# Energy Strategy Call for Evidence

# Response Template

## How to Respond

This template replicates the questions asked in the Call for Evidence found at: https://www.economy-ni.gov.uk/energy-strategy-call-for-evidence

It is recommended that you should read the full consultation document before completing your response. Please note that the text boxes used throughout this template can be expanded to accommodate your response – there is no character limit.

For further information on how we handle your personal data please read our Privacy Notice

Early responses are encouraged but all responses should arrive no later than **5pm on 20 March 2020.**

Please send your response to:

**energystrategy@economy-ni.gov.uk**

Or alternatively by post to:

Energy Strategy
Department for the Economy
Netherleigh
Massey Avenue
Belfast
BT4 2JP

Quote the reference "**Energy Strategy Call for Evidence 2019**"

## 1. General Information

1. **Name (required)**

[redacted]

2. **Are you responding:**

   ☐ **as an individual (please complete 3 to 5 below)**

   ☐✓ **on behalf of an organisation / company (please complete 6 to 8 below)**

**If you are responding as an individual:**

3. **E-mail address**

4. **Address**

5. **If you are responding as an individual, please read the Privacy Notice and tick the statement below as applicable.**

   ☐ **All responses will be published on the Department for the Economy website following completion of the Call for Evidence process. Please tick if you are content for your name to be published alongside your response.**

**If you are responding on behalf of an organisation / company:**

6. **Organisation / Company**

**Geological Survey of Northern Ireland**

7. **Position within Company / Organisation**

[redacted]

8. **Contact details**

   a. **E-mail address**

[redacted]

   b. **Address**

[redacted]

## 2. Energy in Northern Ireland

Q1. What lessons can we learn from elsewhere in addressing energy within an overarching climate action framework?

Q2. What are the key considerations for decarbonising Northern Ireland's energy sector given existing linkages to other jurisdictions?

Q3. To what extent should Northern Ireland implement the key energy-related recommendations from the CCC 'Reducing Emissions in Northern Ireland' report?

Q4. Do you agree with the 30-year timeframe? If not, please state your preferred approach and reasons.

Q1.
The French climate governance framework has been identified by the International Energy Agency (IEA) as a 'world leader' and hailed as an example of best practice for low-carbon strategies in Europe. It benefits from having legally-binding targets (that are often lacking) together with strong governance mechanisms to ensure effective planning on a long-term basis. It highlights the importance of addressing all economic sectors and not just the energy sector on its own, to develop a decarbonisation strategy.

For a more detailed analysis of the French Climate Governance Framework then click the link
https://www.iddri.org/sites/default/files/PDF/Publications/Catalogue%20Iddri/Etude/201805-IddriStudy0318-ClimateGovernanceFrance-EN.pdf

In the UK the Climate Change Committee (CCC) also recognises the need for action across all sectors of the economy and a joined-up approach. This is a central message in the report, *Reducing Emissions in Northern Ireland*, commissioned by DAERA and published by the CCC in February 2019. The report identifies the agriculture, buildings/ industry, power and transport as the main sectors producing GHG emissions with smaller contributions from waste and LULUCF. However, in June 2019 the Government passed legislation requiring the UK to achieve Net Zero Greenhouse Gas Emissions by 2050 replacing the previous target of an 80% reduction in emissions from 1990 levels by 2050. The implication of the Net Zero Target is that emissions reductions must be applied to all sectors and none can be ignored. Energy production and use is central to the emissions from the power, transport, buildings and transport sectors and is a significant component in the agriculture and waste sectors so it follows that energy policy should be integrated, together with policies for these sectors, into an overarching climate action framework.

Q2.
One of the key components of achieving decarbonisation and reducing GHG is the move towards electrification of vehicles. This appears to be seen as a relatively quick and easy win by government. However, there is a fundamental aspect of this route that has been

missed by governments across Europe. Global production of metals required to make batteries is insufficient to meet the demand required for the transition to ULEV in the UK, let alone the rest of the EU. This was highlighted by speakers at the 3rd Annual Critical Minerals Conference, held in Edinburgh in 2019 and in the open letter written by a Professor Richard Herrington of the Natural History Museum in London to the Committee on Climate Change (https://www.nhm.ac.uk/press-office/press-releases/leading-scientists-set-out-resource-challenge-of-meeting-net-zer.html).
It follows that if there is a shortage of the key minerals and metals required for the electrification of vehicles, there will be added pressure on the raw materials needed to build and deploy the infrastructure required for decarbonising energy in Northern Ireland. Global production of many of the metals critical to the increasing development of low carbon technologies is concentrated in a relatively small number of countries and the ability and will of these countries to meet increasing overseas demand is a major risk factor to be considered. Although hydrogen-powered vehicles may be an alternative to EVs, the priority for this fuel type would be for freight and public transport and possibly to meet some of the heat demand (included in the Further Ambition scenario of the CCC Net Zero Technical Report, May 2019) and this technology within the vehicle sector is much less mature than EV.

