



Deploying the Bioeconomy in the EU: A framework approach for bioeconomy strategy development

10 policy recommendations for building
national bioeconomies toward a fair and just
climate neutral Europe

Independent
Expert
Report



Deploying the Bioeconomy in the EU: A framework approach for bioeconomy strategy development
10 policy recommendations for building national bioeconomies toward a fair and just climate neutral Europe

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Deploying the Bioeconomy in the EU: A framework approach for bioeconomy strategy development

***10 policy recommendations for building national
bioeconomies toward a fair and just climate
neutral Europe***

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Table of Contents

EUROPEAN COMMISSION EXPERT GROUP TO SUPPORT THE IMPLEMENTATION OF A BIOECONOMY POLICY SUPPORT FACILITY THROUGH A MUTUAL LEARNING EXERCISE (MLE) 3

1 Executive Summary3

2 Introduction7

 2.1 Bioeconomy Deployment to address MS Strategic Objectives & Challenges 7

 2.2 Structuring, mobilising & progressing bioeconomy development8

 2.3 Bioeconomy & the European Green Deal 9

3 Bioeconomy Policy Framework Approach.....10

4 10 Key Policy Messages to Guide Bioeconomy Strategy and Action Plan Development.....11

4.1 Getting Started.....12

 (i) Ensuring stronger recognition of the importance of bioeconomy policy by decision-makers and stakeholders 12

 (ii) Moving from a bioeconomy concept to developing a vision 14

 (iii) Creating spaces for building collective bioeconomy awareness and leadership 16

4.2 Building Transformative Coalitions18

 (iv) Coordinating across government to support bioeconomy strategy design and development 18

 (v) Identification of existing bioeconomy initiatives for building a coherent action plan 19

 (vi) Establishing collaborative bioeconomy partnerships for co-investment 21

4.3 Steering the Process23

 (vii) Developing linkages and pathways between bioeconomy policy, funding, national and EU strategic research, innovation and investment agendas 23

 (viii) Addressing the concerns and resistance of incumbent industries and patterns of behaviour of citizens and consumers 24

 (ix) Encouraging diffusion of bio-based knowledge, innovation & technological advances to support rural, coastal and regional development 26

 (x) Evaluating and gauging progress to help steer development of sustainable, circular bioeconomies 28

5. Conclusion30

6. References.....31

EUROPEAN COMMISSION EXPERT GROUP TO SUPPORT THE IMPLEMENTATION OF A BIOECONOMY POLICY SUPPORT FACILITY THROUGH A MUTUAL LEARNING EXERCISE

1 Executive Summary

The **bioeconomy** can be a catalyst for sustainable systemic change and transition, tackling key economic, societal and environmental challenges faced by EU Member States (MS). For transitions to sustainable and circular bioeconomy to occur there is a need for policy to support interactions among multiple actors, including businesses, users, scientific communities, policy-makers, social movements and interest groups. These will be evolutionary processes, and they typically will be based on searching, experimenting, reflecting and learning. In this light, bioeconomy policy development will require a much broader policy mix, aligned with national challenges and missions and aimed at enabling innovation, experimentation, diffusion and networking, as well as facilitating structural economic change. This breadth of activities across policy areas and across scales of governance **creates the need for coordination and directionality**.

Bioeconomy transitions will also involve the need to choose between alternative visions of the future and how to get there, **pointing to the importance of public engagement to foster consultation and reflection**. These alternate visions will need to account for MS strategic objectives including addressing **employment, competitiveness and value added whilst addressing sustainability and circularity challenges**. In this light, bioeconomy transitions will involve the need to prepare for unexpected consequences and new emerging issues which implies a need for both exploratory, analytical approaches (e.g. horizon scanning), as well as adaptive governance grounded in horizon scanning, monitoring and learning, that enable reorientation of bioeconomy transition processes. Therefore, **targeted national bioeconomy strategies and/or action plans are necessary** both to aid the implementation of the European Green Deal (EGD) but also to develop benefits and opportunities for rural, coastal, regional and urban areas in each MS.

As a first step towards capturing bioeconomy potential and facilitating transition, **political recognition** and a **mandate** for a structured **strategic** and **consultative process** is needed to develop an impactful national bioeconomy strategy and action plan. This should bring together and collectively engage bioeconomy policy-makers and stakeholders, including primary producers, industry, researchers, academics, non-governmental organisations and citizens. Secondly, **co-creation opportunities** should also be explored with these key actors. These opportunities should seek to address local and regional challenges and concerns while ensuring that national bioeconomy development is underpinned by a set of guiding principles on sustainability, innovation, food security, circularity, environmental management, biodiversity protection and multi-actor engagement. Thirdly, **dynamic evaluation** and ongoing **monitoring** are needed to ensure the implementation of fully integrated policy that enables the breakthrough of bio-based innovation and develops sustainable, circular bioeconomies.

