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SSE Generation Ltd

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KEADBY II COMBINED CYCLE GAS TURBINE GENERATING STATION

COMBINED HEAT AND POWER ASSESSMENT

Keadby II
Combined Cycle Gas Turbine Generating Station

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1 LIST OF ABBREVIATIONS

BAT	Best Available Techniques
CBA	Cost Benefit Analysis
CCGT	Combined Cycle Gas Turbine
CCR	Carbon Capture Readiness
CHP	Combined Heat and Power
CHP-R	Combined Heat and Power Ready
CO_2	carbon dioxide
DECC	Department of Energy and Climate Change
DTI	Department of Trade and Industry
EIA	Environmental Impact Assessment
HP	high pressure
KDL	Keadby Developments Limited
km	kilometres
LHV	lower heating value
LP	low pressure
MJ/s	megajoules per second
MSL	Minimum Stable Load
MW	megawatts
NPS EN-1	Overarching National Policy Statement (NPS) for Energy (EN-1)
NPS EN-2	National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (EN-2)
OS	Ordnance Survey
PES	Primary Energy Savings
SSE	Scottish and Southern Energy
ηCHP	CHP efficiency

2 INTRODUCTION

2.1 Preamble

2.1.1 Ramboll Environ UK Limited (Ramboll Environ) has been commissioned by SSE Generation Ltd (SSE) to conduct a Combined Heat and Power (CHP) Assessment of a combined cycle gas turbine (CCGT) generating station at Keadby, in North Lincolnshire (Keadby II). This Document presents the results of that CHP Assessment. This Document is intended to accompany an application to the Department of Energy and Climate Change (DECC) to vary a consent under Section 36C of the Electricity Act 1989. All work conducted was performed in accordance with Ramboll Environ proposal UKP12-20125 dated 1 June 2015.

2.2 Background

2.2.1 On 10 September 1993, the Secretary of State for Trade and Industry (the Secretary of State) granted consent under Section 36 of the Electricity Act 1989 (the Consent) and directed that planning permission be deemed to be granted pursuant to Section 90(2) of the Town and Country Planning Act 1990 (the Deemed Planning Permission) to Keadby Developments Limited[1] (KDL) for the construction and operation of a 710 MW CCGT generating station at Keadby, in North Lincolnshire (Keadby II or the Development). The Development would be located adjacent to the existing 735 MW Keadby I CCGT generating station owned and operated by SSE.

2.2.2 In 1997 / 1998, the Government undertook a review of the energy industry which affected the timing of decisions on applications for consent under Section 36 of the Electricity Act 1989 and some applications for consent to burn gas as a fuel under Section 14 of the Energy Act 1976. In 1998, the Secretary of State announced that the Government's provisional conclusion arising from this review was for a stricter consents policy regarding generating stations whilst certain reforms of the electricity market were put in place.

2.2.3 At this time, the Secretary of State has already granted Consent for the Development and the Council had confirmed that the Development permitted by the Deemed Planning Permission had been commenced. However, in December 1998, when considering notification by KDL of its proposal to establish a generating station fuelled by natural gas (the Development), the Secretary of State directed that the consented Development should not proceed (under powers granted by Section 14(3) of the Energy Act 1976) with the proviso that it would be expected that this decision would be reviewed once the stricter consents policy was relaxed.

2.2.4 The Government subsequently lifted its stricter consents policy in 2000. However, differing market conditions to those prevailing in 1998 meant that KDL placed the consented Development in abeyance.

2.3 Intention to Vary Consent under S36C of the Electricity Act 1989

2.3.1 In February 2012, SSE announced that against a background of higher costs associated with gas fired generation, they had decided to undertake a comprehensive programme of maintenance to support more flexible operations at its Keadby I CCGT generating station from 2013 onwards, while suspending electricity generation with effect from 26 March 2012.

2.3.2 At the same time, SSE also decided to continue with Keadby II. In making this decision, consideration was given to the significant advances in engineering design that had been made since the granting the Consent and Deemed Planning Permission. These advances included the development of more efficient CCGT units (in particular, gas turbines steadily increasing in size, output and efficiency), with corresponding improvements in environmental and economic performance.

2.3.3 In terms of implementing these advances for Keadby II, requiring variations in design and layout, both the Section 36 Conditions and the Planning Conditions contemplated that, with written agreement of the Secretary of State and the Council respectively, these variations could be sought. Subsequently, in 2012, KDL moved forward with a process of screening the

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[1] Keadby Developments Limited are a wholly owned subsidiary of Scottish and Southern Energy (SSE).

environmental effects of the amended proposals for the Development against the environmental effects of the consented Development (the 2012 Screening Exercise). As part of the 2012 Screening Exercise, additional environmental studies were commenced in order to address the regulatory requirements that had been introduced since the granting of the Consent.

2.3.4 However, the 2012 Screening Exercise was superseded by the enactment of the Growth and Infrastructure Act 2013 and the making of the Electricity Generating Stations (Variation of Consents) (England and Wales) Regulations 2013. This represents the most up-to-date mechanism for seeking to vary an extant Consent under Section 36 of the Electricity Act.

2.3.5 Accordingly to implement the advances in engineering design for Keadby II, KDL are submitting an application to vary the Consent under Section 36C of the Electricity Act 1989 alongside a related application to vary the Deemed Planning Permission under Section 90(2) and (2ZA) of the Town and Country Planning Act 1990 (together, the Variation Application).

2.4 The Structure of this CHP Assessment

2.4.1 This CHP Assessment is structured as follows:

- **Section 1**: Provides a brief introduction, summarising the purpose of this CHP Assessment;
- **Section 2**: Describes the context (i.e. the need for a CHP Assessment) and the assessment methodology that has been employed;
- **Section 3**: Provides a description of the Development (covering the overall proposed Development, the proposed Development site and an assessment of the requirement for the Development to be CHP / CHP-R);
- **Section 4**: Summarises the evaluation of the CHP opportunities for the Development;
- **Section 5**: Describes the preferred CHP opportunity; and,
- **Section 6**: Presents the conclusions of this CHP Assessment.

Supporting information is provided in the Appendices.

3 CONTEXT (THE PURPOSE OF A CHP ASSESSMENT) AND METHODOLOGY

3.1 Context

Introduction

3.1.1 CHP is the generation of electrical power and usable heat in a single process. This is also known as co-generation. CHP is a well proven process for reducing primary energy consumption, and reducing carbon dioxide (CO_2) emissions.

3.1.2 In recognition of the role that CHP can play in meeting the UK's Energy Policy priorities, the UK Government states that it is committed to the development and installation of CHP schemes[2,3].

3.1.3 In particular, wherever possible, the UK Government has committed to promoting CHP schemes which qualify as 'Good Quality CHP' schemes. 'Good Quality CHP' schemes are those which have been certified as highly efficient under the CHP Quality Assurance Programme and, in accordance with Directive 2012/27/EU on energy efficiency (the Energy Efficiency Directive), achieve at least a 10 per cent saving in primary energy consumption.

3.1.4 Information on installed CHP schemes is provided in Chapter 7 of the Digest of UK Energy Statistics[4] (DUKES) (July 2015) and Table 7A notes that in 2014 there were 2,066 CHP schemes in the UK with an electrical capacity of 6,118 MW (or a heat capacity of 22,539 MW). The corresponding electrical power and heat generation was 20,281 GWh and 43,306 GWh respectively. Furthermore, Table 7I notes that in 2014 the use of CHP schemes provided an estimated 12.99 Mt of CO_2 savings against all fossil fuels, and an estimated 7.55 Mt of CO_2 savings against all fuels (including nuclear and renewables).

Requirement for Consideration of CHP in Applications for Consent under Section 36 / 36C of the Electricity Act 1989

3.1.5 Current national policy for energy infrastructure (including the construction / extension of a generating station with a generating capacity of more than 50 MW) is provided in the Overarching National Policy Statement (NPS) for Energy (EN-1) (NPS EN-1), and the technology-specific NPSs. Used together, and in accordance with the provisions of Section 104 of the Planning Act 2008, the NPSs form the primary policy basis for decisions made by the Secretary of State on applications for energy infrastructure comprising Nationally Significant Infrastructure Projects (NSIPs) under the Planning Act 2008. However, it is considered that the NPSs also form a material consideration when determining the Variation Application for the Development.

3.1.6 NPS EN-1 states (at paragraph 4.6.1) that:

"*A CHP station may either supply steam direct to customers of capture waste heat for low-pressure steam, hot water or space heating purposes after it has been used to drive electricity generating turbines. The heat can also be used to drive absorption chillers, thereby providing cooling*".