Q3.
The recommendations in the CCC 'Reducing Emissions in Northern Ireland' report are predicated on the assumption that the UK is working towards a target of 80% reduction in GHG emissions by 2030. Since the report was published the UK Government has enshrined the 2050 Net Zero GHG emissions in law. Consequently, even the scenario in this report with the greatest reductions in GHG emissions – 45% by 2030 – would not be sufficient to put Northern Ireland on the trajectory to meet the 2050 Net Zero Target. It should also be noted that the report's authors stated clearly that they were **not** giving advice about how NI should meet their targets but that they were highlighting recommendations that, if included in NI policy, they thought would help bridge the gap between the predicted performance of the existing policy measures and a 35% reduction target for 2030. However, it should be noted that NI is starting from a much higher emissions level relative to 1990 than the UK as a whole, such that the NI trajectory towards Net Zero is inevitably steeper and the NI energy policy should reflect that fact. It should also be noted that the economy, infrastructure, settlement patterns and physical characteristics of Northern Ireland are different to many other parts of the UK (a fact recognised by the CCC and one of the reasons why they thought the NI Executive were best placed to formulate their own policy) which means that the opportunities and pathways for decarbonisation may also be different. Lastly, the CCC observed in the 2019 report to the UK Government that the UK was **not** on track to meet its targets for the 4th (2023-2027) or 5th (2028-2032) Carbon Budgets which were set under the old 80% reduction 2050 target. In short, the NI energy strategy, which must be aligned with other pan-government policies, must set ambitious targets and these must be accompanied by the incentives and regulatory measures needed to achieve them.

Q4.
The 30-year timeframe is potentially too long and could have a detrimental impact on climate change mitigation efforts. We recognise the importance of positioning the Energy Strategy within the context of the 2050 Net Zero GHG emissions target but consider that the Strategy must be flexible enough to respond to changes in technology. Furthermore, interim targets should align with UK Carbon Budgets (5 year periods) and progress against these targets should be monitored on an annual basis, allowing policy instruments to be revised as necessary.

The Paris Agreement has a long-term goal of keeping the increase in global average temperature to well below 2°C above pre-industrial levels, and to aim to limit the increase to 1.5°C, necessary to avoid dangerous climate change. This is dependent on the need for global emissions to peak as soon as possible, ideally by 2020 and to undertake rapid reductions thereafter.

The Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report established a set of emissions scenarios known as the representative concentration pathways (RCPs) to illustrate the possible projected impacts of anthropogenic climate change. They describe four possible climate futures, only one of which includes mitigation measures. In all cases, the projected climate change is still significant so even with the most optimistic climate change modelling that includes mitigation measures it is unlikely to be enough to prevent dangerous climate change.

The 2030 climate and energy framework (adopted by the European Council in 2014) includes EU-wide targets for the period from 2021-2030 with key targets that include 40% cuts in greenhouse gas emissions (from pre-industrial levels), 32% share for renewable energy, and 32.5% improvement in energy efficiency.

The overall 30-year timeframe could therefore be reduced to a 10-year timeframe and aligned to the 2030 climate and energy framework in order to meet the targets set out as part of the Paris Agreement.

## 3. The Energy Transition in Northern Ireland

Q5. What are the unique characteristics of Northern Ireland that need to be considered in a net zero carbon energy transition?

Q6. Is your organisation undertaking or planning to undertake projects to support the energy transition? If so, please provide further details.

Q5. In the transition to a net zero carbon emissions. Northern Ireland is currently a net importer of hydrocarbons for the energy sector and raw materials and manufactured components for the renewables and new technologies sectors. This makes it particularly exposed to the fluctuations in market prices. To some extent it is not known whether Northern Ireland has indigenous resources of the required raw materials. As the renewables sector grows there will be increasing demand for these materials and the supply chain and carbon intensity of these should be taken into consideration when formulating policy.

Q6

**Geothermal**

The Geological Survey of Northern Ireland (GSNI) holds a wealth of data concerning the subsurface and surface geology and ground conditions, including a borehole repository with in-excess of 20,000 records.

GSNI also maintains a national core repository of geological core and specimens including many from deep boreholes drilled across Northern Ireland.

The GSNI is currently working to assess the geothermal energy potential of Northern Ireland using the core and records archive and is producing a short summary document highlighting the potential to use geothermal energy, from both shallow and deep sources, across Northern Ireland.

GSNI continues to liaise with local councils as they draft their local development plans, e.g. highlighting the potential for geothermal energy in each council area. Maps are being produced of ‘depth–to-geothermal-reservoirs' across Northern Ireland and will be available from the GSNI soon.

GSNI is preparing an €20M EU PEACE PLUS Geothermal project proposal with partners in NI and RoI to establish two shallow district heating pilot schemes and drill two deep geothermal well-doublets to produce off-grid, sustainable, low carbon heat and to fully assess the geothermal energy resource.

