Response	Number 1
Respondent	Anon
Title	
Organisation	
On behalf of	My Sector
Sector	energy intensive industries

Risk to that sector CCUS essential to reach net zero but expensive - production of hydrogen essential but scale up limited - need to balance risk of offshoring more emissions with opportunity of re-shoring some key manufacturing with the carrot of a lower carbon manufacturing hubs

Opportunity for that sector protect existing jobs in steel, refining & chemicals whilst attracting inward investment in sustainable air fuel, battery production, lower carbon hydrogen production and re-shoring manufacturing sectors to reduce overall UK footprint

Barriers from energy policy clarity on how to fund CCUS in clusters, clarity on rewards for manufacturing low carbon hydrogen, what are the future penalties for emitting CO2 and rewards for reducing this?

Key to decarbonising industrial decarbonisation (including gas and biomass fired power) needs CCUS - timeframe before 2030 - need flexible CO2 shipping/transport for UK clusters to reach net zero by 2040 - need low carbon hydrogen now

How to become more active need to derisk and support heat/power alternatives for energy intensive industries such as biomass or hydrogen fuelled boilers - make it easy for private wire where this is a lower carbon electricity source - review the short haul gas tariff challenges as this directly conflicts with attempts to decarbonisation industrial clusters and becomes a disincentive for blue hydrogen in the regions that are going to make the most of this technology

Focus Government investment on the right track but there are too many different funding competitions for the same output - IETF, clean steel, TFI etc. make this simpler

Place-based resources industrial cluster mission phase 2 will support this approach, but often local enterprise partnerships and local authorities in industrial clusters are under resourced and very slow to understand the challenge and opportunities presented through decarbonisation and net zero targets - low levels of industrial know-how and expertise in the public sector

Hard to Decarbonise energy intensive industries that fall outside the current industrial clusters - not clear what they will do to reach net zero - other than tanker or pipe their CO2 to an active CCUs cluster

How to assess efficacy no sure

Cross-party consensus net zero ambitions are well supported but we have hardly touched the surface of the NET in net zero - so many options to remove CO2 from the atmosphere - we must start pursuing them logically and not just going mad for tree planting (how do we measure this properly?)

Policy misalignment use of biomass in production of energy and fuels (transport fuels) we need to be clearer about the value of biomass in these sectors as part of the route to achieve net zero - land use for energy crops vs land use for food or land use for carbon sequestration - all needs to be clearer and streamlined

How to raise awareness more clarity on CO2 removal systems, measuring the before and after via a rigorous system and the training of more people qualified to do this

What to do differently listen to industry and support the actions we can implement now, streamline planning of new CCUS and hydrogen production so we don't have to wait 10 years

Agenda for CoP fast tracking deployment of CCUS and hydrogen production, removing obstacles such as planning and funding/risk

Response	Number 2
Respondent	Cllr Philip Bell
Title spokesperson	Elected member, Aberdeen City hydrogen spokesperson, hydrogen champion & climate
Organisation	Aberdeen City Council
On behalf of	Myself
Sector	Elected Member in Local government

Risk to that sector Cost effectiveness and transitioning region (Aberdeen – North Sea Basin)

Opportunity for that sector Regional energy transition; hydrogen; reducing heat poverty via heat networks

Barriers from energy policy Probably lack of hydrogen strategy from UK Government

Key to decarbonising Timeframe: Being deployed now; ultimately Paris Accord timeframe. Effect: At least maintain, and hopefully increase, local employment. Stepping stone to Aberdeen becoming a Net Positive City. Barriers: Finance & Government policy. Cost: Leveraging in private money from sufficient Government 'pump priming'. Raising money is hard!!

How to become more active Demonstration projects; local strategy; vision and plans for e.g. Hydrogen Highland Hi-Way

Focus Government investment Pump priming significant development and ensuring suitable construction sites are available for e.g. floating offshore wind, energy transition zones, free-ports where appropriate to encourage cost effective local manufacturing, encourage apprenticeships, encourage higher learning courses, add energy transition and climate change to national teaching curriculum

Place-based resources Aberdeen is good example of how this absolutely must be done. Delighted to talk to you about this

Hard to Decarbonise Heating. Gas is 1/8 cost of electricity to transmit. Heat pumps require significant amounts of land, will interact with other local schemes unless developers are encouraged to install communal schemes and require significant amounts of electricity, especially in older housing stock.

How to assess efficacy The total energy requirements for actually making the devices should be included together with the conditions that the materials are obtained in. For instance the 'Democratic Republic of Congo' mining Cobalt with child labour in primitive conditions with hand tools, energy requirements and associated CO2 for producing a Li-Ion battery.

Cross-party consensus Shutting down coal-fired power stations, possibly building suitable base-load with significant spinning reserve, e.g. Nuclear

Policy misalignment Hydrogen and Nuclear

How to raise awareness It's actually a climate crisis; emergency means immediate threat to life, limb and property! Regular updates to the public of where we are in terms of reaching net-zero and how that is being achieved

What to do differently Invest heavily in R&D (ARPA model), promote nuclear, promote building offshore wind facilities (fixed and floating), promote hydrogen with potentially fuel cell and micro-grid capability, 'pump-prime'

with Government money hydrogen refuelling stations, encourage high tech manufacturing of zero/low carbon technology, re-commence heavy engineering & manufacture for industries that UK was good at.

Agenda for CoP R&D and manufacturing of low carbon technology. The UK must be the 'go-to' country not the country that follows the rest

Response	Number 3
Respondent	Anon
Title	
Organisation	
On behalf of	My Sector
Sector	energy

Risk to that sector The key risk is lack of clarity as to who needs to do what, the wrong governance to enable and unlock coherent change, lack of

recognition that the changes needed are transformational not incremental, and a centralising mindset that blocks the roles of

consumers, cities and other scales of activity.

Opportunity for that sector Massive opportunity to transform to a consumer led, digitised energy system, with concomitant benefits to the economy, the

consumer experience, and consumer engagement.

Barriers from energy policy the thicket of individual point solutions to policy problems past and present, that has created a legacy market, regulatory and policy environment unsuited to the transformational changes ahead.

Key to decarbonising This is mostly about unlocking deployment of technologies we have already within a digitised and data driven system, although

hydrogen, CCUS and small nuclear clearly need intensive work as development options. Data and interoperability standards,

governance related matters are critical.

How to become more active through the right products and services being readily available and intelligible.

Focus Government investment See above

Place-based resources Place-based organisations are brilliantly placed to make the most of local synergies and resources, but currently lack skills, powers and financial resources to do so.

Hard to Decarbonise Long-haul aviation appears amongst the most difficult, assuming demand for it returns at scale post COVID-19.

Building stock - owing to the level of invasiveness needed. Alternatives are to produce much more zero carbon energy, which

would be rather more costly.

How to assess efficacy Holistically, including emissions from construction, and imported/exported emissions. This is difficult, so approximations should

be used initially and then refined over time. Benefits calculations should consider co-benefits such as improved heath, as well as

carbon benefits.

Cross-party consensus I don't think there are major cross party differences of substance on these issues, it's more about getting on with delivery.

Policy misalignment Heavy industry

How to raise awareness I think these would tend to follow naturally given clear commitments and action on implementation of decarbonisation measures

What to do differently This isn't really a Brexit or COVID-19 driven activity, but they have been distractions. Decarbonisation action needs to move centre stage, and be fully coordinated across Whitehall, the devolved administrations and city/local government.

Agenda for CoP Clear actions and commitments on what's set out in the Energy White Paper, with evidence of real activity prior to the COP.

Response	Number 4
Respondent	Jon Gluyas
Title	Director DEI
Organisation	Durham Energy Institute
On behalf of	My Sector
Sector	Higher Education

Risk to that sector loss of international exchange and education, or its restriction

Opportunity for that sector attracting the best young minds aligned with decarbonisation aims of DEI

Barriers from energy policy lack support for emerging technologies to be rolled out at scale so that they can compete against entrenched high-carbon activity

Key to decarbonising GHGs associated with heat dominate in the UK. Heat is generated by almost all energy transitions and thrown away. making best

use of this heat and heat from the Earth, heat storage and reuse with lots of associated technologies is the way to maximise its

value, decarbonised heat and reduced emissions by 1/3, meet next carbon budget. Behaviours need to change too.

How to become more active demonstrate benefits of decarbonisation

Focus Government investment support for large scale emerging technologies as have several Govs in supporting offshore wind - consistency!

Place-based resources heat does not travel well and so local and regional solutions must dominate, devolve responsibility and power.

Hard to Decarbonise nothing is hard to decarbonise but cost is a factor. Fossil fuels are energy dense and transport and therefore will always win out

economically if we don't account for emissions. Support to compete on cost will allow all sectors to be decarbonised and enable

2nd and 3rd generation of technologies which will bring cost down...

How to assess efficacy making best use of energy inc heat will deliver on efficiencies, effectiveness will be assessed by speed of take-up

Cross-party consensus not sure there is such consensus

Policy misalignment sensible support for decarbonisation of heat

How to raise awareness awareness is growing rapidly, cost and impact of not decarbonising needs to be driven home.

What to do differently think local and deliver local solutions to solve overall national problem

Agenda for CoP decarbonisation of heating and cooling and heat/cool storage

Response Number 5

Respondent Simon Fowler

Title Managing Director

Organisation Vectec Ltd

On behalf of My company - Vectec Ltd and our supplier Crown Oil. We supply, install and maintain vehicle refuelling systems for the emergency services, local authorities and public companies. Crown Oil also supply heating oil to commercial and domestic users.

Sector Renewable energy – specifically the supply of Hydrotreated Vegetable Oil (HVO) and associated storage and dispensing facilities.

Risk to that sector The cost of the blanket move to electricity or hydrogen for refuelling vehicles, especially for the emergency services and local authorities with fleets of legacy vehicles. New charging infrastructure is very expensive to install

Opportunity for that sector The roll out of HVO to replace mineral diesel/ FAME for refuelling vehicles and the GHG savings that this brings. Also the use of HVO to replace mineral heating oil/FAME in more remote rural locations. 100% HVO is a direct replacement for both products with and provides up to 90% net reduction in greenhouse gas CO2 emission.

Barriers from energy policy Apparent ignorance of the benefits of HVO over mineral diesel/FAME and the obsession with electricity and hydrogen as the only possible energy sources.

Key to decarbonising HVO is currently available and is accepted by an increasing number of vehicle and generator manufacturers. It meets the requirements of the Renewable Energy Directive and is compliant with and approved by the Road Transport Fuel Obligation.

HVO can be stored and dispensed from existing infrastructure without modifications. It does not bring the problems associate with FAME i.e. diesel bug and water retention. Therefore it can be deployed very effectively and easily.

Barriers are minimal but changes in excise duties would aid the deployment.

HVO is a drop in replacement for mineral diesel/FAME and conventional heating oil and gas oil.

How to become more active Blank

Focus Government investment In encouraging the indigenous production of HVO and by altering fuel duties to reflect the environmental benefits of HVO over

alternative products.

Place-based resources Blank

Hard to Decarbonise Building heating in remote and rural communities with no mains gas. The cost of heat pumps would be prohibitive and the

installation difficult on old locations. There is a requirement for a cleaner alternative to domestic heating oil. Using HVO as a

replacement fuel would give an immediate GHG benefit without any additional costs. Also building the electrical charging network

for EV vehicles will involve huge investment and inevitably large GHG emissions from building equipment. HVO's certified GHG

impact is currently 10 times lower than current grid emissions, which are not projected by BEIS to catch up until 2041 and are

predicated on the building of nuclear power plants across the UK. HVO therefore can play an immediate role in GHG reduction,

using existing infrastructure.

How to assess efficacy Blank

Cross-party consensus Blank

Policy misalignment Blank

How to raise awareness More information on alternative solutions rather than "banging on" about electricity and hydrogen as the only solutions.

What to do differently Blank

Agenda for CoP Blank

Response	Number 6
Respondent	Anon
Title	
Organisation	
On behalf of	Myself
Sector	Oil & Gas E&P

Risk to that sector Restricting the amount of oil and gas production onshore and offshore the UK and thereby having to rely on imported products and

feedstock with associated transportation and allied carbon footprint that we can otherwise avoid. Also, restrictions of any type on

UK oil and gas production have an impact on security of energy supply and optionality that needs to be weighed.

Opportunity for that sector To gain social licence to produce petroleum which will be needed in any event as the feedstock for so many petrochemical and

related products that society at large will continue to need and demand but which are currently taken for granted.

Barriers from energy policy Lack of support for training younger generations in the earth sciences (primarily geology) which are the very foundation of

understanding and exploiting, in the most efficient and least damaging manner, subsurface natural resources, be they oil, gas,

minerals, water, bulk materials etc.

Key to decarbonising Carbon Capture [Utilisation] Storage ('CC[U]S'). The subsurface knowledge and skills have been available from within the oil and

gas sector for many years and such projects can be 'easy wins' that can be 'up and running' in a very few years. The largest

barrier, to my mind, is the lobby which argues for zero gas production (and hence no source of CO2 to sequestrate) - it needs to be

made abundantly clear that gas production is, on balance, by far and away the best 'bridge' to the Holy Grail of Net Zero.

How to become more active Apart from continuing mechanical incremental improvements and procedural efficiency gains, the most significant decarbonising

efforts currently are in the electrification of equipment on offshore facilities. There are also opportunities to harness energy using

heat exchangers from the water normally produced alongside oil and/or gas. There are also opportunities to use the pressure

gradient step-down from. produced fluids to pipeline pressure to 'drive' equipment.

Focus Government investment Training geologists, engineers and STEM students who will have the skills to innovate over the next 20 to 30 years and improve

on the gains which are now beginning to materialise.

Place-based resources An obvious candidate is local district heating systems, such as exists in Southampton. Support for similar projects in past

industrial centres (eg coal mining areas with heat from water in abandoned mines) or in the SW using natural high subsurface

temperature gradients around the granites. Have a focus on reducing supply chains - for example, all other things being equal,

encourage the production. of oil and gas in onshore areas where the products can be readily delivered to refineries or

petrochemical plants. This displaces imports with a much higher carbon footprint.

Hard to Decarbonise Plastics of all types have become an integral part of modern society. They are difficult to replace, though ingenuity will no doubt

find replacements - particularly for consumer goods - but where they are integral to industrial equipment or infrastructure it is

difficult to see any alternatives for decades.

How to assess efficacy I am a NED of a private UK company which provides independent assessment of oil and gas reserves and resources which is

about to establish a subsidiary company to offer services in carbon auditing. I am aware that this is a devilishly difficult area and

perhaps the government could take a lead in bringing together such companies to be part of the debate on setting standards (if it

doesn't exist already).

Cross-party consensus CC(U)S, encouraging the use of geothermal energy, domestic heat pumps and insulation of dwellings.

Policy misalignment Inadequate government investment in educating the future geoscientists and engineers who will be responsible for 'keeping the

lights on'.

How to raise awareness Establishment of an independent body (if not already in existence) that appraises submissions from manufacturers of the carbon

footprint of their products and the issue of a simple colour coded rating on merchandise - based on probabilistic not deterministic

inputs so using ranges rather than specific values.

What to do differently Within the UK oil and gas sector there is a vast pool of world-leading technical skills that have three destinies. They can be (i)

neglected and abandoned, (ii) re-deployed in some instances to alternative energy sectors (geothermal, wind turbines, CC(U)S), (iii)

aggressively marketed internationally as a skill base that can ensure that the inevitable oil and gas production that developing

country governments will rely on for many years are conducted to the highest possible industry standards - this is a key export

market for the UK.

Re-double efforts to ensure a secure supply chain of Critical Minerals for the UK as electrons rather than molecules come to rule

the world.

Agenda for CoP Establish a directorate to provide foreign aid in the form of advice to foreign governments on holding oil and gas companies to

account for minimising carbon emissions in their E&P activities and establishing methods of carbon auditing in their countries.

Response	Number 7
Respondent	Nicholas Ash
Title	Project Director
Organisation	Crapper and Sons Landfill Ltd
On behalf of	My company
Sector	Waste, Energy and Sustainability

Risk to that sector Ill judged government policy introducing burdens without addressing the key issues and supporting solutions

Opportunity for that sector Support for Sustainable solutions and business

Barriers from energy policy Monopoly of DNO and the costs and delays resulting

Key to decarbonising CO2 scrubbing from flue gases to use in greenhouses, could be done within 3 years lack of capital and funding will be the blocker

How to become more active Sadly only with embedded generation and a private network. Due to lack of flexibility from DNO

Focus Government investment Providing capital at a reasonable cost to industry as commercial lenders are expensive

Place-based resources We have a plan called 2030 to develop local food production housing and employment we are struggling to attract investment.

Hard to Decarbonise Mobile plant, we see Hydrogen as a solution but the plant and supplies are not available.

How to assess efficacy The bench mark should be the exiting carbon solutions. De carbonised solutions should aim to be cheaper to encourage adoption

and global spread.

Cross-party consensus I don't think the UK has a coherent policy only words

Policy misalignment Blank

How to raise awareness I think awareness is high, support for and progress with solutions is required

What to do differently Re focus the economy on new clean localised production

Agenda for CoP Pushing the potential economic benefits to the industrialised world of decarbonation the opportunity of a fresh start

Response	Number 8
Respondent	Kathryn Porter
Title	Consultant
Organisation	Watt-Logic
On behalf of	myself
Sector	Energy

Risk to that sector Heat due to the widespread impact on consumers

Opportunity for that sector Energy as a service, bundling supply with heating, micro generation, V2G etc and optimisation without the need for consumers to

have to manage this for themselves (with 50% of consumers never having switched, expecting them to optimise their own demand

profiles is unrealistic).

Barriers from energy policy Lack of detail and the lack of a credible roadmap to 2050 targets. The white paper was just the 10 point plan in more words - there

was nothing concrete. We're promised yet more plans and strategies over the coming months, but these need to deliver a

meaningful roadmap that does more than rely on technologies that have yet to be invented (CCGT + CCS for example).

Key to decarbonising New nuclear. Stable baseload supply is still needed, but the Government needs to end its reliance on the unproven EPR

technology and diversify new nuclear supplies.

The first step is to get Wylfa Newydd the support needed (I have no connection with the project or developers). ABWR is an

established technology with 2 reactors built on time and on budget in Japan pre-Fukishima. This cannot be said of the EPR where

the two flagship European projects are massively late and hugely over budget, being plagued with technical problems. ABWRs can

be built quickly, and could enter service in under 4 years.

The funding for nuclear in the 10 point plan was inadequate to truly deliver new nuclear solutions - the amounts committed to EVs

should be reduced and applied to nuclear instead.

How to become more active There is a great deal of focus on "how to make consumers be more flexible and de-carbonise). Consumers are busy trying to

survive covid and navigate Brexit - they lack the resources and management capacity to make major changes to their energy

strategies at this time. The question should be re-framed: how can the industry engage with consumers to offer energy services

that promote flexibility and de-carbonisation. Delivering solutions to consumers is more likely to succeed than expecting all

consumers to individually craft their own solutions to a very complex problem.

Focus Government investment The Government needs to be realistic in its goals. Reliance on unproven or yet-to-be developed technologies, or radical consumer

behavioural change is not realistic. The Government should focus the bulk of its investment on proven technologies and

strategies, with seed, innovation funding elsewhere.

Place-based resources In an increasingly de-centralised system, local frameworks will become more important, as local infrastructure will be a key

determinant of success. This will require co-ordination between local government, local network operators, local consumers (large

I&C users and community groups, housing associations etc) and energy suppliers.

A one-size-fits-all approach is unlikely to be successful - regions will need to approach the challenge with reference to their own

local conditions.

There is a challenge around how to reconcile a de-centralised, local approach with the accountability required to achieve national

targets.

Hard to Decarbonise Heating is the most difficult as it will require engagement from all energy consumers. When 50% of domestic consumers have

never switched despite knowing they can, it is clear that most consumers have little or no engagement with the energy sector. In

addition, there are significant challenges around ownership and access, with the majority of people not owning their own freehold,

meaning that structural changes to buildings are not within their control even though they pay for the energy consumed within the

property.

In addition to this, 14% of households are currently in fuel poverty, so there are serious welfare questions around electrification of

heating, when electric heating tends to be less efficient, particularly at colder temperatures, and more expensive. In other words,

people will need more energy at higher prices in order to heat their homes with electricity in the winter. This is likely to push more

people into fuel poverty. It is also relevant to consider that 7.5% of British adults have never used the internet, and 16% of British

adults have poor literacy skills - a large proportion of society will lack the capability to plan for and implement the changes required

in their homes.

The Government intends to reduce the burden on households by encouraging greater use of energy saving measures, however,

caution is needed to ensure these measures deliver what they claim to deliver. Studies have shown two worrying factors:

1. The energy performance of buildings after they are built is often significantly worse (possibly an order of magnitude worse) than

was anticipated in the planning phase - a phenomenon known as the "performance gap".

2. There is poor understanding among building energy modellers of which features of a building will effectively reduce the energy

use of a building.

One of the reasons for these difficulties is the absence of any requirement to test the energy performance of buildings after

construction, meaning that the industry has no means of learning what works and what does not. This is a serious failing, and one

that will have growing legal and political implications if consumers are encouraged to invest in energy saving measures that

eventually fail to deliver the promised savings because they were not the right measures to adopt.

When the Government looks, as it has indicated it intends to, at Building Regulations, there must be a requirement to test the

energy performance of buildings in use, rather than relying on theoretical determinations. The entire EPC process should be

similarly reformed - the energy performance of buildings should be actual and not theoretical, and the condition of buildings must

be taken into account...it is not sufficient to credit the presence of energy-saving measures if they are incorrectly installed or have

degraded over time.

Finally, when looking at the regulations for new buildings, it is important that embodied emissions are not ignored.

How to assess efficacy This is a vital step and for the sake of transparency the costs of de-carbonisation need to be assessed at the national as well as

individual levels. There have already been various attempts to quantify the cost of net-zero to 2050 in absolute terms (National

Grid) and in GDP terms (CCC) but alongside these there needs to be a cost of not de-carbonising (the counter-factual) and the

impact on end-user bills. Consumers should be able to see what bills they will pay in 2050 (in 2020 money) under different decarbonisation

scenarios, and what capital investments they will need to make along the way.

Effectiveness should be measured in terms of national GHG emissions, energy consumption, carbon intensity and embodied

carbon, on an annual basis. These should be at the national level as well as sub-divided by sector and household (eg average

annual energy consumption per household etc)

Political acceptance will be key to de-carbonisation, but obscuring the costs, as has so far been the case, will risk a political

backlash at a point where value delivery is sub-optimal. It is also un-democratic to seek to hide the impact of policy decisions

from voters.

Cross-party consensus There appears to be consensus around a move towards EVs, but care is needed to avoid groupthink, and to carefully assess the

supply chains for batteries in particular. There are various geopolitical (water disputes, scarcity), environmental (pollution from

mining and processing) and ethical (use of child labour) concerns around the extraction and processing of the lithium and cobalt

used in existing EV battery technologies. As more countries push EV strategies, these problems are likely to increase, potentially

to critical levels where the continuing use of these minerals becomes difficult to justify.

In order to avoid a policy reversal along the lines of the diesel reversal, care needs to be taken that these risks are adequately

assessed before major commitments are made to EVs, and specifically those based on lithium-ion batteries, are strongly

incentivised at the policy level.

Policy misalignment Energy supply. Gas and electricity suppliers have been co-opted to deliver a range of social measures as well as collect taxes on

behalf of the Government. This has a number of unintended consequences:

1. The supply business has become highly complex. Customer service suffers as suppliers struggle to develop accurate billing

systems than can accommodate the wide range of applicable charges, some of which change based on customer numbers,

meaning systems require a high degree of complexity and flexibility.

2. Suppliers are able to control decreasing proportions of their costs. A small supplier that cannot access long-term hedging can

only control around 15-20% of its cost base (operating costs) and even here there is little scope for cost reduction when there is

such a wide range of regulatory obligations (eg information provisions). This is anti-competitive, since it is not possible to create

effective competition when market participants have minimal control over their costs. In addition, these operational burdens

contribute to the high rates of attrition among smaller suppliers, reducing competitive choice.

Following the CMA's erroneous claims in 2016 that suppliers were earning £1.4bn in excess profits, the retail price cap was

introduced, yet both smaller as well as larger suppliers report that the cap is damaging both to their businesses and to the industry.

There needs to be a complete revision and re-structuring of the role of energy suppliers. They should be allowed to focus on

energy supply - costs of de-carbonisation and other social programmes should be recovered through general taxation (the polluter

pays argument has some merit but is undermined by the regressive nature of the process, rendering it socially unfair).

There needs to be a new narrative around suppliers - the "greedy suppliers" narrative promoted by Government in recent years

undermines the very initiatives the Government is seeking to promote - why should people accept smart meters from these

"greedy suppliers" or allow them into their homes to install insulation etc?

The delivery of various energy-related programmes should be assigned to market participants that are most qualified to deliver.

Smart meters should be installed by local network operators (DNOs), home improvements such as insulation should be installed

by building contractors, new boilers should be installed by plumbers etc. If energy companies choose to participate in these

markets, that should be their choice, but they should not be required to engage non-energy businesses such as building

contractors in order to deliver on their obligations.

The current system is inefficient: suppliers are forced to engage in too many activities that have little or nothing to do with the

supply of energy. That they often do these things badly further undermines trust in an already un-trusted sector. This is important

since the delivery of domestic flexibility will require consumers to trust suppliers to optimise their energy use. This idea is already

receiving negative press. The relationship between suppliers, Government and consumers needs to be re-set if net-zero goals are

to be delivered.

How to raise awareness Blank

What to do differently Covid has created a significant reduction in personal mobility, something National Grid ESO sees as essential to delivering NetZero

targets. The main reason is the increase in working-from-home and consequent reduction in commuting. Businesses should

be encouraged to look at how WFH can be incorporated into normal working practices after covid restrictions are lifted. WFH is

unlikely to be optimal for all staff at all times, but many organisations could operate a 2/3 days in, 2/3 days out policy.

Public transport companies should similarly be encouraged to introduce flexible season tickets that make commuting on a flexible

basis more cost effective. Lower passenger numbers can facilitate enhanced services such as additional classes of travel, making

commuting more comfortable and potentially more efficient if passengers can work while commuting (this will require upgrades to

the mobile telephony along the rail and tube network).

Digital infrastructure will be a key enabler and should be a focus of investment.

Agenda for CoP Blank

Response	Number 9
Respondent	Brian Matthews
Title	Managing Director
Organisation	TerraUrsa
On behalf of	My company
Sector	Energy

Risk to that sector The lack of public knowledge and understanding. I've undertook and observed climate jury's and the basic knowledge is really low. To

then talk about CCUS, hydrogen and nuclear with the public is near impossible. We need to radically change the school curriculum on

climate change and energy to ensure people can make informed choices.

