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)**

   X☐ 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**

B9 Energy Storage Ltd

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 USA's Green New Deal proposals are relevant and the 'Cap and Adapt' policy measure refers, see below.
- Q2: Convert natural gas pipelines to 100% H2. This would be a combination of blue H2 from reformers in NI and Scotland and green H2 from local electrolysis in Power-to-X and Power-to-Gas projects. Double installed capacity of wind and solar. Adopt district heating and air sourced heat pumps to decarbonise heat. Use Power-to-X systems to convert excess renewable energy into fuels for transport, power and heat whilst simultaneously reducing need to upgrade electrical (and water) infrastructure.
- Q2: Deploy sub-sea cable from Dundalk to Kilroot / Ballylumford that connects with offshore wind farms en-route and forms a N-S interconnector.
- Q3: Fully implement those recommendations and go further, faster.
- Q4: I support decarbonisation as fast as possible. It is possible to decarbonise within 10 years, indeed coronavirus has shown us we can reduce emissions by huge proportions (some commentary says 25%?) in a few weeks.
- Q4: For decarbonising all sectors of the NI economy that depend on fossil fuels, please consider the 'Cap and Adapt' policy framework. It is described more fully in an article written by Stan Cox and Larry Edwards which is published online in Resilience: https://www.resilience.org/stories/2019-08-28/cap-and-adapt-a-failsafe-approach-to-the-climate-emergency
- Cap and Adapt has two functional objectives. One is to cut fossil fuel emissions to near-zero in a way that is transparent, easy to understand and implement, and is done on a strict schedule that is as failsafe for accomplishment as any politically overseen process can be. The policy will eliminate nearly all of NI's CO2 from fossil fuel combustion. The policy meets this objective with a "cap" on the extraction and importation of fossil fuels. The cap declines on a predetermined, quantity-based (barrels, cubic feet or tons), straight-line schedule to near-zero annual production, by each producer / importer, of each

fossil fuel type. As explained later, this is cap without trade, and is administered through non-inflationary, free permits to companies that extract or import fossil fuels. The second objective is to "adapt" society and the economy to the cap's scheduled decline in fossil fuel production / importation, through programs that are failsafe in ensuring that everyone's needs are met and, beyond that, that all have fair access opportunities to the economy's material productivity. Part of the adaptation is a feature to ensure optimal allocation of fossil energy to all of the economy's sectors. The policy also incorporates the notion of a Green New Deal, to convert the existing fossil-powered portions of the economy to renewable energy, through a just transition. This must include electrification of transportation, industry and the heating of buildings, improved energy efficiency, and reduced demand for final energy. A final adaptation is a standby rationing program, in case the GND's transition at times does not keep pace with the necessary reduction in fossil fuel use and emissions. Its purpose is to provide smooth and fair access to fossil energy (or products manufactured using that energy) if there is a shortfall. This is to avoid chaos like in the 1970s oil crisis and to allow the GND time to get back in sych with the cap. "Near zero" means reduction of CO2 emissions to a very low level that is well-within the capacity of NI's share of natural sinks to withdraw from the air. The important thing is that the vast majority of that capacity be devoted to drawdown of past CO2 emissions.
https://www.eia.gov/energyexplained/energy-and-the-environment/where-greenhouse-gases-come-from.php Much of the efficiency will automatically come from electrification's elimination of the circa two-thirds of consumed energy that is wasted as heat by combustion-based power generation, heating and vehicles. The role or non-role of price in the Cap and Adapt policy framework deserves special mention. The policy controls emissions via its strict cap. Therefore, any use of price or a tax on carbon is a minor matter, for economic fine tuning – if needed. This minimization (and possibly elimination) of reliance on price is a major advantage of Cap and Adapt, given the unpopularity of carbon mitigation mechanisms that rely on price. Witness the Yellow Vest movement in France, recent defeats of Fee and Dividend and carbon tax ballot initiatives in Washington State, and backlash over such measures in Canada. Instead with Cap and Adapt, price controls on fossil fuels can be used, if needed, to prevent profiteering and inflation that would otherwise result from the free production and sectoral allocation permits. The cap cuts the emissions, regardless of that. Personal rations could be tradable or not; and if tradable this could involve price or a priceless (but still fair) method. Cap and Adapt is agnostic to which may be chosen. During WWII, after much deliberation, rations were setup as non-tradable, and it is important to review this history in establishing a new program. An overall objective of Cap and Adapt is to cut fossil fuel use in NI to near-zero as fast as people will tolerate, on a schedule to be specified in an order passed by Stormont to enact

the policy. That schedule can be – and I think must be – much faster than the UK's current reduction schedule specified by Westminster. NI has copious renewable energy resources and a small population and so is able to undertake a much faster decarbonisation transition. Moreover, NI's leadership in making reductions can bring other nations along. As indicated by the dramatically accelerating and shocking climate-related impacts around the world in the past few years, every thousandth of degree of temperature increase that NI policy can avoid (or lead other nations to avoid) is vitally important. We need to act in an emergency-mode that will perform faster and with a smaller temperature increase than can be delivered by any other means. The Cap and Adapt policy framework will work with any fossil fuel phase-out schedule that Stormont may wish to adopt, in terms of the end-date for the straight-line fossil fuels reduction. In the article in Resilience, Stan Cox and Larry Edwards recommend starting with deliberation of a 10-year, straight-line cut in fossil fuel extraction and imports to near-zero. I suggest we use this figure to start with, and then thoroughly explore from that point just how fast a decarbonisation schedule the NI people will tolerate. With climate-related impacts strengthening fast and becoming ever more frequent – even back-to-back or coinciding – we are running out of options. Over the next year or two, decarbonisation schedules or mechanisms that formerly would have received a "No way in hell" response may now start to look like good life boats. Cap and Adapt is one such life boat. If the coronavirus crisis teaches us how to respond to emergency situations then we have hope that a similar response to the climate crisis can be achieved.

