Bioenergy Update

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1. Ministerial Foreword

Paul Wheelhouse - Minister for Energy, Connectivity and the Islands

Decarbonisation of our energy system, and doing so at pace, is essential to meet our ambitious targets of reducing greenhouse gas emissions by 75% by 2030 and Net Zero by 2045. Our Climate Change Plan update (CCPU), published at the end of December 2020, set out bold actions, which chart our pathway to our new emissions reduction targets out to 2032 and sets out the steps we will take to support a green economic recovery and a just transition for the people and communities of Scotland. The CCPU will therefore help to ensure that our transition to net zero is geared to creating jobs, enabling sectors like oil and gas to diversify and one that enables a green economic recovery from the effects of the Covid-19 pandemic.

Recent advice from our statutory advisers, the Climate Change Committee (CCC), states that “sustainable bioenergy is essential for reaching net zero”. This document, in response, sets out our programme of work that we plan to undertake to appraise the potential to scale up our bioenergy sector, in line with the CCC advice.

Biomass provides two main routes to mitigate climate change and reduce emissions. First, as a carbon sink, it helps by removing carbon dioxide from the atmosphere and storing it for long periods of time in soils, trees and other plants. Second, as a renewable energy source, it helps by directly displacing oil, coal and natural gas use or by decarbonising the fuel source for the production of materials such as steel and cement.

Biomass production is part of a land system with finite assets that provide multi-functional uses and benefits for all of Scotland. We need to better understand these relationships and interdependencies, to ensure that the land and resulting biomass are used in the most effective way.

In order to do this we will engage across a wide range of sectors: agriculture, forestry, energy, waste, planning, transport and environment, guided by an Expert Panel, which we will establish over summer 2021.

This will ensure we capture a comprehensive range of perspectives and take a ‘whole system’ view in developing the actions we will take in Scotland in respect of bioenergy.

Our approach, set out in this document, is to understand and support the role and potential of bioenergy to help meet our net zero targets.

Paul Wheelhouse
Minister for Energy, Connectivity and the Islands

2. Introduction

Purpose

To set out the potential role for bioenergy[1] to support our net zero greenhouse emissions targets and outline how we intend to move forward over the next 18 - 24 months to understand the most appropriate and sustainable use of bioenergy resources in Scotland.

Bioenergy is cross–cutting, affecting a wide range of sectors including agriculture, forestry, energy, waste, planning and transport. All relevant Scottish Government policy areas will be part of the work to ensure that a strategic/co-ordinated approach is adopted.

Context

The Scottish Government made a commitment in our Scottish Energy Strategy (December, 2017) to publish a Bioenergy Action Plan. However, since then, there have been a number of key developments at both a UK and Scottish level which may have a bearing on the role that bioenergy could play in the energy transition. These therefore give rise to the need for further investigation before a Bioenergy Action Plan can be agreed; in particular, the following changes are noted:

- The adoption by the Scottish Government of world leading net zero targets by 2045 and a new target to reduce emissions by 75% by 2030, and the commitments in the Climate Change Plan update (December 2020) which relate to bioenergy's role in the transition to net zero.

- The publication of the UK Government Energy White Paper[2] (December 2020) – Powering Net Zero Future, which proposes a number of commitments for bioenergy; and

- The publication of the Climate Change Committee (CCC) 6th carbon budget advice (December 2020), and its view of the role of bioenergy.

[1] Bioenergy is defined as follows: The generation of heat, electricity or transport from material derived from biological sources.

[2] Energy white paper: Powering our net zero future - GOV.UK (www.gov.uk)

Overall the Scottish Government's aim is to see bioenergy used where it has the greatest value in reducing emissions, however this decision is also dependent on which sectors will make the best use of the bioenergy feedstocks that we can grow sustainably or produce domestically in comparison with those we may need to import.

Our overall intention is to develop a strategic framework or set of guiding principles that will complement our waste hierarchy and wider circular economy drivers and commitments.

We will assemble a Scottish Government working group comprised of colleagues from across all relevant policy areas. This group will develop a strategic framework for bioenergy, taking into consideration the competing demands on land for feedstock production, sustainability, technical capabilities and opportunities of a just transition to net-zero.

This working group will be guided by an Expert Panel, to be established during 2021, which will include a wide range of interested and expert parties, including NGOs and pressure groups as well as sectoral representatives in order to capture a comprehensive range of perspectives and take a whole system view.

In summary, we will consider:

- Our existing domestic biomass supply chains. The volume of bioenergy resources that we can sustainably collect, grow or produce within Scotland and the implications of doing do, including the potential to deliver multi-benefits, for example biodiversity, landscape, and economic benefits to local communities.

- The level of imports we believe is viable, and compatible with a sustainable global trade in bioenergy.

- The need to ensure our bioenergy policy is compatible with wider sustainable land use policy including the delivery of environmental goals, and recognising public attitudes to land use change.

- The potential new role of Bioenergy with Carbon Capture and Storage (BECCS) technologies, in helping to support our net zero targets, and the implications of scaling up domestic biomass production to meet this potential demand.

- The potential to increase the market for biomethane production and its injection into the gas grid.

- What new support schemes and/or policy at both a UK Government and Scottish Government level may be required to facilitate development and deployment.

By 2023, in time to inform the next Climate Change Plan update, and to take account of decisions that are reserved to the UK Government, we will publish a Bioenergy Action Plan.

Reserved/Devolved Powers

The Scottish Government's ability to influence future UK energy policy is limited; we do have some important policy levers, such as building standards, environmental regulation and our powers to grant consent and planning permission for energy generators. However market support and its subsequent criteria for different forms of power generation and the regulation of the gas and electricity grids are reserved to the UK Government and Ofgem, respectively.