Opportunity for that sector Technology leaders, jobs (in the UK and exportable) and policy to support that change, allowing others to replicate it.

Barriers from energy policy a cross industry acceptance of a board energy mix and how it all works together to support increased demand while being low carbon.

Key to decarbonising We must start with Education. We must agree on how to compare technologies, LCOE doesn't work. We need to understand how to be

below 100gCO2eq/KWh by 2030 then and realize that none (except SZB) of the current operating plant will be generating in 2050

and what that challenge looks like.

How to become more active Give them options, provide incentives (along with that of decarbonisation)

Focus Government investment Funding mechanism around clear policy. Allow a little more risk taking with advanced tech. Generation strong international

partnerships.

Place-based resources Budgets and legally binding goals.

Hard to Decarbonise Heat much hard than power or transport. 29 millions homes need something doing to them. With everyone needing to commit and

change.

How to assess efficacy Domestically its critical and worked well with a significant drop in energy demand as a result. Do this best we can, accept some house

can't be improved but could be prioritized to be electrically or hydrogen heated.

Cross-party consensus White paper to an energy bill that all agree on, using select committees supported by experts.

Policy misalignment Energy demand increase and capacity increase (new generation assets)

How to raise awareness Schools - start very young. Then we need to do something with adults, lots of learning from Covid, most people in the UK now know

more about pandemics and vaccines than we could have imagined. If climate change is an emergency we could use the same logic of

information sharing.

What to do differently Education, upskilling for a green future.

Agenda for CoP Fossil fuel commitment, when we will all stop using them. then a commitment from the advanced countries to help the others. Nuclear

in Africa etc.

Response	Number 10
Respondent	Professor Peter Styring
Title	0
Organisation	Sheffield University
On behalf of	myself
Sector	R&D Network for CO2 Utilisation

Risk to that sector The risk is negative reaction to utilisation, caused mainly by mis-information.

Opportunity for that sector Providing a Circular Carbon Economy where emissions cease to be a waste and become a chemical feedstock.

Barriers from energy policy Too much reliance on storage of CO2 as the only solution. The perpetuation of fossil carbon use in a linear economy through extraction, use/combustion/landfill (CCS) means that we will still be reliant on fossil resources for a considerable time. We should not be thinking of decarbonisation of the economy (as we will always need carbon), but DEFOSSILISING the economy through carbon reuse.

Key to decarbonising The key to defossilsation is the transition away from using fossil resources. We need carbon, but we need to avoid using virgin fossil carbon. The key is a well-managed transition over 10-20 years.

How to become more active We need to look at consequential impacts of defossilising, not siloing the activity. The move from SIV/CIV vehicles to EVs will not decarbonise; it will simply shift the emissions to low socioeconomic areas (around power stations) until we have 100% low carbon energy options. CCU will provide a route to synthetic fuels for example, reducing tailpipe emissions (and tailpipe emissions) while also increasing reliance on carbon-burning power stations. There needs to be better coordination. We bring together academia, industry, policy makers and finance to provide a wholistic approach. Policy push combined with industry pull. CCU will provide income generation opportunities while CCS will be a taxation that results in profit loss. Like many things in life and industry, both will be needed as neither can work in isolation.

Focus Government investment Investing in technologies that can increase the UK economy rather than imposing a burden. Delayed deployment through policy change and lack of investment, public and private is a potential barrier.

Place-based resources It is importance that life cycle and techno-economic approaches are applied so that positive impacts do not lead to unintended negative consequences. There needs to be a national plan that is aware of regional differences. Clean Air Zones are an example where it is a "sheep-led" approach: we will do it because others are doing it! CAZ approaches typically tax-locally but the income is focused nationally.

Hard to Decarbonise Aviation, maritime and HGV. Electrification will not work and so synthetic fuels from CO2 or other wastes represent the way forward: this is already been done in other nations through companies like LanzaTech and Neste.

How to assess efficacy Scope 3 lifecycle analysis and social LCA. We need to be doing it because it has benefits across the WHOLE of the economy, society and environment.

Cross-party consensus Linking government departments in deployment. CCUS should be led by DEFRA to emphasise the environment. Alignment with BEIS gives the impression it in business/economically driven. The removal of DECC has a big error as it lost the focus of the need. There should be cross-party agreement and common targets and deliverables.

PGES 40th Anniversary Inquiry into Energy Policy APPENDIX III Full listing of responses as received

Policy misalignment Electrification of transport and a reliance on CCS: timescales at present are highly optimistic and current parliamentary cycles do not give confidence in accountability: it is here that a cross-parliamentary approach is important

How to raise awareness Transparent, science and engineering-led policy with increase media briefings. The establishment of a SAGE-like structure of experts to evaluate policy, economy and technology.

What to do differently Address transport emission lifecycle and a work from home policy (balance between transport emissions and heating/technology-related emissions. Look towards developing a transition away from a linear, fossil-led economy to a circular, waste-led economy.

Agenda for CoP Sustainable long-haul, maritime and aviation fuel development in the next 10 years. This was considered at COP 22 in Marrakech but has progressed slowly since: mainly driven by countries outside the UK (Scandinavia, US, Germany. The establishment of a Dep

Response	Number 11
Respondent	Anon
Title	
Organisation	
On behalf of	myself
Sector	Blank

Risk to that sector Regulation.

Opportunity for that sector Availability of appropriate technology. Cost effective commitment.

Barriers from energy policy Public acceptability.

Key to decarbonising Inconsistency.

How to become more active A sense of urgency in the minds of all. This is needed immediately.

Focus Government investment They need the right technology to enable non-carbon energy to be provided accessibly and with low weight of the on-board equipment.

Place-based resources Developing clean or cleaner aviation fuels.

Hard to Decarbonise Organisations with influence should lead by example towards net zero, showing and demonstrating publicly their clear actions in pursuit of the target.

How to assess efficacy Aviation. It is essential, particularly to international trade in both goods and services.

Cross-party consensus Don't know.

Policy misalignment Don't know.

How to raise awareness Don't know.

What to do differently A concerted, short and long term publicity campaign. Identify and publicise the wins. Keep people's interest and commitment by fresh but consistent messaging. Obtain all party commitment, with a well publicised, adult, non-points scoring approach by all. Have strong, involving and consistent messaging in schools and higher education, from early years onwards. Make good climate related behaviour the norm in the hearts and minds of upcoming generations.

Agenda for CoP In terms of formal focus my main interest in energy futures is around the decarbonisation goals that will give aviation and aerospace â€˜licence to growâ€™ in the future and (better) reflect political and social attitudes about being a responsible corpora

Response	Number 12
Respondent	Claire Ackroyd and Arthur Le Geyt
Title	Senior Economic Analyst / Economic Analyst
Organisation	South East Midlands Local Enterprise Partnership (SEMLEP)
On behalf of	my sector
Sector	N/A: as a LEP, we represent the interests of businesses, local authorities and other stakeholders in our area (Northamptonshire, Bedfordshire and Milton Keynes) across all sectors. Opinions included here reflect feedback gathered during our conversations

Risk to that sector We have found that decarbonisation can be difficult for businesses operating on leased premises, as they face barriers to modifying their premises to become more energy efficient or low carbon. However, across all sectors, the key risk to decarbonisation is a lack of grid capacity to enable the shift towards electric powered, low carbon technologies, such as EVs and heat pumps. Grid constraints can also act as a barrier to low carbon distributed generation in some instances.

Opportunity for that sector The South East Midlands area has significant expertise and assets in the development of Future of Mobility technologies, including both electric and hydrogen powered transport (across cars, HGVs and aviation). As a result, the key opportunity is the ability of the area to develop and commercialise low carbon transport solutions, and enable them to become more widely available and affordable.

Barriers from energy policy The elements of energy regulation which prevent non-speculative investment in distribution network infrastructure ahead of need, which constrains low carbon development in certain instances. Linked to this, policy could be clearer regarding the use of flexible capacity trading schemes through battery storage, as well as policy pertaining to the relationship between distributed generation and the national grid, to give businesses and individuals more confidence to use these schemes and relieve capacity constraints.

Key to decarbonising All local authorities in the SEMLEP area have committed to achieving net zero carbon by 2050, with some setting targets much earlier than this. While relevant technologies are already being deployed in the area, we expect the deployment of decarbonisation technology to accelerate as this end date draws closer, in response to technological improvements, changes in consumer behaviour, and the introduction of new policies, such as banning the sale of new petrol and diesel cars by 2030.

- effect of their deployment? An increase in electricity demand, coupled with an increase in local low carbon generation and storage and smarter energy use. We also anticipate greater uptake of electric and hydrogen vehicles, in response to more widely available fuelling and recharging infrastructure.

- barriers to their deployment? Perceived consumer risk around new technologies/ technologies being quickly outdated; regulatory barriers to developing active buildings and distribution network upgrades; insufficient financial resources to invest in requisite infrastructure; uncertainty over future government policy/ which sectors and technologies will be subsidised.

- costs of deployment? Varies by technology, although important to be aware that individuals and businesses may be less willing to invest in the short term due to expectations that costs of deployment may decrease as technology improves. There are also issues around relevant technologies often involving high upfront costs, while savings take a long time to be realised (so schemes that can smooth out costs and benefits over time would be beneficial).

How to become more active Clear and robust regulation, and effective communication of the benefits of flexible power schemes. Policies that reach/ incentivise the owners of commercial premises (often not the same as the businesses residing within them).

Focus Government investment Supporting innovative R&D; subsidising emergent low-carbon technologies; funding low-carbon infrastructure; providing schemes to smooth costs and benefits for businesses investing in low-carbon technologies

Place-based resources LEPs, in partnership with local energy hubs and local authorities, can play a key role in promoting and signposting businesses to funding opportunities and information on how to decarbonise their business and develop distributed generation projects.

Hard to Decarbonise The decarbonisation of buildings, via energy efficient retrofit, is one of the most challenging areas of decarbonisation, due to the cost, scale and complexity of ensuring high quality work is completed on properties, particularly for businesses which lease their premises. This work will be essential, and is dependant on ensuring a good quality supply chain and funding stream is available.

How to assess efficacy A combination of well regulated TrustMarks and other technology quality guarantees, specialised financial products for distributed generation and battery storage, and effective communication of the benefits of investing in low carbon technology and flexible capacity trading (lower energy bills, revenue streams from flexible power schemes etc.)

Cross-party consensus Blank

Policy misalignment Blank

How to raise awareness In our view awareness is already high; what is really needed locally are practical solutions and/or funding for businesses to implement energy efficiency measures.

What to do differently To make access to low carbon grants and finance, for both investment and innovation, more widely available and plentiful, in order to address the scale of the issue and deliver against existing low carbon policies.

Agenda for CoP Blank

Response	Number 13
Respondent	Michael McLaughlin
Title	External Affairs Manager
Organisation	National Grid ESO
On behalf of	My company
Sector	Electricity Transmission

Risk to that sector There are a number of challenges to delivering net-zero, all of which are equally important. To manage a more diverse and decentralised grid we need new markets and services to support grid management and to create the financial incentives to drive innovation to market in a number of technologies. As we move away from gas power stations we need to improve grid flexibility to ensure electricity can get to where its needed at all times. Decarbonisation needs to have accessible incentives for consumers to use energy flexibly, improving data & digital technologies is key to unlocking this.

Opportunity for that sector As the leading decarbonisation sector the energy sector is now uniquely positioned to deliver net-zero. The successful adoption of renewable and low carbon energy sources will allow the UK to transition to zero-carbon operation of various other sectors through electrification. CCUS and Hydrogen will be critical to fully decarbonising the electricity sector, but will also allow the electricity sector to produce negative emissions, supporting the overall decarbonisation of the UK economy and reducing the work needed by harder to decarbonise sectors.

Barriers from energy policy The energy system of the future will need to be smart and highly integrated, by 2050 trillions of pieces of data will be required to run the energy system. Smart technology and open data are essential for market access for local and community renewables plus an interactive demand side through electric vehicles and energy storage - enabling them to participate in local and national markets for energy and flexibility. The recommendations of the Energy Data Taskforce provide a clear roadmap and should be progressed. Coordination between the energy and telecommunications sectors is also needed to support the greater digitalisation of energy, by ensuring the necessary infrastructure is available.

Key to decarbonising The ESO's Future Energy Scenarios clearly show that negative emissions technology needs to be delivered by 2030Policy support will be required to support the deployment of CCUS & Hydrogen, as market signals do not currently provide strong enough investment signals to scale the technology at the pace required. Improvements to smart meters and smart charging however need to be delivered within the next decade to ensure efficiencies are maintained. The complexity of energy system decisions is increasing. Transparent and advanced analysis is critical in making the best decisions for energy consumers. effect of their deployment? Negative emissions are crucial to achieving net-zero as they will allow the energy sector to exceed its decarbonisation requirements, which could support the overall decarbonisation of the economy by taking up the slack from sectors that are harder to decarbonise. Smart technology and metering will allow users to become more flexible which will support the operation of the network through lulls or oversupply periods of renewable generation. Deploying these solutions will support reduced balancing costs reducing consumer bills.

• barriers to their deployment? Negative emissions technologies still require support in their development, including potentially through government policy support. The digitalisation of the energy sector requires a number of issues to be resolved. The smart meter rollout needs to be delivered successfully at pace, alongside the introduction of time of use tariffs to incentivise more flexible electricity use. Consumer education is needed, as well as more aggregator

services to help consumers benefit from the price signals they receive from smart meters. By 2050 this could deliver significant savings to both consumers and grid operators, through the use of smart EV charging.

• costs of deployment? The cost of deploying these technologies in 2019 prices only gives us a glimpse of their costs, as technological advances mean these are likely to change over the next three decades. Negative emissions technologies will help to reduce the overall cost of decarbonisation under all four of National Grid ESO's Future Energy Scenarios as they will help to reduce the cost of decarbonising other sectors.

How to become more active Blank

Focus Government investment As stated in previous answers negative emissions technologies such as CCUS, BECCS and hydrogen production need to be supported to help these technologies reach full development. Decarbonising some sectors, such as heating may require similar policy approaches to the introduction of renewables. To support the uptake of heat pumps over existing natural gas boilers, the Government may need to absorb some of the upfront costs to incentivise the adoption of this currently more expensive technology. Energy Efficiency must continue to be supported as a no-regrets action as it is a force multiplier for the successful decarbonisation of heating.

Place-based resources Local and regional resources are critical to the delivery of heat decarbonisation as recognised by the UK Government's plans for local authority zoning and the Scottish Government's plan for Local Heat and Energy Efficiency Strategies demonstrate. Decarbonising heat is a unique challenge as we know a single solution will not provide a uniform benefit, given the diverse nature of UK housing stock. Whilst decarbonisation poses a challenge to jobs in the oil and gas industry there are potential opportunities for Hydrogen clusters to support the transition of these jobs which will protect those local economies.

Hard to Decarbonise At present the hardest sectors to decarbonise are Aviation, Agriculture, Maritime as well as some industrial processes. The use of negative emissions technology in the energy sector can reduce the burden of reaching net-zero in these sectors. Societal changes may also over time reduce the damage caused by the emissions from these sectors, for instance fewer people choosing to fly will reduce aviation

emissions. Decarbonisation of Heat is the next great challenge for the energy sector, the Government's 2021 Heat & Building Strategy will hopefully provide the necessary roadmap for delivery over the coming decade.

How to assess efficacy Reaching net-zero will require significant investment over the next three decades, however as the Committee for Climate Change have pointed out in their 6th Carbon Budget papers, the significant benefits associated with reaching net-zero mean that costs will likely be outweighed by the benefits. In terms of the ESO's Future Energy Scenarios we also know that the costs of reaching net-zero in the energy sector are likely to be similar to the costs of not reaching this target, meaning that costs should no longer be considered a significant driver for decarbonisation.

Cross-party consensus The implementation of Electric Vehicles and the required network infrastructure at a national and local level. The development of "green" hydrogen, produced from renewables to support the decarbonisation of heat and the further decarbonisation of the energy sector, including for storage. The importance of improved energy efficiency standards to support the decarbonisation of heat and to reduce energy consumption.

Policy misalignment Whilst negative emissions technologies don't necessarily pose an issue between parties there is a debate as to the merits of allowing harder to decarbonise sectors to be bailed out by the use of negative emissions technologies in the energy sector.

How to raise awareness Regional and local heat decarbonisation strategies need to use some form of consultation or public information campaign to ensure that local residents are aware of the heating solutions that are under consideration and that are deliverable in their home. As we move towards time of use tariffs there needs to be a broader education strategy to ensure that consumers understand this change. Consumers should not be expected to actively shift their energy use, instead they should be made aware of affordable, possibly subsidised, aggregator services and storage options to move their demand for them.

What to do differently Many organisations including the ESO have called for a "Green Recovery" post COVID-19 pandemic to ensure that the delivery of net-zero is not postponed as a result of this crisis. The Energy White Paper outlines a number of areas where the UK needs to take decisive action this decade to put the country on course for net-zero by 2050, covering Energy Efficiency, infrastructure & technology development etc. There needs to be sustained momentum over the next twelve months to deliver the policy roadmaps and legislation to support the implementation at pace of these recommendations.

Agenda for CoP Blank

Response Number 14

Respondent Andrew Robinson

Title Business development manager

Organisation Dunphy Combustion Ltd

On behalf of My company

Sector Thermal energy generation burners using combustion equipment for the steam, water, air and process including food, thermal oxidisation, laundry, sterilisation etc.

Risk to that sector A lack of other suitable alternative fuels from a carbon (low carbon or alternative) base including the generation and distribution of these fuels

Opportunity for that sector Very large thermal energy uses and therefore large reductions in Carbon Released to atmosphere

Barriers from energy policy New low carbon fuels including generation, storage and distribution. Also the cost and issues associated with the upgrading of the thermal energy equipment (furnaces, boilers etc.) for businesses especially in the current financial conditions

Key to decarbonising This is a long time scale (2-3 years), even with a new fuel noted, as these become available there needs to be new boilers and combustion equipment, regulations and site evaluation to installation for these new unproven products

How are they deployed to sites that are needing a constant availability of 1mW per hour for possibly 8000 hours per year at a constant quality

Storage and distribution at large volumes. Sites have large capacity natural gas pipeline supplies or fuel oil storage and distribution and to change this infrastructure is a risk and large costs and very difficult to change attitudes in the short time period we have. Even considering 10 years is a short time period.

VERY large for the vast majority of sites. The cost of the combustion equipment is small compared to the distribution costs and risk considerations, that does have a cost, for a suitable, constant and available fuel.

How to become more active Able to design and manufacture new equipment for the environment and provide a Rochdale based R&D plus demonstration location

Focus Government investment In the support of the suitable new fuels for the environment plus how the fuels are to be generated, distributed and regulated. Plus ensuring that companies are made aware that the need to change to a new low carbon environment is critical for the company, county and world environment.

Place-based resources Not sure this is suitable or available for the environment we are working within as it needs to be a large scale consideration

Hard to Decarbonise The volumes of fuels required to be distributed or be able to be stored for the sites we operate in allowing for a 1mW boiler operating on Natural Gas is 116m3/hr or on fuel oil 110L/hr consumption. Allowing for up to 8000 hours operation this then requires large amounts of energy and the average range of combustion equipment we work with is between 1mW to 6mW per hour on a constant use.

How to assess efficacy This is a much larger question to answer than in this document. This has to be a large consideration allowing for all aspects of the life cycle. There should not be a consideration such as biomass grown in Canada for example and then burnt at Drax and considered carbon neutral, this is only up for ridicule

Cross-party consensus I see none in reality, though we must consider that the suitable generation of electrical power and using this in a suitable manner as a very strong future, though there needs to be more localised generation and use of local generation to remove the large distribution losses

Policy misalignment Hydrogen I see as a great prospect though large considerations for the generation of the fuel (large power requirements) distribution of the fuel, suitable regulations and upgrading of equipment for the use of this fuel

How to raise awareness This is marketing and I am no specialist in this field. Though large government institutions such as hospitals and public buildings need to incorporate the use of the new fuels and then be used as an example for the energy and climate improvements that are to be made and then "Shame" large organisations to do the right thing and not use excuses and allow them to pass the blame.

What to do differently No different to what should have been in place in the first place. Provide an example to the world, we started the industrial revolution and we need to take it to the next level. There is business and profit to be made and we need to be at the front and not following. I see no other reason for China to be doing what they are doing other than for these reasons.

Agenda for CoP The importance of local renewable energy and how this is used efficiently and effectively.

Response	Number 15
Respondent	Hari Prabu
Title	Senior Public Affairs Advisor
Organisation	Thames Water
On behalf of	My company
Sector	Water

Risk to that sector The key challenge for us is to find ways to reduce our carbon emissions in energy-intensive areas of our operations such as water and sewage treatment processes. The energy spent in these processes is vital to support good public health, through ensuring drinking water quality, as well as the health of the rivers the public and environment rely on.

We can use the by-products of sewage treatment as carbon-offsets and as a source of renewable energy. For example, biosolids from sewage sludge can be used to displace fertiliser use, which is a high-carbon product. In 2019, when 325,000 tonnes of biosolids were used in the UK, 45,825 tonnes of CO2 were offset. Moreover, heat can be recovered from wastewater to heat homes, and biogas from sewage sludge can be converted into biomethane for injection into the gas grid.

We are looking to pilot the recovery of operational heat from Hogsmill sewage treatment works in London to supply homes and other major heat users in the local community, in partnership with Kingston Borough Council. This project has the potential save 18 GWh a year in energy, preventing 16.5 kilotons of carbon dioxide emissions over 30 years. After its first 15 years of operation, it would result in an 80% reduction in emissions from the buildings supplied compared to their estimated fossil fuel usage.

These reductions will not only help us achieve our net zero target but also support Kingston Borough Council with whom we will share the offset emissions with. It represents the single biggest lever available to them to reduce cardon emissions. We would welcome the opportunity to show APPG members around the Hogsmill site when possible again after COVID-19 restrictions are lifted.

Opportunity for that sector We rely on the natural environment and have a responsibility to protect it from our operational impact. By decarbonising, we can ensure the long-term resilience of our services in the face of increasing demand due to population growth. We've committed to reduce the carbon emissions from our operations to net zero by 2030 and then to go beyond net zero by 2040. We can not only set a world-leading example in the UK but also support other companies to decarbonise by creating and selling carbon offsets to them, and producing renewable energy for the grid.

Barriers from energy policy DEFRA and BEIS do not currently recognise the offsetting impact of selling biosolids as fertiliser, which is already underway, or transferring recovered heat to homes. Both of these activities prevent significant emissions, but the carbon savings require departmental approval to be counted towards

the government's net zero target. Approval would highlight the importance of the circular economy for the UK's net zero strategy and provide support for further carbon offset initiatives at Thames Water and across the economy.

For the conversion of biogas to biomethane to be viable, the eligibility criteria of the Green Gas Support Scheme (GGSS) must be expanded. Currently, existing anaerobic digestion plants are ineligible for the Scheme's subsidised tariffs for the sale of gas to the grid. We would be unable to meet the £150+ million cost of retrofitting our anaerobic

digesters to produce biomethane without access to these tariffs. This would be a missed opportunity as the water sector could meet three-quarters of the Scheme's target of 21.6 megatons of carbon savings over its lifetime.

We are engaging with Ofwat and other stakeholders to realise our full renewable energy potential through these initiatives and others such as PV panel expansion, onshore wind and energy storage.

Key to decarbonising Blank

How to become more active Blank

Focus Government investment Blank

Place-based resources Blank

Hard to Decarbonise Blank

How to assess efficacy We believe that decarbonisation should be assessed on an ongoing, year by year basis. This way we can evaluate which initiatives are making the greatest difference to emissions reduction and decide where further investment can most effectively be made. We will continue to evaluate the initiatives that we have in place and adapt them to increase decarbonisation where possible. In doing so, we will look at how we can reduce both our embodied emissions (emissions from construction) and our ongoing operational emissions, as well as considering the cost of initiatives.

Cross-party consensus Blank

Policy misalignment Blank

How to raise awareness Blank

What to do differently Blank

Agenda for CoP We would like to see the UK use its position as COP host to lead the discussion on how the public and private sectors can work effectively together to meet targets on emissions reduction. For example, we can accelerate decarbonisation of the natural gas g

Response	Number 16
Respondent	Dr Theodore Holton
Title	Director
Organisation	Green Hydrogen Consulting Ltd
On behalf of	My company
Sector	Renewable energy

Risk to that sector The key risks and burdens are not those that are sector specific but those that affect everyone in the world. Here in the UK we must find a way to harness our abundant natural wind energy resources in a sustainable way which means that we need large scale wind energy storage which will supply the energy needs of UK for many days or even some weeks without significant wind blowing (due to natural weather variations).

Opportunity for that sector · Renewable Energy offers the UK an opportunity to harvest almost limitless wealth in a sustainable way – with adequate green hydrogen production using electrolysis and corresponding green hydrogen storage, best combined also with large scale pumped hydro energy storage to handle electrical energy storage, we can capture our bad weather and use it for societal needs and indeed we can export to the whole world our bad weather in the form of 100% sustainable zero emission green hydrogen transport fuel. Renewable energy is delivered to us for free and pure renewables can fully power all our needs including electricity, transport, heat, including agriculture and industry. The Renewable Energy sector will also create jobs in other sectors such as a major national construction programme of pumped hydro energy storage dams and reservoirs, balanced and reasonable planning which recognises that we can and must do this, and by provision of cheap reliable power and heat to industry and domestic consumers.

Barriers from energy policy In the past there has been plenty of welcome support for battery electric vehicles (BEV) which is all good and a welcome part of the picture but this has sorely neglected green hydrogen fuel cell electric vehicles (FCEV). We need at least equal "charging infrastructure" to be available for green hydrogen vehicles by opening green hydrogen filling stations across all major population centres and encouraging green hydrogen vehicles. We can do this via government supported fleets and bus services with filling stations for those vehicles also open to the public and businesses. The biggest thing that is holding all of us back is the lack of understanding or lack of action regarding the need for pumped hydro energy storage. There has been an idiotic rush to deploy stationary lithium batteries for renewable energy storage at wind farms and solar farms but this is absurd because of the high cost and lack of scale which is a fart in the ocean of energy storage need. Only pumped hydro and green hydrogen can offer the necessary scale for national energy storage in a sustainable way. Another major policy mistake is the influence of the carbon capture (fossil fuel) lobby in hoodwinking some members of the government and public that CCS (carbon capture and storage) is anything but an experimental technology which experiments so far do not offer sufficient evidence that CCS can be economic or sustainable – CCS is just a misleading excuse that we can continue burning fossil fuel and everything will be okay. Regards government policy lets be serious – we must use tried and tested reliable sustainable cheap-for-the-consumer green jobs creating renewable energy with national scale renewable energy storage (ie pumped hydro and 100% pure green hydrogen pipelines), not mythical wishful thinking of fossil fuel vested interests, and NOT mixing pure green hydrogen with polluting fossil fuel gas pipelines which has the serious disadvantage of rendering the hydrogen impure and unrecoverable for fuel cells as in hydrogen buses and cars. The cheapest method of green hydrogen gas delivery to customer is via pure green hydrogen pipeline. It can also be exported by ship.