- For more see:
- Griffith, Saul. 2019. "The Green New Deal: The enormous opportunity in shooting for the moon". Other Lab News. 21 Feb 2019. https://medium.com/otherlab-news/decarbonization-and-gnd-b8ddd569de16?source=collection_home---6------1----------
- Cox, S. 2013. "Any way you slice it. The past, present and future of rationing." The New Press, NY & London. https://thenewpress.com/books/any-way-you-slice-it

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.

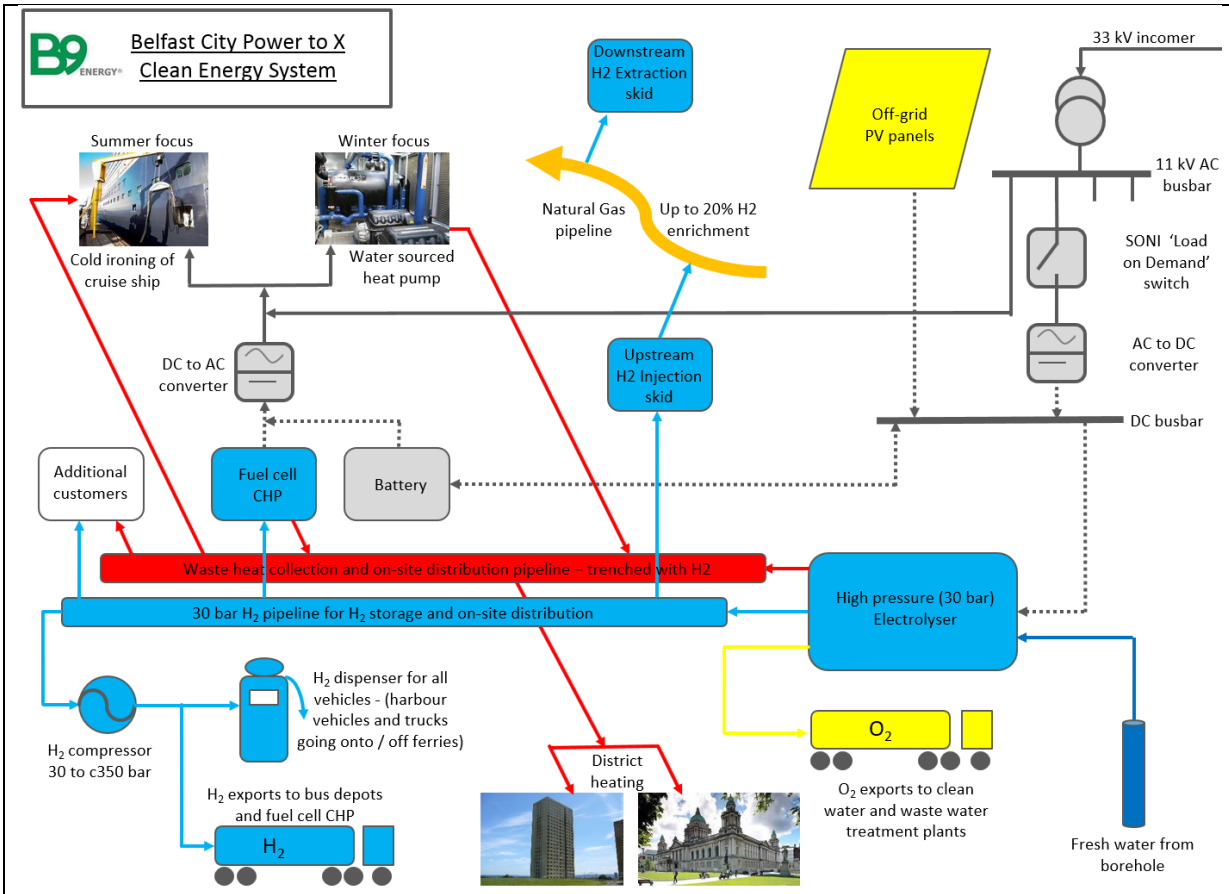
- Q5:
- High wind penetrations
- Grid not fit for purpose
- Only a few points of import for fossil fuels
- No domestic fossil fuel extraction
- No domestic sites for conventional long term carbon sequestration
- High tech companies and workforce
- Peripheral geographical supply chain burdens
- Large agricultural sources of CO2

  Q6:
- Yes, B9 Energy Storage Ltd is developing a number of Power-to-X projects with NI Water, Belfast City Council and ARC21 in Belfast, Mallusk and potentially at many other waste water treatment plant sites across Northern Ireland. The development portfolio size is currently estimated to be 760MWe of electrolyser controllable load. The following is an overview of the Belfast Power-to-X project for information…

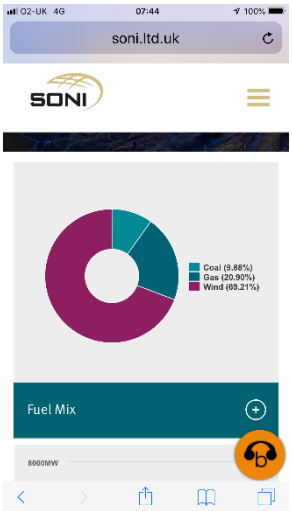
B9 Power to X project overview

This overview describes the features of a project proposal to be located in Belfast, Northern Ireland, which produces hydrogen, oxygen and heat at scale using electrolysis powered by renewable energy and subsequently stores and distributes these gases for later use in heat, power, transport and industrial applications. The schematic diagram below shows the overall Power-to-X system and the text below that provides a description of the following elements….

