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1. PURPOSE

- 1.1 To contract with a Potential Provider for the purposes of capturing an evidence based and up to date assessment of the costs of different options for decarbonising the heat infrastructure in the UK.

2. BACKGROUND TO THE CONTRACTING AUTHORITY

- 2.1 The Authority provides the government with impartial, expert advice on major long-term infrastructure challenges. It has been operating in interim form since October 2015 and was established permanently as an Executive Agency of HM Treasury on 24 January 2017.
- 2.2 The Authority's relationship with government is set out in a published [Charter](#). This explains that it must carry out its work in accordance with a remit (and terms of reference for specific studies) set by the government, but in all other respects it has complete discretion to determine independently its work programme, methodologies and recommendations, as well as the content of its reports and public statements. A mutually agreed [Framework Document](#) provides further details of the Authority's working relationship with government.
- 2.3 The Government has outlined the high-level objectives of the Authority as follows:
- (1) Support sustainable economic growth across all regions of the UK;
 - (2) Improve competitiveness;
 - (3) Improve quality of life.
- 2.4 Each Parliament, the Authority will deliver a National Infrastructure Assessment (NIA). This will examine the UK's long-term strategic infrastructure needs and produce recommendations to address them across six different infrastructure sectors. These are transport, energy, digital communications, water and wastewater, solid waste, flood risk management. The NIA will also consider the interdependencies between different infrastructure systems and their interaction with the built environment.
- 2.5 The delivery of the NIA will be overseen by the Authority's Commissioners, who are able to commission research and call for evidence from public sector bodies and private sector experts.
- 2.6 The NIA will consist of two stages: Vision and Priorities, identifying the vision and long-term infrastructure needs, to be published in mid-2017 and the final National Infrastructure Assessment (NIA), a roadmap of recommendations including both on policy and infrastructure solutions, to be published in early 2018.
- 2.7 In May 2016, the Authority launched a consultation in order to develop the process and methodology for the NIA. The responses to the consultation, as well as HM Treasury's response to its consultation on the Authority, can be found [here](#). An open call for evidence for the NIA ran from 27th October 2016 to 10th February 2017, the details and questions can be found [here](#).
- 2.8 The Authority's remit also includes in-depth studies. Since the Authority's inception, it has produced a number of reports which include: Transport for a World City, Smart Power, Northern Powerhouse, an interim report on Oxford-Cambridge-Milton Keynes

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Growth Corridor and, most recently, 5G. The studies can be found on the Authority's website [here](#).

- 2.9 The Potential Provider must read both the Authority's consultation on the NIA, as well as HM Treasury's response to its consultation on the Authority, in order to understand the broader context for this requirement and to inform their response.

3. BACKGROUND TO REQUIREMENT/OVERVIEW OF REQUIREMENT

- 3.1 The Authority is looking for an accurate and up to date assessment of the costs of decarbonising the UK's heat infrastructure (specifically space heating & hot water) utilising current and future technologies. These include:

- Air Source, Ground Source or Water Source Heat Pumps
- Hydrogen Networks; which should include the production or sourcing/importing of decarbonised hydrogen
- Heat Networks/District Heating; which should consider various fuels/heat sources for the production of heat
- Biogas (biomethane); which should include the potential role of Syngas (SNG)
- Storage Heaters
- Biomass
- Any other technology which may become viable

- 3.2 The aim, therefore, is to deliver a piece of work that informs the debate surrounding the deployment and operating costs of future, decarbonised heat infrastructure options in the UK.

- 3.3 The Potential Provider should build upon the work undertaken by the Committee on Climate Change (CCC) within their 'Next steps for UK heat policy' report, published in October 2016, which can be found [here](#). The CCC identify both the 'low regrets' measures for decarbonising heat and the remaining challenges. The Authority agrees with the low regrets options put forward by the CCC, and is particularly interested in being able to outline the potential costs of these remaining challenges (see Fig 2.2 of CCC report).

4. DEFINITIONS

Expression or Acronym	Definition
Air Source Heat Pump	A system which transfers heat from outside to inside a building, or vice versa, utilising a refrigerant system involving a compressor and a condenser to absorb heat at one place and release it at another to either a hydronic or air flow circulation system.