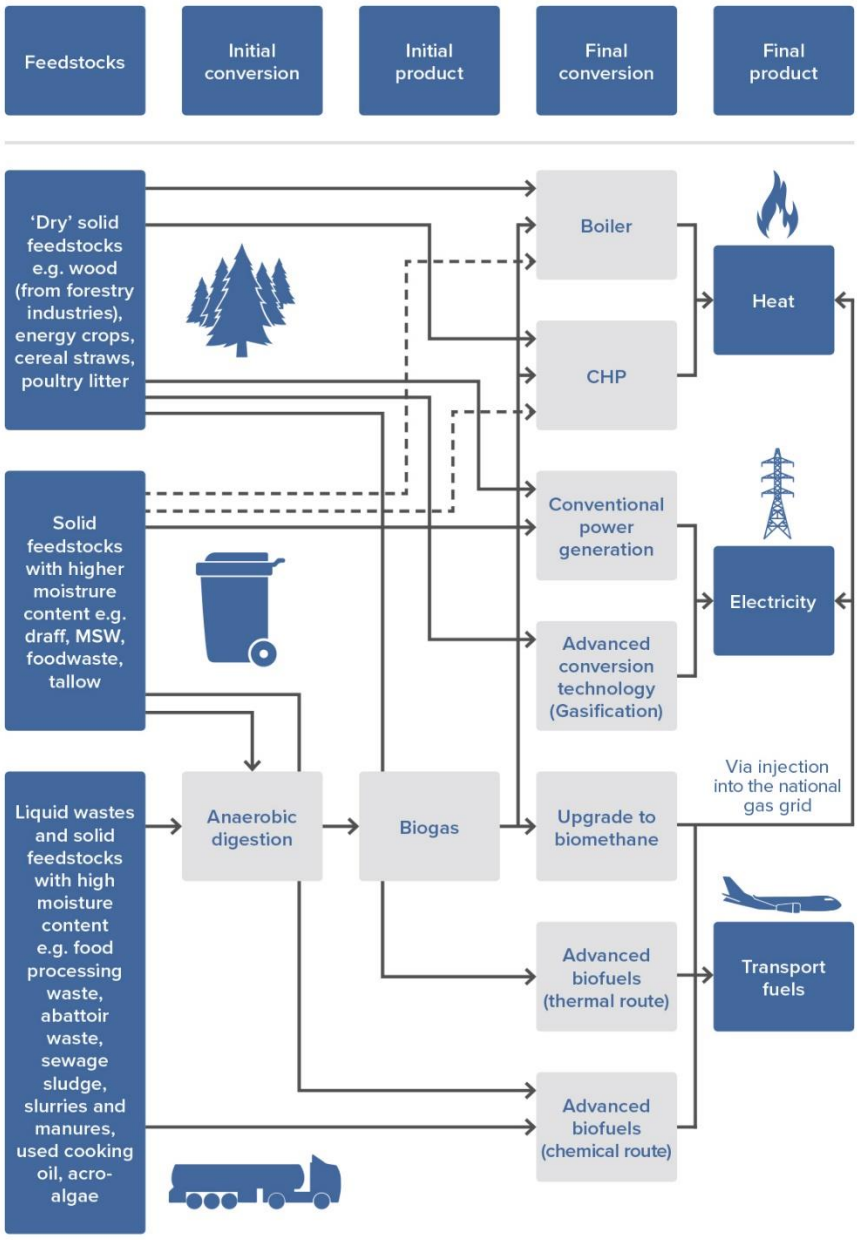
As such, the decisions taken by the UK Government on how it will support bioenergy technologies such as BECCS; future access to biomass imports through trade agreements as well as incentives for green gas production (such as biomethane from anaerobic digestion) will be critical to maximising bioenergy potential in Scotland.

3. Facts and Figures

Facts

Bioenergy is a flexible renewable energy resource that can be used to meet demand for heat, electricity or to support industrial decarbonisation. The feedstock comes from a wide range of diverse sources, and at its simplest is categorised as “dry or “wet”- as outlined below.

Diagram 1. Process for conversion of bioresources to bioenergy



Heat

- The majority of both capacity and output of Scotland's renewable heat in 2019 came from biomass primary combustion and biomass combined heat and power (CHP). Together, these technologies account for 1.65 GW of capacity and 3,678 GWh of output. Biomethane makes up 14% of output, followed by heat pumps (8%) and energy from waste (7%).

- Almost half (44%) of renewable heat output comes from 90 large installations of over 1 MW. [3] The biomass (heat) and CHP feedstock is mostly from forest and timber supply chain wood and woodchip.

- The majority of the rise in renewable heat output in 2019 is due to a 26% increase in biomethane output.

Technology	Annual Output (GWh)	Number of Installations
Biomass	2,906	8,550
Biomass CHP	772	20
Biomethane	716	20
Energy from Waste	383	170

Electricity

- Bioenergy and energy from waste accounted for 8.1% of all renewable electricity generated in Scotland in 2019 (2,472 GWh).

- There is 183 MW of bioenergy projects in the pipeline, the vast majority of which are energy from waste projects.[4]

Diagram 2. Generation of Renewable Electricity from Bioenergy and Waste

[3] Scottish Energy Statistics Hub (shinyapps.io)
[4] Annual Compendium of Scottish Energy Statistics 2020 December.pdf (www.gov.scot)

4. Bioenergy Policy

Current Policy

The Scottish Government has been supporting bioenergy development in Scotland for over a decade. In particular, before the introduction of the Renewable Heat Incentive (RHI), we introduced a biomass support scheme which offered funding to accelerate the uptake of bioenergy. The support was available for supply chain activity and boiler installations and, during (2007-08), over 70 schemes were supported.