Key to decarbonising • What is the timescale for deployment? (a) Pumped hydro energy storage has a long life but a fairly long planning and construction time of around 5 years – I suggest a national pumped hydro

construction programme could be undertaken over 10-20 years; (b) Green hydrogen electrolyser production capacity is a limiting factor for green hydrogen rollout to national energy storage scale but Sheffield-based world leader ITM Power have shown they can scale up production through their Gigafactory so I suggest this problem can be solved by green manufacturing jobs. The green hydrogen gas delivery to customer centres can be solved by pure green hydrogen pipelines, either in parallel or sector-by-sector replacement of existing natural gas grid – this would be the main time consumer taking 10-20 years of green jobs beneficial human effort across the UK whilst green hydrogen refuelling stations could be deployed in 2-5 years across the whole of the UK, and then we can ask about green hydrogen fuel cell vehicle availability at affordable prices but companies such as Toyota(Japan)/Hyundai(Korea) already expressed willingness so perhaps this could be an opportunity within the UK-Japan international trade deal, or others.

- effect of their deployment? The effect will be to create massive new employment opportunities whilst simultaneously eliminating carbon emissions, and delivering cheap sustainable locally/UK generated energy.

- barriers to their deployment? Stupidity and/or the fossil fuel vested interests who do not want us to move onward would be the main barriers.

- costs of deployment? (a) Pumped hydro reversible pump-turbines may certainly be obtained for around £500m per GigaWatt capacity. Considering that the UK total energy needs could be around 100 GW then one might surmise that pumped hydro capacity capable to deliver all of UK needs could be bought for £50 billion (maybe we can manufacture them here too – don't you think UK history includes manufacture of turbines and pumps?). Obviously it would be built over a substantial timescale (10-20 years) so not all the money is needed at once. The capital cost of reservoir and dam construction to match depends very sensitively on the locations used but given large scale good design this will certainly be economically viable. I would suggest an auction process for the UK's celebrated construction companies, planners and developers to compete within. (b) Cost of electrolyser per GW maybe presently a bit more than pumped hydro (please lets just do both), and manufacturing capacity needs ramping up – please contact the UK electrolyser world leaders ITM Power plc based in Sheffield in order to establish the cost at scale of 100 GW.

How to become more active This is a costly illogical diversion. We have free naturally delivered renewable energy in our bad weather. Why should UK consumers limit or control their behaviour in order to avoid burning fossil fuel. Just stop burning fossil fuel and deliver only renewable energy whenever it is needed and the consumer need not have their activities limited. What kind of fool buys lithium batteries for stationary energy storage when one can have pumped hydro energy storage at one hundredth of the price. Lithium batteries are fine for mobile phones and battery electric cars used for their true purpose which is transport.

Focus Government investment Incentivise cheap-for-the-consumer local long life large scale zero emission green-jobs-creating pumped hydro energy storage for handling UK-scale energy storage for many days or weeks of low wind power. Grid scale energy storage also offers better utilisation of existing grid infrastructure and eliminate unnecessary upgrades, whilst providing grid stability through numerous grid ancillary services such as operating reserve, frequency control, etc. Similarly incentivising green hydrogen energy storage is key for transport. The problem is not lack of renewable energy but lack of energy storage!

Place-based resources Blank

Hard to Decarbonise No areas are hard to decarbonise.

How to assess efficacy Blank

Cross-party consensus Blank

Policy misalignment Blank

How to raise awareness Just set up the auctions for a massive transformation programme involving action instead of jabbering. Everyone who needs to and isn't already informed will very quickly get informed.

What to do differently Set up auctions to arrange the construction initially 10 GW of pumped hydro renewable energy storage with 168 hours duration (1680 GWh energy capacity) by 2030. Set up auctions to install 10 GW of electrolyser capacity installed within wind and solar farms by 2030. Require major transport fleets and other applications provide long term consumers of this green hydrogen.

Agenda for CoP Ensure green hydrogen transport for visitors shuttling to Glasgow hotels, maybe the nearby Whitelee wind farm visitor centre. Announce the above auction programmes for pumped hydro and green hydrogen multi-GW development. Ask President Joe Biden if he wil

Response	Number 17
Respondent	Josh Newbury
Title	Senior Parliamentary Officer
Organisation	Energy and Utilities Alliance
On behalf of	My company
Sector	We operate in the energy industry, historically and primarily the gas industry, with the majority of our members being involved with the manufacturing, installation and maintenance of heat appliances, both domestic and commercial. Our members also have op

Risk to that sector When it comes to the decarbonisation of heat, the main potential burden is disruption to consumers and, linked to this, the main risk is therefore a lack of acceptance of low carbon heating technologies and participation in the journey to net zero. Consumers need to be empowered to make informed decisions on which technologies are right for their home and lifestyle, including a decarbonised hydrogen gas grid for the >85% of on-grid homes.

Opportunity for that sector Our sector, and by extension the Government, has an opportunity to ensure the UK becomes a world leader in a number of the low carbon heating technologies of the future, particularly in the production, storage, transmission and usage of hydrogen and in carbon capture, storage and usage. In doing so, we can safeguard the jobs and expertise in our gas industry and create sustainable jobs rather than seeing them move abroad as low carbon heating appliances are increasingly manufactured on the continent.

Barriers from energy policy Holding our industry back is uncertainty over the Government's position on the long term energy landscape in the UK and how they envisage the decarbonisation of our existing housing and commercial building stock. In recent months, this has been somewhat alleviated with positive signals of support for advancing the development of hydrogen for heat in the Government's Energy White Paper but there is still talk in the media of boilers being 'banned' which is alarmist and unhelpful messaging for consumers who have a generally low awareness of the need to decarbonise heating and of the technologies which could achieve that.

Key to decarbonising We believe that a gas grid decarbonised by the gradual replacement of methane with hydrogen will be key to decarbonising heat. This will utilise the major national infrastructure asset of our gas grid, which has almost been made suitable for transporting hydrogen through the iron mains replacement programme. Key to the transition from methane to hydrogen will be minimising disruption for consumers and enabling them to continue to use appliances which are familiar to, and preferred by, them. The Government have set a target for 5GW of low carbon hydrogen to be produced annually by 2030 and by 2025 it is hoped that hydrogen will be trialled in a village with the first town heated by hydrogen targeted for the end of the decade. We are calling for new standards to be introduced which will require all new boilers installed from the middle of this decade to be 'hydrogen-ready' i.e. able to be converted from running on methane to hydrogen simply and affordably with a change of a few components. Decarbonising our gas grid with hydrogen could make an enormous contribution to tackling emissions from heating as well as heavy vehicles and some industrial processes. Studies have shown than even blending hydrogen into our methane gas grid up to 20% of volume, which a trial is showing would be safe and have no impact on existing appliances, would cut CO2 emissions by 6 million tonnes a year, the equivalent of taking 2.5 million petrol and diesel cars off our roads. As previously mentioned, a hydrogen economy would also create and safeguard skilled, well paid jobs in a critical sector. Many of the barriers to deployment of hydrogen at scale are being addressed through various work programmes between Government, the industry and third party consultants. These include setting technical standards, developing appliances and carrying out real world trials. A key question to be addressed is how processes that produce hydrogen in a low carbon way can be scaled up and made commercially

viable; this includes both 'blue' hydrogen produced from steam methane reformation of natural gas and 'green' hydrogen produced by electrolysis using renewable electricity. As so many aspects of our future transition to low carbon heating still need to be resolved, it is difficult to estimate the total cost of transitioning from methane to hydrogen. Once production is scaled up, supply chains are developed and demand is growing, there may be only small differences in the direct costs to consumers. For example, boiler manufacturers are confident that pure hydrogen boilers could be sold at a very similar price to natural gas boilers if the market is allowed to mature and develop.

How to become more active Blank

Focus Government investment The Government setting a clear policy direction and a roadmap to the development of a hydrogen economy will be a vital first step. Subsequent to this, public investment in innovation and the development of hydrogen production and carbon capture and storage will help to kick-start the scaling up and commercialisation we will need for these technologies. Investment in leveraging excess renewable energy for electrolysis as a form of energy storage is also an area in which the Government could play a key role.

Place-based resources When it comes to decarbonising heat, local authorities could play a major role in shaping the future energy landscape for their area. Several councils are already doing work to demonstrate how their area could be converted to hydrogen; Leeds City Council, for example, have been a key player in the H21 Leeds City Gate project which has established that switching Leeds to 100% hydrogen was both technically feasible and could be delivered at a reasonable cost. The Government should seek to harness the expertise of local authorities to ensure the right solutions for each part of the UK are found.

Hard to Decarbonise In terms of the areas in which our members operate, heavy goods vehicles are particularly difficult to decarbonise as electrified alternatives to diesel are not viable, particularly for weight-sensitive sectors such as haulage. Battery electric HGVs would be far too heavy and charging times could impact businesses whilst overhead cables on major roads would be disruptive and expensive to install. HGVs can be, and are being, decarbonised with gas fuels such as LNG and CNG. Renewable CNG produced from wastes, such as food waste and manure, can deliver demonstrable CO2 savings of 84% compared to diesel with the latest fuels being carbon neutral.

How to assess efficacy Aside from the obvious quantitate metrics of emissions reductions delivered compared to costs, we believe that one key measure which is, so far, being largely overlooked in the debate around decarbonisation is disruption to consumers. Retrofitting certain low carbon heating appliances, such as heat pumps, into existing properties would carry an average cost of £26,000 according to a report for the CCC and could entail significant, disruptive in-home modifications. The willingness of consumers to high costs and disruption should be taken into account when weighing up pathways to net zero heating.

Cross-party consensus There is certainly cross-party agreement on the need to decarbonise the way we heat our homes and buildings and to upgrade their energy efficiency. There is also a significant political consensus forming around hydrogen being the primary heating fuel for the future. As previously mentioned, the Government are making positive statements around ambitions for the UK to become a world leader in, and exporter of, hydrogen technologies. At the same time, some of the UK's largest trade unions who represent thousands of workers in the energy industry are calling for a hydrogen strategy and for its widespread adoption.

Policy misalignment One policy issue which is generating increasing debate amongst parliamentarians and the industry is how the transition to net zero heating will be paid for. Understandably, there is considerable concern for safeguarding and supporting fuel poor households who are already facing high energy costs. Given the cost of some low carbon heating technologies and the need to scale up others, the way costs are distributed across society is a controversial issue. Some are advocating Government support for the vast majority of households to make the transition, funded by general taxation, in order to spread costs equitably.

How to raise awareness The Government has a key role to play in explaining to households the impacts that their energy usage has on emissions as well as steps they can take to reduce this. In terms of the long term transition to heat, it will be vital for the Government to set out its anticipated roadmap so that consumers have certainty over

what may be expected of them and when. Key milestones on the road to a hydrogen gas grid will need to be handled strategically with clear messaging, as the transition to methane in the 1960s was.

What to do differently The UK will need to focus on investments and technologies that ensure a high level of self-sufficiency in our energy industry; this will also deliver greater export opportunities as we position ourselves as a world leader. High dependency on products or parts produced abroad could mean we struggle to meet targets for low carbon heating. COVID-19 has left many households in a more precarious financial position than they were in 12 months ago; the long-term effects of this must be taken into account when policy decisions are made on how the transition to low carbon heat will be paid for and what form it takes.

Agenda for CoP The Government should look to build on commitments we have made, such as legislating for net zero emissions; we should seek similar commitments from other major countries which have not already made them. The Government should also be looking to build on

Response	Number 18
Respondent	Lulu Shooter
Title	Head of Policy and Public Affairs
Organisation	Federation of Master Builders
On behalf of	Blank
Sector	Construction

Risk to that sector The small to medium-sized (SME) construction sector will be at the heart of delivering domestic energy efficiency retrofits in line with the Government's net zero carbon and EPC targets. However, as shown by the low numbers of installers accredited to the Green Homes Grant scheme, and with only 3 FMB members successfully achieving accreditation since the scheme was announced, the biggest risk in the domestic retrofit sector will be the lack of capacity building and or poor-quality building work. The Government has rightly required minimum competencies of installers as part of its retrofit schemes. However local builders need greater support – and confidence – to invest in their businesses and secure accreditation. There is currently insufficient support to help small builders, and this is preventing the supply chain from developing. (Reference: https://www.fmb.org.uk/resource/long-term-plan-needed-to-improve-our-homes-says-fmb.html and https://www.gov.uk/government/publications/clean-growth-strategy).

Opportunity for that sector A long-term strategy of domestic energy efficiency upgrades, with the objective of as many properties retrofitted to EPC C by 2035 as possible, will generate a significant economic stimulus and create hundreds of thousands of jobs in each community across the country. Modelling in the Construction Leadership Council's National Retrofit Strategy shows that, over this Parliament, a programme could generate £12.4 billion in Government revenues and 100,000 jobs created. The modelling also finds that these measures would tackle fuel poverty, reduce preventable winter deaths and reduce the burden on the NHS. The National Retrofit Strategy is an opportunity to build back better from the impact of the coronavirus, and create much-needed jobs (Reference: https://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2020/12/CLC-National-Retrofit-Strategy-final-for-consultation.pdf).

Barriers from energy policy Research by the FMB found that the biggest barrier builders face to delivering more retrofit works is 'a lack of a clear pipeline of work'. 16% of respondents to the same survey said that 'a lack of capacity and skills in the construction sector workforce' was the most significant barrier. Without a long-term plan in place, builders do not have the confidence they need to invest in securing the accreditations that are needed to deliver retrofit works. Anecdotally, one FMB members has estimated that it has cost him 160 hours in unpaid work and around £6,000 to secure PAS 2030 accreditation for his firm, as part of the Green Homes Grant scheme. Many small builders will not invest in securing these important accreditations without a long-term pipeline of work, and a national skills strategy that makes fully funded courses available across the country. (References: https://www.fmb.org.uk/resource/long-term-plan-needed-to-improve-our-homes-says-fmb.html and https://www.theguardian.com/environment/2020/nov/14/3bn-green-home-grants-scheme-faltering-just-weeks-after-launch)

Key to decarbonising Many small businesses do not have the quality management systems nor the training in place to achieve the PAS 2030 qualification, required of the Green Homes Grant scheme and other schemes. For many members of the FMB, and typical of local builders, they do not have dedicated administrative support in their business. This creates another barrier to general builders moving into the energy efficiency retrofit sector. In terms of behaviour change, more general builders will need to be brought on board with delivering energy efficiency retrofit to achieve upgrades at scale. Their involvement will also be important in minimising disruption to

households, as much of retrofit can be achieved by taking advantage of natural trigger points, like typical home improvement works or extensions and loft conversions. As local builders recruit local people and train 71% of apprentices, they will also be key to supporting the levelling-up agenda through retrofit.

How to become more active Blank

Focus Government investment The CLC's National Retrofit Strategy calls for Government to invest £5.3 billion over this Parliamentary period, underpinned by a holistic package of policy measures that stimulates the retrofit market. This investment must also be spearheaded by a long-term plan that gives businesses and consumers confidence. The investment by Government should be used across the full range of policy levers to make retrofit a success, including grant funding for low-income households and fiscal measures like a sliding Stamp Duty scale. It must also be used to develop the correct skills and qualifications, as well as a communications campaign that raises awareness and understanding of the need for retrofit. Stronger regulation may also be needed. The communications and qualification development would be supported and assisted by industry. (Reference: https://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2020/12/CLC-National-Retrofit-Strategy-final-for-consultation.pdf).

Place-based resources The Construction Leadership Council's National Retrofit Strategy advocates for the formation of a delivery agency that would oversee widespread energy efficiency installation across the UK. This body would operate as an umbrella working with existing hubs, and other structures across the UK, to develop retrofit activity, assure quality and share learning to bring retrofit into mainstream construction. It needs to ensure that all stakeholders are fully enfranchised. The central body would be responsible for setting standards, securing agreement from local delivery hubs, and supporting co-ordination and knowledge sharing. Local hubs would be responsible for delivery of the work, and monitoring outcomes, alongside quality assurance and enforcement which aligns local conditions and opportunities with the centrally agreed standards. (Reference: https://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2020/12/CLC-National-Retrofit-Strategy-final-for-consultation.pdf)

Hard to Decarbonise Blank

How to assess efficacy The National Retrofit Strategy advocates that the investment required of Government should be calculated according to a cost benefit analysis. Modelling in the strategy shows that £5.3 billion invested over the next four years would generate 100,000 jobs, a £1.84 return on every £1 invested, health benefits equivalent to £1.4 billion and additional GDP to the value of £21.9 billion. This investment would also save 2.53 Mt of carbon dioxide emissions. All these elements should be incorporated into the value of public investment into decarbonisation. (Reference: https://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2020/12/CLC-National-Retrofit-Strategy-final-for-consultation.pdf)

Cross-party consensus Energy efficiency retrofit is an issue that has enjoyed cross-Party support, as demonstrated by debates in the House of Commons, and the recent work of the Environmental Audit Committee. The Green Homes Grant scheme demonstrates the Government's view that investing in improving the energy efficiency of existing buildings is an important step on the path to net zero, as well as the principled capacity of schemes such as this to create jobs and stimulate the economy. (References: https://hansard.parliament.uk/Commons/2020-02-26/debates/63981383-A2DB-4301-ACB8-F51164751EE5/EnergyEfficiencyMeasuresNetZeroBuildings and https://committees.parliament.uk/work/309/energy-efficiency-of-existing-homes/)

Policy misalignment The training and qualifications landscape must be better aligned with the Government's target of achieving as many homes rated EPC C as possible by 2035, as well as their other climate change initiatives like the Future Homes Standard. The skills and training fund underpinning the Green Homes Grant scheme is welcome in unlocking access to the relevant training across the country, however these courses must be fully funded over the long-term to allow more businesses to get accredited to the scheme. Requiring firms to pay for these courses will represent a significant barrier to the general builder. It is also important to ensure that all apprenticeships incorporate retrofit skills, as well as an integrated knowledge of the interaction and sequencing

between different trades on site. This will help address the performance gap in buildings and avoid the need for redress works. High quality apprenticeships will also raise standards in industry.

How to raise awareness The FMB welcomes the findings of the Climate Assembly UK's report commissioned by six House of Commons Select Committees, to assist in their scrutiny of the Government. Top of the priority list for assembly members when they voted on the principles that should underpin the UK's path to net zero was 'informing and educating everyone'. In the space of energy efficiency retrofit, this should be a key function of the delivery agency as advocated for by the CLC's National Retrofit Strategy. Improving understanding of what retrofit is, together with why it is needed, among consumers will remove barriers to delivering retrofit a scale. (Reference: https://www.climateassembly.uk/)

What to do differently Blank

Agenda for CoP Investment in a long-term, ambitious National Retrofit Strategy represents a potential legacy issue not only for the current administration but also the UK. Retrofit is an international challenge. While there are international examples of standalone polic

Response	Number 19
Respondent	Anon
Title	
Organisation	
On behalf of	My company
Sector	Technical Engineering Consultancy

Risk to that sector Blank

Opportunity for that sector Helping our clients develop engineering and technology strategies which help to decarbonise the UK. Supporting our clients decision making and helping them to understanding and integrate low carbon technologies.

Barriers from energy policy Policy which results in electricity networks and energy infrastructure being upgraded on a reactive basis rather than a forward thinking proactive basis.

Key to decarbonising Consumer energy demand reduction and demand shifting. We need to change the way in which we think about and use energy. For example; adopting low carbon technologies, using smart appliances and variable price tariffs, as well as encouraging consumers to adopt energy efficient behaviours. Over the next decade this will require significant upgrades in energy infrastructure to allow for smart homes and interoperability. For example; installing 3 phase electricity supplies into homes would allow critical and non critical loads to be separated. Significant barriers will include changing customer attitudes and upfront infrastructure costs.

How to become more active Blank

Focus Government investment Blank

Place-based resources Blank

Hard to Decarbonise Blank

How to assess efficacy Blank

Cross-party consensus Blank

Policy misalignment Blank

How to raise awareness Blank

What to do differently Continue to encourage essential only travel.

Agenda for CoP Discussions on energy market reform

Response	Number 20
Respondent	Paul Needley
Title	Managing Director
Organisation	Enertek International Ltd
On behalf of	My company
Sector	Engineering Research and Development

Risk to that sector Increased costs for end users or energy following decarbonisation

Opportunity for that sector The opportunity to develop existing technologies to use energy more efficiently and more effectively to reduce consumption and therefore reduce emissions and at the same time, costs.

Barriers from energy policy Energy policies either promote heat or power, electricity or gas. Policies need to be all encompassing and acknowledge that these factors are inter-related and inextricably linked.

Key to decarbonising Decarbonisation of gas is needed to cope with winter heat demands. Electricity is unlikely to provide enough peak demand whilst staying low carbon unless there is a massive investment in nuclear and that is 20 years away. Tidal energy is predictable and guaranteed, wind is not.

How to become more active Not applicable. It is necessary to consume energy to develop appliances or machines which save energy longer term.

Focus Government investment Investment in R&D at industry level. Government investment in blue sky research and academia is good, but it is industry which turns the concepts into reality. All too often, inventions are not commercialised due to lack of funding.

Place-based resources Micro-level intervention is needed by each individual in the population. This is most easily achieved and monitored locally, but needs central leadership and direction. The populations behaviour in response to Covid needs to be replicated with an effort to decarbonise, but 'influencers' like the 'antivac' regime can easily disrupt progress.

Hard to Decarbonise Air travel because planes need to fly reliably and remain commercially viable. The population wants to travel.

How to assess efficacy Energy consumption metrics are widely available for efficiency and effectiveness combined, so a continuation of current measures should prove a reliable indication of how much decarbonisation is taking place

Cross-party consensus Covid restriction seen to have had a remarkable effect but these are not economically or socially sustainable, however many changes will remain, especially where the population see some benefits - a greater degree of working from home, zoom calls etc.

Policy misalignment Current public quotes available include 'cars must become electric' and 'gas boilers should be banned' but this is confusing, no-one is suggesting we ban cars, but we should change the fuel. Likewise in heating, don't change the boiler, change the fuel. Electrification of heat is not an answer unless there is the generating capacity available which there is not, a mix of low carbon generating technologies are needed together with low carbon gas.

How to raise awareness COP 26 has to be a success, The UK cannot do this alone either economically or practically, The whole world has to act together.

What to do differently A decision to move to low carbon gas is needed soon, then industry and academia can work together to produce the products and serviced to match the energy sources moving forward. The UK is in a good position regarding new energy sources and has a good academic grounding in the subject, and a very capable industry and excellent infrastructure to use. This should be used to get our own house in order then export these advantages to the rest of the world

Agenda for CoP Decarbonisation of gas and optimisation of the gas and electrical energy resources in harmony to lead to a more efficient and low carbon future

Response	Number 21
Respondent	James Lee
Title	Director of External Affairs
Organisation	Glass and Glazing Federation (GGF)
On behalf of	My company
Sector	Glass, glazing and fenestration

Risk to that sector Potential burdens Cost to businesses • The burden to most companies in the sector will be the cost to change processes, machinery, products, train staff and improve/change procedures to become carbon-neutral. • Over 95% of companies in the sector are SMEs, who are likely to lack the finance/capital, to adjust their businesses for a long term strategy of making, supplying and installing the best carbon saving products, such as triple glazed windows. Rate of change • The supply chain could be problematic if the rate of change for businesses isn't gradual, phased and co-ordinated. Example: • Over 95% of home improvement companies are currently not PAS 2030 accredited • For the 12,000 companies in the glazing home improvement sector to attain PAS 2030 level, could take many months if not years • The recent Government initiative, the Green Homes Grant Voucher Scheme (GHGVS) requires all participating companies to be PAS 2030 Accredited • The GHGVS is therefore unlikely to be a success as there are not enough installers to carry out the work Potential risks Risk of ineffective Government schemes/initiatives Government home improvement policies, schemes or initiatives are a risk to making existing properties carbon neutral if they are not; • Inclusive of a whole house approach • Placing glazing as a primary measure (as up to 24% of heat energy can leave a building via inefficient windows and doors) • Replacing inefficient double glazing (fitted pre-2002) and single glazing (mainly installed pre-1996). It is estimated that currently in the UK there are over 12 million homes accounting for 100 million windows and 20 million doors that are inefficient (leaky/draughty) and require upgrading. Risk if industry is not supported There is an urgent need for Government to support the glass and glazing industry to encourage an increase in making, supplying and installing glass and glazing products. The glass, glazing and fenestration industry has been extremely proactive in making energy efficient products and helping to reduce CO2 emissions in the last 25 years. • 1996 – Introduction of Low-Emissivity Glass which can reduce the energy lost through windows by up to 75% • 2002 - Introduction of competent person scheme FENSA to regulate the replacement of windows and doors in England and Wales. • 2006 – Introduction of Approved Document L for Conservation of Energy and Fuel in Buildings was including in the Building Regulations • 2007 - The British Fenestration Rating Council was also formed in to rate windows and doors energy performance. This is now the most widely used system in the UK for measuring the energy performance of windows and doors and similar to the rainbow labelling of domestic appliances. Since 2002, the glass, glazing and fenestration industry has invested 100s of millions of pounds in developing and manufacturing modern energy saving glass, glazing components, windows and doors. This has resulted in over 16 million homes benefit from modern energy efficient glazing. With so many avenues/vehicles to promote energy efficiency and carbon reduction to the glass, glazing and fenestration sectors and to homeowners, it would be a risk if the Government were not recognise the importance of the sector's willingness and capability to contribute to the broader plans and initiatives to achieve the CO2 targets. Risk of increasing consumer detriment The informal economy could grow if there is a lack of strong Government incentives schemes for consumers to make their homes more energy efficient/carbon-friendly through approved installers operating through Competent Person Schemes or to PAS 2030. Growth in the informal economy could lead to consumers having inferior products, installed poorly, with no guarantees and instead of improving the environmental situation, it is likely to make it worse. From GGF's independent consumer research 2019: •It is estimated that the informal economy is between 25-30% of the overall glazing home improvement market.