3.1.7 Furthermore, in terms of electricity generating stations and their potential to incorporate CHP, NPS EN-1 states (at paragraph 4.6.2) that:

"*In conventional thermal generating stations, the heat that is raised to drive electricity generation is subsequently emitted to the environment as waste. Supplying steam direct to industrial customers or using lower grade heat, such as in district heating networks, can reduce the amount of fuel otherwise needed to generate the same amount of heat and power separately. CHP is technically feasible for all types of thermal generating stations, including*

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[2] Energy White Paper: 'Our Energy Future – Creating a Low Carbon Economy' (February 2003).
[3] Energy White Paper: 'Meeting the Energy Challenge – A White Paper on Energy' (May 2007).
[4] Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/447639/DUKES_2015_Chapter_7.pdf

nuclear, energy from waste and biomass, although the majority of CHP plants in the UK are fuelled by gas".

3.1.8 When considering CHP opportunities, NPS EN-1 states (at paragraph 4.6.5) that:

"*To be economically viable as a CHP plant, a generating station needs to be located close to industrial or domestic customers with heat demands. The distance will vary according to the size of the generating station and the nature of the heat demand, but is likely to mean within a distance of 15 km*".

3.1.9 In terms of consideration of CHP in applications for Consent, NPS EN-1 states (at paragraph 4.6.6) that:

"*Under guidelines issued by DECC (then DTI) in 2006, any application to develop a thermal generating station under Section 36 of the Electricity Act 1989 must either include CHP or contain evidence that the possibilities for CHP have been fully explored to inform the [Secretary of State's] consideration of the application.* […] *The* [Secretary of State] *should have regard to* [the guidelines issued by DECC] *or any successor to it when considering the CHP aspects of applications for thermal generating stations*".

3.1.10 The guidelines issued by DECC (then DTI) in 2006 are the 'Guidance on Background Information to Accompany Notifications under Section 14(1) of the Energy Act 1976 and Applications under Section 36 of the Electricity Act 1989' (December 2006) (the CHP Guidance).

3.1.11 The CHP Guidance states (at paragraph 24) that:

"*The Government recognises that decisions on major new power station investments, including the location and anticipated load duty of the station (e.g. base load, mid-merit, peak-lopping, support to local industry, etc) will primarily be driven by the market, taking into account fiscal and other incentives now on offer for CHP*".

3.1.12 In this regard, and in terms of the location and anticipated load duty of the station, NPS EN-1 states (at paragraph 4.6.7) that:

"*In developing proposals for new thermal generating stations, developers should consider the opportunities for CHP from the very earliest point and it should be adopted as a criterion when considering locations for a project*".

And (at paragraph 4.6.8) that:

"*Utilisation of useful heat that displaces conventional heat generation from fossil fuel sources is to be encouraged where, as will often be the case, it is more efficient than the alternative electricity / heat generation mix. To encourage proper consideration of CHP, substantial additional positive weight should therefore be given by the* [Secretary of State] *to applications incorporating CHP*".

3.1.13 Further technology-specific information is provided in National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (EN-2) (NPS EN-2). In terms of CHP, NPS EN-2 makes reference to the guidance presented in NPS EN-1 and states (at paragraph 2.3.3) that:

"*The* [Secretary of State] *should not give* [consent] *unless it is satisfied that the applicant has provided appropriate evidence that CHP is included or that the opportunities for CHP have been fully explored. For non-CHP stations, where there is reason to believe that opportunities to supply heat through CHP may arise in the future the* [Secretary of State] *may also require that developers ensure that their stations are 'CHP ready' and are configured in order to allow heat supply at a later date".*

Requirement for Consideration of CHP in Applications for an Environmental Permit under the Environmental Permitting (England and Wales) Regulations 2010, as amended

3.1.14 Further to the publication of the CHP Guidance, guidelines have been issued by the Environment Agency to be used in applications for Environmental Permits under the Environmental Permitting (England and Wales) Regulations 2010, as amended. These

guidelines are the 'CHP Ready Guidance for Combustion and Energy from Waste Power Plants' (February 2013) (the CHP-R Guidance).

3.1.15 However, in terms of the requirements of the CHP-R Guidance in applications for Consent under Section 36 / 36C of the Electricity Act 1989, the CHP-R Guidance states (in Section 3.3) that:

"*When consulted by the planning authorities on relevant consent applications for new plants, the Environment Agency will highlight the need for the plant to be CHP or CHP-R and will make reference to this CHP-R Guidance. Where a* [Consent under Section 36 of the Electricity Act 1989] *is required, the Environment Agency will additionally comment on the results of the CHP Assessment*".

Note on the Implementation of the Energy Efficiency Directive

3.1.16 In addition to the requirements of the CHP-R Guidance, the Energy Efficiency Directive has been implemented in the UK through the Environmental Permitting (England and Wales) (Amendment) Regulations 2015. From 21 March 2015, these Regulations require operators of certain combustion installations to carry out a cost-benefit analysis (CBA) where opportunities for 'Good Quality CHP' schemes (or high efficiency co-generation) are identified. These schemes are those which achieve at least a 10 per cent saving in primary energy consumption.

3.2 Assessment Methodology

3.2.1 Based on the above, in developing the assessment methodology for this CHP Assessment, the requirements of the CHP Guidance and the CHP-R Guidance have been considered holistically and the separate assessment methodologies have been combined. Accordingly, the assessment methodology for this CHP Assessment is shown in Insert 2.1. The relevant extracts of the CHP Guidance (paragraphs 11 and 12) and the CHP-R Guidance (Insert 1) are provided in Appendix A and Appendix B respectively.

3.2.2 In addition to this assessment methodology, wherever relevant, reference is also given to the Energy Efficiency Directive and likely requirement for a CBA to be undertaken when applying for an Environmental Permit under the Environmental Permitting (England and Wales) Regulations 2010, as amended.

INSERT 2.1: ASSESSMENT METHODOLOGY

3.2.3 In terms of Step 2, the requirements of paragraph 16 of the CHP Guidance are that applicants:

- "*Demonstrate that they have properly consulted the results of the UK Heat Mapping Exercise* [...]*;*
- *Demonstrate that they have worked with regional planning bodies and local planning authorities to identify whether opportunities presented by emerging spatial planning strategies can support CHP in planned development and that they have contributed wherever possible, given timing and commercial confidentiality constraints, to such strategies;*
- *Demonstrate that they have explored a number of potential heat markets, either singly or in combination; and,*
- *Demonstrate that they have contacted* [a number of] *organisations that can assist developers in identifying potential CHP customers*".

3.2.4 In terms of Step 7, the requirements of paragraphs 11 and 12 of the CHP Guidance are that applicants include within their application:

- "An explanation of their choice of location, including the potential viability of the site for CHP;
- *A report on the exploration carried out to identify and consider the economic feasibility of local heat opportunities and how to maximise the benefits from CHP;*
- *The results of that exploration; and,*
- *A list of the organisations contacted*".

And if the proposal is for generation without CHP, applicants should include within their application:

- "*The basis for the* […] *conclusion that it is not economically feasible to exploit the existing regional heat markets;*
- *A description of potential future heat requirements in the area; and,*
- *The provisions in the proposed scheme for exploiting any potential heat demand in the future*".

3.3 Checklist

3.3.1 For ease of reference, a link to where the requirements of the CHP Guidance and the CHP-R Guidance are met is provided in Table 2.1 below. This is based on the methodology presented in Insert 2.1 (and the CHP Guidance and the CHP-R Guidance).

TABLE 2.1: CHP ASSESSMENT CHECKLIST

Evidence Required		***Location in this CHP Assessment***
Step 1	Requirement to be CHP or CHP-R	Section 3.6
Step 2	Determination of CHP opportunities	Section 4.2
Step 3	Determination of preferred CHP opportunity	Section 4.3
Step 4	Identification of CHP envelope / Identification of opportunity for a 'Good Quality CHP' scheme	Section 5.2
Step 5	Identification of the effects of the preferred CHP opportunity	Section 5.2
Step 6	Identification of the technical provision / space requirements for the preferred CHP opportunity	Section 5.3 / Figure 1
Step 7	Justification for the degree of CHP	Section 6

4 DESCRIPTION OF THE DEVELOPMENT

4.1 The Consented Development

4.1.1 In September 1993, Consent and Deemed Planning Permission was granted for the construction and operation of Keadby II. The Consent and Deemed Planning Permission was granted for a 710 MW CCGT generating station consisting of:

- Two industrial gas turbines each with an associated boiler and exhaust stack;
- One steam turbine;
- An access road;
- Ancillary plant and equipment; and,
- Other necessary buildings (including administration offices) and civil engineering works.

