Programme Area: Energy Storage and Distribution

Project: Heat Storage

Title: Request for Proposal

Context:

Heat is the biggest end use of energy in the UK - most of it is used for heating homes and providing hot water. This research project examined the feasibility of capturing large quantities of waste heat from power stations and industrial processes and then storing it underground for later use in homes and offices. It investigated the cost effectiveness and practicalities of storing large quantities of heat for long periods of time to meet a significant proportion of the UK's winter heat demand. It evaluated the practical limits for this type of storage, the technology development needs and where in the country large-scale heat storage could be most effectively exploited. International consulting engineers Buro Happold completed the research project in 2011.

Request for Proposals (RfP)

Title of Services for which Proposals are Requested:

Feasibility Study of Geological Heat Storage in the UK

Request Issue Date:

18th June 2010

Deadline for Notification of Intention to Submit a Proposal:

5th July 2010

Bidder Engagement Workshop:

N/A

Closing Date:

Proposals must be received before 5pm on 23rd July 2010

Contact for Enquiries:

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1. Introduction and Overview of the Services Required

1.1. Introduction to the Energy Technologies Institute

The Energy Technologies Institute LLP (the ETI) is a private organisation formed as an innovative Limited Liability Partnership between international industrial energy companies and the UK government.

Our mission is to accelerate the development, demonstration and eventual commercial deployment of a focused portfolio of energy technologies, which will increase energy efficiency, reduce greenhouse gas emissions and help achieve energy and climate change goals.

We will do this by leveraging the skills, capabilities and market access routes of our members, working with other organisations worldwide; to take the most challenging large-scale energy projects to full system demonstration, thus bridging the gulf between laboratory proven technologies and full scale commercially tested systems. Our projects will also develop knowledge, skills and supply-chains, and will inform the development of regulation, standards and policy. Hence we aim to overcome major barriers, de-risk the future development and shorten the lead times to market for secure, affordable, low-carbon energy systems for power, heat and transport.

Our portfolio includes programmes in areas such as Offshore Wind, Marine, Distributed Energy, Transport, Energy Storage & Distribution, Buildings and Carbon Capture & Storage.

Further information on the ETI, its members and its programmes can be found on our web-site at www.energytechnologies.co.uk

1.2. Background to the Project

This project is to investigate the feasibility of storing large quantities of heat for long periods to meet a significant proportion (>10%) of UK winter heating load from heat stored during the summer.

It will investigate optimal performance, economic, environmental and health and safety factors to determine the potential for large scale inter-seasonal heat storage for utility level district heating schemes in the UK. The vision is to store and recover heat more cost effectively from constant running base-load generation than from part time peak shaving generation plant such as municipal boilers. The target cost for delivery of heat from storage to a district heat network is therefore less than £100/MWh(th).

The total annual energy demand for heating buildings and water in the UK is approximately 600 TW.hr. currently 86% of this demand is met by gas heating systems. This system is very robust and cost effective today but it faces two main challenges for the future:

- The depletion of North Sea reserves increasing dependence on imports
- The decarbonisation of the energy system required to meet the governments stated targets of 80% CO2 reduction by 2050.

The ETI is therefore investigating technologies that support alternative heating strategies which could have significant impact at a national level. It is very unlikely that the present system based on domestic gas boilers will be able to meet the UKs aggressive CO2 reduction targets of 34% by 2020 and 80% by 2050. Therefore a substantial proportion of the nation's heat load will need to be transferred to a combination of electrical and direct thermal systems, such as heat pumps and district heating schemes. Many factors will affect the rate of adoption of the different technologies and the maximum capacity of each that can be installed nationally.

A key strength of the current system is its ability to meet the very wide spread of demand that occurs throughout the day and the seasons. Heat demand for all buildings the UK varies between from a daily average of about 40 GW(th) in the summer to 130GW(th) in the winter. Peaks on particularly cold days can exceed 200GW(th). These periods of high demand can last for several days.

The current system operates with excess installed boiler capacity, rated in excess of daily peak demand to enable rapid warm-up. Peak demand for heating and power generation is met from storage capacity in liquefied gas stores and flexible import arrangements through pipelines and LPG tankers. 250GW(th) is probably a realistic conservative estimate of the national hourly peak heat demand during a cold period. A supply, generation and distribution system sized to meet this peak would operate at quarterly load factors of 16%-52% depending on season, or 32% average over the year.

The current electrical system has an installed capacity of 78 GW(e) and typically operates between 30 and 50GW(e), or 38% to 64% load factor and can reach 60 GW(e) peaks. The transfer of a large proportion of the nation's space and water heating load to the electrical system will therefore have a significant impact on the installed capacity required, and the average load factor of this system. This would significantly impact the economics of power generation and distribution, especially as initial capital costs are likely to become relatively more important than fuel costs in the longer term.

Dealing with peak heating demand will require some combination of excess generating capacity used only when required, and storage capacity to balance between the peak and troughs. It would take approximately 100 TWh(th) storage to balance the present UK heat requirement from winter to summer and there are no technologies commercially available that can store this order of magnitude of energy. However there is considerable potential value in technologies to store large quantities of energy to avoid the combined capital and efficiency costs implied by a mix of significant winter peak shaving generating plant and base load generation operating at low load factors.

The scale of the required storage can be appreciated by taking it as of the order of 30TWh of electricity, running for 21 days at 60GW. For reference, Dinorwic has a peak output of 1.9GW for around a quarter of a day. For new buildings there are solutions which involve building heat stores into the ground below the buildings; these solutions are not practical for most existing buildings; at least 80% of the current housing stock will still be in use in 2050.

