adopted Local Plan relating to design.

Finalised Draft Local Plan

5.6.3 **Policy EQ1 'Sustainable Design Principles'** states:

"New development will be required to achieve a high standard of design quality and compliance with principles of sustainable development." It adds that proposals should accord with a number of principles, the following of which are relevant:

a) Natural and Built Heritage. Existing natural built or cultural heritage features should be identified, conserved, enhanced and integrated sensitively into development;

b) Urban and Landscape Design. The scale, siting and design of new development should respond positively and sympathetically to the site's surroundings, and create buildings and spaces that are attractive, safe and easy to use;

c) *Accessibility. Development should be designed to encourage the use of sustainable, integrated transport and to provide safe access for all users;*

d) *Resource Use. Development should promote the efficient use of natural resources, and take account of life cycle costs, in terms of energy efficient design, choice and sourcing of materials, reduction of waste, recycling of materials and exploitation of renewable energy;*

e) *Infrastructure. Infrastructure needs and their impacts should be identified and addressed by sustainable mitigation techniques, with regular regard to drainage, surface water management, flooding, traffic, road safety and noise….."* (page 11).

5.6.4 **Policy EQ22 'Landscape and Visual Assessment'** states:

"Development proposals which are likely to have a significant landscape impact must be accompanied by a comprehensive landscape and visual assessment as part of the Design Statement, which demonstrates that the setting is capable of absorbing the development, in conjunction with suitable landscape mitigation measures, and that the best environmental fit has been achieved, in terms of the landscape character of the area." (page 27)

5.7 Land Use

Structure Plan

5.7.1 **Policy ECON.1: 'Strategic Development Opportunities'** refers to a number of strategic locations and relevant parts of the policy are as follows:

"The Council will promote the following as strategic locations for major economic development:

TOWN CENTRES

2. Grangemouth Docks

SPECIALIST SITES

8. Grangemouth/Kinneil Kerse

Site boundaries will be defined or confirmed in Local Plans. The range of acceptable uses at each of these strategic sites is indicated in Schedule ECON.1." (page 18).

5.7.2 **SCHEDULE ECON.1: 'Strategic Development Opportunities'** (page 19) identifies the proposed uses for the Grangemouth Docks strategic site as follows:

Grangemouth Docks

- Office/Industry/Distribution;
- Leisure/Tourism (Millennium Link related);
- Food Retail/Non-Food Retail (Town Centre Expansion);
- Residential;
- Port-Related Activities; and
- Railway Station.

5.7.3 **Policy ECON.2: 'Strategic Development Opportunities – Development Criteria'** states that:

"Development of the strategic development opportunities identified in Policy ECON.1" will be subject to a number of conditions, the following of which are considered relevant:

1) *high standards of design will be required through a development brief and masterplan for each opportunity which will be approved by the Council and ensure a comprehensive and sensitive approach to site planning;*

2) *provision must be made for walking, cycling and public transport infrastructure to allow a high level of access by transport modes other than the private car;*

3) *development at Grangemouth Docks must not be prejudice the operation of the port and should be compatible with the continuing activities of the petrochemical and chemical industries." (page 22)*

Adopted Local Plan

5.7.4 **Policy Grangemouth One: 'Urban Limit'** states:

"That the boundary of the urban area as indicated on Figures 1 and 3 be regarded as the desirable limit to the growth of Grangemouth for the period of the plan. Accordingly, there shall be a general presumption against proposals for development which would either extend the urban area beyond this limit or which would constitute sporadic development in the countryside.

To reinforce the Strategy of Stabilisation by preventing further significant expansion of the existing urban area." (paragraph 2.10, page 5).

5.7.5 **Policy Grangemouth Two: 'Development within the Urban Area,'** which the site is located within, states:

"That within the urban area, urban uses will generally be acceptable provided they accord with all other relevant District Council policies and standards of provision.

To achieve a balance in the development of the urban area in relation to different land uses, e.g. housing, industry, public open space, schools, community facilities, shops, etc., whilst at the same time permitting a reasonable degree of flexibility." (paragraph 2.10, page 5).

5.7.6 **Policy Grangemouth Four: 'Safeguarding Zone'** states:

"That within the safeguarding zone development will not normally be permitted unless the District Council is satisfied that this would not impose unacceptable restrictions on the type of petrochemical industrial use permitted within the national planning guidelines site.

To ensure that development on the National Planning Guidelines site is not unacceptably restricted." (paragraph 2.10, page 6).

5.7.7 **Policy Grangemouth Seven: 'Major Hazard Consultation Zones'** states:

"That within a major hazard consultation zone development will not normally be permitted unless the District Council is satisfied that future users or occupants will not significantly add to the number of people exposed to the existing risks in the area.

To ensure that the number of people exposed to the existing risks from major hazards is not significantly increased." (paragraph 2.10, page 6).

5.7.8 The Local Plan also provides further detailed policy guidance based on the Grangemouth land use context. Elements of this are relevant to the consideration of the proposed Renewable Energy Plant as a land use in proximity to the operational port and petrochemical industrial uses. The guidance of relevance is detailed below.

Forth Ports Authority Operational Area

"The Policies, Proposals and Choices Report included a policy which defined the limits of the operational land of the Forth Ports Authority. This policy limit has not been included in the Written Statement for the following reasons. The Forth Ports Authority contended that the whole of the Docks area owned by them was operational even if, at this particular time, large areas were unused and derelict. It was also agreed that, in

the past, there had been no insuperable problems in deciding what constituted permitted development in the Docks and that questions arising over the need for planning permission had never acted as an impediment to the District Council or to the Authority. On the basis of representations from the discussions with the Ports Authority, it was decided that a defined operational area was, on balance, not strictly necessary. It was also considered that questions relating to permitted development and the need for planning permission could be dealt with satisfactorily by discussion between the Forth Ports Authority and the District Council within the usual development control process." (paragraph 4.4, page 23)

Industrial Proposals: Docks Area

"The Policies, Proposals and Choices Report included a proposal for general industry and port related industry in a large area of the Docks (Figure 5). This proposal has not been included in this Written Statement for the following reasons. The District Council has taken into account representations from and discussions with the Forth Ports Authority. During these discussions, the Ports Authority gave assurances that it would more actively market its land for industrial development and that it would be willing to accept industry coming to or re-locating within the District. In view of these assurances and because the Docks will be within the urban limit in this Local Plan, it is considered that, on balance, it would not be worthwhile, at this time, to make a proposal for industrial development in the Docks area. However, the District Council, Forth Ports Authority and the Regional Council are aware of the need to encourage the development of the Port and of the Docks area for port related industries. The District Council will, with the co-operation of the Ports Authority and in conjunction with all interested parties, undertake a detailed evaluation of the Docks area to assess its potential for development." (paragraph 4.5, page 24)

Major Hazard Safeguarding Area

"The Health and Safety Executive considers that, in order to permit a full range of petrochemical and associated developments on the site, a safeguarding zone extending to 1 km. from the boundary would be sufficient. Within this zone, certain types of new developments should be restricted e.g. housing would not be permitted. Other developments such as industrial buildings with low density employment or farm buildings or sports club houses could be permitted……." (paragraph 5.12, page 28)

Safeguarding Zone

"In order to permit a full range of petrochemical and associated developments on the site, there will be a safeguarding zone extending to 1 km. from the site boundary. As there is housing at Bo'ness within 500 metres of the site, any notifiable quantities of hazardous substances will be located at the western side of the site. Offices and parking areas etc. can be located at the eastern end of the site as they do not pose undue risks to existing populations." (paragraph 5.31, page 33)

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5.7.9 **Policy EQ28 The Coastal Zone** states:

"The Council will promote an integrated approach to the management of the coastal zone, and will support the provisions of the Forth Integrated Management Strategy. Development and other land management proposals within the coastal zone will be assessed in terms of:

1) *Impacts on the amenity, ecology and water quality of the coastal environment (see Policies EQ24 and EQ25);*

2) *The requirement to safeguard the undeveloped coast, as defined on the Proposals Map, from further development unless it is proven that the development is essential, a coastal location is essential, and no suitable sites exist within the developed coast;*

3) *Long-term flooding risk (see Policy ST12), and compatibility with existing coastal defence strategies, including the desirability of working with natural coastal processes where possible and the need to recognise the wider impacts where intervention is unavoidable; and*

4) *Appropriate promotion of the recreational potential of the coastal zone, including the development of the Forth Foreshore Path and linked coastal access networks, providing it is compatible with Policy EQ24 and the protection of coastal habitats and species." (page 31)*

5.7.10 **Policy EP1 'Strategic Development Opportunities'** states:

"The Council will give priority to the sites detailed in Table 5.1 as the site-specific parts of the Strategic Development Opportunities identified with Policy ECON.1 and Schedule ECON.1 of the Structure Plan. These should be developed in accordance with the principles set out in Structure Plan Policy ECON.2." (page 49)

5.7.11 Grangemouth Docks (ED.GRA2-4) and Grangemouth/Kinneil Kerse (ED.GRA1 Scottish Planning Policy Site) are identified as Strategic Development Opportunities in table 5.1 (page 50).

5.7.12 **Policy EP2 Land for Business and Industrial Use** (incorporating the Council's proposed pre-inquiry modifications and approved Reporter's recommendations) states:

"In order to maintain the business and industrial land supply and the employment role of existing business and industrial areas:

1) *The sites for new business and industrial development identified on the Proposals Map will be safeguarded for the employment use specified for each site; and*

2) *The areas of retention in business and industrial use identified on the Proposals Map will be retained and reserved for Class 4, 5 or 6 uses, except for the established business parks of Callendar Park and Gateway Business Park, Grangemouth which will be reserved for Class 4 uses only and the Glasgow Road Camelon Industrial Area which may include a food retail element as part of the mix.*

Other ancillary employment uses may be permitted within these areas where they are compatible with the principal business/industrial use of the site, will not result in a significant reduction in the availability of business land or property, and are consistent with other Local Plan policies." (page 51)

5.7.13 **Policy EP4 Business and Industrial Development within the Urban and Village Limits** states:

1) *"New business and industrial development, or extensions to such uses, will be supported within the business areas highlighted in Policy EP2 and EP3 (1), where it accords with the use specified for the area and is compatible with the established level of amenity in the business area, and protected habitats and species are safeguarded in accordance with Policy EQ24…."*.

2) *Outwith these areas, proposals within the Urban Limit will not be permitted where the nature and scale of the activity will be compatible with the surrounding area, there will be no adverse impact on neighbouring uses or residential amenity, and the proposal is satisfactory in terms of access, parking and traffic generation." (page 52)*

5.7.14 **Policy EP18 'Major Hazards'** states:

"Within the Major Hazard and Pipeline Consultation Zones identified on the Proposals Map, proposals will be judged in relation to the following criteria:

1) *The increase in the number of people exposed to risk in the area, taking into account the advice of the Health & Safety Executive, any local information pertaining to the hazard, and the existing permitted use of the site or buildings; and*

2) *The extent to which the proposal may achieve regeneration benefits, which cannot be secured by any other means." (page 61)*

5.7.15 In addition to the above criteria, the Council has accepted the Local Plan Inquiry Reporter's recommendation to add a third criterion as follows:

3) *"the potential impact that the proposals may have upon chemical and petro-chemical establishments."*

5.7.16 The Finalised Draft Local Plan, incorporating the Council's proposed pre-inquiry modifications and approved Reporter's recommendations, provides further land use information as detailed below.

Grangemouth Docks

"The Falkirk Council Structure Plan identified the extensive areas of vacant land at Grangemouth Docks as one of nine Strategic Development Opportunities within the Council area. The range of intended uses were listed as: office, industry, distribution, leisure, tourism, retail, residential, new railway station and port related activities.

The Local Plan splits the docks into four zones and provides a general framework for a mix of uses. These are set out under proposals ED.GRA2-ED.GRA4. The potential constraints to redevelopment include ground conditions, access, servicing health and safety, impact on Firth and Forth SPA and marketing. Bearing these in mind the acceptable uses have been deliberately designed to be as flexible as possible whilst still ensuring the development meets wider objectives.

Zone 1 covers the northwards expansion of the Town Centre which has been developed as a retail superstore, petrol filling station and fast food restaurant. Zones 2, 3 and 4 are identified for port-related general industry and storage, whilst retaining flexibility for more mixed use in Zones 2 and 3 should industrial development not be pursued by Forth Ports." (paragraphs 7.5 – 7.7, page 157)

Business and Industry - Existing Business and Industrial Uses

"Other existing industrial areas to be safeguarded under Policy EP2 will be the West Mains Industrial Estate, Wester Newlands Storage area and the remainder of Grangemouth Docks, again for general Industrial purposes. ……." (paragraph 7.13, page 157)

Proposals and Opportunities

5.7.17 Opportunity ED.GRA 4 Grangemouth Docks – Zone 4 is for 'Port Related General Industrial/Storage' development on a site of 35.3ha. The amended text for this proposal following proposed pre-inquiry modifications by the Council and the approval of the Reporters recommendations is as follows:

"Land identified for port related development. A transport assessment would be required, and off-site contributions to upgrading of motorway junctions may be required. Proposals must have no adverse impact on the integrity of the adjacent Firth of Forth SPA. In particular control should be exercised over construction activities likely to cause disturbance from September to March. Project based appropriate assessment may be required for discrete projects once more detail on uses is available. The Habitats Regulations will apply to any detailed proposal (see tests in Policy EQ24(1). Site has been identified as being at medium to high risk of flooding. A flood risk assessment and drainage impact assessment will be required. These assessments may influence the scale, layout and form of development." (page 159).

Freight

"In accordance with Policy TRANS.4 of the Falkirk Council Structure Plan, proposals for rail freight and freight handling facilities will be encouraged in Zone 4 of Grangemouth Docks and the established industrial area of Wester Newlands where there is already a rail freight terminal." (paragraph 8.4, page 161)

5.8 Natural Heritage

Structure Plan

5.8.1 **Policy ENV 3**: **'Nature Conservation'** seeks to protect and promote nature conservation interests. In particular this specifies:

1) *" Any development likely to have a significant effect on a designated or potential European Site under the Habitats or Birds Directives (Special Areas of Conservation and Special Protection Areas) or on a Ramsar or Site of Special Scientific Interest (see Schedule Env.3), must be subject to an appropriate assessment of the implications for the sites conservation objectives……*

2) *Sites of local or regional importance, including Wildlife Sites and Sites of Importance for Nature Conservation, will be defined in Local Plans…… Development likely to have an adverse impact on any such site or feature will not be granted planning permission unless it can be clearly demonstrated that there are reasons which outweigh the need to safeguard the site or feature. Until such areas are defined in Local Plans, identified or potential sites will be afforded the same protection.*

3) *Local Plans will identify opportunities for enhancing the natural heritage including new habitat creation, the identification of 'wildlife corridors' and measures to ensure the protection of priority local habitats and species as identified in the Falkirk Local Biodiversity Action Plan.*

4) *The aims and objectives of the Falkirk Local Biodiversity Action Plan and any associated Species Action Plans and Habitat Action Plans will be a material consideration in assessing any development proposal likely to impact on local priority species and habitats." (page 45)*

Adopted Local Plan

5.8.2 **Policy Grangemouth Fifteen: 'Ecological Sites'** states:

"That in order to protect areas which are of value to wildlife, there will be a general presumption against any development on, or affecting sites of special scientific interest, or which might affect other important wildlife areas.

To protect those habitats which are important for the conservation of wildlife." (paragraph 2.10, page 9)

Finalised Draft Local Plan

5.8.3 **Policy EQ24 'Ecological Sites and Features'** addresses the consideration of natural heritage interests in relation to development proposals. Relevant components of the policy (incorporating the Council's proposed pre-inquiry modifications) include the following:

1) *"Development likely to have a significant effect on Natura 2000 sites (including Special Protection Areas, Special Areas of Conservation, and Ramsar Sites) will be subject to an appropriate assessment. Where an assessment is unable to conclude that a development will not adversely affect the integrity of the site, development will only be permitted where there are no alternative solutions; and there are imperative reasons of overriding public interest, including those of a social or economic nature except where the site has been designated for a European priority habitat or species. Consent can only be issued in such cases where the reasons for overriding public interest relate to human health, public safety, beneficial consequences of primary importance for the environment or other reasons subject to the opinion of the European Commission (via Scottish Ministers).*

2) *Development affecting Sites of Special Scientific interest will not be permitted unless it can be demonstrated that the overall objectives of the designation and the overall integrity of the designated area would not be compromised, or any adverse effects are clearly outweighed by social or economic benefits of national importance.*

3) *Development affecting Wildlife Sites, Sites of Importance for Nature Conservation, Local Nature Reserves, wildlife corridors and other nature conservation sites of regional or local importance will not be permitted unless it can be demonstrated that the overall integrity of the site will not be compromised, or any adverse effects are clearly outweighed by social or economic benefits of substantial local importance.*

4) *Development likely to have an adverse affect on species which are protected under the Wildlife and Countryside Act 1981, as amended, the Habitats and Birds Directives, or the Protection of Badgers Act 1992, will not be permitted.*

5) *Where development is to be approved which could adversely affect any site of significant nature conservation value, the Council will require mitigating measures to conserve and secure future management of the site's natural heritage interest. Where habitat loss is unavoidable, the creation of replacement habitat to compensate for any losses will be required along with provision for its future management." (page 28).*

5.8.4 **Policy EQ25 'Biodiversity'** states:

1) *"The Council will promote the biodiversity of the Council area and ensure that the aims and objectives of the Falkirk Area Biodiversity Action Plan are promoted through the planning process. Accordingly:*

2) *Developments which would have an adverse effect on the national and local priority habitats and species identified in the Falkirk Area Biodiversity Action Plan will not be permitted unless it can be demonstrated that there are overriding national or local circumstances;*

3) *The safeguarding, enhancement and extension of the broad and key habitats and the species of conservation concern identified in 'The Biodiversity of Falkirk' will be given particular attention in the consideration of development proposals;*

4) *Development proposals should incorporate measures to promote, enhance and add to biodiversity, through overall site planning, and infrastructure, landscape and building design, having reference to the Supplementary Planning guidance Note on 'Biodiversity and Development'.; and*

5) *Priority will be given to securing appropriate access to and interpretation of areas of local nature conservation interest. The designation of Local Nature Reserves, in consultation with communities, local wildlife groups and statutory bodies will be pursued." (page 29)*

5.8.5 **Policy EQ27 'Watercourses'** considers the potential impact on watercourses from development proposals. Key aspects of the policy of relevance to the proposals includes the following:

"The Council recognises the importance of watercourses within the Council area in terms of their landscape, ecological, recreational and land drainage functions. Accordingly:

1) *There will be a general resumption against development which would have a detrimental effect of the landscape integrity, water quality, aquatic and riparian ecosystems, or recreational amenity of watercourses. Development proposals adjacent to a watercourse should provide for a substantial undeveloped and suitably landscaped riparian corridor to avoid such impacts;*

2) *There will be general presumption against the culverting of watercourses." (page 30)*

5.9 Built Heritage

Structure Plan

5.9.1 **Policy ENV.5: 'Built Environment and Heritage'** states that:

"Important Archaeological Sites, Scheduled Ancient Monuments, Listed Buildings, Conservation Areas, sites included in the Inventory of Historic Gardens and Designed Landscapes and trees will be protected and enhanced. Local Plans will identify these assets and incorporate policies appropriate to the significance of the area or individual feature, including the following range of measures.

1) *Measures to ensure that assets are maintained in a good state of repair;*
2) *Promotion of appropriate new uses for buildings;*
3) *Promoting sensitive interpretation of heritage assets;*
4) *Protection of the assets and their setting from inappropriate development;*
5) *Where development would damage, or result in the loss of the asset, that provision is made for adequate recording of the current status of the asset; and*
6) *Reviewing the boundaries of areas to ensure their continuing relevance." (page 48)*

Adopted Local Plan

5.9.2 **Policy Grangemouth Twenty Seven: 'Ancient Monuments'** sets out the Councils expectation in relation to the consideration of development proposals on or adjoining Scheduled Ancient Monuments (SAMs), and in locations which may affect their setting. Development is to be opposed on or adjacent to SAMs and will only be permitted where setting is affected subject to the application of appropriate conditions and archaeological monitoring during construction.

Finalised Draft Local Plan

5.9.3 **Policy EQ.16 'Sites of Archaeological Interest'** states:

1) *" Scheduled ancient monuments and other identified nationally important archaeological resources shall be preserved in situ, and within an appropriate setting. Developments which have an adverse effect on scheduled monuments or the integrity of their setting shall not be permitted unless there are exceptional circumstances;*
2) *All other archaeological resources shall be preserved in situ wherever feasible. The Council will weigh the significance of any impacts on archaeological resources and their settings against other merits of the development proposals in the determination of planning applications; and*
3) *Developers may be requested to supply a report of an archaeological evaluation prior to determination of the planning application. Where the case for preservation does not prevail, the developer shall be required to make appropriate and satisfactory provision for archaeological excavation, recording, analysis and publication, in advance of development."* (page 21)

5.10 Transport

Structure Plan

5.10.1 **Policy TRANS.3: Transport Assessment** states that:

"Proposals which could result in a significant increase in travel demand will be required to submit a Transport Assessment and where appropriate a Green Transport Plan. These should demonstrate how the impact of the development on the surrounding traffic networks can be minimised and how other modes of travel rather than car will be encouraged." (page 63)

5.10.2 **Policy TRANS.4: 'Freight Operations'** states that:

"The Council will direct developments generating significant volumes of freight to sites accessible by rail and/or sea. The preferred locations for freight related uses that require port and/or rail access will be:

1) *Grangemouth Docks;*
2) *Grangemounth branch line; and*
3) *Allandale." (page 64).*

Adopted Local Plan

5.10.3 There are no specific policies within the adopted Local Plan relating to transport.

Finalised Draft Local Plan

5.10.4 **Policy ST7 'Transport Assessments'** (incorporating the Council's proposed pre-inquiry modifications) states:

1) *"Falkirk Council will require transport assessments of developments where the impact of that development on the transport network is considered likely to require mitigation.*

2) *Transport assessments will include travel plans and, where necessary, safety audits of proposed mitigation measures and assessment of the likely impacts on air quality as a result of proposed development.*

3) *Developers will agree the scope of the assessment with Falkirk Council, then undertake the assessment in accordance with the scoping. In all cases, the assessment will focus on the hierarchy of transport modes, favouring the use of walking, cycling and public transport over unnecessary use of the car.*

4) *The Council will only grant planning permission where it is satisfied that the transport assessment and travel plan has been appropriately scoped, the network impacts properly defined and suitable mitigation measures identified." (page 70)*

5.10.5 **Policy ST9 'Managing Freight Transport'** states:

1) *"Freight intensive development will be directed to locations that can be accessed without significant impact on local communities, or on the local and strategic road network. Areas with rail or sea access, notably Grangemouth Docks and the connecting branchline, will be particularly favoured.*

2) *Development which will encourage the transfer of freight from road to rail, including the development of freight handling facilities, will be supported subject to other Local Plan policies.*

3) *Signage strategies, junction improvements and network upgrades will be considered where these contribute to improved access for freight.*

4) *The Council will work where appropriate with freight companies, developers and others to bring forward freight quality partnerships.*

5) *The Council will work with other agencies and developers to explore freight use of the lowland Canal network where appropriate." (page 71)*

5.11 Flooding and Drainage Policy

Structure Plan

5.11.1 **Policy ENV.4 'Coastal Planning and Flooding'** states that "*the Council will apply the following general principles with regard to coastal planning and flooding issues:……..*

…..4) In areas where there is a significant risk of flooding, there will be a presumption against new development which would be likely to be at risk or would increase the level of risk for existing development. Where necessary the Council will require applicants to submit supplementary information to assist in the determination of applications." (page 47).

Adopted Local Plan

5.11.2 There are no specific policies within the adopted Local Plan relating to flooding and drainage.

Finalised Draft Local Plan

5.11.3 **Policy ST12 'Flooding'** states:

"There will be a presumption against new development which would be likely to be at risk, would increase the level of risk for existing development or would be likely to require high levels of public expenditure on flood protection works. Applicants will be required to provide information demonstrating that any flood risks can be adequately managed both within and outwith the site."

5.12 Other Policies

5.12.1 In considering polices on a topic by topic basis there are certain policies which do not fit under the above topic headings. These are referred to below as 'Other Policies'.

Structure Plan

5.12.2 **Policy COM.5: 'Developer Contributions'** seeks to ensure that "proper provision is made to meet the physical and social infrastructure needs of new development and to mitigate the impact of such development on the locality" (page 35). Developer funding may be sought for works relating to environmental enhancement, physical infrastructure, and community and recreational facilities.

5.12.3 Further examples of the range of matters which developers may be asked to address are provided in Schedule COM.5 on page 35 of the Plan.

5.12.4 **Policy ENV.14: 'Air Quality'** states that:

"The Council will contribute to the improvement of local air quality through the development and implementation of the Structure Plan Strategy including: consideration of air quality standards in selecting locations for new development and in assessing development application; reducing the need to travel through protecting the viability of individual settlements and shopping centres; and in promoting public transport and an integrated transport system." (page 55)

5.13 National Planning Policy

National Planning Framework 2 (2009)

5.13.1 The National Planning Framework 2 (NPF2) guides Scotland's development to 2030 and sets out strategic development priorities to support the Scottish Government's central purpose of 'sustainable economic growth'. The Planning etc (Scotland) Act 2006 gives the NPF2 and future NPFs a statutory footing as an expression of national planning policy. The document therefore carries considerable weight as a material consideration.

5.13.2 NPF 2 sets Scotland in its wider context and provides strategic planning guidance to address major future planning challenges, including tackling climate change. It contains targets for energy supply and the reduction of greenhouse gas emissions (paragraph 3). NPF 2 takes forward the spatial aspects of the Scottish Government's policy commitments on sustainable economic growth and climate change, which paragraph 5 of the document notes "*will see Scotland move towards a low carbon economy*".

5.13.3 The NPF refers to sustainable development (page 6) and notes that "The Scottish Government's commitment to sustainable development is reflected in its policies on matters such as climate change, transport, renewable energy…."

5.13.4 Climate change is specifically referred to at paragraph 16 *et seq* where NPF2 notes that substantial reductions in greenhouse gas emission will be necessary to minimise the impact of climate change. Paragraph 19 notes that the UK and Scottish Governments are taking an international lead by introducing ambitious statutory emission reduction targets through, respectively, the UK Climate Change Act and the Scottish Climate Change Bill (now the Climate Change (Scotland) Act).

5.13.5 Energy is specifically referred to at paragraph 25 in NPF 2. It notes that:

"tackling climate change and reducing dependence on finite fossil fuels are two of the major global challenges of our time ….. addressing these challenges will demand profound changes in the way we produce, distribute and use energy over the coming decades."

5.13.6 Paragraph 26 notes that the EU has now set a commitment to derive 20% of its energy use from renewable sources by 2020. Reference is also made to the Scottish Government's support for this objective and Scotland's own, higher target for electricity generated from renewable sources, which is 50% by 2020.

5.13.7 NPF 2 also refers to a development strategy at paragraph 53 and notes that the main elements of the spatial strategy to 2030 are to *inter alia*:

"realise the potential of Scotland's renewable energy resources and facilitate the generation of power and heat from all clean, low carbon sources".

5.13.8 In terms of sustainable growth, paragraph 65 notes that energy is a major resource for rural areas and it states that "the Government is committed to realising the power generating potential of renewable sources of energy".

5.13.9 It should also be noted that paragraph 145 in NPF 2 indicates that the Government is committed to establishing Scotland as a leading location for the development of renewable energy technology and an energy exporter over the long term. It encourages a mix of renewable technologies with specific reference to the greater use of biomass. The development of Renewable Energy is to be promoted whilst seeking to safeguard the environment and communities.

5.13.10 Overall, therefore, the NPF 2 sets out the Government's commitment to the further development of renewable energy in Scotland and confirms importance of this resource as a key element of both achieving the spatial strategy for the country up to 2030 and attaining the Government's central purpose of increasing sustainable economic growth.

Scottish Planning Policy (2010)

Introduction

5.13.11 The SPP provides an overview of the purpose of the planning system and states that the Scottish Government's view is that "a properly functioning planning system is essential to achieving its central purpose of increasing sustainable economic growth" (paragraph 4).

5.13.12 The Scottish Government advocates that the planning system should be structured and operated with the purpose of increasing sustainable economic growth and to support the Scottish Government's five strategic objectives and fifteen national outcomes.

5.13.13 Development Management policy advice is set out at paragraph 22 et seq of the SPP. It is stated that Development Management is a key part of the planning system and "should operate in support of the Government's central purpose of increasing sustainable economic growth. This means providing greater certainty and speed of decision making…"

5.13.14 The SPP notes that increasing sustainable economic growth and sustainable development is an overarching principle of the Scottish Government and that the "planning system should promote development that supports the move towards a more economically, socially and environmentally sustainable society". The planning system has an important role in supporting the Government's commitment towards Sustainable Development through its positive influence upon the location and design of new development. Paragraph 37 states that the decision making process within the planning system should:

"contribute to the reduction of greenhouse gas emissions in line with the commitment to reduce emissions by 42% by 2020 and 80% by 2050, contribute to reducing energy consumption and to the development of renewable energy generation opportunities."

5.13.15 In addition, it is also recommended that decision making should protect and enhance cultural heritage, the natural environment (including biodiversity and the landscape) and take into account implications for water, air and soil quality. These matters are addressed in the more detailed Subject Policies within the SPP.

5.13.16 Climate Change, and the need to reduce greenhouse gas emissions, is prominent within the SPP and reaffirms the position of Section 44 of the Climate Change (Scotland) Act 2009 which places a statutory duty on all public bodies to act:

- In the way best calculated to contribute to the delivery of the emissions targets in the Act;
- In the best way calculated o help deliver the Government's climate change adaptation programme; and
- In a way that it considers is most sustainable.

5.13.17 The 2020 and 2050 greenhouse gas reduction targets are noted and it is stated at paragraph 42 of the SPP that "the causes of climate change and the need to adapt to its short and long terms impacts should be taken into account in all decisions throughout the planning system"

5.13.18 In addition to the policy advice summarised above, the SPP provides more detailed planning policy advice with regard to specific subject areas, which has replaced the series of SPPs and NPPGs as referred to above. Specific policy advice is provided within the SPP under the following relevant headings:

- renewable energy,
- economic development,
- historic environment,
- landscape and natural heritage,
- coastal planning,
- transport, and
- flooding.

Renewable Energy

5.13.19 The SPP makes clear the Scottish Government's commitment to increase the amount of electricity generated from renewable sources to meet statutory obligations and states that "the commitment to increase the amount of electricity generated from renewable sources is a vital part of the response to climate change" (paragraph 182).

5.13.20 Scotland's 2020 target for 50% of electricity to be generated from renewable sources is referred to and it is noted that this target is not a cap. The SPP states that Planning Authorities should "support the development of a diverse range of renewable energy technologies, guide development to appropriate locations..." (paragraph 184).

5.13.21 The SPP advises that either Development Plans or Supplementary Guidance clearly explain the factors that will be taken into account when considering renewable energy development proposals and that condition of planning permission should include decommissioning and restoration requirements.

5.13.22 Paragraph 193 of the SPP provides specific advice with regard to large scale biomass plants and notes that their location will be dependent on a number of factors including the economic costs of transporting fuel, the availability of feedstock through the year and the scale of the plant. The SPP advises that Development Plans should identify sites with the potential to accommodate biomass plants as well as explaining the factors that will be considered in decision making. The availability of a variety of technologies to develop energy from waste is also referred to within the SPP and it is identified that industrial sites with the potential to connect to the grid are likely to be suitable for the development of energy from waste.

Economic Development

5.13.23 The SPP sets out the Scottish Government's Policy on economic development between paragraphs 45 and 51. It notes that planning authorities should "respond to the diverse needs and occasional requirements of

different sectors and sizes of businesses and take a flexible approach to ensure that changing circumstances can be accommodated and new economic opportunities realised" (paragraph 45)

5.13.24 The SPP provides 5 criteria by which the planning system should support economic development, which are:-

- Taking account of the economic benefits of proposed development in development plans and development management decisions.
- Promoting development in sustainable locations, particularly in terms of accessibility;
- Promoting regeneration and the full and appropriate use of land, buildings and infrastructure;
- Supporting development which will provide new employment opportunities and enhance the local competitiveness, and
- Promoting the integration of employment generation opportunities with supporting infrastructure and housing development.

Historic Environment

5.13.25 The SPP sets out the Scottish Government's policy on the protection, conservation and enhancement of the historic environment and the role of the planning system.

5.13.26 The SPP states that the historic environment includes ancient monuments, archaeological sites and landscapes, historic buildings, townscapes, parks, gardens and designed landscapes and other features. Non-designated sites, as well as designated sites, are considered by the SPP as an important element of Scotland's heritage which contribute to national identity.

5.13.27 Paragraph 111 notes that "In most cases, the historic environment (excluding archaeology) can accommodate change which is informed and sensitively managed, and can be adapted to accommodate new uses whilst retaining its special character".

5.13.28 The SPP makes reference to the need to take into account Historic Scotland policy in the determination of applications affecting the historic environment; which include Scottish Historic Environment Policy (SHEP) and the 'Managing Change in the Historic Environment' guidance note series.

Landscape and Natural Heritage

5.13.29 The SPP provides policy guidance for the conservation, enhancement and sustainable use of Scotland's landscape and natural heritage at paragraph 125 et seq. Natural heritage is identified as including flora, fauna, geological and physiographical features, its natural beauty and amenity (Natural Heritage (Scotland) Act 1991).

5.13.30 Planning Authorities are directed to take a broader approach to landscape and natural heritage than just conserving designated sites and species. The SPP also states that the "Landscape in both the countryside and urban areas is constantly changing and the aim is to facilitate positive change whilst maintaining and enhancing distinctive character." It is also stated that "Different landscapes will have a different capacity to accommodate new development, and the siting and design of development should be informed by the local landscape character". (paragraph 127).

5.13.31 Paragraph 131 of the SPP states that "While the protection of the landscape and natural heritage may sometimes impose constraints on development, with careful planning and design the potential for conflict can be minimised and the potential for enhancement maximised".

5.13.32 On designated sites, the SPP provides guidance that "Statutory natural heritage designations are important considerations where they are directly or indirectly affected by a development proposal. However, designation does not necessarily imply a prohibition on development" (paragraph 131).

5.13.33 The SPP states that Planning Authorities should only apply the precautionary principle where the impacts of a proposed development are uncertain and where there is "sound evidence" that irreversible damage could occur. In line with this, paragraph 132 is clear in that "The precautionary principle should not be used to impede development unnecessarily. Where development is constrained on the grounds of uncertainty, the potential for research, surveys or assessments to remove or reduce uncertainty should be considered".

5.13.34 The SPP provides detailed guidance on natural heritage resources and classifies those under 5 key headings, namely:

- International Designations;
- National Designations;
- Local designations;
- Protected Species;
- Trees and Woodland.

5.13.35 Sites with international designations, such as Natura 2000 sites, must be subject to appropriate assessment by Planning Authorities on its conservation objectives where developments are likely to result in significant adverse effects on the designation. Development which could have a significant effect on a Natura site will only be permitted where:

- "*An appropriate assessment has demonstrated that it will not adversely affect the integrity of the site; or*
- *There are no alternative solutions; and*
- *There are imperative reasons of overriding public interest, including those of a social or economic nature."* (paragraph 134)

5.13.36 Nationally designated sites, such as National Scenic Areas, SSSIs, National Parks and National Nature Reserves are noted as important material planning considerations in the assessment of applications, and development proposals should only be permitted where:

- *"It will not adversely affect the integrity of the area or the qualities for which it has been designated; or*
- *Any such adverse effects are clearly outweighed by social, environmental or economic benefits of national importance"* (paragraph 137)

Coastal Planning

5.13.37 The SPP provides the Scottish Government's planning policy on coastal planning between paragraphs 98 and 103. It notes that sustainable development of coastal areas is an important contributor to sustainable economic growth and that a large proportion of Scotland's population live near the coast as it is a major focus for economic activity, recreation and tourism.

5.13.38 The SPP notes that statutory planning controls extend to the mean low water mark of ordinary spring tides and that a new marine planning system is currently being introduced through the Marine (Scotland) Bill1. The powers of marine planning will extend up to the mean high water mark where the powers of the planning system end.

5.13.39 The SPP notes that Development Plans should identify areas of the coast which are suitable for development and those areas which are unsuitable such as the isolated coast. It notes that coastal areas likely to be suitable for development include those within existing settlements and within substantial freestanding

[1] The Marine (Scotland) Bill received Royal assent on 10 March 2010 and is now an Act of Parliament.

industrial and energy developments, especially where such development is linked to regeneration or the reuse of brownfield land. It is also noted that coastal areas can contain internationally and nationally designated nature conservation sites and other important environmental resources which require to be protected from inappropriate development.

Transport

5.13.40 Reducing emissions from transportation sources is identified as providing a contribution to the Scottish Government's greenhouse gas reduction targets. Tackling emission levels and congestion will support economic growth and Planning Authorities require to give consideration to the relationship between transport and land use in order to achieve sustainable patterns of development.

5.13.41 Paragraph 167 notes that Planning Authorities should take into account existing transport, environmental and operational constraints, proposed or committed transport projects and demand management schemes, and that "development should be supported in locations that are accessible by walking, cycling and public transport, making best use of or adding to existing network and creating new networks".

5.13.42 Development proposals that have the potential to affect the strategic transport network should be appraised to determine their effects and the SPP requires Planning Authorities to consult Transport Scotland on the proposal, including any potential mitigation.