- Renewable Energy Supply
- Electrolysis
- Hydrogen storage and distribution
- Hydrogen use in the automotive sector
- Hydrogen use for CHP
- Hydrogen enrichment of natural gas
- Oxygen storage and distribution



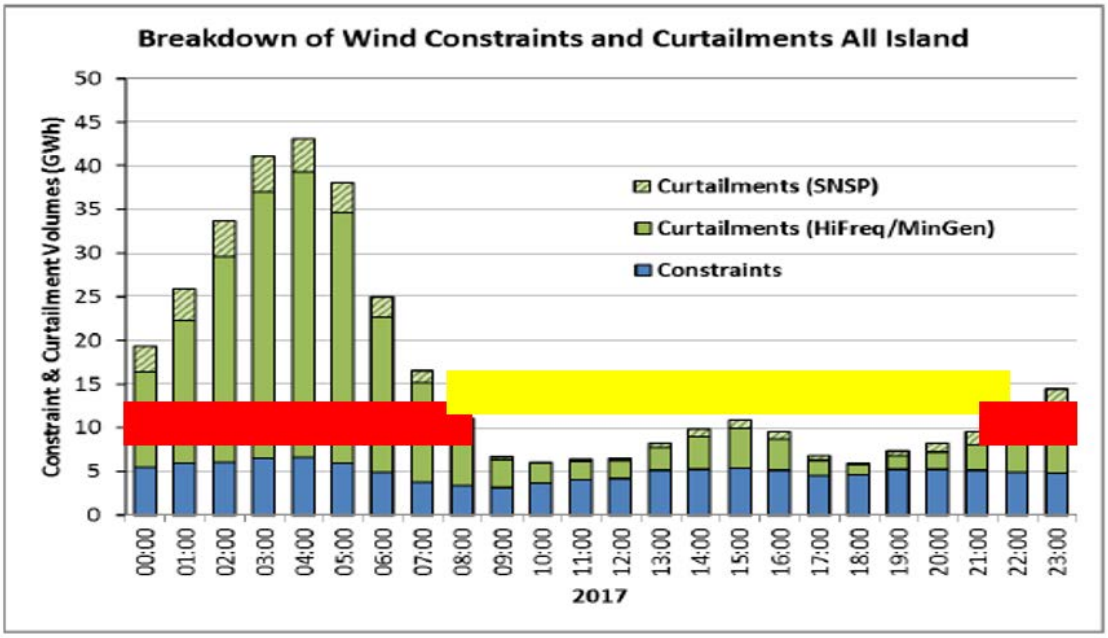
Renewable energy supply



Night-time Wind: Northern Ireland has exceptionally high instantaneous penetrations of wind power on it's electricity grid, with a target limit of 75% by 2020 being set through the utilities 'DS3' program. As a result, it is a regular occurrence for wind turbines to be switched off by the System Operator (SONI) if there is not enough system load to provide balance. These 'curtailment' events normally happen during the night when the load is low and when winds are their strongest. (see graph below). This project will provide the system operator an alternative solution to defer or avoid this wasteful curtailment using large scale, long duration, controllable load, in the form of hydrogen electrolysers to deliver a balancing service. The schematic diagram shows a 33kV incomer cable and 33/11kV substation feeding onto an 11kV busbar (which is all existing equipment) connected to a SONI controlled switch providing a multi-MW supply to the Belfast Power-to-X project during curtailment episodes. The energy prices on the Integrated Single Electricity Market (ISEM) are typically low during curtailment and because our controllable load can be switched off very quickly we can trade in both the capacity and ancillary services 'DS3' markets. The electrolyser load can be easily ramped up or down and does not suffer from part load inefficiency so that it can provide flexibility in the new Balancing Market.

Daytime Solar PV: Because there is little curtailment during daylight hours the project can make use of multi-MW installed capacity of ground mounted solar PV panels during the day. The panels are not grid connected so there are savings on associated electrical equipment and the DC power flows directly to the DC busbar.

The prioritising of renewable energy sources during a 24 hr period can be seen in the graph below…



Electrolysis

The process of splitting water into hydrogen and oxygen is called electrolysis and this is carried out using DC powered high pressure electrolyser equipment which produces the gases at 30bar pressure. Feed water is sourced from a bore hole and must be at least tap water quality to prolong the life of the plant. For every ton of hydrogen produced there will be 8 tons of oxygen and an associated requirement for 9 tons of feed water. It is anticipated that the technical specification will include a mixture of alkaline and PEM electrolyser units. There are no emissions to air or other waste products associated with electrolysis. The units are 70% efficient at converting electricity + water to H_2 + O_2 with the remaining 30% liberated as renewable heat which is directed into the district heating system

Hydrogen storage and on-site distribution

The 30bar hydrogen is stored and distributed around Belfast City via a dedicated pure hydrogen pipeline which is 10” in diameter and approximately 10kM in length. The pipeline network can be extended over time to increase storage capacity and deliver renewable fuel / feedstock to additional retail, commercial and industrial customers at different locations. The route chosen for the hydrogen pipeline follows the existing railway tracks as shown in the project map at the bottom of this paper.

Hydrogen use in automotive sector

When needed as an automotive fuel, the hydrogen is compressed to 350bar and dispensed directly to vehicles locally or to vehicle fleets off-site using road mobile tube trailers. This supply is likely to be for HGVs, buses, trains, agricultural tractors and specialist terminal tractors used for loading/unloading unaccompanied trailers in confined space vehicle decks of cross channel ferries. The majority of the supply will go to Translink buses and trains through the new Weavers Cross transport hub and existing refuelling aprons at Milewater bus centre and Fortwilliam train centre.