4.1.2 This consented Development is based on a number of fundamental aspects, primarily the development of a CCGT generating station adjacent to the existing 735 MW Keadby I CCGT generating station on land within the control of the applicant.

4.1.3 After obtaining approval of all details required prior to commencement of the Development, including discharge of the pre-commencement conditions, material operations commenced in 1998. Accordingly, the Council confirmed that the Development permitted by the Deemed Planning Permission had been commenced for the purposes of Section 56 of the Town and Country Planning Act 1990 and, therefore, the Consent and the Deemed Planning Permission are extant.

4.1.4 However, Consent and Deemed Planning Permission are based on a design (and, more importantly, technology) developed over 20 years ago, and significant advances in engineering design have been made since the granting of the Consent and Deemed Planning Permission. These advances have included the development of more efficient CCGT units (in particular, as turbines steadily increasing in size, output and efficiency), with corresponding improvements in environmental and economic performance.

4.1.5 Therefore, to implement the advances in engineering design for Keadby II, KDL are submitting a Variation Application to the Secretary of State.

4.2 The Proposed Development

4.2.1 In contemplating how to implement the advances in engineering design at Keadby II, KDL have considered various configurations. However studies into the cooling options available for the Development, particularly regarding water availability for the operation of hybrid cooling towers, indicated that while water provision could be assured for approximately 750 MW of generating capacity, any significant additional generating capacity may require alternative solutions.

4.2.2 Therefore, the proposed Development will comprise one gas turbine with associated Heat Recovery Steam Generator (HRSG), one steam turbine unit and associated infrastructure (including the hybrid cooling towers). The generating capacity of the proposed Development will be higher than the consented Development at approximately 810 MW (an increase of approximately 100 MW from the consented Development). This is in part through the advances in engineering design and in part through a proposed operational mode of supplementary firing.

4.2.3 Within the generation process, natural gas will be burnt in the combustion chamber of the gas turbine from which hot gases will expand through the turbine section to generate electricity. The hot exhaust gases still contain recoverable energy and will therefore be used in the HRSG to generate steam, which in turn is used to generate electricity via steam turbine equipment.

4.2.4 The steam exhausting the steam turbine equipment will pass to the hybrid cooling towers where it will be condensed. The source of the make-up water for the hybrid cooling towers

will be the Stainforth and Keadby Canal. The resultant condensate will be returned to the HRSGs to continue the steam cycle.

4.2.5 The flue gases will be discharged via a dedicated stack.

4.2.6 The use of a combined gas and steam cycle increases the overall fuel efficiency of the generating station. As such, the CCGT unit will be capable of generation in combined cycle mode with an overall electrical generation efficiency between approximately 55 to 60 per cent based on the Lower Heating Value (LHV) of the fuel.

4.3 Comparison between the Consented Development and the Proposed Development

4.3.1 There are several differences between the consented Development and the proposed Development. As noted above, the key changes have been adopted to allow KDL to implement the advances in engineering design at Keadby II.

4.3.2 The key differences are presented in Table 3.1.

TABLE 3.1: KEY DIFFERENCES BETWEEN THE CONSENTED DEVELOPMENT AND THE PROPOSED DEVELOPMENT

Consented Development	***Proposed Development***
Redline boundary in two separate parts.	Redline boundary in two separate parts connected by a corridor for cooling water pipe lines.
The consented Development comprises two gas turbines with associated HRSGs and a steam turbine unit with a generating capacity of 710 MW.	The proposed Development comprises one gas turbine with associated HRSG and a steam turbine unit with a generating capacity of approximately 810 MW. The proposed Development will also include provision for supplementary firing.
For cooling, the consented Development envisaged hybrid cooling towers with abstraction of make-up water from either the Stainforth and Keadby Canal or River Trent with effluents piped to the existing Keadby I CCGT generating station culvert.	For cooling, the proposed Development also envisages hybrid cooling towers with abstraction of make-up water from the Stainforth and Keadby Canal. The redline boundary has been extended to include route corridors between the Keadby II site and the Stainforth and Keadby Canal.
The consented Development envisaged that the hybrid cooling towers would be laid out in two separated banks of eight, making 16 hybrid cooling towers in total.	The proposed Development envisages that the hybrid cooling towers will be laid out in two back-to-back banks of eight, making 16 hybrid cooling towers in total.
No provision for an area set aside to demonstrate Carbon Capture Readiness (CCR).	Redline boundary also extended to include area set aside to demonstrate CCR.
Standby fuel oil storage tanks.	No requirement for standby fuel oil or associated fuel oil storage tanks.

4.4 The Proposed Development Site

4.4.1 The proposed Keadby II site lies approximately 7 km to the west of Scunthorpe and approximately 27 km to the north east of Doncaster. The Ordnance Survey (OS) Grid Reference of the centre of the proposed Development site is approximately 482676, 411646. This is the centre of the area designated for the development of the gas turbine, HRSG and steam turbine unit.

4.4.2 The proposed Keadby II site occupies a total area of approximately 17.1 ha, within which approximately 4.0 ha of land has been set aside by KDL for the purposes of CCR.

Factors influencing Selection of the Proposed Development Site

4.4.3 The proposed Keadby II site was selected as the most appropriate site for the Development. Indeed, the proposed Development site offers a number of key benefits including:

- The use of existing infrastructure wherever possible;

- The presence of a skilled workforce at the existing Keadby I CCGT generating station, with established operational systems, who will be available for training new employees;
- The availability of technical support (if required) from the existing Keadby I CCGT generating station;
- The close proximity of the National Grid Gas National Transmission System;
- The close proximity of the National Grid Electricity National Transmission System, and the allowable use of the existing overhead line;
- The availability of sufficient land for the Development;
- An appropriate visual context with the adjoining land uses;
- The opportunities to link beneficially adjoining land uses;
- Compatibility with planning policy; and,
- The existing strong relationships with key stakeholders and the local community.

4.5 Requirement for the Proposed Development to be CHP / CHP-R

4.5.1 The Development will comprise a CCGT unit only. Under the requirements of the CHP Guidance and the CHP-R Guidance, this CCGT unit will be required to be CHP / CHP-R.

5 CHP OPPORTUNITIES

5.1 Introduction

5.1.1 As noted previously, when considering CHP opportunities, NPS EN-1 states (at paragraph 4.6.5) that:

"*To be economically viable as a CHP plant, a generating station needs to be located close to industrial or domestic customers with heat demands. The distance will vary according to the size of the generating station and the nature of the heat demand, but is likely to mean within a distance of 15 km*".

5.1.2 In general, CHP is more attractive in cases when the heat load is large and constant throughout the year. This is typically the case with chemical plants, refineries and factories which depend upon continuous processes and use large amounts of heat (usually supplied as steam).

5.1.3 CHP is less attractive in cases where the heat load is seasonal or intermittent. This is typically the case for district heating in countries (such as the UK) which have a relatively short winter heating season (compared to Scandinavian or Eastern European countries). As such, there is a general absence of significant district heating schemes in the UK and, where they are developed, district heating schemes have generally been associated with new-build publically funded and often high-rise housing where the heat loads can be readily combined and the heat distribution piping is compact.

5.2 CHP Opportunities

Use of Online Resources

5.2.1 The CHP Guidance required that CHP Assessments examine the information available on the Online Industrial Heat Map[5] to identify potential CHP opportunities. Since the publication of the CHP Guidance, the Online Industrial Heat Map has been replaced with the UK CHP Development Map[6].

5.2.2 The results from the examination of the UK CHP Development Map, covering a search area of 15 km centred on the proposed Keadby II site[7] (the CHP search area), are shown in Insert 4.1. The breakdown of the results from the examination of the UK CHP Development Map is shown in Table 4.1.

5.2.3 In addition to the breakdown of results, no large heat loads were identified from examination of the UK CHP Development Map within the CHP search area.

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[5] This was available at: http://www.industrialheatmap.com
[6] This is available at: http://chptools.decc.gov.uk/developmentmap/
[7] Grid Reference for the centre of the proposed Keadby II site is 482676, 411646. This is the centre of the area designated for the development of the gas turbine, HRSG and steam turbine unit. This area has been selected as the most likely location for the off-take of heat.