From this we developed more targeted support programmes for heat only projects, before the RHI became operational in 2011. This early support helped to further develop and refine our overall policy, which included bringing in restrictions under the Renewables Obligation (Scotland) to support electricity only biomass projects up to 15 MW, while incentivising good CHP projects.

In summary, our policy has changed over time but continues to promote biomass (wood fuel) systems which achieve the greatest possible energy efficiencies and deliver the highest possible carbon savings (given that in most cases they will be displacing oil or coal).

This approach strikes a balance between the need to support sustainable energy generation and those of existing industries such as the timber processing sector, who also use wood.

Unlike wood fuel biomass, specific Scottish policies for Anaerobic Digestion (AD) have not been developed owing to the limited scale of deployment to date. AD plants are currently supported by the UK government's Non-Domestic RHI scheme. This supports both the combustion of biogas and injection of biomethane to the gas grid. From April 2022 the RHI scheme will be replaced by the Green Gas Support Scheme which will focus on increasing the proportion of green gas in the grid through support for biomethane injection.

For biofuels, our policy approach to production or use has largely been focused on the promotion of biofuels for transport through the UK wide Renewable Transport Fuel Obligation (RTFO).

Contribution to targets

Bioenergy's overall contribution to Scotland's renewable energy target, as outlined in the previous section is modest, 3% of final consumption from bioenergy and wastes.[5] This reflects the current market conditions and policy drivers at both a UK and Scottish level.

However, there may be scope to consolidate and expand existing bioenergy supply chains. In addition future developments could include:

- Bioenergy combined with carbon capture and storage may be used to deliver negative emissions in the power and industrial sectors. Bioenergy may also be used to produce hydrogen. Deploying bioenergy may therefore be an important part of compensating for any residual emissions as we move towards net zero emissions.

- Biogas and biomethane supporting decarbonisation of heat in Scotland. Our draft Heat in Buildings Strategy, published February 2021, gives details on the role that bioenergy may play in the decarbonisation of heat in buildings, for example in a limited number of hard-to-treat off gas-grid homes where other technologies are inappropriate or, in certain cases, for some small-scale biomass use in local CHP and district heat schemes, as well as for biomethane production for injection into the gas grid.

We explore in the next section, the key issues to be addressed to understand the implications of the future role that bioenergy might play in the energy transition, particularly if that role will involve the scaling up from current levels.

Recent Activity

Since 2017, a number of workstreams/research have been undertaken to improve our understanding of various parts of the bioenergy ecosystem, and wider Scottish Government action including:

- Domestic availability of bioenergy feedstock.

[5] Scottish Energy Statistics Hub (shinyapps.io)

We commissioned research to improve our understanding of the domestic availability of bioenergy feedstock. The research considered the various pathways and processes that can be used to convert biological materials into energy for heat, transport or power and the raw materials, or "feedstock" used. (wood, straw, energy crops, food waste, farm waste, animal slurry, distillery by-products and used cooking oil).

This research was conducted in collaboration with stakeholders throughout 2018 with the final outputs published in May 2019[6]. The main findings were:

The potential contribution of bioenergy to Scotland's energy system – Ricardo 2019

- The use of domestic resources for bioenergy has the potential to more than double from 6.7 TWh per year to 14 TWh per year by 2030.
- The amount of energy that can actually be delivered will depend on the technologies used, and the efficiency with which they convert the feedstock to heat, electricity or fuel.
- Additional bioenergy plant will need to be built and deployed within the next decade. The deployment of further bioenergy plant on a similar scale seen to date is possible within our forecast of resource availability. However, supporting new large scale plant would require an expansion of domestic feedstock production or increase in international imports.
- Several additional anaerobic digestion plant may be technically feasible. This may require the use of a mixture of feedstock and further research and innovation is needed to increase the efficiency of processes.
- There are also a number of more advanced conversion technologies such as gasification for power or to produce synthetic natural gas and advanced biofuels production. These technologies could be commercially proven by 2030.

[6] The potential contribution of bioenergy to Scotland's energy system (climatexchange.org.uk)

- Scotland's potential land availability for perennial energy crops

We commissioned a study[7] in July 2019 to investigate Scotland's potential land availability for perennial energy crops such as short rotation forestry, short rotation coppice and miscanthus. This **initial** analysis (published in December 2020) of the opportunities and constraints for increased bioenergy feedstock production in Scotland highlights the **theoretical** potential for the expansion of bioenergy crop production. We will undertake further work to consider the wider competing demands on land use. The main findings were:

Land Use Impacts of Perennial Energy Crops in Scotland – Ricardo 2020

- The Production of energy crops in Scotland is currently very low, only Short Rotation Coppice (SRC) is grown on a small commercial scale of approximately 250 ha;
- The theoretically suitable total land area identified across all three crops and land types, which include grassland, is more than 900,000 ha;
- If planting on grassland was not considered then the theoretically suitable area for miscanthus and SRC would be around 100,000 ha;
- The majority of this theoretically available land is located in the east of Scotland and the lowlands.
- In practice, the availability of land will be limited by a range of other factors, which were not possible to model in this study e.g. non-spatial constraints and the need for land for other uses, such as food and fodder production, forestry (non-energy), biodiversity etc. These other factors would need to be taken into account if a full evaluation of the areas of energy crops which could actually be planted by 2045 in Scotland is required.

This work along with other recent research undertaken by specific sectors will provide a starting point. Over the coming months we will build on this to develop a Strategic Framework, that will help inform the role of bioenergy in the transition to net zero.

[7] Perennial energy crops and their potential in Scotland: evidence review (climatexchange.org.uk)

5. Related Sectors and Policies

As indicated earlier, bioenergy is cross-cutting, key policies which are interlinked and will be part of our considerations going forward include:

Spatial planning

The National Planning Framework (NPF) 4 Position Statement[8] published last November made it clear that climate change will be at the heart of our new spatial strategy and national planning policies. It signals a key shift towards a net zero agenda, reducing inequality and improving health and wellbeing. It sets out thinking over 4 key themes – net zero emissions, resilient communities, wellbeing economy and better greener places.