Hydrogen use for Combined Heat and Power (CHP)

There is increasing demand for CHP solutions using both hydrogen fuel cells and/or hydrogen IC engines. This is because of their higher conversion efficiency and zero emissions performance. This project provides hydrogen supply at sufficient scale to stimulate the deployment of CHP:

i) within the Belfast City area, using the hydrogen pipeline network,
ii) at off-site locations using compressed hydrogen moved in road mobile tube trailers, and
iii) at off-site locations using hydrogen stored and delivered through existing natural gas pipelines

CHP application for 'cold ironing'

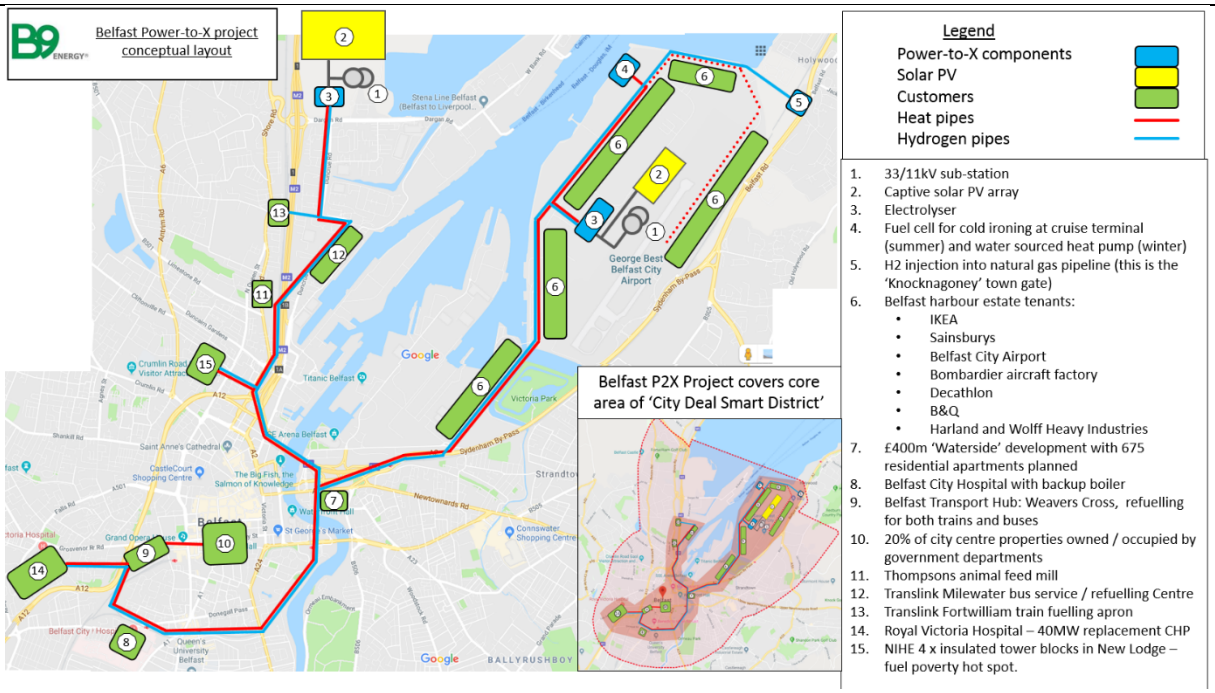
A particular novel application of hydrogen CHP in a port setting is for 'cold ironing'. This term originated in military naval procedures to describe how naval ships, which spend a lot more time in port than commercial ships, are more economically powered from shore side connections rather than from their own engines. In this condition the ironwork of the engines becomes cold. The Belfast Harbour application of cold ironing is to allow visiting cruise vessels to switch off their fossil fuelled on-board generators whilst in port. The result is a step reduction in gaseous emissions and associated particulates that would otherwise contribute to Belfast's air quality problem and because the CHP fuel is renewable there are climate change benefits too. Most modern cruise vessels are fitted with convenient electrical connection interface arrangements and some also have the ability to utilise flow and return hot water services from the fuel cell CHP. Cruise ships only visit during summer months allowing the CHP plant to a drive water sourced heat pump during the winter.

Hydrogen enrichment of natural gas

Trials are underway in GB that should allow natural gas in pipelines to be enriched with hydrogen up to a limit of 20% without causing problems with existing gas appliances such as cookers and boilers. This will provide an additional buffer storage vector for hydrogen and enable access to new emerging markets for predominantly heat. Pressure Swing Adsorption, H2 gas filter separators and H2 pumps will allow down stream extraction of hydrogen for industrial processes and to safeguard equipment such as gas engines that may be intolerant of the hydrogen content.

Oxygen

There are many existing uses for oxygen in both pressurised gas and liquid forms. We have concentrated our early market research on the water utility sector which needs about 40 tons per day in Northern Ireland alone and so will be able to absorb most if not all of our oxygen production. The gas can be used to make ozone which disinfects drinking water before it leaves the clean water treatment plant. It can also be used to increase capacity / extend life of existing waste water treatment plants by substituting aeration for oxygenation in the activated sludge treatment process. In each case, conversion to using imported renewable oxygen from electrolysis will save energy, reduce emissions and defer the costs of plant expansion.



23 x Project Stakeholders :Invest NI collaborative growth fund award awaited.