**Geological storage of energy**

Northern Ireland's geology is well suited for the underground storage of energy, in two distinct settings. Shallow aquifers, such as the Sherwood Sandstone under the Greater Belfast/Lagan Valley area, can be used for Aquifer Thermal Energy Storage (ATES). ATES can be used to provide cooling in the summer and the excess heat stored can then be used in the winter for heating purposes. ATES is used in several European countries and a prime example is the ATES system beneath the German parliament building in Berlin. GSNI will be providing the basic geological data to help assess the potential use of ATES in Northern Ireland.

The second setting is within the thick salt beds that are present deep below the ground in East Antrim, in and around Larne and Islandmagee. Storage caverns, formed by solution mining of salt, have been in use globally for many decades and they can provide large-scale energy storage. A considerable amount of geological and geophysical exploration, including deep drilling, has established that the Permian salt layer is thick and pure and suitable for the creation of such caverns. Energy can be stored in the form of natural gas or as compressed air (CAES), and there may be potential for the storage of hydrogen. Large-scale storage of energy is one of the outstanding issues to be solved to optimise the use of intermittent renewable energy sources such as wind and to help balance the diurnal and seasonal patterns of supply and demand. GSNI is carrying out research to improve the knowledge about the geological characteristics of the salt beds.

**Petroleum**

Minerals and Petroleum Branch (MAPB) within the Department is planning to engage external researchers to review existing research into the economic, societal and environmental impacts of onshore petroleum development in Northern Ireland. The results of this have the potential to better inform the Energy Strategy in terms of the continued need for exploration for indigenous supply of oil and gas.

Minerals

MAPB intends to engage consultants to undertake bespoke research into the economic, societal and environmental impacts of mineral exploration and mining in Northern Ireland. Given the increased demand for minerals resulting from increased use of low carbon energy technology[1] this research also has the potential to better inform the Energy Strategy.

1) https://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_en

## 4. Consumers

Q7. How should we ensure that energy remains affordable for domestic consumers? What approach should be taken to eradicate fuel poverty?

Q8. What steps could be taken to improve the relative cost competitiveness of larger non-domestic consumers?

Q9. Is a strategic position of “enable and protect” the correct policy stance?

a) What policies or schemes are needed to enable active consumers?
b) What policies or schemes are needed to protect vulnerable consumers?

Q10. What types of advice and information are required by all consumers and what are the best mechanisms for facilitating this?

Q11. Are there examples of successful citizen energy projects in Northern Ireland and elsewhere that have delivered improved energy efficiency and/or clean energy to local communities?

Q12. What opportunities are there in both urban and rural areas for citizen energy communities in Northern Ireland? What role could government have in facilitating these?

Q13. What evidence can you provide that identifies the challenges and opportunities for NI energy consumers in decarbonising energy?

Q12.

Large urban areas present a huge opportunity for citizen energy communities. Although there is a potential to generate higher amounts of emissions from energy in urban areas, devolving responsibilities and developing working partnerships with local councils can mean that they can take more of a lead in reducing emissions by setting priorities, coordinating action and leading the conversation with residents, businesses, services and infrastructure providers. There is the potential to create 'eco-cities' that have total integrated design that limits the amount of greenhouse gas emissions from energy and other sources.

For further information see:

Dodman, D. (2009a) Blaming cities for climate change? An analysis of urban greenhouse gas inventories. *Environment and Urbanization*, 21 (1), 185-201.

Available from: http://journals.sagepub.com/doi/pdf/10.1177/0956247809103016

Price, L.K. & McKane, A.T. (2009) *Policies and Measures to Realise Industrial Energy Efficiency and Mitigate Climate Change*. UN-Energy and UNIDO.

Seto K.C., S. Dhakal, A. Bigio, H. Blanco, G.C. Delgado, D. Dewar, L. Huang, A. Inaba, A. Kansal, S. Lwasa, J.E. McMahon, D.B. Müller, J. Murakami, H. Nagendra, and A. Ramaswami (2014) Human settlements, infrastructure and spatial planning. In: *Climate Change 2014: Mitigation of Climate Change*. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (Eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. pp. 923-1000.

UN Habitat (2011) *Cities and Climate Change: Global Report on Human Settlements 2011.* United Nations Human Settlements Programme. http://mirror.unhabitat.org/pmss/listItemDetails.aspx?publicationID=3086

## 5. Energy Efficiency

Q14. What, if any, energy efficiency target or targets should be set for Northern Ireland?

Q15. How should we define, measure and monitor energy efficiency to optimise its potential in our homes, business, economy and environment?

Q16. What are the most important policy levers for government to ensure zero carbon in:

a) New domestic and commercial buildings by 2050?;

b) Existing domestic and commercial buildings by 2050?

Q17. What should the future of energy efficiency support look like and who should be the key delivery bodies?

Q17.