Flooding and Drainage

5.13.43 The SPP provides the national policy on flooding and drainage matters between paragraphs 196 and 211. The SPP notes that planning authorities require to take the risk of flooding into account when preparing development plans and determining applications for planning permission. It notes that development which would have a significant probability of being affected by flooding or a development which would increase the probability of flooding elsewhere should not be permitted. In this respect it is advised that impermeable surface areas are kept to a minimum within new developments.

5.13.44 The SPP identifies that Section 42 of the Flood Risk Management (Scotland) Act 2009, once implemented, will amend the Town and Country Planning (Development Management Procedure) (Scotland) Regulations 2009 with regard to flooding matters and the requirement for flood risk assessments to be provided where a development is likely to result in a material increase in the number of buildings at risk from flooding.

5.13.45 The SPP at paragraph 204 provides a risk framework as a basis for making planning decisions which have flood risk implications.

5.14 Planning Advice Notes (PANs)

5.14.1 PANs provide the Scottish Government's technical planning advice on specific planning matters. They are not expressions of national policy; however, they have relevance to the consideration of the proposed development. The PANs considered of relevance are summarised below in Table 5.3.

Table 5.3: Summary of Related Planning Advice Notes (PANs)

PAN	Title	Summary
PAN 42	Archaeology the Planning Process and Scheduled Ancient Monument Procedures (1994)	Provides best practice advice on addressing archaeological issues within the planning process, and on best practice separate controls over scheduled monuments. Also provides detailed advice on excavation, maintaining records, scheduling and legislation.
PAN 45	Renewable Energy Technologies (2002)	Supports the policies of SPP by providing information and advice on the technologies for harnessing renewable energy for electricity generation.
PAN 56	Planning and Noise (1996)	Demonstrates the role of the planning system in preventing and limiting the adverse effects of noise without prejudicing investment in enterprise, development and transport.
PAN 58	Environmental Impact	Relates specifically to environmental impact assessment for development

PAN	Title	Summary
	Assessment (1999)	projects authorised under planning legislation. It provides information and advice on: the legislative background to EIA, EIAs in Scotland, the process of EIA, environmental studies and statements, the evaluation of environmental information by Planning Authorities.
PAN 60	Planning for Natural Heritage (2000)	Gives basic advice in relation to development and natural heritage. It reiterates the Government's commitment to the protection and enhancement of the natural heritage.
PAN 68	Design Statements	Provides advice on the role and content of Design Statements with a view to seeing the use of Deign Statements within the planning process becoming more effective.
PAN 69	Planning & Building Standards Advice on Flooding (2004)	Supports national planning policy on flooding. Contains advice on addressing flood risk in development plans and in dealing with planning applications.
PAN 75	Planning for Transport (2005)	Provides advice on the requirement to link transport strategies and development plans and the need to take into account accessibility, location, modal split parking and design.
PAN 81	Community Engagement (Planning with People (2007)	Advice to Planning Authorities and developers on how communities should be properly engaged in the planning process.

5.15 Supplementary Planning Guidance

5.15.1 In terms of Supplementary Planning Guidance (SPG) Falkirk Council has no SPG on renewable energy development. There is no other Falkirk Council SPG relevant to the proposed development.

5.16 The Falkirk Council Action Plan for the Economic Downturn

5.16.1 In light of the current economic conditions, Falkirk Council produced an 'Action Plan for the Economic Downturn' in January 2009. This followed from a Committee Meeting which took place on 10th December 2008 at which Falkirk Council representatives discussed the anticipated impacts of the economic downturn, the area's economic strengths and the key actions to be undertaken by the Council to respond to the economic downturn. Falkirk Council Development Management use this document as a material consideration in decision making processes.

5.16.2 The Committee Report (paragraph 2.1) states that:

"The Falkirk area is now experiencing the effects of the economic downturn:

- *Unemployment, which early in 2008 fell to below the Scottish average, its lowest level for 25 years, has increased in the past year and is now 2.7%, with 2,576 people unemployed.*
- *Investment in regeneration projects has slowed. The timescales for delivery of key projects in Bo'ness and Falkirk Gateway have had to be extended due to reduced demand and capacity for investment.*
- *Several local companies have announced redundancies or plan to reduce staff levels. Many local companies experience difficulties in accessing funds to maintain cash flow or progress new investment. Additional problems result from increased energy costs or supply chains fragmenting.*
- *Other evidence of economic stress has been witnessed in reduced trading activity in town centres and increased claims for hardship relief. A substantial drop in house purchases has been witnessed and enquiries for business properties have reduced.*
- *It is anticipated that 2009 will show increases in unemployment, further decline in business confidence and activity and lower levels of investment."*

5.16.3 Based on these effects, Falkirk Council has created a response to the economic downturn and has identified the need to "Exploit opportunities for investment and, despite the financial pressures, maintain expenditure

locally, particularly in the hard-pressed construction sector, to upgrade local infrastructure and maintain the momentum of regeneration projects." (paragraph 2.2) in addition to other measures.

5.16.4 The 'Action Plan for the Economic Downturn' (action 'e') aims to:

"Pursue the case for accelerated capital investment and progress the necessary planning and design work for investment under the recently announced Scottish Government capital programme fund to upgrade infrastructure links at:

- *the Grangemouth Port/Freight Hub and Petrochemical complex*
- *Motorway junctions (M9, M876)."*

5.16.5 The 'Action Plan for the Economic Downturn' (action 'h') aims to maintain investment levels in regeneration by adopting a flexible approach, extending timescales for delivery and by reviewing infrastructure commitments.

5.16.6 Furthermore, action 'i' aims to extend the flexibility of the Council's approach to planning by reviewing their approach to Section 75 agreements and material considerations in planning applications to attract investment and jobs.

5.17 Conclusions

5.17.1 This Chapter has described the relevant planning policy context which is applicable to the consideration of the proposed development. Planning policies have been set out on the basis of the national, strategic and local policies applicable to the proposed Grangemouth Renewable Energy Plant. They have been taken into account in formulating the development proposal and in undertaking the EIA. As explained above, the accompanying Planning Policy Statement provides an assessment of the proposed development against the planning policy context as set out in this Chapter.

Abbreviations

The following is a list of abbreviations adopted in Chapter 5 Planning Policy Context.

FC	Falkirk Council
EIA	Environmental impact assessment
ES	Environmental Statement
LDP	Local Development Plan
m	metre
MIR	Main Issues Report
MWe	Megawatt electrical
NPF2	National Planning Framework 2
PAN	Planning Advice Note
SDP	Strategic Development Plans
SSSI	Site of Special Scientific Interest
SPG	Supplementary Planning Guidance
SPP	Scottish Planning Policy
UK	United Kingdom

Forth Energy

Chapter 6

The Proposed Development

Contents

6 The Proposed Development

6.1 Introduction

6.1.1 This Chapter presents details of the proposed development, outlines the development programme and discusses the construction, operation and decommissioning phases of the Grangemouth Renewable Energy Plant.

6.2 Summary of Development Elements

6.2.1 The key development components of the operational development, described in the following paragraphs, will comprise:

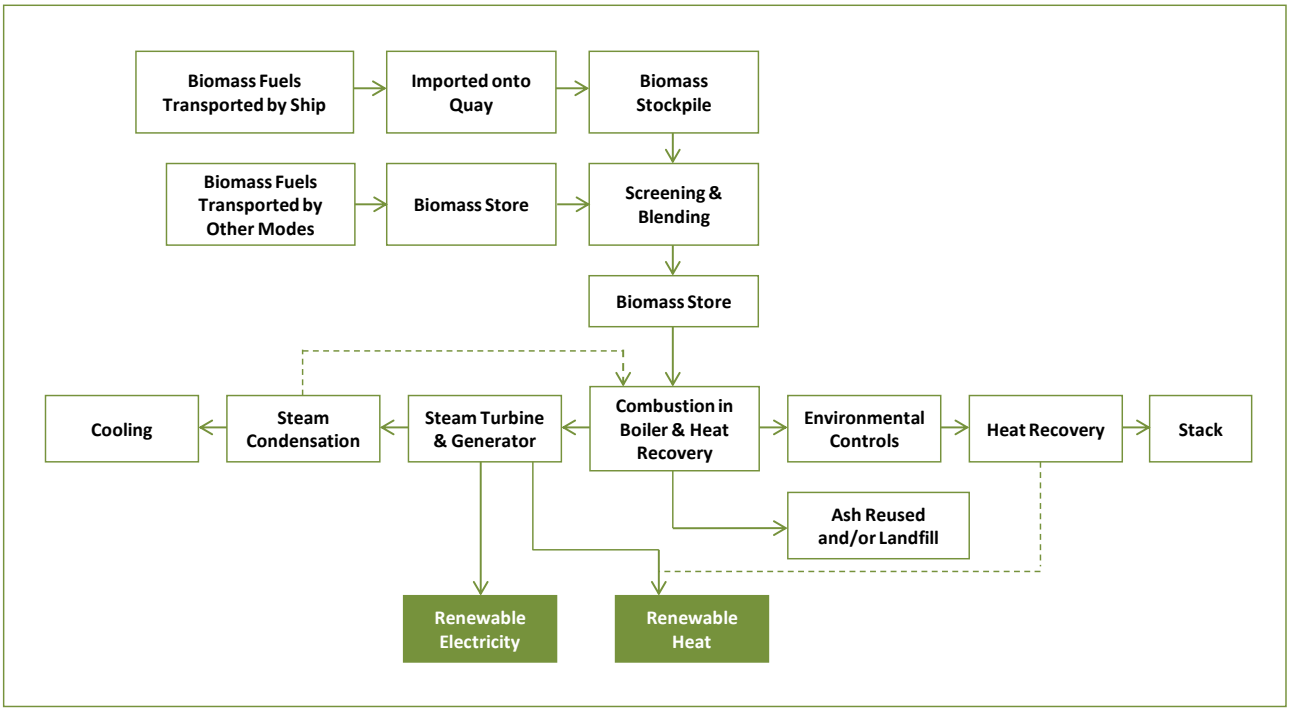
- Boiler hall;
- Main stack;
- Turbine hall;
- Biomass reception and storage facilities;
- Condenser plant;
- Cooling water pipelines, intake and discharge infrastructure;
- Cooling towers;
- Water treatment plant;
- Heat delivery auxiliary boilers and stack;
- Flue gas heat exchanger;
- Heat accumulator tank;
- Fire and potable water storage tanks;
- Demineralised water storage tank;
- Fuel oil storage;
- Back-up generator;
- Fuel conveyors and transfer towers;
- Ash silos and outloading bay;
- Day fuel storage facility with screening equipment;
- Flue gas abatement equipment;
- Bulk chemical storage; and
- Electrical transformer(s) and substation.

6.2.2 In addition, there will be a range of other components as described in Sections 6.4 and 6.5 below.

6.3 Overview of Proposed Development

6.3.1 The proposed Grangemouth Renewable Energy Plant is to be located within the Port of Grangemouth, the general location of which is shown within Figure 1.1. The Section 36 Application boundary is shown in Figure 1.2. The plant will export up to 100 MWe of renewable electricity to the local electricity network and also up to 200 MWth of renewable heat to local users from the use of an estimated 1.5 million tonnes per year of biomass fuel (dependent upon calorific value). The site will incorporate fuel storage, a power plant area, an electrical switchyard and a covered conveyor system for transferring fuel.

6.3.2 The process of power generation fuelled by biomass is shown in the flow diagram in Schematic 6.1.



6.3.3 It is intended that the plant will operate with a range of biomass fuels. The majority of biomass will comprise wood chip or wood pellets (virgin timber and forest residues). Around 10-30% of the biomass is anticipated to comprise other biomass. All fuel will comply with the requirements of the Renewables Obligation Order[1]. All biomass fuels will be environmentally sustainable, in accordance with emerging guidance as outlined in the Sustainability Statement, which has been submitted with the Section 36 Application and provides more information on fuel and its sources.

6.3.4 Although all biomass fuels used will fit within the above categories, the precise fuels to be used will be finalised and agreed with the Scottish Environment Protection Agency (SEPA) as part of the Pollution Prevention and Control (PPC) Permit application[2].

6.3.5 Other than during commissioning, start-up and possible intermittent load support, no supplementary fossil fuel will be combusted in the main boiler. The plant is being designed to use efficient modern technology (including Fluidised Bed (FB) or Pulverised Fuel (PF) technology) with stringent emissions control limits which will be set by SEPA in accordance with appropriate legislation.

6.3.6 Fuel will mainly be delivered to the plant via ship (anticipated to be at least 90 %), discharged at the existing operational quay and transferred to the fuel storage area, via a covered conveyor system. The plant will also be capable of accepting fuel by road (up to 10% by energy content). Forth Energy does not anticipate that biomass will be delivered by rail to the Grangemouth Renewable Energy Plant. There are currently no facilities suitable for handling biomass from the nearby rail line which currently serves the Grangemouth container terminal and petrochemical plant. There is also no biomass fuel market envisaged for the foreseeable future that would be suitable for delivery by rail to Grangemouth.

6.3.7 The proposed development site will comprise:

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[1] Renewables Obligation Order 2009.

[2] Pollution Prevention and Control (Scotland) Regulations 2000.

- the main plant and fuel storage area;
- an area of search for the installation of the cooling water intake;
- two alternative infrastructure corridors for the installation of cooling water discharge pipes (see Figure 6.3);
- an area of search for the installation of the cooling water outfall; and
- an infrastructure corridor for the fuel transfer conveyor.

6.3.8 The total area within the onshore red line boundary is 18.05 ha; the main plant area covering 10.3 ha of this.

6.3.9 The main fuel storage facility will comprise either a circular open-air storage facility or silos as shown in the proposed plant layout diagrams, Figures 6.1 and 6.2 respectively. A smaller enclosed fuel storage facility will also be provided for mixed biomass. During the construction phase, a 'laydown' area will be made available within the redline boundary, it is anticipated that this will be in the area proposed for the storage of biomass shown in these figures.

6.3.10 Biomass from the fuel storage area will be transferred to the main boiler by means of a covered conveyor belt system. The main boiler will raise steam for a single steam turbine generator. Exhaust steam from this turbine will be condensed by an evaporative cooling system using hybrid low plume cooling towers (described in Section 6.4.6). Condensed steam will then be re-circulated back to the boiler. Electricity will be exported from the Renewable Energy Plant via a 132 kV underground electrical connection to the local 132 kV network at Bainsford substation where it will feed onto the main national transmission network (see paragraphs 6.5.63 to 6.5.65).

6.3.11 The flue gases will exit the boiler and pass through flue gas abatement equipment, including a high efficiency dust collection system (i.e. fabric-filters) for particulate removal. The flue gases will then discharge to atmosphere via a 110 m stack, ensuring the appropriate dispersion into the environment. Flue gas emissions are considered in detail in Chapter 9 Air Quality. Continuous emissions monitors will be utilised to ensure compliance.

6.3.12 The biomass fuels intended for use in the Renewable Energy Plant will have a low ash content and the plant is anticipated to produce up to 20,000 tonnes per year of ash which will be recycled, as far as possible, for example, to the construction industry or for soil improver. It will be transported from the Renewable Energy Plant by road.

6.3.13 Cooling water will be extracted from the impounded dock (i.e. the Western Channel) and will then be discharged to the River Carron up to a maximum of 12 ºC warmer (see paragraphs 6.5.55 to 6.5.57).

6.3.14 A water treatment plant will treat mains (i.e. potable) water to provide demineralised water for use in the boiler plant.

6.3.15 A small back-up diesel generator will be provided, to allow safe and controlled shut-down of the plant in the event of grid-connection failure.

6.3.16 The plant is intended to operate as a base-load plant, operating continuously except for periods of maintenance. The development represents a substantial investment by Forth Energy which will lead to the generation of new opportunities for employment and the demand for locally sourced goods and services during the construction, operation and decommissioning phases of the Renewable Energy Plant.

6.3.17 The potential for the plant to increase its efficiency through the supply of steam and/ or hot water to nearby activities has been investigated, resulting in the identification of a number of potential users. Discussions are ongoing and it is Forth Energy's intention that renewable heat/steam will be supplied to local users where there is demand and supply is commercially feasible. The proximity of the Ineos Refinery affords considerable opportunity for Forth Energy to supply an element of its process heat needs. Together with the other process heat users the potential for 200 MW of process heat supply has been identified. A letter

outlining an expression of support from Ineos has been sent to Forth Energy (see Appendix C of the the CHP Feasibility Study.

6.3.18 It is proposed that heat is extracted via flue gas condensation and/or using steam bled from the main turbine, subject to the quantity and temperature of heat required. Two small light fuel oil-fired auxiliary boilers (2 x 10 MWth) and a heat accumulator will also be installed to meet the heat demand when main boiler is not operational. A Combined Heat and Power Feasibility Study is included with the Section 36 Application and this demonstrates that there are a number of potential users in the area and the plant could provide up to 200 MWth of heat.

6.3.19 The proposed Renewable Energy Plant is a low carbon technology and it is not therefore proposed to design or build the plant to be Carbon-Capture Ready. The plant is also below the 300 MWe European Union threshold[3] for the consideration of Carbon Capture Readiness.

6.3.20 The construction period for the proposed plant will be approximately 36 months. It is expected that the construction workforce will peak at approximately 500, although average numbers will be of the order of 300 over the three year construction period. An operational workforce of about 40 is anticipated. In addition, the project will also support 21 additional and 10 existing port operational staff with respect to fuel handling.

6.3.21 Subject to the granting of all necessary planning and environmental consents and permits, construction of the Grangemouth Renewable Energy Plant is envisaged to commence in 2012, with full operation anticipated by 2015.

6.4 Site Layout

6.4.1 Throughout the evolution of the project, Forth Energy has sought to reduce the environmental impact of the Renewable Energy Plant through the appropriate siting and orientation of the plant and its components, whilst optimising the project design and ensuring operational safety. The following factors have been considered:

- Proximity to residential areas and the closest residential receptors;
- Proximity to potential heat users;
- Provisions to minimise noise and visual impact;
- Proximity to existing port facilities;
- Ongoing operational requirements of the Port;
- Operational safety;
- Road access;
- The protection of the site and surroundings against flood risk;
- Compliance with regulatory requirements; and
- Technical requirements.

6.4.2 The site layouts being considered are shown in Figures 6.1 and 6.2 (open and silo storage respectively). The proposed plant is arranged with the main combustion plant to the north (furthest from residential receptors).

6.4.3 The majority of biomass deliveries will be by ship utilising existing operational berths at The Tongue, within the Port of Grangemouth.

[3] Towards Carbon Capture and Storage: Government's Response to Consultation http://www.berr.gov.uk/files/file51115.pdf

6.4.4 The main power plant items will be housed within the boiler hall and separate turbine hall. Cladding and noise insulation materials will be designed to control noise emitted from within the power plant and auxiliary buildings.

6.4.5 The boiler hall will also include:

- All auxiliary equipment associated with the steam plant;
- A control room;
- Workshop and spare gear stores;
- Electrical control cabinets room;
- High-voltage switch room and transformer cage;
- Potable water tank;
- Demineralised water tank;
- Water treatment plant, including neutralisation pit;
- Sand silos;
- Raw water storage tank for boiler make up; and
- Chemicals storage facilities.

6.4.6 The administration building will be located adjacent to the turbine hall and will be the official reception point of the operational Renewable Energy Plant. Operational staff and visitor parking facilities will be located adjacent to the turbine hall and administration building.

6.4.7 Indicative dimensions of buildings and external plant are shown in Table 6.1.

Table 6.1: Indicative Dimensions of Main Buildings and External Plant

Building or external plant item	Length (m)	Width/ Diameter (m)	Height (m)
Mixed fuel store	120	60-109	20
Open circular fuel store	-	125	33
Each fuel storage silo (alternative to open storage) (6 off)	-	28	33
Electrical substation	60	40	
Fuel day store	50	40	20
Fuel screen	30	20	15
Turbine hall & Admin	40	35	65
Boiler hall	60	50	65
Coiling towers (2 off)	80	20	23
Ash silos	-	5	12
ID fan	18	12	10
Fabric filters	20	15	42
Main stack	-	5.22*	110
Auxiliary boiler stack	-	1.2*	45
Heat accumulator	-	14	22
Auxiliary boiler building	26	25	10

Building or external plant item	Length (m)	Width/ Diameter (m)	Height (m)
Day silos (2 off)	-	12	15
Gas Oil Tank	-	7	10
Fire water storage tank	-	7	10
* external diameter			

6.4.8 Whilst a considerable degree of design and specification of the Renewable Energy Plant has been carried out at the time of preparing this ES, the final details will be developed during and subsequent to the Section 36 consent determination. The layout of the key plant items has been optimised within the space available and the fuel storage, boiler hall, turbine hall, flue gas treatment plant and stack will not move significantly from the positions indicated on the layout plans.

6.4.9 The main boiler will be designed to operate predominantly with either woodchips or wood pellets. A decision on the form of the predominant fuel type will be made prior to the detailed design stage, on the basis of a number of economic and technical factors. The type of fuel storage required will depend on whether woodchips or wood pellets will be used. Wood chips will be stored in an open, external facility; pellets must be kept dry and would be stored in silos. The detailed design of the fuel storage is therefore subject to confirmation of the fuel to be used in the plant. The position and arrangement of the biomass storage facilities, the in-feed/out-feed conveyors and minor plant items could move slightly, typically ± 10 m in any direction and may be slightly lower in height, subject to detailed design.

6.4.10 Minor changes to the layout may be necessary as a result of the detailed design phase, however the main plant will remain as indicated. It is not, therefore, expected that the final plant size and layout will differ considerably from the proposals described herein and therefore the ES addresses all potential significant impacts.

6.4.11 Forth Energy will submit details of the final detailed plant layout and design (including architectural design, colours and finishes) to Falkirk Council for approval prior to construction, identifying any minor non-material deviations from the advanced design upon which this ES is based.

6.4.12 The proposed site is located within the operational Port of Grangemouth. Activities associated with cargo handling and transit are Permitted Development under the terms of the General Permitted Development (Scotland) Order 1992 (GPDO) Class 35 1 (a) and (b) which permits "*Development on operational land by statutory undertakers or their lessees in respect of dock, pier, harbour…undertakings required for the purposes of shipping; or in connection with the embarking, disembarking, loading, discharging, or transport of .... goods at a dock, pier or harbour*". All proposed development activities associated with the Renewable Energy Plant will be assessed in accordance with the EIA Regulations[4]. The handling and conveyance of biomass fuel is Permitted Development, and Forth Energy is not seeking Section 36 Consent for permitted activities, consequently this ES assess the environmental impact of the Section 36 application site and not ports and shipping activities that are already permitted that lie outwith the red line in Figure 1.2, i.e.:

- Ship movements;
- Materials handling equipment used to off-load biomass from ships; and
- Biomass conveyance infrastructures between the ship and the storage areas.

[4] Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000.

6.5 Details of the Proposed Development

Fuel type and source

6.5.1 It is intended that the plant will operate with a range of biomass fuels. All biomass fuels will comply with the requirements and definitions of biomass as defined in the Renewables Obligation Order (Scotland)[5]. The fuel mix for the Renewable Energy Plant will primarily comprise wood chip or wood pellets with the remainder from other biomass fuels as outlined in Table 6.2 below. All biomass fuels will be sustainably sourced, as set out in the Sustainability Statement that accompanies this application.

Table 6.2: Fuel mix

Wood (70-90%)	Other Fuels (10-30%)
Wood Chip or pellets: Virgin Timber - including short rotation forestry (e.g. eucalyptus) Forest residues	Purpose Grown Energy Crops: Short rotation coppice (e.g. willow) Grasses (e.g. miscanthus) Agricultural residues (e.g. rape seed meal) Recovered Biomass Materials: Timber (including treated timber) Paper Cardboard

6.5.2 As noted in paragraph 6.5.9 a decision on the form of the predominant fuel type (either woodchip or pellets) will be made prior to the detailed design stage, on the basis of a number of economic and technical factors. Although all biomass fuels will fit within the above categories, the precise fuels to be used will be finalised and agreed with SEPA in the forthcoming PPC permit application. The amount of recovered timber (including treated timber), paper and cardboard in the final fuel portfolio will be determined by a range of commercial and technical factors including; availability; price and plant design. These fuels are considered by SEPA to be wastes and therefore the plant will need to be compliant with the Waste Incineration Directive[6]. No other non-biomass wastes, such as municipal waste, will be used.

6.5.3 The use of biomass resources to produce energy has many benefits for Scotland. Not only does the electricity and heat generated from biomass fuels result in significantly less carbon emissions compared with fossil fuel energy alternatives, but the use of these fuels has the potential to increase the security of Scottish energy supply and stimulate economic growth. The development of biomass energy must however go hand in hand with consideration of environmental protection and resource equality issues if the end product is to be considered sustainable. Forth Energy is committed to only using sustainable biomass in its Renewable Energy Plants.

6.5.4 The Sustainability Statement which is submitted with the Section 36 Application sets out the sustainability strategy that Forth Energy will use to guide its procurement of biomass from sustainable sources. This will include regular auditing of supplier performance against the emerging national and international standards.

6.5.5 It is Forth Energy's intention to procure as much of the fuel from indigenous suppliers as practicable, if this can be economically sourced. However, it is recognised that there is limited availability of UK sourced biomass currently, therefore the majority of the fuel will, at least initially, be procured from overseas.

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[5] Renewable Obligation Order Scotland (2009) as amended.

[6] Official Journal of European Communities, Directive 2000/76/EC on the Incineration of Waste December 2000.

6.5.6 There will be times during commissioning, and periodically during operation, when the main boiler needs to be re-started (after being shut-down). Low sulphur light fuel oil (i.e. gasoil or kerosene or a biofuel of a similar specification) or natural gas will be used at these times to quickly bring the main combustion chamber temperature to the correct operating range prior to introducing the biomass fuel. The on-site back-up generator and auxiliary boilers will use low sulphur light fuel oil.

Fuel Delivery

6.5.7 The Renewable Energy Plant will require approximately 1.5 million tonnes of biomass per year (dependent upon the calorific value of the fuel). Biomass will enter the Renewable Energy Plant in numerous physical shapes and sizes which could be chips, pellets, meals or cakes.

6.5.8 Fuel will mainly be delivered to the plant via ship (at least 90% of the fuel used), the majority of which will come from international sources, however some short-sea delivery from UK sources is anticipated. This will be discharged at the existing quay and transferred to the fuel storage area, via a covered conveyor system. The delivery of fuel will result in circa 120 vessels per annum i.e. one to two vessels per week visiting the Port of Grangemouth.

6.5.9 Over the past decade the number of ships to call at the Port of Grangemouth has varied between per annum 2,548 and 1,884 (in 2009). The number of vessels anticipated to be involved in the delivery of fuel to the Renewable Energy Plant is therefore a small proportion of the number that have called in recent times. They will be using a berth at The Tongue, which is an existing operational berth in the port, currently used for handling a variety of commodities. As noted above, the Port already has permitted development rights for the unloading, transfer and storage of all cargoes (see paragraph 3.2.4) and regularly handles materials akin to the fuel source for the Renewable Energy Plant, in the form of wood chip, biomass briquettes, forest products and bulk commodities.

6.5.10 Up to 10% of fuel may be brought to site by road, which would result in an average of 24 lorries visiting site each day, equating to less than two vehicle movements per hour over a 14 hour day.

6.5.11 Low sulphur light fuel oil will also be delivered to the Renewable Energy Plant via conventional road tankers of around 36 m^3 capacity. It is expected that around 46 deliveries will be required per year, although this could increase to around 80 deliveries per year, depending on the number of main plant start-ups required. This same fuel will also be used by the auxiliary boilers and on-site back-up generator which together will require of the order of 90 deliveries per year, resulting in up to 170 fuel deliveries in total.

Fuel Storage and Handling

6.5.12 There will be two fuel storage facilities: a main fuel store comprising either open storage or pellet silos and an enclosed mixed fuel storage facility. The type of storage facility is dependent on the form of the main fuel to be used. Open storage will be used for woodchips (Figure 6.1) whereas wood pellets must be kept dry and will be stored in silos (Figure 6.2). Ships will be discharged at The Tongue by cranes with grabs onto a conveyor to the main fuel store via a series of hoppers. Ships will typically be unloaded in three days or less.

6.5.13 The main fuel store will accommodate up to 38,000 tonnes of biomass and will be located in the north eastern corner of the main plant area. This is sufficient fuel for 9 days continuous operation of the plant. The store will also have sufficient capacity to cater for ship and demand patterns i.e. should delays occur in the supply chain, sufficient fuel will be available on-site for the power plant to continue to operate and, equally, there will be sufficient space in the storage facility, when needed, to add a full ship load to what fuel is already there. Fuel stocks will therefore vary significantly between ship deliveries of biomass.

6.5.14 The smaller mixed fuel storage facility will comprise an 8,000 tonne mixed biomass store, located in the south western corner of the main plant area. This will be large enough to store a range of biomass fuels separately, providing up to 10% of the fuel needed over a 10 day period. Biomass would be tipped into dedicated receiving units located within the building and transferred to a series of storage bays.

6.5.15 Fuels will be blended on-site to provide the consistent combustion conditions required for optimum safe and efficient operation. Biomass materials will be mixed by controlling the reclaim of biomass types from the fuel storage areas. Fuel will be reclaimed automatically from the main fuel store and transferred via an enclosed conveyor passing over an enclosed fuel screen to a day store. A loading shovel will be used to reclaim biomass from the individual storage bays of the mixed biomass store and will mix the fuels to form a consistent blend for stable combustion. This fuel blend will also be conveyed to the day store. Screening is necessary to protect downstream handling equipment, notably the boiler firing system, thereby improving plant availability. Any oversize fuel will be crushed and forwarded to the boiler. There will be no other fuel processing, such as chipping, on site. A mix of all biomass fuels will be conveyed via an enclosed system from the day store to the boiler for combustion.

6.5.16 The virgin wood store and mixed biomass store will have single stream fuel reclaim through to the day store. Two 100% duty fuel transfer conveyors would be installed between the day store and boiler fuel feed system. Both day store reclaim systems will feed to either one of the two transfer conveyors to the boiler fuel system, giving a cross over system. This provides good operational flexibility and equipment redundancy to cater for equipment failure.

6.5.17 Fire, its prevention and detection, will be carefully considered during the design and layout of the fuel storage area and will be in accordance with good practice and UK guidance. A number of standards are potentially relevant including BS 5306, BS 5839, the NFPA (National Fire Protection Association Standards from ANSI) and HSE guidance publications. The final detailed design will depend on the outcome of a fire risk assessment, in accordance with the Regulatory Reform (Fire Safety) Order 2005. A Fire Prevention Method Statement is presented as Supplementary Information to the Section 36 Application.

6.5.18 Light fuel oil will be stored on site within a bunded or double skinned tank with a capacity of the order of 300 m^3 for use in the main boiler. In addition, a separate tank accommodating 275 m^3 light fuel oil will be provided for use in the auxiliary boilers and will be sufficient to supply 5 days of continuous operation. These tanks (as with all tanks in which liquid chemicals are stored) will have level gauges visible from its filling point and an impermeable bund of 110% of the tank's capacity, to contain any unexpected leakage. Bunds will be fitted with a 'bund full' alarm. The tank will be designed and operated in compliance with the requirements of the Water Environment (Oil Storage) (Scotland) Regulations 2006. If the tanks have open bunds as opposed to being double skinned tanks, rainwater or oil within the bund will be removed by a tanker for disposal at an appropriately licensed facility.

Power Generation

6.5.19 The main boiler plant will use conventional combustion and steam raising plant technology utilising steam extraction for heat off-take and a condensing turbine for maximum efficiency. The proposed combustion technology will use either a Fluidised Bed (FB) or a Pulverised Fuel (PF) boiler which are proven designs used in similar plants currently operating throughout Europe. The selected boiler type will comprise the Best Available Technique (i.e. BAT) and this will be demonstrated at the time of the PPC permit application. The main boiler will supply steam to a single steam turbine and generating unit. Gross electricity production will be approximately 118 MWe, with a net export capacity of 100 MWe, the balance of power being used to operate the plant. The heat export capacity will be up to 200 MWth, the anticipated overall efficiency of the Renewable Energy Plant will be up to 60%.

6.5.20 The bed of a FB boiler, within which the fuel is combusted, is typically made up of sand, which is fluidised by the injection of combustion air upwards from the base of the bed. The fluidising action allows good transfer of heat from the hot sand to the fuel and good mixing of fuel and air, so that efficient combustion occurs. In Pulverised fuel firing, the fuel is first passed through a mill to reduce particle size and is then combusted in Low NOx Burners. PF firing would only be suitable should wood pellets be selected as the predominant fuel.

6.5.21 The hot combustion gases that are produced are used to create high pressure, high temperature steam, which in turn is passed to the steam turbine and electrical generator for the generation of electricity.

Combined Heat and Power (CHP)

6.5.22 Forth Energy aims to optimise the environmental and economic benefit from the Grangemouth Renewable Energy Plant. Therefore, Forth Energy is keen to identify means of improving the overall energy efficiency of the plant by incorporating Combined Heat and Power (CHP)[7] technology, including process use and space heating into the design. The opportunities for CHP in the vicinity of the proposed site have been investigated by Forth Energy as described in the CHP Feasibility Study which accompanies the Section 36 Application.

6.5.23 Initial discussions have been held with process industry heat customers with regard to identifying the potential for the supply of high grade renewable heat (steam). The proximity of the Grangemouth refinery affords considerable opportunity for Forth Energy to supply an element of its process heat needs. Together with other process heat users, the potential for 200 MW of process heat supply has been identified. These discussions have included the management at the Ineos Refinery whose production facilities are located immediately adjacent to the Port. A letter outlining an expression of support from Ineos has been provided (see Appendix C of the CHP Feasibility Study). Confidentiality provisions prevent disclosure of other potential customers at the present time. An indicative Heat Plan has been prepared in order to illustrate the possible phasing of the heat load connections should consent be received.

6.5.24 Discussions with Falkirk Council have identified considerable potential for the development of a District Heating network to service Grangemouth town centre. Use has been made of a Falkirk Council commissioned District Heating report[8] and its identified public sector loads have been accounted for in the development of the indicative Heat Plan. The quantity of medium grade heat available from the flue gases suggest the potential to supply a District Heating network of up to 19 MW capacity. An assessment of the potential to connect residential customers is ongoing.

6.5.25 There will be a multi-phase connection strategy for heat customers, which could include the identified existing users and also any potential new customers that locate in the area. The first phase of the proposed heat network could be completed in 2015 following the commissioning of the Renewable Energy Plant.

6.5.26 Preliminary estimates show potential renewable heat supply volumes ranging from between 1,114 GWh/annum in Year 1 to 1,580GWh/annum in Year 8, the latter being based on a thermal heat use of 200 MWth. Subject to further detailed feasibility assessment it may be possible to accelerate or extend this implementation. Typical heat efficiencies for various heat loads are given in Table 4.2 of the CHP Feasibility Study.

6.5.27 The study demonstrates that there is significant potential for a realistic volume of heat to be supplied from the Grangemouth Renewable Energy Plant. As with all project opportunities of this nature however it will only be possible to undertake detailed feasibility studies and for commercial discussions around contractual terms and conditions to take place, post consent, when there is a confidence that the development of the Grangemouth Renewable Energy Plant will proceed.

Flue Gas Treatment

6.5.28 A fuel combustion temperature (of around 900°C) and residence time (of at least 2 seconds) will ensure high efficiency combustion and low carbon monoxide formation, whilst also limiting the formation of nitrogen oxides

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7 CHP is defined as the simultaneous generation of useful heat and power in a single process.

8 Falkirk Council/BP Grangemouth District Heating Feasibility Study - Grangemouth District Heating Project' Electrowatt-Ekono November 27 2002.

(NOx). The combustion environment will be very turbulent, which avoids the formation of hot or cold areas within the boiler.

6.5.29 Fabric filters will be used to reduce particulate emissions. Sulphur dioxide and hydrogen halide emissions will be limited by the low concentration of sulphur and halogens in the fuel and also, if necessary, by appropriate abatement such as dry lime injection, in line with relevant legislation.

6.5.30 In addition to the inherent control of NOx achievable by the FB technology or the low NOx Burners used in PF boilers, emissions of NOx will be reduced further by Flue Gas Recirculation and Selective Non Catalytic Reduction (SNCR), if required. SNCR is the injection of liquid ammonia or urea solution into the combustion chamber. Activated carbon dosing may also be utilised.

6.5.31 The flue gas abatement equipment will be designed to ensure that the emission limits set by SEPA will be met for all fuels and fuel mixes used in the plant. Due to the use of recovered timber, cardboard and paper, the Renewable Energy Plant will be compliant with the requirements of the Waste Incineration Directive. As the main purpose of the plant is the generation of electricity and heat, the relevant emission limits are those of 'co-incineration' as defined in Annex II of the Directive.

6.5.32 The flue gases will discharge to atmosphere via a stack which is proposed to be 110 m in height. The flue gas exit temperature of at least 75°C and velocities above 15 m/s will be maintained to ensure adequate dispersion. The proposed height of the stack has been determined by atmospheric dispersion modelling, as discussed in Chapter 9. A separate small stack of the order of 45 m will be associated with the auxiliary boiler.

6.5.33 Dependent on the emissions limits, which are to be determined as part of the PPC permitting process for the installation, small amounts of dry powdered flue gas treatment reagents may be delivered to site by road. Continuous emissions monitoring will ensure ongoing emission compliance with the limits to be set by SEPA.

6.5.34 The proposed Renewable Energy Plant is a low carbon technology and it is not therefore proposed to design or build the plant to be Carbon-Capture Ready. The plant is also below the 300 MWe European Union threshold[9] for the consideration of Carbon Capture Readiness.