Based on the feedback from experts in the **Mutual Learning Experience (MLE)**, and taking into account the principles of good governance and systems transition approaches, **10 Key Policy Messages** have been identified to help guide national bioeconomy strategy and/or action plan development. Additionally, each policy message is accompanied by a series of actions that have been identified to aid their implementation. In the following table, the **10 Key Policy Messages** are outlined and one of the key actions per policy message is highlighted.

Getting Started		Brief Description	Highlighted Action
Policy Message 1	<u>Ensuring stronger recognition of the importance of bioeconomy policy by decision-makers and stakeholders</u>	In each MS, it is crucial that at the highest political level necessary, policy-makers ensure demonstrable long-term, ongoing commitment towards the development of a national and regional sustainable, circular bioeconomy	The EU Competitiveness Council should request an update from EU MS on how they have responded to the call in the Council conclusions (14594/19)4 “to develop or update their national strategies on sustainable and circular bioeconomies, taking into consideration macro-regional and regional specificities and appropriate initiatives”. Collaborative initiatives between MS achieving a high-level political commitment to legitimise bioeconomy policymaking should be sought.
Policy Message 2	<u>Moving from a bioeconomy concept to developing a vision</u>	Each MS should examine the status, positioning and importance of the bioeconomy within its own economy from a range of different perspectives to co-create an integrated vision and to ensure a collaborative approach towards the development its bioeconomy.	A shared vision should be co-created between governmental and non-governmental experts of what a future bioeconomy should look like and of what should be undertaken within the bioeconomy to aid the achievement of carbon neutrality by 2050.
Policy Message 3	<u>Creating spaces for building collective bioeconomy awareness and leadership</u>	The development of sustainable and circular bioeconomies in MS will involve multiple actors, inside and outside of government, over extended time periods. To allow for such engagement, there is a need to develop spaces for engagement to identify, design and implement a bioeconomy vision.	In the longer-term, the establishment of formal platforms for engaging stakeholders, such as Bioeconomy Councils, Panels, and Forums should be considered to ensure ongoing engagement in inputting to, monitoring and evaluating bioeconomy strategies and action plans.
Building Transformative Coalitions		Brief Description	Highlighted Action
Policy Message 4	<u>Coordinating across government and across different levels of government to support bioeconomy strategy design and development</u>	The transition to sustainable and circular bioeconomies in MS may not fall neatly under the responsibility of a single government department. A key challenge is the need to build collective leadership capacity to innovate at a scale while integrating numerous policy domains.	Formal groups, such as inter-ministerial groups with mandated members from different ministries and agencies, are considered best practice and should be established to allow for stability in coordination and communication. They also help to ensure long-term commitment to bioeconomy development that outlives electoral cycles and changes in government and its leadership, cabinet compositions or government programmes. The formal groups should reflect the diversity of perspectives needed to represent the transition towards a sustainable and circular bioeconomy.