ABB	ISEM market operating software
Arup	Technical / Commercial modelling including ISEM
B9 Energy Storage	Project management /Project development / O&M
Belfast City Council	Civic engagement / Environmental agenda / heat network operator
Belfast Harbour	Landlord / hydrogen offtake / cruise ship liaison
Bouygues E&S	EPC, turnkey contractor
CBRE	Low carbon project debt
Colloide	M&E design and contracting – e.g. district heating
Hyundai	Vehicle fuelling strategies
Irish Hydrogen Association	Strategic and tactical networking
Kinkead Consulting	HSEQ & Management Consulting
KPMG	Financial services with global reach
Mutual	Natural gas pipeline owner / operator
Newcastle University	Oxygen uses in water industry
NI Water	Clean and waste water treatment plant owner / operator
Northern Cryogenic	Hydrogen and Oxygen road transport
Osborne + Company	Scirrocco works re-development
Solvera Lynx	Integrated system design and specification
SONI / Eirgrid	Electrical System Operator
Strategic Investment Board	Public sector liaison
Translink	Bus and Train owner / operator
Toyota	Vehicle fuelling strategies
UK Water Industry Research	Community of knowledge and expertise
W-TEC / Wrightbus	Electric and H2 bus manufacturer

Consequential benefits:

- Reduced wind farm curtailment providing more efficient use of existing wind farm fleet
- Reduced uncertainty for wind farm owners helps to stimulate ongoing investment in new wind farm sites
- Increase in total installed wind capacity becomes feasible
- Reduction in need to import fossil fuels for transportation requirements
- Improved security of electricity supply
- Addition of controllable load assets will provide increased flexibility in the i-SEM Balancing Market
- Improvement to NI balance of payments
- Enabler for city air quality improvement
- Enabling technology for industrial ventures into circular economy-such as synthesis of liquid marine fuels – e.g. renewable methanol
- Increase in waste water treatment plant capacity will allow more planning permission for new dwellings.
- Future enabling technology for stranded embedded renewable generation assets
- Improved utilisation of existing grid infrastructure – increased revenue for grid operators
- Improved utilisation of existing natural gas network for H2 storage and transportation
- Lower cost developmental / renewable H2 to stimulate early H2 vehicle uptake
- Lighthouse project for Northern Ireland – ultimately scalable to major towns in the region and beyond
- Route to market for ground mounted PV – negating requirement for grid connection infrastructure
- Key project to allow rapid decarbonisation to be achieved

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?

Q7: Power-to-X projects have significant district heating components in urban examples. The heat arises from waste sources such as fuel cells, CHP engines and electrolysers and from non waste sources such as electrode boilers, heat pumps and H2 fired boilers. Heat represents a relatively small proportion of the Power-to-X revenue stack and can be further reduced to levels which are affordable to houses which find themselves in fuel poverty (including zero). The other revenues will effectively cross subsidise this heat but the main body of stakeholders and off takers are happy with this on the grounds of CSR, Corporate Social Responsibility and ESG, Environment, Social, Governance.

Q8: These organisations should go it alone and become pro-sumers.

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?

Q14: Decarbonisation means removal of fossil fuels from the energy mix. About 80% of current energy usage is from fossil fuel sources. Therefore rapid decarbonisation means there will only be 20% of present day energy available after the transition. There will simply not be sufficient time to replace all the fossil fuels with renewable energy so that there will be a period of energy shortage. Energy efficiency will finally be taken seriously and all profligate uses of energy will be stopped: air travel, large cars, fossil gas and oil fired central heating, fertilisers and unsustainable farming practices in general. Cap and Adapt, described earlier, introduces rationing of energy if necessary to remove inflationary pressure in the economy – an approach that was well proven during the second world war emergency.

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?

Q21: Yes, subject to successful trials at Keele in England the HSE will allow up to 20% H2 enrichment of fossil gas network without the need to change end user appliances. Power-to-X projects can be used to convert whole sections of existing urban gas networks to 100% H2 and in these circumstances the appliances will need to be changed to allow for the different gas characteristics such as flame speed and calorific value. This is simply a reversal of the switch from town gas to north sea gas which happened in the 1970's – town gas was 60% hydrogen. The gas network in NI is relatively modern and can be converted to 100% H2 more easily than GB. Note, all suggestions that biomethane should be injected into gas networks or compressed to drive vehicles are counterproductive because the quantities involved are so small in comparison to the huge amounts of fossil gas that need to be displaced that to pursue such a venture, even if described as transitional, would divert effort away from the switch to hydrogen. The oil and gas companies that advocate offshore reforming of natural gas to blue hydrogen for delivery to distribution networks need to get on and show how they intend to do this without relying on carbon pricing in the region of €200/tonne. Blue H2 is to be welcomed but so far there is no commitment being shown. B9 is in discussion with a number of oil majors to offer an alliance around green/blue hydrogen shared infrastructure for delivery to end users, but in not seeing any real urgency on their part we plough on with a purely green H2 play at present.

Q22: Traditionally, successful district heating schemes have been financed by private sector investors in conjunction with municipality stakeholders such as local councils. BCC is keen to explore the implications for the Belfast Power-to-X project district heating assets. Bryson House is keen to carry out the heat sales and marketing function as a charitable organisation and has been introduced to counterparts in Leeds through the P-CAN organisation. In a future

decarbonised world with only 20% of energy available to it, the heat contained in a district heating network suddenly becomes very valuable to investors so that pure private project proposals could be forthcoming. This is not to say that civic partners would not be sought but there would be additional options available.

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?