There are many projects globally that are looking at methods of storing electrical energy, or energy that can be easily converted to/from the electrical system. There are also several installed applications around the world that store heat in district networks for short periods and in individual buildings for months. This project is to investigate the cost effectiveness and practicalities of storing very large amounts of heat for long periods in UK geological formations such as saline aquifers. Many of these formations are accessible to populated areas and could be used to support district heating schemes, but there are many uncertainties regarding the effectiveness, environmental impact and ultimate capacity of such systems in the UK.

1.2.1. Impact of Cost Effective Bulk Heat Storage at key locations in the UK

Cost effective large scale heat storage would impact each of the key interest areas of the ETI

Affordability

- Improved overall system efficiency by making productive use of waste heat from major power stations.
- Minimise the need for generating plant operating at low load factors.

Security of supply

- Reduce dependence on imports of fuel to support short term peaks during the winter when prices are highest
- Low grade heat based systems allow a greater diversity of energy sources to be deployed.
- Reduce susceptibility to generation system and distribution system failures.

Sustainability/Greenhouse Gases

- Large scale heat networks allow greater diversity of low carbon energy sources to be deployed.

- Reduce the need for primary fuel through the overall system efficiency savings.

1.3. Outline Scope of the Project Activities

1) Conduct literature survey and summarise current status of geologically based heat storage and recovery technologies globally.
2) Assess UK geological formations of porous rocks most suitable for heat storage. This would include aquifer thermal energy storage and borehole thermal energy storage and also the use of existing caverns, mineshafts and possibly manmade aquifers using hot dry rock approaches. The suitability of the formation for both higher and lower temperature storage should be considered. This would lead to a statement of technically feasible resources within stated uncertainty bounds.
3) Develop proposals for different configurations of heat storage and recovery, based on expected locations of thermal power stations and major population centres. The ETI will supply working assumptions for example power station location and thermal output for different configurations, including alternative temperatures water can be delivered at and the temperature at which water must be returned. Also the location of population centres and their heat demand will be given. These are outlined in section 3, Appendix C. Based on these assumed inputs the project will assess different configurations including high temperature stores located near the power station versus lower temp stores near the loads. If additional cooling is required to the return water this is to be factored into the study.
4) Outline major process steps throughout life cycle of a storage site, including what is involved in detailed surveys, well drilling, initial loading, steady state operation, and end of life issues.
5) Identify a number of potential test sites and/or applications for large scale demonstration after this feasibility study.
6) Identify Intellectual Property ownership that may affect future commercial exploitation of any technologies proposed.
7) Summarise the current regulatory framework for large scale heat storage in the UK and identify potential safety, health, environmental and regulatory issues.

1.4. Required Outcomes and Critical Success Factors for the Project

This Project will be successful if it enables:

- An assessment of the potential economics and contribution of large scale geological heat storage as part of a future UK energy system with significant heat distribution to domestic housing and commercial buildings;
- Identification of the most promising technologies and their development requirements; and
- Identification of potential locations and scope for the next stage of technology development and demonstration.

The main outputs that will support these outcomes are expected to be:

1. A detailed description of key performance factors for the different geological and hydro-geological features and heat transfer systems that impact system capacity, efficiency and whole life cost.

2. A summary analysis of potential system configurations for generating plant, distribution network and storage delivery and recovery.

3. A GIS database (suitable for import into ArcGIS) of suitable locations in the UK and proximity to the relevant heat supply and demand centres.

4. An economic analysis in a graphical form, showing how the key performance factors, sizing, location etc impact on the preferred solutions.

5. An analysis of key technical, commercial, regulatory, health, safety and environmental risk areas and suggestions for mitigation strategies.

6. Recommendations and specifications for two to three potential site specific development and demonstration projects.

A successful project outcome will be characterised by the ETI being able to understand the potential for large scale heat storage to contribute to the UK Energy System out to 2050 and to decide on suitable technology development and demonstration projects. The quality of the analysis and presentation of information will be important to gaining the support of key stakeholders.

1.5. Anticipated Project Organisation Structure

It is possible that one Participant may undertake the Project on a sole/prime contractor basis (with or without using subcontractors), or that more than one Participant organisations / entities will be needed to work together in order to provide all the necessary knowledge, skills, experience and inputs to complete the Project (as detailed in Section 2.2).

Therefore, several Participants may choose to form a consortium, contracted with the ETI, governed by its own Consortium Agreement and led by a "Lead Coordinator" to act as primary interface with the ETI.

Alternatively, a single Participant may act as a Prime Contractor and form a contract with the ETI, entering into separate sub-contracts with third parties for specific identified parts of the Project scope (subject to agreement with the ETI).

Either of these contracting arrangements is acceptable to the ETI, but there must be a single organisation (Lead Coordinator or Prime Contractor) leading and acting as the primary interface with the ETI. This organisation shall appoint a Project Manager to lead and coordinate all activities of the Project Participants, and to liaise regularly with the ETI's Programme Manager to whom he/she is accountable on behalf of the Participants. This organisation shall also act as the Respondent for the purposes of this Request for Proposals.

1.6. ETI and State Aid

Funding from the ETI for this Project constitutes state aid. The ETI has a specific state aid clearance from the European Commission. In relation to their Proposals, Respondents should note:

- Further information may be required to support the specific state aid requirements of any Proposal during the procurement process;
- Successful Respondent(s) will be required to provide full transparency of costs throughout the Project to ensure both the Participant(s) and the ETI comply with EU state aid law;
- Participants will need to agree to certain contractual obligations related to the state aid requirements including the duration of Project records and obligations to return ETI funding in certain exceptional circumstances.