Policy Message 5	<u>Identification of existing bioeconomy initiatives for building a coherent action plan</u>	The identification of existing and on-going bioeconomy initiatives and lead innovators is a first step towards developing a coherent action plan. These initiatives can serve as lighthouse projects, motivating case studies or learning environments.	MS should use various activities funded through EAFRD, ERDF, Horizon 2020/Europe and national funding to identify existing bioeconomy actions. In this way, they can capture emerging ideas, collect information and connect with local stakeholders. Such activity will yield valuable information through the diversity of perspectives, priorities and concerns. It will also aid the identification of lead innovators who can play a major role in transforming value chains when they adopt new technologies and practices. In doing so, they can help disseminate innovative best practices which can have a significant impact in developing the bioeconomy.
Policy Message 6	<u>Establishing collaborative bioeconomy partnerships for co-investment</u>	Bioeconomy developments by their very nature are highly collaborative activities, requiring participation, expertise and investment on the part of multiple actors. These include government, the private sector, primary producers and entrepreneurs at project level and civil society through engagement consultation and participation.	State agencies/companies and clusters should develop their own plans to facilitate bioeconomy strategic development to allow for alignment of their mandates and sectoral objectives with national and EU bioeconomy strategy goals and objectives.
Steering the Process		Brief Description	Highlighted Action
Policy Message 7	<u>Developing linkages and pathways between bioeconomy policy, funding and national and EU strategic research, infrastructure, innovation and investment agendas</u>	Policy-maker will need to help combine a mix of policies and funding sources, at rural, regional and national level. This will enable multi-actor approaches boosting ecological and technological innovation for sustainable and circular bioeconomies.	Strategic Research, Innovation, Infrastructure and Investment Agendas should be developed between EU MS e.g., with potential activities in the SCAR SWG Bioeconomy and other research networks, to support bioeconomy development at national and pan-European level.
Policy Message 8	<u>Addressing the concerns and resistance of incumbent industries and patterns of behaviour of citizens and consumers</u>	Addressing concerns and resistance is important for developing sustainable circular bioeconomy strategies and action plans. A key political and communications challenge is ensuring that all stakeholders feel that their voices have been heard and that their concerns are being listened to and addressed.	Methodologies for engaging stakeholders, including concerned citizens, industries, workers, consumers and students, should be developed and implemented for their continuous involvement in bioeconomy implementation and monitoring. This could include the creation of dedicated bioeconomy 'weeks' and 'days' which ideally would be developed together with updated online information about local bioeconomy planned developments and seasonal events.

<p>Policy Message 9</p>	<p><u>Encouraging diffusion of bio-based knowledge, innovation & technological advances to support rural and regional development</u></p>	<p>In the transition to sustainable circular bioeconomies, relevant agro-ecological good practice, bio-based innovation, and technologies are increasingly available. Enabling diffusion and sharing of these could bring significant benefits for bioeconomies throughout the EU.</p>	<p>The Common Agricultural Policy (CAP) proposes that EU MS develop their National Agriculture (and Rural Development) Knowledge and Innovation System (AKIS). A Horizon Europe coordination and support funding opportunity could be offered to develop prototype AKIS activities for Knowledge Exchange, Farm Advisory Services, EIP-AGRI & LEADER and CAP Networks, to facilitate up-take of bioeconomy opportunities by primary producers, rural economy entrepreneurs and industry in collaborative ventures. This could include technological developments emerging from the BBI-JU and Circular Bio-based Europe biomass conversion toolbox.</p>
<p>Policy Message 10</p>	<p><u>Evaluating and gauging progress to help steer development of sustainable, circular bioeconomies</u></p>	<p>Evaluation will increasingly play a crucial role in gauging progress and steering developments from current bioeconomies towards more sustainable and circular bioeconomy. Monitoring and evaluation needs to be deeply integrated into all stages of the policy making cycle to generate continuous learning, to guide progress and to manage risk.</p>	<p>A Horizon Europe coordination and support action opportunity could be considered to facilitate EU MS to work together to develop a bioeconomy monitoring and evaluation system to support bioeconomy strategy design, development and implementation at national level/in their countries. This should also include consideration of how to align with JRC guidance on monitoring the EU Bioeconomy Monitoring System implemented by the JRC.</p>

2 Introduction

The **bioeconomy** covers all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles. It includes and interlinks: land and marine ecosystems and the services they provide; all primary production sectors that use and produce biological resources (agriculture, forestry, fisheries and aquaculture); and all economic and industrial sectors that use biological resources and processes to produce food, feed, bio-based products, energy and services [1].

The **bio-based industry** is the part of economy formed by companies that use biological input (feedstock) to produce material, products and services. The biological input can be the biomass extracted from natural environment and purpose grown biomass (e.g. from agriculture and forestry, fisheries and aquaculture), as well as different forms of biological waste, side streams and residues¹.

Bio-based innovation is a novel concept, technology, process, material or product based on the use and transformation of biological input. The benefits of bio-based innovation include one or more of the following: increased energy or material efficiency of production process, new properties of produced material or product, ability to use and valorise waste, and elimination of pollution [2].

2.1 Bioeconomy Deployment to address MS Strategic Objectives & Challenges

The EU Bioeconomy Strategy [1,7] encourages MS to develop their national bioeconomy Strategies and other policies to stimulate the connection between the primary sectors, bio-based industries and researchers in order to deliver on EU & MS strategic objectives [3]. Currently, nine EU MS (Austria, Finland, France, Germany, Ireland, Italy, Latvia, Spain, and the Netherlands) have a national strategy while other MS are involved in national, regional [4] or macro-regional [5] bioeconomy development [6]. The 2018 update of the Bioeconomy Strategy [7] aims to accelerate the deployment of a sustainable European bioeconomy so as to maximise its contribution towards the 2030 Agenda and its Sustainable Development Goals (SDGs), as well as the Paris Agreement.