Cooling System

6.5.35 Exhaust steam from the steam turbine will be condensed in a water-cooled tube surface condenser, within the turbine hall, for re-use within the steam cycle. It is proposed that water from the impounded dock (i.e. the Western Channel) will cool both the condenser and other parts of the plant and will itself be re-circulated after passage through the hybrid low plume cooling towers. There will be two rows of six cooling tower cells (80 m by 20 m by 23 m in height - see Figures 6.1 and 6.2). The alternatives considered with respect to the type of cooling technology to be used for the proposed Renewable Energy Plant and the main reasons for the choice made, taking into account potential environmental effects, are discussed in Chapter 7 Site 'Selection and Alternatives'.

6.5.36 Unlike the 115 m hyperbolic natural draught cooling towers used on older thermal power plants, the proposed hybrid cooling towers will have fans mounted on the top to force air through. This permits a shorter tower, which will be up to 23 m in height. In addition, in order to reduce the visual impact still further, hybrid cooling towers have both wet and dry sections, which enable the cooling tower to be designed to be plume free down to an ambient temperature of 5ºC and a relative humidity of 95 %. At this location this would result in the frequency of occurrence of a visible plume of less than 2.5 % per year of daylight hours, based on five years' (2005-2009) relative humidity and temperature data available from the meteorological station at Edinburgh Gogarbank, approximately 24 km to the south west of the site.

[9] Towards Carbon Capture and Storage: Government's Response to Consultation http://www.berr.gov.uk/files/file51115.pdf

6.5.37 In combining wet and dry sections, cooling is achieved through both the dry heat exchange and wet evaporative processes. Warm cooling water passes from the condenser to the dry section of the cooling tower, which is located toward the top. The water passes through finned tubes where heat is transferred to some of the towers' cooling air, producing warm air. Having passed through the tubes of the dry section, the cooling water is then sprayed over a packing system contained in the lower portion of the cooling towers. Here heat is transferred through direct contact with the air flowing up through the tower and also by evaporation. The evaporative process is a very effective and efficient cooling process. In the top section of the cooling tower damp air from the wet section is mixed with warm dry air from the dry section thereby reducing the occurrence of a visible plume.

6.5.38 The water falling through the wet section is collected in the cooling tower basin from where it is abstracted for re-use in the power plant's condensers.

6.5.39 The operation of the cooling tower can be optimised by varying the air flow and the extent of usage of the dry section and wet section in order to avoid frost damage, minimise visual impact when necessary and maximise the efficiency of the system when the occurrence of a visible plume is not likely. The plume from the cooling towers, although generally not visible, will contain clean water and, as such, is not a pollution problem.

6.5.40 The water used in the cooling water system will contain solids and minerals which will become concentrated in the cooling tower due to the evaporation. In order to prevent the levels of these impurities from increasing above levels where corrosion and deposition can occur, it will be necessary to continually purge or 'blow-down' some of the water from the system and replace with fresh water. In addition to the water required to replace that lost due to the continual need to purge, water will also be required to make up for the evaporation losses and to a lesser extent the small quantities of water lost through drift (i.e. fine droplets of water blown from the tower).

6.5.41 It is proposed that make-up cooling water will be extracted from the impounded dock. The cooling water system will require a water supply in the order of 1,400 m^3/hr. This would result in a discharge of approximately 1,120 m^3/hr of water, however in order to ensure adequate mixing in the River Carron this blowdown water will only be discharged to the river on a falling tide, i.e. for four hours after each high tide, when there is the maximum amount of water available in the river, The discharge flow rate at such times will be 3,360 m^3/hour.

6.5.42 The cooling water intake structure will be attached to the western end of the impounded dock, within an area bounded by dolphins which prevent navigation in this area (see Figure 6.3). Warmed water will be discharged to the River Carron. The design detail of the outflow will ensure flow velocity is suitable to minimise its impact: typically this might involve an outlet manifold with multiple discharge points. Water will only be discharged on a falling tide in order to ensure rapid dispersion of the cooling water (see Chapter 13 Aquatic Ecology). Water will be returned to the estuary up to 12°C warmer than ambient.

6.5.43 Cooling water pumps will be installed within a pump-house, which will be located in the boiler hall. The cooling water outfall structure will be located within the 'area of search for cooling water infrastructure' on the River Carron. The 'area of search' has been selected so that any structures constructed here would not impact on the navigational channel and would be acceptable to British Waterways Scotland.

6.5.44 There are two alternative routes for the discharge pipework:

- Option 1 – leading northwards from the site, beneath the cut between the Western Channel and the Carron Dock and then skirting eastwards around the Dry Dock before heading north to the River Carron. This is the shortest route and therefore the preferred option; and
- Option 2 – leading westwards from the site to skirt the Carron Dock to the south. The route crosses under the dock, beneath the swing bridge, to pass to the north of Carron Dock before heading northwards to pass to the north east of the Old Dock to the River Carron.

6.5.45 The cooling water supply will be treated with a biocide to control fouling and the growth of micro-organisms in order to:

- promote overall plant energy efficiency by maintaining clean heat exchanger surfaces. The formation of slime and deposits on the inner surfaces of the cooling water condenser tubes adversely affects heat transfer and unit efficiency;
- protect cooling system equipment from corrosion; and
- prevent the proliferation of biological organisms that may present a risk to human health..

6.5.46 Small concentrations of the biocide, probably sodium hypochlorite, will therefore be added to the cooling water in order to prevent slimes and algal growth. A free chlorine level of 0.2 to 0.5 mg/l at the condenser inlet is required to limit growth of slimes, while >1 mg/l is typically required to control algal growth. The dosing regime will be optimised to minimise use of the biocide but any remaining biocide in the cooling water will degrade rapidly in the cooling water discharge (see Chapter 13 Aquatic Ecology).

6.5.47 The steam turbine lubricating oil, generator, boiler circulating pumps, sample coolers and other minor systems will all be cooled by a closed circuit system which will in turn be cooled by the cooling water. The closed circuit cooling water system will be filled with deionized water to which a suitable corrosion inhibitor will be added. The total volume of water in the closed cooling water system will be small, of the order of 60 m^3 and thus the quantity of corrosion inhibitor used will also be very small. The cooling water system will not normally produce an aqueous effluent. On the rare occasions when the system has to be drained for maintenance, the water can be safely discharged at a low flow rate and mixed with the other plant effluents for discharge in accordance with the PPC permit that will be obtained from SEPA.

Water Treatment Plant

6.5.48 Water quality in the main boiler water/steam circuit will be controlled by continuously purging or 'blowing down' small quantities of the water from the system to avoid internal corrosion and ensure optimal efficiency. This water will be replaced with high purity water supplied by an on-site water treatment plant and will be stored in a treated water storage tank.

6.5.49 The water treatment plant is expected to treat potable water (i.e. drinking or mains water) supplied by Scottish Water, using ion exchange and/or reverse osmosis to produce high quality demineralised water.

6.5.50 Should ion exchange technology be used, the ion exchange beds will require periodic regeneration. This is where the anions and cations, removed from the water supply and held by the resins in the ion exchange beds, are displaced with hydrogen and hydroxide ions from an acid and sodium hydroxide respectively. This results in an effluent that is neutralised prior to disposal.

6.5.51 A reverse osmosis plant would include filtration and reverse osmosis followed by ion exchange in mixed beds. In the reverse osmosis process, pressure is used to force high purity water through a semi-permeable membrane leaving the small quantities of dissolved impurities originally present in the potable water behind in a more concentrated form for disposal. The mixed bed units will then further purify the water to give the high purity water required for boiler water make-up.

6.5.52 The water treatment plant will be able to produce up to 45 m^3/hour of treated water, resulting in approximately 4-6 m^3/hour of effluent. This effluent will be discharged with the cooling water discharge from the Renewable Energy Plant.

Process, Surface and Foul Water Drainage

6.5.53 Process effluents from the Renewable Energy Plant will comprise cooling water, boiler blow-down, water treatment plant effluent, flue gas condensate and other minor discharges. It is proposed that this process water, with the exception of flue gas condensate, will be discharged to the Forth Estuary via the River Carron,

as described in paragraphs 6.5.35 to 6.5.44. The discharge will comply with the limits agreed with SEPA as part of the project's PPC Permit. The flue gas condensate will be treated on site (neutralisation and solid removal) prior to discharge to sewer or other appropriate treatment.

6.5.54 The Renewable Energy Plant will generate around 1 m^3 per day of foul water drainage from toilets, showers, and hand basins which will be discharged to the local sewerage system or via a package treatment plant (e.g. a biocube) prior to discharge to the River Carron on a falling tide.

6.5.55 Surface water will be discharged to the dock. Surface water drainage from the Renewable Energy Plant (from areas with a potential for oily contamination, such as in the vicinity of the combustion plant) will pass through a Class I oil interceptor prior to discharge.

Auxiliary boilers and heat accumulator

6.5.56 A heat accumulator will be provided to enable the Renewable Energy Plant to meet likely peak heat requirements of the district heating (DH) system and to provide heat at times when the main boiler is not in operation. The heat accumulator will comprise a large hot water tank sized to provide approximately 100 MWh capacity. The accumulator will be able to supplement the heat provided by the main plant at times of peak demand, for a period of just over 12 hours and will be able to supply full demand for approximately 6 hours. The accumulator is sized to match district heating demands, as process steam users will utilise their own auxiliary supplies of heat at such times.

6.5.57 Two small light fuel oil fired auxiliary boilers (2 x 10 MWth) will be installed to meet the needs of heat customers at those times when neither the main boiler nor the heat accumulator are in operation. The boilers have been designed to:

- Be large enough to meet maximum demand with respect to district heating;
- Have the ability to grow with the system;
- Be located for maximum flexibility; and
- Provide a high level of redundancy, to ensure district heating demand can be met at all times.

6.5.58 The advantages of two 10 MWth boilers would be:

- The boilers can deal with lowest summer load, a 10 MWth boiler can deal with heat demand as low as 2 MWth; and
- A 10 MWth boiler could be used as a backup if the other is not working. However, during periods of maximum demand, if one of the boilers is not operational; the other boiler may not be of sufficient capacity to meet the maximum demand. This will be avoided, as far as practicable, by servicing boilers before the winter season and monitoring closely throughout it.

6.5.59 A separate blowdown system local to the auxiliary boilers would be provided which would cool the boiler blowdown before being discharged to the plant effluent system.

6.5.60 Dosing chemicals will be injected directly into the auxiliary boilers to prevent corrosion during periods of prolonged shutdown. These chemicals will be consistent with the chemicals used within the main boiler system.

6.5.61 The auxiliary boilers will have a dual flued dedicated stack of up to 45 m in height. The emissions from the auxiliary boiler will be controlled in compliance with the relevant legislation.

Auxiliary diesel generators

6.5.62 A small 1 MVA back-up diesel generator and a diesel fire fighting pump will be installed within either the boiler or turbine hall. The back-up diesel generator will enable safe shut-down of the plant and provide electricity to

run plant services,, including emergency lighting, in the event of total loss of electrical supply. Both generators will be tested on a routine basis to ensure that they start properly when required.

Electricity Export

6.5.63 A new onsite 132 kV substation will be built to transform and transmit the electrical output from the plant to the local 132 kV network at Bainsford substation via a 132 kV underground electrical connection. It is not anticipated that any modifications to the existing substation will be necessary. The connection between the Renewable Energy Plant and the point of connection will be undertaken by the host network operator Scottish Power Transmission Limited (SPTL) under their permitted development rights. The routing and design of the connection would therefore be undertaken by SPTL. The cable installation is expected to be laid using the traditional open-cut method with cables buried directly in the ground. An indicative route of the cable is shown on Figure 6.5. The route of the underground grid connection route is only indicative at the present time but it would be entirely located beneath the highway network and would likely follow Central Dock Road southwest to North Shore Road, continue southwest along Earl's Road, cross the M9 at Earl's Gate Roundabout to follow Falkirk Road to Westfield Roundabout, before turning north along the A9 and enter the Bainsford Grid Substation via Abbotts Road. The cable will cross a dismantled railway on Falkirk Road and the Forth and Clyde Canal on the A9.

6.5.64 A Grid Connection Application for this project will be submitted to National Grid Electricity Transmission (NGET), once Section 36 consent has been granted, seeking a Connect and Manage Offer with a suitable connection date that fits within the Forth Energy development timescale of commercial operation by the first quarter 2015. It is not anticipated that any modifications to the local substations will be necessary.

6.5.65 The off-site electrical connection is not within the scope of the Section 36 Application and this EIA. However, wherever possible the known impacts of the cable are discussed.

Civil Engineering

6.5.66 The Renewable Energy Plant will most likely be based on pile foundations supporting a reinforced concrete plinth. Pile foundations ensure the required structural stability and prevention of damage by ground settlement. Pile foundations will support the structures such as the boiler hall, turbine hall and fuel storage facilities. Foundations for rotating or vibrating equipment will be designed in accordance with specified conditions to ensure the following:

- that there will be no settlement of the units that could affect their operation;
- that vibration from the foundations will not adversely affect other nearby structures; and
- that there will be no resonance between the driving frequencies and the natural frequencies.

6.5.67 In undertaking ground excavations, the potential exists for any contamination within the ground to be mobilised. The potential for contamination is assessed in Chapter 14 (Hydrology, Hydrogeology, Geology and Soils) which provides an assessment of environmental impacts arising from the potential contamination and identifies a range of mitigation measures that will be employed such that there are no predicted residual effects on soils during construction.

Building Superstructure

6.5.68 Construction of the building superstructure will comprise the erection of the steel building frames, main boiler, construction of the lower level walls and cladding of the upper level walls (including window installation) and roofs.

6.5.69 Internal structures and fixings such as flooring, walls, stairs, wiring, communication links and plumbing will be installed when weather proofing of the buildings is completed.

6.5.70 Belt conveyors will connect the fuel storage facilities to the main boiler.

Administration and Control Rooms

6.5.71 The accommodation building will be located adjacent to the turbine hall. The office accommodation will include work stations and offices for operational staff, a reception area, meeting rooms, a canteen, rest rooms, shower rooms, lavatories and storage rooms.

6.5.72 The control room will be incorporated within the boiler hall building. The control room will house the Renewable Energy Plant's Supervisory Control and Data Acquisition (SCADA) system and will control and monitor the operation of the Renewable Energy Plant.

6.5.73 Workshops and stores will also be located within the boiler hall at ground level.

6.5.74 The minimum level of lighting required for security and operational purposes will be provided. Lighting design will be undertaken for both construction and operation by a professional design engineer, in compliance with guidance issued by the Institution of Lighting Engineers (Guidance Notes for the Reduction Obtrusive Light 2005) and Controlling Light Pollution and Reducing Lighting Energy Consumption, March 2007, Scottish Executive. During the operational phase lighting will be required continuously.

6.5.75 It is currently Forth Energy's intention that all site lighting, during all phases of the development, will be directed downwards and inwards to reduce any light pollution off-site and will not therefore have a significant adverse effect on local amenity. However, as the architectural design of the plant progresses, the use of architectural lighting may be included to complement and augment the appearance of the development. The use and design of such lighting would be agreed with Falkirk Council.

Waste Generation and Disposal

6.5.76 The biomass fuels intended for use in the Renewable Energy Plant will have a low ash content. The plant is anticipated to produce up to 20,000 tonnes per year of ash[10]. The ash resulting from the fuel combustion process takes two forms, 'bottom ash' which is extracted from the main boiler combustion chamber and 'fly ash' which is extracted from the exhaust gas stream via the dust control equipment (i.e. fabric filters). Subject to the boiler technology utilised, the ratio of ash streams would be approximately 10-40% bottom ash, 60-90% fly ash by weight.

6.5.77 Both fly ash and bottom ash will be removed from the boiler and fabric filters, respectively, and transported by closed conveyor to dedicated enclosed ash storage silos located adjacent to the boiler hall. These will provide up to 4 days ash storage capacity.

6.5.78 It is Forth Energy's intention to recycle the ash generated, as far as practicable, in order to avoid its disposal to landfill. The ash should be suitable for re-use in e.g. the construction and fertiliser industries (as a soil improver) and Forth Energy is currently investigating a range of recycling options. Any ash for which a recycling option is not available will be disposed of to landfill, in accordance with current waste management requirements.

6.5.79 The quality of the ash produced will dictate which type of landfill it will be sent to. Depending on the amount of activated carbon and lime needed to control emissions when burning waste wood, paper and cardboard, the ash could be classified as hazardous. Data published by SEPA (2008)[11] indicate that there is one hazardous waste landfill facility within 5 km of the site with capacity to receive 200,000 tonne of waste per annum. There

[10] For comparison Longannet Power Station (2400 MW) produces approximately 350,000 te per year of ash (assuming 40% load factor x 1000 te of coal /hour x 24 hours x 365 days x 10% ash) and Cockenzie Power Station (1200 MW) 130,000 te per year of ash (assuming 30% load factor x 500 te of coal per hour x 365 x 10% ash).

[11] SEPA Capacity Report 2008 (http://www.sepa.org.uk/waste/waste_data_top.aspx).

are also 5 non-hazardous landfill facilities within a 75 km radius of the site with aggregate capacity to receive over 1.6 million tonnes of waste per annum.

6.5.80 Some conditioning of the ash may occur on site to ensure that it is of an acceptable form for delivery to its end user. This would typically involve addition of water for dust suppression and size reduction to remove lumps. Infrastructure for the export and conditioning of ash is included in the proposed development. The ash will be transported from site by road and/or ship.

6.5.81 Other solid wastes generated from the Renewable Energy Plant will be generally restricted to the following:

- Separated oil/sludge from oil/water separators;
- Used chemical storage containers;
- Spent ion exchange resins/ reverse osmosis membranes;
- Package treatment plant sludge;
- General maintenance waste, including batteries; and
- General office / canteen waste.

6.5.82 This waste will be disposed of appropriately in reference to the waste hierarchy of reduce, reuse and recycle. The wastes will generally be returned to the original supplier or removed by a licensed contractor for re-use, recycling or treatment and disposal at a suitably licensed waste management facility.

6.5.83 At this stage in the process it is difficult to predict the level and amount of waste that may be produced accurately, however this information will be provided with the PPC application.

6.5.84 Prior to works commencing on site a waste management plan would be prepared to cover the construction and operational phases and identify appropriate disposal or recycling routes for the various materials.

6.6 Development Programme

6.6.1 Preliminary works associated with undertaking the Renewable Energy Plant's EIA commenced in the autumn of 2009. The Section 36 application (which this ES accompanies) was submitted in July 2010 and a decision on the Section 36 application is expected in 2011.

6.6.2 Should Section 36 consent be granted, construction is programmed to commence in 2012 and will take approximately 36 months to complete. The plant would therefore be commissioned in 2015.

6.7 Environmental Management Plans (EMPs)

6.7.1 In order to ensure that environmental considerations are addressed, construction, operation and decommissioning activities will be carried out in accordance with:

- The mitigation measures proposed within this ES;
- Any consent and PPC permit requirements placed on Forth Energy; and
- All relevant statutory requirements and published guidelines, and reflect 'good practice', such as the Construction Industry Research and Information Association's (CIRIA) guidance.

6.7.2 To facilitate this, Environmental Management Plans (EMPs) will be prepared for the construction, operation and decommissioning phases. The EMPs will describe the environmental risks and potential impacts of site activities and outline how the proposed mitigation measures and procedures will be implemented to manage these risks and impacts.

6.7.3 The EMPs will provide clear guidance on good working practices on site in order to minimise impacts on the soil, geology, hydrology and hydrogeology, ecology, noise and emissions amongst other aspects. The EMPs

will be based on Chapter 19 Pollution Prevention. A proposed audit and monitoring schedule will be included within each EMP.

6.7.4 All personnel will be obliged to comply with the EMPs and will be trained in relevant environmental management, aspects and impacts. A site representative will be responsible for the environmental management of the site and the adherence of personnel with the EMPs.

6.7.5 The EMPs will follow the requirements of ISO14001 - 'Environmental Management Systems - Specification and Guidance for Use'. The plans will include the following:

- Details of the relevant environmental policy (e.g. the contractor's during construction, the operator's during operation);
- Assessment of environmental aspects and impacts;
- Procedures, controls and objectives for environmental management;
- Environmental monitoring details and reporting systems;
- Schedule of contractual and legislative requirements; and
- Schedule of relevant consents, licences and authorisations.

6.7.6 Periodic environmental audits will be carried out in line with the EMPs to identify areas for improvement in the environmental management system.

6.7.7 For short periods of time during commissioning, emissions to atmosphere from the stack will occur, dependent on the commissioning activity being undertaken. The continuous emission monitoring equipment within the stack will monitor atmospheric emissions in order to provide operators with information on the progress of the commissioning activities and to monitor combustion performance.

6.7.8 Monitoring of surface water drainage and foul water effluent will be undertaken during all phases of the development. The discharge of process effluents during the commissioning phase will be agreed, as necessary, with SEPA.

6.7.9 A continuous ambient air quality monitoring station will also be installed at a location outwith the Renewable Energy Plant. The positioning and specification of this continuous air quality monitoring station will be agreed with the local authority and SEPA prior to construction and will be installed at least six months prior to commissioning of the main boiler. The monitor will be operated for at least three years after completion of the main boiler commissioning period. Ambient air quality data from the continuous ambient air quality monitoring station will be provided to Falkirk Council and SEPA on an annual basis or as otherwise agreed.

6.8 Construction Phase

Overview

6.8.1 Paragraphs 6.8.1 to 6.8.19 describe the key activities and components associated with the construction and commissioning of the Grangemouth Renewable Energy Plant. Construction of the Renewable Energy Plant is likely to take 36 months and will be constructed on a rolling programme as (indicatively) outlined in Figure 6.4. The construction activities on site will follow on from approximately six months of detailed design and manufacturing stages.

6.8.2 During construction, the development site will operate around an 11-hour day (10 hour shift plus one hour break), Monday-Sunday between 0700-1800 hours.

Site Clearance

6.8.3 Initial construction works will comprise site clearance, including demolition of the existing buildings, soil stripping and removal or remediation of any existing contamination present within the site (see Chapter 14 Hydrology Hydrogeology, Geology and Soils).

6.8.4 In parallel with the site clearance, a temporary construction compound will be located within the fuel storage area and reserved area (as shown on Figures 6.1 and 6.2). This laydown area will be used to house temporary construction site offices (including canteen, lavatory and first aid facilities), material and equipment storage, fuel storage and car parking, and may also be used for component fabrication works.

Equipment and Material Delivery

6.8.5 Vehicles delivering items to the Renewable Energy Plant will include the following:

- heavy goods vehicles (for items such as aggregate and steel work);
- low loaders (for items such as steel works, pre-cast pile foundations, boiler components and turbine components);
- abnormal loads (for items such as steel works, pre-cast pile foundations, main boiler components, steam turbine, generator and transformer). However abnormal loads will be brought to site by ship where practicable;
- road tankers (for items such as fuel and chemicals);
- ready mixed cement vehicles;
- light goods vehicles; and
- passenger vehicles (including cars, vans and mini-buses).

6.8.6 All heavy commercial traffic arriving at, or leaving the Grangemouth Renewable Energy Plant site (regardless of its origin or destination) will travel via the A904 Earls Road / Station Road which provides direct access to the trunk road network at junction 6 of the M9., as described in detail in the Transport Statement (Volume 4).

6.8.7 Equipment and material delivery will take place at varying degrees of intensity during the construction of the Renewable Energy Plant. The associated impact on the local transport system is assessed within Chapter 17 of this ES and in a separate Transport Statement (Volume 4).

6.8.8 A Traffic Management Plan governing vehicle movements during construction will be developed and agreed with the local highways authority (Falkirk Council) and Transport Scotland prior to construction.

Waste Generation and Disposal

6.8.9 The principles of the waste hierarchy will be followed on site to reduce the amount of waste generated, recycle/reuse as much material as possible and recovering all allowable material/energy. The design of the plant and specification of materials will aim to avoid the generation of waste. Construction practices will where practicable minimise the use of raw materials and maximise the use of secondary aggregates and recycled or renewable materials. Waste for disposal will, however, be generated on site and the final disposal of this waste will be decided following the best practicable environmental option.

6.8.10 All construction surplus and waste materials will be stored in dedicated areas and will be regularly removed to a licensed waste management site by an appropriately licensed waste carrier.

6.8.11 The amount of soil taken off site during construction will be determined at detailed design. It is not envisaged that there will be significant amounts of additional waste material removed from the proposed development site once it is levelled and foundations are prepared.

6.8.12 Much of the equipment delivered to the site will be packaged. The building contractors will be responsible for the removal and disposal of all packaging and other waste materials that arise during the construction and commissioning.

6.8.13 A site specific site waste management plan will be developed and implemented. This will be in accordance with the objectives of Scottish Planning Policy and the National Waste Plan.

Commissioning

6.8.14 Commissioning of the Renewable Energy Plant will take approximately six to nine months and will start with final erection checks, pre-commissioning and setting to work of individual component parts. Once individual component testing is complete, the Renewable Energy Plant will be tested to prove the technical capability of the plant, in line with schedules in the construction contracts and as agreed with finance and insurance parties.

6.8.15 Tests on completion will demonstrate the fitness for purpose of the Renewable Energy Plant prior to commercial operation. Performance tests will demonstrate that the Renewable Energy Plant complies with the performance guarantees specified at the detailed design stage, including, for example, the emission limits stipulated in the project's permits. Reliability will be demonstrated by operating the plant under commercial conditions for a period without major failure of any item of plant or equipment.

6.8.16 During the commissioning period there will be a period of operations which may generate noise which is not in accordance with normal operating conditions. This could include but not be limited to such things as steam blows and safety valve testing. The Construction EMP will cover the management of these events.

Personnel

6.8.17 Numbers of construction personnel on-site are expected to peak at around 500, average numbers will be of the order of 300 over the three year construction period. A member of the senior management team will have responsibility for environmental management issues during the construction phase and will be able to call upon a team of appropriately qualified scientists covering a range of disciplines when needed. Skill disciplines required during the construction period include (but are not limited to):

- Demolition experts;
- Specialist steel workers;
- Management;
- Planners;
- Health and safety experts;
- Environmental experts;
- Welders;
- Bricklayers;
- Joiners;
- Civil works personnel (i.e. excavations, pipe works, concreting and formwork);
- Electricians;
- Foremen;
- Crane operators;
- Plumbers;
- Riggers and cladding fixers;

- Heavy equipment operators;
- Labourers;
- Security;
- Painters; and
- Office administrators.

6.8.18 Forth Energy is in the process of establishing a register for interested companies and individuals where local contractors and workers can express their interest for construction and operational works.

6.8.19 Personnel at all levels during all phases of the development and including all subcontractors, will receive training related to environmental management and health and safety that is appropriate to their job function.

6.9 Operational Phase

Overview

6.9.1 The following paragraphs describe the key activities and components associated with the operation of the Grangemouth Renewable Energy Plant.

Operational Modes

6.9.2 The Grangemouth Renewable Energy Plant is designed to operate continuously on a baseload (i.e. 24 hours per day, seven days per week). The Renewable Energy Plant is designed to be able to operate for the equivalent of around 7,500 hours per annum (i.e. 85 % availability factor) allowing for 1200 hours per annum for maintenance.

6.9.3 An Environmental Management System (EMS) certified to the international standard ISO 14001 will be prepared for the operational phase which will address the environmental aspects of the site, including the requirements of the PPC Permit. It will describe the environmental risks and potential impacts of site activities and detail how site procedures will be implemented to prevent or minimise them.

6.9.4 During the operational phase, emissions from the main boiler stack will be continuously monitored and any deviations from normal operating conditions will be recorded and investigated. As a component of the PPC Permit, records of prescribed substance emissions will be required to be submitted to SEPA and placed on the public register.

Personnel

6.9.5 The Renewable Energy Plant is expected to have a total workforce of 40 staff. The 16 office based staff will normally be on site between 0800-1700 hours on weekdays, with a complement of operational, maintenance, and fuels staff split over a seven-day shift pattern. This would equate to the following staff/shift profile:

- 0800-1700 = 24 staff;
- 1700-2400 = 4 staff;
- 2400-0800 = 4 staff.

6.9.6 Skill disciplines required during the operation of the Renewable Energy Plant include (but are not limited to):

- Plant Manager 1
- Operations Manager 1
- Maintenance Manager 1
- Office Administrators 2
- Safety Health and Environment Officer 1

- Electrical Supervisor 1
- Mechanical Supervisor 1
- Technicians 6
- Labourers 2
- Shift Manager 6
- Shift Plant Operator 12
- Fuels and Ash Supervisor 1
- Fuels and Ash Staff 5

6.9.7 It is also anticipated that the project will support 21 additional and 10 existing port operational staff with respect to fuel handling.

6.10 Decommissioning Phase

Overview

6.10.1 The Renewable Energy Plant will be designed for an operational life of at least 25 years. The key factors that determine when a plant is to be decommissioned are the economics of maintaining the plant to ensure that it remains reliable and safe to operate and compliant with environmental requirements. In addition, the cost of fuel and the capability of the plant to earn revenues in the prevailing electricity and heat market conditions will be considerations.

6.10.2 The implications of decommissioning will be reviewed once it is evident that the plant is approaching the end of its working life. In addition, the plant's PPC Permit will require the preparation of a decommissioning plan to be submitted to SEPA within a few months of start-up.

6.10.3 The Grangemouth Renewable Energy Plant will be decommissioned and any reinstatement agreed with the relevant authorities at the time, to a level depending on the desired future use of the site. Decommissioning activities would take account of the relevant environmental legislation and the technology available. Any necessary licences or permits would be obtained.

6.10.4 The key activities and components associated with the decommissioning of the Renewable Energy Plant are described below.

Programme

6.10.5 Decommissioning is expected to take around nine months with the reinstatement of ground taking place towards the end of this period. The indicative decommissioning programme is outlined in the following figure.

Table 6.3: Grangemouth Renewable Energy Plant Indicative Decommissioning Programme

Activity	Commercial operation	Month									On-going maintenance of reinstatement works
		1	2	3	4	5	6	7	8	9	
De-energising and making plant safe											
Dismantling & demolition											
Reinstatement and re-use or landscaping and habitat creation (if required by planned future use)											

Decommissioning and Demolition

6.10.6 The first step of decommissioning will be to make the Renewable Energy Plant safe for work in accordance with relevant safety procedures. The Renewable Energy Plant would be de-energised in conjunction with the network operator. Stored materials would be sold where possible or disposed of off-site by a licensed contractor. Storage tanks and pipes would be emptied. Closed vessels, pipes and other areas which could have potentially hazardous gases present would be vented in accordance with normal operating procedures. These would then be tested to ensure that they are safe for removal or entry.

6.10.7 Once the plant is completely disconnected and all potentially hazardous materials removed, the dismantling and demolition work will commence.

6.10.8 Site buildings and structures will, where possible, be re-used or removed to permit the future use of the site. Below ground pile foundations and cabling will be sealed and remain in-situ, depending on what is appropriate at the time to both the regulators and the landlord.

Waste Generation and Disposal

6.10.9 It is probable that most of the plant and equipment will be at the end of its useful operating life and will be unsuitable for further use. It will therefore be dismantled for recycling where it is economic to do so. Unsalvageable material will be disposed of at a licensed waste management facility. Any remaining aqueous effluents would be disposed of in accordance with the normal operating licence or as agreed with the regulatory authorities.

6.10.10 Any hazardous wastes and waste containers will be stored on the site in an appropriate manner before removal by a licensed contractor for disposal by an approved method.

Reinstatement

6.10.11 After removal of above ground elements, any reinstatement of the site will be dependent on its planned future use.

Personnel

6.10.12 Decommissioning personnel numbers are expected to peak at around 200, although average numbers would be around 100.

6.10.13 Skill disciplines required during the decommissioning period include (but are not limited to):

- Welders;
- Demolition experts;

- Heavy equipment operators;
- Electricians;
- Foremen;
- Crane operators;
- Labourers;
- Security; and
- Office administrators.

6.10.14 Local contractors will be encouraged to tender for decommissioning works packages..

6.11 Safety

6.11.1 Safety will be paramount within all aspects of Forth Energy's operations and this philosophy will be maintained through the construction, operation and decommissioning stages of the Grangemouth Renewable Energy Plant.

Construction

6.11.2 A pre-contract Health and Safety Plan will be prepared in order to identify and address all potential health and safety hazards associated with the installation of the proposed facility. This will allow Contractors to prepare the construction stage Health and Safety Plan.

6.11.3 A Construction Health and Safety Plan will be prepared by Forth Energy safety specialists to regulate on-site activities and achieve a high level of safety and continuous improvement. Regular training and safety inspections will also be carried out by independent safety specialists. The requirements of the Construction (Design & Management) [CDM] Regulations 1994[12], and subsequent amendments, will be fully complied with throughout the duration of the relevant phases of the project.

6.11.4 A Permit to Work system will be introduced during construction to ensure that only authorised construction personnel are on site and that an accurate record of site based personnel is available in case of emergency.

6.11.5 Site security during the construction phase will be strict. Access to the Port is currently controlled and access to the site will be prevented by the use of temporary fencing to prevent unauthorised access. A compound for the temporary storage of equipment or materials would be provided. This will be locked with restricted access. Security staff will be utilised as appropriate.

6.11.6 Visitors to the Renewable Energy Plant during construction will be required to report to the construction site reception office and will only be permitted to access the construction area under escort by appropriately authorised staff or following successful completion of site specific safety training.

Operation

6.11.7 Forth Energy will develop a site safety plan to regulate site activities to achieve a high level of safety. Regular training and safety inspections will also be carried out.

6.11.8 The Renewable Energy Plant will not be a Control of Major Accident Hazards (COMAH)[13] site and will not impact on the health and safety activities of any such sites in the vicinity.

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[12] The Construction (Design and Management) Regulations 1994, Statutory Instrument 1994 No. 3140

[13] Control of Major Accident Hazards Regulations 1999 and amendments

6.11.9 Integrated within the design of the Renewable Energy Plant will be mechanisms for ensuring the highest standard of electrical safety and protection, including the requirements under the Electricity Safety, Quality and Continuity Regulations 2002[14] and amendments. Such mechanisms include:

- Compliance with current codes of practice for the specification, design, installation and operation of electrical components and their connection to the distribution grid, including system analysis studies to ensure the integrity of the electrical distribution system is maintained during operation of the Renewable Energy Plant;
- Monitoring of the Renewable Energy Plant by a CCTV system, controlled from the on-site control building. CCTV cameras will permit views of sensitive locations such as the site entrance, fuel store area, and fuel conveyor belts; and
- The use of back-up systems or components to ensure adequate redundancy to protect equipment from damage and protect the safety of the personnel.

6.11.10 The Renewable Energy Plant will be within the secure port estate and therefore will be free from unauthorised entry. Visitors to the Renewable Energy Plant will be required to report to the reception area, and will only be permitted to access the operational areas of the Renewable Energy Plant under escort by operational staff or following successful completion of a site specific safety induction.

6.11.11 The proposed plant will be designed to ensure there is no impact on the safety of routine port operations or the safety of any of its existing tenants.

6.11.12 An information board will be displayed in a publicly accessible location at all times, giving the name and telephone number of Forth Energy's site representative. Warning signs will also be erected.

Decommissioning

6.11.13 Safety issues during the decommissioning phase will be controlled in accordance with guidance and regulations relevant at the time and will be similar to those outlined above for the construction phase of the Renewable Energy Plant.

6.12 Summary and Conclusions

6.12.1 This Chapter has described the key items of the 100 MWe/200 Mth Renewable Energy Plant and also the various phases of its development.

6.12.2 The plant will be designed and operated in accordance with the principles of BAT i.e. the Best Available Techniques. Good practice with respect to the environment, health and safety will be considered carefully during the detailed design.

6.12.3 The plant is designed to use efficient modern technology generating both power and heat from fluidised bed boiler technology and a condensing steam turbine.

6.12.4 Stringent emissions control limits will be established with SEPA in accordance with legislation and waste streams such as ash will be minimised and recycled where feasible.

6.12.5 Fuel (mainly imported wood) will predominately be delivered to the plant via ship, discharged at the existing operational quay and transferred to the fuel storage area, via a covered conveyor system. The plant will also be capable of accepting fuel by road (up to 10% by energy content).

6.12.6 All biomass fuels will be sustainably sourced, as outlined in the Sustainability Statement.

[14] Electricity Safety, Quality and Continuity Regulations 2002, ISBN 0 11 042920 6

Abbreviations

The following is a list of abbreviations adopted in Chapter 6 'The Proposed Development'.

ANSI	American National Standards Institute
BAT	Best Available Technique
CCTV	Closed Circuit Television
CHP	Combined Heat and Power
COMAH	Control of Major Accident Hazards
DH	District Heating
EMP	Environmental Management Plan
ES	Environmental Statement
FB	Fluidised Bed
GPDO	General Permitted Development (Scotland) Order 1992
ha	Hectare
HSE	Health and Safety Executive
km	Kilometre
kV	Kilovolt
m	Metre
m^3	Cubic metre
m^3/s	Cubic metre per second
m^3/hr	Cubic metre per hour
mg/l	Milligrammes/litre
MWh	Megawatt hour
MWe	Megawatt electrical
MWth	Megawatt thermal
NFPA	National Fire Protection Association Standards
NGET	National Grid Electricity Transmission
NOx	Oxides of nitrogen
PF	Pulverised Fuel
PPC	Pollution Prevention and Control
SCADA	Supervisory Control and Data Acquisition
SEPA	Scottish Environment Protection Agency
SHET	Scottish Hydro Electric Transmission Limited
SNCR	Selective Non Catalytic Reduction
SPTL	Scottish Power Transmission Limited

Forth Energy

Chapter 7

Site Selection and Consideration of Alternatives

Contents

7 Site Selection and Consideration of Alternatives

The assessment and selection of an appropriate site for development is integral to the concept of environmental mitigation through avoidance. This Chapter describes the site selection process and the criteria adopted by Forth Energy when selecting a potential site for the development of the 100 MWe Renewable Energy Plant. The Chapter outlines the reasons for the selection of the proposed site, taking into account environmental effects. This Chapter also includes a consideration of the alternative options considered by Forth Energy during the project's development.