Biogas	A gaseous fuel, especially methane, produced by the fermentation of organic matter, or through thermal processing of waste matter.
Carbon Capture and Storage (CCS)	A technology that can capture carbon dioxide emissions produced from the use of fossil fuels, preventing the carbon dioxide from entering the atmosphere. Storing the emitted carbon dioxide to prevent release.
Energy Efficiency Measures	This refers to changes made to the fabric of buildings to reduce the demand for energy (heat) in these buildings and associated carbon emissions
Ground Source Heat Pump	A heating and/or cooling system that transfers heat to or from the ground. Utilising the earth as a heat source (in the winter) or a heat sink (in the summer).
Heat	Meeting needs for process heat (above 100C), domestic water heating (above 60C) and space heating (below 30C) to the economy.
Heat Network	Also known as District heating. A system for distributing heat generated in a centralised location for residential and commercial heating requirements such as space heating and water heating.
Hydrogen Network	An infrastructure network delivering hydrogen gas to consumers as a fuel source for the production of heat.
Resistive Electric Heating	Can take a variety of forms; Radiant Heating, Convection Heating, Fan Heating or Storage Heating. Resistive heating works through the process of converting electrical energy to heat, the heating element in all electrical heaters is a resistor. The electricity passing through a resistor is converted to heat.
Syngas	A fuel gas mixture consisting primarily of hydrogen, carbon monoxide, and very often some carbon dioxide. The name comes from its use as intermediates in creating synthetic natural gas (SNG).
Water Source Heat Pump	Water source heat pumps work on a similar principle to both air source and ground source heat pumps. Instead of taking advantage of the heat in the air or the ground, they take advantage of the relatively consistent temperatures found in a body of water.

5. SCOPE OF REQUIREMENT

- 5.1 The high level scope of the requirement is to outline, compare and contrast the associated costs of different options for meeting the proposed reduction in emissions of over 20% by 2030, with the near complete decarbonisation of heat infrastructure in the UK by 2050, in line with the Committee on Climate Change (CCC) recommendations.



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- 5.2 The Authority also seeks to understand what the pathway to 2050 for this decarbonisation could be, the steps required to implement and roll out the option mix identified and the timescale, whilst avoiding prematurely closing down other options e.g. larger steps taken in the near term, or no regret options implemented first and major changes left until towards the 2050 deadline.
- 5.3 The Potential Provider should build upon the work undertaken by the CCC within their 'Next steps for UK heat policy' report, published in October 2016. The CCC identify both the 'low regrets' measures for decarbonising heat and the remaining challenges, especially for buildings connected to the gas grid in areas where heat networks are not cost-effective. The Authority is particularly interested in being able to outline the potential costs of these remaining challenges.
- 5.4 The review should analyse a small number of scenarios which include the deployment of a mix of the following technologies, either alone or in combination:
- Air Source, Ground Source or Water Source Heat Pumps
 - Hydrogen Networks; which should include the production or sourcing/importing of decarbonised hydrogen
 - Heat Networks/District Heating; which should consider various fuels/heat sources for the production of heat
 - Biogas (biomethane); which should include the potential role of Syngas (SNG)
 - Storage Heaters
 - Biomass
 - Any other technology which may become viable
- 5.5 The Potential Provider should highlight where any of these technologies may help facilitate decarbonisation options in other sectors, e.g. industrial processes or transport.
- 5.6 The Potential Provider must propose and agree upon with the Authority the appropriate specifications of the aforementioned technologies. This will be tested and confirmed with other third parties of the Authority's choice.
- 5.7 The costs identified for each option should take into account; 1) the capital expenditure costs to the UK of building new infrastructure, 2) the upfront costs of conversion to the end consumer; 3) the running costs of heating as compared to the projected costs of natural gas, with gas price projections agreed with the Authority (cost per kWh and/or annual bill difference); 4) other additional costs such as loss of space, scrappage costs and upgrade cost where relevant.
- 5.8 A range of levels of installed building energy efficiency measures should be used to produce costs brackets, for each level of energy efficiency measure these costs should be included in the assessment.