Most Central and Eastern European (CEE) countries lag in the development of dedicated national Bioeconomy Strategies and/or action plans. As a result, there is an uneven distribution of activity associated with the development of sustainable, circular bioeconomies across the EU MS, impacting the potential to deliver both on the EGD and national objectives. This has direct, tangible impacts for citizens on turnover, jobs, welfare, prosperity, access to innovation and labour productivity amongst many other important factors [8]. One concrete indicator is the uneven distribution of industrial processing and biorefining facilities [9], which create high added value throughout bio-based value chains.

Developing national bioeconomy strategies can significantly contribute to addressing key needs for CEE MS. These include ensuring no one is left behind in the EU climate action transition, by offering alternative economy models to regions currently dependent on fossil fuels, increasing access to sustainable and affordable energy, building a green industrial base, preserving Europe's natural capital and ensuring the transformation of agriculture and rural areas including moving towards a zero-pollution environment. Locally, advances in circular bioeconomy strategy development would also support the production of value-adding green and digital products, boosting employment and sustainable socio-economic development. This would in turn support positive demographic trends and a more equitable distribution of wealth across communities and territories. In this context, and in relation to

¹ In this impact assessment biomedicines and health biotechnology is excluded from the definition of the bio-based industry in line with the EU Bioeconomy Strategy.

delivering on the global SDGs, there is a consensus amongst MS on the fundamental need for additional policy support for Bioeconomy strategy deployment across the EU, particularly in CEE.

Post-COVID 19, the bioeconomy can also contribute significantly to sustainable socio-economic recovery [10] and development as sustainable biomass can be supplied locally to support bio-based industries. Once established, these local resource bases, coupled with higher-value industrial activity, can help make MS bioeconomies more resilient to external crises and fluctuations in the availability and cost of raw materials. The bioeconomy can also provide opportunities for generating additional income and activity which delivers on the protection of biodiversity and the enhancement of carbon sinks. Overall, a key challenge is presented with the need to ensure the strategic development of the bioeconomy and bio-based industry in those parts of Europe where suitable conditions exist for bioeconomy activities, but insufficient investment, innovation, infrastructure or knowledge capacity currently exists.

2.2 Structuring, mobilising & progressing bioeconomy development

There is growing awareness that the **bioeconomy** - and its industrial part the '**bio-based industry**' - have an increasingly important role to play in delivering sustainable, climate neutral solutions through **bio-based innovation**. This innovation potential can be realised both in rural, regional and coastal territories where biomass is produced as well as in urban areas where biowaste accumulates.

Bio-based industries, leveraging research and innovation developments [11], are accelerating the market deployment of a broad range of circular, bio-based solutions. However, additional support measures are still needed by bio-based industries and primary producers throughout the EU. Such measures are needed in order to better capture the innovative potential of bio-based industries for contributing to national objectives, the EGD and the UN SDGs including in particular the **integration of sustainable production and processing practices across landscapes. This type of innovation needs to be developed, tested and scaled-up in real-life environments so as to be brought to the market.**

Bio-based industries are often start-ups or SMEs which struggle to emerge and develop in the currently well-established fossil carbon markets. They are often multi-stakeholder initiatives which are capital intensive; involve higher-financial risks and longer-term investments. Therefore, they often face **innovation and market challenges as well as strategic and sustainability challenges which need to be addressed at EU and MS levels** [2,12].

In this context, the 'Bio-based Industries Joint Technology Initiative' (BBI Joint Undertaking or BBI JU) - a public-private research and innovation partnership between the EU and the Bio-based Industries Consortium - has provided a valuable framework for co-created innovation aligning the Commission, bio-based industries, research and non-governmental organisations. This Joint Undertaking framework has helped transform the funding landscape for bio-based industries to support the phased development of environmental and climate neutral solutions, products and services through **bio-based innovation. It has created a platform** where biological resources, technologies and multiple-stakeholders have been enabled to address specific challenges. This **structuring and mobilising effect** can now further progress, expanding the scope of partnerships activities, the involvement of stakeholders (e.g. NGOs, brand owners, citizens) and engagement with MS, regions and municipalities. The Circular Bio-based Europe Joint Undertaking will be further developed on this basis to build on these foundations. **Further synergies on innovative structuring and mobilisation can now be achieved if alignment is also developed between the EU bio-based framework approach and national strategic developments.**