Some of the most significant changes we expect to explore in the development of NPF4 include stronger support for sustainable, low and zero carbon developments. We will lay the draft NPF4 in Parliament in autumn 2021. Public consultation will run alongside Parliament's consideration during autumn 2021 and we anticipate producing a final version of NPF4 for approval and adoption around spring 2022.

Agriculture

The Climate Change Plan update (CCPU) set out our policy to support farmers and crofters to produce food for people and livestock more sustainably, but we also want them to use appropriate land to support carbon sequestration and storage through planting trees and restoring peatland.

The CCPU included a new policy proposal to explore options for land-use change. Going forward, we will open a discussion on optimum land uses beyond just farming and food production to multi-faceted land use including forestry, peatland restoration and management and the growth of crops for biomass at scale.

These are new commitments and it will be important to consider the relevant evidence and data required to inform such a discussion and

[8] Fourth National Planning Framework: position statement - gov.scot (www.gov.scot)

plan an approach across agriculture and all other land uses to ensure all competing demands on rural land are being considered together.

Land Use, Land Use Change and Forestry (LULUCF)

Current domestic biomass supply comes primarily as an output from the forestry and timber industries. Our [9]research suggests increases in biomass availability as current forests mature, which leads to an increase in the availability of processing residues from sawmills as well as an increase in the availability of small diameter timber from the forest. Scottish Government policies seek to increase forestry and woodland from 18% of Scotland's land area to 21%, resulting from an additional 18,000 ha of forestry and woodland plantation per year.

How best to incentivise and reward high nature value farming, including peatland restoration and agro-forestry, will be considered and included in our policy and approach to future rural support, which will also include sustainable food production, emissions reduction, production of biofuel crops and appropriate land use change. All proposals for land use change on a significant scale will need to take account of the public attitudes to such changes.

Waste

In line with the waste hierarchy, our primary focus is on preventing waste and promoting the reuse of materials. However, we still need capacity to dispose of residual waste while we make the transition to a circular economy.

In the context of the latest CCC recommendations and building on progress already made by the sector, we will consider measures to ensure new energy from waste plants are more efficient and how waste infrastructure can be ‘future-proofed’ for carbon capture and storage (CCS) technology. In line with EU Commission’s Circular Economy Package, we will also consult on requirements to separately collect garden waste (by 2023).

We will also consult on extending the ban on sending biodegradable municipal waste to landfill to include biodegradable non-municipal

[9] The potential contribution of bioenergy to Scotland’s energy system (climatexchange.org.uk)

wastes and consult on the current rural exemption and food separation requirements for food waste collections.

Transport

Significant change in behaviours and patterns of mobility is essential to decarbonising our transport system to support the net zero transition. However, considerable demand for powered vehicles will remain and we believe electrification of the majority of vehicles on Scotland's roads to be the optimum solution.

For some classes of vehicles however, electrification is simply more difficult, with market-ready options still some time away. There are also large numbers of petrol and diesel engine vehicles in use today that have significant lifespans remaining. Lower carbon fuels such as biomass-derived fuels or those from green hydrogen – will play a role as we decarbonise. The extent of this role will be clarified in the context of wider bioenergy policy choices, as well as the development of other technologies.

While there have been promising developments in fully electric, hybrid and hydrogen aircraft, it is not expected that these aircraft can be used for long haul routes in the foreseeable future. Sustainable Aviation Fuels have a number of different production routes and feedstocks, with the maximum percentage blend currently at 50%. At the moment, there is no Sustainable Aviation Fuel production in the UK.

Our policy approach to the production or use of biofuels has largely been focused on the promotion of biofuels for transport through the UK-wide Renewable Transport Fuel Obligation (RTFO). Through that mechanism, lower carbon liquid fuels are already blended in increasing amounts into standard petrol and diesel road fuel supply chains. RTFO also supports other more advanced fuels like hydrogen and waste-derived biofuels.

The Scottish Government welcomes the Department of Transport’s consideration of widening the support of RTFO to include other transport sectors like rail and aviation, as well as more fully supporting advanced low carbon fuel markets.

Air Quality

Bioenergy can be a source of certain air pollutants, notably fine particulate matter, nitrogen dioxide and sulphur dioxide, which impact on human and environmental health. Where certain conditions are met, the impacts of bioenergy deployment for heat production can be managed to minimise impacts on local air quality. These conditions are:

- all new biomass plant are of high quality, corresponding to the best performing units currently on the market;
- the majority of biomass heat uptake replaces or displaces existing coal and oil fired heating;
- the majority of uptake is located off the gas grid and therefore generally away from densely populated urban areas; and
- levels of uptake where a local authority has declared an Air Quality Management Area are substantially lower than other areas.

Current air quality policy is set out in the Cleaner Air for Scotland strategy[10]. A new strategy will be published later in 2021.

Bioeconomy

The growth of our bioeconomy is crucial to reduce Scotland's dependency on carbon intensive feedstocks and to make our manufacturing sector more sustainable. In 2019, Scotland refreshed its National Plan for Industrial Biotechnology (IB)[11] which set out ambitious targets of a £900 million turnover and over 200 companies active in industrial biotechnology by 2025 with a focus on five key themes: Policy & Public Engagement, Industry Engagement, Innovation, Skills and Biorefining.

The biorefining theme identifies how we can further develop Scotland's bio-based economy through 6 key bio resources identified in the Bio-refinery Roadmap for Scotland (2019)[12] - whisky co-products, municipal solid waste and food processing by-products, agricultural biomass, forestry biomass, and marine biomass.