1.7 ETI Approach to Health and Safety

The health and safety of those who may be affected by ETI projects is of paramount importance to the ETI. The ETI expects those who receive ETI funding to demonstrate a commitment to best practice in HSE management as well as meeting legal requirements. The ETI expects any successful Participant(s) to work with the ETI to demonstrate to the ETI that HSE safety management is maintained.

2. Request for Proposals Process and Terms

2.1. Content and Format of Proposals

Any contractor interested in bidding for this Geological Heat Storage in the UK Flexible Research Project ("Respondent") is requested to submit a Proposal which shall be arranged according to the structure detailed in Appendix A and shall include all the information listed therein.

The Proposal must be written in a succinct manner and must not include imprecise statements, generalities or repeated information. The Proposal must be easily readable with appropriate font sizes, margins, etc, and **shall not exceed a maximum of 15 pages** (excluding the due-diligence information required under Section 9 of Appendix A and any other information explicitly stated in Appendix A to be exempt from this limit).

Additional information (such as organisational brochures, etc) may be provided to accompany the Proposal if this is expected to add value (although it is not necessarily required by the ETI), but such additional information will not usually be taken into account when reviewing Proposals.

The Proposal shall consist of **three (3) complete hard copies and one (1) complete electronic copy**. The latter shall be provided in both PDF and Microsoft Word formats.

2.2. Acceptance, Review and Selection of Proposals

Proposals will be reviewed and judged primarily against the criteria listed below.

- The knowledge and capability of the project team to address the key issues:
  - Availability of key staff (especially the key roles of project manager and project technology leader) as presented in their CVs;
  - Understanding of UK geology and access to relevant geological data;
  - Experience of the technologies required to develop and operate deep heat storage facilities at the scale required to support major population centres;
  - High level understanding of the economics and technologies involved in heat distribution;
  - Understanding of the likely regulatory environment and risk factors for geological heat storage; and
  - Capability in systems design and analysis, including model building and economics.
- Project approach and plan, including proposed management of specific risks and issues, Gantt chart and suitable payment milestones (if appropriate)
- Compliance with terms and conditions, including any intellectual property issues (such as acceptance of ETI IP terms, or the existence of any IP issues which may affect the ability to carry out the Project and exploit the results)
- Value for money for the ETI and confidence in achieving outcomes versus price.

The ETI at its discretion may request further information in order to assess a Proposal, and may reject any Proposal which does not provide sufficient information.

This RfP is not an agreement to purchase goods or services, and the ETI is not bound to enter into a Contract with any Respondent. All decisions made by the ETI relating to the acceptance, review and selection or otherwise of Proposals are final. The ETI will be under no obligation to explain or justify any such decisions at any time.

2.3. Estimated Time-Frames

The following timetable outlines the anticipated schedule for the contract process. The timing and the sequence of events resulting from this Request for Proposals may vary and shall ultimately be determined by the ETI.

Event	Anticipated Date(s)
Closing Date for Responses to RfP	23rd July 2010
Clarification Meetings (as required)	August 2010
Preferred Bidder Identified	3rd September 2010
Project Detailing and Contract Agreement	September 2010
Contract Approval	4th October 2010
Project Start	1st November 2010
Project Duration	Approx 3 - 6 months (TBD)

2.4. Ownership of Proposals and Confidentiality of Information

All documents, including Proposals, submitted to the ETI become the property of the ETI. They will be received and held in confidence by the ETI, subject to the ETI reserving the right to provide such documents to third parties engaged by the ETI in its assessment of them. Organisations selected by the ETI to be taken forward to the Project Detailing Stage will be required to sign non-disclosure agreements.

3. Price and Payment

Any funding to be paid by the ETI for this Project will be paid on a ***"fixed price" basis***. The Project Contract will include defined deliverables, with acceptance criteria, and defined Payment Milestones by which one or more deliverables will have been completed. Payments will be made against each defined Payment Milestone, subject to ETI acceptance of the Milestone Completion Report. Unless otherwise agreed as part of a formal contract variation process, the ETI shall not be liable for any payments above the maximum stated in the Project Contract.

Further information is contained in the Terms and Conditions contained in Appendix B.

4. Terms and Conditions for Project Contract

During the Project Detailing Stage, a Project Contract will be drawn up by the ETI based on its standard contracts for such work and incorporating appropriate information from the ETI's RfP and the Respondent's Proposal. Full terms and Conditions will be agreed at that time, but a Summary of Terms is included in Appendix B.

If a Project is to be undertaken by a Consortium, then the Consortium members will be required to execute a Consortium Agreement between themselves prior to signature of the Project contract with the ETI. The ETI may request a copy of this Agreement for review/approval, and a Model Consortium Agreement is available from the ETI.

Appendix A – Content and Format of Proposals

The Proposal shall be arranged according to the structure defined below and shall explicitly include all the information listed.

1. Executive Summary *[maximum 1 page]*

A summary of the Proposal, describing briefly:

- The organisation(s) undertaking the work
- Summary of the technical approach and ***key*** deliverables
- Confirmation of compliance with the Specification detailed in the Request for Proposals and/or brief summary of ***key*** exceptions/deviations
- Duration of key activities.
- Fixed Price.

2. Background to Proposed Participants and Subcontractors *[typically 2 pages]*

The Respondent should provide a brief description of each organisation involved, including:

- Key skills, capabilities, knowledge, experience and previous track record in the area (technical, commercial and project management, including any UK-specific issues such as technology applicability to UK systems, UK industry practice, UK market/industry knowledge, etc)–
- Key staff members involved (including designated Project Manager and Project Technologist), with the amount of each individual's time which will be dedicated to the Project, and detailing their experience – with CVs included in an Appendix (maximum 2 pages per individual) – I think that the chief tech person is very important to explicitly name
- Any major Subcontractors (including where practicable the above "Key skills" (etc) and "Key staff" information in relation to each)

The Respondent should identify in their Proposal any anticipated potential issues or difficulties in executing subcontracts (as appropriate).