7.1 Site Selection Process

7.1.1 Port locations with operational berths are ideal for the installation of biomass-fired Renewable Energy Plants having infrastructure to handle large quantities of fuel. The fuel can be delivered by ship, which is the most carbon efficient form of freight transportation. They are also industrial locations, with urban hinterlands and a strong demand for electricity and potentially heat. Such locations also provide access to cooling water for the plant.

7.1.2 Forth Ports own and operate the following six ports in Scotland:

- Grangemouth; (Firth of Forth, Falkirk Council area);
- Burntisland; (Firth of Forth, Fife Council area);
- Methil; (Firth of Forth, Fife Council area);
- Leith; (Firth of Forth, City of Edinburgh Council area);
- Rosyth;(Firth of Forth, Fife Council area); and
- Dundee; (Firth of Tay, Dundee City Council area).

7.1.3 Forth Ports also own the Port of Tilbury, near London, which has not been considered in this work.

7.1.4 A high level assessment was initially undertaken to assess the six Scottish ports for their suitability for the construction and operation of a Renewable Energy Plant. The following technical requirements were considered at this early screening stage:

- **Land availability -** sufficient area of land must be available within Forth Ports' landholding;
- **Presence of appropriate marine access and a suitable quay** that is capable of accommodating sufficiently large vessels from national or international sources;
- **Electrical grid connection -** a 132, 275 or 400 kV electrical network must be available in close proximity to connect the Renewable Energy Plant to the electricity transmission system economically; and
- **Opportunities for Combined Heat and Power (CHP)** with proximity to existing heat users or the availability of land for co-locating potential future heat users**.**

7.1.5 The assessment indicated that the Ports of Methil and Burntisland did not have sufficient land available in proximity to the quayside for the construction of a Renewable Energy Plant of the appropriate scale at the current time, nor were these ports capable of accepting sufficiently large size vessels.

7.1.6 The Ports of Grangemouth, Dundee, Leith, and Rosyth were identified as meeting the above technical requirements and therefore being potentially suitable as the location of a large-scale Renewable Energy Plant. The next step in the process was to consider appropriate locations within these ports to site the plant and alternatives were identified for further investigation of environmental and technical feasibility.

7.1.7 Using the criteria above plus the following additional criteria a preferred location at each site was identified with particular attention being paid to any location that would have an unacceptable environmental impact:

- **Road access** - adequate access to the site from the national road system must be available to facilitate access during construction and operation as well as for the transportation by road of limited percentages of fuel
- **Planning suitability** - the development of a Renewable Energy Plant at a particular site will ideally comply with the development plan, and national policy and guidelines.
- **Sensitive land use receptors** - proximity to residential and other sensitive land uses, with respect to air quality, noise and visual amenity**;**
- **Archaeology** - the presence of or proximity to cultural heritage features, in particular nationally designated sites such as Scheduled Monuments and Listed Buildings;
- **Air Quality** - a review of local air quality and the potential of the area to accommodate an additional source of atmospheric emissions;
- **Ecology** - proximity to national, international and locally designated sites and potential presence of protected species on site;
- **Settings and views** - proximity to National Scenic Areas, Regional Scenic Areas, Candidate Special Landscape Areas, Areas of Great Landscape Value, Registered Historic Gardens and Designed Landscapes and Conservation Areas; and
- **Climate change -** any risks posed to the site as identified by recent future climate scenarios produced by the UK Climate Impacts Programme.

Review against criteria

7.1.8 Five potentially suitable sites were identified at the Port of Grangemouth, as shown on Figure 7.1:

- A: Distribution Centre (18.05 ha site) - this is the site proposed and is described in detail in Section 1.4 of the ES;
- B: Areas Q & S (2.6 ha site) - currently used for storage of wind turbine components;
- C: Junction Dock (3.5 ha site) - a dock that would require infilling prior to use;
- D: Deep Water Berth Terminal Area (27.75 ha site) - currently unused; and
- E: Areas P&Q 10.25 ha site) - currently unused.

7.1.9 Paragraphs 7.1.10 to 7.1.58 compare the suitability of these five sites against the above criteria. Paragraphs 7.1.59 to 7.1.63 summarise the differences between the five sites and provides the main reasons for the selection of the Distribution Centre site, taking into account environmental effects.

Land Availability

7.1.10 Sufficient land must be available at the selected site to ensure that the key plant items associated with the proposed development can be accommodated. All the sites are located within the operational area of the port. Of the sites identified, Sites B and C were considered to be too small for the development of the Renewable Energy Plant, being just 2.6 and 3.5 ha respectively. These sites would be more suitable for a fuel store or a heat user. These sites were not therefore considered further.

7.1.11 Sites A, D and E are all of sufficient size to present no restrictions to the development of a Renewable Energy Plant. The sites also have sufficient land available to accommodate a co-located heat user.

7.1.12 The geotechnical context at all sites indicates that considerable piling would be required through soft sediment to ensure suitable building foundations are provided due to the existing ground conditions.

Presence of appropriate Marine Access and a suitable Quay

7.1.13 The Port of Grangemouth has several existing quays capable of taking suitably sized ships from national or international locations and has space for the infrastructure to receive and discharge large quantities of biomass fuel. Grangemouth is capable of accommodating ships up to 40,000 Dead Weight Tonnage (DWT)[1]. This size of ship and type of cargo is handled routinely at the port. Ships capable of delivering the required quantity of fuel would be able to enter the port into the Western and Eastern Channel. Within the Western Channel, the Grange Dock and the Tongue are predominantly used for container ships, in this area the East Wall and the Tongue are considered the most suitable for accommodating vessels for the proposed Renewable Energy Plant. Within the Eastern Channel, a disused Jetty close to the East Wall was also identified as suitable for berthing ships of the size required.

7.1.14 Fuel for the Distribution Centre site could be discharged at the Tongue and conveyed a short route to site. Conveyor routes for Site E would also be short. For site D, a crossing of the Container Terminal and Grange Burn would be required.

7.1.15 Sites A and E were therefore considered to have advantages with respect to fuel distribution.

Electrical Grid Connection

7.1.16 The export of 100 MWe of electricity requires connection to the national electricity transmission system at a voltage of at least 132 kV. The feasibility of connecting a Renewable Energy Plant to the national electricity transmission system is dependent on the proximity of the transmission system and the capacity within the transmission system to accept the additional electricity generated.

7.1.17 The port is located approximately 5 km from the 132/33 kV substation at Bainsford, approximately 3 km from the Grangemouth 275/33 kV substation and approximately 10 km from the 275 kV overhead line / underground cable transition point on the supply circuit from Kincardine. A connection could be made to these locations using single underground cable circuits. All of the potential sites are well placed to export the power generated.

Opportunities for Combined Heat and Power (CHP)

7.1.18 The ability to increase the overall operational efficiency of the Renewable Energy Plant through the supply of renewable heat was an important criterion in the selection of an appropriate site. The three remaining sites (Sites A, D and E) all have sufficient land adjacent or nearby for the location of a new heat user (should they wish to locate in the port).

7.1.19 Potential existing heat users with a demand for steam and/or heat identified at the screening stage in the vicinity of the port included the Ineos Oil Refinery, Biomar (fishmeal processing plant) and the chemical complexes located on Earls Road, Grangemouth. While the Ineos complex and Earls Road complex are currently supplied by on-site CHP plants, this would not preclude the supply of heat from the proposed Renewable Energy Plant to these areas.

7.1.20 The costs of pipeline installation and therefore the distance between the CHP plant and the heat user, are key factors in the economic viability of such schemes as the pipeline can cost up to £1,500 per metre. Table 7.1 below provides the approximate distance of each site to the three potential heat users.

[1] DWT is tonnage of cargo only. The dead weight tonnage (DWT) is not the restriction for wood chips but rather the volume of material that can be stowed on the vessel.

Table 7.1 Distance to Potential Heat Users

Option Site	Distance to Potential Heat User (km)			
	Ineos	Biomar	Earls Road	Total Minimum Distance (km)
Site A: Distribution Centre	0.25	0.26	0.89	1.4
Site D: Deep Water Berth Terminal Area	Adjacent	0.95	2.9	3.85
Site E: Areas P&Q	0.65	1.4	3.4	5.45

7.1.21 The approximate distance from each of the sites to each of the identified potential heat users was considered an important differentiator in the selection of the site, with site A having a significantly shorter overall route to the three identified potential major heat users. The vicinity of Site A has also been identified by Forth Ports for future development to attract further port trade to this area, including the development of additional warehousing, container storage and additional businesses to improve the services available at the port.

Road Access / Traffic & Transport

7.1.22 Although Forth Energy intends that the majority of the biomass fuel will be delivered to the Renewable Energy Plant by ship, the development still requires road access to accommodate road delivery of fuel, materials, equipment and personnel during construction, operation and decommissioning. The port regularly handles large numbers of vehicle movements and is also capable of importing and exporting abnormal loads. Grangemouth is Scotland's largest container port. The port can handle up to 5,000 lorry movements per week, and currently handles approximately 4,000 movements per week.

7.1.23 Access to the motorway network by the M9 is readily available from the port and the port also has good rail links, with rail lines and sidings within the port area for a petrochemical tenant and the container terminal. A good internal road network allows for easy vehicular movement within the majority of the port area.

7.1.24 Sites A and E have good road access however, site D, the Deep Water Berth Terminal site, is isolated from the rest of the port area by:

- The Grange Burn that runs along the north-eastern boundary of the site;
- A railway line and the Ineos Oil Refinery and the Oil Storage tanks to the south and west.

7.1.25 The only currently available access to this site from the rest of the port is across a footbridge which links this site to Site E. Access to and egress from this site is therefore poor and if development were to occur at this location, the burn would need to be bridged or access would need to be provided though the oil refinery and across the existing railway line.

Sensitive Land Use Receptors

7.1.26 The five potential sites are all located within the industrial area of the operational Port of Grangemouth, with the closest housing being to the south and west. Housing is located the following distances from the centre of each site:

- 280 m to Site A, the Distribution Centre site;
- 2.02 km to Site D, the Deep Water Berth Terminal Site; and
- 2.12 km to Site E, the Areas P&Q.

7.1.27 Of the five sites considered, Site A, the Distribution Centre site, is closest to sensitive land users, however Forth Energy considered at the time of the site selection study that potential environmental impacts, such as: setting and views; noise; and air quality could be controlled so that no significant impact occurs at the housing close

to the Port of Grangemouth. It was, therefore, decided that the proximity of sensitive receptors was not a significant differentiator between the three sites and this has been confirmed by the findings of this EIA.

Archaeology

7.1.28 There are no known features of historic interest registered within any of the three sites considered in detail. The Distribution Centre site is adjacent to the Swing Bridge, a Grade B Listed Building which is also registered in the National Monuments Record of Scotland. The presence of this port-related cultural heritage feature was not considered to be a differentiator between the sites when examined in the context of other selection issues.

Air Quality

7.1.29 Falkirk Council has assessed air quality in the area with respect to the National Air Quality Standards (NAQS) and has declared an Air Quality Management Area (AQMA) for sulphur dioxide (SO_2) covering the whole of Grangemouth, indicating that levels of this pollutant exceed the National Air Quality Standards. It is noted that Falkirk Council also intend to designate an AQMA in the centre of Falkirk for nitrogen dioxide (NO_2). The presence of the AQMA for SO_2 and the proposed AQMA for NO_2 is considered to be of equal significance for all three of the potential sites within Grangemouth. At the time of the site selection, Forth Energy was confident that, with an appropriately designed stack height and with appropriate emissions abatement, the proposed Renewable Energy Plant could be operated with no significant impact on the AQMA. This has been confirmed by the findings of this EIA.

Settings and views

7.1.30 There are no National Scenic Areas or Regional Scenic Areas within 10 km of Grangemouth. The Port of Grangemouth is an industrial port, with oil and gas storage located around the Eastern Channel of the port, container storage and handling along the southern shore of the Grange Dock, and the Biomar fish meal plant adjacent to the Western Channel. Longannet Power Station is located directly across the Forth Estuary from Grangemouth and the Ineos Refinery and Petrochemical Plants currently dominate the views of and from Grangemouth and a large portion of the surrounding areas. The general context and character of the port and the character of the estuary at this point is therefore broadly industrial.

7.1.31 Despite this industrial nature of the locality, the development of a Renewable Energy Plant at any of the considered sites would be visible from many locations within Grangemouth, and the surrounding area. However, on balance, the setting and views of the three potential sites were not considered to be a significant differentiator in the site selection process.

Ecology

7.1.32 The Firth of Forth Special Protection Area (SPA) and Ramsar site is designated for *inter alia* regularly supporting over 20,000 waterfowl in winter and for regularly supporting wintering populations of species of European/international importance (see Chapter 12 for more detail). In the vicinity of Grangemouth, the Firth of Forth SPA designation covers the adjacent intertidal areas with two of the key bird areas in the Firth immediately adjacent to the port – Skinflats to the west and Kinneil to the east. The intertidal areas of, the Grange Burn and River Carron are also part of the designated site and flow out into the estuary immediately east and west of the port.

7.1.33 Site D, the Deep Water Berth Terminal Area, abuts the SPA on three sides of the site. In addition, the marshy grass behind the site offers an attractive habitat for certain species. Construction at this site could result in disturbance impacts on the mudflats and a loss of open habitat and fragmentation of the habitats of the SPA. The use of this site would result in removal of habitat adjacent to the SPA and there is also the potential for shading of the Grange Burn habitat. This site was therefore considered to be the least suitable with respect to ecology due to the potential impacts upon the SPA.

7.1.34 Site E, also known as the Areas P&Q site, also borders with the SPA on two sides and has similar potential issues to Site B. Site A, the Distribution Centre site, was considered to be the most favourable site with respect to ecology, as this site is furthest from the SPA. This site is also buffered from the SPA by development to the east and the docks to the west. This site was considered least likely to have an impact upon the SPA.

Climate Change

7.1.35 The most recent future climate scenarios[2] indicate that Site A is currently at a lower risk of flooding that the other options as it is located in flood zone one (Sites D and E are located in flood zone two). Other climate change factors (i.e. low precipitation in summer and higher precipitation in winter) would be common to all sites.

Site Selection

7.1.36 Table 7.2 presents a summary of the review undertaken at each location based upon the site selection criteria.

Table 7.2 Environmental and Technical Review of Grangemouth Sites

1	Site A: Distribution Centre		Site D: Deep Water Berth Terminal Area		Site E: Areas P&Q		Differentiator?
Presence of appropriate marine access and a suitable quay	No significant issues		Fuel distribution requires detailed design considerations.		No significant issues		Yes –in favour of A and E but not significant
Land Availability	Sufficient area for total development		Sufficient area for total development		Sufficient area for total development		No
Electrical Grid Connection	No significant issues		No significant issues		No significant issues		No
Opportunities for Combined Heat and Power	1.4 km to potential heat user		3.85 km to potential heat user		5.45 km to potential heat user		Yes – in favour of Site A
Road Access	Access and egress considered good		Site completely isolated from the port		Access and egress considered good		Yes – in favour of site A and E
Sensitive Land Use Receptors	0.28 km to housing		2.05 km to housing		2.12 km to housing		Yes in favour of D and E but not significant
Archaeology	No known sites within site boundary – however adjacent to Listed Building		No known sites		No known sites		Yes – in favour of D and E but not significant
Air Quality	AQMA declared and AQMA advised for area. Careful consideration needed for stack height and emissions control		AQMA declared and AQMA advised for area. Careful consideration needed for stack height and emissions control		AQMA declared and AQMA advised for area. Careful consideration needed for stack height and emissions control		No
Settings and Views	Industrial area		Industrial area		Industrial area		No
Ecology	Least potential impact upon SPA		Potential serious impact upon SPA		Potential serious impact upon SPA		Yes – in favour of site A
Climate change	No significant issues – flood zone 1		Flood zone 2		Flood zone 2		Yes – in favour of site A

Key:		Development critical Issue		Aspects requiring careful management during detailed design and EIA		Aspect requiring some management during detailed design and EIA		Site matches ideal criteria

[2] http://ukclimateprojections.defra.gov.uk/

7.1.37 The site selection studies indicated the Distribution Centre site (Site A) would be the most suitable for the location of the proposed Renewable Energy Plant. The most significant differentiators identified between this site and the other two sites of sufficient area can be summarised as follows:

- **Transport Issues -** Site D is isolated from the existing port infrastructure and significant additional work would be required to cross the Grange Burn between the port and this site before it could be considered viable. The preferred site (Site A) and also Site E are located in close proximity to good road access within the port.
- **Ecology Issues –** Sites D and E are both adjacent to the SPA and construction at these sites could potentially result in disturbance impacts on the mudflats and a loss of open habitat and fragmentation of the habitats of the SPA. There is also the potential for shading of the Grange Burn habitat and removal of habitat that is adjacent to the SPA. The preferred site is located furthest from the SPA in comparison to the other two sites, a significant differentiator.
- **Proximity to Potential Heat Users –** the preferred site (Site A) is located within the closest proximity to the three potential heat users identified in the area which is a significant differentiator in the selection of this site.

7.1.38 Following a review of the site selection criteria and the identified significant differentiators, it was judged that the main considerations at Grangemouth were the selected site's proximity to potential heat users and the ecology and transport issues presented by the other potential sites. Thus the Distribution Centre site was considered to be the most favourable site at Grangemouth.

7.1.39 The vicinity of the preferred site has also been identified by Forth Ports for future development to attract further port trade to this area, including the development of additional warehousing, container storage and additional businesses to improve the services available at the port and enhance Grangemouth's role as the premier port in Scotland. The development of a Renewable Energy Plant on the Distribution Centre site would facilitate the distribution of heat, electricity and cooling (where required) to this area.

7.1.40 The Distribution Centre site at Grangemouth was considered to meet all of Forth Energy's environmental and technical selection criteria and the decision was made to undertake further detailed studies with the commissioning of this ES. This preliminary assessment has since been confirmed by the EIA. In addition, the site is sufficiently large to incorporate all mitigation measures identified during the EIA process. Therefore, the Grangemouth Distribution Centre site is considered to be able to accommodate the proposed Renewable Energy Plant within the environmental character and baseline of the area satisfactorily.

7.2 Consideration of Alternatives

7.2.1 It is a requirement of the EIA Regulations that the ES includes an outline of the main alternatives studied by the applicant and provides an indication of the main reasons for the choice made, taking into account the environmental effects. In addition to the selection of the site described in Section 7.1, Forth Energy has considered a number of alternatives during this development phase:

- The use of biomass as opposed to other forms of power generation;
- The size of the plant;
- The use of open or enclosed biomass storage facilities;
- The combustion technology;
- The cooling technology;
- Location of cooling water outfall; and
- Control of particulates.

7.2.2 These alternatives are described in paragraphs below, including the 'do nothing scenario'. In addition to these alternatives, a number of decisions cannot be made by Forth Energy until a later stage in the development programme when undertaking detailed design and these options will therefore be addressed where relevant throughout the EIA:

- The principal form of fuel to be used will be wood in the form of either woodchip or wood pellets, this has yet to be determined and will be subject to further more detailed market investigation. This can only be carried out with potential suppliers when it can be demonstrated that the project is likely to proceed i.e. following consent;
- The location and route of the cooling water discharge, with two alternatives identified and shown as Option 1 and 2 on Figures 6.3. The preferred route is Option 1 which is significantly shorter. The feasibility and economics of this route, in particular the ability to directionally drill a tunnel beneath the cut separating the Carron Dock and Western Channel, will not be known until later in the design of the plant.
- The type of storage facility for the main fuel store i.e. open storage or silos. This is dependent on the selection of the principal fuel. Vertical silos are required to store wood pellets as these must be kept dry, however wood chips can be stored in the open air (see paragraphs 7.2.14 to 7.2.16); and
- The detailed architectural design of the proposals. Gordon Murray Architects have been appointed to produce a concept scheme for the Renewable Energy Plant, as shown within the Design Statement which accompanies this Section 36 Application. This demonstrates an indicative concept design of how the appearance of the plant could be enhanced, however it is not until the project receives Section 36 Consent (if granted) and the project progresses to the detailed design stage that a firm architectural design can be developed. The scheme will be developed and agreed with Falkirk Council.

The use of Biomass

7.2.3 Forth Energy is currently considering a variety of renewable energy projects at Forth Ports' sites in Scotland and is developing these where viable and sustainable projects are identified. In addition, to the four proposed Renewable Energy Plants, Forth Energy is currently progressing proposals for wind turbine developments at Grangemouth and Dundee. To complement the variable nature of renewable generation, such as wind, Forth Energy recognised the need to develop baseload renewable power generation, with biomass being the most appropriate renewable-fuelled baseload option. The need for such baseload power also arises from the current and planned closures of a large number of power plants in the UK, and the Scottish Government deciding not to favour future nuclear power.

7.2.4 Forth Energy is ideally situated to develop biomass power generation due to the land ownership portfolio of Forth Ports. Port side locations were the obvious locations as the substantial quantities of fuel can be transported by sea. The Ports owned by the company have existing infrastructure for handling large quantities of biomass. Fuel can be delivered by ship, which is the most carbon efficient form of transportation for bulk cargo. The Ports are considered industrial locations, with adjacent urban hinterlands that have potentially strong electricity and heat demands.

7.2.5 Each of the four ports chosen have existing experience in handling bulk materials such as wood chip and the facilities are large enough to accept the required size of vessel, with adjacent urban areas that could benefit from the power and heat generated.

7.2.6 Forth Energy strongly believes that the use of biomass resources to produce energy has many benefits for Scotland. The electricity and heat generated from biomass fuels result in lower lifecycle carbon emissions compared with fossil fuel energy alternatives, and the use of these fuels has the potential to increase the security of Scottish energy supply and stimulate economic growth. Biomass is an important component of the Scottish energy mix. Being a baseload power generator, with a high availability, the project will complement the intermittent forms of renewable generation including wind, wave and tidal and the flexibility of hydro-

power. This is particularly important as many existing continuous generators (or baseload generating stations), particularly coal, are to be shutdown in future years because of their age and new emission regulations. The benefits of the use of biomass for power generation are reflected in the weight of Scottish, UK and international legislative and policy drivers for the increased use of biomass for energy generation. These are described in detail in Chapter 4 - The Need for the Proposed Development.

Size of Plant

7.2.7 As described in section 7.1 an assessment of the six Scottish Ports owned by Forth Ports found that the ports at Grangemouth, Dundee, Leith and Rosyth met the necessary technical requirements for the installation of a Renewable Energy Plant. The environmental and technical feasibility of the various areas available at these Ports were therefore investigated with the intention of developing four large-scale biomass plants. Four medium-sized plants rather than one or two larger plants were considered to be the preferred option for the following reasons:

- Flexibility of fuel delivery;
- The size of the draught at each of the ports;
- Space for fuel storage required for a larger plant.
- Matching local electricity and heat demands
- Grid connection capacity

7.2.8 The engineering of the plants and the fuel supply chain, plus the ability to supply heat to local customers mean that there is no benefit to making applications for a smaller number of larger plants.

7.2.9 The proposed Grangemouth Renewable Energy Plant will have a net electrical output of 100 MWe and a thermal output of up to 200 MWth. The size of the plant has been determined by a number of contributory factors, as follows:

- The strategic fit of plant with the requirements of Falkirk, i.e. it will be large enough to supply almost all of the (industrial, commercial and domestic) electricity requirements of the district (c. 92%[3]) and a large proportion of its heat demand. It is difficult to assess the heat demand requirements for Grangemouth however the plant has the capacity to supply 2.6 % of the target heat requirements set out by the Scottish Government as part of Scotland 2020 Renewable Heat target.
- The Port of Grangemouth is able to receive ships of sufficient size (40,000 DWT) and to unload to ensure sufficient fuel for the operation of a 100 MWe + 200 MWth plant;
- The size of the site provides sufficient storage for at least 9 days fuel supply;
- The local grid network has sufficient capacity for 100 MWe without significant additional reinforcement works; and
- The economics and balance of risk in financing and constructing the installation meets Forth Energy's required criteria.

[3] The Digest of UK Energy Statistics states that the current load across Falkirk district on an annual basis is 806 GWh, (this is net of the Grangemouth refinery complex's internal energy requirements), the proposed plant will provide 745 GWh, with an assumed availability of 85%.

Combustion Technology

7.2.10 The following proven technologies are considered to be suitable for the combustion of biomass as stated within the Integrated Pollution Prevention and Control Reference Document on Best Available Techniques for Large Combustion Plant[4], (the BREF):

- Integrated Gasification Combined Cycle (IGCC);
- Grate firing;
- Pulverised fuel firing; and
- Fluidised bed combustion.

7.2.11 Fluidised bed or Pulverised Fuel (PF) combustion have been selected for use at the Grangemouth Renewable Energy Plant for the following reasons:

- **IGCC:** In the IGCC process, a solid fuel is gasified prior to combustion in a Combined Cycle Gas Turbine plant. This is a relatively new technology and does not have the proven track record of other types of combustion, particularly at the scale being considered. In addition, IGCC would not be suitable for the proposed range of biomass to be used in the Grangemouth Renewable Energy Plant;
- **Grate firing**: There are no manufacturers producing grate fired boilers of the required unit size (100 MWe). Typical grate boiler efficiencies for the combustion of biomass are only around 20%. Grate combustion systems can also lead to higher carbon in ash, oxides of nitrogen (NOx) and carbon monoxide emissions than are achieved in the more uniform combustion of a fluidised bed;
- **Fluidised bed**: A fluidised bed (FB) combustion system provides the residence time to allow large biomass particles to fully combust. Combustion temperatures within the fluidised bed are more uniform and lower than in a pulverised fuel boiler, which leads to inherently lower flue gas emissions of nitrogen oxides and high efficiencies. There are two main types of FB boilers which are commercially available: bubbling fluidised bed combustion (BFB) and circulating fluidised bed (CFB) combustion. A third type of fluidised bed is the pressurised fluidised bed; this technology is not proposed because it is more suited to combined cycle plants incorporating gas turbine technologies.
- **Pulverised fuel firing**: This would be an option should wood pellets be the predominant fuel and would achieve similar efficiencies as FB combustion. Low NOx Burners would be used to ensure low flue gas emissions.

7.2.12 The preferred combustion technology for the project is FB or PF, which are widely used for biomass projects and are noted in the BREF[5] as complying with BAT.

Biomass Storage

7.2.13 The form of storage to be used can only be determined once the form of fuel (wood chip of pellet) has been identified. For wood pellets the vertical pellet silos offer the best form of storage, occupying the minimum amount of space whilst also minimising secondary handling required.

7.2.14 For wood-chips an open stock pile would be the preferred form of storage as they do not require to be protected from the elements and the need for a permanent structure can be avoided.

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[4] Sustainable Development Commission Scotland, July 2009, Renewable Heat in Scotland, Report to the Scottish Government

[5] Integrated Pollution Prevention and Control, Reference Document on Best Available Techniques for Large Combustion Plant, July 2006

Cooling Technology

7.2.15 There are a number of options available for the cooling systems and the type chosen can have a large bearing on power plant efficiency, which in turn affects the mass of emissions per MWh. The three most widely applied systems are:

- Once-through cooling;
- Cooling towers; and
- Air-cooled condensers.

Once-through Cooling

7.2.16 Once-through cooling provides the greatest efficiency of the potential technologies. This is recognised by the IPPC Sector Guidance Note, Combustion Activities 2005 which states:

7.2.17 "*In terms of the overall energy efficiency of an installation, the use of once-through systems is BAT, in particular for processes requiring large cooling capacities (e.g. > 10 MWth).*"

7.2.18 Once-through cooling for a 100 MWe plant would need to continuously abstract and discharge 4.9 m^3/s of water from a nearby surface water body. The impounded dock at Grangemouth is enclosed, with a water replenishment rate which is too low to supply this quantity of water. Likewise the flow rate of the River Carron can drop to less than 1 m^3/s at times of low flow in the summer months[6] and is also too low to provide/accept this quantity of water. This quantity of water would therefore need to be abstracted from the main channel of the Forth Estuary, below the low water mark, which in addition to having sufficient flows is not a designated site with respect to ecology. In order to reach the mean low water mark, a pipe route approx. 3,500 m long, would be required, the costs of which would be prohibitive and would far outweigh income arising from efficiency savings. In addition, the construction of the outfall across the mudflats would be technically difficult and may have ecological impacts on the Forth Estuary SSSI, SPA and Ramsar site. Once - through cooling was not therefore considered to be a viable option at Grangemouth.

Cooling towers

7.2.19 Natural, or mechanical, draught cooling towers use evaporative cooling and require significantly smaller cooling water flow rates compared to once-through cooling (an abstraction rate of 0.39 m^3/s compared to 4.9 m^3s). This flow rate of water would be available from the Western Channel and can be discharged to the River Carron on a falling tide without significant environmental impact (see Chapter 13 Aquatic Ecology). However, as the re-cooled water from a cooling tower passing to the condenser is at a higher temperature than that in the once-through cooling system, the efficiency of the system is typically lower by approximately 1% than that for once-through cooling.

7.2.20 Natural draught cooling towers are large hyperbolic constructions. In most meteorological conditions large vapour plumes are visible. There is, therefore, a significant visual impact associated with the towers.

7.2.21 The flow of air through the tower gained by the thermal buoyancy of the heated air in natural draught cooling towers is induced by the use of fans in a mechanical draught cooling tower. These towers are therefore considerably smaller than natural draught towers (of the order of 15 m tall). However, this form of cooling also results in a visible plume.

7.2.22 Hybrid cooling towers use a combination of air cooling and evaporative cooling. The use of air and evaporative cooling significantly reduces the occurrence of a visible plume. The heat removed from the cooling water passing through the 'air cooling' section can be used to heat the rising air and water vapour above the dew point to reduce the occurrence of a visible plume. Low plume hybrids can be designed to be

[6] http://www.nerc-wallingford.ac.uk/ih/nrfa/station_summaries/017/001.html

plume-free down to an ambient temperature of 5ºC and a relative humidity of 95 %. At this location this would result in the frequency of occurrence of a visible plume of less than 2.5 % per year of daylight hours, based on five years' (2005-2009) relative humidity and temperature data available from the meteorological station at Edinburgh Gogarbank, approximately 24 km to the south west of the site.

7.2.23 The disadvantage of natural or mechanical draught cooling towers is that they result in a lower efficiency than once-through cooling as the re-cooled water from a cooling tower passing to the condenser is at a higher temperature than that in the once-through cooling system.

Air-cooled Condensers

7.2.24 While air cooled condensers avoid the use of cooling water, these do have the lowest process efficiency of the systems available (typically 3% less than that of once-through cooling). Air cooled condensers directly condense the steam in a condenser which is cooled by an air flow created by fans, rather than water. The resultant temperature of the condensate to be returned to the boiler can only approach the ambient air temperature, rather than approaching source water temperature. Air cooled condensers can also be a significant source of noise unless adequate mitigation measures are adopted. They are also typically taller, and therefore potentially more visually intrusive than hybrid cooling towers.

Reasons for Selection

7.2.25 Forth Energy considers an evaporative system using hybrid low plume cooling towers to be the Best Available Technique for the Grangemouth Renewable Energy Plant. At locations such as Grangemouth, where insufficient water is available for once-through cooling, hybrid low plume cooling towers optimize efficiency while reducing visual impact. Although the use of air cooled condensers would remove the need for abstracting a larger volume of cooling water supply, the efficiency penalty along with the higher noise levels, potential for increased visual impact and cost are considered to outweigh this benefit.

Location of Cooling Water Intake and Outfall

7.2.26 As the abstraction and discharge of water to and from below the main channel of the Forth Estuary is not considered feasible due to the length of pipework involved (see paragraph 7.2.19), the options for the installation of the cooling water intake and outfall infrastructure comprised:

- The impounded docks (Western Channel or Carron Dock);
- The River Carron; and
- The Grange Burn, which was ruled out due to its small size and low flow rates.

7.2.27 The impounded man-made docks are less sensitive ecologically than the River Carron, which is part of the Firth of Forth SSSI, SPA and Ramsar site. However, although there is sufficient flow through the docks to permit the abstraction of the necessary volumes of cooling water, the flow rate is not sufficient to avoid the build up of heat within the water body should the warmed cooling water be returned to the docks. The recirculation of heat in this way would reduce the efficiency of the cooling system to an unacceptable level and would also not present an acceptable solution in relation to the environment.

7.2.28 The discharge of the cooling water to the River Carron was therefore considered. In order to minimise impacts on this watercourse, cooling water will only be discharged on a falling tide when mixing will be sufficient to ensure adequate dispersal of the heated water. An 'area of search' for cooling water infrastructure has been identified as shown on Figure 1.2. The impact of the discharge on aquatic ecology have been assessed (as shown in Chapter 13) and shown to result in no significant impacts and, therefore, this discharge route is considered to comply with the requirements of BAT.

Particulate Control

7.2.29 The particulate controls considered for the project comprised ceramic filters, fabric (bag) filters and electrostatic precipitators (ESPs). The Combustion Activities IPPC Sector Guidance Note (July 2009) states that:

"The best available techniques for removing suspended particulate matter from the combustion waste gases, such as electrostatic precipitators, bag filters or ceramic filters can maintain removal efficiencies of 99.5% over long periods provided that good control instrumentation and maintenance are employed."

7.2.30 When using low sulphur fuels such as biomass, there is a potential for a reduction in the performance of ESPs due to the low flue-gas sulphur dioxide concentrations emitted and while this could be controlled by the injection of sulphur trioxide upstream of the precipitator, these were discounted for this project.

7.2.31 Ceramic filters are typically more resilient to thermal degradation than fabric filters and are therefore better suited to higher temperature flue gas filtering applications, i.e. greater than 250°C. However, the ceramic based construction can result in a filter which is less flexible than that of fabric based bag filter designs and is therefore less responsive to shaking induced for cleaning purposes. Inefficient operational cleaning can result in a progressive "blinding" of the ceramic filter pores with particulate matter. Ceramic filters can therefore be more susceptible than fabric bag filters to a reduction in filtering efficiency during operation. While ceramic filters provide an alternative where high temperature filtration is required, the temperature at the fabric filter stage for the Grangemouth Renewable Energy Plant is likely to be approximately 140°C. At this temperature, and for this specific application, fabric filters are considered by Forth Energy to be BAT.

'Do nothing' Scenario

7.2.32 An important part of the EIA process is considering the 'do-nothing scenario', i.e. what would occur if the project did not go ahead. Whether the baseline environment would in any case change under the 'do nothing scenario' is discussed under the relevant section of the EIA. The major benefits of the project which would not be realised are summarised below, (as described in full in Chapter 4).

- the provision of 100 MWe of renewable, and sustainable, electrical generating capacity, to contribute to Scotland's, the UK's and EU's targets with respect to renewable energy and carbon reduction;
- the provision of up to 200 MWth of renewable heat.
- the provision of 100 MWe generating capacity to contribute to meeting the UK's generation gap;
- improved security of electricity supply, through contributing to the diversification of fuel used to generate electricity in Scotland; and
- improved reliability of energy supply both locally and nationally, through the construction of a 100 MWe power plant with a high availability and controllability.

7.2.33 In addition, should the project not progress, the following positive socio-economic benefits will be lost which would accrue from the construction, operation and maintenance, supply chain, and decommissioning of the Grangemouth Renewable Energy Plant over the total project period (See Chapter 16 Socioeconomics):

Table 7.3: The Socio-economic benefits of the proposed development

Benefit	Grangemouth	Scotland
Direct jobs	206 jobs directly	206 jobs directly
Indirect jobs	157 jobs indirectly	219.3jobs indirectly
Total jobs	337 jobs in total	425 .3 jobs in total
Gross Value Added per annum.	£26.45 million	£30.1 million

7.2.34 The wider qualitative socio-economic benefits, which would not accrue include:

- Overall renewables industry supply chain benefits;
- Biomass / wood-fuel resource supply chain benefits;
- Enhancement in biomass / woodfuel sustainable supply in Scotland;
- A range of potential skills and training opportunities; and
- Opportunities for the use of Renewable Heat for a wide range of neighbouring activities in community, commercial, business, retail, leisure, and residential sectors, together with the potential economic benefits which would derive from the operation and maintenance of the new heat network.

7.3 Consideration of Alternatives Summary and Conclusions

7.3.1 A number of alternatives have been studied by Forth Energy. The reasoning for the decisions made, taking into account the environmental effects, is summarised below.

7.3.2 The decision by Forth Energy to develop biomass power generation facilities was based on both the need for baseload renewable generation and the development opportunity at a port side location allowing fuel to be delivered directly by ship, offering the most carbon efficient form of transportation for bulk cargo.

7.3.3 The electrical output of the plant was selected, amongst other things, for its strategic fit with the electricity and heat requirements of Falkirk council area.

7.3.4 The choice of combustion technology (FB boilers), cooling technology and particulate control were selected as these represent 'best available techniques' i.e. BAT, in accordance with the requirements of the PPC permitting regime.

7.3.5 The location of the cooling water discharge on the River Carron was selected in order to avoid heat build-up, should the warmed cooling water be returned to the impounded docks. The recirculation of heat in this way would reduce the efficiency of the cooling system to an unacceptable level, and would also not present an acceptable solution in relation to the environment. In order to minimise impacts on the River Carron, cooling water will only be discharged on a falling tide when mixing will be sufficient to ensure adequate dispersal of the heated water. The impact of the discharge on aquatic ecology have been assessed (as shown in Chapter 13) and shown to result in no significant impacts and, therefore, this discharge route is considered to comply with the requirements of BAT.