Many parts of Northern Ireland suit themselves to implementation of geological solutions to improve energy efficiency, such as Aquifer Thermal Energy Storage (ATES), which is a well-established technology. The distribution of porous aquifers in Northern Ireland is well known[1]. An example of how this can be implemented successfully elsewhere can be seen across the Netherlands. Since 1995 the implementation of ATES systems in the Netherlands has grown substantially. In 2015 there were 2,500+ systems in place[2], with a total capacity superior to 1,000 MW (3.4 billion BTU). Projections of installed systems for the year 2020 surpass the number 20,000, contributing to a 10% national reduction of GHG emissions[3]. Besides direct benefits, including a 40% reduction of heating energy consumption, a 65% reduction of cooling energy consumption, and a 90% reduction in peak power, an ATES system saves building space, increases its value due to higher levels of LEED certification, and results in a more stable climate control in the building[3]. Depending on size of the system and condition of the aquifers, the payback period of an ATES system is between 4 to 8 years[3]. However, the initial capital costs of drilling may prove a deterrent and support mechanisms such as grants should be considered. Such financial incentives, and corresponding regulatory measures, have proved effective in countries such as the Netherlands, Germany and France.

1) Raine, R.J. & Reay, D.M. 2019. A review of geothermal reservoir properties of Triassic, Permian and Carboniferous sandstones in Northern Ireland. GSNI Report, Internal Report 19/01. Available on https://nora.nerc.ac.uk/id/eprint/527287/

2) https://pangea.stanford.edu/ERE/db/WGC/papers/WGC/2015/01016.pdf

3) https://dutch-ates.com/wp-content/uploads/2016/09/DutchPolicyOnATESSystems092016.pdf.

## 6. Heat

Q18. What is the appropriate pathway and timeline for the decarbonisation of heat between now and 2030, and subsequently to 2050?

Q19. What are the appropriate ways to measure the progress of decarbonising heat?

Q20. What are the most cost-effective and sustainable steps that government might take to accelerate the reduction of the carbon intensity of heating fuels?

Q21. Is decarbonisation of the gas grid a viable option and what evidence can be provided on both the speed and affordability of decarbonising the gas grid?

Q22. What evidence can you provide on the opportunities for district heating schemes in Northern Ireland and where should responsibility lie for facilitating these?

Q23. Can you provide any evidence or information on the opportunities for geothermal heat supply?

Q.18

The main decarbonisation effort in Northern Ireland has been in the power sector; the heat sector is still approximately 90% based on fossil fuels. The substitution of gas for oil and coal in Northern Ireland has resulted in some reduction in GHG emissions in this sector but this is not decarbonisation – gas ($CH_4$) is a fossil fuel and burning gas, whether it is biogas or gas with 10% $H_2$, is not a pathway towards Net Zero. In terms of Climate Action the Climate Change Committee has yet to publish its revised pathways towards Net Zero (these will be included in the 6$^{th}$ Carbon Budget) but it is likely that the 2030 target for NI will be at least a 45% reduction from 1990 levels by 2030. Targets will vary across sectors but the ultimate goal of Net Zero must be kept in mind – a target of a 50% reduction in GHG emissions by 2030 (i.e. approximately an additional 33% on what has been achieved to date). Heat has a long way to go but the CCC has outlined various strategies for decarbonising this sector, with a large emphasis on the development of heat networks and the deployment of heat pumps. These technologies are particularly suitable for the buildings that are off the gas grid which applies to a much greater percentage in NI than in the rest of the UK. A 2030 target of 30 – 40% for heat would be challenging but would probably be necessary to help achieve Net Zero by 2050. Expanding the gas network may yield GHG reductions in the short term but would be counter-productive in the long-term even if eventual network conversion to hydrogen were possible. The 2019 report produced by Element Energy and UCL for the CCC, Analysis on abating emissions from 'hard-to-decarbonise' homes, outlined three decarbonisation scenarios using energy efficiency measures and low carbon technologies. The middle of these scenarios, Further Ambition, would allow 95% of direct emissions to be abated by 2050 and the cost for this abatement would lowest in the off-gas grid locations. For example, to achieve

90% reduction the cost was calculated at £418/t$CO_2$ but in an off-grid location in Northern Ireland the cost was estimated at £70/ t$CO_2$. This scenario envisaged the installation of 18.5 million heat pumps (including hybrids) and 1 million communal ASHPs. In Northern Ireland, where there is more dispersed housing than the rest of the UK, it may be more appropriate to increase the proportion of heat pump systems that are Ground Source Heat Pumps, which are more efficient than ASHPs but require more space, both for individual dwellings and for communal systems.

Q21.

Decarbonisation of the gas grid - i.e. conversion to hydrogen - may be feasible but this would only work if the hydrogen were produced by a low carbon method (e.g. electrolysis) rather than the normal production from fossil fuels. The priority for hydrogen may also lie in the decarbonisation of the heavy transport sector.

Q22.