3. Programme of Work *[typically 3-4 pages]*

The Respondent should provide a summary of the overall approach to delivery of the project, and a Task-by-Task breakdown of the proposed work, identifying for each Task:

- the Task leader
- other Participants and/or Subcontractors involved
- key dependencies
- the technical approach (including use of any specific methodologies, techniques or tools)
- Task objectives
- deliverables, including for each deliverable a specification (e.g. quality, appearance, scope, function and purpose as appropriate) and proposed Acceptance Criteria

The Respondent should be specific about the activities within the Task, e.g. including test/simulation matrices or stating a number of tests/simulations.

The description of the tasks should be in sufficient detail for someone familiar with the field to understand the proposed technical approach; Appendix C details the issues that are expected to be addressed in the relevant work packages:

Any issues or assumptions in defining the programme or schedule (e.g. inputs required from the ETI or other projects) should be explicitly stated.

A specific project management Task (or Tasks) should be identified describing all the activities in this area for the project scope (e.g. regular meetings, reporting, Stage Gates etc). ***Note that throughout Project delivery the ETI will require reports of monthly progress with supporting financial data, reports to substantiate completion of each milestone, etc.*** If appropriate, a work flow diagram should be provided to illustrate the relationships between Tasks.

Any relevant activities related to but not included within this Project and the relationships with these activities, should also be described.

4. Deliverables & Payment Milestones *[typically 1 page]*

Following the detailed specifications of each deliverable in the previous section, a summary table should be provided here listing all the Project Payment Milestones (i.e. key points in the Project where one or more Deliverables will have been provided and payment is requested from the ETI), and their constituent deliverables, with due dates for each deliverable and Payment Milestone.

5. Project Schedule *[typically 1 page]*

The Respondent should provide a time schedule for the Project (e.g. in the form of a Gantt chart) showing the main Work Packages, Project stages and main Tasks within each Work Package and stage. This should clearly identify:

- Task durations and dependencies (including any inputs required from the ETI or other parties and any other external dependencies)
- Project Deliverables
- Payment Milestones and other relevant milestones
- Project Stage Gates, Design Reviews and other review points.

6. Risk Management *[typically 1 pages]*

The Respondent should describe the proposed Risk Management Strategy (i.e. how risks to the successful delivery of the Project will be identified and managed throughout the Project). They should also provide a Risk Register, identifying the key challenges, risks (including any assumptions or dependencies identified earlier), issues and opportunities which may affect the successful delivery of the Project outcomes and identifying planned activities to address / mitigate each item.

The ETI expects that the work required for the Project will be entirely desk based. The Respondent should identify and describe any work it proposes to carry out in relation to the Project that is other than desk based, in order that the ETI may assess any implications of such work (for example, in relation to HSE management).

7. Statement of Compliance *[typically 1 page or less]*

The Respondent shall provide a statement that the Proposal is fully compliant with the Specification and all other aspects of the Request for Proposals (including the Summary of Terms in Appendix B), or shall state clearly any exceptions, deviations, alternative approaches or additions to the required

Specification, with justification. ***Note that in the absence of any specifically-stated deviation in this section of the Proposal, in the case of any subsequent dispute, the ETI's specification will take precedence over the Proposal.*** Additional comments and clarifications should also be listed where appropriate (for example to clarify interpretation of requirements), but these must be differentiated from any deviations / exceptions above.

8. Price and Project Payment *[typically 1 – 2 pages]*

Project Payments

In respect of any proposed payments by the ETI, the following information should be provided:

The Respondent should provide:

- a figure for the ***fixed price total contract value*** for the Project
- a ***breakdown*** between Tasks.

If there are any assumptions or limitations to this price, these should be clearly stated. The Respondent should also provide a ***breakdown of the total contract value (only) by category***, as specified in the Table below.

	Participant 1 (Lead Coordinator or Prime Contractor)	Participant 2	Participant 3	Participant 4	Participant 5	Total
Number of Person-days						
Base Labour						
Materials						
Capital						
Subcontractors						
Travel & Subsistence						
Overheads						
Other						
Profit						
TOTALS						
Profit Margin, %						

Notes on Category Breakdown table:

1. Base Labour should include direct add-ons (eg NI, pension etc)
2. Capital costs should be based on depreciation during the Project x % usage on Project
3. Participants will be required to provide justification of overhead calculations during the Project detailing stage. ETI can provide a spreadsheet to calculate overheads on request
4. Participants are required to declare their profit margins
5. Academic Participants should determine their costs using the JeS system. Note that ETI funds Academic Participants at 100% Full Economic Cost.

9. Due Diligence Information *[this is excluded from the page limit]*

The ETI requires Participants to provide due diligence information. The due diligence is carried out in two stages. Certain information is required to be provided at the same time as the proposal (part A) and further information is required to be provided if any proposal is selected to proceed to the Contract Detailing stage (part B).

Please note that successful completion of all elements of the due diligence is a pre-requisite to any contract award. Even if a proposal is selected to move to the Contract Detailing stage, failure to meet due diligence requirements at that stage may result in the exclusion of that Participant or the proposal from the ETI's selection process.

Please provide the due diligence information as set out below. Please note information for questions A and B are required from ALL Participants.