7.3.6 By doing nothing, significant opportunities will be missed including; contributions to national renewable energy and heat targets, improved national security and reliability of energy supply and the socio economic benefits that would be associated with the development of Renewable Energy Plant within the Port of Grangemouth.

Abbreviations

The following is a list of abbreviations adopted in Chapter 7 Site Selection and Consideration of Alternatives.

AQMA	Air Quality Management Area
BAT	Best Available Technique
BFB	Bubbling Fluidised Bed
BREF	Integrated Pollution Prevention and Control Reference Document on Best Available Techniques for Large Combustion Plant
CFB	Circulating Fluidised Bed
CHP	Combined Heat and Power
DWT	Dead Weight Tonnage
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESP	Electrostatic Precipitators
EU	European Union
FB	Fluidised Bed
GPDO	General Permitted Development (Scotland) Order 1992
ha	Hectare
IGCC	Integrated Gasification Combined Cycle
IPPC	Integrated Pollution Prevention and Control
km	Kilometre
kV	Kilovolt
m	Metre
m/s	Metre per second
MW	Megawatt
MWe	Megawatt electrical
MWth	Megawatt thermal
NAQS	National Air Quality Standards
NOx	Oxides of nitrogen
SO_2	Sulphur dioxide
SPA	Special Protection Agency
Te	Tonnes
UK	United Kingdom

Forth Energy

Chapter 8

Environmental Impact Assessment Methodology

Contents

8 Environmental Impact Assessment Methodology

8.1 Overview

8.1.1 This Environmental Statement (ES) records the results and conclusions of the environmental impact assessment (EIA) that was performed to:

- identify the environmental baseline, constraints and opportunities within the study area, taking account of the characteristics of the development and the local environment;
- identify significant potential impacts and interpret the nature of these impacts;
- describe the mitigation measures envisaged to avoid, reduce or compensate any significant adverse effects on the environment; and
- determine the significance of any residual environmental effects following the implementation of such mitigation measures.

8.1.2 The EIA has considered the various stages of the proposed development including:

- Construction: impacts may arise from construction activities. Typically the effects are short term;
- Operation: impacts may result from land take and the operation of the proposed plant. They generally last for the life of the project; and
- Decommissioning: there will be short term impacts associated with the removal of plant. Any longer term impacts of decommissioning are generally considered not to be significant.

8.1.3 This Chapter describes the broad methodology adopted within the EIA. Subsequent EIA impact assessment chapters (i.e. Chapters 9 – 18) expand on methodologies used for specific assessments.

8.2 Overview of Statutory Requirements

8.2.1 This EIA has been conducted in accordance with the latest Scottish Government Regulations and advice on good practice comprising:

- The Electricity Works (Environmental Impact Assessment) Regulations (Scotland) 2000 (the EIA Regulations);
- Planning Advice Note (PAN) 58 - Environmental Impact Assessment, September 1999; and
- The Environmental Impact Assessment (Scotland) Regulations 1999, Circular 15/1999.

8.2.2 The EIA Regulations (Part II of Schedule 4) set out that an ES should include, as a minimum, the following information:

- A description of the development, comprising information on the site, design and size of the development;
- A description of the measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse effects;
- The data required to identify and assess the main effects which the development is likely to have on the environment;
- An outline of the main alternatives studied by the applicant or appellant and an indication of the main reasons for its choice, taking into account the environmental effects; and
- A non-technical summary of the information provided under the above bullet points.

8.2.3 Part I of Schedule 4 expands in detail on the contents of an ES that would comply fully with the spirit of the Regulations. Table 8.1 indicates where in the ES the requirements of Part 1 of Schedule 4 of the EIA Regulations are met.

Table 8.1: Content of the Environmental Statement with respect to Schedule 4 of the EIA Regulations

Schedule 4 requirement	Location within the ES
1. Description of the development, including in particular–	Chapter 6 The Proposed Development
(a) a description of the physical characteristics of the whole development and the land-use requirements during the construction and operational phases;	Section 6.3 Overview of Proposed Development, Section 6.4 Site layout
(b) a description of the main characteristics of the production processes, for instance, nature and quality of the materials used; and	Chapter 6 The Proposed Development
(c) an estimate, by type and quantity, of expected residues and emissions (water, air and soil pollution, noise, vibration, light, heat, radiation, etc.) resulting from the operation of the proposed development.	Water: Section 6.5.7 Cooling System, Section 6.5.9 Process, Surface and Foul Water Drainage, Chapter 14 Hydrology, Hydrogeology, Geology and Soils and Chapter 13 Aquatic Ecology Air: Chapter 9 Air Quality Soil: Chapter 14 Hydrology, Hydrogeology, Geology and Soils Noise and vibration: Chapter 11 Noise, Chapter 12 Terrestrial Ecology and Chapter 13 Aquatic Ecology Light : Chapter 6 The Proposed Development, Chapter 10 Landscape and Visual and Chapter 12 Terrestrial Ecology. Heat: Chapter 13 Aquatic Ecology Radiation: No impacts identified
2. A description of the aspects of the environment likely to be significantly affected by the development, including, in particular,	Each specialist impact assessment chapter includes a discussion of the existing conditions, services, and physical environment of the site and its surroundings where appropriate, as follows:
population	Chapter 16 Socioeconomics
fauna and flora	Chapter 12 Terrestrial Ecology, Chapter 13 Aquatic Ecology
soil, water	Chapter 14 Hydrology, Hydrogeology, Geology and Soils
air	Chapter 9 Air quality
climatic factors	Section 4: -The major project benefit is the provision of renewable energy and consequent reduction in greenhouse gas emissions from UK power generation. In combination with other renewable energy projects throughout the rest of the UK, the cumulative CO_2 reductions will assist the UK in meeting its commitments to combating climate change. Appendix F Flood Risk Assessment
material assets, including the architectural and archaeological heritage.	Chapter 15 Cultural Heritage, Chapter 17 Aviation and Telecommunication Systems
landscape	Chapter 10 Landscape and Visual Impact
and the inter-relationship between the above factors.	Each specialist chapter where relevant
3. A description of the likely significant effects of the development on the environment, which should cover the direct effects and any indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the development, resulting from – (a) the existence of the development; (b) the use of natural resources; and (c) the emission of pollutants, the creation of nuisances	Each impact assessment chapter - the Residual Effects section of each impact assessment chapter contains a description of likely significant effects. A description of the forecasting methods used is included in each impact assessment chapter in the Assessment Methodology section.

Schedule 4 requirement	Location within the ES
and the elimination of waste, and the description by the applicant of the forecasting methods used to assess the effects on the environment.	
4. A description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment.	Each impact assessment chapter within the 'Mitigation' section
5. A non-technical summary of the information provided under paragraphs 1 to 4 above.	Volume 1 Non-Technical Summary
6. An indication of any difficulties (technical deficiencies or lack of know-how) encountered by the applicant in compiling the required information.	Each impact assessment chapter within the 'Assessment Methodology' section.
7. An outline of the main alternatives studied by the applicant and an indication of the main reasons for his choice, taking into account the environmental effects	Chapter 7 Site Selection and Consideration of Alternatives

8.3 Guidance

8.3.1 The EIA has been carried out taking due consideration of non-statutory guidance where appropriate such as that contained within the Institute of Environmental Management and Assessment's (IEMA) 'Guidelines for Environmental Impact Assessment'[1], along with various guidance documents relating to the assessment of individual aspects of the environment (see individual impact assessment chapters).

8.3.2 Good practice advises that EIA should be treated as an iterative process, rather than as a one-off, post-design environmental appraisal. Interested parties should be consulted at an early stage in order to identify key impacts and design appropriate mitigation. In this way, the findings from the EIA can be fed into the design process, leading to the production of a project which achieves a 'best fit' within the environment. This approach was used throughout the EIA.

8.3.3 The EIA process is designed to be systematic and transparent and involves the key stages outlined in Sections 8.4 to 8.7. The EIA culminates in the preparation of the ES and supporting documentation.

8.4 Scoping and Consultation

8.4.1 Best practice requires that the EIA process begins with a request for a Scoping Opinion, in this case to the Energy Consents Unit on behalf of the Scottish Ministers, as described in Section 3.2[2]. The Scoping Opinion focuses attention on the key likely environmental impacts of a project and thereby the priority issues to be addressed. Scoping also identifies those matters which do not need to be assessed in detail. Scoping allows stakeholders and consultees an early opportunity to comment on the proposed structure, methodology and content of the EIA. EIA is, however, an iterative process and the scope of the EIA may change during the project development stage, for example as the result of the findings of technical studies or as a result of information supplied by consultees.

8.4.2 Consultation with relevant statutory consultees and other stakeholders continues throughout the EIA process, the determination period and post-consent phase.

8.5 Baseline Assessment

8.5.1 The early stages of the EIA relate primarily to organising and planning the overall process. The baseline assessment is a more specific process undertaken for each technical assessment. The aim is to establish the

[1] IEMA, 2004, Guidelines for Environmental Impact Assessment

[2] As the project represents an EIA project (see Section 1.4) a formal Screening Opinion was not requested.

existing and future baseline conditions, services, and physical environment of the site and its surroundings which may be changed by the development, including an indication of the sensitivity of the receptors where appropriate. The process, which varies according to the nature of the topic, involves:

- a desk top review of published information, including identification of statutory and other designations;
- consultation to gather unpublished information; and
- field surveys and monitoring, where necessary, to an agreed methodology, possibly supplemented by further surveys/monitoring as a result of initial findings.

8.6 Assessment of Environmental Impacts and their Significance

8.6.1 This is a four stage process. Firstly, the potential significant changes to the existing situation which may result from the development, prior to the implementation of mitigating measures, are predicted. An assessment of these impacts determines the need for mitigation measures to reduce the identified impacts. The significant potential impacts do not therefore necessarily reflect the real effects of the development. Impacts can have both direct and indirect effects, be cumulative, short term, medium term or long term, permanent or temporary and have positive or negative effects and may also interact with each other

8.6.2 Necessary mitigation is then identified as described in Section 8.7. The residual effects, following implementation of the proposed mitigation, are then identified and characterised using appropriate and agreed methodologies. These changes are then evaluated in terms of their significance.

8.6.3 In order to evaluate environmental effects and determine their significance it is important that assessment criteria are identified. Criteria are used to provide the basis behind the conclusions reached regarding the significance of a particular impact. The criteria used and methodologies adopted to assess effects are often matrix based and described within individual impact assessment chapters of this ES (Chapters 9 – 18). Because the criteria and associated matrices have been developed independently, the terminology used to describe effects varies between matrices; each chapter defines what constitutes a significant impact under that assessment heading. In the majority of cases, expert professional judgement builds upon the initial results of matrix analysis to refine and qualify the residual effects and subsequent assessment of significance.

8.6.4 Some thresholds are quantitative (e.g. transport and air quality), while others are qualitative (e.g. visual effects); the latter being assessed on the basis of professional judgement. In general, effects are assessed by a combination of sensitivity of the environment and the degree of alteration or 'magnitude of change' which is predicted due to the development. The significance of these effects will be defined in relation to their magnitude, geographical extent, duration, frequency, reversibility and any regulatory standards that may apply. It does not necessarily follow, for example, that a high magnitude change will always be significant; conversely a low magnitude change will not necessarily always be insignificant. Where an assessment of significance cannot be determined (due to lack of information, unpredictable nature of an effect or uncertainty over magnitude of change) this is highlighted and discussed within the text.

8.6.5 In assessing the residual effects, account is taken of relevant design features and management practices which will mitigate any effects, to ensure that the assessment is practical. Throughout the EIA, and in particular the residual effect assessment, there is an iteration by which the interim findings are used to inform the evolving design of the project. Where likely significant adverse impacts are predicted, or sensitive environments are identified, the results of the EIA are used to influence the design, site layout, and general construction, operation and decommissioning methodologies of the development.

8.6.6 With respect to indirect effects and impact interactions, these have been assessed as an integral part of all stages of the EIA process[3]. Indirect effects are not a direct result of the project and are often produced away from or as a result of a complex pathway. These are sometimes referred to as a secondary impact (for example, the expenditure in local shops by construction workers employed by the development). For this EIA, the assessment of indirect and impact interactions were based on the experience of the project co-ordinator and the specialists appointed to the project team. This approach was facilitated by close interaction between members of the project team.

8.7 Mitigation Philosophy

8.7.1 Mitigation can be defined as the measures proposed through the consideration of alternatives, physical design, project management or operation to avoid, reduce, offset or compensate any significant adverse effects on people and the environment resulting from the proposed development. In some instances, the development may be able to offer enhancement or improvement under certain environmental headings.

8.7.2 This hierarchical strategy of avoidance, reduction, offset and compensation is an iterative one which seeks to avoid potential impacts, reduce those that remain and, where no other measures are possible, put forward compensation or offset measures through each stage of the proposal's evolution.

8.7.3 The project team has considered the mitigation of significant effects as an integral part of the overall project design process throughout the EIA and the project's development, whereby the design of the proposed development has been amended with the primary aim of minimising environmental effects through avoidance or reduction.

8.8 Structure of the assessment Chapters

8.8.1 Each specialist impact assessment chapter will typically include the following information:

- Introduction;
- Assessment Methodology and Significance Criteria;
- Baseline;
- Potential impacts;
- Mitigation;
- Residual effects; and
- Cumulative effects.

8.8.2 In outlining the methodology adopted in undertaking the impact assessment, the relevant guidelines or legislative standards to be followed are identified and details of any difficulties (technical difficulties or lack of know-how) encountered are discussed.

8.9 Other Developments and Cumulative Effect Assessment

8.9.1 In line with the EIA Regulations and best practice, the Grangemouth Renewable Energy Plant EIA has taken into account other planned developments and considers the cumulative impacts (positive and negative) associated with these developments. For the purpose of this ES, the assessment of cumulative effects focuses on developments in operation, consented or within the planning system (i.e. awaiting determination, or at appeal or scoping, and where sufficient information is available on the project). There are a number of such developments in the area of the Renewable Energy Plant which may have a potential cumulative impact

[3] Office for Official Publications of the European Communities, May 1999, Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions

with the project as shown within Table 8.1 and on Figure 8.1. The degree of interaction between these developments and the Renewable Energy Plant will vary depending on the distance from the Renewable Energy Plant and the precise nature of each development's operations.

Table 8.1: Developments Considered to have a Potential Cumulative Impact

Development	Description	Status	Distance from centre of Renewable Energy Plant (km)
Grangemouth Biodiesel Plant	Ineos is seeking to develop a 500,000 te/annum biodiesel production plant within its Grangemouth complex	Planning permission granted.	2.3
Longannet Biomass Plant	A 25 MW biosolids and mixed waste wood power plant proposed by ScottishPower	Planning permission granted.	3.1
Rosyth Renewable Energy Plant	Forth Energy's proposal for a 100 MWe plant at the Port of Rosyth	EIA stage	17.1
Leith Renewable Energy Plant	Forth Energy's proposal for a 200 MWe plant at the Port of Leith	EIA stage	34.7

8.9.2 In addition to the above projects, Forth Energy is considering a wind turbine development within the Port of Grangemouth. While this has been the subject of a scoping request, the site layout for the proposals have not been finalised and it is not therefore possible to assess the cumulative effects of the wind turbines with those of the Renewable Energy Plant at this stage. It is therefore proposed that these cumulative effects be considered at the time of the preparation of the ES for the wind turbine development.

8.9.3 The following chapters (Chapter 9 to 17) therefore include consideration of the potential for cumulative impacts with the projects listed in Table 8.1 where relevant. For example, the Noise and Vibration Chapter (Chapter 11) considers the cumulative impacts of the project with the Longannet Biomass Plant upon relevant receptors.

8.10 Environment Impact Assessment Project Team

8.10.1 SKM Enviros was appointed by Forth Energy to carry out the EIA and prepare the ES for the Grangemouth Renewable Energy Plant.

8.10.2 SKM Enviros is a Registered Environmental Impact Assessor with the Institute of Environmental Management and Assessment (IEMA), a leading international organisation dedicated to the promotion of sustainable development and the promotion of best practice standards in environmental assessment and management.

8.10.3 In carrying out the EIA, SKM Enviros has utilised a number of experienced specialist consultants to assist in the assessment process, including Fichtners (technical), Pentran (CDM), Jones Lang LaSalle (planning policy), Spectrum Acoustics (noise), TPM Landscape (landscape and visual), MS Environmental (visualisations), Pisces (aquatic ecology), Headland Archaeology (archaeology) and Roger Tym and Partners (socio-economics).

8.10.4 Additional details of the EIA project team are included within the document 'Section 36 Application Consent Team', one of the Main Documents within the consent pack.

Abbreviations

The following is a list of abbreviations adopted in Chapter 8 Environmental Impact Assessment Methodology.

CDM	Construction (Design & Management)
EIA	Environmental Impact Assessment
ES	Environmental Statement
km	Kilometre

Forth Energy

Chapter 9

Air Quality

Contents

9 Air Quality

9.1 Introduction

9.1.1 This Chapter provides an assessment of the potential air quality and health issues associated with emissions to air from the proposed Grangemouth Renewable Energy Plant. The facility will have a number of potential emission sources to air which may give rise to emissions of a range of substances. A detailed description of the development is given in Chapter 6, 'The Proposed Development'. The potential sources, the substances emitted and how these have the potential to affect air quality are summarised below:

- Point source emissions of combustion gases from the main and auxiliary boilers could potentially have an effect on local air quality. The emissions considered include the substances associated with combustion: oxides of nitrogen (NO_x), carbon monoxide (CO), particulate matter (primarily PM_{10} and $PM_{2.5}$ i.e. those particles of 10 µm and 2.5 µm aerodynamic diameter or less, respectively) and sulphur dioxide (SO_2). For completeness, to ensure the flexibility of fuels which may be employed, and to cover any potential abatement techniques agreed with the Scottish Environment Protection Agency (SEPA) as part of the Pollution Prevention and Control (PPC) permit application, this assessment also considers emissions of heavy metals, hydrogen chloride (HCl), hydrogen fluoride (HF), volatile organic compounds (VOCs), ammonia (NH_3), polycyclic aromatic hydrocarbons (PAHs) and dioxins and furans;
- Point source emissions of acidic compounds and nitrogen-containing species from the main and auxiliary boilers could potentially affect sensitive habitat sites such as Sites of Special Scientific Interest (SSSIs) which are designated at a national level and Special Protection Area (SPA), Special Area of Conservation (SAC) and Ramsar sites which are designated at a European level. This could occur if the pH balance in soils at sensitive sites were to be influenced by the deposition of acid gases directly, or as acids in rainwater. Increased levels of nitrogen in soils and water bodies (known as eutrophication) can result in the growth of unwanted species, at the expense of other species which have evolved to cope with low levels of nitrogen. The substances of potential concern with regard to deposition comprise oxides of nitrogen, sulphur dioxide and ammonia;
- Emissions of pollutants from road traffic (oxides of nitrogen and PM_{10}) from vehicles travelling to and from the site during the construction, operation and decommissioning of the plant could potentially affect local air quality close to the routes between the site and the main road network;
- Dust generated during the construction and decommissioning of the Renewable Energy Plant could potentially cause a nuisance to local residents, unless properly controlled; and
- Fugitive emissions from the biomass handling and storage could potentially give rise to dust and odours at nearby sensitive locations, unless properly controlled.

9.1.2 The air quality assessment addresses the potential sources set out above. The predicted impacts are assessed against the current legislative objectives for the protection of human health and vegetation with the intention of confirming that, for all pollutants considered, the predicted environmental concentrations in the vicinity of the proposed Renewable Energy Plant (even when in conjunction with the other proposed developments in the area) will not exceed the Scottish Air Quality Objectives or other relevant health based benchmarks and guidelines.

9.1.3 In view of the potential for adverse environmental effects, the design and operation of the proposed Renewable Energy Plant is intended to ensure that emissions from the above processes are minimised or prevented where possible. A number of measures, as outlined below, are incorporated in the design of the plant (full details of the mitigation measures incorporated into the design proposed for the development are set out in Section 9.6):

- Utilisation of modern technology, combustion controls and appropriate flue gas abatement techniques to minimise emissions from the boilers;
- Good construction practice and monitoring throughout the construction and decommissioning period; and
- Enclosing or utilising dedicated buildings for fuel storage and handling activities, where necessary.

9.1.4 The need for, and the extent of, flue gas abatement techniques necessary to meet the relevant legislation and to reflect the nature of the fuels to be employed will be agreed in more detail with SEPA during the PPC permit application process.

9.2 Key Consultations

9.2.1 In addition to the dissemination of the Scoping Statement, discussions have been held with Falkirk Council and SEPA with regard to the scope and methodology of the assessment, and the nature and extent of baseline information available for use within the assessment.

9.3 Assessment Methodology and Significance Criteria

Assessment Methodology

9.3.1 This air quality impact assessment considers the impact on human health, vegetation and ecosystems associated with the emission and dispersion of emissions to air from the combustion of biomass during operation as well as the displacement and subsequent dispersion of dust during the construction and decommissioning of the Grangemouth Renewable Energy Plant. The assessment also considers the potential impacts associated with increased road traffic movements during the construction and operational phases.

9.3.2 The relevant air quality impact assessment criteria have been identified following a review of the standards and established guidelines for the protection of air quality for the relevant pollutants.

9.3.3 A review of existing ambient air quality in the area has been undertaken to understand the baseline conditions with respect to the above mentioned pollutants, including the location and nature of existing sources of emissions in the locality of the proposed development site. These existing conditions were determined by review of the extensive data already available for the area. It has not been necessary to carry out any new ambient air quality monitoring as it is considered that sufficient data are already available to undertake a robust assessment.

9.3.4 Detailed atmospheric dispersion modelling (using the Atmospheric Dispersion Modelling System, Version 4.2 (ADMS)) was the main technique used to identify the potential impact associated with the operation of the Renewable Energy Plant combustion plant. The ADMS model has been accepted by SEPA as a means of estimating the dispersion of operational emissions from a specific source (e.g. a stack), and the subsequent ground level concentrations at specified locations (e.g. a sensitive receptor). Modelling has been undertaken in accordance with the SEPA guidance 'Air dispersion modelling report guidelines'[1]. In doing so, the *process contribution* (PC) from the Renewable Energy Plant for a number of species are calculated based on the emissions parameters given in Table 9.7. Combining the PC with the existing ambient air quality levels produces the *predicted environmental concentration (PEC)* for each of the relevant pollutants. These PECs can then be compared with the appropriate air quality objective, benchmark or guideline value.

9.3.5 Using dispersion modelling, nitrogen and acid deposition have been predicted using the methodologies presented in the Environment Agency Technical Guidance note: AQTAG 06 "Technical Guidance on Detailed

[1] SEPA, IPPC H1, Environmental Assessment and Appraisal of BAT, July 2003

Modelling Approach for an Appropriate Assessment for Emissions to Air" (in the absence of Scottish guidance) as described in Appendix C.

9.3.6 A study grid extending 2.5 km in each direction from the proposed stack location has been utilised for assessing potential impacts at human sensitive locations. The air quality study area also extended to include sensitive habitat sites within 15 km of the proposed plant.

9.3.7 Several sensitivity analyses have been carried out to demonstrate the robustness of the model predictions and to ensure that predictions are more likely to be overestimates than underestimates.

9.3.8 Road traffic emissions associated with the development were assessed using the approach and criteria set out in the Environmental Protection UK guidance[2] and guidance produced by the Scottish Government[3]. The road network which is forecast to carry the bulk of the traffic to and from the development was considered in this assessment.

9.3.9 Further details of the dispersion modelling methodology and inputs to the modelling study are included in Appendix C of the ES.

Air quality limits and significance criteria

9.3.10 Any exceedances of the air quality objectives or guidelines described below, as a result of the proposed development, would be considered to be a significant impact in this assessment.

National Air Quality Strategy

9.3.11 The UK Air Quality Strategy[4] (AQS) stipulates a number of Air Quality Objectives (AQOs) with respect to ambient levels of air quality. These have been established for both the protection of human health and also the protection of vegetation and include the requirements of the relevant EU Directives[5] [6] [7] [8]. The Air Quality Objectives are laid down in the Air Quality (Scotland) Regulations and Air Quality Standards (Scotland) Regulations.[9] [10] [11] The objectives set for the protection of human health of relevance to the proposed project are summarised in Table 9.1. For those species for which there is no AQO, the Environmental Assessment Level (EAL) is considered, as described below.

9.3.12 AQOs are in place for nitrogen dioxide, carbon monoxide, PM_{10}, sulphur dioxide, arsenic, cadmium, lead and nickel although these only formally apply to locations where people are exposed for the relevant periods.

9.3.13 Guidance is also set out in the Local Air Quality Management Technical Guidance (LAQM.TG(09))[12]

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2 Environmental Protection UK, Development Control: Planning for Air Quality (2010 Update), April 2010.

3 Department for Environment, Food and Rural Affairs and the Devolved Administrations, Local Air Quality Management, Technical Guidance LAQM.TG(09)

4 Department for Environment, Food and Rural Affairs and the Devolved Administrations, The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, July 2007

5 First Air Quality Daughter Directive. Council Directive 1999/30/EC

6 Second Air Quality Daughter Directive. Council Directive 2000/69/EC

7 Fourth Air Quality Directive. Council Directive 2004/107/EC

8 Air Quality Directive 2008/50/EC on ambient air quality and cleaner air for Europe

9 The Air Quality Standards (Scotland) Regulations 2007 – Scottish Statutory Instrument 2007 No. 182

10 The Air Quality (Scotland) Regulations 2000 - Scottish Statutory Instrument 2000 No. 97

11 The Air Quality (Scotland) Amendment Regulations 2002 - Scottish Statutory Instrument 2002 No. 297

12 The Scottish Executive, Local Air Quality Management Policy Guidance (Scotland) 2009 (LAQM.PG(S)(09))

Table 9.1: Air Quality Objectives Set Out in the Regulations [6, 7, 8]

Pollutants	Objective ($\mu g/m^3$)	Concentration measured as
Nitrogen dioxide	40	Annual mean
	200	1 hour mean not to be exceeded more than 18 times a year, (equivalent to the 98.8th percentile)
Oxides of nitrogen	30	Annual mean limit value for the protection of vegetation
Carbon monoxide	10,000	Maximum daily running 8 hour mean
Particulates (PM_{10})	18	Annual mean
	50	24 hour mean not to be exceeded more than 7 times per year (equivalent to the 98.08th percentile)
Sulphur dioxide	20	Annual mean limit value for the protection of vegetation
	350	1 hour mean not to be exceeded more than 24 times per year (equivalent to the 99.73th percentile)
	125	24 hour mean not to be exceeded more than 3 times per year (equivalent to the 99.18th percentile)
	266	15 minute mean not to be exceeded more than 35 times per year (equivalent to the 99.9th percentile)
Arsenic (As)	0.006	Annual mean
Lead (Pb)	0.5	Annual mean
Cadmium (Cd)	0.005	Annual mean
Nickel (Ni)	0.02	Annual mean

9.3.14 The AQS was updated in July 2007 when a non-statutory, annual average, target for $PM_{2.5}$ of 12 $\mu g/m^3$, to be achieved by 2020, was included. The strategy also introduced a target of a 15% reduction in concentrations of $PM_{2.5}$ at urban background locations between 2010 and 2020.

9.3.15 The UK Government intends that the objectives for the protection of vegetation and ecosystems will apply in those parts of the UK that are:

- Representative of at least 1,000 km²;
- More than 20 km from an agglomeration;
- More than 5 km away from industrial sources regulated under Part A of the 1990 Environment Act; and
- More than 5 km from motorways; and built up areas of more than 5,000 people.

9.3.16 The objectives presented above do not therefore apply to most of the designated sites within 15 km of the proposed installation, due to being within 5 km of a regulated Part A installation, a motorway or built up areas. However, to provide confidence that the proposed Grangemouth Renewable Energy Plant will not have a significant impact on nearby vegetation and ecosystems, the objectives are used here to assess the effects of air quality at all the statutory designated sites within 15 km of the site.

Environmental Assessment Levels

9.3.17 In addition to the Scottish AQOs, Environmental Assessment Levels (EALs) exist for the other substances assessed in this study, with the exception of dioxins and furans (these are assessed separately – see paragraphs 9.3.28 to 9.3.33), and volatile organic compounds (VOCs). The term "volatile organic compounds" covers a wide range of substances. There is no air quality standard for VOCs collectively, although air quality standards or guidelines are set for some individual VOCs.

9.3.18 EALs are set out in the latest H1 Environmental Risk Assessment guidance note[13]. SEPA advised that the EALs set out in this document should be used in combination with the SEPA H1 guidance note[14]. None of these recommendations currently have a statutory basis, but have been included in the study for completeness. Table 9.2 sets out the EALs relevant to this study.

Table 9.2: Environmental Assessment Levels (EALs)

Pollutant		Concentration (µg/m^3)	Measured as
Hydrogen chloride (HCl)		750	Maximum 1 hour mean (EPAQS recommendation)
		20	Annual mean
Hydrogen fluoride (HF)		160	Maximum 1 hour mean (EPAQS recommendation)
		16	Annual mean
Ammonia (NH_3)		2500	Maximum 1 hour mean
		180	Annual mean
		3	Annual mean guideline for protection of vegetation where moss / lichens are not a key habitat feature
		1	Annual mean guideline for protection of vegetation where moss / lichens are a key habitat feature
Antimony (Sb)		150	Maximum 1 hour mean
		5	Annual mean
Arsenic (As)		15	Maximum 1 hour mean
		0.003	Annual mean (EPAQS recommendation)
Cadmium (Cd)		1.5	Maximum 1 hour mean
		0.005	Annual mean
Chromium	Cr (II and III)	150	Maximum 1 hour mean
		5	Annual mean
	Cr (VI)	0.0002	Annual mean
Cobalt (Co)		6	Maximum 1 hour mean
		0.2	Annual mean
Copper (Cu)		200	Maximum 1 hour mean
		10	Annual mean
Manganese (Mn)		1500	Maximum 1 hour mean
		0.15	Annual mean
Mercury (Hg)		7.5	Maximum 1 hour mean
		0.25	Annual mean
Nickel (Ni)		30	Maximum 1 hour mean
Thallium (Tl)		30	Maximum 1 hour mean
		1	Annual mean
Vanadium (V)		1	Maximum 24 hour mean
		5	Annual mean
Note: The more stringent EAL value for arsenic used in preference to the AQO set out in Table 9.1			

[13] Environment Agency, H1 Environmental Risk Assessment, Annex (f) Air Emissions, April 2010

[14] Scottish Environment Protection Agency, IPPC H1, Environmental Assessment and Appraisal of BAT, July 2003

9.3.19 For the purposes of this assessment, the Air Quality Objectives and EALs are collectively termed as Environmental Quality Standards (EQS) in the results tables set out in Section 9.7.

9.3.20 Many substances exhibit a threshold, below which there are no significant effects on health. The health effects of these substances will be managed by ensuring that the proposed process does not result in a breach of the air quality objectives or EALs specified above. Emissions of other substances do not exhibit any apparent threshold for effects. The health risks associated with these substances can be evaluated by ensuring that air quality standards and guidelines for these substances (where available) are not breached at relevant off-site locations. As well as this, it is also possible to calculate the potential effects on health due to forecast levels of some of these substances as a cross-check on the evaluation against air quality standards and guidelines.

9.3.21 Dioxins and furans are a group of chemicals with the full name of polychlorinated dibenzo para-dioxins (PCDDs) and poly-chlorinated dibenzo furans (PCDFs). Emissions of dioxins and furans from the proposed facilities could have an effect on health via exposure routes such as consumption of locally grown produce, as well as by breathing ambient air. This is because dioxins and furans deposited onto farmland, gardens or allotments can be absorbed into vegetables or by farm animals and subsequently consumed by people eating farm products. This will be assessed by estimating the highest likely exposure to dioxins and furans, and evaluating this against the UK standard for the tolerable daily intake of dioxins and furans.

9.3.22 The following text describes the methodology for assessing these impacts and the relevant significance criteria.

Dose-Response Factors

9.3.23 Dose-response factors are values which relate the change in a health outcome to the received dose of a substance or substances. They can be used in some circumstances to estimate the health consequences of substances which do not exhibit a threshold for health effects.

9.3.24 The World Health Organisation (WHO) has published a set of dose-response factors for exposure to genotoxic carcinogens. These set out the increased risk of cancer associated with exposure to increased airborne concentrations of specific substances. They are subject to considerable uncertainty, mainly because they are derived from exposure of populations in workplaces with very high levels of the substances under concern. By using the factors, the assumption is also made that the same response relative to an increased dose of the substance occurs right down to extremely low incremental concentrations.

9.3.25 The relevant substances and the associated dose-response factors are set out in Table 9.3.

Table 9.3: Dose-Response Functions for Exposure to Carcinogens

Substance	Dose-Response Factor (increase in lifetime cancer risk per 1 µg/m^3 increase in exposure)
Arsenic	0.0025(µg/m^3)$^{-1}$
Nickel	0.00038(µg/m^3)$^{-1}$
Chromium VI	0.004(µg/m^3)$^{-1}$
Benzo(a)pyrene	0.09(µg/m^3)$^{-1}$

9.3.26 The incremental risk to health posed by exposure to the substances listed in Table 9.3 can be assessed against a reference point established in the Royal Committee on Environmental Pollution 17th report[15]. This report suggests that an individual development should not be permitted to result in an incremental health risk greater than one additional death per million population per year. Limiting individual development impacts in this way means that other influences on health such as diet, health, workplace exposure, and other sources of environmental pollution (e.g. road traffic) are much more significant influences on health.

9.3.27 The dose response factors given in Table 9.3 will be combined with the maximum modelled concentrations on the receptor grid to give the average incremental risk per year based on an average life span of 70 years.

Outline Exposure Assessment for Dioxins and Furans

9.3.28 One of the emissions from combustion processes that frequently gives rise to concern is the group of chemicals collectively known as 'dioxins and furans,' or simply 'dioxins'. These are present throughout the environment.

9.3.29 Emissions of dioxins and furans need to be assessed in a different way to other substances. For most emissions to air, exposure via inhalation is the main route of concern. The situation is different for dioxins and furans: inhalation exposure is usually only a minor source of exposure. The majority of dioxins and furans to which we are exposed enter the body via foods – particularly, meat, milk and fish products. This occurs because dioxins and furans can become concentrated in the food chain.

9.3.30 As no standards exist for ambient concentrations in air of dioxins and furans, an outline exposure assessment has been carried out to assess the potential health risk due to air emissions from the proposed development.

9.3.31 The outline exposure assessment was carried out using a model derived for Her Majesty's Inspectorate of Pollution (a forerunner to the Environment Agency and SEPA)[16] (in the absence of Scottish guidance). This document provides an assessment of exposure of local residents to emissions from Municipal Solid Waste (MSW) incinerator plant. It was adapted using the modelled levels of dioxins and furans set out in Table 9.8 below to give an estimate of the highest exposure likely to be experienced by people living near the proposed Renewable Energy Plant. Modelled predictions of dioxin concentrations have been assessed against the UK benchmark for the tolerable daily intake (TDI) of dioxins and furans of 2 picograms toxic equivalent per kilogram body weight per day (pq TEQ/ (kgBW – day))[17].

9.3.32 Emissions of dioxins and furans from the proposed Renewable Energy Plant could have an effect on health by routes such as consumption of locally grown produce, as well as by inhalation. This is because dioxins and furans deposited onto farmland, gardens or allotments can be absorbed into vegetables or by farm animals

[15] Royal Commission on Environmental Pollution, 17th Report "Incineration of Waste," 1995

[16] Her Majesty's Inspectorate Of Pollution, "Risk Assessment of Dioxin Releases from Municipal Waste Incineration Processes," HMIP/CPR2/41/1/181, 1996

[17] Food Standards Agency, Committee on Toxicity, "Statement on the tolerable daily intake for dioxins and dioxin-like polychlorinated biphenyls," 2001

and subsequently be consumed by people eating these products. Possible public exposure to dioxins and furans was assessed in outline using a model prepared for Her Majesty's Inspectorate of Pollution. This model provides an assessment of public exposure via routes which include:

- Inhalation;
- Deposition on gardens and recreation areas, followed by dermal (skin) exposure;
- Deposition on gardens, allotments and farmland, followed by consumption of vegetation;
- Deposition on gardens, allotments and farmland, followed by consumption of eggs and poultry;
- Deposition on farmland, followed by consumption of beef, lamb and pork; and
- Deposition on watercourses, followed by consumption of fish.

9.3.33 Not all the exposure routes may apply to the study area at present, although over the project lifetime it is conceivable that most exposure routes considered in the model could occur. The estimated exposure routes can be assessed by comparison with the recommended UK Tolerable Daily Intake (TDI) of 2 picograms toxic equivalent (TEQ) per kilogram body weight per day. One picogram is a million millionth of a gram, or 10^{-12} grams. So, for an adult of body weight of 70kg, the tolerable daily intake would be 1.4×10^{-10} grams TEQ, or 0.00000000014 grams TEQ.

Critical Loads

9.3.34 Estimated critical loads for statutory designated habitat sites in the UK have been published by the Centre for Ecology and Hydrology (CEH) and are available from the Air Pollution Information System[18]. These are considered to be the maximum levels of acid and nutrient nitrogen that can be tolerated without harm to the most sensitive features of these habitat sites. Compliance with these benchmarks is likely to result in no significant adverse effects on the natural environment at these locations. The estimated critical loads for the designated habitat sites that will require a critical load assessment due to designation at the European level or based on the results of the dispersion modelling study are as follows (Table 9.4).