There are opportunities for district heating schemes (heat networks) in Northern Ireland. The evidence for this comes from other European countries where district heating is much more developed than in the UK. In GB a number of cities (e.g. Southampton, Nottingham) have heat networks – in the case of Southampton deep geothermal energy provides some of the heat input[1]. The UK Government has recognised the importance of heat networks and established the Heat Network Delivery Unit in 2013, providing grants and other funding opportunities. Heat networks are deployed in Europe at a range of scales that match the heating (and cooling) demands that can be found in urban areas across Northern Ireland.

Q.23.

Geothermal energy can be an effective way to obtain heat from a sustainable low carbon source. If geothermal energy was to be utilised in Northern Ireland this could be done relatively quickly with shallow Ground Source Heat Pump (GSHP) installations using horizontal loops or borehole heat exchangers. GSHPs have advantages over Air Source Heat Pumps (ASHPs) in that they generally have a higher Coefficient of Seasonal Performance (the multiple of heating or cooling energy output per unit of electrical input, up to about x4), work efficiently all year round and can provide both heating and cooling – although they have a higher capital cost and require either greater space (horizontal loops) or access for a small drilling rig (vertical or borehole loops). GSHPs can be used singly to provide heating and cooling for individual buildings or as borehole arrays that can provide this for larger premises (e.g. a

GSHP system comprising an array of borehole heat exchangers beneath the carpark meets the heating and cooling for IKEA's flagship store in Dublin) or small communal heat networks.

Deep geothermal energy sources can provide both heating and, if hot enough, electricity at much larger scales than shallow GSHP systems. Deep geothermal energy resources in Northern Ireland are classified as low enthalpy and are distinct from the high enthalpy resources in volcanic regions that make up most of the current 3.1GWe installed capacity in Europe (EGEC Geothermal Market Report 2018). Although there are a small number of EGS projects in development in western Europe these tend to have a long lead time and it is unlikely that any EGS projects would be developed in Northern Ireland before 2030 (although there is EGS resource potential in the Mournes and other granites in Ireland).

The best potential for the use of deep geothermal energy in Northern Ireland is to use the heat from the water in hot saline aquifers (water-bearing rocks). Where these rocks are at their deepest there may be potential for these low enthalpy resources in Northern Ireland to be exploited for Combined Heat and Power (CHP) using binary or Organic Rankine Cycle technologies. Such systems have been and are being developed in Germany, the Netherlands and Denmark in sedimentary basins with similar geology to those in Northern Ireland. However, most of the deep geothermal aquifers in Northern Ireland are below 90$^{o}$C and more suitable for direct heating networks and these could be deployed at several locations within Northern Ireland.

Appropriate support mechanisms are necessary to attract investment in an energy sector where the main risks and capital expenditure are associated with drilling to prove the resource potential. In some European countries (France[2], Germany, Iceland, The Netherlands, Denmark[3] and Switzerland) there are government-backed insurance schemes to protect investors against technical/geological failure at this stage.

For deeper and hotter geothermal aquifers in Northern Ireland, work is required to further de-risk any exploration. This could be done by geophysical surveys, analysis of existing exploration data one or more demonstrator projects involving drilling of successful boreholes. In addition to this, a suitable regulatory system is needed for exploration for heat and the distribution or sale of geothermal heat. Companies may be reluctant to invest in projects without this regulatory framework and de-risking of the resources. However, the Scottish Government has looked at the issue of regulation and believes that geothermal exploration can be adequately regulated under existing legislation.

Geothermal heat is present across Northern Ireland[4]. The geothermal gradient is in the order of 30°C per km in Northern Ireland, which is greater than the average values in Great Britain or Ireland (Raine & Reay 2019). GSNI holds maps of depth to geothermal reservoirs and their predicted temperature across Northern Ireland. Shallow geothermal could be accessed in most locations in NI. Two reports have served to highlight the potential for geothermal energy and have quantified some of the resources (CSA 2005, 2008 available from gsni@economy-ni.gov.uk). There has been a focus on the Triassic and the Permian Sandstones, but reservoir quality studies by GSNI have proven that these and Carboniferous Sandstones may be porous and permeable at depth[5]. It should be noted that the recent GSNI review of deep geothermal energy concludes that the previous estimates have underestimated geothermal gradients because of the use of uncorrected Bottom Hole Temperatures, and consequently, the geothermal reservoir temperatures and available heat energy have also been underestimated. This conclusion is supported from downhole temperature logs run after the wellbore has equilibrated with the water contained in the reservoir/aquifer.

Deep geothermal resource has been quantified in two detailed reports (CSA 2005, 2008). The sandstone reservoirs around Antrim for example were calculated to contain 1140 $MWh_{th}$ (Megawatt hours) of thermal energy, roughly equivalent to the annual heating requirements of 100,000 homes. Only a fraction of this resource could be used but, as an example, a well doublet in Unterhaching (near Munich) drilled into a geothermal reservoir of a similar thermal capacity, produces 47,000MWth annually, meeting the heat requirements of approximately 3,000 homes.