Please note that the following information will be required for part B of the due diligence at Contract Detailing if a proposal is selected to proceed to that stage:-

a. It is anticipated that this project is going to be desk based and so it is not anticipated that the ETI will carry out a full health and safety competency. If a Respondent proposes to incorporate non-desk based aspects, the ETI will carry out a tailored health and safety competency assessment.

b. IP due diligence:-

   A detailed Background IP questionnaire will be issued for completion identifying the relevant Background IP for the Project and Participants and Subcontractors (if any) may be asked to provide evidence of either ownership or rights to use if there is relevant Background IP for the Project and use of the results.

c. Copies of each Participant's insurance policies will need to be provided.

d. Any other information that the ETI reasonably requires in order to fund the proposed project.

PART A – RfP Stage

A. State Aid

ALL Participants shall confirm that there are no potential, threatened, pending or outstanding recovery orders by the European Commission in respect of any funding received by any Participant.

B. Insurance

All Participants: Please confirm for each Participant insurance cover for the following risks is held, and confirm levels of cover and expiry for each. ETI will require evidence of these during the Project Detailing phase.

a. Property damage
b. Business interruption
c. Employer's liability
d. Public liability
e. Product liability (or justify its exclusion if not appropriate)
f. Professional Indemnity

Participants should identify if they self insure for any of these risks.

C. All Participants (except ETI Members, universities / higher education institutions and UK/EU government laboratories / agencies) which provide more than 20% of the resources for the Project or which provide an input which is critical to the Project's success, shall provide Due Diligence Information to the ETI according to the table below.

Details of organisation
Full name:
Registered Office:
Type of Business (sole trader, limited company, partnership etc):
Names of directors/partners/owner:
VAT number:
Details of directors, partners or associates
Have any directors, partners or associates of the organisation been involved in any organisation which has been liquidated or gone into receivership? (Yes/No)
Have any directors, partners or associates of the organisation been convicted of a criminal offence relevant to the business or profession? (Yes/No)
Please give (and attach if necessary) full details if you have answered 'Yes' to either of the two previous questions.
Audited Financial Accounts
Please supply Audited Financial Accounts for the last 3 years for the organisation, or relevant part thereof.
Claims or litigation
Please provide (and attach if necessary) details of any claims or litigation against the organisation, outstanding and/or anticipated.

Part B (during the Project Detailing Stage)

The anticipated work required for this study is a desk top study using available information and it is not anticipated that any site visits or experimental or laboratory work will be required. Accordingly the Health and Safety requirements are restricted to reviews by the Energy Technologies Institute as deemed necessary.

Should any of the Participants propose any other work beyond a desk top study the Participant is required to inform the Energy Technologies Institute, prior to the commencement of that work, so that a review of the health, safety and environmental implications can be reviewed.

10. Intellectual Property (IP) *[typically 1 – 2 pages]*

Arising IP:

Any Project commissioned by the ETI will be subject to the appropriate ETI terms and conditions, (a summary of which is included in Appendix B), which state that all Arising IP will belong to the ETI. The Respondent should provide a brief overview of the nature of any anticipated Arising IP from the Project.

Any licensing of Arising IP from the ETI to the Participants may be discussed if appropriate. If Participants wish to discuss any licence to use the Arising IP, Participants should note that under state aid rules profit cannot be paid for the Project in addition to the grant of a licence of Arising IP.

Background IP:

The Respondent should describe any Background IP (e.g. patents, proprietary data, computer algorithms, know how or other IP) only to the extent there is Background IP:

- which is needed (whether by the ETI, or to be licensed from one Participant to another Participant or a Subcontractor, or to be licensed by a Subcontractor to a Participant or to another Subcontractor, or otherwise) to carry out the Project or which may be used during the Project; or
- which may be needed by the ETI to exploit the Arising IP.

The description of any such Background IP should detail:

- the nature of the IP (including the legal nature of the IP right),
- rights to that IP, and
- ownership and control, whether this is by any of the Project Participants or by any third parties.

Academic Institutions/Publishing:

Generally, the ETI will grant rights to Participants who are academic institutions for the purposes of academic research and teaching if requested. Publication of appropriate parts of the Project results will generally be permitted subject to an approval process. Participants should include details of their desired requirements in relation to academic research, teaching and publication in their Proposal.

Appendix B – Terms and Conditions for Project Contract

TECHNOLOGY CONTRACT

Summary of Terms

Introduction

The following represents a summary of the key contractual terms which the ETI would expect to be included in the Technology Contract for a project under which the ETI owns all arising IP. This summary assumes that the Project will be carried out by a single contractor, the Prime Contractor, which may have specific parts of the Project scope subcontracted, subject to the approval of the ETI. Further/alternative provisions are indicated where relevant in the event that the Project is carried out on a multi-party consortium basis.

Structure

1. Where the Project will be carried out by a Prime Contractor, the Prime Contractor will manage the Project. Where there are Subcontractors, the Prime Contractor shall be solely responsible for the management and coordination of the activities of the Subcontractors. The Prime Contractor will be responsible for and administer payment for all of its Subcontractors.

2. Where the Project will be performed by a multi-party consortium, the Participants shall be represented in dealings with the ETI by a Lead Co-ordinator, who shall, in the majority of instances, be the intermediary for any communication between the ETI and the Participants. This role includes providing notices of meetings and other activities to the ETI, reviewing and commenting on project reports (as required under the Project) and administering payment of invoices for all Participants.

Project Management

3. The Prime Contractor or, in the event of a consortium, the Participants will appoint a Project Manager for the day-to-day management of the Project. The ETI will appoint a Programme Manager to act on behalf of the ETI with regards to the Project.

4. Where the Project will be performed by a consortium, the Participants shall form a Steering Committee to make decisions on day-to-day matters (excluding decisions affecting the overall scope, structure and timing of the Project). The frequency of meetings of the Steering Committee will be agreed with the ETI. The ETI and its members shall be entitled to attend any meetings of the Steering Committee.