2.3 Bioeconomy & the European Green Deal

The EDG sets out a transformative set of inclusive policies to boost the integration of sustainability into all aspects of the lives of EU citizens. Its conception responds to increasing societal awareness of the growing environmental, climate, biodiversity and economic challenges that EU citizens face. **In particular, there are new demands, targets and challenges that need to be addressed by EU MS.** The role of the bioeconomy is presented in a cross-cutting manner in the European Green Deal [13] in relation to e.g. Circular Economy [14], Farm to Fork [15], Methane emissions reductions [16], Biodiversity protection [17], Chemicals [18], EU forest strategy to name a few. Indeed, sustainable and circular bioeconomy development offers solutions to help address all of the objectives set out by the EGD, aligned with the European Climate Law [19]. These include achieving a climate-neutral economy by 2050, contributing to clean mobility, a zero-pollution ambition and shifting towards greener industries while striving to preserve and enhance natural ecosystems and their services.

The development of a sustainable and circular bioeconomy in each MS therefore will be essential to deliver on the EGD objectives. It therefore follows that either the bioeconomy must be consciously integrated into each objective by responsible ministries and directorates or a dedicated centralised strategy, addressing all relevant aspects is needed. Since the bioeconomy crosses numerous sectors and disciplines there is a clear rationale for the latter option, whereby synergies, conflicts of interest and unintended consequences could be more easily managed. **There is now a clear need for MS to undertake National Bioeconomy Strategy Development, and its implementation, including continuous updates to the Strategy and Action plans, with the aim of clear focus fully contributing towards achieving national, EGD, COVID-19 recovery and SDG objectives.**

3 Bioeconomy Policy Framework Approach

Bioeconomy strategy development therefore offers an **innovative and implementable pathway** to support the shift towards a **sustainable, climate neutral economy**. In this respect, there is no perfect blueprint for strategy or action plan development. However, international evidence suggests that following a series of well-recognised steps can help support the development of sound governance and systems transition approaches. This can ultimately lead to improved outcomes for citizens, society and businesses: reinforcing Europe's position as a leader in global sustainability, innovation and competitiveness while improving MS and citizen's prosperity. This report is therefore guided by the need to:

- Align with a **sound public governance [20] framework approach**. This should help to provide governments at all levels with a tool '*to aid policy support for the development of Strategies and Action plans for the deployment of bioeconomies in EU MS*'. This governance approach seeks to incorporate: **evidence-based decision making, stakeholder engagement, leadership, vision and commitment, cross-government coordination** and an **innovation outlook to support the introduction and implementation of new ideas**.
- Align with a **systems transition approach**, which recognises that many of our current systems are considered unsustainable and in need of systemic change. It also takes into consideration that many of the issues that we hope to address through development of sustainable, circular bioeconomies, e.g. climate change and biodiversity loss need both local and global solutions. Guidance can be found in literature and policy briefs [21-22] and in EEA [23] and OECD [24] generated approaches, outlining how to integrate systems transition approaches in policy making.

The Mutual Learning Exercise (MLE) has therefore identified, **key messages and actions** that align with **sound public governance** and **systems transition** approaches. This **reference framework** has been developed with a view to supporting the transition from current national bioeconomies to **sustainable and circular bioeconomies**. The **key messages and actions** in the framework have been developed based on feedback from MS experts. These recommendations aim to provide an **integrated diagnostic, guidance and benchmarking tool** to help enable 'policy support for the development of Strategies and Action plans for the deployment of bioeconomies in EU MS'. It is expected that this tool will be very useful for the **European Bioeconomy Policy Forum** and whilst the messages and key actions will need to evolve over time, the reference framework provides a long-term structure to debate and develop new messages and actions.

4 10 Key Policy Messages to Guide Bioeconomy Strategy and Action Plan Development

Collectively, there is growing recognition that addressing the major societal challenges and achieving sustainability and prosperity objectives will require fundamental changes in lifestyles and patterns of consumption and production in EU MS.

The EGD expresses this clearly, indicating that achieving the transition to net-zero emissions by 2050 will require economic and societal transformations and the engagement of all sectors including the bioeconomy and society. The Commission's 'reflection paper' on the 2030 Agenda for Sustainable Development also refers to the need for a sustainability transition to achieve the UN SDGs.

This report sets out 10 messages (i-x) for policy-makers, explored in sections **4.1 Getting Started**, **4.2 Building Transformative Coalitions** and **4.3 Steering the Process**. The policy messages are provided as **a set of guiding steps for transformation** and focused on engaging with the bio-based sectors of the economy and with society. It is envisaged that the policy messages may be applicable, at least in part, to all EU MS.