Q24: Install on and offshore wind and solar PV and use electrolysis to spread the energy into the transport heat and power sectors. Shut down the fossil fuelled power stations.
Q25: additional 1600MW installed capacity
Q26: By forgetting about the existing electricity system – it is not fit for purpose of accommodating large amounts of intermittent power now and with further reliance on renewables it never will be. We need a work around: offshore cables, offgrid solar arrays driving electrolysers, controllable load at nighttime, use gas grid as storage and transport vector.
Q27: Without long duration controllable load provided by Power-to-X and Power-to-Gas the risk of curtailment and constraint associated with greater installed capacity of wind will grow to the extent that wind farm investor confidence will collapse – 20% curtailment is the difference between a profitable and loss making venture. Future wind projects will need to have an associated co-investment in Power-to-X or some sort of offtake agreement for the balancing load. A new tariff called 'Load on Demand' has been devised within the context of the Belfast Power-to-X Project, see Q28 below. Important innovations are multi storage vector management control algorithms, membrane free electrolyser technology for lower unit CAPEX and lapsing of patents on ionic liquid piston hydrogen compressors allowing competition in high performance compression.
Q28: Large scale investment in renewable generation assets will need to be in association with appropriate investment in energy storage assets so that curtailment risk can be reduced to low enough levels as to maintain investor confidence. These energy storage assets need to have long duration capability of at least 10 hours without being 'full' because this is the duration of an overnight

curtailment episode caused by the coincidence of strong winds and low background electrical load. Note: batteries are not good storage devices for this purpose as they have durations of only an hour or two, although if they are aggregated together in a suitable charging control algorithm then they will have a role to play.

A new market incentive needs to be introduced. B9 refers to this as 'Load on Demand'. Here is the logic to the scheme…

- The system operator for NI (SONI) is responsible for keeping the electricity supply and demand in instantaneous balance and thereby maintaining the frequency and voltage within statutory limits.
- When the wind picks up at night time and there is low background load there is a tendency for the frequency / voltage to rise on the electrical system. This triggers a curtailment episode.
- The curtailment response is for SONI to dispatch down (switch off) sufficient numbers of wind turbines across NI so that balance is restored.
- Outcome1) Revenues for wind farmers are interrupted during curtailment episodes.
- Outcome 2) Opportunity for SONI and NIEN to receive Use Of System charges for transportation of wind energy from generator to end user is also interrupted during curtailment episodes.
- Outcome 3) With wind turbines sitting idle when strong winds are available there is also a lost opportunity for the NI government to see reductions in CO2 emissions (e.g. from the transport sector if the power could have been used to make alternative fuels such as H2)
- If controllable load in the form of electrolysers is made available for dispatch by SONI at any time they demand it, and this load is switched on instead of switching off wind turbines – then the net effect is the same and the balance is maintained. This is what we call 'Load on Demand'
- If Load on Demand is dispatched then the outcomes are much better:
- Outcome 1) Revenues for wind farmers are preserved during the curtailment episode, balance sheet performance remains viable and in line with original projections, investor confidence remains positive and appetite for further investment is guaranteed.
- Outcome 2) More electricity is transported from generators to customer end users so that SONI and NIEN enjoy increased revenues from their business of owning and operating the transmission and distribution infrastructure. (Same asset + more energy transportation = increased rate of return)
- Outcome 3) With the wind turbines no longer sitting idle but instead being used to make renewable transport fuels such as H2, which displaces the need to import fossil transport fuels, there is demonstrable savings in CO2 emissions (and balance of payments) that can be accounted for as

improvements in NI's carbon budget. These benefits can be monetised as diesel fuel equivalent price or carbon traded price.

- These 3 outcomes are great for wind farmers, system operators and the government but do not manifest themselves as additional revenue streams for the enabling energy storage projects that have provided the Load on Demand services.
- B9's recommendation is that a new market mechanism / policy is introduced to remedy this. We suggest the following…
- A proportion of the additional revenue enjoyed by wind farmers and system operators during curtailment events could be paid into a Load on Demand account. Carbon savings money could be paid into the same account.
- Eligible providers of long duration load on demand could be the recipients of payments from the Load on Demand fund. This could be administered as an auction, a market or some other vehicle deemed to be appropriate.
- The new market mechanism would be phased out once the prices of equipment had reduced due to technical maturity, absorption of R&D costs and introduction of mass production. The mechanism would give confidence to embark on appropriate (large) scale deployment, bulk orders to supply chain participants, component manufacture and final assembly of electrolysers and compressors in Northern Ireland for the all island market (SEM and high wind penetration drivers are identical in ROI)

Q29: B9 was a consortium member with RES and Dong Energy to develop the First Flight Wind offshore wind farm project off the Co.Down coast. The project was shelved after the ROC deadline was artificially shortened for NI and we still feel aggrieved that bureaucracy and vested interests that didn't want to see the progress of offshore wind were able to stifle this industry sector in its infancy. We should be able to pick up where we left off without having to go through all the hoops and hurdles associated with due process. There were many months of deliberation and expert advice consumed in the process of developing the last SEF and nothing much has changed since except the need for the project is all the more urgent. Please fast tract the administrative landscape so that we can pick up where we left off.
The following is a vision of how we see the relevance of First Flight Wind today…