5. The Prime Contractor or, in the event of a consortium, the Participants must fulfil various reporting obligations. The requirements for reports will depend upon the nature of the project, the deliverables under it and the duration of the Project but are likely to include monthly

reports and a final report. Each report must address a specified list of topics required by the ETI.

6. The ETI will require the right to carry out a Stage Gate review on completion of a Stage (or from time to time at a frequency to be agreed) in order to assess whether the Project continues to deliver against ETI outcomes and also in order to carry out a validation exercise against the business case. The ETI may carry out Stage Gate reviews more frequently if the Project is in jeopardy. The need for Stage Gate reviews and the definition of a stage will depend upon the nature of the Project.

7. The ETI will require that the Project is carried out in accordance with health and safety law and will require reports and information as evidence of such compliance from time to time (tailored to the Project).

Finance

8. ETI will pay a fixed price against defined Payment Milestones for the work done under the Project (as set out at Section 3 of this RfP, "Price and Payment"). Acceptance of deliverables and milestones will be determined by the ETI, where appropriate, against agreed acceptance criteria. Any increase in costs in carrying out the Project over and above the agreed contractual amounts will only be payable by the ETI in the event that such charges are agreed in accordance with the contractual variation control procedure.

9. Costs are payable in Sterling and ETI will pay valid invoices within 30 days of receipt of invoice following acceptance of a milestone.

10. The ETI reserves the right to require the return of funding in certain circumstances (such as in the event of corruption or fraud, overpayment, costs incurred in respect of unapproved project changes and failure to comply with State Aid obligations).

Confidentiality

11. Restrictions on disclosure of any other party's confidential information will apply. Any publication of results (if appropriate) will be subject to the confidentiality provisions in the agreement.

Audits and Records

12. ETI will require the right to audit the Project, the Prime Contractor (alternatively, in the event of a consortium, the Participants) and any and all Subcontractors during the Project and, in certain circumstances, up to 7 years from the end of the Project on financial or technical grounds.

13. All parties involved in the Project will be required to maintain the majority of Project records for a minimum of 10 years from the Project end date and for potentially more than 20 years where the records relate to registered intellectual property rights. The Prime Contractor shall require no less obligations from its Subcontractors.

Sub-contracting

14. Sub-contracting is not permitted without consent, except for agreed known subcontractors included/detailed in the Technology Contract at signing.

Variation

15. Any variations to the Project must be made via the variation control procedure.

Liability/ Warrranty / Indemnity etc.

16. The ETI will require that warranties and undertakings be given by the Prime Contractor or Participants (as appropriate), including without limitation in relation to rights to Background IP and the amount of the Project costs spent on research and development as defined in the Income and Corporation Taxes Act 1988.

17. There will be an indemnity in favour of the ETI members for tax losses in the event that the Prime Contractor or Participants (as appropriate) fails to provide complete and accurate information relating to the Project costs spent on research and development as defined in the Income and Corporation Taxes Act 1988.

18. The liability provisions relating to the Prime Contractor, alternatively in the case of a consortium the Participants, will be tailored on a case-by-case basis but are likely to be capped at the amounts payable under the Project (except in the case of IP infringement claims, certain third party claims or other liabilities which cannot be limited or excluded by law. For these claims, no cap will apply). Recovery of indirect, consequential etc. damages will usually be excluded. The Prime Contractor will be liable for the acts and omissions of the Subcontractors.

Withdrawal

19. Withdrawal from the Project is only possible with the express consent of the ETI and, in the event of a consortium, with the unanimous consent of the other Participants. In such circumstances, the Contractor or withdrawing Participant(s), as appropriate, cannot recover outstanding costs, unless otherwise agreed.

Termination and Suspension

20. The ETI reserves the right to terminate the agreement in certain circumstances (such as breach by the Contractor (which shall include without limitation a breach by a Subcontractor) or, in the event of a consortium, a Participant, insolvency or change of control of a Contractor/Subcontractor/Participant etc.). The ETI also reserves the right to terminate the agreement unilaterally upon giving a (to be agreed) period of notice to the Contractor or Participants, as appropriate. Upon termination, the ETI will pay the eligible costs incurred by the Contractor or Participants (as appropriate) up to the date of termination.

21. The ETI will reserve the right to suspend the Project in certain defined circumstances.

Intellectual Property

22. All arising IP from the Project will be owned by the ETI. The Contractor (or, in the event of a consortium, the Participants) and any Subcontractor(s) will, to the extent required, be required to assign all relevant arising IP to the ETI.

23. The Contractor (or, in the event of a consortium, the Participants) and any Subcontractor(s) will be required to licence their Background IP: (i) to the other parties (including for the avoidance of doubt Subcontractors) involved in the Project on a royalty free basis where required for the purposes of the Project; (ii) to the ETI or sub-licensees of the ETI, where required for the use or exploitation of the arising IP.

Appendix C – Description of Work Activities and Input Assumptions

a) Estimate potential heat flow rates into and out of reservoir based on induced and natural liquid flows, conductivity and heat capacity of the formation. Investigate whether natural flow could be a suitable transport mechanism for the heat network system from supply to demand to minimise pumping losses.

b) Identify environmental Impacts, including bio-geochemistry changes due to heat and also impact on competing users such as fresh water aquifers, CO_2 or LNG storage

c) Identify any significant geotechnical impacts due to cyclic heat storage and abstraction.

d) Identify novel opportunities, such as engineering rocks to create heat exchanger or improve heat flow rates, and using naturally occurring temperature gradients to increase efficiency.

e) Outline any water treatment processes and operational strategies required to prevent clogging, scaling and corrosion of pipe work, well screens and other plant items.

f) Propose different plant arrangements to handle different temperatures based on assumptions given below. This should include an overview of materials and components such as pipe work, pumps and heat exchangers suited to different temperatures.

g) Estimate transmission lengths and flow rates to transport heat from nearest thermal source to major demand centres given below, and estimate thermal and pumping losses of this network. A cost of £600K/km can be assumed for building such heat transmission networks if better data is not available within the team.

h) Complete a number of simulations using suitable software for the different configurations to test the thermal efficiency in different geological and hydro-geological formations and applications.

i) Estimate well drilling cost curves for the different formations above, and different arrangements such as horizontal drilling to increase flow rates. (inc geo-engineering costs for these applications)

j) Estimate surface plant whole life costs, heat exchangers compressors.

k) Estimate the cost curves for other significant variables identified by the project team.