- The first section *Getting Started* addresses the need for **long-term political commitment** and **provision of spaces and activities** for stakeholder awareness raising and the co-creation of shared vision for a future bioeconomy.
- The second section *Building Transformative Coalitions* addresses how governments and other actors can **coordinate for bioeconomy development focused on systemic change** and **steering of projects towards long-term climate action, sustainability and rural and regional prosperity goals**.
- The final section *Steering the Process* addresses the **policy mixes and other actions needed to stimulate and enable system innovation** where bioeconomy intersects namely natural capital, primary production, bio-based industries and its products and services. These messages have a clear focus on funding, knowledge and innovation, diffusion, and reconfiguration of bioeconomies to sustainable and circular systems through the development of appropriate monitoring and evaluating.

4.1 Getting Started

(i) *Ensuring stronger recognition of the importance of bioeconomy policy by decision-makers and stakeholders*

In each MS, it is crucial that at the highest political level necessary, policy-makers ensure the long-term commitment and demonstration of **national political will to endorse and pursue bioeconomy policy**. Good practice indicates this is best organised through the design and development of national bioeconomy strategies and/or action plans with accompanying **stakeholder engagement** and **implementation** and **monitoring** processes.

High-level political endorsement good practices

- **Italy:** In 2017 the Italian government promoted the development of a national Bioeconomy Strategy (BIT), and more recently updated (BIT II) to interconnect more efficiently the pillars of the national bioeconomy: production of renewable biological resources, their conversion into valuable food/feed, bio-based products and bioenergy, and transformation and valorization of bio-waste streams. BIT II aims to improve coordination between Ministries and Italian regions in alignment of policies, regulations, R&I funding programmes and infrastructures investment. The goal is a 15 % increase in turnover and employment in the Italian bioeconomy by 2030. Based on Italy's strategic geopolitical position in the Mediterranean basin, BIT II also includes actions to improve sustainable productivity, social cohesion and political stability through the implementation of bioeconomy strategies in this area [25].
- **France:** France began its inter-departmental engagement work following the COP21. This was initially mediated by the Prime Minister who made the decision to develop a bioeconomy strategy. The strategy was adopted by the Council of Ministers in January 2017. Every ministry with a link to the bioeconomy strategy was involved and, in particular, the ministries of education, research, agriculture, environment and the economy.

Bioeconomy Integrity, Openness & Inclusiveness good practices

- **Austria:** The Austrian Bioeconomy Strategy [26] is one of the flagship projects found in the Austrian climate and energy strategy. Key cornerstones of the strategy development process included stakeholder engagement and the creation of an interdisciplinary advisory group (i.e. a bioeconomy-platform). The engagement process also involved two broad online consultations and sought to engage with and build on existing regional expertise, previous strategies and studies.
- **Germany:** The German Bioeconomy Strategy [27] identified the need to bring in (additional) expertise from outside. Remarks and recommendations were provided by 16 state governments, the German Bioeconomy Council, 4 scientific institutions, 17 sectoral associations and 15 NGOs from environmental, development, and consumer protection domains.
- **Ireland:** Through a scoping exercise with high-level policy-makers a baseline assessment was initially established of bioeconomy activity and opportunities across the various related sectors. A consultative seminar to co-create an integrated vision for the bioeconomy in Ireland was then held, with key stakeholders including development agencies & the private sector. Finally, a public consultation was then undertaken to further contribute to the publication of a high-level policy statement on the bioeconomy which described a long-term vision and broad actions for the transition to a sustainable and circular bioeconomy.

Discussion:

Leadership by MS governments and their civil service is fundamental for bioeconomy policy development. Senior civil servants in particular play a key role in **bridging the gap** between bottom-up developments, such as bioeconomy research and innovation, and top-down government strategy formulation and implementation. MS's without bioeconomy strategies therefore need to identify key senior civil servants who can help link **government objectives to the opportunity offered by bioeconomy strategy and/or action plan development**. In addition, good practice indicates that, as a minimum, two dedicated bioeconomy policy officers, from two different key ministries, can effectively lead bioeconomy strategy development, implementation and cross-government coordination.