Opportunity for that sector Improving existing properties • The CO2 emissions per household in the UK is estimated to be 5 tonnes per annum. • If multiplied by the number of homes (28 million) it equals approx. 140m tonnes per annum. • The UK total CO2 emission is 350m tonnes per annum (source ONS) • Existing UK Buildings therefore contribute 40% of the total CO2 emissions in the UK per annum. With existing UK buildings contributing this volume of CO2 emissions there are huge opportunities to grow the home improvement sector and local economies and simultaneously reduce CO2 emissions considerably. • Of the 28 million homes in the UK. At least 16 million have modern energy efficient windows and/or doors (source LABC/CPSF) • Approximately 12 million homes don't have energy efficient glazing and are therefore the most likely to be the highest contributor to CO2 emissions from existing buildings. • The 12 million homes that require upgrades are highly likely to have single glazing or inefficient double glazing fitted pre-2002. • Currently 1.6 million homes (source LABC) have energy efficient glazing installed each year If there was a national long terms energy efficiency scheme offering potentially 12 million consumers a viable incentive to upgrade their properties and significantly reduce C02 emissions, the glass, glazing and fenestration sectors could grow substantially if an incentive was developed to upgrade 50% more properties per year for the next 10 years. This would see estimated growth in the following ways: Installation of windows and doors to increase by 25% per year: • 2022: o 2 million homes upgraded (25% increase on 1.6m). o Additional, 12 million windows/doors installed o Estimated increase in installer jobs = 6000 o Estimated increase in local businesses = 1200-1500 o Estimated additional revenue created = £2b • 2023: o 2.5 million homes upgraded (25% increase on 2m). o Additional, 15 million windows/doors installed o Estimated increase in installer jobs = 8000 o Estimated increase in local businesses = 1500-2000 o Estimated additional revenue created = £2.5b By 2030, and following a steady increase of 25% (p.a) more homes having energy efficient glazing installed, the incremental increase would: • Make an additional 11.9 homes more energy efficient through glazing measures • Potential double the number of companies in the sector • Create almost 50,000 new jobs for installers in the sector • Would achieve at least half of the 100 million windows and 20 doors requiring upgrade in the UK building stock • Would grow the industry from £4b to £14b in ten years

Barriers from energy policy Government strategies/policies • Lack of clear long-term integrated construction, training, energy and decarbonisation policy/strategy • Lack of focus on addressing one of the main contributors to C02 emissions in the UK, namely upgrading the existing building stock • Lack of support for the retrofit/home improvement sector • Lack of clear and simple promotion of energy efficiency policies and schemes to consumers from Government • Poor understanding of energy efficiency and homes improvements from some local authorities when it comes to improving buildings in conservation areas • Government not discussing and/or fully appreciating how the construction sector works in practice and the scale of the issue of upgrading existing UK building stock Building regulations • Currently Building Regulations allow the installation of windows that can achieve a U Value of 1.4. • Long term the aim is for the requirement to be a U-Value of 0.8 • Currently there are over 100 million windows installed pre-2002 with a U Value of 2 or over. • Clearly windows installed pre-2002, do not meet the Building Regulations therefore it would surely make sense for any properties having energy efficient measures in their homes under a government scheme must first address the issue of their glazing to check it meets the Building Regulations energy performance standards.

Key to decarbonising Companies making energy efficient products could become reluctant to invest more into the energy saving side if they are not seeing returns on their investment or if they feel Government aren't supporting their efforts to contribute to the zero carbon targets. Government changing energy efficient schemes to ensure it's a whole approach and not piece-meal. Government (local and national) appreciating the significant difference modern energy efficient glazing can make to a property, its occupants' wellbeing and the environment. The drive to recruit more young people into the industry. A main issue is the lack of skilled workers in the sector. Please comment on its timescale for deployment; likely effect; barriers to and cost of deployment? The timescales required for the manufacture and installation for 100 million windows and 40 million doors in the millions of homes requiring an upgrade is between 5-10 years. The likely effect of a scheme to drive this, could see and Barriers are; Government officials understanding of the glazing market issues and scale of the problems and not substantially supporting the sector. Product standards and installations not being policed properly, causing the informal economy to grow. Homeowners not being fully aware of the benefits of modern energy efficient glazing

or being aware but needing government support to incentivize them to invest. Lack of skilled workers and new people coming into the industry is a barrier – not just in glazing but across construction.

How to become more active Government could offer consumer incentives and provide more information / programmes / training & education for the sector to become engaged in energy consumption and energy saving.

Focus Government investment • Fund companies to attain PAS 2030 accreditation • Offer more funding for training packages to upskill employees • Invest in promotion of the sector to young people looking to have a career in the industry • Reduce VAT to 5% on energy saving products • Reduce VAT to 0% on the installation of energy efficient products in both domestic and commercial sectors • Launch a new long term (at least 5 years) consumer home improvement scheme that put replacement or pre-2002 windows and doors as a primary measure

Place-based resources By autumn 2020, over 75 per cent of councils and combined authorities in England had declared climate emergencies, with most also setting targets for their area to meet a net zero carbon goal, the majority by 2030 The pandemic is causing job losses on a wide scale across the country. Over the long term, around 28,000 jobs could be lost in the coal, oil and gas industries in the North of England by 2030 as the UK moves to low carbon power. But it is also estimated that, in the same timescale, new low carbon energy related jobs in this region could employ nearly 46,000 with the right policy framework. Councils do have direct responsibility over emissions in some sectors, such as social housing, where they own 38 per cent of England's stock. Greenhouse gas emissions from dwellings in England have only fallen by around 15 per cent in the past decade. The government has an ambition to retrofit all homes to reach energy rating EPC band C or above by 2035. But only around 30 per cent of homes are currently at this level so this will be a stretching target to meet. Furthermore, even if EPC C is reached it will not be sufficient for housing to play its full part in meeting the net zero goal. District, borough and unitary councils are responsible for local planning and building standards, and the delivery of housing targets, but within a framework set by national government. Local authorities have been discouraged from setting more stringent requirements for house builders in their areas and have been encouraged to focus on housebuilding targets in preference to other issues. Similarly, the refurbishment of existing housing, beyond that still owned by local authorities, is largely dependent on central government policy and funding. Emissions from housing and transport in England are not falling fast enough. In the housing sector, estimates suggest a national programme to retrofit every home to meet energy rating EPC C by 2030 would sustain 108,000 new jobs annually, with economic benefits possible across the country. Those areas hit hardest by the pandemic, with high unemployment and levels of fuel poverty, could particularly benefit. Public spending to improve housing energy efficiency in England has continually decreased over time, with no flagship national policy since the end of the Green Deal in 2015. Annual public spending on energy efficiency is now only £8 per head in England, compared to £35 in Scotland, £23 in Northern Ireland and £17 in Wales. 29 This lack of commitment has depleted supply chains and reduced the skills base just when they are most needed. The £2 billion package for domestic energy efficiency, including the Green Homes Grant, announced in the summer of 2020 will begin to fill this gap, but only if it is the start of a reliable long term retrofit programme. It is recommended that the Treasury should invest a further £7.8 billion in home energy efficiency over the next four years to fulfil the government's manifesto pledge. On top of this, £5.8 billion should be allocated to heat pump deployment, drawing from the £100 billion infrastructure budget for this parliament. Further support is required to build supply chains and bring costs down for more innovative methods of whole house retrofit, which can make homes low carbon by installing a number of measures in one step. Efforts to build greener housing were undermined by the ending of the Zero Carbon Homes standard in 2015. Although the government plans to restart this agenda with its forthcoming Future Homes Standard, trust in the system has been damaged and will take time to recover. A number of well-resourced local authorities have defied government pressure not to apply their own, more ambitious, buildings standards, including Guildford Borough Council which requires an additional 20 per cent carbon emissions reduction. For others, introducing higher standards is extremely difficult with limited resources, and they are unlikely to win against Planning Inspectorate decisions. The Future Homes Standard and forthcoming planning reforms could even formally ban councils from going beyond national standards. National buildings policy ignores the carbon embodied in construction too. The Greater London Authority is beginning to address this by mandating lifecycle assessments for some building projects but the Future Homes Standard may actually prevent other authorities following suit. A centralised Government framework which helps local authorities is imperative. It would make National government and local authorities jointly

responsible for ensuring all new housing developments are designed and built to the best low carbon specification. What is clear is that local authorities cannot act alone. The monumental task of retrofitting all of England's housing stock with energy efficient glazing to the highest possible standard will take ambitious national leadership. Local authorities, guided by national policy, need the flexibility to do what works best for their areas and communities.

Hard to Decarbonise The hard to treat homes for glazing are those within conservation areas where many local councils (conservation departments) refuse to have modern materials used to upgrade properties. The drive for decarbonisation could convince many local councils that modern materials used in the right way, so they are not detrimental in appearance to the surrounding environment, would be advantageous to homeowners, local companies, the life of the properties would be extended and ultimately the environment would benefit from modern energy efficient products being used to upgrade buildings in conservation areas and heritage buildings. The alternative is to scrap the Article 4 Directive and replace it with centralised legislation that allows properties to be upgraded using modern materials so long as the look/design and facade of the property isn't detrimental to the overall area or environment.

How to assess efficacy Clearly in the number of measures installed. The C02 emitted before and after to show the difference. The estimated cost of the installation (and manufacture perhaps also transport) should be accounted for within each installation. All put together against: Total UK CO2 emissions per year (to show effectiveness and gradual decrease. The increase in jobs, revenues, taxes paid etc from the jobs/businesses created in the drive towards reducing the C02 from housing stock. Perhaps each company who makes, supplies or installs and energy efficient product should be allowed to claim back some tax upon showing proof of the contribution towards zero carbon.

Cross-party consensus Health policy at present has cross party consensus due to the pandemic and there is a drive to relieve the strain on NHS resources. There is a general consensus to improve people's health and most of the UK's domestic building stock, there exists inefficient (leaky/draughty) window and doors. This can cause respiratory illness, bronchitis, asthma and numerous similar health problems. In the UK in 2019 (according to HACT stats) an estimated 10,000 people died from cold damp living conditions caused by poorly maintained properties. Quick action would be to offer all those with such illnesses a grant to upgrade their home's insulation, so they are living in a healthier home that also contributes to the overall environment and the government's zero carbon targets.

Policy misalignment UK policies need to be aligned and integrated with each other for the decarbonisation plan for Zero Carbon by 2050 to be achieved. This includes (though not exhaustive); • Housing and construction policy • Health policy • Energy policy • Economic policy • Training and Skills policy

How to raise awareness Broad and sustained integrated multi-media communications campaign by Government highlighting the scale of the problem, how each person can play their part and the list of things they can do including upgrading their homes to be more energy efficient.

What to do differently • Reduce the VAT on energy saving products and installation. (reducing to 5% or to make VAT neutral or a VAT holiday for 3-5 years) • Pre-Brexit the UK Government always pointed this VAT issue to the EU where VAT rates were set and controlled. • Post-Brexit, the VAT setting and controlling is firmly with HM Treasury • A positive action such as reducing VAT or offering a VAT holiday for three to five years on all home improvement that saves energy, would be hugely beneficial. • It would offer homeowners and local business a huge boost and long term, grow the economy and improve the environment. Consider preventing a health crisis by having healthier homes rather than waiting for one to happen before reacting.

Agenda for CoP Realise that the construction sector and in particular home improvements (existing buildings as well as new build) is an essential sector if decarbonisation is to happen and zero-carbon realised. Recognise the efforts and investments companies in co

Response	Number 22
Respondent	Anon
Title	
Organisation	
On behalf of	Blank
Sector	Energy Research and Innovation

Risk to that sector For our members (universities) the focus for decarbonisation is to achieve low-carbon and net-zero campuses, and they are all working towards this. A good example of this is at Keele University with its Smart Energy Network Demonstrator which is enabling the testing of new energy technologies. This includes the HyDeploy programme which is replacing 20% of the natural gas in the campus heating network with hydrogen.

Opportunity for that sector Aside from the benefits of decarbonisation of campuses which will improve the environment for students, staff and the local communities in which our universities are based. The greater contribution that we can make as the Energy Research Accelerator partners is in the research, development, demonstration and implementation of new low-carbon technologies.

Barriers from energy policy For ERA, being a wide ranging energy innovation project covering all aspects of energy research innovation, it is difficult to find the route for future funding for such a diverse project. Most funding pots for energy research are for very specific aspects of research, not for a comprehensive project such as ours, incorporating the spectrum of research and innovation, along with skills development and the close involvement of industrial partners. We would like to see more flexibility in the funding of future energy innovation and research programmes.

Key to decarbonising Probably the most pressing issue facing the UK is the decarbonisation of the domestic heating network. The strategic direction for low-carbon heating such as heat-pumps, hydrogen, biomass, biogas and district heating is not fully defined but will hopefully emerge through a national heat policy. ERA is proposing and seeking funding for the development of a National Centre for the Decarbonisation of Heat which will be based at Tyseley Energy Park in Birmingham which will create space for scale-up development, skills and training, plus standards and verification laboratories and a business incubation centre. The Centre would focus on manufacturing acceleration, low-carbon fuel development, skills academy, business incubator, living-labs and standards and verification. Generating low-carbon heat requires a national infrastructure programme which could unlock investment of over £500 billion.

How to become more active As a partnership of universities we are bringing our Estates Directors and Managers together to discuss and share best practice and support the implementation of low-carbon practices.

Focus Government investment If some of the UK government investment in energy research and innovation could be flexible and bespoke in order to incorporate wide-ranging projects such as the Energy Research Accelerator and other projects such as our, that would be extremely beneficial.

Place-based resources We are working with the Midlands Engine on the development of a regional energy and green-growth action plan. This has brought together partners from industry, universities, local-authorities, LEPs etc who have brought their ideas to the table for a co-ordinated, regional plan. This will be published in the Spring, and it would be greatly appreciated for national government to support regional energy initiatives by if possible providing the funding required to implement the actions.

Hard to Decarbonise The big decarbonisation challenges are Decarbonisation of Heat and Transportation, the latter including cars, air, rail, marine and road freight. Both of these areas are essential, and significant investment and efforts will be needed in order to achieve decarbonisation in both of these sectors.

How to assess efficacy The period between now and 2050 has to be seen as the critical period for putting the measures and infrastructure into place to achieve decarbonisation. The move to alternative fuels and energy storage, new methods of transportation, decarbonising heat etc will be expensive but will also create new opportunities for businesses, lots of new jobs will be created.

Cross-party consensus We have engaged with MPs across all parties and it is encouraging that there is a wide cross-party consensus for taking the actions that are needed to achieve net-zero. Quick action can be taken to support energy research, innovation and demonstration projects at a regional scale, which will support businesses, create jobs, new skills and bring investment to regions.

Policy misalignment We need policies which will 1. help to accelerate the move towards the decarbonisation of heating; 2. support the development of hydrogen technology and infrastructure for transportation; 3 introduce policies which will support and reward SMEs in the low-carbon sector, delivering export sales and sector growth; 4. to support the development of alternative fuels; 5. integrate resource recovery, including waste management, with energy production; 6. to support the development of medium duration energy storage (i.e. compressed air energy storage).

How to raise awareness In terms of raising awareness about energy, I think that there needs to be more education about how the UK's energy use will need couple of decades in order to achieve net-zero, and what that will mean in terms of the way we live, the impact on transport, businesses and all other aspects of life.

What to do differently Post Brexit it will be even more important for us to establish links in the fast developing economies, particularly China. The Chinese are very keen to establish links with universities and businesses in the UK that can help to advance and implement new technologies and innovations. The move to net-zero will play a key role in the post Covid-19 recovery. New energy technologies and the infrastructure required in homes, businesses, for transport etc will create new jobs, new innovation and encourage investment. The government should definitely see energy innovation as one of the main routes back to economic growth, post-Covid.

Agenda for CoP The UK leads the way in research and innovation in energy. We should call on the world's scientists to work together with us to provide solutions for all countries, as climate change is a global problem and needs a global solution.

Response	Number 23
Respondent	Fflur Lawton
Title	Head of Public Affairs
Organisation	Smart Energy GB
On behalf of	My company
Sector	Energy

Risk to that sector Inaction, or lack of urgency in, engaging consumers to help decarbonise Britain's homes and policy measures to support consumer uptake. National Grid ESO states that immediate action and cross-society engagement is required to hit net zero by 2050. The smart meter rollout has shown how targeted engagement can help consumers to make more informed choices about energy use and efficiency in the home. The amount and complexity of choices consumers will have to make will increase on the road to net zero, which should be underpinned by reliable, impartial information. (National Grid ESO, Future Energy Scenarios, July 2020: https://bit.ly/2YEhruZ)

Opportunity for that sector Smart meters enable consumers to take advantage of new dynamic time-of-use tariffs and automated heating controls, which are key drivers of demand-side response (DSR). With the electrification of heating and transport set to increase overall demand, a high level of DSR participation is needed to flatten peak demand and overcome the intermittence of renewable energy sources so we can achieve our carbon reduction targets. Adoption of DSR is one of the largest areas of uncertainty relating to consumer behaviour change, and can also affect adoption of smart appliances and other connected technologies of the smart home. (Delta-EE, Role of smart meters in responding to climate change, May 2019: https://bit.ly/3r1lTQz)

Barriers from energy policy Reform of the regulatory regime needs to happen quickly if we're to maximise the benefits of a smart energy system. The key to making our energy system lower cost is to be able to value flexibility as highly as we do new generation. We need to reward consumers for providing flexibility to the grid. Programmes like settlement reform should not be delayed.

Key to decarbonising Energy flexibility is vital. Smart meters are the foundation of a smart and flexible energy system, and are a key enabler of large-scale domestic demand shifting. A report by Delta-EE shows that without smart meters, the decarbonisation of homes will cost more and take longer, and runs a higher risk of Britain missing its net zero targets altogether. An upgraded, data-driven energy system, with smart meters at its heart, will better harness renewable energy and reduce our reliance on higher risk carbon reduction strategies. (Delta-EE, Role of smart meters in responding to climate change, May 2019: https://bit.ly/3r1lTQz) Timescale for deployment: Over 22.2m smart meters are already installed (over 1/3 of all meters), and the remainder are being rolled out to every home and small businesses in Great Britain by 2025. This is not an insubstantial achievement, given the task of installing telecommunications equipment in Britain's incredibly diverse housing stocks. However, for momentum to be maintained a broad effort will be required, including continued optimisation from energy suppliers and policy support from Government. Effect of deployment: Smart meters are an essential first step for consumers to play their full part in decarbonisation. They create a unique opportunity to engage every home in GB in decarbonising and upgrading our energy system. Smart meters are being offered to all consumers at no extra cost, allowing everyone to access the benefits and provide near-real time data to the energy system. Smart meter data provides essential visibility of supply and demand on the system, and innovative time-of-use tariffs can incentivise consumers to use energy when demand is low and there are high levels of renewable energy are available, reducing reliance on fossil fuel sources of energy. Barriers to their deployment: While 32% of Britain now has a smart meter and a further 35% would seek out or accept the offer of an installation within 6 months, the additional offerings around

smart meters have been slow to evolve in order to maintain and build interest for consumers who are less likely to engage with them. As a foundational technology which supports other connected technology and services, smart meters have and will naturally engage the 'early adopters' or those more interested in their energy use. As the rollout progresses, and the urgency with which our energy system must be upgraded increases, more compelling reasons and offerings must be made to convert sections of the public who are at present less likely to accept a smart meter. Costs of deployment?: The Government's 2019 cost-benefit analysis for the smart meter rollout projects costs of £13.5bn, but it is expected to deliver benefits of £19.5bn, providing a net benefit of £6bn through 2034. Independent analysis by Delta-EE has shown that households engaged in smart meter enabled time-of-use tariffs, auto switching and other energy-saving behaviours can save significantly more than government projects, without requiring any cost investment. A summary of the costs and benefits across all the different areas of the rollout and smart metering system can be found on page 63 of the 2019 cost-benefit analysis. (Delta-EE, Smart Meter Benefits: Cost savings households could make within a smart energy future Feb 2019:

How to become more active Blank

Focus Government investment Research, development and promotion of new technologies and business models that can harness smart meter and energy grid data to increase consumer buy-in and participation in DSR, as evidenced by programmes such as NDSEMIC, BASEE, and the Ofgem Innovation Sandbox. These initiatives have shown the benefit of providing industry with funding and space to trial technical solutions before releasing to market, and also allows for cross-industry collaboration. Broader and easier access to consumer data, with appropriate account of consumer consent, would also significantly improve the ability for data-led offerings to consumers – simplifying the process for third-party organisations to access smart meter data would help to reduce financial and operational barriers to newcomers on the market.

Place-based resources Through the Smart Energy GB in Communities programme, we have already seen success in delivering grants and partnering with trusted local and regional organisations in Britain to deliver tailored information, advice and support about the smart meter rollout. Through harnessing local expertise and existing relationships those who are harder to reach in their communities (for example with over 65s, those without access to the internet, or people whose first language is not English), these groups can be included in the transition to net zero and not be left behind.

Hard to Decarbonise Nearly 15% of carbon emissions in the UK comes from electricity and natural gas demand in homes – primarily from heating and power. The scale of work that needs to be done to reduce the carbon impact of homes is vast. If we are to reach net zero by 2050, consumers will need to be actively engaged in making decisions about upgrading the energy efficiency of their homes and appliances, or changing when they use energy. As we transition to a smart and flexible energy system there will be a need for advice and assistance in the more complex energy market of the future, supporting consumers to adopt new services and technologies.

How to assess efficacy Whilst they naturally cannot capture all of the benefits that may flow in the future from digitising our energy system, the impact assessments and cost-benefit analyses conducted over the course of the smart meter rollout have been beneficial to the programme as they do take a reasonably whole system approach to projecting the benefits. These have included full categories of costs and benefits for the consumer, energy suppliers and networks, as well as impacts to carbon and air quality. We recommend a systems-wide approach to looking at policies in support of decarbonisation of homes, including the impacts of DSR, which if looked at in isolation would significantly under-count its benefit.

Cross-party consensus There is already broad support for the UK's ambition to meet net zero by 2050. Key to this is upgrading Britain's energy system to one that is smarter, more flexible and better able to integrate renewable energy while meeting growing demands for electricity. Smart meters are essential to this upgrade, bringing the smart grid into every home and allowing consumers to take part in the smart future while helping Britain to achieve its carbon reduction targets.

Policy misalignment To ensure a just transition to net zero, everyone needs to be able to access and experience the benefits of the smart future. Vulnerable consumers and those less able to make financial investment should not

be left behind, otherwise there is a risk of large groups being unable to take advantage of future products and services. Incentivising flexibility in energy use could also reduce the need for unnecessary capital investment in our energy system, which can help bring the overall cost of decarbonisation down for everyone. Care should be taken on where the costs of decarbonisation fall to ensure a just transition to a smart energy system.

How to raise awareness As we decarbonise and transition to net zero emissions, both government and industry need to be open and honest with consumers about the scale of what will be required to meet this target. Consumers need to understand that while the journey to net zero may not be without issue, the end result of upgrading to a modern and flexible energy system, more energy efficient homes and lower energy bills will be worth the challenge. The smart meter rollout has an important role to play in increasing consumer engagement with their household energy use, and empowering consumers to make informed decisions to support the transition to net zero.

What to do differently It's more important than ever that the most vulnerable in society are not left behind. Smart meters are already improving experiences for those on prepay, in fuel poverty or in other vulnerable circumstances. 70% of people with a disability, mental health condition or on low income say that having a smart meter has made managing their energy easier, and polling by Citizens Advice shows that people on prepay are less likely to self-disconnect if they have a smart meter installed. The Covid-19 pandemic has highlighted the importance of ensuring no one is left behind on the journey to net zero.

Agenda for CoP Blank

Response	Number 24
Respondent	Dai Richards
Title	Director of External Affairs
Organisation	Hitachi ABB Power Grids
On behalf of	My company
Sector	Electricity supply chain

Risk to that sector Decarbonisation of the electricity system cannot be tackled in isolation; a whole systems approach is required that considers the whole of the electricity value chain and its integration within the holistic energy system. Failure to take a holistic approach will decrease the pace and increase the cost of decarbonisation.

Opportunity for that sector Electricity will be the backbone of the future energy system, so plays a pivotal role in achieving net zero and tackling climate change. Transformation across every part of the electricity value chain, (generation, transmission, distribution and smart consumption) is required. This will require significant investment (capacity will have to at least double) across the whole of the UK and create tens of thousands of jobs.

Barriers from energy policy The energy transition is inevitable, but the pace, cost and effectiveness of the transition are highly dependent on policy. These factors will also determine the economic opportunity created for the UK economy and supply chain as all major economies are also looking to 'green recoveries' to create advantage for their domestic supply chain. An attractive energy market to private investors is essential as this investment will drive the pace of transition. Specific and firm (i.e. long term) energy policies that prioritise net zero and the pace of change are essential. These policy priorities must be reflected in both Government's and Ofgem's actions.

Key to decarbonising As described above we strongly feel that a holistic systems approach is essential for an optimum and most cost effective transition, so focusing on one technology, at the expense of other parts of the ecosystem, will be counterproductive. For example massively increasing the demand for electricity for EVs, without increasing the share of renewable generation will not reduce CO2 as much as progressing both aspects in parallel. Similarly increasing offshore wind capacity without both increasing electrical grid capacity and making the grid smart enough to handle more intermittent supplies will respectively result in curtailing renewable generation or the loss of grid reliability. We believe that the electricity grid is often overlooked, but without a larger, stronger and smarter grid the energy transition will not happen, regardless of how many windfarms or heat pumps are installed.

How to become more active One important area where all organisations can improve is in improving energy efficiency in their operations, an often forgotten key area of decarbonisation. This could come from changes to operating processes or from investment in more energy efficient technologies. The payback period for some energy efficient technologies is often beyond the 1-2 years which many companies seek, so incentives to invest are helpful. Education / advocacy within our supply chains, of the opportunities of creating flexible energy systems, and prioritising decarbonisation as a criteria in procurement are also important weapons in the armoury.

Focus Government investment We see two key areas for beneficial investment, skills and new technologies. Skills to meet the growing demand for decarbonising buildings, offshore wind, offshore transmission systems etc. will be a limiting factor in the pace of transition and could prevent the UK from developing a leading capability in key, exportable, technologies. Investment should be made in a skills system that both meets our needs and trains / retrains those most disadvantaged by the pandemic. Investment in emerging key decarbonisation technologies (hydrogen, marine, storage, system modelling etc.) across the whole lifecycle (R&D, first commercial projects) would be effective. The selected technologies should be those that will be attractive globally.

Place-based resources The investment required in skills and retraining will be required across the whole of the UK and the design of suitable skills programmes is best organised locally to meet the local situation and requirements. The investments in the energy system will continue for many decades and will be needed in all regions so local plans for decarbonising local energy systems are essential.

Hard to Decarbonise The technologies to decarbonise the electricity system are all available today. Decarbonising heat, 'heavy' transport and carbon intensive industries is more difficult and requires considerable technology developments / cost reductions. These technologies also create economic opportunities as they are targeted at meeting global needs. One alternative to decarbonising HGV traffic and some aviation is to encourage the shift to rail travel. The full decarbonisation of rail should also be accelerated through either the full electrification of routes or alternatives such as battery trains that can be operational more quickly.