Input assumptions.

For the sake of this study heat from 3 theoretical configurations of CHP power station can be assumed. These options for heat delivery from the power stations are described in the table below:

	Turbine	Out temp (C)	Inlet Temp (C)	Thermal Output (GW(th)
Option 1	3 stage optimised for electrical output	35	17	1
Option 2	3 stage optimized for 120C water output	120	17	1
Option 3	2 stage optimized for maximum thermal output	200	17	1

Comparisons should be made for district heat networks operating at 3 optional temperatures of 120C, 85C & 50C.

The location of existing major thermal power stations and heat demand will be provided to the project team in electronic format. This key data is represented in figure 1 below. It can be assumed that the nuclear power stations will most likely to be running base load power and would therefore be favoured for seasonal heat storage.

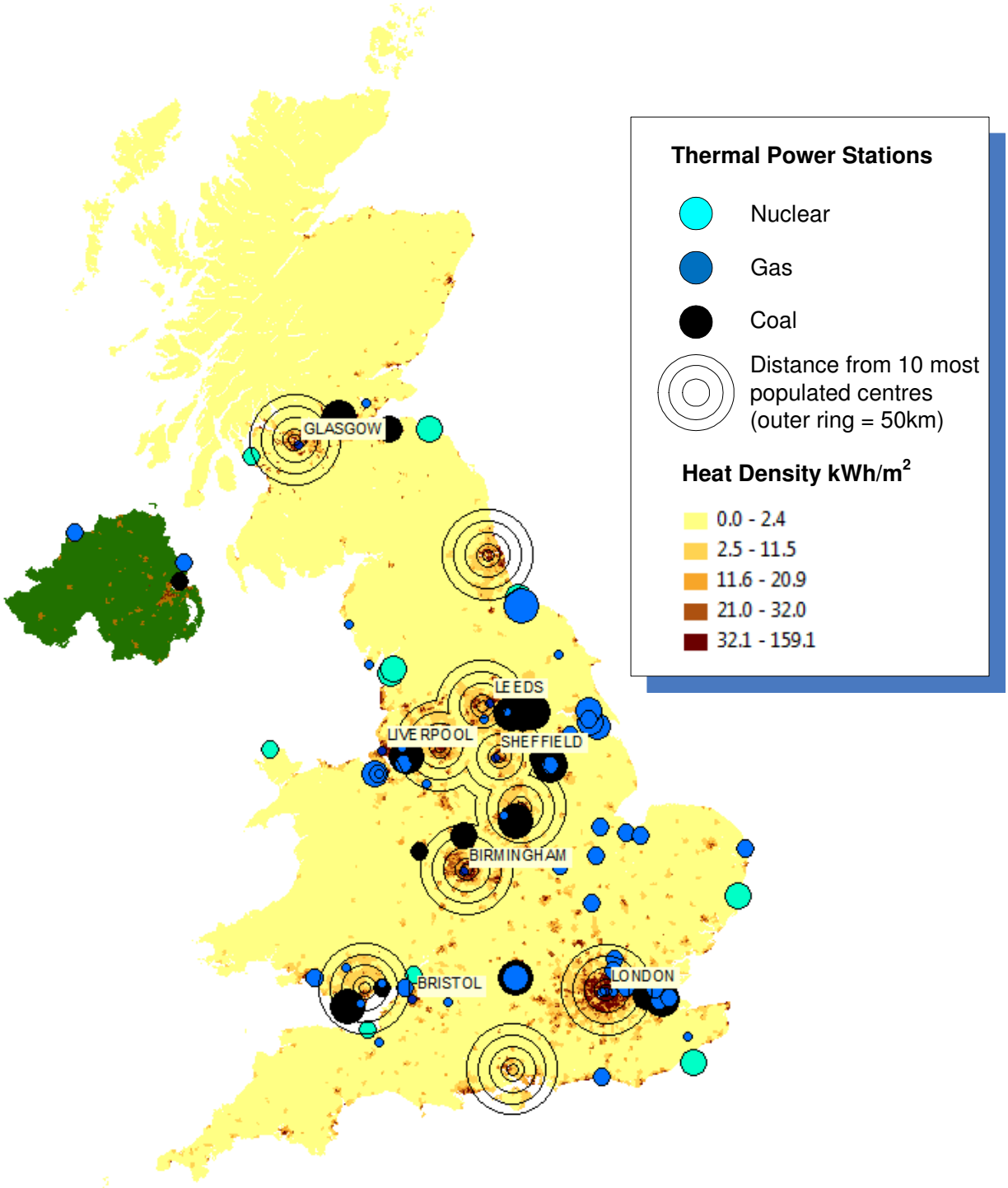

Figure 1 Location of potential major heat supplies and demand in the UK

The annual distribution of heat demand derived from national grid statistics will be also provided as illustrated in figure 2