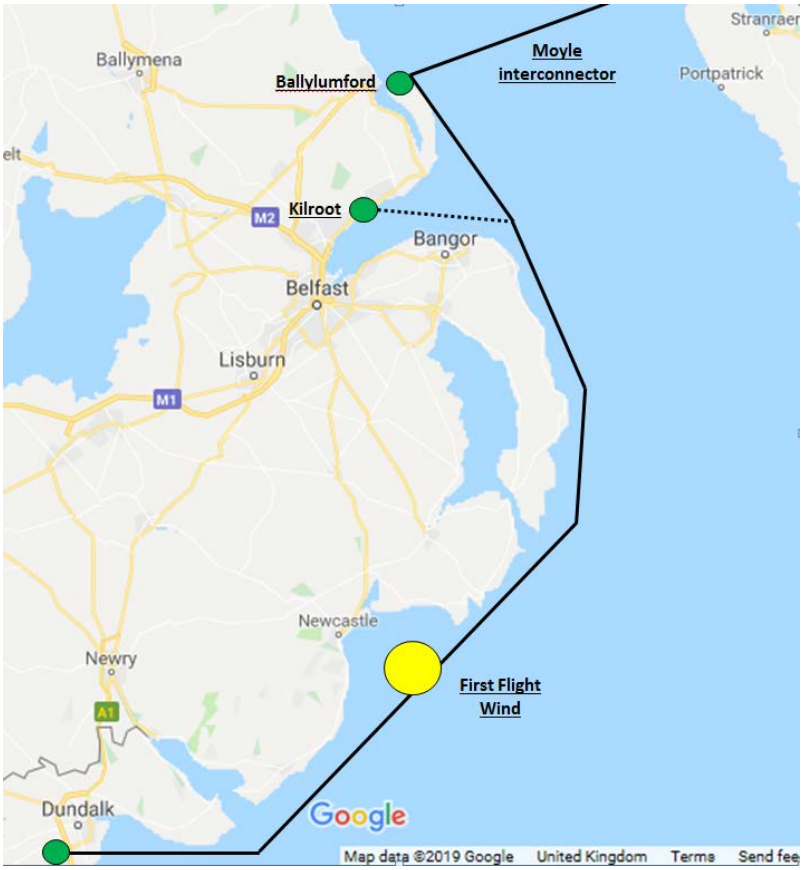
<u>An alternative subsea North South Interconnector option.</u>

<u>Kilroot option</u>
In light of continuing difficulties with development of the existing onshore North South Interconnector project, the following is a high level description of

an option to place the cable on the seabed instead and to join up with a stalled offshore wind farm project along the route.

The project to install a 600MW offshore wind farm off the coast of Newcastle Co.Down, called ‘First Flight Wind’, was shelved in 2014 due to an unfavourable commercial support process. However, before that, the site had been reduced in size to 300MW for several reasons including the lack of an operational North South Interconnector which made projections of curtailment prohibitive for 600MW. The 300MW proposal had its own issues with opposition to over ground grid connection cabling to Castlereagh connection point and so a subsea option to Kilroot was considered. Whilst the capital cost was higher the lack of opposition allowed certainty in the construction timelines which was very important in a project of this sort.

In recent months, B9 Energy has been approached by an ROI developer to see if the offshore wind site could be resurrected because a large multinational ICT firm needs power for a data centre to be located in the Dundalk area. On its own this might not be sufficient to make a viable project but by extending the cable to Kilroot and forming a subsea North South Interconnector as an additional feature the prospect would certainly be improved. The subsea option would be more expensive than undergrounding the cable along the onshore route but it would allow a large (by Irish standards) offshore wind farm to be built with acceptable levels of curtailment.



Ballylumford option

Another option for consideration would be to terminate the northern subsea cable at the now closed Ballylumford B station on Islandmagee. Whilst the cable length would be almost the same on this route there are some additional factors that could make it a favourable option…

As decarbonisation of road and rail transport accelerates under the Paris agreement, diesel fuel will be increasingly displaced by renewable hydrogen produced by electrolysis powered by renewable energy.

The economics of electrolysis are helped by larger scale installations and Ballylumford B could accommodate many hundreds of MW of electrolysers in and outside the existing buildings and reuse much of the existing grid connection equipment. Some of the boilers and turbines have been decommissioned / removed.

The electrolysers would be energised by SONI in preference to curtailment of wind and as a flexible tool for reducing volatility in the new ISEM balancing market. The electrolysers can be switched off in milliseconds so that the load can be traded in the capacity market and ancillary services market (DS3). These features are unique to the NI/ROI grid and could result in the lowest price point for renewable hydrogen yet seen in Europe.

Compressed hydrogen (at 350bar) could be exported by sea or road.

The hydrogen could be exported by 20% to circa 60% enrichment of the natural gas pipeline

For every 1 x ton of hydrogen that is produced there would be 8 x tons of oxygen.

The oxygen could be used to enrich the combustion air being fed to the adjacent Ballylumford C station gas turbine engines from the natural level of 21% up to as much as 30%. The effect would be to increase thermal efficiency (especially at part load conditions when there could be a 20% to 25% improvement), reduce fuel consumption and lower carbon emissions. There would be a small rise in NOx emissions

Oxygen could also be exported by sea or road.

Hydrogen can potentially penetrate the marine transport fuel market much faster by being synthesised with CO2 in a catalytic reactor to form a convenient liquid fuel at room temperature and pressure – methanol (CH3OH).

Methanol is an ideal fuel for cross channel ferries, as demonstrated by Stena with their 'Stena Germanica' conversion. Northern Ireland is unique within the UK as we alone have to decarbonise domestic sea connections with the mainland. Stena operates 6 vessels from Belfast Harbour to mainland UK.

The methanol can also be enhanced with an additive to allow it to substitute directly for diesel in road and rail vehicles.

Methanol can be further catalytically reacted with more CO2 to produce DMC (Dimethyl carbonate) which is a feedstock to the chemical industry or a fossil fuel additive to reduce particulate emissions.