Table 9.4: Critical Load Values

Site name and designation	Critical load for acid deposition (kEqH+/ha-year)	Critical load for nutrient nitrogen deposition (kg N/ha-year)
Firth of Forth (SPA, SSSI)	Not sensitive to acid deposition	30 – 40
Slamannan Plateau (SPA/SSSI) *	0.62	5 – 10
Blawhorn Moss (SAC/SSSI)	0.61	5 – 10
Black Loch Moss (SAC/SSSI)	0.59	5 – 10
Howierig Muir (SSSI)	1.50	5 - 10
Lockshaw Mosses (SSSI)	0.75	5 - 10
Steelend Moss (SSSI)	0.75	5 - 10
kEqH+/ha-year: kilo-equivalents hydrogen ion per hectare per year kgN/ha-year: kilograms of nitrogen per hectare per year		

Note * - the critical loads for Slamannan Plateau are based on the most conservative values for raised and blanket bog. This feature is likely to be located further from the proposed Renewable Energy Plant than assessed here.

[18] UK Air Pollution Information System, http://www.apis.ac.uk/index.html

9.4 Baseline Conditions and Receptors

Surrounding Area

9.4.1 The location of the site is shown in Figure 1.1. Figures 6.1 and 6.2 show the two potential site layouts with open storage and silo storage respectively. The maximum building envelope of both of these, i.e. the open storage, has been used in this assessment.

9.4.2 The development site is located adjacent to the Western Chanel within the Port of Grangemouth, on the Forth Estuary, to the north of Grangemouth. Topographical levels within the site or the wider area do not vary significantly. The immediate vicinity of the site is mainly industrial in nature, including the docks and associated installations, as well as adjacent petrochemical process to the northeast and an oil refinery to the southeast. There are also residential properties, the closest being those in Grangemouth approximately 380 m to the south of the stack location.

9.4.3 The main plant area is bounded to the north by the docks and to the south by some unused grassland and storage facilities.

Ambient Air Quality Levels

9.4.4 In order to complete the assessment, it was necessary to combine modelled concentrations of substances emitted from the proposed plant with baseline concentrations present in the environment due to emissions from other sources.

9.4.5 Information on baseline air quality in the vicinity of the proposed facility was obtained or derived from a range of sources. Where local air quality monitoring data were available, this information was reviewed. Where no local information was available other appropriate sources of information were reviewed to obtain a representative assessment of local background air quality.

9.4.6 Falkirk Council (FC) undertakes ambient air quality monitoring at a number of locations throughout their jurisdiction. The results of this monitoring are discussed below.

9.4.7 For each of the pollutants considered, the monitoring indicates that levels of most pollutants do not approach or exceed the relevant air quality guidelines except for the 15 minute mean sulphur dioxide concentrations. Falkirk Council has therefore declared an Air Quality Management Area (AQMA) for the area encompassing the town of Grangemouth with respect to the 15 minute mean sulphur dioxide air quality objective. The declaration of this AQMA indicates that the problems are largely as a result of emissions from the Grangemouth petrochemical complex.

9.4.8 The following sections review the ambient air quality data available for the pollutants of interest. A summary of the baseline air quality levels used in the assessment is shown in Table 9.5, with all background data considered shown in Appendix C of this ES.

Oxides of Nitrogen and Nitrogen Dioxide

9.4.9 Nitrogen dioxide (NO_2) and nitric oxide (NO) are both oxides of nitrogen and together they are referred to as oxides of nitrogen. Principally, it is nitrogen dioxide which is associated with adverse effects on human health. The main source of oxides of nitrogen in the UK is road transport.

9.4.10 FC has recently completed a Local Air Quality Management (LAQM) report known as the Updating and Screening Assessment 2009.

9.4.11 FC currently operates three automatic monitoring stations for nitrogen dioxide, one of which is an urban background location. FC also has diffusion tube monitoring data for the area.

9.4.12 Actual monitoring data has been used to determine a baseline level in preference to background mapping data available from by Defra and the Devolved Administrations in order to adopt a more accurate approach. The ambient concentration of nitrogen dioxide adopted for this study was taken from the diffusion tube located

on Inchyra Road, Grangemouth (diffusion tube 57) an urban background / industrial diffusion tube location. The Inchyra Road location was chosen as this has the highest measured value for the Grangemouth area. It is common practice in air quality assessments to predict a baseline nitrogen dioxide level for the first year of operation of a project as nationally, levels of this pollutant are expected to fall in the short to medium term. This is carried out on the basis of monitoring data currently available, using factors derived from information available on the UK Air Quality Archive website. This has not been undertaken in this instance, because of ongoing concern regarding the expected reduction in future years.

9.4.13 The background level of oxides of nitrogen and nitrogen dioxide used in this assessment are shown in Table 9.5, with all considered data presented in Appendix C.

Particulate Matter

9.4.14 Air quality objectives have been set for particulate matter because of the relationships between airborne levels and potential human health effects. Until recently, the air quality objectives have been established with regard to particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}). PM_{10} has been linked to human health effects such as respiratory and cardiovascular diseases, and exacerbation of symptoms in those with pre-existing conditions. Recently, health effects associated with particulate matter have been linked with the more fine fraction; $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5 microns or less). The smaller size particles including any substances that may be adsorbed onto the particles, are able to penetrate deeper into the lung. As a result, a target value for levels of $PM_{2.5}$ and a target reduction level for urban background concentrations has been set across the UK.

PM_{10}

9.4.15 FC monitors PM_{10} levels at three automatic monitoring stations: Grangemouth Murray; Grangemouth Municipal Chambers; and Grangemouth Inchyra Park. Data was obtained for all of these automatic monitoring stations for 2009. The levels used in this study were the concentrations recorded at the Grangemouth Municipal Chambers monitoring station, as this results in the highest measured concentrations[19].

9.4.16 The concentrations of PM_{10} measured at the Grangemouth Municipal Chambers monitoring station were within the annual mean and short term daily air quality objectives.

$PM_{2.5}$

9.4.17 $PM_{2.5}$ is monitored at the Grangemouth Inchyra Park monitoring station. The measured levels of $PM_{2.5}$ during 2009 were used in this assessment. The concentrations of $PM_{2.5}$ measured at the Grangemouth Inchyra Park monitoring station were within the annual mean air quality objective.

Sulphur Dioxide

9.4.18 Sulphur dioxide is also monitored at three automatic monitoring stations by FC: Grangemouth Moray; Grangemouth Municipal Chambers and Grangemouth Inchyra Park. Baseline levels of sulphur dioxide were utilised from the Grangemouth Moray automatic monitoring station based on measurements in 2009, as this station recorded the highest measured concentrations.

[19] Department for Environment, Food and Rural Affairs and the Devolved Administrations, Local Air Quality Management, Technical Guidance LAQM.TG(09).

Carbon Monoxide

9.4.19 Carbon monoxide is not monitored by FC. Baseline levels of carbon monoxide were obtained from background maps produced by Defra and the Devolved Administrations[20]. Concentrations of carbon monoxide were obtained for the grid square where the proposed facility is located, and the eight immediately surrounding grid squares in each cardinal direction. The maximum carbon monoxide concentration across the grid squares surrounding the site were used for the assessment.

Dioxins and Furans

9.4.20 Dioxins and furans are products of incomplete combustion and are considered carcinogenic. These substances are not widely monitored across the UK, and so there is very little available baseline data. Baseline levels of dioxins and furans were obtained from the results of a survey carried out at several locations across the UK, with the average recorded levels for 2008 across all sites used for this assessment. The baseline information was accessed via the UK National Air Quality Archive[20] where monitoring data from across the UK is stored centrally.

Polycyclic Aromatic Hydrocarbons

9.4.21 Polycyclic Aromatic Hydrocarbons (PAHs) are a group of persistent organic compounds generated via combustion processes, some of which are possible or proven human carcinogens. A study on PAHs carried out by the Expert Panel on Air Quality Standards (EPAQS)[21] provided an air quality guideline value for PAHs based on the level of one specific PAH, benzo(a)pyrene. As a result, background levels of benzo(a)pyrene have been considered for this study as an indicator of levels of PAHs.

9.4.22 Monitoring of PAHs is not generally undertaken by individual local authorities. Information on background levels of PAHs was obtained from the PAH monitoring network operated by Defra. The background concentration used in this assessment was the average value of benzo(a)pyrene across all monitoring locations during 2009 (the most recent year for which data is available) using the Andersen Sampler monitoring method.

Ammonia

9.4.23 Information on background levels of ammonia were sourced from the Centre for Ecology and Hydrology (CEH)[22]. UK pollutant deposition website which collates data from the network supported by Defra and the Devolved Administrations. The closest monitoring location to the proposed development site, located in a similar setting, was the Edinburgh St Leonards automatic monitoring station. The average value for 2008 (the most recent year for which data is available) was used in this assessment.

Trace Metals

9.4.24 Data concerning trace metals was sourced from the UK National Air Quality Archive[20]. Background concentrations were available for arsenic, cadmium, chromium, copper, manganese, nickel, lead, vanadium and mercury (particle and vapour phase). Of the available monitoring locations, an average value for each metal was taken from the Bristol Avonmouth (urban background), Redcar Automatic Urban and Rural Network (AURN) (industrial background) and Motherwell Centre (urban background) monitoring sites. These sites were selected to provide a reasonable representation of the proposed facility location as locally recorded

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[20] Department for Environment, Food and Rural Affairs and the Devolved Administrations, UK Air Quality Archive, www.airquality.co.uk, accessed April 2009.

[21] The Expert Panel on Air Quality Standards, Report on Polycyclic Aromatic Hydrocarbons. The Stationery Office, 1999

[22] Centre for Ecology and Hydrology, UK Pollutant Deposition – Ammonia, acid gases and aerosols, and heavy metals monitoring networks for the UK, http://www.uk-pollutantdeposition.ceh.ac.uk/networks Accessed February 2010

measurements were not available. As no information is available on background levels of antimony, cobalt and thallium from this data source, measurement data from an alternative monitoring study was utilised (see Table 9.5).

Hydrogen Chloride

9.4.25 Hydrogen chloride and other acid gasses are monitored at different locations across the UK by the Acid Gases and Aerosol Monitoring Network. Background levels of hydrogen chloride were sourced from CEH[22]. The closest monitoring location to the proposed development site was the Bush 1 (LHS) monitoring station, located approximately 10 kilometres south of the centre of Edinburgh. The average value for 2008 was used in this assessment.

Hydrogen Fluoride

9.4.26 Baseline monitoring of hydrogen fluoride is not carried out on an on-going basis across the UK. The concentration of hydrogen fluoride in ambient air was based on findings from a report by EPAQS in 2006[23]. A range of background concentration values was provided in the report for heavily industrialised urban areas within Europe with the maximum in the range adopted for use in this assessment.

Adopted Ambient Air Quality Levels

9.4.27 Appropriate background air quality levels upon which to base this assessment, have been established for each parameter, as described above

9.4.28 A summary of the ambient air quality levels adopted for the assessment are shown in Table 9.5, with all considered background levels provided in Appendix C.

Table 9.5: Adopted ambient air quality levels

Substance	Long-term mean baseline concentration ($\mu g/m^3$)	Basis
Nitrogen dioxide	27.8	Maximum value from Defra background mapping of grid squares immediately surrounding the proposed site, centred on 293500, 682500 - 2009. This value was doubled to obtain the short term concentration.
Sulphur dioxide	11.2	Annual mean concentration measured at Grangemouth Moray monitoring site – 2009. This value was doubled to obtain the short term concentration.
PM_{10}	16.1	Annual mean concentration from Grangemouth Municipal Chambers monitoring site – 2009.
	33.9	98.08th percentile concentration from Grangemouth Municipal Chambers monitoring site – 2009.
$PM_{2.5}$	8.8	Maximum value from Defra background mapping of grid squares immediately surrounding the proposed site, centred on 293500, 682500 - 2009.
Hydrogen chloride	0.20	Level measured at Bush 1 (LHS), 2008. This value was doubled to obtain the short term concentration.
Hydrogen fluoride	3.5	Estimated maximum in industrial areas based on EPAQS report. This value was doubled to obtain the short term concentration.
Dioxins and furans	1.1×10^{-8}	Average measured levels during national surveys 2008 (value given is Toxic Equivalent (WHO, 2006), TEQ).
Arsenic	0.00051	Average level recorded across three national survey sites - 2009. These values were doubled to obtain the short term concentrations.
Cadmium	0.00017	
Chromium	0.00236	

[23] Department for Environment, Food and Rural Affairs and the Devolved Administrations, Expert Panel on Air Quality Standards, Guidelines for Halogens and Hydrogen Halides in Ambient Air for Protecting Human Health against Acute Irritancy Effects, 2006

Substance	Long-term mean baseline concentration ($\mu g/m^3$)	Basis
Copper	0.00588	
Manganese	0.01180	
Nickel	0.00090	
Lead	0.00836	
Vanadium	0.00189	
Mercury	0.00204	
Antimony	0.0017	There is little information available on these substances. In the absence of site specific data levels measured in Staffordshire for a planning application in 2008, and representative of semi-rural location have been used[24]. This is considered a reasonable approach in the circumstances. These values were doubled to obtain the short term concentrations.
Cobalt	0.0007	
Thallium	0.0008	
PAH -(Benzo(a)pyrene)	0.46	Average measured levels during national surveys – 2009
Carbon monoxide	243	Maximum value from Defra background mapping of grid squares immediately surrounding the proposed site, centred on 293500, 682500 - 2001. This value was doubled to obtain the short term concentration.
Ammonia	1.2	Level measured at Edinburgh St Leonards – 2008. This value was doubled to obtain the short term concentration.
*The short term background concentrations are mainly derived from doubling the annual mean background concentration as addressed in SEPAs H1 guidance[13]. See Appendix C for further details		

9.5 Potential Impacts

Construction

9.5.1 Construction of the proposed development has the potential to impact on local air quality principally through the generation and deposition of dust. There are no receptors directly downwind of the predominant wind direction (that is wind blowing from the west to south-west of the Renewable Energy Plant). However, the closest residential properties in Grangemouth are located approximately 200 m to the south of the proposed worksite boundary. There is therefore some small potential for unmitigated construction dust emissions to impact upon these properties when the wind is blowing from a northerly direction.

9.5.2 As with any construction site, dust may be generated as a result of surface preparation and earthworks, including earth moving and materials handling. Internal site traffic moving on un-metalled roads within the development site may cause sufficient mechanical disturbance of loose surface materials to generate dust during prolonged periods of dry weather. The proposed development includes the following main components which may, without sufficient management or mitigation, generate dust:

- Demolition of existing structures on site;
- Preparatory earthworks to allow the construction of the development; and
- The construction of the main components of the Renewable Energy Plant.

9.5.3 Other emissions will be associated with the plant and machinery used on the site during the construction phase and construction traffic using roads in the vicinity of the development. Emissions arising from construction traffic have been assessed as part of this air quality impact assessment, however due to the expected minor impact of the emissions arising from on-site construction plant and machinery, these do not form part of this air quality impact assessment.

[24] Staffordshire County Council, Project W2R Provision of a Residual Waste Treatment Facility, Environmental Statement, May 2008

9.5.4 There is the potential for a limited period of elevated emission concentrations[25] during commissioning of the boiler, although these will be short lived and with low flow rates. These emissions will be controlled through a commissioning plan agreed with SEPA as part of the PPC permit. No significant impacts are expected and no further assessment has therefore been undertaken.

9.5.5 Pollutants that will be considered for the construction phase therefore comprise:

- Particulate matter comprising of $PM_{2.5}$, PM_{10} and larger dust particles; and
- Nitrogen dioxide and PM_{10} emissions from construction traffic emissions.

Operation

9.5.6 The combustion of biomass, and the emission control techniques which may be adopted, can result in flue gases containing the following species that have the potential to have a significant impact on local air quality:

- NO_x
- CO
- SO_2
- Particulate matter (including heavy metals)
- Ammonia
- Dioxins and furans
- VOCs
- HCl
- HF

9.5.7 Light fuel oil firing to stabilise combustion during start-up of the Renewable Energy Plant will also result in the emission of sulphur dioxide, oxides of nitrogen, carbon monoxide and particulates. Light fuel oil firing is likely to occur for less than 140 hours per annum during start-up operations and will result in emissions well within the limits given below for the combustion of biomass.

9.5.8 The emergency generator and firewater pump engine will not be used during normal operation other than for testing purposes to confirm their availability. The small size of these engines, coupled with their infrequent operation, will result in a minimal impact on local air quality. Therefore, their emissions are not assessed further within the air quality assessment.

9.5.9 Two 10 MWth light fuel oil fuelled auxiliary boilers may operate to provide steam for Combined Heat and Power users when the main Renewable Energy Plant is offline. The boilers will emit sulphur dioxide, oxides of nitrogen, carbon monoxide and particulate matter via a dedicated twin flue stack. Emissions from these auxiliary boilers have been included as part of the assessment and have been assessed against the short term air quality objectives as the boiler is only likely to operate for a maximum of 12% of the year.

9.5.10 There may also be visible water vapour plumes emitted under certain weather conditions from the main Renewable Energy Plant stack. The frequency of occurrence of this plume is assessed in detail in this chapter.

9.5.11 In addition, there is the potential for release of particulate matter and odour from fugitive dust blown from fuel and ash storage area and the ash silos and transfer area.

9.5.12 The storage and use of the fuel will be such that the potential for the formation and release of bioaerosols will be minimised. During normal operations the fuel will be used before the generation of bioaerosols can occur. In additional the fuel may be stored in silos if wood pellet is used as fuel. Thus the potential for any release of bioaerosols is considered to be negligible.

[25] i.e. levels in excess of those guaranteed for the normal operation of the Renewable Energy Plant as stipulated within the project specification

9.5.13 The number of traffic movements associated with any fuel brought to site by road will be less than the traffic movements generated during the construction phase.

9.5.14 In summary, pollutants that will be considered in detail for the impact assessment during the operational phase of the Renewable Energy Plant therefore comprise:

- NO_x due to combustion of biomass fuel and light fuel oil within the main boiler;
- CO due to combustion of biomass and light fuel oil within the main boiler;
- PM_{10}, $PM_{2.5}$ and larger dust particles due to combustion of biomass and light fuel oil within the main boiler, and due to fugitive releases from fuel storage and processing areas;
- Ammonia, due to the potential use of Selective Non Catalytic Reduction to control NOx;
- HCl and HF due to the combustion of biomass within the main boiler;
- Other trace emissions (of heavy metals, VOCs, PAHs and dioxins and furans) due to the combustion of biomass within the main boiler; and
- The water vapour plume from the main boiler stack produced by the moisture content in the fuel.

Cumulative impacts

9.5.15 There is an existing oil refinery located to the southeast of the site which contributes to ground level pollutant concentrations within vicinity of the plant. However, following discussions with SEPA[26], it was advised modelling should initially be carried out using a publically available background dataset that takes into account substantial emission sources within the area.

9.5.16 To take the cumulative impact of other existing sources in the area into account the baseline air quality levels used in this study were the maximum measured concentrations at any of the monitoring locations within Grangemouth. The measured baseline concentrations will already include a contribution from the existing oil refinery and other local sources or air pollution.

9.5.17 The contribution from other committed or proposed developments will not be included in the existing measured baseline concentrations utilised for the assessment. These future sources were considered and included in the cumulative assessment where appropriate.

Decommissioning

9.5.18 All emissions from the Renewable Energy Plant will cease during decommissioning. There may, however, be dust generated during the demolition of the Renewable Energy Plant, as well as emissions from plant and machinery used on the site during the decommissioning phase and traffic using roads in the vicinity of the development. However, due to the expected minor impact of these emissions, plant and machinery emissions do not form part of this air quality impact assessment.

9.5.19 Pollutants that will be considered for the decommissioning phase therefore comprise:

- Particulate matter ($PM_{2.5}$, PM_{10} and larger dust particles).

9.6 Mitigation

Construction

9.6.1 Dust generation and dispersion during construction will be minimised through good construction practice and monitoring throughout the construction period. The mitigation measures will aim to prevent dust from being

[26] SEPA, correspondence in an email, dated 08/06/2010

dispersed off-site and, thereby, protect nearby properties and other receptors from significant dust impacts. The following mitigation measures will be adopted where practicable and necessary:

- Plant and equipment will be designed and used in a manner which minimises dust generation;
- Water spray dampening of soils and spoil may be undertaken to prevent dust blow during hot, dry weather conditions;
- Careful location, grading and management of stockpiles of soil and similar materials will be undertaken to prevent wind-blow;
- Sealing and / or re-vegetation of completed earthworks will be undertaken as soon as reasonably practicable;
- Site roads will be surfaced early in the construction programme – vehicle speeds will be limited to less than 20 mph;
- Lorries will be sheeted during transportation of friable construction materials and spoil;
- Drop heights will be minimised during material transfer activities, such as unloading of friable materials;
- Regular cleaning of surfaced roads and maintenance of un-surfaced roads will be undertaken to reduce off-site transport of soils and to avoid dust generation;
- Wheel washing facilities will be provided for heavy commercial vehicles and any other vehicle which has an operating weight exceeding three tonnes entering the public road system; and
- Positioning and movement of construction equipment will be undertaken in a manner which minimises dust generation.

9.6.2 In order to ensure fugitive dust emissions are controlled to acceptable levels, regular monitoring will be undertaken. Such monitoring is likely to comprise the use of hand held portable monitors at a downwind location where exposure to dust emissions is likely to be highest. Where monitoring indicates high local concentrations prevention measures can be implemented.

Operation

9.6.3 A number of mitigation measures will be integral to the design and operation of the proposed Renewable Energy Plant. These will include:

- The use of modern combustion technology and potentially Selective Non Catalytic Reduction (SNCR) to control the generation of NOx emissions;
- The use of a low-chloride, low-ash, fuel (i.e. biomass and light fuel oil);
- The use of a low-sulphur fuel (i.e. biomass and light fuel oil);
- The use of activated carbon to control heavy metals and dioxins and furans, when necessary;
- The use of lime injection to control acid gases when necessary;
- Appropriately designed stacks to ensure adequate dispersion of emissions to atmosphere;
- A high efficiency dust collection system (fabric-filters) which will control emissions of particulates;
- The use of effective combustion control to limit carbon monoxide and oxides of nitrogen emissions;
- If the main fuel is wood pellet, the storage of all fuels will be fully enclosed hence eliminating any potential for wind-blown dust and odours;
- If the main fuel is woodchip, an open stockpile will be utilised to store the woodchip prior to transfer to the enclose Screen and Day Store building. As the moisture content of woodchip is typically greater

than 45% by weight, the material is inherently non-dusty. Woodchip will also be supplied to a specification that limits the amount of smaller particles which could become wind-blown. To prevent the woodchip drying out and becoming dusty and prevent generation of bioaerosols within the fuel, the woodchip stored in the open stockpile will be transported to the Day Store and Mixed Fuel Store on a first-in, first-out basis;

- The transfer of fuel from the fuel storage areas to the Day Store and the boiler will be carried out using enclosed conveyor systems which will be designed to minimise production of dust. This will prevent the potential for wind-blown dust and odours;
- Fuel delivery areas will be enclosed where appropriate;
- The storage of ash in an enclosed silo; and
- Lorries will be sheeted during transportation of friable materials.

9.6.4 The main boiler stack will be fitted with Continuous Emissions Monitors to monitor the emissions of pollutants in accordance with the appropriate requirements of the PPC Regulations for co-incineration plants under the Waste Incineration Directive. The ammonia monitor will provide feedback to the reagent injection system of the SNCR to minimise emissions of ammonia (i.e. ammonia slip), where appropriate.

9.6.5 A comprehensive fire prevention and safety system will be adopted to minimise the risk of fire from the fuel store area. This is discussed in the Fire Prevention Method Statement which accompanies the Section 36 Application.

Decommissioning

9.6.6 A site closure plan will be produced and submitted to SEPA prior to the start of decommissioning and in accordance with environmental controls relevant at the time. This will include a range of mitigation measures similar to those noted above for the construction phase.

9.7 Assessment of Residual Effects

Construction

Dust

9.7.1 The level of dust generation and dispersion is dependent upon a number of factors including:

- The type of construction activities taking place;
- The occurrence of hot, dry weather;
- The prevailing wind speed and direction; and
- The mitigation measures adopted.

9.7.2 The potential for dust to be generated during the construction phase will be short-term and temporary in nature. Site clearance and bulk excavation works (the construction works of greatest potential impact) will be carried out during the initial phase of construction. Excavation and site levelling will use machinery such as front loaders, bulldozers and similar plant, with spoil material which will not be incorporated into development and landscaping being removed from site.

9.7.3 There are no residential receptors downwind of the predominant wind direction (that is wind blowing from the south-west of the site), which is the direction which would typically be the most susceptible to dust emissions. The closest residential properties are located in Grangemouth and are approximately 220 m to the south of the proposed site boundary. There is the potential for unmitigated windblown dust emissions to reach these

properties. The wind direction (based on 2008 data from Edinburgh Gogarbank[27]) is towards the closest receptor in Grangemouth (310° – 50°) approximately 11% of the year. The mitigation measures proposed above are considered likely to prevent such events from occurring. However, in the event that handheld monitoring finds that dust concentrations at these locations are unacceptable during certain meteorological conditions (i.e. a hot dry period), construction work will be tailored or additional mitigation put in place to ensure that particulate levels due to the construction works reduce to acceptable levels.

9.7.4 Given this fact, and with the use of the mitigation measures outlined above, the impacts of dust generation on receptors in the area will be minimised and no significant impact is predicted.

Road Traffic

9.7.5 Full details of the traffic generated during the construction phase are provided in Chapter 18 (Traffic and Transport). The maximum number of daily movements during the construction phase is 600. This comprises 234 arrivals and departures of construction staff and 66 arrivals and departures of civil/mechanical works vehicles. The distribution of the additional movements on the local road network is also set out in Chapter 18.

9.7.6 The potential impact from road traffic was determined by considering the additional movements on the main road network using the Environmental Protection UK (EPUK) guidance[28]. The EPUK guidance states that an air quality assessment is needed for a particular road link when:

- The annual average daily traffic flow (AADT) is greater than 10,000;
- The increase in traffic is greater than 5%; and
- The increase in HGVs is greater than 200 vehicles per day.

9.7.7 Table 9.6 shows a summary of the screening assessment used to determine if an air quality assessment is required. The traffic data are set out in more detail in Appendix C.

Table 9.6: Construction Traffic Air Quality Screening Assessment

Road Link	AADT > 10,000	Relevant Exposure Close to Road	Traffic Flow increase >5%	HGV increase > 200 per day	More detailed assessment required?
North Shore Road	No	No	Yes	No	**No**
A904 Earls Road	Yes	Yes (1 property)	No	No	**No**
A904 Station Road / Bo'Ness Road	Yes	Yes	No	No	**No**
Forth & Clyde Way / South Bridge Street	No	Yes	No	No	**No**
A905 Glensburgh Road	Yes	Yes	No	No	**No**
A905 Beancross Road	Yes	Yes	No	No	**No**
B9132 Newlands Road	Yes	Yes	No	No	**No**
A904 Falkirk Road	Yes	No	No	No	**No**
A9 Lauriston Bypass	Yes	Yes	No	No	**No**

[27] Meteorological data recorded at Edinburgh Gogarbank used for the main assessment as this is the nearest and most appropriate weather station operated by the Meteorological Office which provides fully validated measurements for use in dispersion modelling.

[28] Environmental Protection UK, Development Control, Planning for air quality (2010 update), April 2010.

9.7.8 The screening assessment indicates that an air quality assessment of the emissions from construction traffic is not required and that any changes in air quality would not likely be measureable due to the additional vehicle movements generated during the construction phase. No significant impact is therefore anticipated.

Operation

Road Traffic

9.7.9 Traffic flows likely to occur during the operational phase would be significantly less than those during the construction phase (i.e. 114 daily movements during the operational phase (which includes fuel deliveries and staff vehicles) compared to around 600 daily movements during the construction phase). As set out above, the construction phase of the development does not require an air quality assessment. On this basis, the potential impact due to road traffic emissions during the operational phase will be significantly less than during the construction phase, assessment for the operational phase was therefore not considered necessary and on this basis, the potential impacts due to traffic during the operational phase are not considered significant.

9.7.10 As the impact from road traffic emissions is insignificant during the operational phase, there will not be a measureable contribution to the cumulative impact (i.e. at locations where the stack emissions also contribute to ground level concentrations) from road traffic emissions at any locations in the vicinity of the site.

Operational Emission Limits

9.7.11 Emissions from the Renewable Energy Plant will be in compliance with relevant legislation and at the levels agreed with SEPA as being achievable through the use of Best Available Techniques[29]. The fuels will include recovered timber, paper and cardboard which are classed as waste materials. Therefore, the plant will be designed to meet the requirements of the Waste Incineration Directive. As the main purpose of the plant is the generation of electricity and heat, the relevant emission limits are those of 'co-incineration' as defined in Annex II of the Directive. The plant will also be in accordance with the Large Combustion Plant Directive[30] and the draft Industrial Emissions Directive[31] for large combustion plants. Emission limits will be set by SEPA in the plant's PPC permit. For the purposes of this EIA, the concentrations presented in Table 9.7 have been assumed. Although emissions for all substances included in the PPC Regulations for co-incineration have been included in the assessment, as the fuel is biomass it is unlikely that all of these contaminant will be present in the flue gas all of the time. These are the maximum emissions anticipated and hence provide a pessimistic projection of the impacts of the proposed plant.

9.7.12 As biomass will be utilised for the majority of the year (98% of the anticipated operational hours of the main biomass boiler), the assessment is based on the emissions from combusting biomass.

9.7.13 Detailed atmospheric dispersion modelling using the ADMS 4.2 computer model has been carried out for operational emissions to identify the process contribution from the Renewable Energy Plant and identify the most appropriate stack height. Through the dispersion modelling study, it is concluded that a stack height of 110 m, gives sufficient dispersion of the flue gases, such that all residual effects are not significant and that all PECs, including the contributions from the other proposed developments in the area, are well within the relevant AQO and no exceedances are anticipated. This modelling, including the stack height selection study is discussed in Appendix C.

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[29] The term „Best Available Techniques" (BAT) is defined as: Best meaning the most effective techniques for achieving a high level of protection of the environment as a whole; Available meaning techniques developed on a scale which allows them to be used in the relevant industrial sector, under economically and technically viable conditions, taking into account of the costs and advantages; and Techniques includes both the technology and the way the installation is designed, built, maintained, operated and decommissioned.

[30] Scottish Statutory Instrument 2002 no. 493. The Large Combustion Plant (Scotland) Regulations 2002.

[31] Commissions of the European Communities. The Draft Industrial Emissions Directive COM/2007/0844 final

Atmospheric Dispersion Modelling

9.7.14 Table 9.7 presents the input parameters specified within the ADMS dispersion model for the detailed dispersion modelling analysis of the Grangemouth Renewable Energy Plant. Further details are given in Appendix C, including the emissions scenario utilised for the assessment and the conservative assumptions adopted throughout the modelling study.

Two scenarios were modelled:

- Scenario 1: 70% virgin wood and 30% waste wood is combusted; and
- Scenario 2: 100% virgin wood is combusted.

For this assessment, the substances which may be emitted due to the combustion of waste wood, such as: heavy metals, dioxins, hydrogen chloride and hydrogen fluoride, have been assessed using Scenario 1 (these substances would not be emitted for Scenario 2 where only virgin wood is combusted). The assessment of all other substances will be based on the emissions from Scenario 2, as this represents the scenario with the maximum potential effect due to the higher mass emissions for this scenario compared to Scenario 1.

Table 9.7: Exhaust Gas Parameters as Used Within Dispersion Model

Parameter	Value	
	Scenario 1	Scenario 2
Stack height	110 m	110 m
Flue diameter at exit	4.93 m	4.93 m
Exhaust gas temperature	75 °C	75 °C
Exit gas exit velocity	15.8 m/s	18 m/s
Volumetric flow rate (at stack discharge conditions)	301 m^3/s	343 m^3/s
Volumetric flow rate (at standard reference conditions)*	202 m^3/s	218 Nm^3/s
Exit gas moisture content (at stack discharge conditions)	16%	22.5%
Exit gas oxygen content (at stack discharge conditions)	5.1%	4.8%
NO_x emission concentration (standard reference conditions)*	200 mg/Nm^3	200 mg/Nm^3
NO_x emission rate	40.4 g/s	43.5 g/s
CO emission concentration (standard reference conditions)*	220 mg/Nm^3	220 mg/Nm^3
CO emission rate	44.5 g/s	47.9 g/s
SO_2 emission concentration (standard reference conditions)*	75 mg/Nm^3	75 mg/Nm^3
SO_2 emission rate	15.2 g/s	16.3 g/s
PM_{10} emission concentration (standard reference conditions)*	10 mg/Nm^3	10 mg/Nm^3
PM_{10} emission rate	2.0 g/s	2.2 g/s
$PM_{2.5}$ emission concentration (standard reference conditions)*	10 mg/Nm^3	10 mg/Nm^3
$PM_{2.5}$ emission rate	2.0 g/s	2.2 g/s
HCl emission concentration (standard reference conditions)*	15 mg/Nm^3	-
HCl emission rate	3.0 g/s	-
HF emission concentration (standard reference conditions)*	1.5 mg/Nm^3	-
HF emission rate	0.30 g/s	-
VOC emission concentration (standard reference conditions)*	15 mg/Nm^3	15 mg/Nm^3
VOC emission rate	3.0 g/s	3.3 g/s

Parameter	Value	
	Scenario 1	Scenario 2
Dioxins and furans emission concentration (standard reference conditions)*	0.1 ng/Nm^3	-
Dioxins and furans emission rate	20.2 ng/s	-
Cadmium and thallium total emission concentration (standard reference conditions)*	0.025 mg/Nm^3	-
Cadmium and thallium total emission rate	0.005 g/s	-
Mercury emission concentration (standard reference conditions)*	0.025 mg/Nm^3	-
Mercury emission rate	0.005 g/s	-
Antimony, arsenic, lead, chromium, cobalt, copper, manganese, nickel, vanadium total emission concentration (standard reference conditions)*	0.25 mg/Nm^3	-
Antimony, arsenic, lead, chromium, cobalt, copper, manganese, nickel, vanadium total emission rate	0.05 g/s	-
NH_3 emission concentration (standard reference conditions)*	10 mg/Nm^3	10 mg/Nm^3
NH_3 emission rate	2.0 g/s	2.2 g/s
PAH emission concentration (standard reference conditions)*	0.002 mg/Nm^3	0.002 mg/Nm^3
PAH emission rate	0.0004 g/s	0.0004 g/s
Notes: * Standard reference conditions are: dry gas, 273 K, 101.3 kPa and 6% Oxygen v/v For the assessment of $PM_{2.5}$, emissions of particulate matter were assumed to be entirely in the form of $PM_{2.5}$. Making this assumption the most conservative approach		

Emissions of Metals

9.7.15 The Waste Incineration Directive sets an aggregate limit of 0.5 mg/Nm^3 on a group of nine metals (antimony, arsenic, lead, chromium, cobalt, copper, manganese, nickel, vanadium). Emissions of individual metals are likely to be well below the aggregate limit set out in the Waste Incineration Directive as virgin wood, which will comprise at least 70% of the biomass fuel combusted by the plant, does not contain metals. Furthermore, only a small proportion of the 30% of non-virgin biomass to be consumed by the plant, the recovered biomass materials, will potentially contain traces of metals. The other non-virgin biomass materials will consist of willow, grasses and agricultural residues like rape-seed meal and are unlikely to contain any traces of metals. In addition, some of the recovered biomass materials will not contain metals as these will consist of paper and cardboard. On this basis, emissions of metals from the proposed plant will be significantly less than a plant combusting only 100% waste materials such as municipal waste and it was therefore assumed that the modelled level of emissions of metals would be half of the limit for these metals set out in the Waste Incineration Directive. The dispersion modelling study assumed that each metal was released at one ninth of the aggregate emission concentration adopted as the limit. Chromium is normally found in different forms (known as "oxidation states"), referred to as chromium II, chromium III, and chromium VI. Chromium VI is the most potentially toxic form. For Chromium (VI), it was assumed that 5% of chromium emissions are in the form of Chromium (VI)[32].

9.7.16 Emissions of cadmium and thallium are also measured as a group, and a limit applied to the group total. For the purposes of this study, it was assumed that both cadmium and thallium were present at half of the group emission limit, although this would not occur in practice. Again, this represents a conservative approach. In line with the approach taken for the group of nine metals, the emissions of these metals were assumed to be

[32] Department for Environment, Food and Rural Affairs and the Devolved Administrations, Expert Panel on Air Quality Standards, Guidelines for metals and metalloids in ambient air for the protection of human health, May 2009

half of the aggregate limit set out in the Waste Incineration Directive. This also applies to emissions of mercury which has a specific emissions limit set out in the Waste Incineration Directive..

Emissions of VOCs

9.7.17 VOCs emitted from combustion process consist of a wide range of compounds and are not generally of concern with regards to local air environmental impacts. Consequently, emissions of VOCs were not assessed against any EALs. However, semi volatile organic compounds such as PAHs and dioxins were addressed.

Auxiliary Boilers

9.7.18 In addition to an assessment of the main boiler emissions, the emissions from the auxiliary boilers were assessed against the short term air quality objectives because the boilers will only run for a maximum of 12% of the year. As described in Chapter 6, the auxiliary boilers will be utilised to meet the heat demand of local heat users when the main boiler is not operational. The main boiler and auxiliary boilers will not operate at the same time. The emissions data for the auxiliary boilers are provided in Appendix C.

Assessment

9.7.19 The maximum ground level process contribution from the Renewable Energy Plant and the equivalent PEC for 2015 for each of the gaseous species considered are shown within Tables 9.8.