INSERT 4.1: RESULTS FROM THE EXAMINATION OF THE UK CHP DEVELOPMENT MAP

TABLE 4.1: BREAKDOWN OF THE RESULTS FROM THE EXAMINATION OF THE UK CHP DEVELOPMENT MAP

Sector	***Total MW***	***% of Total Heat Load***
Communications and Transport	0.27	0.05%
Commercial Offices	4.10	0.70%
Domestic	513.59	87.12%
Education	5.04	0.86%
Government Buildings	3.54	0.60%
Hotels	5.56	0.94%
Health	1.41	0.24%
Other	3.71	0.63%
Small Industrial	25.65	4.35%
Prisons	3.90	0.66%
Retail	6.84	1.16%
Sport and Leisure	1.53	0.26%
Warehouses	14.41	2.44%
Total Heat Load in the CHP Search Area	**589.55**	**100%**

5.2.4 Based on the use of Table 4.1 it can be seen that the largest heat loads within the CHP search area were related to:

i) Domestic;

ii) Small Industrial; and,

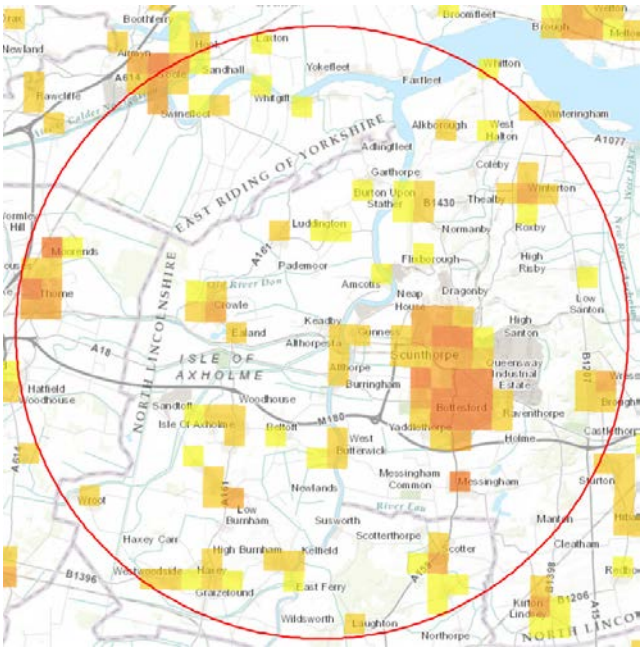
iii) Warehouses.

5.2.5 These heat loads are examined further in this sub-Section.

Domestic

5.2.6 In terms of the domestic heat loads within the CHP search area, the results from the specific examination of the UK CHP Development Map are shown in Insert 4.2.

INSERT 4.2: DOMESTIC HEAT LOAD RESULTS FROM THE EXAMINATION OF THE UK CHP DEVELOPMENT MAP



5.2.7 The results show that the domestic heat load within the CHP search area is 514 MW, approximately 87 per cent of the total heat load within the CHP search area. Based on the use of Insert 4.2, this domestic heat load is spread across the settlements that lie within the CHP search area, in particular at Scunthorpe to the east of the proposed Development site.

5.2.8 In combination with the domestic heat load spread, NPS EN-1 states (at paragraph 4.6.5) in terms of district heating networks that:

"*A 2009 Report for DECC[8] on district heating networks suggested that, for example, a district heating network using waste heat from a generating station would be cost-effective where there was a demand for 200 MWth of heat* [assumed to be located in a concentrated area] *within 15 km. Additionally, the provision of CHP is most likely to be cost-effective and practical where it is included as part of the initial design and is part of a mixed-use development. For example, retrofitting a district heating network to an existing housing estate may not be efficient*".

5.2.9 As the domestic heat load is spread across the CHP search area (i.e. is characterised by disparate, smaller settlements) and is not representative of a new heat load, the costs and practical benefits of including it as part of any initial design cannot be realised. Therefore, this domestic heat load is not considered to be a viable CHP opportunity.

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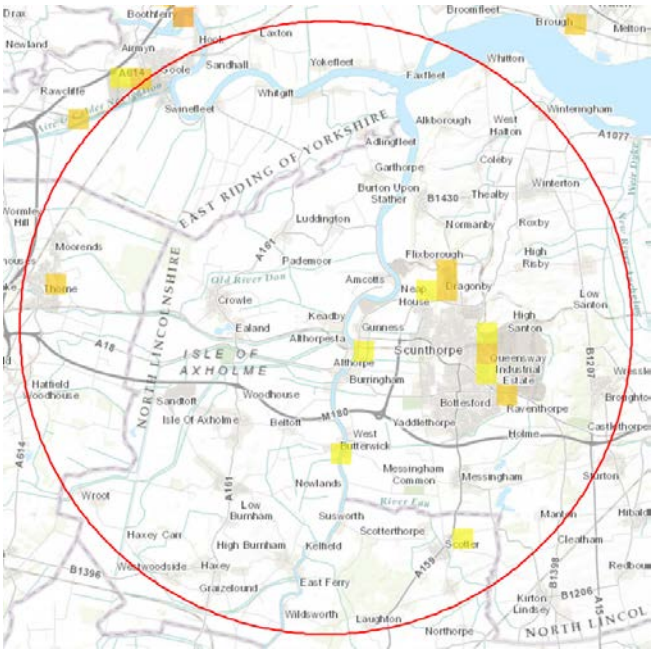
[8] 'The Potential and Costs of District Heating Networks', April 2009. Pöyry and Faber Maunsell

Small Industrial

5.2.10 In terms of the small industrial heat loads within the CHP search area, the results from the specific examination of the UK CHP Development Map are shown in Insert 4.3.

INSERT 4.3: SMALL INDUSTRIAL HEAT LOAD RESULTS FROM THE EXAMINATION OF THE UK CHP DEVELOPMENT MAP



5.2.11 The results show that the small industrial heat load within the CHP search area is 26 MW, approximately 4 per cent of the total heat load within the CHP search area. Based on the use of Insert 4.3, this small industrial heat load is located in a number of disparate areas, mostly around Scunthorpe to the east.

5.2.12 However, as with the domestic heat load, as the small industrial heat load is not representative of a new heat load, the costs and practical benefits of including it as part of any initial design cannot be realised. Therefore, the small industrial heat load is not considered to be a viable CHP opportunity.

Warehouses

5.2.13 In terms of the warehouse heat loads, the results from the specific examination of the UK CHP Development Map do not allow for the identification of their locations. However, the results show that the warehouse heat load within the CHP search area is 14 MW, approximately 2 per cent of the total heat load within the CHP search area.

Additional Consultations

5.2.14 Further to the examination of the UK CHP Development Map, consultation has been undertaken with the organisations identified by DECC (and in the CHP Guidance) that can assist developers in identifying potential CHP opportunities. These are:

- DECC;
- Lincolnshire County Council / North Lincolnshire Council;
- Environment Agency;
- NHS Property Services Limited;
- Association of Decentralised Energy (formerly the CHP Association); and,
- The Carbon Trust / Energy Saving Trust.

5.2.15 A summary of this additional consultation is provided in Table 4.2

TABLE 4.2: SUMMARY OF ADDITIONAL CONSULTATIONS

Organisation	***Summary of Consultation***
DECC	DECC's 'Heat Map Team' advised that they were not aware of any significant developments / installations within 15 km of the proposed site. DECC further advised consultation with the Homes and Communities Agency and the Humber Local Enterprise Partnership.
North Lincolnshire Council	North Lincolnshire Council advised of plans for up to 6,000 homes at the 'Lincolnshire Lakes' Development in the parish of Burringham (west of Scunthorpe). The 'Lincolnshire Lakes' Development lies approximately 3 km to the south east of the proposed site. Applications have been submitted on behalf of the Lucent Group[9],[10] (see summary provided in Appendix C) and Maltgrade Limited[11] (see summary provided in Appendix D). To accompany the applications, separate Energy Strategies have been prepared for both the Lucent Group development and the Maltgrade Limited development. Whilst both Energy Strategies note that district heating networks may be viable, they also note that further work needs to be undertaken as the detailed design of the overall development progresses. Therefore, within this Document, to provide a 'best case' CHP scenario, it has been assumed that the Proposed Development would provide the overall heat requirements for both overall developments (i.e. could provide for up to 6,000 homes).
Environment Agency	The Environment Agency advised that they were not aware of any significant developments / installations within 15 km of the proposed site that were at an early stage (and therefore would not have been included in the UK CHP Development Map).
NHS Property Services Limited	Whilst NHS Property Services Limited advised that they would potentially be interested in developing CHP opportunities, they did not identify any specific opportunities at the current time. In particular, NHS Property Services Limited were interested in whether any future new builds with "*small demands*" (e.g. clinics) would be considered an attractive CHP opportunity. Ramboll advised that these would likely be captured by consideration of district heating schemes. It is expected that, as the proposed Development, progresses, further consultation will be undertaken, which will cover any future new builds which could be developed as a CHP opportunity. This commitment will form part of the Environmental Permit which will be required under the Environmental Permitting (England and Wales) Regulations 2010, as amended.
The Association of Decentralised Energy	The Association of Decentralised Energy advised that they were unable to help with the identification of specific heat loads, but provided general guidance on identifying potential CHP opportunities (e.g. large industrial, domestic). This advice has been followed through examination of the UK CHP Development Map.
The Carbon Trust / The Energy Saving Trust	The Carbon Trust advised that they were unable to help with the identification of specific heat loads.
Homes and Communities Agency	The Homes and Communities Agency advised that they were unable to help with the identification of specific heat loads.
Humber Local Enterprise Partnership	Whilst the Humber Local Enterprise Partnership advised that they would potentially be interested in developing CHP opportunities, they did not identify any specific opportunities at the current time. It is expected that, as the proposed Development, progresses, further consultation will be undertaken. This commitment will form part of the Environmental Permit which will be required under the Environmental Permitting (England and Wales) Regulations 2010, as amended.