[10] Cleaner air for Scotland: the road to a healthier future - gov.scot (www.gov.scot)
[11] National-Plan-for-IB-2019-PDF.pdf (lifesciencesscotland.com)

[12] Biorefinery-Roadmap-Building-a-Sustainable-Future (www.ibioic.com)

The themes in the National Plan for IB align well with the UK Bioeconomy Strategy which discusses how understanding resource flows, creating national and international supply chains for new bioenergy businesses and encouraging new entrants to invest in biorefining and liquid fuel production facilities is critical for growth of the bioeconomy.

6. Future Roles for Bioenergy

Relationships and Links

As highlighted earlier, there is the potential for bioenergy to play a more significant role in the transition to net zero. The recent CCC advice made clear that “sustainable bioenergy is essential for reaching net zero”. An enhanced role for bioenergy would therefore require a scaling up of domestic supply, to meet anticipated future demand.

Biomass supply

Biomass feedstock is the common factor across all related sectors outlined in the previous section. See diagrams below which highlights the cross–cutting issues to be considered.

Diagram 3. Relationships and Links: Dry feedstock

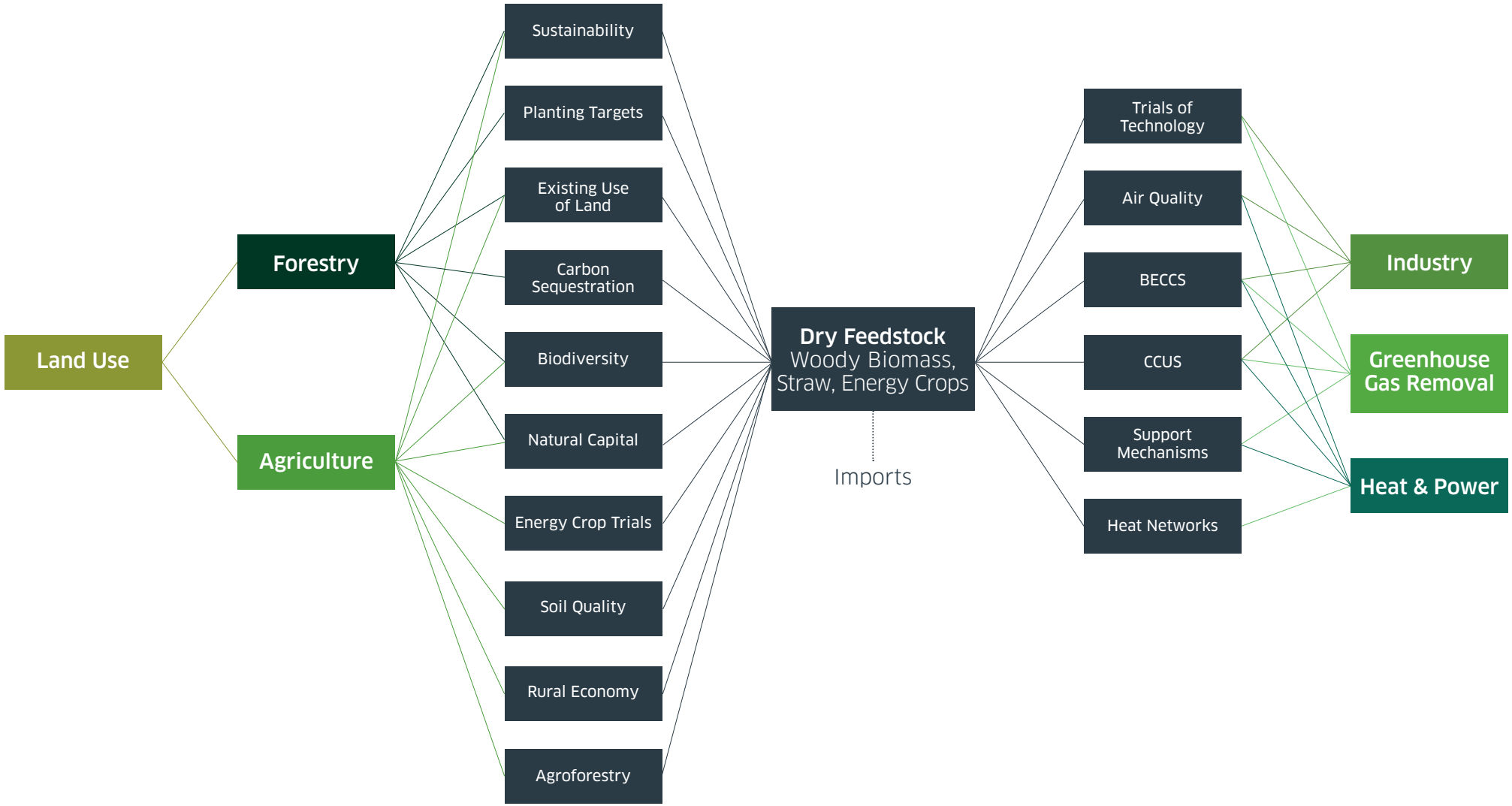
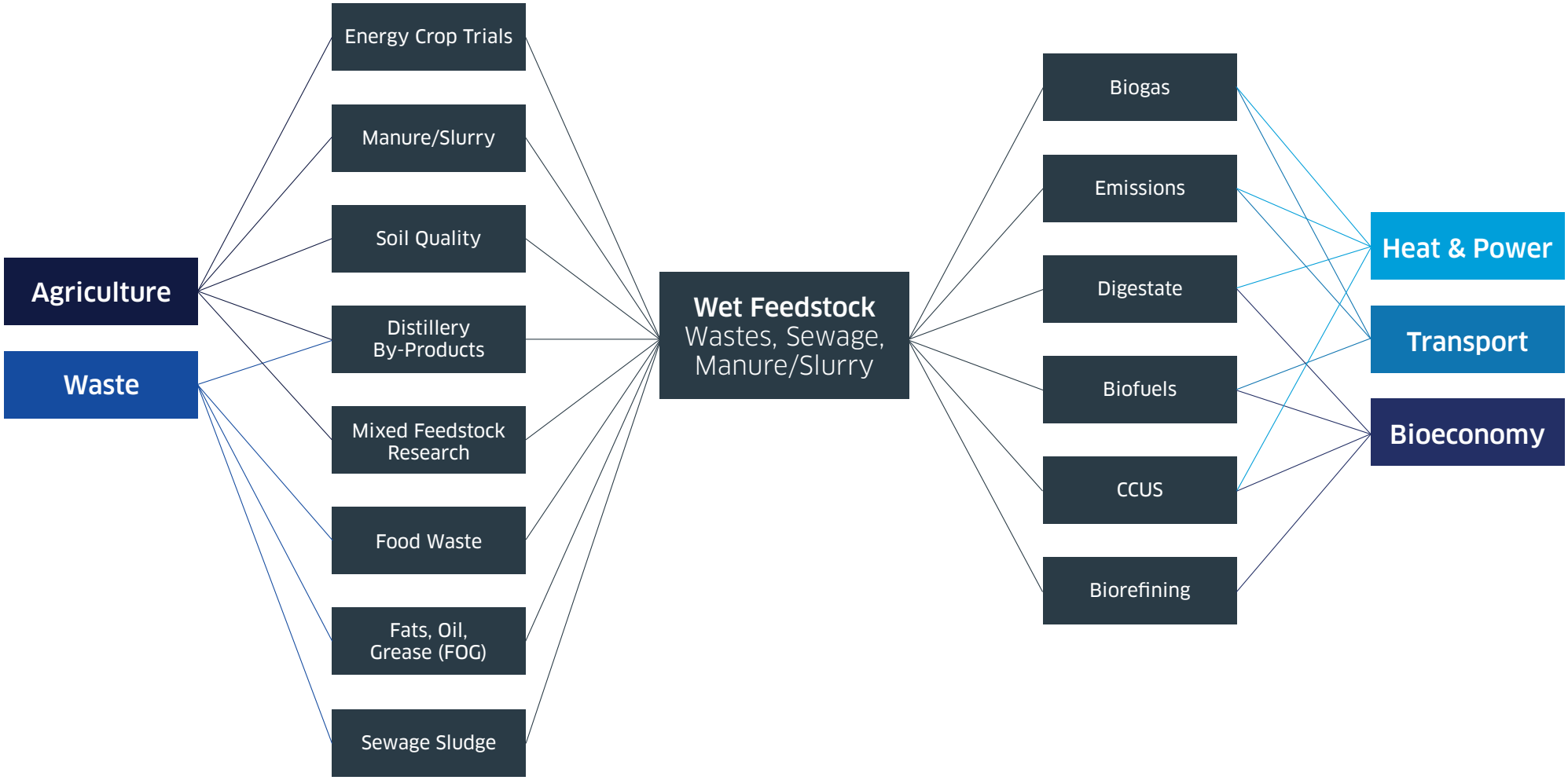