9.7.20 Whilst five years hourly sequential meteorological data has been used for the detailed dispersion modelling (as discussed in Appendix C), the results shown below relate to the highest concentrations predicted during the five years modelled (2004 to 2008). It is therefore considered that this represents the maximum potential effect that could reasonably be expected to occur as a result of the Renewable Energy Plant. The other conservative assumptions utilised throughout the assessment to ensure model predictions are likely to be over-estimates rather than under-estimates are set out in Appendix C.

9.7.21 The site boundary, stack location, modelled domain and residential receptor areas are shown in Figure 9.1. Model results are shown graphically in Figures 9.2 – Figure 9.5 for substances where the PC was greater than 1% of the EQS for long term means or where the PC was greater than 10% of the EQS for short term means, therefore having the highest process contribution values as a proportion of the relevant air quality standards or guidelines (i.e. those substances with the most potential for effects on air quality). The contour plots showing the substances are as follows:

- Figure 9.2: Annual mean nitrogen dioxide process contributions (2008);
- Figure 9.3: Annual mean cadmium process contributions (2008);
- Figure 9.4: Annual mean arsenic, and nickel process contributions (2008);
- Figure 9.5: Annual mean chromium (vi) process contributions (2008); and
- Figure 9.6: Annual mean benzo(a)pyrene process contributions (2008).

9.7.22 The results presented in Table 9.8 are the maximum predicted concentrations at any off-site location for the assessment of short term concentrations and the maximum predicted concentrations at any residential areas for assessment of annual mean concentrations within the air quality study area. The concentrations at all other locations will be less than those presented in Table 9.8.

Table 9.8: Atmospheric Dispersion Modelling Results

Pollutant	Averaging period	EQS (µg/m^3)	Adopted ambient air quality level (µg/m^3)	PC (µg/m^3)	PEC (µg/m^3)	PC / EQS (%)	PEC / EQS (%)	Year of met dataset resulting in maximum PC
Nitrogen dioxide	Annual mean	40	27.8	0.83	28.7	2.1%	71.7%	2008
	1 hour mean (99.8th %ile)	200	55.7	16.8	72.5	8.4%	36.2%	2008
Carbon monoxide	Maximum 8 hour running mean	10,000	486	50	536	0.50%	5.4%	2006
PM_{10}	Annual mean	18	16.1	0.06	16.1	0.33%	89.6%	2008
	24 hour mean (98.08th %ile) (method 1)	50	33.9	0.12	34.0	0.24%	68.1%	2008
	24 hour mean (98.08th %ile) (method 2)	50	32.1	1.4	33.6	2.9%	67.2%	2004
$PM_{2.5}$	Annual mean	12	8.8	0.059	8.9	0.49%	74.2%	2008
Sulphur dioxide	15 minute mean (99.9th %ile) (method 1)	266	22.3	19.1	41.4	7.2%	15.6%	2007
	1 hour mean (99.9th %ile) (method 2)	266	22.3	24.4	46.7	9.2%	17.6%	2007
	1 hour mean (99.73th %ile)	350	22.3	18.0	40.3	5.1%	11.5%	2008
	24 hour mean (99.18th %ile)	125	22.3	12.2	34.5	9.7%	27.6%	2007
Hydrogen chloride	Annual mean	20	0.20	0.096	0.29	0.48%	1.5%	2008
	Maximum hourly mean	750	0.39	4.3	4.7	0.58%	0.63%	2007
Hydrogen fluoride	Annual mean	16	3.5	0.0096	3.5	0.060%	21.9%	2008
	Maximum hourly mean	160	7.0	0.43	7.4	0.27%	4.6%	2007
Cadmium	Annual mean	0.005	0.00017	0.00007	0.00024	1.4%	4.7%	2008
	Maximum hourly mean	1.5	0.00034	0.0032	0.0035	0.21%	0.23%	2005
Thallium	Annual mean	1	0.00080	0.00007	0.0009	0.007%	0.087%	2008
	Maximum hourly mean	30	0.0016	0.0032	0.005	0.011%	0.016%	2005
Mercury	Annual mean	0.25	0.0020	0.00014	0.0022	0.06%	0.87%	2008
	Maximum hourly mean	7.5	0.0041	0.006	0.0104	0.08%	0.14%	2005
Antimony	Annual mean	5	0.0017	0.0002	0.0019	0.0031%	0.037%	2008
	Maximum hourly mean	150	0.0034	0.007	0.010	0.0047%	0.007%	2005
Arsenic	Annual mean	0.003	0.00051	0.00015	0.00067	5.1%	22%	2008
	Maximum hourly mean	15	0.00102	0.007	0.008	0.047%	0.05%	2005
Lead	Annual mean	0.5	0.0084	0.00015	0.0085	0.031%	1.7%	2008
Chromium (II and	Annual mean	5	0.0024	0.00015	0.0025	0.0031%	0.050%	2008

Pollutant	Averaging period	EQS (µg/m^3)	Adopted ambient air quality level (µg/m^3)	PC (µg/m^3)	PEC (µg/m^3)	PC / EQS (%)	PEC / EQS (%)	Year of met dataset resulting in maximum PC
III)	Maximum hourly mean	150	0.0047	0.0070	0.012	0.0047%	0.008%	2005
Chromium (VI)	Annual mean	0.0002	0.00012	0.000008	0.00013	3.8%	63%	2008
Cobalt	Annual mean	0.2	0.00070	0.00015	0.0009	0.08%	0.43%	2008
	Maximum hourly mean	6	0.0014	0.007	0.008	0.12%	0.14%	2005
Copper	Annual mean	10	0.0059	0.00015	0.0060	0.0015%	0.060%	2008
	Maximum hourly mean	200	0.012	0.007	0.019	0.0035%	0.009%	2005
Manganese	Annual mean	0.15	0.012	0.0002	0.012	0.10%	8.0%	2008
	Maximum daily mean	1500	0.024	0.007	0.031	0.00047%	0.0020%	2005
Nickel	Annual mean	0.02	0.00090	0.00015	0.0011	0.8%	5.3%	2008
	Maximum hourly mean	30	0.0018	0.007	0.009	0.023%	0.030%	2005
Vanadium	Annual mean	5	0.0019	0.0002	0.0020	0.0031%	0.041%	2008
	Maximum daily mean	1	0.0038	0.005	0.009	0.49%	0.9%	2005
Ammonia	Annual mean	180	1.2	0.059	1.2	0.033%	0.69%	2008
	Maximum hourly mean	2500	2.4	2.7	5.1	0.11%	0.20%	2005
PAHs (BaP)	Annual mean	0.001	0.00046	0.000012	0.00047	1.2%	47%	2008
Dioxins and furans	Annual mean	n/a	$1.1x10^{-08}$	$5.5x10^{-10}$	$1.2x10^{-08}$	n/a	n/a	2008
VOCs	Annual mean	n/a	No baseline	0.09	No baseline	n/a	No baseline	2008
	Maximum hourly mean	n/a	No baseline	4.1	No baseline	n/a	No baseline	2005
Note: BaP is Benzo(a)pyrene								

Impact Assessment

Nitrogen dioxide

9.7.23 With reference to the nitrogen dioxide results presented within Table 9.8, operation of the Renewable Energy Plant it is predicted to contribute a maximum of 2.1% of the annual mean nitrogen dioxide objective and 8.4% of the 1 hour mean nitrogen dioxide objective. Combining the Renewable Energy Plant nitrogen dioxide PC with the adopted ambient air quality level, the PEC is calculated to be 72% of the annual mean nitrogen dioxide objective, and 36% of the 1 hour mean nitrogen dioxide objective.

9.7.24 As these PECs do not exceed or approach the AQOs for nitrogen dioxide, the predicted impact of the Renewable Energy Plant on ambient nitrogen dioxide concentrations is considered not to be significant.

Carbon monoxide

9.7.25 The carbon monoxide results presented within Table 9.8 indicate that operation of the Renewable Energy Plant is predicted to contribute only 0.50% of the maximum running 8 hour mean carbon monoxide objective. Combining the Renewable Energy Plant carbon monoxide PC with the adopted ambient air quality level, the

PEC is calculated to be 5.4% of the maximum running 8 hour mean carbon monoxide objective. As this PEC does not exceed or approach the AQO for carbon monoxide, the predicted impact of the Renewable Energy Plant on ambient carbon monoxide concentrations is insignificant.

PM_{10}

9.7.26 Table 9.8 presents the results of the dispersion modelling with respect to PM_{10}. Operation of the Renewable Energy Plant is predicted to contribute a maximum 0.33% of the annual mean PM_{10} objective and 2.9% of the 98th percentile of the daily mean PM_{10} objective. Combining the Renewable Energy Plant PM_{10} PC with the relevant ambient air quality levels, the PEC is calculated to be 90% of the annual mean PM_{10} objective, and 68% of the 98th percentile of the daily mean PM_{10} objective. As these PECs do not exceed the AQO for PM_{10} and the PCs are less than 1% and 10% of the long term and short term AQOs[14], the predicted impact of the Renewable Energy Plant on ambient PM_{10} concentrations is insignificant.

$PM_{2.5}$

9.7.27 There are currently no statutory ambient air quality limits for $PM_{2.5}$ (particles of 2.5 µm and less) at present, however, future targets are included as part of the UK Air Quality Strategy[33]. As $PM_{2.5}$ particles are a constituent of PM_{10}, which covers a range including larger particles, concentrations of $PM_{2.5}$ must be lower than those for PM_{10}. Table 9.8 shows that the maximum predicted annual average PC of $PM_{2.5}$ is 0.059 µg/m^3, which is 0.49% of the AQO for $PM_{2.5}$. Including the background concentration, the maximum PEC of $PM_{2.5}$ is 8.9 µg/m^3, 74% of the AQO for $PM_{2.5}$ and therefore, even with the conservative assumption that all particulate matter emissions from the proposed plant are in the form of $PM_{2.5}$, the PEC would be within the AQO and therefore the predicted impact is insignificant.

Sulphur dioxide

9.7.28 With reference to the sulphur dioxide results presented within Table 9.8, operation of the Renewable Energy Plant is predicted to contribute a maximum of 9.2% to the 15-minute mean AQO, resulting in a PEC of 18% of the AQO when added to the adopted baseline level. PCs to the hourly and daily mean AQOs are predicted to be 5.1% and 9.7% respectively, resulting in PECs of 12% and 28% of the respective AQOs. A PC of less than 10% compared to the relevant short-term AQOs indicates that the contribution of the proposed Renewable Energy Plant to sulphur dioxide concentrations inside the Grangemouth AQMA is considered insignificant[14].

9.7.29 As part of the Local Air Quality Management process, Falkirk Council has carried out a detailed analysis of sulphur dioxide measurements in the Grangemouth Air Quality Management Area[34]. The assessment covered the year 2007 and provided analysis of measurements from the three continuous sulphur dioxide analysers in Grangemouth (Municipal Chambers (MC), Moray Primary School (Moray) and Inchyra Park) together with wind measurements from a number of locations recorded during the same period. The study focussed on the two analysers which recorded exceedences of the 15-minute mean air quality objective:

- Moray: this analyser is located approximately 1km south of the proposed Renewable Energy Plant and is in the middle of the residential area of Grangemouth. The analyser recorded exceedences when the wind was blowing from the east, with some occurrences from the south east and east north-east. The pollution rose suggested that the primary source of sulphur dioxide at the Moray analyser is located to the east of the monitoring station; and

[33] Department for Environment, Food and Rural Affairs, The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, July 2007

[34] Falkirk Council, Grangemouth AQMA – Further Assessment, June 2010

- MC: this analyser is located approximately 750m south west of the proposed Renewable Energy Plant and is on the north west edge of the residential area of Grangemouth. The analyser recorded exceedences when the wind was blowing from the east and south east, and the pollution rose suggested that the primary source of sulphur dioxide at the Moray analyser is located to the east of the monitoring station.

9.7.30 The analysis concluded that the main source of sulphur dioxide in the area was the Ineos Petrochemical complex which is located to the east and north east of Grangemouth. The complex is located between 1 – 2 km to the east south-east and south east of the Renewable Energy Plant. The analysis also indicated that exceedences generally occurred on sunny days with low wind speeds and no cloud cover (i.e. unstable conditions). The windroses in the Falkirk Council report indicated that exceedences were measured for wind speeds ranging from calm conditions (i.e. 0 m/s) up to 5 – 8 m/s, based on the range of wind speed measurements carried out. The modelling study was carried out using the default settings in ADMS where wind speeds less than 0.75m/s are not used. In order to ensure a robust approach, a sensitivity analysis was carried out to determine if setting the dispersion model to model all wind speeds and assume calm conditions were modelled with a wind speed of 0.3 m/s. This approach is consistent with the approach undertaken by Falkirk Council in the Further Assessment. The results indicated that the modelled 15-minute mean process contributions were within 0.1% of the default study method. On this basis, modelling calm conditions would not affect the model results presented in this chapter.

9.7.31 Based on the analysis carried out by Falkirk Council and summarised above, the proposed Renewable Energy Plant is unlikely to contribute to exceedences of the 15-minute mean objective at sensitive locations in Grangemouth when there are measured exceedences due to emissions from the Ineos Petrochemical complex. When the wind is blowing from the east, the Renewable Energy Plant emissions will be dispersed towards the Carron Dock, Junction Dock and Old Dock area and beyond towards Glensburgh; and would not contribute to exceedences of the 15-minute mean objective measured at the Moray or MC analysers. When the wind is blowing from the south east, emissions from the Renewable Energy Plant will disperse over Carron Dock and beyond to the Skinflats area and would not contribute to exceedences of the 15-minute mean objective measured at the Moray or MC analysers in Grangemouth. When the wind is blowing from the east north-east, emissions from the Renewable Energy Plant will disperse towards the north western edge of the Grangemouth residential area and the MC analyser location. However, as stated above, this area of Grangemouth does not experience any exceedences of the 15-minute mean objective when the wind is blowing from the east north-east or north east. Exceedences are generally measured in the central areas of Grangemouth for these wind directions which is directly south of the Renewable Energy Plant. Furthermore, the results in Table 9.8 indicate that the maximum contribution from the Renewable Energy Plant to 15-minute mean concentrations is less than 10% of the objective value and considered insignificant.

9.7.32 A contour plot showing the predicted 15-minute mean sulphur dioxide concentrations due to emissions from the proposed Renewable Energy Plant is provided in Figure 9.7. The plot shows that for wind blowing from the east north-east, the plant contributes less than 20 µg/m^3 to the 99.9th percentile of 15-minute mean concentrations at the north western edge of the Grangemouth residential area. The point of maximum concentrations is in the restricted port area to the north east of the Renewable Energy Plant. This would not contribute to emissions from the Ineos Petrochemical complex as south westerly winds would disperse emissions from the complex out to the Forth Estuary.

9.7.33 Due to the existing number of exceedences in the Grangemouth area, the use of twice the long term baseline concentration to determine the short term baseline concentration was investigated with Falkirk Council. It was agreed that this approach would be suitable and that the highest measured annual mean concentration recorded at any of the analysers in the Grangemouth area should be used.

Hydrogen chloride and hydrogen fluoride

9.7.34 The results for hydrogen chloride demonstrates that based on the maximum predicted PC of 0.096 µg/m^3 for the annual mean and an adopted air quality level of 0.2 µg/m^3, the PC and the PEC represent 0.48% and

1.5% of the EAL respectively, these are both considered insignificant in terms of their environmental impact. The maximum hourly mean PC for hydrogen chloride is 4.3 µg/m^3 with a baseline air quality level of 0.39 µg/m^3 resulting in a PEC of 4.7 µg/m^3. The PC and PEC represent 0.58% and 0.63% of the EAL respectively. These are considered insignificant in terms of their environmental impact.

9.7.35 The results for hydrogen fluoride demonstrates that based on the maximum predicted PC of 0.0096 µg/m^3 for the annual mean and an adopted air quality level of 3.5 µg/m^3, the PC and the PEC represent 0.06% and 21.9% of the EAL respectively, these are both considered insignificant in terms of their environmental impact. The maximum hourly mean PC for hydrogen fluoride is 0.43 µg/m^3 with a baseline air quality level of 7.0 µg/m^3 resulting in a PEC of 7.4 µg/m^3. The PC and PEC represent 0.27% and 4.6% of the EAL respectively. These are considered insignificant in terms of their environmental impact.

Cadmium and Thallium

9.7.36 The maximum PC for both cadmium and thallium is predicted to be 0.00007 µg/m^3. This is equivalent to 1.4% and 0.007% of the EAL for cadmium and thallium, respectively. The PEC as a percentage of the EAL is 4.7% and 0.087% for cadmium and thallium, respectively. This is considered not significant in terms of the environmental impact of these two species. The maximum hourly mean PC for cadmium and thallium is 0.0032 µg/m^3, which represents 0.21% of the EAL for cadmium (the more stringent EAL) and is considered insignificant in terms of environmental impact.

Mercury

9.7.37 The results for mercury demonstrates that the predicted maximum annual mean PC is 0.00014 µg/m^3 which is 0.06% of the EAL, and is considered insignificant. The maximum hourly mean value for mercury of 0.006 µg/m^3 represents 0.08% of the EAL, and again is considered insignificant.

Antimony, Arsenic, Lead, Chromium, Cobalt, Copper, Manganese, Nickel, Vanadium

9.7.38 The maximum predicted annual mean PC for each of these substances is 0.00015 µg/m^3. This maximum predicted PC as a percentage of the EAL is 5.1% for arsenic, as this has the most stringent EAL. For the other metals (excluding Chromium VI), with less stringent EALs, the contribution to the annual mean EAL ranges from 0.0015% (copper) to 0.8% (nickel). For Chromium (VI), the annual mean PC is 0.000008 µg/m^3 which represents 3.8% of the EAL. The maximum hourly mean values for these species is 0.007 µg/m^3 which represents 0.12% (cobalt) of the most stringent EAL. The maximum daily mean vanadium concentration is 0.005 µg/m^3 which represents 0.5% of the EAL. This is considered to be an insignificant environmental effect.

PAHs

9.7.39 Table 9.8 presents the results of the dispersion modelling with respect to PAHs, assumed to be in the form of benzo(a)pyrene. Operation of the Renewable Energy Plant is predicted to contribute a maximum 1.2% of the annual mean benzo(a)pyrene EAL. Combining the Renewable Energy Plant benzo(a)pyrene PC with the relevant ambient air quality levels, the PEC is calculated to be 47% of the annual mean benzo(a)pyrene EAL. As this PEC does not exceed the EAL for benzo(a)pyrene, the predicted impact of the Renewable Energy Plant on ambient benzo(a)pyrene and PAH concentrations is considered not significant.

Auxiliary Boiler

9.7.40 The results of the dispersion modelling of the auxiliary boiler are shown in Table C.16 of Appendix C. The results were only compared to the short term air quality objectives as described in Section 9.7.18. The results indicate that even assuming continuous operation throughout the year (they are projected to only run 12% of the year) the predicted concentration form the auxiliary boiler will also comply with the relevant air quality objectives.

Airborne Pollutants (Non-Threshold Substances)

9.7.41 Emissions of some substances do not exhibit any apparent threshold for effects. The health risks associated with levels of these substances need to be managed by controlling exposures to very low levels. One method of assessing levels of these substances is by comparing levels of the substances to air quality standards and guidelines, where these are available. These are set at levels which have no significant adverse health effects, based on current scientific knowledge. The risk of health effects can be reduced to a minimal level by ensuring that air quality standards and guidelines for these substances are not breached. This is set out above.

9.7.42 As well as this, it is also possible to calculate the possible effects on health due to forecast levels of these substances as a cross-check on the evaluation against air quality standards and guidelines.

9.7.43 The risks to health associated with emissions of carcinogenic substances are set out in Table 9.9. This calculation would be appropriate for an individual located permanently at the point of maximum modelled impact. Because all the carcinogens of potential concern act on the lung, it is appropriate to provide a maximum total incremental health risk due to exposure to all the carcinogenic substances assessed.

Table 9.9 Health Effects of Exposure to Carcinogens (Incremental Risk)

Substance	Dose-response factor (increase in lifetime cancer risk per 1 µg/m^3 increase in exposure)	Maximum modelled concentration (µg/m^3)	Incremental annual risk
Arsenic	0.0025 (µg/m^3)$^{-1}$	0.00018	6.3 x 10^{-9}
Nickel	0.00038 (µg/m^3)$^{-1}$	0.00018	9.6 x 10^{-10}
Chromium VI	0.004 (µg/m^3)$^{-1}$	0.000009	5.1 x 10^{-10}
Benzo(a)pyrene	0.09 (µg/m^3)$^{-1}$	0.000012	1.5 x 10^{-8}
Total			**2.3 x 10^{-8}**

9.7.44 The total incremental annual risk of contracting cancer due to emissions of carcinogenic substances from the Renewable Energy plant at the point of maximum modelled concentration is 2.3 × 10^{-8} per year. This value is equivalent to approximately a one in 43 million chance per year for an individual located at the point of maximum modelled concentration. A guideline set by the Royal Commission on Environmental Pollution[11] is one in one million per year – that is, the incremental risk associated with the proposed process is one forty third of the highest acceptable risk.

9.7.45 It is also possible to use the modelled concentrations to estimate the likely number per year of cancer cases which would be expected to arise in people living in the vicinity of the Renewable Energy Plant. The assessment was based on an area extending 5 km × 5 km centred on the Renewable Energy Plant, with a population density of 507 people/km^2. The assessment is set out in Table 9.10.

Table 9.10 Health Effects of Exposure to Carcinogens (Number of Additional Cases)

Substance	Average concentration (µg/m^3)	Number of additional cases per year
Arsenic	0.000055	0.000018
Nickel	0.000055	0.0000027
Chromium VI	0.0000027	0.0000014
Benzo(a)pyrene	0.0000038	0.000045
Total		**0.000067**

9.7.46 The total number of additional cancer cases due to exposure to emissions from the proposed Renewable Energy Plant is estimated to be 0.000067 per year. This was based on the highest average modelled concentration for any of the five years of meteorological data. The study area was limited to a 5 km by 5 km zone surrounding the plant, minus the area taken up by the Forth Estuary. Extending the zone further would give an increase on this figure, but the modelling study indicates that the increase is a relatively small increment on the values shown in Table 9.10. This is because, as the study area is extended, the modelled concentrations decrease more rapidly than the size of the study area increases. Over a 25 year lifetime, the annual figures correspond to 0.0017 additional cases in the study area (as a result of exposure to the substances listed in Table 9.10).

Outline Exposure Assessment for Dioxins and Furans

9.7.47 The model provides estimated exposure levels for different age groups, and different exposure patterns. As well as the likely maximum exposure relevant for most residents, the model also provides estimated maximum exposure levels for farmers. A theoretical maximum exposure is also considered, based on extreme assumptions regarding exposure. This is referred to as the "maximum exposed individual" (MEI), and includes assumptions such as spending 100% of the time at the point of maximum modelled dioxin and furan concentrations, and eating exclusively produce grown at the point of maximum impact. Clearly, these assumptions will result in a substantial over-estimate of likely exposure.

9.7.48 The estimated exposure levels due to the Renewable Energy Plant are set out in Table 9.11.

Table 9.11: Estimated Exposures to Dioxins and Furans

Case	Maximum Estimated Exposure	Average Body Weight	Daily Exposure per Unit Body Weight	% of UK long-term Recommended Tolerable Daily Intake of 2 pg TEQ/ kgBW-Day
	pg TEQ /day	Kg	pg TEQ/(kgBW-Day)	
Adult MEI	0.79	70.1	0.0113	0.57%
Adult Resident	0.069	70.1	0.00098	0.049%
Adult Farmer	0.030	70.1	0.00043	0.021%
Child MEI	0.23	15	0.016	0.78%
Child Resident	0.026	15	0.0017	0.085%
Child of Farmer	0.0101	15	0.00068	0.034%
Infant MEI	0.93	8.5	0.109	5.5%
Infant Resident	0.082	8.5	0.0096	0.48%
Infant of Farmer	0.035	8.5	0.0041	0.20%
School Child 6 to 11	0.048	32.5	0.0015	0.074%
School Child 11 to 16	0.051	52.5	0.00096	0.048%

9.7.49 The highest forecast level of exposure is for the hypothetical case of the infant MEI. The highest forecast exposure is 5.5% of the tolerable daily intake value. As noted above, extreme assumptions are used to assess the hypothetical MEI. The modelled exposure levels for residents and farmers are more realistic, while still likely to over-estimate exposure. The highest forecast exposure level for residents and farmers is approximately 0.48% of the tolerable daily intake value. While any increase in intake of dioxins and furans is undesirable, the forecast level of intake from the proposed facility is much smaller than could be detectable in practice, and is likely to be dwarfed by other sources of exposure such as consumption of fish and dairy products. Furthermore, these estimates are based on conservative assumptions regarding the emission concentration of dioxins and furans.

Modelling Sensitivity Analyses

9.7.50 Various sensitivity analyses were carried out to see how changes to some of the modelling options impact on the predicted modelled concentrations. These analyses were based on meteorological data from the Edinburgh Gogarbank meteorological station for 2008, which resulted in the highest predicted concentrations for most substances on the receptor grid. The sensitivity cases are summarised in Table 9.12.

Table 9.12: Sensitivity cases

Sensitivity Analyses	Description
Sensitivity Analysis 1	Model without the buildings option in ADMS, rather than with buildings
Sensitivity Analysis 2	Model with a 20 m receptor grid, rather than the 50 m used
Sensitivity Analysis 3	Model with a fixed low surface roughness value of 0.001m rather than the variable values used in the main modelling
Sensitivity Analysis 4	Model with a fixed high surface roughness value of 0.8m selected rather than the variable values used in the main modelling
Sensitivity Analysis 5	Model using the Edinburgh Gogarbank 2008 meteorological data using an alternative dispersion model, AERMOD (as requested by SEPA)
Sensitivity Analysis 6	Model using measured wind speed and wind direction data from Falkirk Council with all other meteorological parameters from Edinburgh Gogarbank meteorological station

9.7.51 The results of the sensitivity analysis are shown in Table 9.13 – Table 9.18.

Table 9.13: Sensitivity Analysis 1: Buildings

Substance	Averaging period	With buildings		Without buildings		Difference in PC / EQS (%)
		PC / EQS (%)	PEC / EQS (%)	PC / EQS (%)	PEC / EQS (%)	
Nitrogen Dioxide	Annual mean	2.1%	70.6%	0.9%	69.4%	-1.2%
	99.8th percentile of 1 hour means	8.4%	35.8%	3.7%	31.1%	-4.7%
Sulphur Dioxide	99.9th percentile of 15 minute means (method 2)	9.1%	17.5%	6.5%	14.9%	-2.7%
	99.7th percentile of 1 hour means	5.1%	11.5%	2.2%	8.6%	-2.9%
	99.2nd percentile of daily means	8.9%	26.8%	2.8%	20.7%	-6.1%

9.7.52 The results set out in Table 9.13 indicate that the concentrations are higher with the significant buildings and structures included in the model. Therefore, including the buildings is a conservative approach and the preferred option for this study.

Table 9.14: Sensitivity Analysis 2: 20 m Receptor Grid

Substance	Averaging period	With 50 m receptor grid		With 20 m receptor grid		Difference in PC / EQS (%)
		PC / EQS (%)	PEC / EQS (%)	PC / EQS (%)	PEC / EQS (%)	
Nitrogen Dioxide	Annual mean	2.1%	70.6%	2.1%	70.6%	0.02%
	99.8th percentile of 1 hour means	8.4%	35.8%	8.4%	35.8%	-0.01%
Sulphur Dioxide	99.9th percentile of 15 minute means (method 2)	9.1%	17.5%	9.2%	17.6%	0.03%
	99.7th percentile of 1 hour means	5.1%	11.5%	5.1%	11.5%	-0.01%
	99.2nd percentile of daily means	8.9%	26.8%	9.0%	26.9%	0.1%

9.7.53 The results set out in Table 9.14 indicate that the results from modelling air pollutant concentrations on a 20 m receptor grid compared with a 50 m receptor grid are variable. In some cases the predicted concentrations increase when modelled on a 20 m receptor grid and in some cases the concentration decreases marginally. The impact of modelling air pollution concentrations on a 20 m grid does not significantly affect the study findings. Using a 50 m receptor grid in the dispersion modelling is considered to be satisfactory for this study.

Table 9.15: Sensitivity Analysis 3 Variable Surface Roughness Compared to a Constant Surface Roughness of 0.001m

Substance	Averaging period	With variable surface roughness		With a fixed surface roughness of 0.001m		Difference in PC / EQS (%)
		PC / EQS (%)	PEC / EQS (%)	PC / EQS (%)	PEC / EQS (%)	
Nitrogen Dioxide	Annual mean	2.1%	70.6%	1.0%	69.5%	-1.1%
	99.8th percentile of 1 hour means	8.4%	35.8%	10.0%	37.4%	1.6%
Sulphur Dioxide	99.9th percentile of 15 minute means (method 2)	9.1%	17.5%	11.0%	19.4%	1.8%
	99.7th percentile of 1 hour means	5.1%	11.5%	6.1%	12.5%	0.9%
	99.2nd percentile of daily means	8.9%	26.8%	8.7%	26.6%	-0.2%

Table 9.16: Sensitivity Analysis 4: Variable Surface Roughness Compared to a Constant Surface Roughness of 0.8m

Substance	Averaging period	With variable surface roughness		With a fixed surface roughness of 0.8m		Difference in PC / EQS (%)
		PC / EQS (%)	PEC / EQS (%)	PC / EQS (%)	PEC / EQS (%)	
Nitrogen Dioxide	Annual mean	2.1%	70.6%	2.2%	70.8%	0.2%
	99.8th percentile of 1 hour means	8.4%	35.8%	8.7%	36.1%	0.3%
Sulphur Dioxide	99.9th percentile of 15 minute means (method 2)	9.1%	17.5%	9.4%	17.8%	0.3%
	99.7th percentile of 1 hour means	5.1%	11.5%	5.3%	11.7%	0.1%
	99.2nd percentile of daily means	8.9%	26.8%	9.3%	27.2%	0.4%

9.7.54 The results set out in Table 9.15 and Table 9.16 indicate that the concentrations are generally slightly lower with the variable surface roughness included in the model. However, including the variable surface roughness is considered a more realistic approach and the preferred option for this study.

Table 9.17: Sensitivity Analysis 5: AERMOD

Substance	Averaging period	With ADMS 4.2		With AERMOD		Difference in PC / EQS (%)
		PC / EQS (%)	PEC / EQS (%)	PC / EQS (%)	PEC / EQS (%)	
Nitrogen Dioxide	Annual mean	2.1%	70.6%	2.2%	70.8%	0.1%
	99.8th percentile of 1 hour means	8.4%	35.8%	19.4%	46.8%	11.0%
Sulphur Dioxide	99.9th percentile of 15 minute means (method 2)	9.1%	17.5%	21.7%	30.1%	12.6%
	99.7th percentile of 1 hour means	5.1%	11.5%	11.3%	17.7%	6.2%
	99.2nd percentile of daily means	8.9%	26.8%	5.7%	23.6%	-3.2%

9.7.55 The results set out in Table 9.17 indicate that the predicted ground level concentrations are higher with the ADMS model for the 24-hour mean sulphur dioxide concentrations. Predicted annual mean concentrations are very similar using both models. The 15-minute mean and 1-hour mean concentrations are higher using AERMOD. These differences in model predictions are due to the slightly different methods utilised by each model to calculate plume rise, building effects and process the meteorological data. Even with the higher results, the predicted concentrations are not expected to exceed the air quality objectives. The analysis of sulphur dioxide concentrations carried out in section 9.7.29 – 9.7.33 indicate that using the higher 15-minute mean concentrations predicted by AERMOD would not lead to a contribution to measured exceedences of the air quality objective value in the Grangemouth area.

Table 9.18: Sensitivity Analysis 6: Meteorological data

Substance	Averaging period	Edinburgh Gogarbank data		Falkirk Council data		Difference in PC / EQS (%)
		PC / EQS (%)	PEC / EQS (%)	PC / EQS (%)	PEC / EQS (%)	
Nitrogen Dioxide	Annual mean	2.1%	70.6%	2.1%	70.7%	0.07%
	99.8th percentile of 1 hour means	8.4%	35.8%	8.3%	35.7%	-0.14%
Sulphur Dioxide	99.9th percentile of 15 minute means (method 2)	9.1%	17.5%	9.3%	17.7%	0.18%
	99.7th percentile of 1 hour means	5.1%	11.5%	5.0%	11.4%	-0.11%
	99.2nd percentile of daily means	8.9%	26.8%	8.6%	26.5%	-0.30%

9.7.56 The meteorological data used in this study were obtained from the Edinburgh Gogarbank meteorological station, located approximately 25 km southeast of the site. Wind speed and direction data were also obtained from Falkirk Council, from a measurement station co-located with the Grangemouth Municipal Chambers air quality monitoring station. A sensitivity study was conducted to assess the difference in modelled process contributions using the Edinburgh Gogarbank meteorological data and the wind measurements from Falkirk Council.

9.7.57 The wind speed and direction data from Falkirk Council were used, and all other meteorological parameters were assumed to be the same as at Edinburgh Gogarbank. One year of hourly data were used in the models (01/01/2008 to 31/12/2008). Falkirk Council wind measurements were taken at 3 m above the ground. This was accounted for in ADMS.

9.7.58 The model results (Table 9.18) using Edinburgh Gogarbank meteorological data generally predicted higher concentrations than the model using the Falkirk Council measured wind data. Annual mean and 15-minute mean concentrations were slightly higher using AERMOD. As the full Edinburgh Gogarbank meteorological dataset was used in the modelling, these results confirm that a suitable approach was adopted throughout the study.

Air quality, and nitrogen and acid deposition at designated sites

9.7.59 Figure 12.2 shows the European and national designated sites for nature conservation within 15 km of the proposed development site. There are 24 designated habitat sites within 15 km of proposed biomass site, four of these have European designations, including the Firth of Forth (North and South shore) SPA/SSSI, Blawhorn Moss and Black Loch Moss SAC/SSSI, and the remaining 20 are nationally designated SSSI sites. These are all described in Appendix C.

Air Quality

9.7.60 Whilst only nitrogen dioxide may impact human health, both nitrogen dioxide and nitric oxide are absorbed by vegetation. Their effects on plants are additive and the scientific consensus is that they should be treated together (i.e. as total oxides of nitrogen (NO_x)). Site specific information on background levels of the pollutants of concern with regards to such sites, i.e. oxides of nitrogen and sulphur dioxide, at each of the designated sites is available from the Air Pollution Information System (APIS) database[18] and has been used in this assessment.

9.7.61 There are 24 potentially sensitive designated habitat sites within 15 km of the proposed facility. Forecast levels of oxides of nitrogen, sulphur dioxide and ammonia at these locations were assessed against the relevant standards and guidelines for protection of vegetation. The results in Table 9.19 show the modelled concentrations for all European designated habitat sites and also any nationally designated habitat sites with a PC greater than 1% of the relevant air quality objectives and guidelines for any substance. A full set of the results are given in Appendix C.

9.7.62 The table also shows the expected maximum additional increments to the existing ground level concentrations of oxides of nitrogen and sulphur dioxide at the protected sites due to full load operation. The maximum concentrations over the five meteorological years modelled are presented to ensure a suitably precautionary approach.

Table 9.19: Predicted Maximum levels of released substances at designated habitat sites

Pollutant	Designated Habitat Site	Averaging period	EQS (µg/m³)	Adopted ambient air quality level (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC / EQS (%)	PEC / EQS (%)
Oxides of nitrogen	Firth of Forth (SPA/SSSI)	Annual mean	30	23.9	3.9	28	13%	93%
	Slamannan Plateau (SPA/SSSI)			10.8	0.16	10.9	0.52%	36.5%
	Blawhorn Moss (SAC/SSSI)			9.8	0.04	9.9	0.14%	33%
	Black Loch Moss (SAC/SSSI)			9.4	0.05	9.5	0.16%	32%
	Howierig Muir (SSSI)			11.8	0.23	12	0.8%	40%
	Lockshaw Mosses (SSSI)			10.7	0.22	11	0.7%	36%
	Steelend Moss (SSSI)			10.9	0.28	11	0.9%	37%
Sulphur dioxide	Firth of Forth (SPA/SSSI)	Annual mean	20	8.0	1.48	9.4	7.4%	47%
	Slamannan Plateau (SPA/SSSI)			1.5	0.06	1.6	0.3%	8.0%
	Blawhorn Moss (SAC/SSSI)			1.8	0.02	1.8	0.1%	9%
	Black Loch Moss (SAC/SSSI)			1.5	0.02	1.5	0.1%	7%
	Howierig Muir (SSSI)			1.4	0.09	1.5	0.43%	7.5%
	Lockshaw Mosses (SSSI)			3.2	0.08	3.3	0.40%	17%
	Steelend Moss (SSSI)			4.2	0.10	4.3	0.52%	22%
Ammonia	Firth of Forth (SPA/SSSI)	Annual mean	3	1.2	0.20	1.4	6.7%	47%
	Slamannan Plateau (SPA/SSSI)		3		0.008	1.20	0.3%	40%
	Blawhorn Moss (SAC/SSSI)		1		0.002	1.19	0.2%	119%
	Black Loch Moss (SAC/SSSI)		1		0.002	1.19	0.2%	119%
	Howierig Muir (SSSI)		1		0.011	1.2	1.1%	120%
	Lockshaw Mosses (SSSI)		1		0.011	1.2	1.1%	120%
	Steelend Moss (SSSI)		1		0.014	1.2	1.4%	120%

Pollutant	Designated Habitat Site	Averaging period	EQS (µg/m^3)	Adopted ambient air quality level (µg/m^3)	PC (µg/m^3)	PEC (µg/m^3)	PC / EQS (%)	PEC / EQS (%)
	Firth of Forth (SPA/SSSI)	Maximum hourly mean	3300	2.4	2.4	4.8	0.073%	0.15%
	Slamannan Plateau (SPA/SSSI)				0.37	2.75	0.01%	0.08%
	Blawhorn Moss (SAC/SSSI)				0.32	2.70	0.01%	0.08%
	Black Loch Moss (SAC/SSSI)				0.34	2.72	0.01%	0.08%
	Howierig Muir (SSSI)				0.45	2.8	0.014%	0.086%
	Lockshaw Mosses (SSSI)				0.46	2.8	0.014%	0.086%
	Steelend Moss (SSSI)				0.29	2.7	0.0089%	0.081%

9.7.63 The expected increments of oxides of nitrogen, sulphur dioxide and ammonia at the protected sites are generally low apart from at the Firth of Forth SPA/SSSI. The maximum annual average process contribution of either pollutant at the Firth of Forth SPA/SSSI is 13% of the air quality objective for the protection of vegetation. The predicted environmental concentrations comply with the respective guideline levels for all substances apart from annual mean ammonia at the Firth of Forth SPA/SSSI, Howierig Muir SSSI, Lockshaw Mosses SSSI and Steelend Moss SSSI. However, the background ammonia concentration at these sites alone exceeds the air quality objective.