How to assess efficacy As discussed above decarbonisation should be considered in its totality across the energy, industrial and transport sectors. In the short term there will be significant investment required, but in the longer term there will be net cost reduction across the energy system, as shown by the CCC's latest report. This positive long term return does not take into account the additional financial benefits from decarbonisation, including reducing health costs and the economic value from the jobs created. This points to both measuring progress and effectiveness in the long term (e.g. 2050) and holistically (e.g. energy systems, social benefits, employment). However with such a long term endeavour there must also be short term milestones set to monitor progress (carbon reduction, cost, technology mix etc.), which implies having a measurable roadmap in place.

Cross-party consensus We believe that at the current level of policy definition there is cross party support for the direction described in the Energy White Paper. However the White Paper lacks many specific points of action and we would urge the Government to deliver specific, actionable policies as quickly as possible in order to allow implementation to progress at pace. As described above we believe investor confidence in the stability of energy policy is critical in delivering the energy transition and therefore cross party consensus on policy details is to be wished for.

Policy misalignment As we have discussed this is a critical point as there must be alignment between all areas of the energy system and between the energy, transport and industrial sectors. The overall ecosystem must be optimised, rather than prioritising a particular sector in isolation. Governance of the transition to net zero should span all government departments to avoid any potential misalignments and the role of an 'energy transition agency' would be welcome.

How to raise awareness While we believe that at a conceptual level the importance of combating climate change and the transition to net zero is generally understood and accepted we do feel that there is a general lack of understanding (amongst some politicians, parts of the industry and the public) of the consequences, the specifics and most importantly the actions required to minimise climate change. Our energy systems are very complex and integrated, as described above, but we do believe a coordinated attempt by government and the industry to raise awareness of the important issues is possible and would be beneficial. The governance mechanism alluded to in the previous question could deliver this action.

What to do differently We don't feel that either leaving the EU or moving out of the pandemic should change what the UK aims to do. However both events do make delivering the transition more important and more urgent. The intent for the UK to become a global leader in implementing net zero systems is more important than ever. The need to deliver new 'green jobs', particularly in areas that have been most impacted by Covid, is more urgent than ever and demands an acceleration in pace of the transition

Agenda for CoP The UK will be most effective at COP by demonstrating ambitious leadership across the 5 themes of the conference. Ambitious targets and aspirations are part of demonstrating leadership, but having in place a credible actionable roadmap that has cross part

Response	Number 25
Respondent	Dr Martin Hanton
Title	Technical Director
Organisation	TUV SUD National Engineering Laboratory
On behalf of	My company
Sector	Energy

Risk to that sector The energy trilemma of environment, cost and security represents three risks that must be balanced. Crucially from a UK perspective, the primary overall risk is one of excessive burden that could in turn lead to carbon offshoring, and hence an economic penalty to the UK with no environmental benefit and perhaps even worse environmental outcomes.

Opportunity for that sector The key opportunity is an economic one. Creating a long-term economic driver for the UK that creates jobs and prosperity, whilst also benefiting the environment. A hydrogen economy can be absolutely central to this, not just domestically, but through great potential for large exports of green hydrogen.

Barriers from energy policy Lack of clarity on what policy will be, and what mechanisms of market support will exist. At present, this is one of the key barriers preventing investment in hydrogen related technologies in the UK.

Key to decarbonising There is no single 'key' technology, we will need 'all the tools in the box'. At present, an excessive favouritism towards electrification could be seen as a barrier to other necessary technologies such as hydrogen - both will be needed. The importance of behavioural aspects in decarbonisation should not be underestimated. In some applications hydrogen has the benefit of not requiring behavioural change, e.g. for home heating and how vehicles can be used in some circumstances.

How to become more active It is important that a variety of options for decarbonisation are available, so that organisations in different situations have options to choose from, in finding the solution that works best for them.

Focus Government investment By providing support that leads to a market functioning without subsidies as soon as possible.

Place-based resources Different regions have varying strengths and needs. By using local and regional resources and organisations, place-specific optimum pathways for decarbonisation will emerge in the most efficient way. For example, in some places heat provided by heat-pumps may be preferable, whereas elsewhere hydrogen may be more optimal, or even a mixture of the two.

Hard to Decarbonise Electricity production has been relatively easy to decarbonise, and where direct electrification can be used to decarbonise end use easily, it should be. But applications like industrial heating, heavy transport (and high-duty cycle light transport) and some home heating are very hard to decarbonise with electricity for a variety of reasons. Green and blue hydrogen provide a ready solution, that in most cases requires no change in end user behaviour.

How to assess efficacy It will be crucial to take a whole lifecycle and whole system approach, and a range of standards should be developed to ensure this is applied consistently and transparently. Frequently comparisons are made based on levelised cost of energy (e.g. £ per MWh), and this should be made consistent across the source of energy, but also expanded to account for a levelised cost of emissions.

Cross-party consensus n/a

Policy misalignment Whatever the UK develops in terms of a low carbon hydrogen standard needs to be harmonised/compatible with that used in the EU, and any other potential export markets for green/low carbon hydrogen.

How to raise awareness A lot of good action has already occurred in this area, but moving forwards more focus should be placed on how action can support the principles of a Just Transition; not just because this is ethically desirable, but because the public will be more supportive if they can see the benefits for them at a personal level.

What to do differently The build back better ethos should be followed to ensure that there is not a resumption of 'business as usual', but rather a fundamental shift towards more sustainable policies and approaches.

Agenda for CoP It is important that the UK backs up its world leading climate change legislation (talk) with funding commitments and policies (action) that support making the goals set realistically achievable.

Response	Number 26
Respondent	Paul Pearcy
Title	Senior EHS Adviser
Organisation	British Glass
On behalf of	My sector
Sector	Glass Manufacturer (Container, Flat, Continuous filament fibre)

Risk to that sector • Glass industry is at risk of carbon leakage and excessive energy and compliance costs risk making the sector uncompetitive with the rest of the world. • Long investment cycles for furnaces between 10-15 years. • High cost of low carbon fuels not economically feasible without support – electricity is estimated to be three times the costs of natural gas. • Infrastructure for electrification and hydrogen is not available to majority of the sites, most sites will not be within clusters so will not have access to hydrogen when it comes available. • Costs for capacity upgrades for electrical network to enable electrification is up to £12million with a lead time of between 4 and 7 years. • Technical feasibility and large-scale demonstration of some low carbon technologies especially hydrogen and CCUS.

Opportunity for that sector • Lower carbon compliance costs. • Glass becoming more sustainable material with a lower carbon footprint.

Barriers from energy policy • Industrial electricity prices in the UK are among the highest in the EU due to environmental policy costs and network charges. • Support of Energy Intensive Industry to cover CAPEX and OPEX costs for switching to low carbon fuels (as per the CCC 6th Carbon Budget recommendations). • Further protection from carbon leakage such as carbon border tariffs for Energy Intensive Products. • Lack of clear long-term energy and decarbonisation policy/strategy.

Key to decarbonising Effect of all the fuel switching options. This would reduce carbon emissions from glass by around 75-80% with the remaining carbon from raw materials. Costs Many of the costs are unknown and the costs below are estimates, the glass sector is currently undertaking a government funded fuel switching project to look in detail at the CAPEX and OPEX costs associated with fuel switching (due to be published at the end of 2021). Electrification (Est. 2030 onwards) Barriers • Cost – The high cost of electricity in the UK is the main barrier. Based on a typical container glass furnace, the energy cost for electric melting is around three times that of natural gas. Upgrading the sites electricity connection could also cost up to £12M. • Security of supply – An interruption in power supply for longer than 2 hours, would cause serious issues and potential loss of the furnace. The site supply would require double circuit security to minimise the risk. • Infrastructure – Most sites would need to upgrade their connection. It is estimated that the infrastructure could take between 4-7 years to implement. • Technical feasibility – electric furnaces are currently only viable up to 250t/day (small container glass furnace size) further development and demonstration is required to increase beyond this for large glass manufacturers. Estimated Costs • Electrical capacity upgrades = estimated up to £12 million for the additional capacity. • Electricity is around three times higher than natural gas. Bio-fuels (Est 2020s-onwards) Biofuels offer a short-term solution to decarbonise a large proportion of site CO2 emissions using existing burner technologies. Prior to using natural gas, glass furnaces in the UK ran on either heavy fuel oil or diesel, so the sector is confident that liquid biofuels with similar properties to these can be used. It is important that biofuels used by the sector meet strict sustainability criteria. Fuels associated with indirect land use change which releases stored CO2 should be avoided. As part of the BEIS fuel switching project led by Glass Futures, Encirc will trial using liquid biofuel on one of their furnaces at the Derrylin site. This will be the world's first trial of using liquid biofuel to fuel a glass furnace. If successful, the trial is expected to be extended to other glass sites. Barriers • Technical feasibility –not all sites will have sufficient

space for fuel storage tanks as the original tanks will have been replaced with other infrastructure such as flue gas abatement since the switch to natural gas. • Security of supply – Long term there is uncertainty over availability of biofuels. • Cost- As the carbon price increases, the cost of zero-carbon rated sustainable biofuels will increase cost due to competition for this limited resource as more industries/countries realise the carbon benefit. Hybrid Furnace (Est 2030 onwards) A hybrid furnace is a furnace that can run on multiple fuels. Traditional gas fired furnaces already use a small proportion of electricity; however, the new designs of hybrid furnace can supply 80% of the melting energy with electric boost. The hybrid furnace concept has the potential to tackle one of the key issues for decarbonising the glass sector which is the long furnace life of between 10 and 20 years. The hybrid furnace approach allows manufactures to future proof their furnace so that as electricity becomes more cost competitive with natural gas, they can switch to using a higher proportion for glass melting. It is hoped that future designs will also be compatible with hydrogen so that the switch to hydrogen can be made when it becomes available at a particular site. Another advantage of a hybrid furnace is that the control system can be set up to respond to changes in energy prices. This would allow manufacturers to be paid to turn down electricity during peak times and take advantage of cheaper electricity when there is an excess from renewables. Barriers • Cost – Upgrading the site electricity connection may cost up to £12M. • Infrastructure – Most sites will need to upgrade their electricity connection. • Large scale demonstration - The new designs have not yet been demonstrated. Hydrogen (2030 onwards) Although hydrogen was initially rejected in the glass roadmap due to the low flame luminosity, there has been renewed interest driven by plans in the EU and UK for large scale production and eventual replacement of natural gas with hydrogen. There are currently five projects in the UK and Europe looking at the feasibility of using hydrogen for glass melting. Barriers • Cost- As hydrogen is still a long way off it is difficult to predict the cost. It is possible that taxes may be levied on other fuels to offset the cost of production. • Infrastructure – Hydrogen is initially planned to be available in a small number of industrial clusters. Initially only a few glass sites which are located close to these clusters will be able to use hydrogen. The CCC predict that hydrogen will start to be available outside of the clusters by 2035. • Technical feasibility – The technical feasibility of using hydrogen is still being investigated (via glass futures fuel switching project), however initial results are promising. Carbon capture Utilisation storage (CCUS) - (Est 2030-onwards) The glass sector originally rejected CCS as a viable option in the sector roadmap, however, now that the target has changed from an 80% reduction to net zero, CCS may be necessary on some sites to capture the remaining process emission. Barriers • Technical feasibility – Viability of capturing CO2 from the furnace waste gas still needs to be demonstrated. The current technologies are not compatible with glass furnace flue gases. • Cost and CC footprint- CCUS is likely to be an expensive option for reducing process emissions and the anticipated footprint required for a CC plant is likely to be challenging to accommodate on existing glass manufacturing sites. • Utilisation and/or Storage – The captured CO2 requires a conveniently located destination to be identified, be this a CO2 user, storage site or both, and accessible infrastructure to transport it to this destination. This will be particularly challenging for sites located outside of industrial clusters.

How to become more active If glass manufacturers opt for hybrid furnace, then they may be able to be more flexible with usage of energy dependent on cost and demand. The glass manufacturing process is a continuous process and therefore has limited flexibility within energy usage, the furnace requires continuous heating to ensure the glass remains melted.

Focus Government investment Government must focus investment on the following. •Support of Energy Intensive Industry to cover CAPEX and OPEX costs for switching to low carbon fuels (as per the CCC 6th Carbon Budget recommendations) • Large scale demonstration of low carbon fuels and CCU/S. • Support and investment for Infrastructure for electrification of glass and hydrogen networks. • Reduce the costs of industrial energy prices through exemptions for EII to ensure that low carbon fuels are economically viable. • Ongoing R&D for low carbon technologies • Enable CC/U by supporting an active network for partnering CO2 emitters and users

Place-based resources • Regional delivered funding to possibly be given to Local Enterprise Partnerships (LEPs).

Hard to Decarbonise Process emissions that originate from the carbon-based raw materials in the glass sector contribute around 20% of the CO2 emissions from an installation and these are essential to making glass. Solutions

for reduce process emissions • Increasing cullet (recycled glass) use reduces the amount of carbonate raw materials required therefore reducing CO2 emissions. Every tonne of cullet that is remelted to make new glass products saves 1.2 tonnes of raw materials and reduces emissions (scope 1,2 and 3) of CO2 by 600kg. • Calcined materials such as CaO which is produced from heating limestone to remove the CO2 could be used to replace carbonates in the batch and reduce site CO2 emissions. Further work is needed to understand the impact of using these materials as they are hazardous and corrosive. • Alternative raw materials There is on-going work looking at alternative raw materials such as mineral slags, waste ashes and other secondary raw materials. Some of these could be used to replace carbonate raw materials, whilst others may reduce the melting temperature of the glass therefore reducing the energy requirements. Further work is needed to understand the impact and availability of using these materials. • CCUS – carbon capture is an option that would capture all the CO2 from the process but the technology is unproven for glass melting emissions containing high levels of acid gas emissions and low levels of CO2. Space requirements on site are also a potential barrier. Further work is needed to find a solution that may be viable for CCUS on the glass process.

How to assess efficacy Government money should be focused on investment £ / CO2 abated and focused on the best value for money in terms of CO2.

Cross-party consensus • Help and support UK foundation industries to decarbonise, remain competitive and secure foundation industry jobs that are key to deliver Net Zero. • Look at further protection for UK manufacturing by considering Carbon Border Tariffs or similar schemes to ensure that UK manufacturing remains competitive while decarbonising at a greater to rate to other countries. With focus on those industries most at most risk of carbon leakage. • Support for green jobs and infrastructure to help deliver net zero.

Policy misalignment • Compensation scheme and the different criteria required means some industries only receive some of the compensation from energy policy costs. • Policy/Energy costs – consumers have paid for the energy sector to decarbonise with high electricity prices due to the costs been passed on to consumers. Energy Intensive industries cannot easily pass these costs through to consumers as they have to remain competitive with the rest of the world.

How to raise awareness The public need to be aware of what the future will look like in their homes and what the likely cost will be to decarbonise in the UK. Products are likely to cost more in the future due to the higher costs required for low carbon fuels and further work is required on green product standards and creating markets for green or energy efficiency products to help on the journey to net zero.

What to do differently Clear long-term policies to help investment in low carbon technologies.

Agenda for CoP Agreement on all countries matching the UK ambition of Net Zero by 2050.

Response	Number 27
Respondent	Mike Lakin
Title	MD
Organisation	ENVOI Limited
On behalf of	My company
Sector	International upstream oil and gas, exploration and production

Risk to that sector Cost implications to commercially exploring for, and successfully producing oil and gas. Also the lack of future investment due to the knee jerk reaction to ESG policy by the financial sector which does not seem to have thought through the longer term implications of trying to 'switch off' the use of hydrocarbons the economy is still 80% reliant upon for its cost effective energy, as compared to a measure 'transition' over an achievable time frame

Opportunity for that sector Helping the world to transition and leading the way as it did to transition away from coal in the 1960's when oil and particularly gas was discovered in the Southern North Sea. To cut out the use of gas and oil without a cost effective and less carbon intensive alternative is far less likely to be achieved. Given the challenge, the industry can help lead the way if it is engaged to do so as its future depends on it. So encouraging a lower carbon footprint from oil and gas exploration & production, it could be used to help accelerate decarbonisation and diversify using its proven E&P skills to create alternatives, in particular drilling into aquifers for Geothermal power generation projects (unlike the proven issues associated with fracking).

Barriers from energy policy A general perception that oil and gas is no longer needed where alternatives (including renewables) can quickly take their place. This has in turn driven the rush of 'go green', ESG investment policies and the almost cessation of any market or city investment in finding essential new sources of oil and gas that are still needed to replace the existing but rapidly declining fields (which were discovered and developed before the last 5+ years of downturn and growth of then green revolution). This new feedstock is going to essential when energy use returned to pre-Covid levels and before energy transition has any chance of catching up and filling the rapidly growing gap (See: https://www.rystadenergy.com/newsevents/news/press-releases/as-2021-will-bring-the-largest-crude-deficits-in-years-a-window-of-opportunity-opens-for-producers/)

Key to decarbonising i. More practical (less emotional) and more informed decision making about how decarbonisation and how the carbon foot-print can be effectively be reduced but in a way that the energy still needed, can be cost effectively generated and distribution. ii. Far greater engagement with the upstream and downstream energy sector about how this can be achieved (how many members of PGES are from the upstream sector with the experience to advise on its current activities and ways of helping achieve decarbonisation?) iii. Creation of some simple metrics to measure and compare the relative carbon footprints of all aspect of the energy supply chain so that this can then be used to effectively compare and define the highest carbon generators and how they can be reduced (i.e. Replace all / any coal usage with gas as quickly as possible) iv. Capture and sequestrate C02 (e.g. use of the many depleted oil and gas field reservoirs using the old pipelines to store it) but this will need subsidies and tax incentives v. Implement a clear, simple and understandable formula with appropriate tax incentives over the next 5 – 10- years, but which does impede commercial investment in finding the new energy needed to effectively fill the looming gap in energy transition vi. Use of 100% of any Carbon tax to help accelerate decarbonisation and not fund anything else. This will incentivise the decarbonisation required that if it's just seen as a tax generating tool! vii. Involve the energy experts to help educate political decision makers and reduce ill ill-informed interference that inhibits the practicalities of decarbonisation

How to become more active Engagement with the upstream E&P sector and involvement in the discussions and implementation of a process to ensure that measures are implemented that will cost effectively achieve accelerated decarbonisation whilst still being able to supply the energy needed.

Focus Government investment Fund and incentivise the appropriate research for new technologies and most effective path to achieve and implementation a decarbonisation process. This should involve realistic incentives to the whole education process encouraging students to study the engineering and sciences that will ne needed for effective energy transition over 20+ years

Place-based resources Full value chain accountability and education (i.e. the buy in) of all users and particularly the general, voting public that has been arguably misguided by overly emotional hype and misleading facts about the whole energy issue about how net zero emissions can be achieved. Few realise the associated high cost and related life style changes that will required by ALL if Energy Transition is not properly thought-out, planned implemented and incentivised.

Hard to Decarbonise There are 4 main carbon omission contributors comprising Manufacturing, Transport, Agriculture and most importantly the end users. Without the end users (customers) which make up 100% of this country's growing population, the supply chain would not need to produce, grow or transport as much so the carbon footprint is reduced (i.e. The global COVID travel restrictions are thought to have reduced the C02 output by the 30% estimated to be required over the next 30 years to reduce the effect on climate change). Commitment from the whole country is required to properly, safely and cost effectively use less, waste less and re-cycle more that will ensure effective decarbonisation. This is the simple 'Maths of Energy Transition'

How to assess efficacy Be clear and simple message that even the general public can understand so they engage (like the successful Brexit slogan which caught the emotion 'Take Back Control' there needs to be a similar theme to hang the effective energy transition message onto). Use of incentives and no alternative but achievable measures (tax and tax incentives) to encourage recycling or indeed anything that leads to the decarbonisation of as many activities and/or usage as possible. Again, 100% of any taxes need to be used for accelerating decarbonisation and associated energy research for effective population buy-in!

Cross-party consensus i. A clear agreement on the Aim ('mission') and results required to achieve decarbonisation ii. Clear facts rather than emotion and knee jerk decision making iii. A pragmatic approach to achieving the simple aims and in an achievable time frame (i.e. 10 – 20 year and not the quite impossible few years perceived or 5 years of each successive governments) iv. A clear long-term plan that will actually achieve aims agreed

Policy misalignment Unrealistic decarbonisation target that appears to target the use of fossil fuels with seemingly no clear joined up, realistic and cost-effective solution or plan of achieving energy transition in a way that will ensure decarbonization, yet provide the energy the population expects, at an affordable cost and in away that will not change end users life style (i.e. one based on freely available energy that costs less than the expensive alternatives).

How to raise awareness As already highlighted, the fact that Energy Transition will have to be slow but progressive if its to be effective. Also cost effective and affordable where we still need oil and gas. This can only be reduced if and when cost effective alternatives are freely available, resigned to paying much higher prices and/or the end users are incentivised to change their current hydrocarbon energy and related product dependencies.

What to do differently 'Sell' a message of realistic Energy Transition based on a clear plan and ensure the whole country realises what it will take. Invest in new research that could lead the world in new alternative energy. Also recycling. There is no reason why the UK can't become the World leader in Energy Transition including fully sustainable recycling, low carbon transport design and engineering, manufacturing processes and agriculture. Particularly if the right incentives are put in place. This could be a future global export of expertise and services if implemented properly. The only way this can be achieved though is via a 10 – 20 plan, backed by successive governments and correctly sold to the entire population of this country so that it becomes the norm to want to change, over an achievable time scale.

Agenda for CoP A clear, practical, unemotional but simple Energy Transition plan that is fully supported by the data and ability for the full supply chain to then implement over an achievable time frame.

Response	Number 28
Respondent	Dr Grant Wilson
Title	Lead, Energy Informatics Group
Organisation	University of Birmingham
On behalf of	Myself
Sector	Higher Education

Risk to that sector Blank

Opportunity for that sector To build world leading teaching and learning with the experience gained from being immersed in the UK's net-zero transition. i.e. as the UK gains experience from overcoming the challenges of net-zero, the UK becomes an even better place to study the decarbonisation of energy systems. Energy systems will have to change around the world - with net-zero timeframes - the UK is at the forefront of this. Campuses could look to support their wider energy networks i.e. they would provide a benefit to their immediate surroundings in terms of energy systems.

Barriers from energy policy Blank

Key to decarbonising (behaviour) continued social licence for energy system changes is going to be an increasing factor in the transition particularly around the decarbonisation of heating. spreading the costs away from consumer bills and having a more progressive way of spreading the network upgrade costs across the economy is an area that needs detailed consideration. Timescale - needs 'deployed' over the next network regulatory timeframes before significant increases of network costs appear in the regulatory timeframe after that. (technology) at scale green hydrogen production through electrolysis. This is needed to a) manage the significant levels of electrical overproduction and b) provide a fuel for tens of TWh levels of seasonal energy storage. Timescale for deployment - through the 2020s for a scale up in deployment. Some innovation from policy and regulation to accelerate the innovation generations would be helpful. i.e. pay a more generous amount of incentive to developers in the medium term precisely to get increased turnover of technology on the ground. UK market pull policy has proven adept and innovative - policy makers would come up with a suitable solution to drive investment in e.g. 3 x generations of electrolysers to be deployed and replaced on the ground by 2030. By that point - it should be much clearer on the cost trajectory for green hydrogen from e.g. electrolysis.

How to become more active For Higher Education campuses, a combination of batteries, thermal energy stores to help support their local energy networks. Similar to the concept of Active Buildings - but at a campus level

Focus Government investment Continued funding for energy research through UKRI helps the Higher Education sector interact with Business to overcome key challenges, to develop staff, and attract international talent.

Place-based resources Local and regional resources and organisations need access to timely, robust and granular local, regional and national energy system data to allow them to consider how they are going to deliver net zero. At a national level, pay for this data resource centrally and make it available for low or no cost to local authorities, LEPs, combined authorities and Energy Hubs. A trusted one stop shop of energy and related data is something that would be utilised by many stakeholders. An additional step is to provide detailed network assessments of local areas, and zoning for heating. If this had all already happened, the UK would be in a much better shape to consider how local and regional organisations could be further harnessed to deliver net-zero i.e. how can they provide active support to the transition (as opposed to passively waiting for the wider system to decarbonise).

Hard to Decarbonise enteric emissions from livestock, creation of methane is a natural process. they are essential to various farming communities and dairy production, alternative is to reduce the livestock headcount.

How to assess efficacy Blank

Cross-party consensus to improve building fabric with a focus on those in fuel poverty and potentially with registered social landlords. to invest in developing supply chain skills needed particularly for the transition to low carbon heating and retrofit of buildings. Decarbonisation of industrial clusters.

Policy misalignment Blank

How to raise awareness greater openness of local energy and energy related data for wider stakeholder engagement

What to do differently set up regional resources to measure and identify the performance gap of new build housing, and retrofit fabric improvements, perhaps using the energy hubs as a pilot? this will provide independent evidence to focus on driving standards up throughout the construction sector

Agenda for CoP Not the most important perhaps - but something it could certainly propose that would have a lasting legacy is to kick start or pump prime a fund to allow international students to come to the UK to study energy courses, and vice versa, i.e. a fund to allo

Response	Number 29
Respondent	David Wallace
Title	Senior Strategy Manager
Organisation	Offshore Renewable Energy Catapult
On behalf of	My sector
Sector	Offshore Renewable Energy

Risk to that sector Decarbonisation is not a risk, or burden, to the offshore renewable energy sector.

Opportunity for that sector Offshore renewables can play a greatly increased role in energy supply, energy exports, and related employment and wealth creation.

Barriers from energy policy Energy policy should have more long-term, integrated, planning, across infrastructure, markets and innovation.

Key to decarbonising Offshore renewables, especially wind, can affordably decarbonise the great majority of our economy, and provide an inexhaustible energy export industry. Deployment could be limited by lack of long-term infrastructure planning, and fragmented consenting and regulations. Deployment could easily exceed 5 gigawatts per year, with appropriate investment. Continued scale-up and innovation will drive costs even lower. Scale-up and cost reduction of medium to long term storage, especially electrolytic hydrogen, are required to enable the full potential of offshore renewables.

How to become more active Offshore renewables is an energy supply sector. However, wind farms can make a large contribution to energy flexibility, by providing real-time ancillary services via control of turbines, and by deploying combined generation-storage assets, e.g. offshore wind and hydrogen.

Focus Government investment Coordinated innovation support for research, technology validation facilities, key demonstration projects, and commercial scale-up (e.g. revenue support for floating wind farms and tidal stream projects), including for energy storage, and investments in energy infrastructure, including adaptation of gas infrastructure to green hydrogen.

Place-based resources Good progress is being made with partnerships between local authorities, local supply chain companies, and the multinational project developers and OEMs that lead deployment of offshore wind, especially under the sector deal. Building upon this good progress, deeper partnerships between central government, local authorities and other key players, such as port operators, will be required to accelerate deployment of offshore renewables. The same partnership models for economic development and inward investment that were applied in offshore oil and gas development and in attracting auto manufacturers, should also be applied to development of regional infrastructure and clusters for offshore renewables: coordination of, tax policy and incentives, regulations and consenting, public investment in large-scale infrastructure, innovation programmes, skills training, etc.