Furthermore, as the bioeconomy involves multiple stakeholders, on-going, balanced and long-term stakeholder engagement is necessary. From the outset of bioeconomy strategy development, government ministries and agencies should ensure that stakeholders are included in the process. **Stakeholders concerns and priorities need to be heard and addressed in order to build trust and a collective sense of responsibility**. They are also needed to develop an effective action plan or to enlist the help, resources and expertise of the stakeholder community to implement such a plan. MS's with bioeconomy strategies have used different engagement instruments at national and regional level, including public consultations, to identify and engage with stakeholders who have an interest in or who may be impacted by developments in the bioeconomy. In some CEE countries, engaging stakeholders in a bioeconomy strategy needs to be considered in context as MS feedback has indicated that stakeholder engagement is generally not seen as high priority in terms of Ministerial responsibilities. Overall, **stakeholder awareness-raising** should not be a 'one off' process and **needs to be an ongoing effort which is appropriately resourced**.

Actions:

- a) The EU Competitiveness Council should request an update from EU MS on how they have responded to the call in the Council conclusions (14594/19)⁴ "to develop or update their national strategies on sustainable and circular bioeconomies, taking into consideration macro-regional and regional specificities and appropriate initiatives". Collaborative initiatives between MS achieving, a **high-level political commitment to legitimise bioeconomy policymaking** should be sought.
- b) MS should indicate how they will address the following good practice steps [28]:
 1. Identification of an **"institutional catalyst"** (central unit, lead ministry or lead group of ministries etc.) to take charge of linking government objectives with bioeconomy policy planning, strategy development and implementation, including its coherence and integration with relevant line ministries, central agencies and other public institutions.
 2. Ensure that governments, through lead senior civil servants, undertake preparation of a **national bioeconomy concept/position paper** in consultation with national stakeholders. Each MS should, as necessary, develop a **national bioeconomy strategy development roadmap** that outlines formative policy-making steps to bridge the gap from research activities to the development of a political statement or mandate.
 3. A **dedicated stakeholder engagement process** should accompany bioeconomy strategy and action plan development and implementation. Stakeholder engagement should be outlined in the bioeconomy **concept/position paper** and should be supported by **resources** and **professional expertise**, external if necessary, to deliver on this commitment.

- c) As the bioeconomy requires a long-term policy and investment outlook, **clarity is required regarding the mainstreaming of bioeconomy policy at EU level**. Policy gaps and sectoral coherence issues, especially with regards to the role of the bioeconomy in EU's Circular Economy and Industrial Policy and its EGD objectives, should be addressed by the EU Commission, with steps taken to ensure harmonisation.

(ii) *Moving from a bioeconomy concept to developing a vision*

Each MS needs to **examine the current status, positioning and importance of the bioeconomy within its own economy** from a range of different perspectives [7, 29, 30]. This is an important step in enabling the co-creation of **an integrated vision and collaborative approach to develop its bioeconomy**. This activity helps each MS and its stakeholders to understand the key challenges that need to be addressed. It also helps to support an **evidence-based decision-making process**, setting out a vision for a sustainable and circular bioeconomy which identifies guiding principles, strategic objectives and specific actions.

Bioeconomy Commitment, Vision & Leadership Good Practices

- **Finland Bioeconomy Vision:** High level stakeholders in Finland see the bioeconomy as the next 'wave' of economy, following on from using fossil-carbon based resources. The bioeconomy is defined as '*an economy that relies on renewable natural resources to produce food, energy, products and services. The bioeconomy strives to reduce our dependence on fossil natural resources, to prevent biodiversity loss and to create new economic growth and jobs in line with the principles of sustainable development*'. Finland considers that there is a need to understand the bioeconomy as a political path towards an environmentally and socially sustainable and just society, where the economy can flourish within the limits of nature and local and global social equality.
- **Austria Bioeconomy Vision:** Bioeconomy stands for an economic concept that aims to replace fossil resources (raw materials and energy sources) with renewable raw materials in as many areas and applications as possible. It covers all industrial and economic sectors that produce, process, handle or use biological resources. The bioeconomy thus offers a great opportunity to tackle global challenges, such as increasing climate change, food and water scarcity or growing environmental pollution, while at the same time strengthening economic development. The Austrian land is limited, so a sustainable bioeconomy also needs a reduction of consumption with a special focus on waste prevention.