9.7.64 The highest concentrations at the Firth of Forth SPA/SSSI reported in Table 9.19 are predicted to occur at mudflat areas to the north east of the development site that are below the high tide line of the Forth Estuary. As a consequence, these areas are regularly covered and inundated by the open water of the Forth Estuary and there would be little or no impact due to airborne concentrations of pollutants at these locations. Concentrations of oxides of nitrogen, sulphur dioxide and ammonia were therefore also predicted at areas within the Firth of Forth SPA and SSSI areas that are above the high tide line of the Forth Estuary. The areas in the vicinity of the site which were assessed are as follows:

- Area of the Firth of Forth SPA/SSSI at Skinflats adjacent to the Forth Estuary;
- Area of the Firth of Forth SSSI at Skinflats (not part of the Firth of Forth SPA);
- Area of the Firth of Forth SPA/SSSI at Kinneil adjacent to inland tidal lagoon and Forth Estuary;
- Area of the Firth of Forth SPA/SSSI to the north west of Bo'ness, adjacent to the Forth Estuary; and
- Preston Island, part of the Firth of Forth SSSI (not part of the Firth of Forth SPA) on the north side of the Forth Estuary.

9.7.65 The predicted concentrations of oxides of nitrogen, sulphur dioxide and ammonia at these locations are set out in Table 9.20.

Table 9.20: Predicted Maximum levels of released substances at Firth of Forth SPA/SSSI areas not regularly covered or inundated by Forth Estuary

Pollutant	Designated Habitat Site	Averaging period	EQS (µg/m³)	PC (µg/m³)	PC / EQS (%)
Oxides of nitrogen	Skinflats SPA area	Annual mean	30	0.20	0.68%
	Skinflats SSSI area			0.20	0.68%
	Kinneil SPA area			0.13	0.44%
	Bo'ness SPA area			0.16	0.55%
	Preston Island SSSI area			0.76	2.5%
Sulphur dioxide	Skinflats SPA area	Annual mean	20	0.076	0.38%
	Skinflats SSSI area			0.077	0.38%
	Kinneil SPA area			0.049	0.25%
	Bo'ness SPA area			0.061	0.31%
	Preston Island SSSI area			0.28	1.4%
Ammonia	Skinflats SPA area	Annual mean	3	0.009	0.32%
	Skinflats SSSI area			0.010	0.34%
	Kinneil SPA area			0.007	0.22%
	Bo'ness SPA area			0.008	0.27%
	Preston Island SSSI area			0.038	1.3%

9.7.66 The results in Table 9.20 indicate that at the Firth of Forth SPA areas not regularly covered or inundated by open water from the Forth Estuary, the predicted annual mean process contributions of oxides of nitrogen, sulphur dioxide and ammonia are relatively low and are all below 1% of the relevant air quality objectives and guidelines. At the Firth of Forth SSSI areas which are not part of the SPA, the highest predicted annual mean process contribution is 2.5% of the relevant air quality objective or guideline. This occurs at the Preston Island area of the Firth of Forth SSSI. This indicates that emissions from the proposed Renewable Energy Plant are unlikely to significantly affect the sensitive Firth of Forth SPA areas above the water line.

9.7.67 The annual mean oxides of nitrogen, sulphur dioxide and ammonia process contributions are greater than 1% of the relevant EQS at the Firth of Forth SSSI (Preston Island) and the annual mean ammonia concentration is greater than 1% at Howierig Muir, Lockshaw Mosses and Steelend Moss SSSI. This indicates that the need for a further deposition assessment for these designated habitat sites. This is described below in the Acid and Nitrogen Deposition section. Although the predicted concentrations at the Firth of Forth SPA areas above the high tide line are considered insignificant, these areas were included in the deposition assessment due to their proximity to the proposed site.

9.7.68 In order to determine the potential impact beyond a radius if 15 km from the proposed plant, the results for each substance were plotted to determine where the predicted ground level concentrations (PC) of each substance fell below the 1% criteria (i.e. where PC / EQS was less than 1%). For the annual mean oxides of nitrogen, sulphur dioxide and ammonia (3 µg/m³) guidelines, the 1% contour was at 15 km or less from the plant. For the 1 µg/m³ guideline for ammonia, the 1% contour extended up to approximately 25 km to the north east of the plant. Information on the location of habitat sites greater than 15 km from the plant was obtained and the locations compared to this contour plot. There are no national or European designated habitat sites within the 1% contour for the annual mean ammonia guideline of 1 µg/m³. On this basis, no designated habitat sites other than those assessed here will potentially be affected by emissions to air from the proposed plant.

Acid and Nitrogen Deposition

9.7.69 The rate of deposition of acidic compounds and nitrogen-containing species at Firth of Forth SPA/SSSI, Blawhorn Moss SAC/SSSI, Black Loch Moss SAC/SSSI and Howierig Muir, Lockshaw Mosses and Steelend

Moss SSSI sites has been estimated. This allows the potential for adverse effects to be evaluated by comparison with critical loads for acid and nutrient nitrogen deposition. The assessment took account of emissions of sulphur dioxide, oxides of nitrogen and ammonia.

9.7.70 Critical load functions for acid deposition at European sites (SPA or SAC) are specified on the basis of both nitrogen-derived acid and sulphur-derived acid. This information, including existing deposition levels at habitat sites, is available on the UK Air Pollution Information System (APIS)[18]. The critical load function contains separate critical load values for sulphur derived and nitrogen derived acid deposition and is site specific. The next step is to calculate the critical load as a total acid deposition value and this is carried out by summing the sulphur and nitrogen critical load function values. On this same basis, the process contribution is calculated by summing the sulphur and nitrogen derived acid deposition so that a direct comparison can be made to the total acid deposition critical load value calculated previously The process contribution can then be calculated as a percentage of this critical load value. This data was collected for the Firth of Forth SPA/SSSI, Blawhorn Moss SAC/SSSI and Black Loch Moss SAC/SSSI where available.

9.7.71 At nationally designated sites (SSSI), the critical load is expressed as a single total acid deposition value and the process contribution was calculated by summing the sulphur and nitrogen derived acid deposition.

9.7.72 For the on-land areas of the Firth of Forth SPA/SSSI above the mean high tide line, critical load values and existing acid and nitrogen deposition data were obtained from the APIS website based on location and range of habitat types which may be present at the location. This approach was also used for the nationally designated (SSSI) sites. Further information on the assessment of deposition is provided in Appendix C. The results are set out in Tables 9.21 and Table 9.22.

Table 9.21: Expected Contribution to Acid Deposition at designated sites (kEqH+ /ha/yr)

Site		Estimated acid deposition (kEqH+/ha-year)					
		Critical Load (CL)	PC	PC/CL (%)	Existing levels	PEC	PEC/CL (%)
Firth of Forth SPA/SSSI	Mudflats below high tide	Not sensitive to acid deposition (no critical load available)					
	Skinflats area	4.00	0.018	0.4%	1.13	1.15	29%
	Kinneil area	4.00	0.012	0.3%	1.01	1.02	26%
	Bo'ness area	0.75	0.015	1.9%	1.01	1.02	137%
Firth of Forth SSSI	Skinflats area	4.00	0.018	0.5%	1.13	1.15	29%
	Preston Island	0.75	0.067	9.0%	1.03	1.10	146%
Slamannan Plateau SPA/SSSI		0.62	0.014	2.2%	1.30	1.31	212%
Blawhorn Moss SAC/SSSI		0.61	0.004	0.6%	1.06	1.06	174%
Black Loch Moss SAC/SSSI		0.59	0.004	0.7%	1.07	1.07	182%
Howierig Muir SSSI		1.5	0.014	1.4%	1.24	1.25	84%
Lockshaw Mosses SSSI		0.75	0.013	2.5%	1.03	1.04	139%
Steelend Moss SSSI		0.75	0.017	3.3%	1.19	1.21	161%

9.7.73 The results show that the modelled process contribution to acid deposition is below the critical loads at all designated sites. The critical load at several sites is exceeded due to the existing background acid deposition. The highest acid deposition contribution occurs at the Preston Island area of the Firth of Forth SSSI. The highest acid deposition contributions at the European designated sites are 2.2% of the critical load at the Slamannan Plateau SPA and 1.9% at the Bo'ness area of the Firth of Forth SPA. Existing acid deposition at these areas is above the critical load values. The process contribution at the Blawhorn Moss and Black Loch Moss SACs is below 1% of the critical load.

Table 9.22: Expected Contribution to Dry Deposition of Nitrogen at designated sites (kg nitrogen/ha/yr)

Site		Estimated nutrient N deposition (kgN/ha-year)					
		Critical Load (CL)	PC	PC/CL (%)	Existing levels	PEC	PEC/CL (%)
Firth of Forth SSSI, SPA	Mudflats below high tide level	30	1.42	4.7%	19.0	20.4	68%
	Skinflats area	10	0.070	0.7%	14.0	14.1	141%
	Kinneil area	10	0.048	0.5%	12.2	12.2	122%
	Bo'ness area	10	0.059	0.6%	12.2	12.3	123%
Firth of Forth SSSI	Skinflats area	10	0.074	0.7%	14.0	14.1	141%
	Preston Island	10	0.27	2.7%	12.7	13.0	130%
Slamannan Plateau SPA/SSSI		5	0.06	1.1%	14.8	14.86	297%
Blawhorn Moss SAC/SSSI		5	0.015	0.3%	10.9	10.92	218%
Black Loch Moss SAC/SSSI		5	0.018	0.4%	10.9	10.92	218%
Howierig Muir SSSI		5	0.08	1.7%	15.4	15.5	310%
Lockshaw Mosses SSSI		5	0.08	1.6%	12.7	12.8	256%
Steelend Moss SSSI		5	0.10	2.0%	15.0	15.1	302%

9.7.74 The results show that the modelled process contribution to nutrient nitrogen deposition is below the critical loads at all designated sites. The critical load at most of the sites is exceeded due to the existing background nitrogen deposition. The highest nitrogen deposition contribution occurs at the Preston Island area of the Firth of Forth SSSI. The highest nitrogen deposition contribution at a European designated site is 4.7% of the critical load. However, as discussed in 9.7.59, these areas of the Firth of Forth SPA are below the high tide and are regularly covered and inundated with open water from the Forth Estuary. At areas above the high tide within the SPA area, the nitrogen deposition is no higher than 0.7% of the relevant critical load. (Skinflats area the Firth of Forth SPA). At the Slamannan Plateau, the modelled nitrogen deposition is 1.1% of the relevant critical load.

9.7.75 With respect to European sites, a process contribution to acid or nitrogen deposition of more than 1% of the critical load triggers the need for a Habitat Regulations Appropriate Assessment[35]. In this case the acid deposition process contribution at a relevant location within the Firth of Forth SPA is 1.9% of the critical load and existing acid deposition levels exceed the critical load. The predicted acid and nitrogen deposition at the Slamannan Plateau SPA are above 1% of the relevant critical loads. The significance of the predicted deposition at the SPAs is addressed in Chapter 12 Terrestrial Ecology.

Sea Haar

9.7.76 The east coast of Scotland experiences a meteorological phenomenon known as Haar. Haar is a local name for a sea fog formation commonly occurring between April and September on or near the east coast or the Northern Isles.

9.7.77 Haar is formed when a warm parcel of air passes over the cold North Sea. The warm air at the bottom of the parcel is cooled by the cold air beneath it below its "dew-point", when the moisture within the parcel

[35] Environment Agency, 2007. EU Habitats and Birds Directive Handbook

condenses. Under certain conditions, the air parcel is blown onshore and the condensate can be spread upwards to form the Haar[36].

9.7.78 Ground level pollutant concentrations are often highest during warmer sunny conditions, when solar radiation more easily penetrates the atmosphere, resulting in increased atmospheric turbulence. Under Haar conditions, atmospheric turbulence is often decreased through a reduction in solar energy penetration to the ground, and the resulting cooling of the ground. As a result, ground level pollutant concentrations are predicted to be lower under Haar conditions.

9.7.79 However, more stable atmospheric conditions, coupled with a boundary layer temperature inversion, can reduce the boundary layer mixing height. Under these conditions, vertical mixing and dispersion of the pollutants released from the proposed Renewable Energy Plant stack may be reduced. However, if the stable conditions are such that the temperature inversion occurs at a level below the proposed stack height, this may also reduce the ground level pollutant concentrations.

9.7.80 Cooler conditions during the winter often reduce the likelihood of Haar formation, and so its impacts are less pronounced.

9.7.81 The dispersion modelling assessment for the proposed Renewable Energy Plant at Grangemouth has been undertaken using meteorological data collected at the Edinburgh Gogarbank meteorological station, approximately 25 km east south-east of the site. The location of the meteorological station on the east coast of Scotland is known to experience Haar conditions. Therefore, Haar conditions have been taken into account within the modelling assessment through the use of meteorological data recorded at this station. A sensitivity analysis using meteorological data recorded at the port facility was also included in the assessment and these data would also include Haar conditions.

Cumulative Impacts

9.7.82 Potential cumulative effects with adjacent existing industrial sources have been accounted for in the assessment through the use of background concentrations which include a contribution from these sources. There is a development with planning permission close to the existing Longannet Power Station, the Longannet Biomass Power Station, which is not yet operational. The Longannet Biomass Power Station will be located across the Firth of Forth, approximately 4 km to the north of the proposed Renewable Energy Plant. The Environmental Statement (ES) for the Longannet Life Extension Project[37] indicates that emissions of oxides of nitrogen and sulphur dioxide will be reduced significantly due to the Flue Gas Desulphurisation and Life Extension projects. The ES also concludes that these projects would offset emissions from the proposed Longannet Biomass Power Station and the overall impact of the on air quality would be of neutral significance. On this basis, and due to the fact that the proposed Longannet Biomass Power Station plant is over 4km to the of the proposed Renewable Energy Plant and therefore not upwind or downwind of the prevailing wind directions (see windroses in Appendix C), there is unlikely to be any cumulative effects due to the Longannet Biomass Power Station and no further consideration of this source is required. The proposed Grangemouth Biodiesel plant was screened out as insignificant with respect to air quality in the ES carried out for the development[38]. Emissions to air were described as “negligible.” On this basis, there is unlikely to be any cumulative effects due to the Biodiesel plant and no further consideration of this source is required.

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[36] J.M Lewis, D Koracin, K.T Redmond, Fog Reasearch in the United Kingdon and the United States, A Historical Essay Including Outlook, The Bulletin of the American Meteorological Society, Vol 85, Issue 3, p395 – 408, March 2004.

[37] Scottish Power, Application under Section 36 of the Electricity Act 1989: Environmental Upgrades at Longannet Generating Station, Fife and Revisions to the Ash Disposal Strategy at Valleyfield and Longannet Ash lagoons, Fife. Volume 2 Environmental Statement – Main Report, April 2009.

[38] Ineos Enterprises, Grangemouth Biodiesel Project, Environmental Statement, Volume 2 (of 3): Main Text, 13 March 2007, Issue 7.

9.7.83 There is the potential for cumulative effects at designated habitat locations due to emissions from the other proposed Renewable Energy Plants located adjacent to the Forth Estuary and Firth of Forth. These proposed by Forth Energy for sites at Rosyth and Leith. The proposed Rosyth and Leith Renewable Energy Plants are located approximately 18 km and 34 km to the east of the proposed Grangemouth plant, respectively. Cumulative levels of oxides of nitrogen, sulphur dioxide and ammonia were forecast at the 24 sensitive designated habitat sites within 15 km of the proposed Grangemouth facility. The full results are set out in Appendix C and show the expected increment at the habitat sites due to the emissions from the other two plants. The results in Table 9.23 show the modelled concentrations for all European designated habitat sites and also any nationally designated habitat sites with a PC greater than 1% of the relevant air quality objectives and guidelines for any substance.

Table 9.23: Predicted Maximum levels of released substances at designated habitat sites, cumulative impacts

Pollutant	Designated Habitat Site	Averaging period	EQS (µg/m³)	Adopted ambient air quality level (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC / EQS (%)	PEC / EQS (%)
Oxides of nitrogen	Firth of Forth (SPA/SSSI)	Annual mean	30	23.9	3.99	27.9	13.3%	92.9%
	Slamannan Plateau (SPA/SSSI)			10.8	0.22	11.0	0.75%	36.7%
	Blawhorn Moss (SAC/SSSI)			9.8	0.14	10.0	0.47%	33.3%
	Black Loch Moss (SAC/SSSI)			9.4	0.14	9.6	0.46%	31.9%
	Howierig Muir (SSSI)			11.8	0.30	12.1	0.99%	40.2%
	Lockshaw Mosses (SSSI)			10.7	0.20	20.5	0.67%	68.2%
	Steelend Moss (SSSI)			10.9	0.05	11.3	0.17%	37.6%
Sulphur dioxide	Firth of Forth (SPA/SSSI)	Annual mean	20	8.0	1.50	9.4	7.5%	47.2%
	Slamannan Plateau (SPA/SSSI)			1.5	0.08	1.6	0.4%	8.1%
	Blawhorn Moss (SAC/SSSI)			1.8	0.05	1.8	0.3%	9.0%
	Black Loch Moss (SAC/SSSI)			1.5	0.05	1.5	0.3%	7.5%
	Howierig Muir (SSSI)			1.4	0.11	1.5	0.6%	7.6%
	Lockshaw Mosses (SSSI)			3.2	0.08	2.7	0.4%	13.3%
	Steelend Moss (SSSI)			4.2	0.02	1.7	0.1%	8.7%
Ammonia	Firth of Forth (SPA/SSSI)	Annual mean	3	1.2	0.20	1.39	6.7%	46%
	Slamannan Plateau (SPA/SSSI)		3		0.01	1.20	0.4%	40%
	Blawhorn Moss (SAC/SSSI)		1		0.01	1.20	0.7%	120%
	Black Loch Moss (SAC/SSSI)		1		0.01	1.20	0.7%	120%
	Howierig Muir (SSSI)		1		0.01	1.20	1.5%	120%
	Lockshaw Mosses (SSSI)		1		0.01	1.20	0.3%	40%
	Steelend Moss (SSSI)		1		0.00	1.19	0.1%	40%
	Firth of Forth (SPA/SSSI)	Maximum hourly mean	3300	2.4	2.80	5.18	0.08%	0.16%
	Slamannan Plateau (SPA/SSSI)				0.66	3.04	0.02%	0.09%
	Blawhorn Moss (SAC/SSSI)				0.65	3.03	0.02%	0.09%
	Black Loch Moss (SAC/SSSI)				0.63	3.01	0.02%	0.09%
	Howierig Muir (SSSI)				0.76	3.14	0.02%	0.10%
	Lockshaw Mosses (SSSI)				0.94	3.32	0.03%	0.10%
	Steelend Moss (SSSI)				0.80	3.18	0.02%	0.10%

9.7.84 The results in Table 9.23 indicate that when emissions from the proposed Rosyth and Leith Renewable Energy Plants are included, no additional sites are forecast to exceed the criteria of process contribution greater than 1% of the relevant air quality objectives and guidelines. In line with the assessment carried out for the proposed Grangemouth Renewable Energy Plant in isolation, concentrations of oxides of nitrogen, sulphur dioxide and ammonia were also predicted at areas within the Firth of Forth SPA and SSSI that are above the high tide line of the Forth Estuary. The results are set out in Table 9.24.

Table 9.24: Predicted Maximum levels of released substances at Firth of Forth SPA/SSSI areas not regularly covered or inundated by Forth Estuary, cumulative impacts

Pollutant	Designated Habitat Site	Averaging period	EQS (µg/m^3)	PC (µg/m^3)	PC / EQS (%)
Oxides of nitrogen	Skinflats SPA area	Annual mean	30	0.26	0.86%
	Skinflats SSSI area			0.26	0.86%
	Kinneil SPA area			0.23	0.78%
	Bo'ness SPA area			0.26	0.88%
	Preston Island SSSI area			0.79	2.6%
Sulphur dioxide	Skinflats SPA area	Annual mean	20	0.10	0.48%
	Skinflats SSSI area			0.10	0.49%
	Kinneil SPA area			0.09	0.44%
	Bo'ness SPA area			0.10	0.49%
	Preston Island SSSI area			0.30	1.5%
Ammonia	Skinflats SPA area	Annual mean	3	0.013	0.43%
	Skinflats SSSI area			0.013	0.43%
	Kinneil SPA area			0.012	0.39%
	Bo'ness SPA area			0.013	0.44%
	Preston Island SSSI area			0.039	1.3%

9.7.85 The results set out in Table 9.24 indicate that there is little additional impact at the assessed areas and no additional sites are forecast to exceed the 1% criteria.

9.7.86 The rate of deposition of acidic compounds and nitrogen-containing species at Firth of Forth SPA /SSSI, Blawhorn Moss SAC/SSSI, Black Loch Moss SAC/SSSI Howierig Muir, Lockshaw Mosses and Steelend Moss SSSI sites has been estimated. The assessment took account of emissions of sulphur dioxide, oxides of nitrogen and ammonia from the three proposed Renewable Energy Plants. The results are set out in Table 9.25 and Table 9.26. The results presented are the maximum predicted at each assessed area.

Table 9.25: Expected Contribution to Acid Deposition at designated sites (kEqH+ /ha/yr), cumulative impacts

Site		Estimated acid deposition (kEqH+/ha-year)					
		Critical Load (CL)	PC	PC/CL (%)	Existing levels	PEC	PEC/CL (%)
Firth of Forth SPA/SSSI	Mudflats below high tide	Not sensitive to acid deposition (no critical load available)					
	Skinflats area	4.00	0.023	0.6%	1.13	1.15	29%
	Kinneil area	4.00	0.021	0.5%	1.01	1.03	26%
	Bo'ness area	0.75	0.023	3.1%	1.01	1.03	138%
Firth of Forth SSSI	Skinflats area	4.00	0.023	0.6%	1.13	1.15	29%
	Preston Island	0.75	0.070	9.3%	1.03	1.10	147%
Slamannan Plateau (SPA/SSSI)		0.62	0.020	3.2%	1.30	1.32	213%
Blawhorn Moss SAC		0.61	0.012	2.0%	1.06	1.07	176%
Black Loch Moss SAC		0.59	0.012	2.1%	1.07	1.08	183%
Howierig Muir SSSI		1.5	0.026	1.7%	1.24	1.27	84%
Lockshaw Mosses SSSI		0.75	0.021	2.8%	1.03	1.05	140%
Steelend Moss SSSI		0.75	0.026	3.5%	1.19	1.22	162%

9.7.87 The results show that when the Rosyth and Leith Renewable Energy Plants are included, the modelled process contribution at the SSSIs does not change significantly. For the European designated sites, the Bo'ness area of the Firth of Forth SPA increases from 1.9% of the critical load to 3.1% and at Slamannan Plateau the acid deposition increases from 2.2% to 3.2% of the critical load. Similarly, the increases at the Blawhorn Moss and Black Loch Moss SACs result in a process contribution which is above 1% of the relevant critical loads. Existing acid deposition is above the critical loads at these sites, and the increase due to the cumulative emissions from the three Renewable Energy Plants (0.008 kEqH+/ha-year) represents less than 1% of the existing acid deposition levels. The significance of these cumulative deposition rates for the various designated sites is addressed in Chapter 12 Terrestrial Ecology.

Table 9.26: Expected Contribution to Dry Deposition of Nitrogen at designated sites (kg nitrogen/ha/yr), cumulative impacts

Site		Estimated nutrient N deposition (kgN/ha-year)					
		Critical Load (CL)	PC	PC/CL (%)	Existing levels	PEC	PEC/CL (%)
Firth of Forth SSSI, SPA	Mudflats below high tide level	30	1.44	4.8%	19.0	20.44	68%
	Skinflats area	10	0.093	0.9%	14.0	14.1	141%
	Kinneil area	10	0.085	0.9%	12.2	12.3	123%
	Bo'ness area	10	0.095	1.0%	12.2	12.3	123%
Firth of Forth SSSI	Skinflats area	10	0.094	0.9%	14.0	14.1	141%
	Preston Island	10	0.28	2.8%	12.7	13.0	130%
Slamannan Plateau (SPA/SSSI)		5	0.08	1.6%	14.8	14.88	298%
Blawhorn Moss SAC		5	0.05	1.0%	10.9	10.95	219%
Black Loch Moss SAC		5	0.05	1.0%	10.9	10.95	219%
Howierig Muir SSSI		5	0.11	2.1%	15.4	15.51	310%
Lockshaw Mosses SSSI		5	0.09	1.7%	12.7	12.79	256%
Steelend Moss SSSI		5	0.026	3.5%	15.0	15.11	302%

9.7.88 The results show that when including the Rosyth and Leith Renewable Energy Plants, the modelled process contribution at the SSSIs does not change significantly. The largest relative increase is at Steelend Moss SSSI where existing nitrogen deposition levels are considerably higher than the critical load. The increase due to the cumulative emissions from the three Renewable Energy Plants (0.016 kgN/ha-year) represents 0.1% of the existing nitrogen deposition levels. For the European designated sites, the cumulative impacts do not lead to the process contributions exceeding 1% of the relevant critical loads at any of the assessed areas, however, nitrogen deposition at Slamannan Plateau SPA increases from 1.1% to 1.6% of the critical load.

9.7.89 With respect to European designated sites, a process contribution to acid or nitrogen deposition of more than 1% of the relevant critical load triggers the need for a Habitat Regulations Assessment. In this case acid deposition process contribution at a relevant location within the Firth of Forth SPA is 3.1% of the critical load and, when combined with the existing deposition levels, is 138% of the critical load. The acid deposition process contribution at the Blawhorn Moss and Black Loch Moss SACs is 2.0 – 2.1% of the critical load and existing acid deposition levels exceed the critical load. The significance of the predicted deposition at the SPA and SACs is addressed in Chapter 12 Terrestrial Ecology.

Plume Visibility Results

9.7.90 The Renewable Energy Plant has the potential to release a visible plume of water vapour from the stack. Under the meteorological conditions in the UK, such plumes are rare, only becoming visible when the water content of the air exceeds its holding capacity at that particular temperature. Existing thermal power stations in the UK (firing on gas, coal or oil) inherently produce few visible plumes however a biomass fired plant is more likely to produce a visible water vapour plume due to the composition and potentially higher moisture content of the fuel.

9.7.91 Table 9.27 presents the results of the plume visibility modelling undertaken using the emission data provided within Table 9.7 above and meteorological data from Edinburgh Gogarbank covering the years 2004 to 2008.

Table 9.27: Plume Visibility Modelling Results

Parameter	Year					
	2004	2005	2006	2007	2008	Average
Plumes visible during daylight hours outside site boundary	37%	34%	32%	34%	35%	34%

9.7.92 The results set out in Table 9.27 indicate that the visible plume length extends beyond the site boundary during daylight hours on average 34% of the daylight hours in the year. This would be considered a high impact according to the SEPA guidance. The average plume length of the visible plumes during daylight hours is forecast to be 103 m which is less than the average distance from the stack to the site boundary of approximately 160 m. The relatively high occurrence of visible plumes during daylight hours is due to a number of factors as set out below:

- The air quality assessment was undertaken for the scenario where efficiency of the plant is maximised by recovering heat from the flue gas. This results in a lower flue gas temperature and increases the likelihood of the plume becoming visible. Less efficient combustion plant utilising the same fuel and where the flue gas temperatures are higher would have a lower occurrence of visible plumes;
- The air quality assessment was undertaken for the scenario which utilises 100% virgin wood chip (Scenario 2). The moisture content of the virgin wood chip is relatively high (up to approximately 40%) and is higher than other solid fuels such as coal. Non-virgin biomass materials and wood pellet has inherently lower moisture content and the predicted visible plumes would be less than presented above; and

- The northern site boundary is approximately 50 – 70 m from the stack location and is downwind of the prevailing wind direction, thus increasing the likelihood that any visible plumes will extend beyond the boundary.

9.7.93 Overall, this is considered to have the potential to have a high impact. However, the land use downwind of the prevailing wind direction from the eastern site boundary is related to the port facility and the sensitivity to visible plumes would be less than more sensitive uses such as residential housing. A figure showing the distribution of the visible plumes during daylight hours is provided in Figure 9.8.

9.7.94 The hybrid cooling towers will be designed to be plume-free down to an ambient temperature of 5ºC and a relative humidity of 95 %. At this location this would result in the frequency of occurrence of a visible plume of less than 2.5 % per year of daylight hours, based on five years' (2005-2009) relative humidity and temperature data available from the meteorological station at Edinburgh Gogarbank.

Decommissioning

9.7.95 As with the construction stage, the potential for dust to be generated during the decommissioning phase will be short-term and temporary in nature. Receptors downwind of the predominant wind direction (that is wind blowing from the west to south-west of the Renewable Energy Plant) would typically be the most susceptible to dust emissions. As discussed earlier, there are no receptors in this direction from the site. The nearest dwellings are approximately 220 m from the southern site boundary.

9.7.96 Given this fact, and with the use of the mitigation measures outlined above, it is predicted that the impacts of dust generation on receptors in the area will be minimised. Impacts due to dust generated from the proposed decommissioning of the Renewable Energy Plant are predicted to be negligible.

9.8 Summary and Conclusions

9.8.1 This chapter has addressed the potential for long-term impact on air quality arising from emissions of nitrogen dioxide, carbon monoxide, particulate matter (primarily PM_{10} and $PM_{2.5}$) and sulphur dioxide, as well as some trace species from the proposed development, and the shorter term impacts associated with emissions for particulate matter and traffic emissions from its construction and decommissioning. The predicted impacts have been assessed against the current legislative objectives.

9.8.2 The air quality impact assessment identified the relevant legislative air quality objectives and Environmental Assessment Levels for the protection of air quality for the above species and reviewed the existing ambient air quality within the area. A number of mitigation measures have been identified to reduce or remove potential impacts during the construction and operational phases; including suitable dust control and monitoring, the selection of efficient combustion technology, carefully selected stack height and the continuous monitoring of stack emissions.

9.8.3 With the use of the mitigation measures outlined in this chapter, the impacts of dust generation on sensitive receptors in the area will be minimised and no significant impact is predicted during the construction or decommissioning phases.

9.8.4 The potential impact due to road traffic emissions during the construction and operational phases is forecast not to be significant.

9.8.5 Several conservative assumptions were adopted throughout the modelling assessment to ensure that the model predictions would likely be over-estimates rather than under-estimates, these are summarised below:

- It was assumed that the proposed Renewable Energy plant will operate continuously at maximum load. In practice, the plant will have periods of shut-down and maintenance.
- The study is based on emissions being continuously at the emission limits specified;

- The highest predicted concentration at any off-site location on land in and around Grangemouth was used in the assessment of short term environmental effects. Long term environmental effects were assessed at relevant long term exposure locations. Concentrations at other locations will be less than the maximum values presented;
- The highest predicted concentrations obtained using any of the five different years of met data have been used in this assessment. During a typical year the ground level concentrations are likely to be lower;
- It was assumed that 70% of oxides of nitrogen emitted from the plant will be converted to nitrogen dioxide at ground level in the vicinity of the plant for determination of the annual mean. It was assumed that 35% of oxides of nitrogen will be converted to nitrogen dioxide for determination of the short term concentrations. The actual conversion to nitrogen dioxide is likely to be less than this;
- It was assumed that 100% of the particulate matter emitted from the plant is in the PM_{10} size fraction. The actual proportion will be less than 100%;
- It was assumed that 100% of the particulate matter emitted from the plant is in the $PM_{2.5}$ size fraction. The actual proportion will be less than 100%. Other studies submitted to SEPA have used a value of 33%;

9.8.6 Even with the use of the above conservative assumptions, the dispersion modelling results indicated that no air quality objectives or environmental assessment levels specified for the protection of human health were forecast to be exceeded due to emissions from the Renewable Energy Plant during the operational phase.

9.8.7 The calculated maximum process contributions to nitrogen and acid deposition at a number of designated habitat sites have been calculated for the Renewable Energy Plant. The assessment, using a number of conservative assumptions, found that the maximum process contribution to acid deposition would be more than 1% of the relevant critical load at one specific area of the Firth of Forth SPA (the Bo'ness area) and acid and nitrogen would be more than 1% of the relevant critical loads at Slamannan Plateau SPA. Acid and nitrogen deposition exceeded 1% of the relevant critical loads at the Preston Island area of the Firth of Forth SSSI and at Howierig Muir SSSI, Lockshaw Mosses SSSI and Steelend Moss SSSI. This will therefore trigger the need for a Habitat Regulations Appropriate Assessment[35] with respect to the Firth of Forth SPA and Slamannan Plateau SPA and the significance of the predicted deposition at these sites is addressed in Chapter 12 Terrestrial Ecology. An Appropriate Assessment would be carried out to ensure that there would not be a significant adverse effect on the integrity of the European site in light of its conservation objectives. When the cumulative impact of the three proposed Renewable Energy Plants situated on the Forth Estuary (Grangemouth, Rosyth and Leith) was considered, the predicted acid deposition at the Blawhorn Moss SAC and Black Loch Moss SAC was slightly above 1% of the relevant critical loads. For the Grangemouth plant operating in isolation, the predicted acid and nitrogen deposition at the SACs was below the 1% criteria.

9.8.8 A number of sensitivity analyses were carried out to ensure the dispersion modelling methodology and predictions were robust. The results of the sensitivity analyses indicated that the model predictions would not be materially affected by the various aspects considered.

9.8.9 The visible plume will extend beyond the site boundary during daylight hours on average 34% of the year. This is due to a number of factors, including that the plant will be designed to be as energy efficient as possible.

9.8.10 The residual impact on air quality due to the construction, operation and decommissioning of the Renewable Energy Plant has been assessed and it is concluded that the plant will not have a significant impact with respect to all pollutants. The predicted environmental concentrations (i.e. the process contribution plus background levels) are within the relevant air quality objectives and environmental assessment levels for each pollutant considered. Therefore, no significant residual effect with respect to local air quality is predicted.

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Abbreviations

The following is a list of abbreviations adopted in Chapter 9 Air Quality.

%	Per cent
°	Degrees
°C	Degrees Celsius
µg	Microgram(s)
AADT	Annual Average Daily Traffic
ADMS	Atmospheric Dispersion Modelling System
APIS	Air Pollution Information System
AQMA	Air Quality Management Area
AQO	Air quality objective
AQS	Air quality strategy
AURN	Automatic Urban and Rural Network
BaP	Benzo(a)pyrene
CEH	Centre for Ecology and Hydrology
CL	Critical load
CO	Carbon monoxide
Co	Cobalt
Cr	Chromium
Cu	Copper
EAL	Environmental Assessment Level
EIA	Environmental Impact Assessment
EPAQS	Expert panel on air quality standards
EQS	Environmental Quality Standard
ES	Environmental Statement
FCC	Falkirk City Council
g/s	Grams per second
ha	Hectare
HCl	Hydrogen chloride
HF	Hydrogen fluoride
Hg	Mercury
HGV	Heavy goods vehicle
kg	Kilogram(s)
km	Kilometre(s)
kPa	Kilopascal(s)
LAQM	Local Air Quality Management
m	Metre(s)
m/s	Metres per second

m^3/s	Cubic metres per second
MEI	Maximum exposed individual
mg	Milligram(s)
mg/Nm^3	Milligram per normalised cubic metre
Mn	Manganese
MWth	Megawatts thermal
N	Nitrogen
ng	Nanograms
ng/s	Nanograms per second
NH_3	Ammonia
Nm_3	A cubic metre of gas at the quoted standard reference conditions (normalised cubic metre)
NO_x	Oxides of nitrogen
PAHs	Poly aromatic hydrocarbons
PC	Process contribution
PEC	Predicted environmental concentration
PM_{10}	Particulate matter with aerodynamic diameter 10 microns or less
$PM_{2.5}$	Particulate matter with aerodynamic diameter 2.5 microns or less
PPC	Pollution Prevention and Control
SAC	Special Area of Conservation
Sb	Antimony
SEPA	Scottish Environment Protection Agency
SNCR	Selective Non Catalytic Reduction
SO_2	Sulphur dioxide
SPA	Special Protection Area
SSSI	Sites of Special Scientific Interest
TDI	Tolerable daily intake
TEQ	Toxic equivalent
TG	Technical guidance
Tl	Thallium
UK	United Kingdom
V	Vanadium
v/v	Volume in volume
VOCs	Volatile Organic Compounds
WHO	World Health Organisation