1) https://geothermalcommunities.eu/assets/elearning/5.13.SOUTH_EN.PDF

2) https://pangea.stanford.edu/ERE/db/WGC/papers/WGC/2015/04019.pdf

3)https://www.thinkgeoenergy.com/denmark-compensation-guarantee-scheme-for-geothermal-drilling/

4) https://www.geothermal-energy.org/pdf/IGAstandard/WGC/2010/1625.pdf

5) Raine, R.J. & Reay, D.M. 2019. A review of geothermal reservoir properties of Triassic, Permian and Carboniferous sandstones in Northern Ireland. GSNI Report, Internal Report 19/01. Available on https://nora.nerc.ac.uk/id/eprint/527287/

## 7. Power

Q24. What is the appropriate pathway for the decarbonisation of power from now to 2030, and subsequently to 2050?

Q25. What target for electricity consumption generated from renewable sources by 2030 is ambitious, achievable and affordable?

Q26. How can the new infrastructure necessary to meet a new renewable electricity target be delivered in a timely, affordable and acceptable way for consumers and society?

Q27. What innovations and solutions could contribute to meeting a new renewable electricity target?

Q28. What market incentives and support are necessary for investors to deliver the investment in renewable generation assets at a scale that will achieve a new renewable electricity target?

Q29. What steps need to be taken by Government to facilitate investment in offshore and marine renewables for NI?

Q.27

In recent years there have been two project feasibility studies in the Larne Lough/Islandmagee area – both of which were designated as EC Projects of Common Interest for energy infrastructure. The Islandmagee Storage Larne Lough gas storage project envisages 7 storage caverns beneath Larne Lough for the storage of natural gas whilst the Ballylumford Compressed Air Energy Storage (CAES) project comprised plans for two caverns using excess electricity generated from wind to compress and store air to help drive a 330MW CCGT plant. InfraStrata plc have drilled an exploration borehole and completed the FEED studies for the former but the latter project is in abeyance because of the collapse of the company behind it (Gaelectric Energy Storage Ltd.). However, the storage potential has been demonstrated and the geology has been de-risked to a significant extent. When compared to the available Battery Energy Storage capacity a single CAES facility should be considered as a strategic grid-scale facility. Engineered salt caverns may also have potential for the large-scale storage of hydrogen.

Q29. More detailed mapping of the seabed geology around Northern Ireland is necessary prior to installation of marine renewables. This has been carried out in the Republic of Ireland by the Infomar programme[1] and in GB by the British Geological Survey[2]

1) https://www.infomar.ie/
2) https://www.bgs.ac.uk/research/marine/seabedGeologicalConstraints.html

## 8. Transport

Q30. What would be an appropriate pathway to decarbonised energy for transport to 2050?

Q31. What role should active travel have in the decarbonisation of the transport sector and what should government do to support this?

Q32. What energy infrastructure is needed to facilitate the uptake of electric vehicles in line with UK Government's 'Road to Zero' targets?

Q33. How will transport integrate with other energy uses (e.g. homes with solar generation, battery storage, EV charging) and what can government do to optimise the opportunities represented by this integration?

Q34. To what extent can alternative low carbon transport fuels contribute to decarbonisation of the transport sector?

Q35. Do you have any data/research to help inform and reduce the carbon intensity of our transport energy in order to achieve net zero carbon by 2050?

Q30.
There are several policy options that could lead to an appropriate pathway to decarbonised energy for transport:

1. **Subsidies:** these could be for research into low-carbon technologies and systems, for the use of public transport, for biofuel production and consumption, for consumer purchases of low-carbon emissions vehicles and/or to overcome 'lock-in' problems.
2. **Taxes:** on high carbon modes of transport (aviation and road), and on particularly high energy or carbon intense vehicles
3. **Regulations:** to promote particular mode of transport or standards, to use particular technologies in new vehicles, particular emissions standards
4. **Behavioural change:** to encourage greater use of low energy / low carbon transport, car sharing, active travel, public transport
5. **Transport and infrastructural development policies**: important in facilitating or hindering the promotion of more efficient transport use
6. **Spatial, social and economic development planning:** important for infrastructural development and location of services

For further information see: Sims R., R. Schaeffer, F. Creutzig, X. Cruz-Núñez, M. D'Agosto, D. Dimitriu, M.J. Figueroa Meza, L. Fulton, S. Kobayashi, O. Lah, A. McKinnon, P. Newman, M. Ouyang, J.J. Schauer, D. Sperling, and G. Tiwari (2014) Transport. In: *Climate Change 2014: Mitigation of Climate Change*. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on

Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (Eds.)]. Cambridge and New York, Cambridge University Press. pp. 599-670. Available from: http://www.ipcc.ch/report/ar5/wg3/

Q31.
Active travel has an important role to play in the decarbonisation of the transport sector by reducing the amount of motorised transport and their associated greenhouse gas emissions. It has the added co-benefit of having a positive impact on societal health and well-being. However, it is only possible as part of a fully integrated transport system with the necessary infrastructure and policy support.