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- 5.9 The work must provide a range of deployment and operating costs for each heat infrastructure option based on chosen technologies and the range of levels of energy efficiency measures for each option.
- 5.10 The Authority expects that the cost components must be to an appropriately granular level as outlined in paragraph 5.7, to be agreed upon with the Authority. The level of uncertainty for each variable must also be set out. The most prominent and/or uncertain, variables must be identified in order for the Authority to understand where there is potential for costs to be reduced or change.
- 5.11 The Potential Provider, additionally, should demonstrate their findings graphically for the deployment levels of the various technologies in differing types of location e.g. urban vs rural.
- 5.12 All assumptions made must be clearly stated and agreed upon with the Authority. These include:
- The weighted average cost of capital (WACC). The Potential Provider is expected to set out relevant capital expenditure costs and to calculate total project cost using an approach to setting the WACC agreed with the Authority. The Potential Provider is expected to make a recommendation on the appropriate WACC to use based on empirical evidence.
 - Future gas and carbon prices. The Potential Provider is expected to use the BEIS central projections and explore the sensitivity of the results to these parameters.
 - The Potential Provider should make clear in their analysis who it is assumed will own and operate the infrastructure required to deliver the alternative heating solutions and therefore their assumptions about how these changes to infrastructure may be funded.
 - Technological change. The Potential Provider must also consider the effect of technological change on cost and set out how this would affect the different options e.g. the impact the advancement in technology may have on the coefficient of heat pumps relative to the cost of these heat pumps.
 - Learning rate and economies of scale. The Potential Provider must clearly state any learning rates and economies of scale and the approach used to estimate them for each option if they have an impact on cost estimates.
- 5.13 The Potential Provider should indicate options of how the upfront capital costs for various options could be recovered and the proposed period of time for this recovery.
- 5.14 For future technologies, time to deploy and the predicted life time cost of maintaining the asset must also be taken into account. This should include consideration of the opportunity cost of not deploying or maintaining another energy infrastructure option e.g. impacts of electrification of heat on the electricity and gas networks.
- 5.15 Where possible, the Potential Provider should compare their figures to the existing costs and cost recovery models for gas infrastructure.
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- 5.16 The scope of the requirement includes an analysis of re-use of existing infrastructure, particularly where this involves, or has the potential to involve, a significant impact on costs. The Potential Provider must make clear how both deployment and operating costs can vary between: (1) using existing infrastructure, and (2) building new infrastructure.
- 5.17 The scope of the requirement excludes an assessment of current and future demand, this encompasses take-up scenarios and also revenue potentials. The Authority will provide the Potential Provider with access to baseline demand assumptions used for modelling.

6. THE REQUIREMENT

- 6.1 The key output from this project will be a cost analysis of decarbonising heat infrastructure in the UK through the following technologies, either alone or in combination:
- Air Source, Ground Source or Water Source Heat Pumps
 - Hydrogen Networks; which should include the production or sourcing/importing of decarbonised hydrogen
 - Heat Networks/District Heating; which should consider various fuels/heat sources for the production of heat
 - Biogas (biomethane); which should include the potential role of Syngas (SNG)
 - Storage Heaters
 - Biomass
 - Any other technology which may become viable
- 6.2 The report will analyse and compare the relative costs of deploying and maintaining each option across the UK and the ongoing costs to consumers.
- 6.3 These products must be delivered by no later than 15th December 2017 to ensure that the findings of the report can be used to inform the NIA. Delivery will be staggered, with initial high level output being supplied to the Authority from the 4th September 2017, with 15th December 2017 an absolute deadline for all products. The Potential Provider must therefore ensure that, following feedback and comments by the Authority of the first draft on 4th September 2017, interim findings can be provided by 15th September 2017.
- 6.4 It is expected that the findings presented in the report are quality assured, including through peer review with relevant experts and that the report is finished to a publishable standard. All assumptions and caveats must be clearly highlighted and agreed upon with the Authority.
- 6.5 All materials assumptions and inputs used to generate the analysis must be made available to the Authority for future use.

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- 6.6 At the start of the project the Authority expects to hold an inception/scoping meeting with the Potential Provider, and for a short inception report to then be provided by the Potential Provider which clarifies the approach to be taken, along with a plan setting out key milestones and dates for deliverables, risks and how these will be managed etc. – for agreement, before proceeding to carry out the analysis. The Authority expects the Potential Provider to work closely with the Authority, including through weekly meetings or phone calls.
- 6.7 The Potential Provider will present the report to technical and non-technical members of the Authority in a clear and concise fashion. The purpose would be to set out the key findings from the report, and the key assumptions, results, and caveats in a clear and concise fashion, to ensure these are fully understood by Commissioners.
- 6.8 The Potential Provider must submit a final report detailing analysis, findings and comments in a clear and concise fashion – this should reflect any inputs/requests made by the Authority during the production phase. The Authority intends to publish this report.