RE

[9] Application Reference: PA/2013/1000 (See: http://www.planning.northlincs.gov.uk/planning/newplanet/planetMain.aspx?refno=PA/2013/1000)
[10] Application Reference: PA/2013/1001 (See: http://www.planning.northlincs.gov.uk/planning/newplanet/planetMain.aspx?refno=PA/2013/1001)
[11] Application Reference: PA/2015/0396 (See: http://www.planning.northlincs.gov.uk/planning/newplanet/planetMain.aspx?refno=PA/2015/0396)

5.3 Summary of the Preferred CHP Opportunity

5.3.1 Based on the examination of the online UK CHP Development Map and the additional consultation which has been undertaken, the preferred CHP opportunity is considered to comprise the plans for up to 6,000 homes at the 'Lincolnshire Lakes' Development. The 'Lincolnshire Lakes' Development lies approximately 3 km to the south east of the proposed site. Within this Document, to provide for a 'best case' CHP scenario, it has been assumed that the Proposed Development would provide the overall heat requirements for up to 6,000 homes. Whilst no detailed information is available on the final design requirements for the 'Lincolnshire Lakes' Development, this is considered to represent an overall heat load of approximately 33 megajoules per second (MJ/s).

6 PREFERRED CHP OPPORTUNITY

6.1 Introduction

6.1.1 Based on the preferred CHP opportunity (the 6,000 homes at the 'Lincolnshire Lakes' Development), this Section describes the proposals for a CHP-R design.

6.2 Identification of the CHP Envelope

6.2.1 Based on the preferred CHP opportunity, it is expected that the design of the CCGT unit would be identical to conventional CCGT units with the inclusion of the following additional items:

- Accessible tie-in locations in either the:
  - High pressure (HP) steam turbine exhaust (from the cold re-heat line); or,
  - Low pressure (LP) steam turbine inlet.
- A stack design that would allow for future retrofit of flue gas extraction equipment; and,
- Control systems linked to the connections.

6.2.2 These provisions are comparable to those required as part of demonstrating the CCGT unit is CCR, with the design allowing for the extraction of steam from the electricity generating cycle.

6.2.3 Therefore, the potential CHP-R designs evaluated related to the different extraction points. These are:

- HP steam turbine CHP-R design;
- LP steam turbine CHP-R design; and,
- Stack heating CHP-R design.

6.2.4 If implemented, the HP steam turbine CHP-R design and LP steam turbine CHP-R design would have an effect on the steam cycle (and therefore performance) of the CCGT unit. The stack heating CHP-R design would not have an effect on the CCGT unit. Therefore only the HP steam turbine CHP-R design and LP steam turbine CHP-R design are evaluated further here. Accordingly, heat and power envelopes for the HP steam turbine CHP-R design and LP steam turbine CHP-R design showing the possible operating ranges for the CCGT unit have been prepared.

6.2.5 On the heat and power envelopes, the limits are defined as follows:

A: Minimum Stable Load (with no Heat Extraction)

B: Minimum Stable Load (with maximum Heat Extraction)

C: 100 per cent Load (with maximum Heat Extraction)

D: 100 per cent Load (with no Heat Extraction)

6.2.6 The CHP efficiency (ηCHP) is defined as:

$$\eta_{CHP} = \frac{\text{Net Process Heat Output + Net Power Output}}{\text{Fuel Input}}$$

6.2.7 Additionally, on the heat and power envelopes, the heat loads where 'Good Quality CHP' schemes would be feasible are also defined. This is shown as the Primary Energy Saving (PES) locus. Heat loads above the PES locus would mean that there would be a 10 per cent saving in primary energy consumption.

6.2.8 However, it should be noted that the heat and power envelopes should not be considered as definitive, and would ultimately depend on the required steam conditions and the steam turbine design of the CCGT unit.

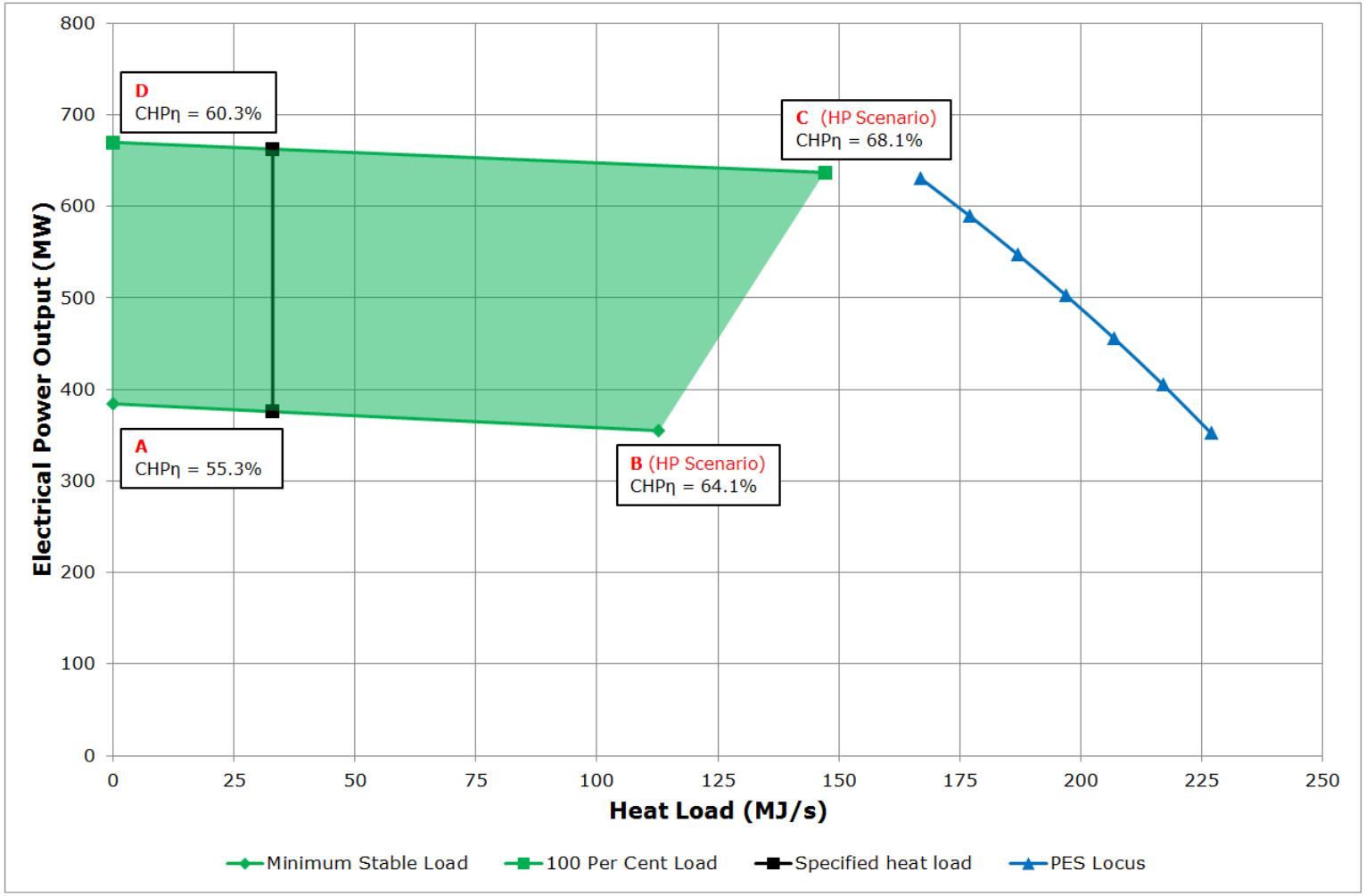
HP Steam Turbine CHP-R Design

6.2.9 The heat and power envelope for the HP steam turbine CHP-R design is shown in Insert 5.1. The performance of the CCGT unit (i.e. the indicative heat and power envelope data) is summarised in Table 5.1.