Hard to Decarbonise Transport emissions from vessels - for windfarm installation and maintenance - are challenging, as is carbon embodied in materials (steel, concrete, etc).

How to assess efficacy For offshore renewables, the cost of electricity (LCOE) has served as a useful sector target. However, offshore renewables scores very highly on effectiveness as an instrument for decarbonisation - deliverability, certainty of emission reductions, investability, public acceptability, etc. Decision makers need to be well-informed on these advantages and should take them into account, along with other evidence such as LCOE projections and energy system-level modelling.

Cross-party consensus There is broad support for innovation programmes to build on our technology lead, in offshore wind, and marine, technologies, including revenue support (such as Contracts for Difference) for accelerating cost-reduction of essential options such as floating offshore wind, and large-scale green hydrogen.

Policy misalignment Accelerated deployment of offshore renewables will need greater policy alignment around: attracting inward investment, enabling key demonstrations within the framework of the energy market, infrastructure development (ports and energy networks), European-level energy markets and infrastructure, project consenting (especially environmental and security/military).

How to raise awareness General awareness is already high. The government has done much to highlight the potential for offshore renewables as a climate solution, and a source of jobs, and could always do more.

What to do differently There is a unique opportunity for major green spending, including offshore renewables and related areas such as green hydrogen, that will immediately boost GDP (the CCC estimates a 3% increase) and secure a transition to a zero-carbon economy. Spending on offshore renewables is particularly effective in reaching disadvantaged regions.

Agenda for CoP The UK can its leadership in setting carbon budgets, and the return of the US to the process, as an opportunity for the international community to revert to clear, quantified, carbon reduction targets.

Response	Number 30
Respondent	Douglas Irvine
Title	Executive Manager - Future Energy
Organisation	Shetland Islands Council
On behalf of	Blank
Sector	Energy Transition

Risk to that sector Lack of funding for developing large scale green energy projects.

Opportunity for that sector Green hydrogen production based on floating offshore wind.

Barriers from energy policy Lack of strategy for actions, including adequate funding to back up strong, green government rhetoric.

Key to decarbonising Using the vast wind resource in UK waters to produce green hydrogen and related products such as ammonia. Developing this sector at scale could provide for all of the UK's hydrogen requirements by mid century and enable a lucrative export market to the EU and beyond. Green hydrogen is most sustainable future energy available at industrial volumes in the UK and will eventually replace natural gas and blue hydrogen as a mainstream national fuel. Advances in technology suggest that industrial scale green hydrogen will be developed by 2030, providing that UK based funding for research is increased and the best floating offshore wind sites are licensed and developed.

How to become more active The transitioning energy sector can become most active with access to adequate research funding and robust joint working practices involving technology, energy production companies, the energy transmission sector and the supply chain.

Focus Government investment By providing more funding for research, feasibility studies and pilot projects.

Place-based resources The importance of place based energy hubs based on using existing oil and gas infrastructure for transitioning to renewable forms of energy has been recognised by the Uk's Oil and Gas Authority. The Shetland region could produce 10% of the UK's future hydrogen requirement based on the strongest wind regime in the UK and using existing oil and gas infrastructure. The UK and Scottish Governments and large scale energy producers need to work closer with the ORION project team in Shetland to harness resources and achieve an internationally important future energy source.

Hard to Decarbonise Aspects of major transport such as air, sea and larger road vehicles are the most difficult to decarbonise. These are all essential for modern living so a great deal of effort is required to identify the alternatives to using fossil fuels. In time all activities have to be either decarbonised or be subjected to related net zero activities such as forestry developments, peatland restoration, kelp production etc.

How to assess efficacy The current work on producing carbon balance sheets at national level needs to be advanced to a stage where every energy related activity has to be measured to assess carbon impacts.

Cross-party consensus Replacing petrol and diesel fuelled cars and other light vehicles with electric and other alternative forms of energy such as hydrogen fuel cells.

Policy misalignment The UK Government has to encourage more coherent working with the energy industry, academia etc to coordinate the national approach to energy transition in line with leading nations.

How to raise awareness The current communication should be sustained and backed up with more substantial measures to drive change.

What to do differently The UK has to commit to the level of resources for transitioning energy as other nations such as Germany and France are doing. We are still some way off the pace of change that is required to meet our climate change targets.

Agenda for CoP Developing green hydrogen production at international scale. The UK has the resource to be a global leader.

Response	Number 31
Respondent	Nigel Holmes
Title	Chief Executive
Organisation	Scottish Hydrogen & Fuel Cell Association
On behalf of	Scottish Hydrogen & Fuel Cell Association
Sector	Hydrogen and Fuel Cells

Risk to that sector The three main risks of energy system decarbonisation are reflected in the Energy Trilemma: Cost, Security, & Environment. Increasing energy costs will impact both consumers and industry, and the transition to renewables may disrupt security of energy supply. Need to carefully consider wider environmental impacts, such as methane production emissions. Avoid offshoring of UK energy intensive industries, and then reimporting the same products but with a much higher overall carbon footprint (see also border carbon adjustment). The Just Transition is a guiding principle; the key risks and burdens often land on those least able to adapt or afford change.

Opportunity for that sector We must overcome the siloed thinking that doesn't consider whole system impacts and needs, for example energy storage. The UK can take a leading position on rapid energy system decarbonisation, based on access to very large scale offshore wind resources for electrification and production of green hydrogen. Green hydrogen coupled with pipelines, linepack, and geological storage of hydrogen at multi-TWh scale is the enabler for Net Zero. This allows integration of variable renewable energy sources with variable local and export energy demands. Hydrogen has the added potential to deliver carbon free heating with least overall disruption to consumers and industry.

Barriers from energy policy Uncertainty and lack of direction on hydrogen strategy is currently holding the UK hydrogen economy back compared to other European countries. UK strategy and clarity on market support mechanisms is essential to enable early projects to happen, and encourage private sector investors to commit the scale of funds necessary to build hydrogen infrastructure at the scale necessary to bring costs down and make a significant impact. It often appears that policymakers are waiting for 'silver bullet solutions' and lack the confidence or will to try out different options quickly to assess real opportunities. All this requires bold decisions, and now.

Key to decarbonising Hydrogen is key to achieving Net Zero targets. Hydrogen for heat offers minimum disruption to the 85% of UK households already using natural gas as there is no need to change behaviour. Hydrogen for heat also attractive to UK industry, and already clear market pull from Scotch whisky sector with Net Zero by 2040. EU and all the European national strategies for hydrogen recognise that industry will be the easiest and cheapest market sector to decarbonise with hydrogen, followed by transport, then domestic heat. This is because of the seasonal nature of domestic heat demand and the cost of storage.

Hydrogen can be deployed in time to deliver Net Zero for Scotland/UK by 2045/2050 respectively. Any indecision in government policy will be a rate-determining step. We need a coordinated energy system wide approach for electricity and hydrogen, which connects national scale generation/production and storage assets across UK. Using electricity and hydrogen together the overall cost can be reduced and speed of deployment increased. We have to avoid silo thinking and the search for perfect future answers getting in the way of pragmatic solutions now. We need significant investment in hydrogen now to realise the same cost reductions as offshore wind.

Hydrogen is key to achieving Net Zero targets. Hydrogen for heat offers minimum disruption to the 85% of UK households already using natural gas as there is no need to change behaviour. Hydrogen for heat also attractive to UK industry, and already clear market pull from Scotch whisky sector with Net Zero by 2040. EU and all the European

national strategies for hydrogen recognise that industry will be the easiest and cheapest market sector to decarbonise with hydrogen, followed by transport, then domestic heat. This is because of the seasonal nature of domestic heat demand and the cost of storage.

Green hydrogen enables the scaling up of offshore wind and much higher levels of energy system integration. Better energy system integration together with linepack energy storage reduces curtailment of wind and associated costs, and the re-purposing of existing offshore and gas pipeline infrastructure can be a key enabler. The use of large hydrogen pipelines enables very large energy transmission over long distance with low losses. Use of salt caverns can provide up to 250 GWh of energy storage per cavern, using proven technology, can enable rapid supply of energy to meet UK-wide peak domestic heat on cold mornings.

The coordinated 'energy system architect' approach becomes hugely complex and unwieldly at the UK level. Each region of the UK is unique, and should develop better regional whole systems thinking as a more effective alternative. The search for perfect answers must not get in the way of pragmatic solutions, and avoid introducing market competition until there is sufficient capacity for the performance of early solutions to be compared on a like-for-like basis. Need to build public awareness and confidence in the use and costs of hydrogen to the consumer, for example through trials in real-world settings such as H100 Fife.

The overall cost to the UK of not deploying hydrogen will be higher energy costs, poorer energy security, fewer jobs, and poorer balance of trade. There is no agreed mechanism for understanding and comparing project costs for hydrogen or electrification projects. There is no generally accepted LCoE calculation and we need real data taken at key points in project lifecycles (e.g. at initial funding, FID, commissioning and regular intervals during operation) to make informed cost estimates. The costs of deployment also need to be consider along with the benefits which can be delivered to our community, local, and national economies.

How to become more active Our 130+ SHFCA members are both energy solutions providers and energy consumers. SHFCA also has close links with 30+ other trade associations; many of these are similar national H&FC associations, but we are increasingly building links with trade associations who are seeking to support their members through the use of low carbon energy solutions. As one example SHFCA has an MoU with the Scottish Wholesale Association, who have just started an initiative to map out SWA fleet decarbonisation opportunities with hydrogen. We intend to develop further similar relationships with other willing trade organisations.

Focus Government investment The UK Government can use public sector support mechanisms to derisk private sector investment and accelerate deployment. Public sector support for decarbonisation of heat sector should support large scale consumer trials for electrification, heat pumps, and hydrogen. Any public sector support should also seek to enable highest level possible of local content and local jobs. A supportive hydrogen strategy could leverage inward investment for UK projects to increase scale and speed of deployment of renewables for green hydrogen production. There is significant investor appetite and this is consistent with the post-Covid 'rebuild back greener' direction of travel for the UK.

Place-based resources Support local area initiatives, such as hydrogen hub projects with industry, local government and communities. These can offer a co-ordinated energy systems approach to using hydrogen to de-carbonise transport, industry and heat across the hub area by identifying and involving local demand and matching this to energy supply opportunities and industry investment. The recently announced Free Ports (Scottish Green Ports) offer opportunities for scale-up and improving the balance of UK trade. It is easier to apply whole energy systems thinking in discrete geographies and play to their regional strengths, e.g. hydrogen in Scotland, geothermal in NE England etc.

Hard to Decarbonise Hydrogen widely recognised as way forward to tackle hard to treat areas such as heavy transport, heating, and industrial fuel switching. Domestic heating is a particularly tough challenge because of the scale and seasonal variability of demand. The installation of more efficient low temperature heating into existing properties can be very disruptive. Domestic heating is an essential need and hydrogen offers a means to provide central heating in the same way as natural gas without significant lifestyle changes. With transport the use of hydrogen fuelled vehicles offers a user experience very similar to petrol and diesel vehicles, but without emissions.

How to assess efficacy Take a 'whole systems' approach looking at not only cost but also the benefits, in particular UK jobs and the export opportunities at a critical time for our economy. Comparisons on cost need to be between different net zero solutions rather than the fuels used today. Comparisons based on the efficiency of hydrogen vs electrification often overlook need for a secure and resilient system to meet peak demands 24h/365d. LCoE is an generally accepted measure in £/MWh across the lifetime of a project, but his should be supplemented with the levelised cost of carbon, measured in £/tonne of carbon saved.

Cross-party consensus There is broad agreement that green hydrogen and electrification are long term sustainable solutions. There is however a need to develop better understanding of timeline and economics for eliminating grey hydrogen, interim deployment of blue hydrogen, and for CCUS in the long term. Similar need to develop better understanding of timeline and economics for scaling up renewables, electrification, and green hydrogen. Also need better practical understanding of the complementary nature of electrification and hydrogen routes to decarbonisation, and demonstrate the role hydrogen could play in delivering net zero heating.

Policy misalignment Positive use of public sector support to enable higher local content and local jobs.

Support UK manufacturing sector energy costs and build post-Covid local supply chain security.

Importance and full societal value attached to all UK jobs, not just 'high value' jobs.

Carbon footprint of blue hydrogen must include all natural gas unabated production emissions.

Carbon border adjustments policy needs to be developed for embedded emissions in imports/exports.

CCS is critical to get to net zero, yet is still not well liked or understood by the general public.

Ban on Enhanced Oil Recovery in UK waters using CO2.

How to raise awareness) Adopt the Sustainable Investment Taxonomy and similar best practice to inform all public sector investment and procurement decisions, together with Sustainable Investment Hierarchy or similar best practice for developing suitable transport and planning policies. Adopt UNEP guidance for sustainable finance and investments, and use this together with Just Transition guidance. Consider government regulated financial guidance and support to inform public and workforce about making climate positive investment approaches for pension and similar long term investments. In addition to any public awareness raising initiatives there should be work to understand the most effective means for helping positive attitudes become positive behaviours.

What to do differently The UK should use COP26 to rebuild bridges and support international activities on development and deployment of low carbon energy systems using hydrogen and electrification. Post-Covid opportunity to build back better with strategic investment in sustainable UK energy system, with focus on local content and long-term UK jobs for all. Reshore industry and manufacturing using low carbon energy and rebuild resilient local supply chains, manufacturing capacity, and innovation capabilities. Be bolder, take more risks, back more solutions now (conditionally) for example with heating trials to build hard evidence in terms of cost, performance and public acceptability before making final decisions.

Agenda for CoP The UK needs to clearly demonstrate ambition in setting Net Zero targets backed up with a track record of delivery against interim milestones. This is true leadership by example. It includes a willingness to share lessons learned across the UK and with ot

Response	Number 32
Respondent	Charlotte Thomson
Title	Sourcing Manager
Organisation	Air Products Ltd
On behalf of	My Company
Sector	Industrial Gases

Risk to that sector The industrial gases sector provides vital inputs to energy-intensive industrial sectors such as steel, cement, chemicals, glass etc. Those same inputs are also important to those sectors' individual efforts to reduce their GHG emissions. However the industrial gas sector is itself one of the most energy-intensive; the majority of its emissions are due indirectly to the unavoidable electricity intensity of our processes and much can be done to reduce these emissions provided that sufficient, competitively priced, renewable electricity becomes available. Improvements in energy efficiency can and have also contributed but the maturity of process technologies and long capital cycles - c. 20 years – limit future opportunities to improve efficiency. For the reasons noted below, unintended consequences of policy-driven cost increases may be to add cost to vulnerable manufacturing sectors and to hold back the decarbonisation efforts of those sectors. In addition, it should be noted that the outsourcing business model for industrial gases has brought environmental and economic benefits; policies intended to drive decarbonisation must be drafted to ensure that a level playing field is maintained with the competing "insourcing" or captive model of production.

Opportunity for that sector As noted above, the advanced production processes and emissions mitigation measures of many other sectors are reliant upon the supplies of industrial gases; examples include steel, cement and glass. To these efforts must now be added the use of the industrial gases oxygen and hydrogen – the latter both "blue" and "green" - in the production of low-carbon electricity and decarbonised gas; also in decarbonised transport. Notably, to supplement domestic production the UK swift and decisive action should be taken to open the UK for the import of "green" energy – including hydrogen - from regions of the world which are well placed for its generation e.g. Middle-East. The expertise of industrial gas companies, developed over decades of specialism, has an important role to play in these rapid developments.

Barriers from energy policy As noted above, the availability of sufficient renewable electricity at competitive prices is critical. A further concern is that Climate Change Agreements (CCAs) are current restricted to only those existing sites that currently hold agreements. This prohibits the development of newer and more efficient plants, potentially in more geographically suitable locations; such plants would provide benefits in terms of reduced "Scope 2" and "Scope 3" emissions.

Key to decarbonising As noted above, the availability of sufficient renewable electricity at competitive prices is critical. A further concern is that Climate Change Agreements (CCAs) are current restricted to only those existing sites that currently hold agreements. This prohibits the development of newer and more efficient plants, potentially in more geographically suitable locations; such plants would provide benefits in terms of reduced "Scope 2" and "Scope 3" emissions.

The future availability of competitively priced renewable electricity is not under the industrial gas sector's control. However, we look forward to the development of policies to encourage the domestic production and import of "blue" and "green" hydrogen; 2025 is likely to be a point where we should expect rapid acceleration of development.

The continued growth in availability of renewable electricity and completion by the Government of its measures to support renewable and low-carbon hydrogen will be critical.

Costs , recognising that different technological and commercial options for decarbonisation may require differing levels of support.

How to become more active Companies in the industrial gases sector are already contributing to electricity load management and, where the market permits, purchasing significant quantities of renewable electricity.

Focus Government investment In addition to the points made above, it would be helpful were full relief from CCL to be provided for industrial gases, thereby reducing administrative burden.

Place-based resources Blank

Hard to Decarbonise Industrial processes can be hard to decarbonise and their cost penalisation would carry a risk of carbon leakage.

How to assess efficacy Criteria based on t/CO2 saved play a role but should not be the sole criteria.

Cross-party consensus Blank

Policy misalignment Blank

How to raise awareness Blank

What to do differently Uphold GHG reduction commitments and provide the support necessary.

Agenda for CoP Demonstrate that the low-carbon agenda can be met without loss of industrial competitiveness. Also demonstrate acceptance of the value of imported renewable energy to bridge the gap between national supply and demand.

Response	Number 33
Respondent	Anon
Title	
Organisation	Independent
On behalf of	Myself
Sector	Energy Policy and Regulation

Risk to that sector Unless all sectors work together and apply a holistic and collaborative approach we may not optimise all opportunities. There must be a degree of fairness when deciding 'Who Pays'.

Opportunity for that sector We have a strong history of innovation, engineering and leadership. We must encourage collaboration, shared learning and hugely improve education and incentivise delivery of our Net Zero future.

Barriers from energy policy The industry will not succeed to transition efficiently and effectively unless a clear long term plan is devised and implemented. This will inevitably highlight that some gains will be gained in the short term whilst others will take longer to be realised because of interdependencies. The long term nature of the delivery plan will necessitate clear support across all political parties. With a need to embrace a wide range of technological solutions, as one size will not fit all, we must work together as a nation to champion those who can move quickly whilst supporting those who will require help and assistance to achieve the desired outcome. These are unprecedented times that require strong and clear buy in and leadership.

Key to decarbonising If we accept, and I do, that the Committee on Climate Change has provided the best view of the path we must adopt to achieve Net Zero then I see no problem in supporting its holistic approach across societal, industrial and behavioural change. The Government has an opportunity to act as a facilitator for delivery, however the reality of a fixed term Parliament will not support this necessarily long term project. It is therefore paramount that we engage across the House to ensure cross party support to establish a Department to oversee delivery of Net Zero as a United Kingdom project, with key National, Regional and Local inputs. The Department should have the power to call in expertise from all affected interested parties, thus ensuring this is a project driven by the science, relevant technologies, business and academic leaders whilst understanding and supporting the needs of the nation ie. those who will ultimately benefit, but share the costs of the transition.

Delivery of our Net Zero ambitions and enhancing the opportunity to educate and therefore expand/sell knowledge abroad to assist others and encourage wider collaborations and success.

I fear politics and those sectors that are afraid to, or do not acknowledge the need for, climate change action may adversely impact progress.

I do not know a final figure however I do know that unless we have some form of central co-ordination then we may end up investing public or private funds in the wrong projects at a time, Post Covid and Post BrExit, when we can least afford to do so.

How to become more active Education is severely lacking in this area. Something simple like a 'Tomorrow's World' forward looking prime Time TV program could work wonders. Look how we all revere Sir David Attenborough! This will encourage interest from the public, business, its investors and manufacturing sectors. Link this to a really inclusive and informative range of educational qualifications, so we have the work force to employ within the new areas of opportunity that will inevitably arise and we should have a win-win situation here.

PGES 40th Anniversary Inquiry into Energy Policy APPENDIX III Full listing of responses as received

Focus Government investment Concentrate on making a clear plan. Do not take too long to do so. Do not be afraid of amendments as we grow our knowledge and experience. Encourage transparency. It is amazing how much interest can be nurtured when we openly extend participation.

Place-based resources Make sure that they are part of the solution right from the start. Local and regional knowledge is valuable and often ignored. In the race to Net Zero it would be remarkable if 'One Size were Fit for All'.

Hard to Decarbonise It is interesting to note that the industries lagging behind on the decarbonisation front are often those that have been reluctant to embrace change. Post Covid and BrExit we must ensure that the necessary costs required to deliver the benefits of change are not socialised on those who can least afford to enjoy the new, cleaner future we wish to work towards. Take for example house building. It is widely acknowledged that it is far cheaper to install rudimentary Energy Efficient enhancements during the construction phase rather than wait to retrofit later. For example a Smart Meter, electricity generation in the form of solar PV, more than minimum home Insulation options, improved home heating systems, etc.

How to assess efficacy Assess carbon saved. Better still do not allow carbon production unless it is captured, utilised and/or sequestered,

Cross-party consensus The route to Net Zero is a must. If we do not ensure that from the 'get go' then we will see constant tinkering continue. We have no time to waste on vanity projects. Long-term collaboration is key.

Policy misalignment The area of most concern will be who pays, when and why. Socialising via energy bills is not fair, particularly for those who have to choose whether to 'heat or eat'. Green policies are an HMT remit.

How to raise awareness Improve education, public relations and build upon the good work undertaken by the Citizens Assembly. We need to create a national, regional and local platform to ensure inclusivity on this issue.

What to do differently Collaboration is key to avoid unnecessary and expensive duplication and ensure that carbon emissions are reduced wherever possible as soon as practicable. Due to the long term nature of our race to Net Zero Parliament should establish cross party support for a Department to oversee Net Zero as a United Kingdom project, with key national, regional and local input.

Agenda for CoP Identify how we work collaboratively across all participants going forward in order to maximise benefits for all, not just for those that can afford to move the fastest.

Response	Number 34
Respondent	Richard Gow
Title	Policy and Government Relations Manager
Organisation	Drax Group plc
On behalf of	My Company
Sector	Power Sector

Risk to that sector Power/Energy sector will need to fully decarbonise over the next few years to meet net zero targets. As a result, the way energy is produced, stored, and distributed will need to fundamentally change. We are already in the process of undergoing this change with the phase out of coal and the rise of renewables generation. The National Grid ESO Future Energy Scenarios predict a large increase in electricity demand from 300 TWh today to between 450-600TWh by 2050 and at the same time a significant volume of unabated fossil generation will need to come offline as well as the closure and decommissioning of the ageing nuclear fleet. It is expected that the majority of generation output in 2050 will be met by intermittent renewables however these technologies are highly variable by their nature and will be unable to fully meet demand by themselves. There will be a need to invest in firm non-intermittent capacity and storage technology to ensure that generation can continue to meet demand. The scenarios estimate that net-zero can be achieved in the power sector between 2030 and 2033 subject to the right policy framework being developed in the early 2020's which enables this to happen.

Opportunity for that sector ? Whilst the decarbonisation of the power/energy sector presents challenges for the operation of the power system, there are many opportunities to be had in helping to manage these operational challenges. The deployment of flexibility and storage technologies will be important in helping to balance an increase in demand on the system, and the intermittency of renewable technologies such as solar and wind. Drax are already successfully navigating these challenges with their Pumped Hydro Storage facility, Cruachan. Cruachan provides both storage and a range of system support services such as inertia, voltage control, and frequency response to the grid helping to support the deployment of intermittent renewable technologies. The role of Bioenergy with Carbon Capture and Storage (BECCS) and the accompanying generation of 'negative emissions' also presents a significant opportunity for the sector. Since negative emissions will be a vital aspect of reaching net zero those companies, such as Drax, who are able to invest and deploy the technology to provide negative emissions will be well placed to support the transition to net zero.

Barriers from energy policy The lack of market frameworks in both storage/flexibility technologies and for negative emissions means that investment in Pumped Hydro Storage and BECCS technologies cannot take place unless policy intervention supports the development of these markets. We believe BEIS and the wider UK government should look to support the rollout of these technologies, given their vital role in net zero, through policy intervention to improve market frameworks. This policy intervention should occur as soon as possible, and ideally within the next year or so, given the urgency in which net zero needs to be achieved.

Key to decarbonising Answer to previous question: BECCS and Pumped Storage Hydro. Timescales for deployment: BECCS can be deployed at scale from the late 2020's. Pumped Storage Hydro is a mature technology that is ready for deployment from today. Both technologies have a long construction time scale of approximately 4 years. The deployment timescales of both technologies is dependent on a suitable market/policy framework.

The deployment of pumped storage hydro technologies such as the deployment of an additional pumped hydro facility at the Cruachan site would provide additional support to the grid by absorbing greater amounts of excess renewables generation and providing more system support services to support a stable and safe operation of the

network. The wider decarbonisation agenda also presents risks to those sectors which are unable to fully decarbonise and continue to produce difficult or expensive to decarbonise 'residual emissions'. These sectors, such as the aviation and agricultural sectors will need to offset these residual emissions through the deployment of Greenhouse Gas Removal technologies (GGR) such as BECCS which can produce 'negative emissions'.

The barriers to deployment of both Pumped Hydro and BECCS are the lack of market frameworks in place to support investment in the technologies. Policy intervention will be required to support the deployment of these technologies which will be vital if we are the reach our net zero targets. For pumped hydro technology the primary issue is related to revenue uncertainty, a new facility would be exposed to fluctuations in multiple revenue streams. Therefore BEIS should explore the possibility of introducing a revenue stabilisation mechanism to support pumped hydro and other large scale storage facilities. For BECCS the primary issue is related to a lack of remuneration for negative emissions produced. At present negative emissions are not rewarded through carbon pricing or any other policy mechanism meaning that investment in these technologies cannot occur. BEIS is currently exploring how BECCS and other GGR technologies can be supported.

How to become more active Drax's current Pumped Storage Hydro facility Cruachan in Scotland provides both storage and a range of system support services such as inertia, voltage control, and frequency response to the grid helping to support the deployment of intermittent renewable technologies. Our proposed expansion of this facility under 'Cruachan 2' would enable Drax to provide additional support to the grid by absorbing greater amounts of excess renewables generation and providing more system support services to support a stable and safe operation of the network. To enable this expansion the UK government will need to tackle the market framework issue that currently makes investing in the large-scale infrastructure project difficult.

Focus Government investment If the market framework issue is resolved, Drax will be able to mobilise private investment in both Pumped Hydro and BECCS technologies. We therefore encourage the government to address policy issues which are preventing the deployment of these technologies.