An example of this working well is in Bogota, Colombia where the TransMilenio mass urban transport system was developed with the aim of improving the public transport system, restricting private car use, expanding and improving bicycle paths, enhancing public space as well as reducing air pollution and greenhouse gas emissions. The project was developed via a public-private partnership. The public sector is responsible for the implementation of the infrastructure and for the planning, control and monitoring of the system operation, while the private sector is in charge of operating and maintaining the buses.

For more detailed information on the TransMilenio system then click here https://www.ids.ac.uk/download.php?file=files/dmfile/LHcasestudy05-BogotaBRT.pdf

## 9. Other Issues:

### a. Security of Supply

Q36. What specific risks to security of energy supply are likely to emerge as a result of our changing energy mix, and what actions can be taken to mitigate these?

Q37. What measures or indicators could be adopted or developed to monitor energy security of supply?

Q36.
The IPCC states that 'the atmospheric concentrations of carbon dioxide ($CO_2$), methane, and nitrous oxide have increased to levels unprecedented in at least the last 800 000 years. $CO_2$ concentrations have increased by 40% since pre-industrial times, primarily from fossil fuel emissions and secondarily from net land use change emissions'

The scale and scope of problems posed by climate change will lead to very large impacts on terrestrial and aquatic ecosystems and on critical aspects of the lives and welfare of millions of people. This will include amongst other issues, energy security.

There are a number of risks to energy security from climate change as a result of not just extreme weather events but also from gradual changes. These include:

1. Frequent and intense extreme weather events
2. Reduction in water supply
3. Climatic implications for sea level challenging the integrity of pipelines and electricity grids
4. Siting for power production and distribution
5. Improved or diminished condition for biomass, wind or solar

Energy is essential for economic growth but climate change alters the disaster risks for electricity generation that and this is often overlooked in energy research and policy. It is therefore necessary to assess both existing and future disaster risks and this is key to ensuring energy security in a changing climate. There are several ways that energy and electricity policy can improve climate resilience including:

1. Ensure that current and future climate change impacts are including in Environment Impact Assessments
2. Adequate assessment of existing infrastructure to evaluate resilience to future events
3. Ensure that climate change is included at all levels in mainstream energy policy and planning
4. Improve linkages
5. Improved collaboration

For further information on the specific measures for adapting to climate-related disasters in the energy sector including options for energy generation, supply lines and grids see: Urban, F. & Mitchell, T. (2011) *Climate Change, Disasters and Electricity Generation*. Institute of Development Studies (IDS), Brighton. Strengthening Climate Resilience Discussion Paper No 8. Available from: https://www.ids.ac.uk/files/dmfile/UrbanAndMitchell_2011_ElectricityDP82.pdf

On a local scale, whilst oil and gas remain a significant part of the energy sector, Northern Ireland remains dependent on imports by sea (oil) and pipeline (gas). Any disruption in the pipeline system would leave Northern Ireland's power generation and gas network liable to shutdown. The construction of gas storage facilities and/or the discovery and development of indigenous oil or gas resources would reduce this risk.
Unless, and until, the generating capacity of the wind (and to a much lesser extent the solar power) sector is able to meet all power demand within NI then this sector will remain dependent on the use of gas and oil. Large-scale energy storage would help to mitigate this risk. The recent development of the gas network leaves much of the heat sector both with a built-in fossil fuel dependency and also vulnerable to interruptions in supplies of these imported fuels. Conversion of the network to hydrogen, if technically and economically viable, would reduce this risk, provided the hydrogen was produced from renewable electricity using electrolysis and suitable hydrogen storage systems were developed. However, the electrification of heat using heat pumps provides another well-established (in other European countries) pathway to decarbonisation that would be dependent only on indigenous energy resources.

### b. The Role of Data

Q38. What is the most cost-effective method of capturing consumer energy usage data in electricity and natural gas (where meters are in place)? In heating oil (where there is no metering obligation)?

Q39. What concerns need to be addressed regarding data privacy, security and/or ownership?

Q40. What are your views on applying the key recommendations of the Energy Data Taskforce for NI?

Q41. What organisations or businesses do you see as having a key role in optimising the value of data? How will they do this?

### c. Carbon Capture and Storage

Q42. What steps, if any, should NI policy-makers consider with regard to the development or implementation of CCUS in NI?

Q42. There has been limited study into the potential for CCUS in NI and around the island of Ireland[1,2]. Although the UK CCC points out the lack of storage sites in the region there will be a need for the UK to commission a site in the Irish Sea to meet the needs of the western side of GB – such a site could meet the needs of Scotland, NW England, Wales, Northern Ireland and Ireland. The depleted South Morecambe gas field has been identified as a candidate storage site although there is also larger volume, but less de-risked, storage potential in the saline aquifers of the Peel, Portpatrick and Kish Bank sedimentary basins in the Irish Sea.