LP Steam Turbine CHP-R Design

6.2.10 The heat and power envelope for the LP steam turbine CHP-R design is shown in Insert 5.2. The performance of the CCGT unit (i.e. the indicative heat and power envelope data) is summarised in Table 5.2

INSERT 5.1: HP STEAM TURBINE SCENARIO – HEAT AND POWER ENVELOPE



INSERT 5.2: LP STEAM TURBINE SCENARIO – HEAT AND POWER ENVELOPE

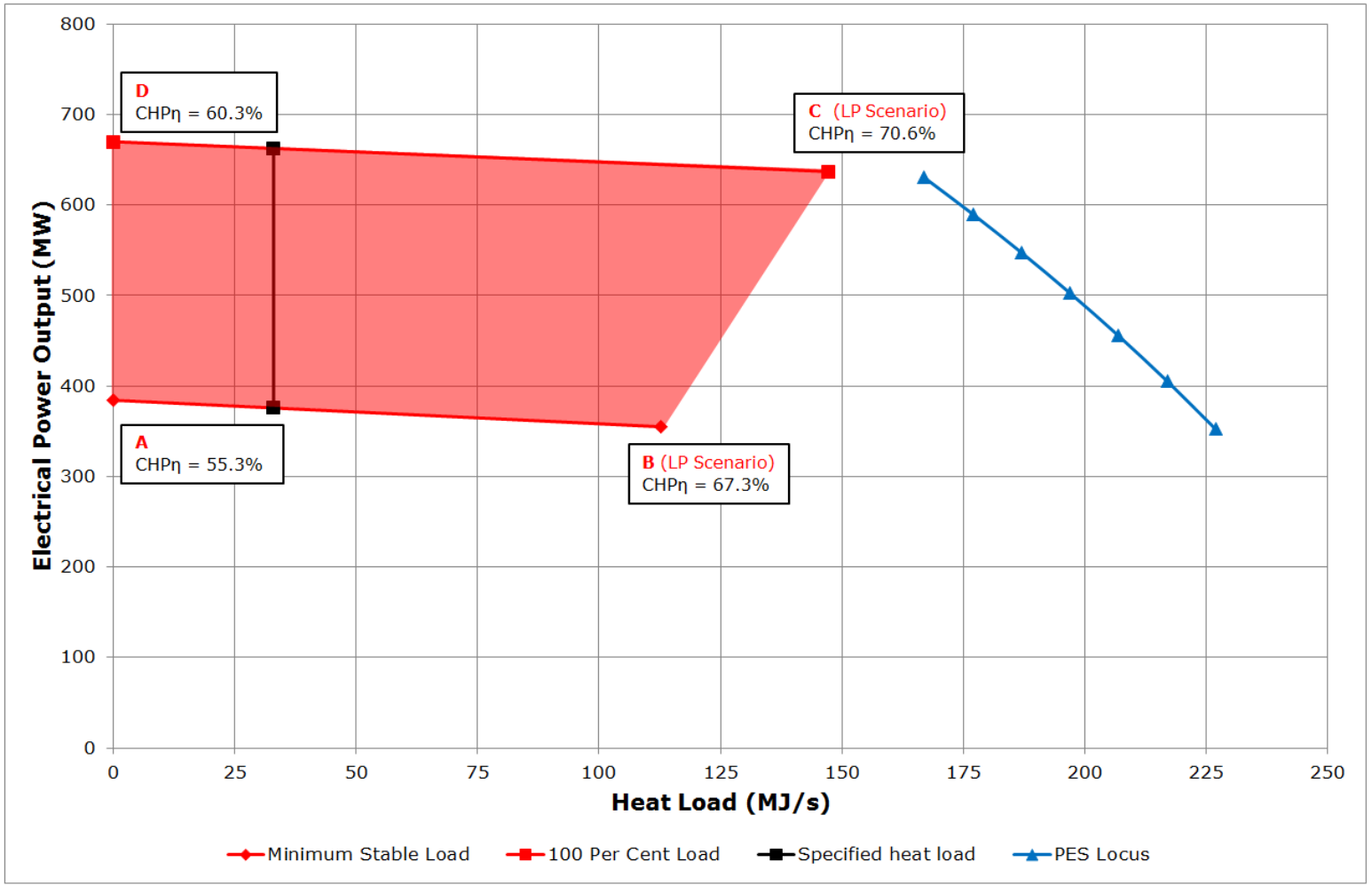


TABLE 5.1: HP STEAM TURBINE SCENARIO INDICATIVE HEAT AND POWER ENVELOPE DATA

		No Heat Extraction	Maximum Heat Extraction
Minimum Stable Load (MSL)		**A**	**B**
Fuel Input*	MJ/s	695	695
Net Process Heat Output	MW	0	95
Net Electrical Power Output	MW	384	350
Total Heat and Power Output	MW	384	446
CHP Efficiency	%	55.3	64.1
100 Per Cent Load		**D**	**C**
Fuel Input*	MJ/s	1111	1111
Net Process Heat Output	MW	0	130
Net Electrical Power Output	MW	670	627
Total Heat and Power Output	MW	670	757
CHP Efficiency	%	60.3	68.1

*Fuel input is based on the Lower Heating Value (LHV)

TABLE 5.2: LP STEAM TURBINE SCENARIO INDICATIVE HEAT AND POWER ENVELOPE DATA

		No Heat Extraction	Maximum Heat Extraction
Minimum Stable Load (MSL)		**A**	**B**
Fuel Input*	MJ/s	695	695
Net Process Heat Output	MW	0	113
Net Electrical Power Output	MW	384	355
Total Heat and Power Output	MW	384	468
CHP Efficiency	%	55.3	67.3
100 Per Cent Load		**D**	**D**
Fuel Input*	MJ/s	1111	1111
Net Process Heat Output	MW	0	147
Net Electrical Power Output	MW	670	637
Total Heat and Power Output	MW	670	784
CHP Efficiency	%	60.3	70.6

Summary of HP Steam Turbine CHP-R Heat and Power Envelope

6.2.11 Insert 5.1 and Table 5.1 indicate that:

- The CCGT unit could supply heat loads up to approximately 95 MJ/s, without an impact upon the operational range (i.e. the CCGT unit could operate anywhere between MSL and 100% Load);
- The CCGT unit could supply heat loads between approximately 95 MJ/s and 130 MJ/s, with an associated impact upon the operational range (i.e. the CCGT unit would not be able to operate down to MSL); and,
- The CCGT unit would not be able to (in isolation) supply heat loads above approximately 130 MJ/s.

Summary of LP Steam Turbine CHP-R Heat and Power Envelope

6.2.12 Insert 5.2 and Table 5.2 indicate that:

- The CCGT unit could supply heat loads up to approximately 113 MJ/s, without an impact upon the operational range (i.e. the CCGT unit could operate anywhere between MSL and 100% Load);
- The CCGT unit could supply heat loads between approximately 113 MJ/s and 147 MJ/s, with an associated impact upon the operational range (i.e. the CCGT unit would not be able to operate down to MSL); and,
- The CCGT unit would not be able to (in isolation) supply heat loads above approximately 147 MJ/s.

Summary

6.2.13 Based on the use of Insert 5.1 and Insert 5.2 (and the corresponding information in Table 5.1 and Table 5.2), both the HP steam turbine CHP-R design and the LP steam turbine CHP-R design would be suitable for the preferred CHP opportunity. Furthermore, within both design options there may also be additional capability to supply other head loads (in addition to the preferred CHP opportunity) should they be identified in the future.

6.2.14 In addition, both Insert 5.1 and Insert 5.2 show that any 'Good Quality CHP' schemes would likely lie outside of the identified heat and power envelopes (i.e. the . Therefore, even if such a scheme was identified, it is likely that a bespoke steam cycle design would be required.