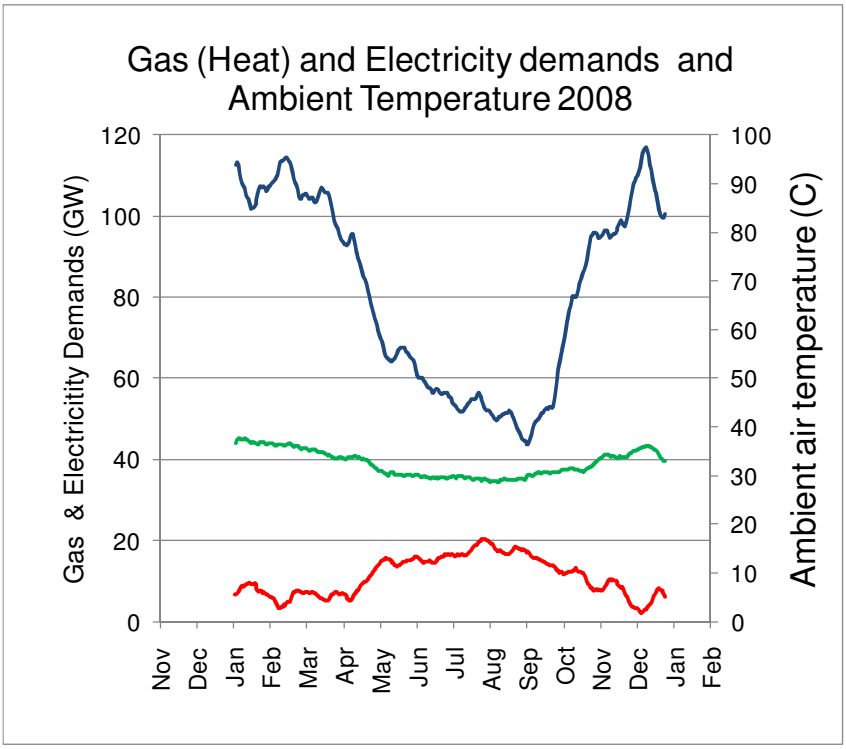

Figure 2 Typical seasonal variation for heat in the UK

Appendix D – Glossary

Term	Definition
ETI Project Manager	The individual who may be appointed by the ETI to manage the ETI's interaction with the project team. (via the Project Manager of the Lead Coordinator or Prime Contractor), or is otherwise agreed by the Project Participants, to carry out its responsibilities.
Participant	An organisation which is responsible for the delivery of all or part of the Project scope and which is therefore a member of the Project, (for the avoidance of doubt excluding any subcontractor(s) to any of these organisations), as described in Section 1.5.
Payment Milestone	A contract milestone with defined constituent deliverables, associated deliverable acceptance criteria, and milestone value (all to be detailed in the Respondent's Proposal and agreed in the Project Contract) which should be completed in order to reach the said milestone, and at which, subject to acceptance by the ETI that the milestone has in fact been reached, payment may be claimed from the ETI on the basis described in Section 3 and on the Terms in Appendix C,
Prime Contractor	A Participant which is solely responsible for delivery of the Project, as described in Section 1.5.
Programme	The ETI's Energy Storage and Distribution (ESD) Programme.
Programme Manager	The individual appointed by the ETI to manage the overall ETI programme to which this Project is affiliated, and to whom the Project Manager is accountable. An ETI Project Manager may also be appointed by the Programme Manager to manage the ETI's interaction with the project team.
Project	The project for which the purpose, scope of work and other details are described in this Request for Proposals.
Project Contract	The contract, as described in Section 1.5, to be entered into between the ETI and the Participants (whether as a Consortium, Prime Contractor or single contractor)
Project Detailing Stage	The stage of Project commissioning carried out by the ETI if and after it has decided to take forward a Proposal, during which full and final Project details are established and a Project Contract is agreed.
Project Manager	The individual who is appointed by the Prime Contractor, or is otherwise agreed by the Participants, to carry out its responsibilities. This individual is accountable to the ETI's Programme Manager and to the ETI Project Manager if one is appointed by the ETI.
Project Organisation	The entity or group of entities / organisations, and the contracting and management structure which they adopt, as described in Section 1.5, which together will carry out the Project if commissioned by the ETI.
Proposal	The proposal for the Project submitted to the ETI, as described in Section 2.1, in response to this Request for Proposals.
Respondent	The organisation submitting a Proposal to the ETI, as described in Section 2.1, on behalf of themselves and of any Consortium or Subcontract Participants.
Stage	A group of activities within the Project leading to specific deliverables and/or outcomes which are normally required to be completed before commencing subsequent Stages.
Stage Gate	A project review at which the ETI, supported by the Project Participants, can determine whether or not a Stage has been satisfactorily completed, whether or not activity on subsequent Stages should be commenced, what if any remedial actions are required, and in extremis whether the project should be terminated.

Subcontract	A contractual arrangement between the Prime Contractor (described in Section1.5) and a (non-Participant) third party organisation to which work has been subcontracted, such organisation being a "Subcontractor". Where a Project is carried out by a consortium, this includes third party organisations subcontracted in turn by Participant organisations, but for the avoidance of doubt the Prime Contractor is not defined as a Subcontractor to the ETI.
Task	A significant activity or group of activities (within a Work Package) which results in completion of a deliverable or a significant part of one, or which represents a significant step in the process towards one.
Technology Readiness Level (TRL)	A scale, originally devised by NASA and now in widespread use, to quantify the status of development of a technology from concept definition, through laboratory and full scale demonstration in a range of environments increasingly close to final application conditions, finally reaching mature technology.
Work Package (WP)	A major section of the Project scope of work, which may be identified in this RfP or in the Respondent's Proposal, in order to break up the scope of work into separate manageable parts. A Work Package will usually consist of a number of Tasks.