Diagram 4. Relationships and Links: Wet Feedstock



On biomass supply, the CCC indicates that fast growing energy crops can provide a rapid and therefore important source of biomass feedstock for fuel use and are recommending that during this decade, government policies should assist a transition towards use of biomass (including energy crops) as a fuel with Carbon, Capture and Storage (CCS), and away from use for heating buildings and generating power without CCS.

The CCC, are also recommending some 'wet' biomass such as food waste and sewage are likely to continue to be best used with AD, with the resulting syngas to be upgraded to biomethane and injected into the gas grid wherever possible. However, the potential location of farm based AD plants may be too far from the gas grid to allow methane injection. In these circumstances biomass feedstocks may be better used for local production of heat and power.

The “balanced net zero pathway”[13] suggested by the CCC, estimates that biofuel from waste fats/oil/grease will remain at similar levels as today for road transport. There is potential for some additional uses in off-road machinery and agricultural equipment through the early 2030s before these uses are phased out around 2040. Aviation fuel then becomes the core output, providing 6% of the UK’s demand by 2050.

It is clear that we need to gather further evidence to understand the current availability of such feedstock and the scope to increase collection of it. Alongside this, we need to support innovation to optimise feedstock mixtures and increase the efficiency of the processes.

Deciding where bioenergy will be most effectively deployed will depend on which sectors will make the best use of the bioenergy feedstocks that we can grow domestically or import. The use of bioenergy resources in the energy system must also be compatible with a sustainable land use policy and our obligations to ensure a sustainable global transition.

We have already indicated in our Climate Change Plan update our intention to work to identify in which applications across the energy system bioenergy can be most effective. The work we will undertake will seek to better understand the interdependencies and relationships with the aim of producing a strategic framework or set of guiding principles.

[13] Sixth Carbon Budget - Climate Change Committee (theccc.org.uk)

Negative Emissions Technologies

A key issue to consider is the role that Negative Emissions Technologies (NETs) or Greenhouse Gas Removal technologies as they are also referred to, are expected to play in the pathway to net zero, compensating for the residual emissions in hard-to-decarbonise sectors, such as agriculture and international aviation.

As set out in our Climate Change Plan update, based upon TIMES whole systems energy modelling, a specific emissions envelope has been developed for NETs, allowing us to be transparent with our assumptions of these evolving technologies.

We estimate that a small quantity of negative emissions could be delivered during the late 2020s from trial and demonstrations projects. The relatively small contribution that NETs makes in 2029 (0.5 Mt) reflects this. However, in 2030 we expect NETs to begin making a meaningful contribution to meeting our emission envelopes.