6.3 Further Consideration of CHP

6.3.1 To allow the identified (and any additional future) CHP opportunity to be realised, it is anticipated that the design and final build of the Development will incorporate a number of appropriate provisions which will allow for the future implementation of CHP. In terms of these appropriate provisions, it is expected that the design of the CCGT unit would be identical to conventional CCGT units with the inclusion of the following additional items:

- Accessible tie-in locations in either the:
  - HP steam turbine exhaust (from the cold re-heat line); or,
  - LP steam turbine inlet.
- A stack design that would allow for future retrofit of flue gas extraction equipment; and,
- Control systems linked to the connections.

6.3.2 The indicative location of these appropriate provisions is shown in Figure 1. These provisions are comparable to those required as part of demonstrating the CCGT unit is CCR, with the design allowing for the extraction of steam from the electricity generating cycle.

6.3.3 Accordingly, it is considered that the CCGT unit will be designed and built CHP-R. It is considered that this degree of CHP / CHP-R is an appropriate solution given the current status and uncertainty surrounding the preferred CHP / CHP-R opportunity. It is expected

that this requirement will be prescribed through amended Section 36 / Planning Conditions for the Development.

6.4 A Note on the Potential Implementation of CHP

6.4.1 Whilst the CCGT unit will be designed and built CHP-R, the ultimate implementation of CHP at the Development will be dependent on a number of factors. These factors include:

- ***Compatibility of the running regime of the CCGT unit with the requirements of the head load***;

  The anticipated role of the proposed Development is to provide a mixture of base load and flexing capacity to the National Grid National Electricity Transmission System. Therefore, the running regime and load of the CCGT unit will be somewhat unpredictable. In contrast, a primary requirement of a viable and effective CHP scheme is that it should be capable of meeting the requirements of the identified heat load (for example, requirements for residential heat loads (such as those likely to be required by the 'Lincolnshire Lakes' development) would be steady and consistent over the majority of the year). As a result, the ultimate running regime and load of the CCGT unit may not coincide with the requirements of the identified heat load, and this incompatibility may affect the viability and effectiveness implementing a CHP scheme.

- ***Compatibility with the specific Energy Policies of the heat load developments***; and,

  As noted previously, separate Energy Strategies have been prepared for both the Lucent Group development and the Maltgrade Limited development. These Energy Strategies will be based on specific Energy Policies for the developments. Any CHP scheme to be implemented will need to be compatible with these specific Energy Policies.

- ***Economic feasibility***.

7 CONCLUSIONS

7.1.1 To implement advances in engineering design for Keadby II, KDL are submitting a Variation Application to the Secretary of State. To accompany the Variation Application, KDL is providing supporting information to DECC. This Document is the CHP Assessment.

7.1.2 The proposed Keadby II site lies approximately 7 km to the west of Scunthorpe and approximately 27 km to the north east of Doncaster. The Ordnance Survey (OS) Grid Reference of the centre of the proposed Development site is approximately 482676, 411646. This is the centre of the area designated for the development of the gas turbine, HRSG and steam turbine unit. The factors influencing the selection of the proposed Development site include:

- The use of existing infrastructure wherever possible;
- The presence of a skilled workforce at the existing Keadby I CCGT generating station, with established operational systems, who will be available for training new employees;
- The availability of technical support (if required) from the existing Keadby I CCGT generating station;
- The close proximity of the National Grid Gas National Transmission System;
- The close proximity of the National Grid Electricity National Transmission System, and the allowable use of the existing overhead line;
- The availability of sufficient land for the Development;
- An appropriate visual context with the adjoining land uses;
- The opportunities to link beneficially adjoining land uses;
- Compatibility with planning policy; and,
- The existing strong relationships with key stakeholders and the local community.

7.1.3 As part of this CHP Assessment, both online resources and additional consultation has been undertaken to determine whether there are any CHP opportunities within 15 km of the proposed Development site. In this regard:

- The examination of the online UK CHP Development Map did not identify any viable CHP opportunities in the CHP search area; and
- The additional consultation undertaken with North Lincolnshire Council identified the plans for up to 6,000 homes at the 'Lincolnshire Lakes' Development. The 'Lincolnshire Lakes' Development lies approximately 3 km to the south east of the proposed site. Applications have been submitted on behalf of the Lucent Group and Maltgrade Limited. To accompany the applications, separate Energy Strategies have been prepared for both the Lucent Group development and the Maltgrade Limited development. Whilst both Energy Strategies not that district heating networks may be viable, they also note that further work needs to be undertaken as the detailed design of the overall development progresses.

7.1.4 Based on the examination of the online UK CHP Development Map and the additional consultation which has been undertaken, the preferred CHP opportunity is considered to comprise the plans for up to 6,000 homes at the 'Lincolnshire Lakes' Development. Within this Document, to provide for a 'best case' CHP scenario, it has been assumed that the Proposed Development would provide the overall heat requirements for up to 6,000 homes. This is considered to represent an overall heat load of approximately 33 MJ/s.

7.1.5 To allow the identified (and any additional future) CHP opportunity to be realised, the design and final build of the Development will incorporate a number of appropriate provisions which will allow for the future implementation of CHP. In terms of these appropriate provisions, it is expected that the design of the CCGT unit would be identical to conventional CCGT units with the inclusion of the following additional items:

- Accessible tie-in locations in either the:
  - HP steam turbine exhaust (from the cold re-heat line); or,
  - LP steam turbine inlet.
- A stack design that would allow for future retrofit of flue gas extraction equipment; and,
- Control systems linked to the connections.

7.1.6 These provisions are comparable to those required as part of demonstrating the CCGT unit is CCR, with the design allowing for the extraction of steam from the electricity generating cycle.

7.1.7 Accordingly, it is considered that the CCGT unit will be designed and built CHP-R. It is considered that this degree of CHP / CHP-R is an appropriate solution given the current status and uncertainty surrounding the preferred CHP / CHP-R opportunity. It is expected that this requirement will be prescribed through amended Section 36 / Planning Conditions for the Development.

Appendix 1
Relevant Extract from the CHP Guidance

APPENDIX 1: RELEVANT EXTRACT OF THE CHP GUIDANCE

11. Developers should therefore provide evidence to show the steps that they had taken to assess the viability of CHP opportunities within the vicinity of their proposed location for the plant. Their application or notification should contain:

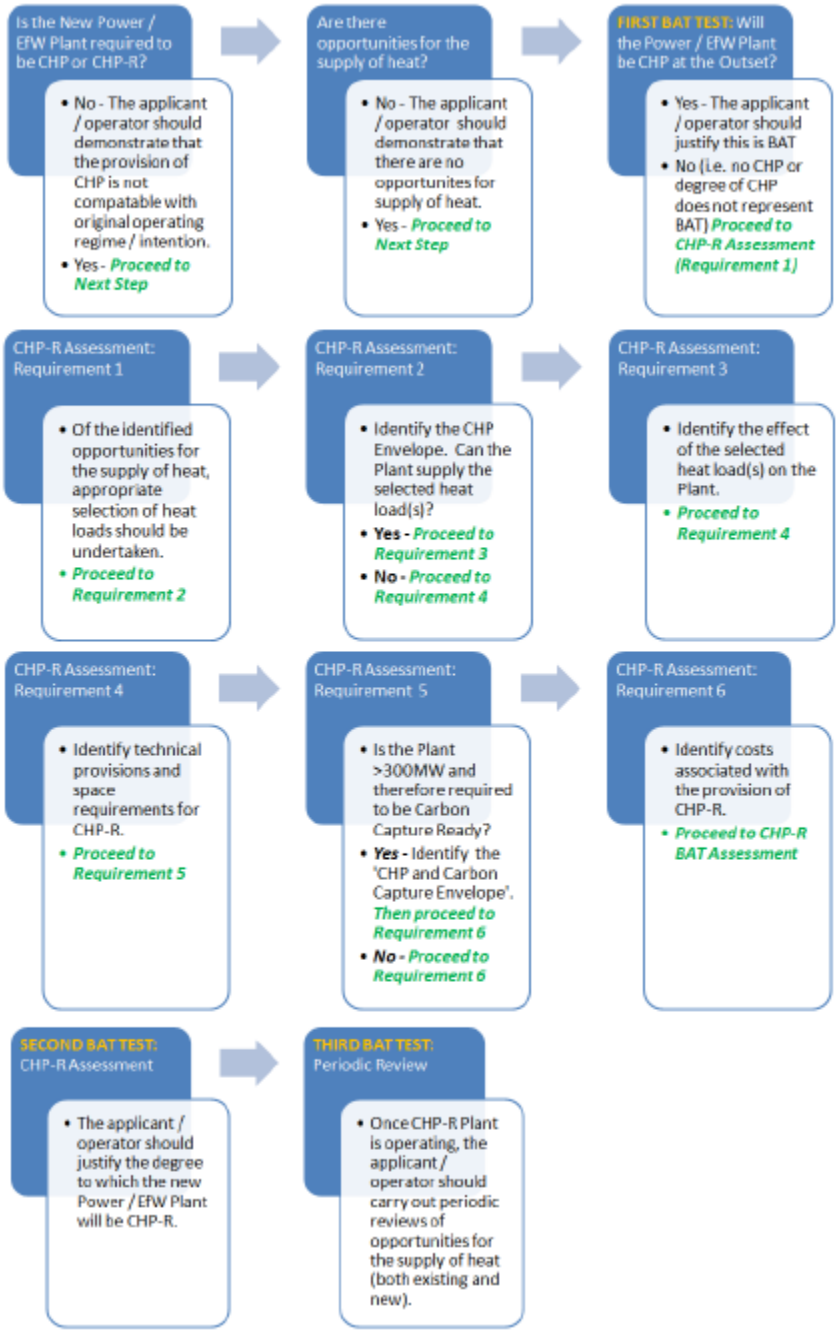
- *an explanation of their choice of location, including the potential viability of the site for CHP;*
- *a report on the exploration carried out to identify and consider the economic feasibility of local heat opportunities and how to maximise the benefits from CHP;*
- *the results of that exploration; and*
- *a list of organisations contacted.*