Place-based resources Blank

Hard to Decarbonise The UK's Climate Change Committee in their 6th Carbon Budget advice to government outlined that a number of sectors will be difficult to decarbonise fully by 2050. These sectors include the aviation and agricultural sectors and to a lesser extent the waste and industrial manufacturing sectors. Primarily the reason that these sectors are unable to decarbonise is due to a combination of a lack of low-carbon alternatives, alternatives that are prohibitively expensive to decarbonise, or due a reliance of large-scale behavioural change. Therefore the CCC recommends that Greenhouse Gas Removal technologies such as BECCS should be deployed to offset the residual emissions produced by these sectors. Of the 58MtCO2 of negative emissions required from Greenhouse Gas Removal technologies around 53MtCO2 of these will be produced by BECCS which Drax are pioneering.

How to assess efficacy Blank

Cross-party consensus Blank

Policy misalignment Blank

How to raise awareness Blank

What to do differently Blank

Agenda for CoP Blank

Response	Number 35
Respondent	Andrew Large
Title	Chairman
Organisation	Energy Intensive Users Group
On behalf of	my sector
Sector	Energy Intensive Industries (EIIs)

Risk to that sector	Questions not followed
Opportunity for that sector	Questions not followed
Barriers from energy policy	Questions not followed
Key to decarbonising	Questions not followed
How to become more active	Questions not followed
Focus Government investment	Questions not followed
Place-based resources	Questions not followed
Hard to Decarbonise	Questions not followed
How to assess efficacy	Questions not followed
Cross-party consensus	Questions not followed
Policy misalignment	Questions not followed
How to raise awareness	Questions not followed
What to do differently	Questions not followed
Agenda for CoP	Questions not followed

Response	Number 36
Respondent	Lara Santos Ayllon
Title	Engagement Officer
Organisation	The European Marine Energy Centre Ltd
On behalf of	my sector
Sector	Marine renewable energy, green hydrogen, and low-carbon energy systems.

Risk to that sector The main risk is not moving quickly enough to meet net-zero target delivery. We can meet UK net-zero targets, but we must take decisive action now, playing to our strengths. In this line, there is also a risk that world leading innovation sectors like wave and tidal energy technologies move abroad due to lack of appropriate UK support, taking export opportunities with them. Globally, countries with good marine resources are now aggressively supporting this industry – including Canada, France, China and Japan.

Opportunity for that sector The tidal stream industry could generate a net cumulative benefit to the UK by 2030 of £1.4bn and the creation of 4,000 jobs. Wave energy could add a cumulative benefit to the UK by 2040 of £4.0bn and create 8,100 jobs . Moreover, the marine energy industry has the potential to give the UK £25bn of a £76bn global market by 2050 . Additionally, this offers the potential for the UK to become supply chain leaders, with marine energy projects currently at 60-90% local supply chain content. Moreover, wave and tidal stream energy could meet up to 20% of the UK's electricity demand , representing a 30-to-50 gigawatt (GW) installed capacity, a crucial resource to reach net zero whilst introducing flexibility and stability into the grid. Finally, these technologies offer tangible opportunities to level-up UK coastal, remote and island areas, which, further coupled with the development of electrolytic green hydrogen, will have tremendous development impacts on these areas.

Barriers from energy policy Lack of tailored policy signals that would enable sectoral development and provide certainty to investors to drive private investment. These policy signals include a ringfenced minima for tidal stream and wave energies in future CfD rounds, establishing a strike price of £250/MWh and implementing an Innovation Power Purchase Agreement (IPPA) for technologies not yet at CfD stage.

Key to decarbonising We firmly believe ocean energy is key in our future energy systems, both at utility scale and within niche markets such as offshore sectors. Ocean energy will provide predictability, supply and size flexibility and stability. Moreover, negative environmental impacts currently recorded are negligible (though monitoring must continue) and ocean energy will also be key for the coastal and offshore production of green hydrogen. Green hydrogen will be crucial for decarbonisation as storage capability, for instance, and particularly as a fuel. In this space, EMEC believes more effort needs to be applied to the conversion of hydrogen into more stable fuels such as ammonia or methanol.

- Behaviour-wise, there is a need to drastically shift our consumption model to empower consumers to understand and interact with energy consumption. Coupled with policy-led shifts towards circularity, low-waste societies and greater transparency on climate change and our environment, these technologies and behavioural changes will play important roles in decarbonisation.

Marine renewable energy in the UK, particularly tidal stream, could reach 1GW by 2030 at a cost of £90/MWh with the right policy support. There is currently a tidal stream active development pipeline of c1 GW, with 124 MW at an advanced stage and preparing to bid in. In their 2018 report, ORE Catapult assumed a 10-year lag in technology deployment for wave energy. It concluded that wave energy has an estimated practical resource of 23GW with deployment focused in the 2030s and could deploy up to 1GW of wave energy by 2040 .

Globally, IRENA identified 3 core business opportunities for ocean energy, including their essential place in hybrid electricity systems; ocean energy's synergies with offshore markets; and finally, ocean energy's role in decarbonising islands whilst meeting energy security and economic development needs . All of these are UK-relevant, given the high level of wind energy content in need of combination with other clean energy sources to ensure flexibility and stability of supply; the UK's extensive offshore industry in transformation and the array of coastal areas and islands across the UK necessitating economic generation. Additionally, the marine energy sector could create over 12,000 jobs by 2040 in the UK ; huge supply chain and export opportunities and holds great potential for green hydrogen production, valuable to meeting UK hydrogen and net zero commitments.

Barriers to marine energy development in the UK primarily originate from lack of clear policy commitments. There are investor concerns over the lack of a clear route to market in the form of revenue support. Moreover, to date most projects have deployed single turbines versus arrays, thus, technologies still carry perceived risk, which can make them uninsurable and hence not bankable. Whilst the technology for tidal stream is at near-commercial stage, with Orbital Marine Power, for instance, currently in process of manufacturing the O2, their first commercial turbine, and various other developers at TRL stages 7-9; wave energy is at an earlier stage of development. A reform of the CfD scheme, including ringfencing capacity for marine energy technologies and the establishment of a specific strike price, would enable these technologies to compete and secure public and private funding. The implementation of an IPPA would further support early stage technology development until it can compete in the CfD process.

- With regards to hydrogen, de-risking investments in hydrogen production facilities can currently be very challenging, given the absence of secure off-take commitments from not-yet-existent consumers. Moreover, a key barrier is the lack of structured regulation and standardisation of hydrogen usage and health and safety, which notably hinders demonstration projects and the investment that would accompany them.

The IPPA would be a direct cost to the HMT for the development of early stage marine energy technologies. It is estimated that this proposal will cost approximately £52.6m per year over 20 years, £26m per year less than the £78.3m per year cost of subsidising 78MW of floating offshore wind deployment that at present is showing very little UK content. Importantly, private capital takes all the risk - rebates are only available if the energy is generated and sold.

How to become more active In Orkney, our sector is designing active and flexible energy system models to enable consumers to decarbonise their lifestyles through bottom-up empowerment. As an example, the ReFLEX Orkney project, managed by a local consortium of partners, including EMEC, and led by Aquatera; will demonstrate a first-of-its-kind Virtual Energy System (VES) interlinking local electricity, transport, and heat networks into one controllable, overarching system whilst maintaining affordability. The project aims to create a 'smart energy island', demonstrating the energy system of the future, which will reduce and eventually eliminate the need for fossil fuels.

- The decarbonisation of our specific sector will come with clear roadmaps around marine renewable energy deployment which will enable long-term planning, increasing efficiency. Moreover, circular economy regulations will be key to reducing our sector's infrastructural carbon footprint whilst creating economic opportunities, increasing sectoral exchange and flexibility.

Focus Government investment Investment in marine renewable energy and in local energy systems will boost the UK supply chain and manufacturing sector, two key objectives highlighted in BEIS's Clean Growth Strategy , 2017; will secure UK export leads in a £76bn global marine energy industry and supply chain; and will result in innovative local solutions in UK regions in need of regeneration.

- Energy White Paper commitments to develop CCS facilities alongside steam methane reformation hydrogen production plants will uplift industrial clusters, yet these projects will not level-up all UK regions. 'Green' electrolytic hydrogen production facilities powered by offshore renewable generation technologies including wind, wave and tidal energy convertors offer greater longevity than those reliant upon dwindling fossil fuel sources and can provide significant opportunities for energy system resilience and economic development in UK coastal and island communities, aligning with 'net-zero' and 'levelling-up' ambitions.

Place-based resources The energy transformation must be bottom-up, directly engaging local communities and organisations, given the profound impact that it is having on individual livelihoods, economic opportunities, and regional community transformation. Place-based organisations are well-positioned to lead given their extensive experience and knowledge of what this can look like.

- As an example, EMEC is based in the Orkney Islands, which produce over 100% of energy demand from renewable sources since 2013. At EMEC, we have led and participated in innovative system decarbonisation projects by collaborating across islands, in partnership with organisations such as Aquatera, community wind providers such as Eday Renewable Energy and the Orkney Islands Council. We have pioneered green hydrogen demonstration projects tied to marine energy and have established hydrogen production and storage facilities across islands, harnessing the clean power and available resources at hand. Following the welcomed Islands Deal announced in 2020, there are various local decarbonisation projects in the pipeline, and the Orkney Islands have announced a net-zero by 2030 commitment.

Hard to Decarbonise Areas include transport, particularly shipping and aviation, and agriculture, amongst others. These sectors are essential for economic stability and are coastal and island lifeline services, whilst tackling large UK greenhouse gas emissions. There is a clear necessity for policy roadmap commitments in these arenas.

- The challenges of hydrogen use in shipping are regulatory, not technical. Codes written for other fuels are silent on hydrogen use and the regulatory environment seems isolated and impervious to terrestrial experiences. Moreover, the storage of large volumes of gaseous hydrogen remains a considerable challenge, and more effort is needed in the conversion of hydrogen into more stable fuels such as ammonia. Tackling these challenges in the shipping sector, where fuel demand is high, may facilitate transition in other fuel-reliant sectors including agriculture, aviation, and perhaps even road transport.

- EMEC also highlights the agriculture decarbonisation necessity. Orkney is an agrarian community and its 'red diesel' use is considerable, making agriculture a priority sector in local decarbonisation efforts. It is unclear if agriculture will follow a battery/hydrogen route or a hydrogen-derived fuel route. Research, development, and demonstration should be supported to test new approaches, engaging with farms. Additionally, research into innovative agriculture systems, including vertical farming and regenerative agriculture as models which capture carbon through agricultural activities hold interesting potential for the UK.

How to assess efficacy

Cross-party consensus Supporting marine energy is an area where cross-party consensus can be found, given that economic benefits, job creation and regeneration are spread across the widest reaching geographies, from supply chain and manufacturing impacts all the way to energy generation, security and exports. The Westminster Hall debate held in December 2020 saw cross-party support for revenue support mechanisms for marine energy, exemplifying this perspective.

Policy misalignment Recent government hydrogen commitments span an array of sectors and 'colours' of hydrogen generation. Whilst CCUS and hydrogen are important opportunities to revitalise industrial clusters, there is a requirement to position green, electrolytic generated hydrogen at centre-stage for three key reasons: this form of hydrogen production offers greater longevity than those reliant upon dwindling fossil fuel sources; it presents significant opportunities for energy systems resilience in coastal and island communities across the UK; and is directly aligned with government commitments to decarbonise the energy system through long-term solutions towards net zero by 2050

How to raise awareness There are an immense variety of actions which can be combined to raise awareness. Amongst them, regional and local government empowerment will be key to reach individuals and local businesses. Moreover, there is a need and opportunity for consumers to understand the links between energy consumption, consumer empowerment and climate and energy justice. Being conscious of the social dimensions of our energy system and the distributional impacts it has locally, nationally and internationally if these are not taken into account has begun to take shape through 'just transition' notions, but requires further integration in decisions at legislator,

investor, business and individual levels. Additionally, increased engagement at schooling level through activities and curricula will contribute towards preparing future generations.

What to do differently The UK has made some welcomed announcements throughout 2020. However, the pathway to green growth remains unclear, given, for instance, simultaneous new coal and gas plant construction – the government must clearly signal its clean path to decarbonisation.

- There is also an opportunity post-Covid-19 and EU exit to boost the "Demonstration" of UK R&D programmes while enhancing cross-industry collaboration . This will move the UK away from a solely research-focused, "science superpower" towards a "science and innovation superpower", one whose innovation talent stays in the UK to commercially develop and exploit its research, something we have traditionally been poor at .

- Moreover, Covid-19 has demonstrated the need to invest in high-quality lifeline and public services such as health or transport. It has also demonstrated how major shocks exacerbate inequalities drastically, analogous to the impacts of climate change and their distribution across populations nationally and globally. Just Transition commitments should span beyond the fossil fuel sector to include other mainland regions and island communities which must also undergo a 'just transition' towards new production, industry and energy consumption models, a major driver for place-based strategies to ensure that no one is left behind.

Agenda for CoP COP26 was originally planned for November 2020, until our reality was drastically overturned by Covid-19. Over the course of 2020, the UK Government has ramped up decarbonisation support and ambition funnelled through the tangible need for a 'green recove

Response	Number 37
Respondent	Adya Deshmukh
Title	Senior Process Engineer
Organisation	Fluor
On behalf of	My Company
Sector	Fluor is an engineering and construction contractor, operating in Energy & Chemicals

Risk to that sector A financial risk is that the cost of a decarbonisation technology, such as carbon capture, is not offset by either financial gain, through increased production or revenue, nor does regulation impose an appropriate financial penalty. Therefore, it is difficult for our Clients to make a business case for the design development, capital investment or the operating costs.

A logistical risk is identifying suitable storage location for carbon sequestration. These must be identified ahead of project planning. Proximity to a suitable storage site and viable dense phase (high pressure) pipeline transportation are paramount issues.

Opportunity for that sector A financial risk is that the cost of a decarbonisation technology, such as carbon capture, is not offset by either financial gain, through increased production or revenue, nor does regulation impose an appropriate financial penalty. Therefore, it is difficult for our Clients to make a business case for the design development, capital investment or the operating costs.

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Barriers from energy policy A financial risk is that the cost of a decarbonisation technology, such as carbon capture, is not offset by either financial gain, through increased production or revenue, nor does regulation impose an appropriate financial penalty. Therefore, it is difficult for our Clients to make a business case for the design development, capital investment or the operating costs.

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Key to decarbonising The key technology to start the decarbonisation process is carbon capture. There are a variety of proven carbon capture technologies. Some of these can be retrofitted to existing plants and are available for immediate deployment. The cost of renewables continues to decrease rapidly, and there is potential for a combined approach coupling renewable sources and decarbonised fossil fuel plants, with the latter supplying base load electricity.

Post combustion capture units can be retrofitted to existing plants minimising the disruption to production. The immediate impact of their deployment would be a reduction in carbon dioxide emissions by approximately 90% and they will enable existing facilities to operate with significantly lower emissions for their remaining plant life. Deployment of renewables will be the first step from fossil fuel energy, and can be supported by existing plants, the knowledge gained can further assist the development of green hydrogen.

There is no requirement for new plants to be “net zero” or have a defined pathway to achieve net zero. The current energy policy supports fossil fuel energy without any decarbonisation measures. This means that there is no financial

driving force for the oil & gas or power industries to invest in carbon capture, renewables or other methods of decarbonisation.

Capital costs are highly dependent on the specific application and site location, but would include licensor fees, engineering, procurement, construction, materials and labour costs. There will also be ongoing operation and maintenance costs.

How to become more active Fluor UK follows the Greenhouse Gas (GHG) Emissions Protocol standards for inventory over which we maintain operational control and update emission factors periodically. In 2019, we reduced our Scope 1 emissions by 3.8%, Scope 2 by 10.1% and Scope 3 by 11.7% compared to 2018. In order to help our industrial Clients decarbonise Fluor has knowledge and experience in carbon capture, biofuels, offshore wind farms, renewable fuels, renewable energy, nuclear and thermal power. In addition, Fluor is building knowledge and experience in blue hydrogen with carbon capture and green hydrogen.

Focus Government investment Fluor UK follows the Greenhouse Gas (GHG) Emissions Protocol standards for inventory over which we maintain operational control and update emission factors periodically. In 2019, we reduced our Scope 1 emissions by 3.8%, Scope 2 by 10.1% and Scope 3 by 11.7% compared to 2018. In order to help our industrial Clients decarbonise Fluor has knowledge and experience in carbon capture, biofuels, offshore wind farms, renewable fuels, renewable energy, nuclear and thermal power. In addition, Fluor is building knowledge and experience in blue hydrogen with carbon capture and green hydrogen.

Place-based resources Assist with public interface to highlight the benefits of reducing greenhouse gas emissions, including local benefits, such as cleaner air, high-skilled jobs, and investment, and addressing any local concerns.

Co-ordinate government and local authority efforts, for example with government support, local authorities may be able to assist with local plans and potentially suitable sites to help accelerate deployment of greener technologies or facilities.

Commit to clear and sustainable long-term green policy objectives and action plans for decarbonisation, with cross party representation, to encourage investment and planning from now to 2050. These measures can help reduce uncertainty for businesses, investors and communities, and secure long term benefits from investment.

Hard to Decarbonise Existing fossil fuel plants may be difficult to decarbonise as there may be insufficient space available to retrofit a carbon capture unit. Emissions can be reduced by increasing energy efficiency or ensuring policies are in place in order to amend and implement planning laws for industry to be “net-zero”.

The aviation and shipping sectors are challenging to decarbonise due to the limited energy density of current batteries compared to high density petroleum-based fuels. Furthermore, space and weight constraints limit the deployment of emissions capture units. However, possible solutions include improving energy efficiency and incorporating alternative low-carbon fuels.

How to assess efficacy Until recently, feasibility studies were conducted to evaluate the efficiency, effectiveness and cost of decarbonisation for the facility and if possible, the life cycle of the entire chain. This is complex due to differing ownership within the supply chain. The cost of decarbonisation needs to be assessed against the criticality of the climate crisis and therefore the subsequent impact of inaction. Potential impacts to the UK if our industry is not decarbonised include land lost due to rising water levels, increased flooding (including lost time for affected commercial buildings), changes to the ecosystem and public perception.

Cross-party consensus The 2050 Target Amendment to the Climate Change Act 2008 achieved a cross party consensus that the UK’s target will be to bring all greenhouse gas emissions to net zero by 2050 and restrict global warming to within 2°C above pre-industrial levels, as per the Paris Agreement. Further action can be taken to review and align existing policies, review and adjust the new UK-wide Emissions Trading System and continue support of energy efficiency initiatives.

Policy misalignment Controversies can arise when policies contradict each other, are ambiguous or open to opposing interpretation. For example, the existing planning policy hasn’t been updated to be in-line with the UK’s

net-zero commitment, as legislated via the amendment to the Climate Change Act 2008. This resulted in the approval of a large new gas fired power station in the UK. The power station will be "zero carbon ready" but will not be designed nor constructed as a "net zero" facility (that is, the power plant will generate and emit all greenhouse gases to the atmosphere). Existing policies need to be reviewed and updated in order for the UK to meet its emissions target.

How to raise awareness The core skills required are available in the workforce, however the level of experience will vary from the established carbon capture technologies to renewables and electrification to emerging technologies currently at the research and development stage, like blue hydrogen with carbon capture or green hydrogen. It might be worth considering incentive schemes that may provide opportunities to more companies to invest, grow and expand the knowledge and experience required to make the UK a leader. Highlight the importance of tackling the climate crisis and outline the UK's policy response through the media using accessible and easy-to-understand language.

What to do differently Brexit presents an opportunity for the UK to build and export world-leading expertise in decarbonisation. The UK needs to review existing policies to bring them in line with our climate targets. Post combustion carbon capture units can be retrofitted to existing fossil fuel plants. We can ensure new facilities are "net zero" with existing technology, such as nuclear and renewables, and continue to explore blue and green hydrogen.

The success of remote working across parts of the engineering sector during the CoVID-19 crisis may help companies to reduce their carbon footprint through dynamic partial work-from-home policies and reduced air travel.

Agenda for CoP The Paris Agreement was to restrict global warming to within 2°C above pre-industrial levels. A primary focus of COP26 may be to consider how this can be achieved, consider how to move away from new fossil fuel plants to renewables and explore the potenti

Response Number 38

Respondent Gerry Agnew

Title Director

Organisation Hydrogen Accelerator

On behalf of my sector

Sector The hydrogen economy in Scotland, supporting the development of hydrogen technologies for transport, commercial/domestic heating, industry (feedstock and process heat); generation of green hydrogen, its distribution, storage and export potential.

Risk to that sector Several key risks associated with developing the hydrogen economy 1) Some technologies are still within pre-commercialisation stage. Realisation will require substantial investment from private sector 2) Slow progress in modal shift towards zero emission technologies 3) Limited knowledge of existing technologies and associated benefits with potential end users 4) Risk aversion of end users 5) Relatively high cost of producing green hydrogen, currently, due to small scale 6) Lack of OEMs bringing products to market in the UK immediately. Whilst there is a desire to decarbonise heavy duty fleets in the public and private sectors, a shortage of offerings, particularly in the mass market segments, risks meeting decarbonisation targets

Opportunity for that sector The UK hydrogen sector provides a route to decarbonisation due to the UK's renewable resources. This not only gives energy security for the UK but capability for mass export of green hydrogen. The creation of a green economy would be well positioned in the UK given the skills and capabilities from the key oil and gas industry. Public and private sectors will be benefit by combining the transition to zero carbon technologies with enabling rationalisation and operational efficiencies of their fleets. Enhanced fuel efficiency allows for extended duty cycles of zero emission fleet vehicles, allowing for fewer vehicles being utilised overall, thus reducing capital expenditure.

Barriers from energy policy There is a lack of consistent policy and a coherent understanding of the sector's capabilities in the decarbonisation of the UK which currently limit mass deployment. While the UK government continues to incentivise fossil fuel production, transition to a net zero economy will lack momentum and create uncertainty for investors in green technology. The introduction of a fiscal framework that deters further investment in fossil fuels but encourages some key oil and gas majors to diversify to low or zero carbon technologies would be beneficial. This would make green technologies more economically competitive and more viable for large scale investment.

Key to decarbonising 1) Hydrogen powered heavy duty vehicles (HDV), both in public and private sectors: 1-2 years for small scale deployment of local authorities/public sector HDV fleets and associated refuelling infrastructure 2) Collaboration between public and private sector enables rapid scaling up of zero emissions technologies within the hydrogen sector 3) Battery technology will remain essential for decarbonising light duty vehicles (LDV) and is required to support fuel cell electric technology. This is a more mature market in comparison with hydrogen vehicles.

1) Reduction in carbon emissions 2) Reduction in air pollution, such as NOx and particulates 3) Reduction in noise pollution (particularly in urban areas) 4) The effects listed above will lead to improved health and well-being of the general population. This in turn will create a reduction in pressure on the health services with economic benefits from lower sickness levels. 5) Visibility of zero emission vehicles will aid in creating broad public acceptance of new green technology and appreciation of their benefits but more engagement with the community will be required 6) Enables the UK to meet climate change targets

1) Lack in confidence in hydrogen pricing, which is driven by uncertainty over demand and supply of renewables 2) Lack of transparency on pricing of both hydrogen and underlying off-grid renewable electricity, creating uncertainty for investors to invest in green hydrogen production. 3) Immature supply chain for hydrogen technologies 4) Lack of public funding to de-risk the economics of new solutions in green hydrogen

Due to small volumes and new technology, capital costs are currently high. Maturation of technology and economies of scale will bring these down and are expected to make technologies competitive with incumbent ones. Similarly, the operational use of green hydrogen is still relatively expensive too. This would benefit from government incentives and the appropriate fiscal framework with regards to non-renewable fuels. The cost of green hydrogen is largely dependent on the cost of electricity and clear pricing policy on this front would give the private sector confidence in further investing in green hydrogen to create economies of scale

How to become more active 1) Hydrogen Fuel Cell technologies have been proved to be suited to heavy fleet vehicles. Public sector organisations could conduct joint procurement frameworks thereby achieving economies of scale for the vehicles and hydrogen fuel supply/scale. 2) Public and private sector fleet operators can achieve improvements in overall operational efficiency of their fleets, due to fuel efficiency improvements for zero emission technology. This allows for extended duty cycles per vehicle and thus a smaller overall number of vehicles would need to be operated, therefore lower capital investments. 3) It is critical to de-risk the longer operating hours of high value hydrogen assets to ensure competitiveness through total cost of ownership.

Focus Government investment 1) Investment in better component, systems, subsystems and process integration of hydrogen technologies to achieve their full potential; this should include technology around fuel cells and electrolysers. This would result in more effective decarbonisation in a wide range of sectors such as transport (including rail, aviation and maritime), agriculture and heavy industries 2) The corresponding infrastructure for large scale deployment of hydrogen. This should include high density storage solutions, such as ammonia or synthetic fuels. We see these as more viable than liquid hydrogen.

Place-based resources 1) Drive the green agenda communications to ensure that citizens are fully aware of the benefits that the green agenda will have on their own lives - fairer, healthier wellbeing. Creation of green jobs, strong green economy. 2) Support and educate public/private sector organisations on the benefits of zero emission technologies. 3) Incentivise the modal shift to zero emission technologies. 4) Communicate and recognise the benefits of increased air quality to the public in terms of physical and mental wellbeing 5) Overall economic benefit of improving public health 6) Provision of green housing, local transport and infrastructure to ensure that all citizens remain connected.

Hard to Decarbonise 1) Heavy duty transport; battery technologies are not an option due to the intensity of duty cycles 2) Heavy industry (steel, cement, petrochemical, etc.). These have high heat requirements (currently provided by burning fossil fuels) and high carbon emissions due to processing of feedstock 3) Commercial and domestic heating - heating by hydrogen is viable particularly if distribution is through existing natural gas infrastructure 4) Behavioural shifts encouraging the public to use public transport instead of passenger vehicles is an alternative to decarbonising light duty vehicles 5) De-risking the economics of new solutions in green hydrogen is essential so investors are confident in their investments

How to assess efficacy The cost of decarbonisation should be assessed through full life cycle analysis. This should include not only direct and easily identifiable costs, such as capital and operational expenditure of energy production, storage and distribution, but also indirect benefits from the green transition. The latter includes improvements in physical and mental well-being, economic gross values added through new high value inward investment.

Cross-party consensus 1) The building of the UK's green hydrogen economy creating a leading role for the UK in the global hydrogen market with huge export potential 2) Continuing the UK's reputation of science and innovation excellence by leading the energy transition 3) Diversification of our oil and gas industry into sectors such as hydrogen utilising skills and expertise, and building strong manufacturing/supply chains.

PGES 40th Anniversary Inquiry into Energy Policy APPENDIX III Full listing of responses as received

Policy misalignment 1) To enable innovation at pace there is an urgent requirement to review public procurement policies as currently it is a real barrier to achieving decarbonisation targets. 2) Disproportionate investment in road infrastructure despite the need for decarbonisation.

How to raise awareness 1) Education and communication on climate change information to the general public - providing foresight of the long-term effects of carbon, NOx and particulates. 2) Communication of how day-to-day life will change for the general public and how these measures will contribute to fighting climate change.