There are a range of different NETs pathways, which combine bioenergy, electricity generation, fuel and hydrogen production and industrial processes. We will undertake detailed feasibility studies on NETS to assess the opportunities for negative emissions in Scotland, and identify applications with the greatest potential, including specific sites where possible. This work, will be carried out in parallel to the work being proposed for bioenergy but the findings will be made available to help inform the Bioenergy Action Plan.

With the exception of Direct Air Capture with Carbon Storage (DACCS), NETs pathways depend on the use of bioenergy. A key part of developing NETs will be to understand the implications, scale and pace with which bioenergy resources should be focused on each of the possible pathways, and how this interacts with other uses for bioenergy.

For example, where we use biomass grown or produced in Scotland we need to fully understand and consider the impacts on our agriculture and other land use sectors. Where we import biomass, it will be important to do so in a way that supports efforts to tackle the global climate emergency, which means adopting a sustainable way of using bioenergy resources produced elsewhere, and considering the growing importance of bioenergy as a pathway to decarbonisation in other countries.

The CCC has indicated that Scotland is an ideal place to deploy BECCS towards the late 2020s. In the event that BECCS is deployed at scale it will require a strategic approach to consider the interdependencies to ensure competing demands do not lead to tensions or conflicts. Primarily we will need to understand how we source and use finite bioenergy resources, while taking account of other sectors. As mentioned earlier this could be presented as a strategic framework or a set of "guiding principles".

Further Investigation and Evidence Gathering

A summary of the key areas that require further investigation is outlined below:

Category	Further Investigation
Feedstock Availability	<u>Dry feedstock</u> • Investigate the opportunity for upscaling energy crop planting - types suited to Scotland (through crop trials and demonstration of particular land use conversions) and land availability. • How will changes in diet and demand for different food products impact on the potential availability of energy crops • Step change for farming – consider competing priorities alongside assessing value for money and work already underway within the Farming and Food Production Group. • Forestry sector – upscaling of sustainable biomass production • What level of imports are desired, what level is feasible, and how can these be guaranteed to be sourced sustainably <u>Wet feedstock</u> • How to collect and maximise value of the 2.4 TWh of feedstock that is currently not utilised (looking at ease of collection, transport, cost per MWh, environmental impact and carbon savings).

Competing Demands	• Afforestation, peatland restoration, energy crops, habitats and species protection and enhancement and food production all place demands on a finite amount of land. • How should competing uses for resources be prioritised and what incentives can help to prioritise use of feedstock which has no other value. • Consider guiding principles for all feedstocks across sectors and technologies to maximise the carbon reduction impact from biomass.
Environmental and Sustainability Issues	• How to fully realise the economic opportunities from our land and natural resources whilst protecting and enhancing biodiversity and existing ecosystems. • How to minimise the global environmental impacts of any imported feedstock. • Establish a market for digestate to be used as fertiliser. • Attitudes of land owners, land users, the public and visitors to the significant land use changes (and change in the appearance of our landscapes) required to meet climate goals.
Technology Readiness	• Reliance on Carbon Capture Utilisation and Storage (CCUS) infrastructure. Ensure that, as we support and develop CCS infrastructure in Scotland, it is sufficiently flexible to integrate a range of Bioenergy and other NETS technologies in the future. • Feasibility of BECCS technologies for power, hydrogen, waste management, heat in industrial processes and biofuels, including which manufacturing industries

	in Scotland are considering BECCS as part of their route to net zero. • Skills and standardised infrastructure are required to support increased biomethane injection to the gas grid. • Investigate mixed feedstocks for AD processes.
Reserved/Devolved areas	• New methods and incentives will need to be developed which reflect the value of capturing carbon and careful consideration given to how these are funded. • We ask that the UK Government signals its intention to put in place market and regulatory frameworks to support the acceleration of negative emissions technologies and the role of BECCS. • UK Green Gas Support Scheme. • Ensure that the increased costs of support mechanisms do not adversely affect the poorest in society. • Engage with the UK government on specific elements of their Energy White Paper and the UK Biomass Strategy (by 2022). • Consider what new support schemes and/or policy at both a UK Government and Scottish Government level may be required to facilitate development and deployment.

Reserved/Devolved Levers

Some key levers in the expansion of bioenergy are currently reserved to the UK Government. Our work will seek to align with the UK Government decisions on market and regulatory frameworks. This will enable us to make the most appropriate decisions for our overall decarbonisation pathway, including a whole system approach to bioenergy and negative emissions.

7. Next Steps and Timeline

Working Groups

To help inform our policy development, and the publication of a Bioenergy Action Plan for Scotland, over the next 18-24 months we will:

- Establish a Scottish Government working group comprised of all relevant policy areas. This group will develop a strategic framework (guiding principles) for bioenergy and its role in the net zero transition.

This working group will be guided by an Expert Panel, to be established during 2021, which will include a wide range of interested and expertise parties, including NGOs and pressure groups as well as sectoral representatives in order to capture a comprehensive range of perspectives and take a whole system view.

The work of these groups will report regularly to the senior level Scottish Government group that oversees the governance and delivery of the Climate Change Plan, to ensure all areas of work inform one another and the roles and linkage are clear. In addition, we will seek to establish links with other related work and stakeholder partnerships as required.