12. And, if the proposal is for generation without CHP:

- *the basis for the developer's conclusion that it is not economically feasible to exploit existing regional heat markets;*
- *a description of potential future heat requirements in the area; and*
- *the provisions in the proposed scheme for exploiting any potential heat demand in the future.*

APPENDIX 2
Relevant Extract from the CHP-R Guidance

APPENDIX B: RELEVANT EXTRACT OF THE CHP-R GUIDANCE



APPENDIX 3
Summary of the Application for the 'Lincolnshire Lakes' Development Submitted on behalf of the Lucent Group

SUMMARY OF THE APPLICATION FOR THE 'LINCOLNSHIRE LAKES' DEVELOPMENT SUBMITTED ON BEHALF OF THE LUCENT GROUP

The overall development comprises:

- Application 1: "*An outline application, with all matters reserved with the exception of access, for the development of up to 500 new homes (Use Class C3), a village centre (Use Class A1, A2, A3, A4, A5, B1, D1), a care / retirement home (Use Class C2), a health care facility (Use Class D1), new roads and footpaths, informal areas of open space, play areas and sports pitches*";
- Application 2: "*A full application for highway works to deliver the new terminating junction to the M181 Motorway (due to the de-trunked section of the highway to the north of the terminating junction) and the development of the western section of the east west link road*";
- Application 3: "*An outline application for a commercial park comprising Use Class A1 (food and non-food), A2, A3, A4, A5, D2, C1 and B1*"; and,
- Application 4: An "*outline application, with all matters reserved except for access, for the development of up to 3,000 new homes (Use Class C3), a 3 form of entry primary school (Use Class D1), a village centre (Use Class A1, A2, A3, A4, A5, B1), a care / retirement home (Use Class C2), community facilities (D1), new roads and footpaths, informal areas of open space, play areas and sports pitches and new wildlife habitat, lakes and wetlands*".

As part of the application documents, an Energy Strategy has been prepared (WSP Environmental, August 2013). The Energy Strategy summarises an overarching strategy for the overall development.

The strategy considered followed the hierarchy principles of: 'Be Lean' (i.e. use less energy); to 'Be Clean' (i.e. supply energy efficiently); to 'Be Green' (i.e. use renewable energy systems).

The Lean Energy measures considered were mostly related to specific building design features, and are not considered further here.

The Clean / Green Energy measures considered included "*gas CHP*" and "*district heating – waste CHP*".

Gas CHP represented a dedicated on-site CHP development, and was not considered to be able to meet the project targets of 20% of energy delivered from renewables. Therefore, it was recommended that gas CHP from a dedicated on-site CHP development was not considered further for the overall development.

District Heating – Waste CHP represented "*the recovery of exhausted heat energy (otherwise rejected from power stations / generators as waste heat) which can be used to provide heating for both residential and non-residential purposes".* However, the consideration of these schemes related to de-centralised biomass / waste CHP developments which would contribute to the project target of 20% of energy delivered from renewables. Furthermore, the Energy Strategy noted that: *"due to the low housing density within the residential site area (c 30 – 35 dwellings per hectare), the provision of district heating to the dwellings is not considered to be technically or economically feasible. However, the mix of uses within the commercial park may provide a high electrical baseload and a significant 'anchor load' for constant heating requirements. Therefore, the provision of heat and electricity to the non-residential elements via a decentralised renewable energy centre may be feasible*". Therefore, it was recommended that district heating – waste CHP should be considered further for the overall development.

In summary, the Energy Strategy concluded that "*although district heating is not recommended on a site wide basis it is possible that [CHP] may be viable in some areas, particularly the commercial park*".

APPENDIX 4
Summary of the Application for the 'Lincolnshire Lakes' Development Submitted on behalf of Maltgrade Limited

SUMMARY OF THE APPLICATION FOR THE 'LINCOLNSHIRE LAKES' DEVELOPMENT SUBMITTED ON BEHALF OF MALTGRADE LIMITED

The overall development comprises:

- Application 1: "*Outline application for the development of up to 2,500 new homes, a 3 form of entry primary school, village centres, community facilities, new roads and footpaths, informal areas of open space, play areas and sports pitches and new wildlife habitat, lakes and wetlands*";
- Application 2: "*Outline application for highway works to deliver the new terminating junction to the M181 Motorway (due to the de-trunked section of the highway to the north of the terminating junction) and the development of an east and west link road connecting to the existing B1450, Burringham Road*"; and,
- Application 3: "*Outline application for recreational, community and leisure facilities, new roads and footpaths, informal areas of open space, play areas, and new wildlife habitat, parkland, lakes and wetlands*".

As part of the application documents, an Energy Strategy has been prepared (fortynine design, December 2014). Whilst the Energy Strategy noted that detailed strategies would continue to be confirmed as detailed applications are prepared and submitted, an overarching strategy had been prepared to aid understanding of the overall development proposed.

The Energy Strategy noted that, throughout the development of the proposals: "*careful consideration has been given to the incorporation of sustainable design features into the layout and form in order to create a legible and functional development, with energy efficiency at the forefront*". And that: "*this* [overarching Energy Strategy] *considers the strategic low and zero carbon energy strategies that may be adopted at the site to meet policy and regulatory requirements*".

The strategies considered followed the hierarchy principles of: 'Be Lean' (i.e. use less energy); to 'Be Clean' (i.e. supply energy efficiently); to 'Be Green' (i.e. use renewable energy systems).

The Lean Energy measures considered were mostly related to specific building design features, and are not considered further here.

The Clean / Green Energy measures considered included "*gas CHP*", noting that this would be applied at a macro scale (i.e. at district scale or larger). Of the Clean / Green Energy measures considered, the Energy Strategy states that: "*at this stage in the Proposed Development it is concluded that whilst certain technologies may go a considerable way to meeting energy demands and creating carbon savings, no single technology can fulfil the site's total energy demand and carbon reduction target. Therefor a combined technology solution will be required*".

Furthermore, in terms of the Clean / Green Energy measures, the Energy Strategy stated that: "*at this early stage of development it is important to determine the most appropriate means of serving the heating, cooling and power demands of the* [Proposed Development], *looking for opportunities for sustainable energy choices, sharing demand and supply and taking into account local and national policy requirements. The proposals must be affordable, to developers and end-users, be technically feasible and appropriate to the site*".

Accordingly, the Energy Strategy noted that the only possible technologies to be considered were: district heating network; and / or, wind turbines. In terms of the district heating network, this could include gas CHP and the Energy Strategy notes that: "*the likely heat profile may support the use of a local energy centre to supply a district heat network*".

However, the Energy Strategy also notes that "*numerous studies suggest that for district heat networks to be economically viable (for the operator and the customer) a density of at least 40 – 45 dwellings per hectare (dph) is required and need a steady, year round, demand for heat (typically from a large heat user like a leisure centre, known as an anchor load)". Furthermore: "whilst parts of the site do reach the above density, there is no obvious*

anchor load, either planned or existing, which would help make a local energy centre feasible in terms of energy efficiency or economic viability".

Nevertheless, the Energy Strategy recommended that district heat networks may be viable in some areas of the site providing all thermal demand for that zone. And furthermore: "*due to its scale, phased approach and impact or market forces on the* [overall development] *further details will be submitted as part of each detailed design phase*".