What to do differently The post-COVID-19 recovery and climate emergency provide perfect opportunities to dispel equalities across the UK through skills development of existing workforce and the creation of high value jobs within the green economy of the future. Engineering and manufacturing expertise should be effectively utilised to build the UK's renewable industry to affect this green transition. This industry encompasses renewable energy generation, such as wind, solar, tidal and wave power, but also energy storage and conversion technologies. The health benefits of using green technologies will ultimately lead to reductions in inequality; the effects of which have been laid bare by the COVID-19 pandemic.

Agenda for CoP COP26 is a golden opportunity for the UK to demonstrate to the world how it is taking the climate emergency into the heart of our transition to a green economy. Innovation, skills, expertise, our abundance of renewables and the ambition to create a green

Response	Number 39
Respondent	Amy Fleming
Title	Public Affairs and Campaigns Adviser
Organisation	Local Government Association
On behalf of	my sector
Sector	Local Government

Risk to that sector Developing renewable energy projects carries risk for councils, and the risks will vary according to the nature of each individual site. Specialist and technical expertise is required and there is an upfront cost, if a council takes on the development role themselves.

These risks are set against a broader backdrop of financial uncertainty for councils, and the pressures of Covid-19 on already stretched budgets. The LGA is calling for government to support councils by giving them have clarity and certainty about how all local services will be funded over the next few years and beyond.

Opportunity for that sector Councils have expert localised knowledge of their places and residents and have been proactive in this area for some time. Scaling up the supply of renewable energy to meet decarbonisation targets will require a step change in the amount of activity and the scale of projects. This was the subject of a recent renewable energy good practice guide developed for the LGA by Local Partnerships. The guide notes that solar PV could be a viable option for development, but without subsidy the most feasible options are solar farms with a private wire connection or larger sites over twenty megawatts. The opportunity to develop onshore wind appears to be difficult because of planning constraints. Councils also have a key opportunity to unlock growth in local green jobs, and this is addressed further on in our submission.

Barriers from energy policy Councils can play a lead role in developing a flexible, low carbon, resilient energy supply if they are given the tools and powers. Realising the full benefits will require greater investment in and incentives for renewable energy solutions. In particular, significant opportunities present in the green growth sector if the approach to delivery is flexible and designed around place.

Key to decarbonising We want to work with government to establish an overarching framework for decarbonisation and tackling the climate emergency, that will define a clear route for adopting the behaviours and technologies that will meet net zero ambitions. The framework should set out responsibilities for the Government nationally – for example, aligning the regulatory system, including the planning system and national tax incentives – and the local responsibilities, together with a commitment to cooperate with local public sector bodies. There should be a process of engagement between central and local government to enable councils to fulfil their role to translate a national framework into transformative local plans that deliver on this agenda and invest in solutions for a green recovery and future.

How to become more active Local government has made significant progress in reducing energy use in its own buildings. Programmes such as the Re:fit programme operated by Local Partnerships and the GLA provide a financial framework for investing in energy efficiency measures. The One Public Estate programme is delivered jointly by the LGA and the Cabinet Office, and although not targeted specifically at decarbonisation it has supported councils and other public sector organisations to rationalise the land and buildings they own and provide services in a way that meets the need of their local communities.

Focus Government investment Investment in a new generation of social housing could return £320 billion to the nation over 50 years. It is therefore imperative that the right measures and reforms are in place to support councils

to deliver 100,000 high quality social homes per year, which will help to boost the economy, support the low carbon transition and provide well-needed affordable homes.

Greater investment in and incentives for retrofitting renewable energy will help accelerate improvements in our existing housing stock and faster deployment of low-carbon solutions such as for heating. We know from work that we have commissioned from Savills that the cost to councils of achieving net zero carbon emissions from their housing stock is around £1 billion per year over the next 30 years. Further detail is set out in our submission to the Spending Review 2020.

Place-based resources Councils can use their role as local leaders to bring together the skills and low carbon agendas to unlock growth in their areas, as shown in LGA commissioned analysis by Ecuity. It found that nearly 700,000 jobs could be created in England's low-carbon and renewable energy economy by 2030, rising to more than one million by 2050. Nearly half will be in clean electricity generation and providing low-carbon heat for homes and businesses (manufacturing wind turbines, installing solar panels and installing heat pumps).

An integrated and devolved approach to development of skills can achieve better outcomes for local communities and the economy. This could be delivered using the LGA's Work Local proposal for devolving funding and powers over skills to local areas.

Hard to Decarbonise Blank

How to assess efficacy Blank

Cross-party consensus Blank

Policy misalignment Blank

How to raise awareness Our evidence indicates that councils are highly aware of the link. In February 2020 the Local Government Association (LGA) conducted a survey of Directors of Environment or equivalent of all councils in England. The purpose of the survey was both to assess what actions councils have already taken to mitigate and/or adapt to climate change and to ask them what policy changes would enable them to do this in future more effectively. The most frequently delivered climate change mitigation projects included installing energy saving measures in the council's own building stock and electric vehicle charging points, along with communications campaigns around climate change and small-scale photovoltaic installations.

What to do differently It is vital that the economic recovery is climate smart and prioritising environmental goals is a key part of this. This can be best achieved by working through local government and greater devolution of funding, powers and flexibilities.

Scaling up energy generation from renewable energy sources is vital for meeting the 2050 net zero target and to build capacity in energy infrastructure to meet the additional energy demands from electrification of transport and heating. This could also allow the UK to become self-sufficient in its energy supply and continue to make rapid progress towards eliminating the use of fossil fuels to generate energy.

Agenda for CoP We want to work closely with Government on its work to deliver COP26. As leaders of place, it is the role of local government to translate a national framework into a transformative local plan that communicates the co-benefits and shapes behaviour, invest

Response	Number 40
Respondent	Dr Diana Casey
Title	Director, Energy and Climate Change
Organisation	Mineral Products Association
On behalf of	my sector
Sector	Minerals (cement, lime, asphalt, silica sand, aggregates, concrete etc)

Risk to that sector For sectors operating in international markets, like cement and lime, the key risk is that the cost of decarbonisation damages competitiveness. High UK energy prices compared to those faced by competitors in other countries are a significant contributor to this risk. For other mineral products, the key risk is that policy moves faster than the technology that enables decarbonisation e.g. the rebate on red diesel is being removed to try and phase out its use, but there is currently no alternative for heavy quarry vehicles and so this policy just places a burden on industry and can result in an increase in infrastructure and housing costs.

Opportunity for that sector The opportunity to provide a secure domestic supply of low or zero carbon mineral products. Mineral products have the potential to be net negative carbon, i.e. used as a greenhouse gas removal technology to extract CO2 from the atmosphere and therefore help offset emissions from other sectors. This could offer new market opportunities for MPA members and contribute greater GVA and jobs to the UK economy.

Barriers from energy policy The cost of decarbonising power generation adds £millions to industrial energy bills and diverts funds away from industrial decarbonisation. These energy costs will only increase as networks are expanded and reinforced to adapt to more intermittent and dispersed electricity generation. Although domestic consumers are protected from price rises, industrial consumers are not. While UK energy prices remain some of the highest in the world, the competitiveness of industry is at risk. The MPA is concerned that gas supply is increasing subject to the same pressures, with the introduction of the Green Gas Levy and increase in Climate Change Levy.

Key to decarbonising The UK concrete and cement industry roadmap to beyond net zero highlights seven different technologies that can reduce emissions to net zero and remove more greenhouse gases from the atmosphere, thereby helping to offset emissions from harder to decarbonise sectors. Many of these technologies have wider applicability across the mineral product industry. Some technology deployment is underway but others require further technology development, funding support, or national infrastructure (e.g. greater electrical capacity or transport networks for CO2/hydrogen) . Timescales very much depends on national policy to accelerate infrastructure projects and to ensure industry can remain competitive whilst investing in decarbonisation.

Decarbonising foundation industries, like mineral products, will have positive consequences for the decarbonisation of downstream supply chains e.g. ensuring zero carbon concrete is used in building homes and infrastructure, decarbonising water supply and wastewater treatment. There is also an opportunity for mineral products to extract further CO2 from the atmosphere, thereby helping to offset emissions from other sectors.

Decarbonising heat is a key barrier for our sector and is hampered by bioenergy policy approaches. For example, Government policy is incentivising bioenergy away from the sector. The CCC have highlighted that limited biomass should be targeted and combined with CCUS. The cement and lime sectors are ideal for this but can't access policy incentives including CfDs or the Green Gas Support Scheme, to enable them to compete with incentivised consumers. Another barrier is the dispersed rural locations of mineral sites. Current policy focus is industrial clusters, but dispersed sites must be considered in parallel to enable decarbonisation by 2050

CCUS is probably the most costly technology for mineral producers to deploy. Not only will the capex be in the region of hundreds of millions of pounds but ongoing operational costs could double the cost of mineral production compared to today. Policy can also increase costs. For example, MPA members are struggling to access biomass to switch away from fossil fuels because of policies that incentivise its use elsewhere. MPA analysis suggests that current policy approaches to bioenergy and waste have the potential to cost the sector £1.6 billion between 2021 and 2050 and increase sector emissions by 200 million tonnes.

How to become more active Cement production already uses energy flexibly through diversification of fuel mix from fossil fuels to waste biomass fuels. The lime sector could replace its natural gas with biogas, but current policy incentives make it more cost effective to use biogas to produce biomethane for the gas grid or to generate electricity, both of which are less efficient uses. Hydrogen may be an option for cement and lime production but this depends on availability of a secure, cost-effective supply and the conversion of kilns to its use. It is not possible to switch energy demand off instantly for continuous mineral production processes. However, such processes offer the benefit of a steady and continuous baseload that can help balance energy grids.

Focus Government investment Government investment would be best used to support and accelerate the deployment of innovative technologies (e.g. CCUS and hydrogen production and use in the natural gas grid) that would not be possible whilst there is an unequal global carbon price and unequal UK energy incentives. Government must finance the CO2 and hydrogen infrastructure and support the deployment of fuel switching, including the use of biomass and biogas, and carbon capture in industry. Ensuring that industry is not overburdened with the costs of increased electricity capacity requirements will also be important.

Place-based resources Procuring and championing locally produced low carbon products may help generate markets for such products. Ensuring planning applications related to decarbonisation can be turned around quickly is also required if the 2050 target is to be met. A focus on public procurement that examines whole life carbon rather than just embodied carbon will support the adoption of the most environmentally appropriate solutions. This will help protect UK manufacturing from offshoring emissions by encouraging UK place-based industry not to be replaced with international imports.

Hard to Decarbonise Process emissions from cement and lime production are hard to decarbonise as there is no alternative to reduce them besides carbon capture, a technology which is yet to be tested in cement production and which is costly to deploy. This is made even more difficult by the rural location of many of these plants. Maritime transport, HGV and non road mobile machinery also pose a decarbonisation challenge. The long distances some HGV's have to travel make alternatives to diesel more difficult to design and the high energy required to transport tonnes of stone/rock around quarries also presents a challenge.

How to assess efficacy Firstly measurement of consumption emissions must rise up the agenda, to ensure the UK is truly decarbonising and not just shifting the problem elsewhere. Government policy and incentives must be more widely assessed to ensure there are no unintended consequences outside of the sectors for which they are intended. For example, MPA analysis suggests that current policy approaches to bioenergy and waste have the potential to cost the sector £1.6 billion between 2021 and 2050 and increase sector emissions by 200 million tonnes.

Cross-party consensus There is consensus regarding clean growth, i.e. decarbonising, but not through deindustrialisation. Therefore more action is required to provide support to industry to enable and accelerate its decarbonisation.

Policy misalignment There is limited recognition of how essential mineral resources and associated products are to society. Despite the role that minerals play throughout the economy, supply is often assumed without any understanding of the time, effort and investment needed to maintain the availability of these important materials and products. Planning takes decades to progress, environmental permits and biodiversity management are prerequisites. Without policy development and decision making recognising the essential contribution made by mineral products, strategic ambitions for infrastructure, for public services and for housing, will not be delivered in the most cost effective or sustainable manner. Another possible controversy is related to energy costs and how these are distributed between domestic and industrial consumers. The Energy White Paper makes it clear that

Government intend to keep domestic users costs down, and support UK industry, but what solution can achieve both these aims?

How to raise awareness Whole system policy decision-making is needed to achieve net zero. Government policy impact assessments need to assess how a policy adds to the cumulative burden of policy costs already existing, rather than assess its impact in isolation. The cumulative burden of energy and climate change policy costs is of great concern to mineral products. For example, the cumulative burden on the cement sector is estimated to be £10/t cement in 2020, rising to £55/t cement in 2030. When rising network costs are factored in, the cost in 2030 rises to almost £60/t cement. This equates to costs across the cement sector of almost £600m per year in 2030.

What to do differently Reassess how energy costs are distributed to ensure the burden doesn't fall on energy intensive industries rendering them uncompetitive in international markets. Ensure benchmarking and subsequently free allocation is assessed at UK level for UK ETS. Initially, the system is based on EU plant data only and in some sectors, it is not representative of UK plants. As a result, it disadvantages some UK sectors compared to their European Competitors. For example, the UK lime sector benchmark will be unachievable for UK plants because the EU data was skewed by a handful of plants in southern Europe that have access to biomass fuels, not available anywhere else

Agenda for CoP The UK needs to press for a level -playing field on international carbon pricing. Border adjustment mechanisms are rising up the agenda and should be a consideration for UK policy and the UK should lead the debate on this issue. The UK should also be lead

Response	Number 41
Respondent	Jon Cape
Title	Managing Director
Organisation	Power Circle Ltd
On behalf of	My Company
Sector	Energy

Risk to that sector Enabling a swift and also just transition

Opportunity for that sector A new fairer and more effective energy system

Barriers from energy policy Fossil fuel subsidies

Key to decarbonising Answer to question above: Smart Local Energy Systems (SLES). Timescale: Now

This will deliver all four 'D's of the Energy Transition, if done in the right way: Decarbonise, Decentralise, Digitalise, Democratise.

We have witnessed barriers to scaling up SLES and low carbon deployment generally as follows: constraints on meeting capital costs, staff and management time and/or expertise constraints, risk appetite, 'not our core business/too complex'. We have designed a business model which addresses each of these barriers. See next section.

Cost depends on how solutions are structured: Conventional approach: prohibitively high upfront cost. Energy services company(esco) approach: manageable costs since principal financial appraisal criterion shifts from capital cost to whole life economics i.e. NPV/IRR.

How to become more active By partnering to adopt the kind of business model we outline below

Focus Government investment Pump-priming projects utilising new business models such as esco models and PACE-style programmes. Esco models are described in the next section. PACE-style programmes: these have been hugely successful in Canada and the US with some $7bn investment over the past decade. They are what the Green Deal should have been. They can be Government or privately financed. Here is a summary: Website for co-ordinating organisation in the UShttps://pacenation.org/Since 2009:$7.7bn funding provided across 30 states 282,000 projects. Thus average project cost: $27,305 Notes from Sept 2019 – Canada/US figures from a PACE service provider, not verified: Default rate <0.001%PACE ranks over mortgage debt150,000 homes with PACE loans and no claims against risk reserve PACE term up to 20 years, 10-15 years typical. Typical interest rate 4%Local authority margin (for admin of loans) c0.5-0.75%Set up cost for local authority: c £50-100,000.Loan runs with the property but most loans paid off on house sale (I presume a higher purchase price can be commanded with lower running costs) Applicable to new build – in US but not yet in Canada Loans structured with no upfront cost and cash flow positive from Y1 with flexible early payments No penalty for early repayment Accelerated repayment is frequent Legislative basis: state legislation and LA bye-law. Claim that studies show increase in property value (I don't have the details) Household and SMEs can access PACE Source of finance: US 100% private, Canada mostly public. Scope for public/private mix.

Place-based resources We believe, from the evidence we have witnessed, that they can best be harnessed by promotion and adoption of the type of social esco/VPP model we have developed as outlined below. Power Circle provides one example. We don't expect or want to be the only one, however at present the Energy Systems Catapult – in a study carried out for us – has not found others quite the same. Power Circle social esco/virtual power plant

(VPP) model: Power Circle helps all sections of the community to benefit from the new energy world and to decentralise power in an economic sense as well as physically. To achieve this, Power Circle is being established as a new social Energy Service Company (esco) and Virtual Power Plant (VPP). The esco provides development, management and, where needed, funding. The VPP links sites together, getting paid to help energy companies cut costs and carbon. We can provide more details.

Hard to Decarbonise Many. One example we have been working on is gas central heating. It is cheap, simple to operate and popular. There are instances of social landlords, under pressure from tenants, taking out newly installed heat pumps and reverting to gas. This is understandable, where a simple approach is taken as the tenant often finds bills rising. In our model, where the heat pump forms part of a smart local energy system, heating bills can be competitive with gas, bills for other electricity uses fall and the system is as easy to operate for the tenant as gas.

How to assess efficacy (i) take 'whole life economics' not capital cost as primary energy option appraisal criterion, and have the business models in place and accessible and trustworthy (trust in utilities is low, esco approaches need long term customer agreements, our social enterprise-based model combines scalability with trust) to support that shift (ii) build in 'externalities' e.g. climate damage to the assessed cost of high carbon options.

Cross-party consensus Climate goals are shared in not always timeframes. From this base, we can build consensus around the types of solution we outline here, where Government money is a pump-primer not an endless subsidy.

Policy misalignment Effective carbon pricing

How to raise awareness Highlighting the need for new approaches to deliver a transition which is both swift and just is one example: Meeting carbon targets and keeping energy affordable is a big challenge. A study for National Energy Action has projected that, on reasonable assumptions with today's solutions, getting to net zero will place up to 2 ½ million more people into fuel poverty and add between £200 and £800 per year to household energy bills. We can raise awareness both of this challenge and of new approaches like outs which are needed to meet the challenge.

What to do differently (i) Build Back Greener and make the economic stimulus package which will be needed something along the lines of a Green New Deal with effective support on scale for insulation programmes, as an example. (ii) Post Brexit seek to reduce the significant trade frictions with EU companies which we are experiencing,

Agenda for CoP Actually delivering on Paris.

Response	Number 42
Respondent	Ian Roberts
Title	Director
Organisation	Roberts Durur Ltd
On behalf of	My Company
Sector	Process steam and high temperature hot water generation equipment (boilers).

Risk to that sector Currently there are no viable alternatives to hydro-carbon fuels

Opportunity for that sector It could use surplus electricity from constrained wind farms to displace hydro-carbon fuels if it were made available at a competitive price.

Barriers from energy policy A market for this surplus electricity does not exist. At present the wind farms are paid a very large subsidy to shut down and not generate.

Key to decarbonising Immediate using off the shelf technology for initial full scale demonstration / industrial take up.

Potential for up to 0.75 million tonnes of CO2 emissions to be prevented (based on data to 31/03/2020)

BUT A market to unlock this does not exist.

Once demonstrated, if the pricing is competitive the end users would likely bear much if not all of the cost as there is a huge desire within many industries to de-carbonise.

How to become more active This would essentially be a form of Demand Turn Up (DTU). DTU is not suitable because it is opaque and does not provide any long term certainty.

Focus Government investment Create a viable market in which the surplus electricity can be used which provides long term certainty. The only previous option for this, Demand Turn Up is not currently operating and does not offer any certainty to the end user (boiler operator).

Place-based resources Blank

Hard to Decarbonise Process steam and high temperature hot water – no technology other than conventional boilers are currently available. All de-carbonisation to date has been via fuel switching which still results in signification amounts of CO2 emissions. The boilers are essential in many sectors.

How to assess efficacy Blank

Cross-party consensus Blank

Policy misalignment The proposal would result in a reduction in the subsidy paid to wind farms which frequently attracts negative press coverage.

How to raise awareness Blank

What to do differently Blank

Agenda for CoP Whilst this isn't the most important, it would provide a boost to the UK as there are no similar proposals anywhere else in the world that I am aware of – it could be a world first.

Response	Number 43
Respondent	Celia Greaves
Title	CEO
Organisation	UK Hydrogen and Fuel Cell Association
On behalf of	my sector
Sector	UK Hydrogen and Fuel Cell Association

Risk to that sector A key risk is that the UK fails to place hydrogen and fuel cells at the centre of its decarbonisation strategy, as recommended the Committee on Climate Change and other key thought leaders. Government needs to define immediate steps for the roll-out and scale up of hydrogen and fuel cells in the UK. Action should be focused on supporting sector development between 2020-25, from 2025 to 2030 and with an indicative pathway from 2030 onwards.

Opportunity for that sector It is widely recognised that hydrogen and fuel cells are essential to net zero. Not only are they the only option for delivery in hard to decarbonise sectors, they also offer a cost-effective alternative across a range of other parts of the energy landscape, and can deliver system balancing and resilience through hydrogen storage. More broadly, hydrogen and fuel cells have the potential to become a leading sector for job creation and UK exports. National Grid's Future Energy Scenarios 2020 suggest that up 190TWh of hydrogen will be needed by 2050. See also question on timescales for deployment.

Barriers from energy policy Reflecting its importance in net zero, there has been growing momentum around hydrogen. This now needs to be reflected across all aspects of Government's approach to energy, heat, transport and system flexibility. A comprehensive hydrogen strategy that encompasses the full breadth of opportunities for hydrogen to deliver decarbonisation and provides the policy levers to support change in the timescales needed to achieve net zero is a key requirement. Many leading nations are accelerating plans and activities to support hydrogen and fuel cells, and the UK is at risk of missing out – see also our answer on the effects of deployment.

Key to decarbonising Whilst we support Government's target of 5GW low carbon hydrogen production by 2030, we believe there is scope for greater ambition, with UK industry ready to deliver 25GW of low carbon hydrogen. Hydrogen fuelled fuel cells, which deliver zero carbon power, heat and transport, are already being deployed (see below). As hydrogen production costs fall with scale-up, and with policy mechanisms which recognise the contribution of hydrogen applications to both net zero and UK global competitiveness, demand will grow exponentially beyond 2030 (see Aurora's 'Hydrogen for a Net Zero BG' study and National Grids' FES 2020 for potential rates).

Effect: As well as being critical for the achievement of net zero, hydrogen and fuel cells have the potential to become a leading job creation and export sector. The UK has world leading hydrogen production, fuel cell system and supply chain capabilities. With appropriate policy support, these are well placed to flourish as the global hydrogen economy grows to be worth $2.5 trillion, and support 30 million jobs, by 2050. The Hydrogen Taskforce recently concluded that a commitment to hydrogen by Government could create over 74,000 jobs and generate up to £18billion of GVA for the UK per annum by 2035.

Barriers: The key barrier to deployment is the lack of a cohesive whole system strategy for hydrogen which encompasses power, heat, transport and system resilience. The strategy will not only need to cover the short-term support and policy / investable funding mechanisms needed to build capacity, reduce cost and stimulate demand (for example, a direct production price support such as a Feed-in-tariff), but also address specific barriers, such as

the lack of coverage of the RTFO for transport modes other than cars, allowing hydrogen to qualify for the green gas levy, development / adaptation of safety regulations and standards etc.

How to become more active Blank

Focus Government investment Investment is needed now to scale up supply and stimulate demand. Much of this will be initially focused in regions of the UK covered by the 'levelling up' agenda, with decarbonisation of industrial clusters via hydrogen in areas such as the Humber and North West. These clusters can then form the focus for further hydrogen infrastructure development, for example in transport.

Place-based resources Blank

Hard to Decarbonise Blank

How to assess efficacy Blank

Cross-party consensus There is broad cross-party support for the role of hydrogen in line with the CCC's view of it being a 'key enabler' for net zero. However, a recent report from Ballard and Deloitte found that "UK Government support for hydrogen and the fuel cell market was less consistent and coordinated compared with other European countries". If the UK is to seize the opportunity which hydrogen and fuel cells offer not only for decarbonisation but also to build on our world leading capabilities to grow a new and valuable green industry, it needs to act now and decisively.

Policy misalignment Blank

How to raise awareness Blank

What to do differently The key requirement post BREXIT and CoVID-19 is to rapidly shift from analysis to action. As we look to grow back our economy, and build industries for the 2030s and beyond, hydrogen and fuel cells can enable the UK to become a leading exporter of knowledge and technology in the global market. Associated jobs will replace those in shrinking industries, such as conventional oil and gas. It will be important to ensure that lessons are learned from experiences in, for example, offshore wind, where early UK leads in terms of the domestic industry were lost.

Agenda for CoP We support the notion of a strong focus on green recovery at COP26. As discussed above, hydrogen and fuel cells have a key role to play in delivering this recovery, with substantial growth potential and a key role in achieving net zero. COP26 provides a

Response	Number 44
Respondent	Anon
Title	
Organisation	
On behalf of	myself
Sector	Energy

Risk to that sector A key risk is that decabonistaion of homes requires mass adoption of behaviour or equipment, despite a great lack of understanding of the issues

Opportunity for that sector Domestic heat. Displacement of methane with hydrogen. The lifestyle revolution we have just experienced demonstrates that behaviour change is possible if people believe in what they are being asked to do. When they lose faith in advisers, they cease to follow the lead (The Cummings Effect)

Barriers from energy policy Supply dominance in policy thinking. There is no market for surplus weather based electricity, instead generators are subsidised to cease production.

Continual reference to engaging consumers with the energy market is futile, until they are actually involved in generation, storage and consumption.

Key to decarbonising Key behaviour change is to eliminate wasted energy.

Key technology, utilisation of excess weather based energy.

How to become more active Change Building Regulations immediately to require the installation of: smart meters; stored hot water (or other storage facility); solar generation (heat or power); the pipework and underground elements of heat pumps.

Enforce B Regs at change of occupancy.

Focus Government investment Invest in R&D, perhaps by means of tax credit for carbon/energy reduction developments.

Link "Build Back Better" incentives to carbon/energy reduction measures and activities

Place-based resources Use local and regional bodies to drive installation of waste reduction (energy efficiency) measures. These can only be fitted in situ.

Hard to Decarbonise All forms of energy have some form of pollution or effect on their surroundings Carbon is essential in many processes. De-fossilisation is probably closer to the intent.

How to assess efficacy Efficiency should be measured, not deemed, especially in household consumption and effect.

Cross-party consensus Hydrogen

Policy misalignment Nuclear

How to raise awareness Education at all ages. Until people understand the issues and what they need to do they will not act.

What to do differently Change VAT, so that it is lower on energy waste reduction measures than on the fuel being wasted.

Promote energy efficiency as the elimination of waste.

Remove social policy from energy policy - Fuel Poverty is Poverty. Those who are able to pay should be included (and obliged) in the drive to reduce wasted energy.

Because climate and energy policy has its effect way beyond the length of any parliament, set legally binding targets and milestones for achievement of the Net Zero ambition, but do not specify the technologies that will achieve it.

Agenda for CoP Secure agreement to treat Climate Change with as much urgency as CoViD.