7. KEY MILESTONES

- 7.1 The Potential Provider should note the following project milestones that the Authority will measure the quality of delivery against:

Milestone	Description	Timeframe
1	Project inception meeting with the Authority, to agree the milestones for the project and precise coverage of the report.	Within week 1 of Contract Award
2	An inception report to be provided, and agreed by the Authority, clarifying the approach to be taken, along with a plan setting out key milestones and dates for deliverables, risks and how these will be managed.	Within week 2 of Contract Award
3	Update meeting / phone call on the project including any findings or assumptions to agree upon.	Weekly
4	First draft of the interim findings to be shared with and presented to the Authority.	4 th September 2017
5	Second draft of the interim findings, following comments and feedback by the Authority.	15 th September 2017
6	Draft version of the report.	4 th December 2017
7	Final version of the report suitable for publication, following comments and feedback by the Authority.	15 th December 2017

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8. AUTHORITY'S RESPONSIBILITIES

- 8.1 The Authority will share pertinent information received through relevant stakeholders and introduce the Potential Provider to relevant stakeholders, which can offer valuable advice on the requirement.

9. VOLUMES

- 9.1 This is a substantial piece of work – the expectation is that the key outputs and related materials will be both extensive and of publishable standard.

10. CONTINUOUS IMPROVEMENT

- 10.1 The Potential Provider will be expected to give due consideration to how the way in which the required Services are to be delivered throughout the Contract duration can be continually improved.
- 10.2 The Potential Provider must present new ways of working to the Authority during weekly Contract review meetings or phone calls.
- 10.3 Changes to the way in which the Services are to be delivered must be brought to the Authority's attention and agreed prior to any changes being implemented.

11. QUALITY

- 11.1 The recommendations to government in the National Infrastructure Assessment (NIA) will be informed by this report. The preliminary findings must first be presented to the Authority by 4th September 2017 for feedback, with the final interim findings provided by 15th September 2017 as an absolute deadline. The absolute deadline for the final report is the 15th December 2017, with a first draft provided to the Authority for comments by 4th December 2017. The report must be to a publishable standard, with all assumptions and caveats clearly highlighted and referenced appropriately.
- 11.2 As part of the Authority's quality assurance process, the Authority can and will choose to have peer review of the output to be conducted by third parties and/or the Authority's expert advisory panels. The quality assurance process must be agreed with the Authority once the Potential Provider has been selected. It is required that the Potential Provider will need to work proactively and collaboratively with the Authority to consider any reasonable comments and to incorporate them into their work and output accordingly.

12. PRICE

- 12.1 Prices should be capped for the term of the contract, inclusive of expenses and exclusive of VAT.
- 12.2 Bids are expected to range between £60,000 and £95,000 excluding VAT, bids with a price above the maximum ceiling will be classed as non-compliant and will not be evaluated.
- 12.3 Potential Provider are reminded that this is an open competition and to submit the best possible bid price.
- 12.4 It is the Authority's intention to adopt the following payment schedule:
- 12.4.1 10% of the total contract price for successful delivery of milestone [4];

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- 12.4.2 20% of the total contract price for successful delivery of milestone [5];
 - 12.4.3 20% of the total contract price for successful delivery of milestone [6];
and
 - 12.4.4 50% of the total contract price for successful delivery of milestone [7].
- 12.5 Prices are to be submitted via the e-Sourcing Suite using the template at Appendix E excluding VAT.

13. STAFF AND CUSTOMER SERVICE

- 13.1 The Authority requires the Potential Provider to provide a sufficient level of resource throughout the duration of the Contract in order to consistently deliver a quality service to all Parties.
- 13.2 The Potential Provider’s staff assigned to the Contract shall have the relevant qualifications and experience to deliver the Contract.
- 13.3 The Potential Provider shall ensure that staff understand the Authority’s vision and objectives and will provide excellent customer service to the Authority throughout the duration of the Contract.

14. SERVICE LEVELS AND PERFORMANCE

- 14.1 The Authority will measure the quality of the Potential Provider’s delivery by utilising the table at 14.2.1.
- 14.2 Penalty charges will be imposed as a recourse only when remedial action cannot be agreed. It will be expected that the Potential Provider will escalate all risks and issues to the Authority at the earliest opportunity and suggest mitigating actions and resolutions.