Further work should be carried out in conjunction with the Irish Government, the devolved administrations in Scotland and Wales, and the authorities in NW England, together with the large emitters, to assess the requirement for CCUS in the Irish Sea region and to further assess the technical suitability and economic case for the development of such a facility.

1) https://www.sciencedirect.com/science/article/pii/S1876610209006766
2) https://www.seai.ie/publications/Assessment-of-the-Potential-for-Geological-Storage-of-CO2-for-the-Island-of-Ireland.pdf

### d. Energy and the Economy

Q43. What specific economic opportunities will arise from the decarbonisation of energy?

Q44. What skills are needed to realise the potential economic benefits of energy in the future?

Q45. What are your views on the future of overall energy demand in NI and how can we ensure that any potential demand growth aligns with our net zero carbon target?

Q.43 Economic opportunities may include innovation in the manufacture and installation of heat pump technology and borehole heat exchangers.
There is interest in subsurface energy storage, especially in solution-mined caverns in halite, but also in storage in porous media, thermal and hydrogen storage. Northern Ireland has thick salt deposits that would be suitable for cavern storage solutions for energy. Energy storage was identified by BEIS as one of 'Eight Great Technologies' that the UK can lead the world[1].

1) https://stfc.ukri.org/research/engineering-and-enabling-technologies/the-eight-great-technologies/

Q.44. It was highlighted by the Climate Change Committee that the development of UK-based carbon capture and storage technology is essential to reducing greenhouse gas emissions across the economy, and to meet the UK's climate change targets[1]. Underground storage will require specific technical skills with regards the geoscience sector. Utilisation of geothermal energy will additionally require specific skills associated with heat modelling and drilling which require some geological knowledge. An Ulster University study[2] highlighted that physical/environmental sciences are in the top three skills "gaps" for Northern Ireland going forward. The skills supply could be supported by some of the existing capabilities, with potential for increased skills supply via regional colleges and universities.

1) https://www.theccc.org.uk/2018/11/28/ccc-welcomes-governments-recommitment-to-carbon-capture-and-storage-technology/
2) https://www.economy-ni.gov.uk/publications/northern-ireland-skills-barometer-2019-update

Q45. There are two potential scenarios for future climactic conditions in Northern Ireland, both resulting from what happens to the Gulf Stream. In one scenario, global warming results in the introduction of fresh water into the Atlantic system from melting ice on Greenland. This effectively slows or cuts of the Gulf Stream flow and causes cooling of NW Europe and Northern Ireland experiences winter temperatures like those in Labrador, Canada, which sits on the same latitude. This would result in an increased demand for domestic warming.

In the second scenario the reduction in flow of the warm Gulf waters across the Atlantic to NW Europe will result in a reduction of atmospheric heat being retained by the Atlantic Ocean, with a rise in temperatures and an associated increased demand for domestic and industrial cooling. https://www.nature.com/articles/s41586-018-0320-y.epdf

In either case, the future demand for energy is likely to increase. Uncertainty lies in whether demand will be for increased heating or increased cooling.

### e. Delivery Framework for an Energy Strategy

Q46. Do the existing division of responsibilities and powers across government enable the most effective approach to the overall aim of decarbonising energy? If not, what are your suggestions for improvement?

Q47. What are the opportunities for local government to contribute to the delivery of the net zero carbon target?

Q48. What are your views on how statutory duties and accompanying legislation and regulatory frameworks would need to change to facilitate the transition to net zero carbon by 2050?

Q49. Is there a need for a dedicated organisation to champion, lead and deliver sustainable energy interventions? If so, what should this look like?

Q46. Planning decisions for national resources, where there is likely a wider impact, are best managed at a national level.

Q47. Energy system planning should form an integral part of strategic planning at a local authority level. There are opportunities for local communities to be involved in the decisions about energy provision in their areas, and the transition to a low carbon society. Northern Ireland is characterised by a larger percentage of its population living in rural settings and dispersed settlements, and a lower gas grid penetration, than other parts of the UK. Its wind energy resources are greater than most other parts of the UK and the geology offers the potential for the development of low carbon geothermal energy and grid-scale geological storage of energy. The development of these sectors is strategically significant for Northern Ireland but offers benefits and challenges at a local level, such that the involvement of local government is essential.

Q48. It is apparent from the progress so far towards decarbonisation (with the projected shortfall against the 4$^{th}$ and 5$^{th}$ carbon budgets) that the market alone will not deliver decarbonisation in the necessary timescale. Clear and consistent policy is required, with fiscal and monetary support mechanisms to incentivise the development of nascent low carbon sectors, and appropriate legislation to provide the regulatory framework to steer NI along the decarbonisation pathway to 2050 net zero GHG.

Q49. The sustainable energy interventions must form an integral part of the NI Climate Change strategy, which must in itself be pan-government. It may be appropriate for a single body to have responsibility for energy across all sectors/departments but, for this to work, it must have the authority to deliver the policy objectives.

## 10. Additional information

Q50. Is there anything else you would like to add in response to this Call for Evidence?