Workstreams

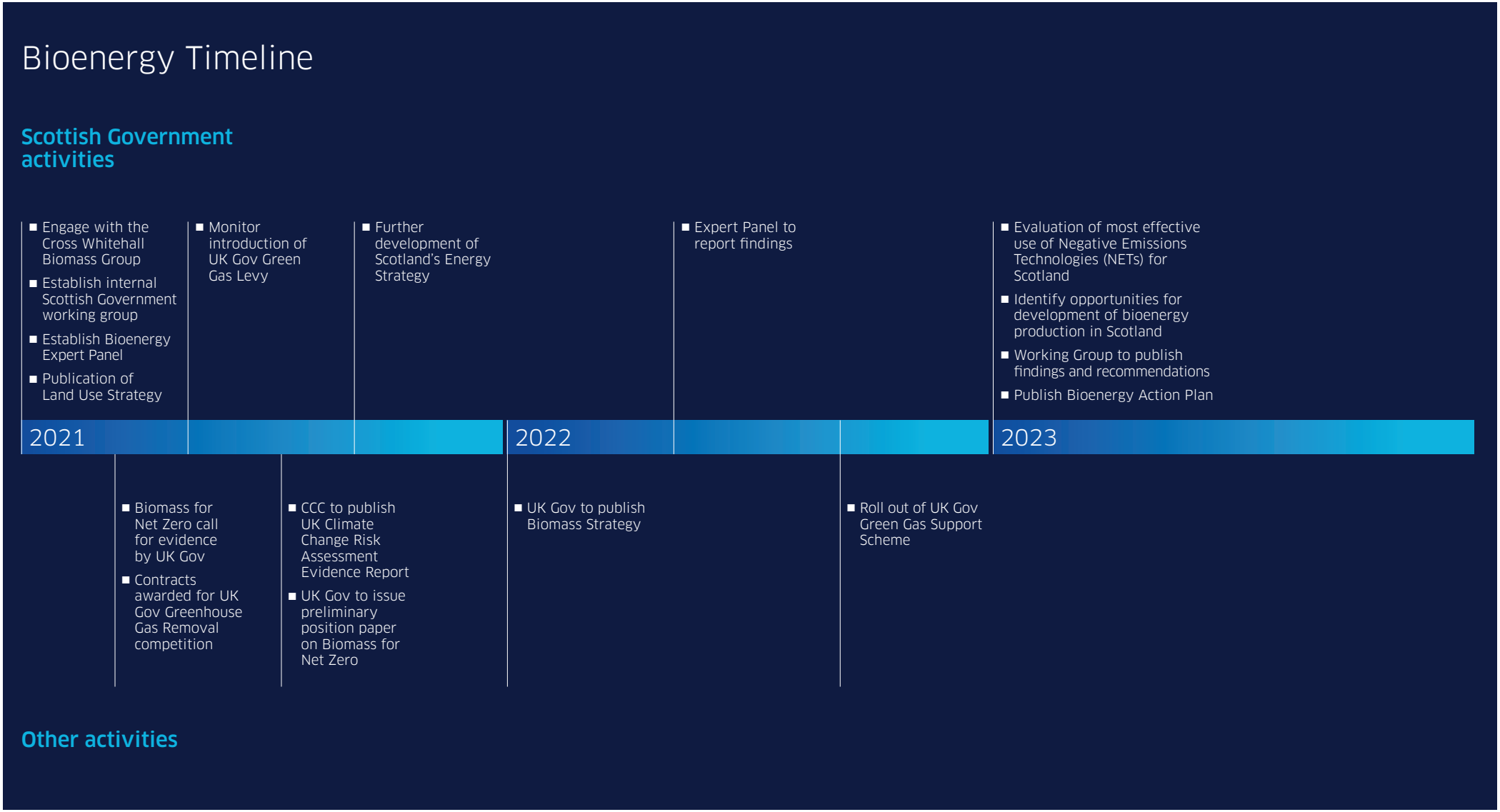
The focus in the early stages will be on evidence and knowledge gathering. The key workstreams that the group will investigate and review are outlined in the previous section and fall into the broad categories:

- Biomass availability
- Competing Demands
- Environmental and Sustainability issues
- Technology Readiness
- Reserved/Devolved areas

Timeline

A provisional timeline is set out below, it will be reviewed and updated regularly.

Diagram 5. Bioenergy Policy Timeline



8. Glossary of Terms

Anaerobic Digestion (AD)	A collection of processes by which microorganisms break down biodegradable material in the absence of oxygen. The process is used for industrial or domestic purposes to manage waste and/or to produce fuels.
Bioeconomy	The bioeconomy means using renewable biological resources from land and sea, like crops, forests, fish, animals and micro-organisms to produce food, materials and energy.
Bioenergy	Refers to heat or electricity produced using biomass or gaseous and liquid fuels with a biological origin such as biomethane produced from biomass.
Bioenergy with Carbon Capture and Storage (BECCS)	The process of extracting bioenergy from biomass and capturing and storing the carbon, thereby removing it from the atmosphere.
Biomass	Refers to any material of biological origin used as a feedstock or products (e.g. wood in construction to make chemicals and materials, like bio-based plastics), or as a fuel for bioenergy (heat, electricity and gaseous fuels such as biomethane and hydrogen) or biofuels (transport fuels).
Biomethane	A form of gas that is produced by processing biomass It can be used for the same purposes as natural gas, like producing electricity or heat, and can use the same infrastructure for transmission and end-user equipment.
Combined Heat and Power (CHP)	Cogeneration of both heat and electricity
Digestate	The material remaining after the anaerobic digestion of a biodegradable feedstock.
Gasification	A process that converts organic- or fossil fuel-based carbonaceous materials into carbon monoxide, hydrogen and carbon dioxide.
Just Transition	How to move to a carbon-neutral economy in a way that is fair to all, and does not leave anyone behind.
Land Use, Land Use Change and Forestry (LULUCF)	How we use our land to deliver nature based solutions to climate change, including through increased tree cover and restoration of degraded peatland.
Renewable Heat Incentive (RHI)	A financial incentive to promote the use of renewable heat.
Renewable Transport Fuel Obligation (RTFO)	This supports reducing greenhouse gas emissions from vehicles by encouraging the production of biofuels.

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Any enquiries regarding this publication should be sent to us at

The Scottish Government
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Edinburgh
EH1 3DG

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