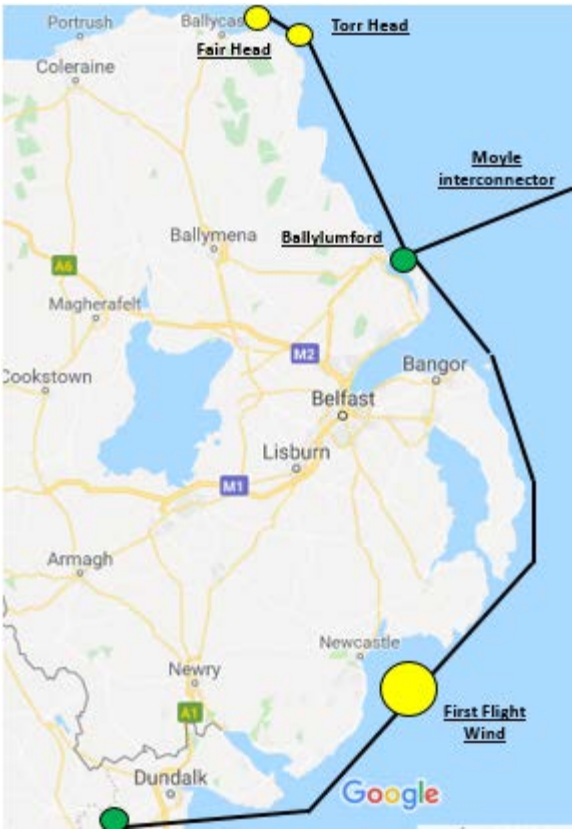
The CO2 supply would be scrubbed and captured from the exhaust of the C station and fed directly to the methanol reactor. This would reduce the carbon footprint of Northern Ireland's largest power station as some of the carbon would end up being burned twice – first time in the C station and second time in an existing Stena ferry, for example.

Methanol could be exported by sea or road.

In addition, Ballylumford is the location where the Moyle interconnector from Scotland is connected so that power could potentially be traded between ROI, NI and Scotland. Ballylumford is also the location where the natural gas transmission pipeline comes ashore from Scotland. It is anticipated that natural gas pipelines will be converted during the decarbonisation transition to contain 100% hydrogen, as described in the HiNet project in Lancashire. But before that, subject to successful trials at Keele University during 2019/20, HSE will allow 20% enrichment of natural gas with hydrogen because at this level there is no need to modify gas appliances. The best place to inject this hydrogen into the pipe would be at the Ballylumford landfall.

Northern cable extension to tidal energy projects

The 2 tidal energy projects located off the north coast at Fair Head and Torr Head have a proposed combined installed capacity of 200MW. The development of both projects has stalled due in part to a lack of cost effective grid connection in the Ballycastle area. The problem could be solved by extending the subsea cable north from Ballylumford to connect at the tidal farms. The electrical output from the tidal energy sites occurs in 4 episodes each day, one of which is always during the nightime period of low electrical demand. It would not be desirable in commercial or engineering terms to curtail tidal turbines so energising controllable load in 'generation following' mode is the optimum solution. The electrolysis plant at Ballylumford would provide this controllable load every night. This usage pattern would increase the overall electrolyser duty factor and significantly contribute towards making the project viable.



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: Batteries for cars, H2 for HGV, buses, trains and agricultural tractors. Forget about aircraft – synthetic fuels are possible but the energy shortages would direct these to more deserving customers such as households. Methanol and Ammonia for ships.
Q32: I have been driving an EV for 20 years now. In my opinion once these vehicles are able to drive for 200 to 300 miles on a charge there will be no need to stop and charge it up in the normal usage pattern of NI. If you are going so far that you would need to charge it then you should be on a bus or train in any case. Charging infrastructure lag has been a convenient topic told to drivers to slow the uptake of EVs in the last 20 years
Q33: Given there will be a shortage of energy during and immediately after the decarbonisation transition, there will simply not be enough energy available for all current car drivers to just convert to driving an EV for personal mobility. People will have to travel less. Many more journeys will need to be in buses and on foot and by bicycle. Being a prosumer and charging at home will be an obvious step for people to take if they have the circumstances to do so.
Q34: Low carbon fuels will be applicable to vans, HGVs, buses, trains and agricultural tractors. Cars will be EVs. There will be no limits to the use of hydrogen. I would not recommend any further support for development of transition fuels such as CNG, LNG, LPG, biogas, biomethane etc as they are available in such small quantities and need infrastructure development for only a small window of use.

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?

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: Ascertain if the oil and gas majors are actually serious about developing the facilities for sequestering liquid CO2 at offshore locations which has been delivered to them by products tanker vessels. Accept the fact that if they continue to sit on their hands there will be no such thing as NET ZERO and instead we will need to strive towards ACTUAL ZERO.

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?

Q43: Low carbon economy, circular economy, manufacturing of electrolysers and compressors, service provision for domestic market that can subsequently be exported to GB and beyond once those regions develop high penetrations of wind on their systems too.
The aircraft industry is under severe and terminal threat of being decimated by the end of mass travel by air. – Air travel and the tourist industry it supports is only possible because it is predicated on cheap abundant fossil fuel that is not burdened with even the most basic on environmental taxation. Internalise the external costs and ticket prices would increase at least 4 fold rendering the industry dead. Alternative fuels will not come to the rescue anytime soon. Bombardier will not survive this transition and neither will the supply chain in NI that supports it. The aim of a just transition under a Green New Deal (or UK equivalent) would be to transfer these jobs into the green sector. This should be possible to do.
Q44: Skills are very similar to those in most other industries.

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: There should be a government department set up to oversee decarbonisation that has access into the relevant affairs of all other existing departments. It should be headed up by John Green who currently works for SIB in this area.
Q47: Local government (initially BCC) should use the city deal structure to introduce a decarbonisation zone in the city centre area which functions in a similar way to enterprise zones but which has decarbonisation as the dominant theme. Rent holidays, soft loads, loan guarantees etc etc and any other incentive that can be devised wold be put into action in these zones.

10. Additional information

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