14.2.1

KPI/SLA	Service Area	KPI/SLA description	Target	Remedy
#1	Agreed approach	An inception report to be provided, and agreed by the Authority, clarifying the approach to be taken, along with a plan setting out key milestones and dates for deliverables, risks and how these will be managed.	Within 2 weeks of contract award	N/A



<p>#2 (Milestone 4)</p>	<p>Key outputs delivered in draft</p>	<p>A first draft of the skeleton structure including:</p> <ul style="list-style-type: none"> • Interim findings • Evidence based and up to date assessment of the costs of deploying and maintaining the following heat infrastructure options in the UK: <ul style="list-style-type: none"> • Air Source, Ground Source or Water Source Heat Pumps • Hydrogen Networks; which should include the production or sourcing/importing of decarbonised hydrogen • Heat Networks/District Heating; which should consider various fuels/heat sources for the production of heat • Biogas (biomethane); which should include the potential role of Syngas (SNG) • Storage Heaters • Biomass • Any other technology which may become viable 	<p>4th September 2017</p>	<p>10% penalty charge of the payment for milestone 4</p>
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<p>#3 (Milestone 5)</p>	<p>Key outputs delivered in draft</p>	<p>A second draft of the skeleton structure covering:</p> <ul style="list-style-type: none"> • The Authority’s comments on the interim findings • Evidence based and up to date assessment of the costs of deploying and maintaining the following heat infrastructure options in the UK: <ul style="list-style-type: none"> • Air Source, Ground Source or Water Source Heat Pumps • Hydrogen Networks; which should include the production or sourcing/importing of decarbonised hydrogen • Heat Networks/District Heating; which should consider various fuels/heat sources for the production of heat • Biogas (biomethane); which should include the potential role of Syngas (SNG) • Storage Heaters • Biomass • Any other technology which may become viable 	<p>15th September 2017</p>	<p>10% penalty charge of the payment for milestone 5</p>
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<p>#4 (Milestone 6)</p>	<p>Key outputs in final, publishable form</p>	<p>A draft final report that presents</p> <ul style="list-style-type: none"> • The Authority's comments on the second draft and throughout the process • Evidence based and up to date assessment of the costs in deploying and maintaining the following heat infrastructure options in the UK: <ul style="list-style-type: none"> • Air Source, Ground Source or Water Source Heat Pumps • Hydrogen Networks; which should include the production or sourcing/importing of decarbonised hydrogen • Heat Networks/District Heating; which should consider various fuels/heat sources for the production of heat • Biogas (biomethane); which should include the potential role of Syngas (SNG) • Storage Heaters • Biomass • Any other technology which may become viable 	<p>4th December 2017</p>	<p>20% penalty charge of the payment for milestone 6</p>
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<p>#5 (Milestone 7)</p>	<p>Key outputs in final, publishable form</p>	<p>A final report that presents</p> <ul style="list-style-type: none"> • The Authority's comments on the draft final report and throughout the process • Evidence based and up to date assessment of the costs in deploying and maintaining the following heat infrastructure options in the UK: <ul style="list-style-type: none"> • Air Source, Ground Source or Water Source Heat Pumps • Hydrogen Networks; which should include the production or sourcing/importing of decarbonised hydrogen • Heat Networks/District Heating; which should consider various fuels/heat sources for the production of heat • Biogas (biomethane); which should include the potential role of Syngas (SNG) • Storage Heaters • Biomass • Any other technology which may become viable 	<p>15th December 2017</p>	<p>20% penalty charge of the payment for milestone 7</p>
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15. SECURITY REQUIREMENTS

15.1 As outlined in Appendix C, terms and conditions of services.

16. INTELLECTUAL PROPERTY RIGHTS (IPR)

16.1 All materials, assumptions and inputs used to generate the outputs must be provided to the Authority for future use. Further details outlined in Appendix C, terms and conditions of services

17. PAYMENT

17.1 Payment can only be made following satisfactory delivery of pre-agreed certified products and deliverables.

17.2 Before payment can be considered, each invoice must include a detailed elemental breakdown of work completed and the associated costs.

18. ADDITIONAL INFORMATION

18.1 The Potential Provider should demonstrate that they are open to working collaboratively with other Suppliers, contracted by the Authority in order to deliver related pieces of analysis.

19. LOCATION

19.1 The location of the Services will be carried out at the offices of the Potential Provider – however frequent meeting will need to take place with the Authority who are based in the City of London.