Equitable & Evidence Informed Bioeconomy Policy Making

- **Ireland:** Research on **value-chain analysis** [30] was undertaken through an online Delphi study conducted with 75 bioeconomy experts to assesses and prioritise value chain opportunities for the Irish bioeconomy. This showcases fora to achieve stakeholder inclusion and interaction. The results are relevant for the development and governance of bioeconomies worldwide, identifying areas of consensus, caveats and conditions for bioeconomy strategy development. The initiative included consideration of factors from supply to demand, including the scale and fragmentation of feedstock, the capital investment required at the transformation technology stage and consumer acceptance of the bio-based output.
- **The EU Commission's 2020 Strategic Foresight Report** [10] notes the potential of a sustainable bioeconomy, to transform Europe's agricultural and industrial base and create new jobs, whilst enhancing our natural resources and ecosystems. In collaboration with DG Research and Innovation, the Joint Research Centre has created

an ad-hoc network of research experts to contribute to the EC's Knowledge Centre for Bioeconomy with forward-looking analyses. [Four alternative scenarios for the EU bioeconomy in 2050](#) [31] were outlined describing the world, Europe and the bioeconomy in 2050. They also explored the extent to which each scenario would contribute to the objectives of the EU Bioeconomy Strategy and to selected UN SDGs.

Discussion:

In moving from a bioeconomy concept towards developing a bioeconomy vision there are numerous elements and questions to consider. For example, it is necessary to identify details on the level of **current biomass feedstock production** and **future potential, natural capital accounting, greenhouse gas emissions** and **carbon sinks**. Information is also needed on the **current performance of the bio-based industry** and on indicating how well the MS exploits the potential of the bioeconomy based on past innovation. The **level of investment** should also be considered, including the **intensity of R&I activities**. In addition, the **development of supporting policies** such as strategies and action plans that indicate how the **bioeconomy, bio-based industry** and **bio-based innovation** will be developed and optimised in the future should be identified.

Discussions with stakeholders on these topics will allow the development of **an understanding of MS bioeconomy opportunities** and **challenges** and provide the building blocks **to develop a shared vision** of what a sustainable and circular bioeconomy system could look like at national level. **Inter-ministerial leadership** is extremely valuable at this point in engaging stakeholders, in confirming long-term political commitment and in attracting the necessary competences, expertise, resources and data from stakeholder communities.

MS feedback indicated suitable approaches towards building collective understanding across government for integrated and cohesive policy making included: scoping and feasibility studies; and baseline assessment of national bioeconomy activity. These tools and activities provide initial opportunities to **build understanding and to develop shared language** for bioeconomy strategy design and development in ministries and agencies and with stakeholders. They prepare the ground for the early establishment of **ad-hoc or informal hubs, networks or inter-ministerial steering groups**. These informal groups can act as conduits to receive and build on the outputs of activities such as e.g. from the BIOEAST initiative. Therefore, ensuring from the start that a common vision and language is established of what the bioeconomy is for the MS is important. In addition, establishing a broad agreement with stakeholders on a direction of travel, and on what the MS bioeconomy should become is a valuable part of the process of strategy and action plan design. This can help ensure that stakeholders are invested and engaged from the initial phase of the strategy design process for the long term. It also helps maximise the likelihood that relevant data and information is provided and that an implementable action plan with clear responsibilities can be shaped.

Actions:

- a) **Develop an understanding of the current bioeconomy and of what this represents in terms of economic, social and environmental benefits.** Indicators e.g., may include **GDP**, value added, jobs, rural regeneration aspects, type and volume of biomass produced, GHG emissions reduction and industrial defossilisation potential.
- b) **Co-create a shared vision with governmental and non-governmental experts of what a future bioeconomy could look like** and what should be undertaken within the bioeconomy to aid the achievement of carbon neutrality by 2050.

1. Perform **gap and/or scenario analysis** to understand what is needed from now until 2050 to reach the desired goals including e.g., which sustainable practices, innovation, demonstration, and commercial infrastructures will play a role in the future system.
 2. Put in place methodologies to identify **competing uses for biomass**, and **identification of ecological boundaries for a sustainable and circular bioeconomy** (e.g., the need to protect food security, carbon sinks, and natural capital including biodiversity [32]).
 3. Explore **possible synergies** with developments on e.g., nature-based solutions, carbon-neutral farming and blue carbon initiatives.
- c) **Identify and choose the main strategic issues, potential benefits and priorities** to focus on for bioeconomy strategy development with governmental experts and stakeholders.
1. **Check with stakeholders** (referencing the EU bioeconomy definition) **whether a national bioeconomy definition is needed**. Where this is the case, such a definition, should represent a harmonised vision, providing a common understanding and language for use by stakeholders.
 2. **Identify national bioeconomy strengths, weaknesses, opportunities and threats (SWOT)** together with stakeholders, taking into account political, socio-economic, technological and environmental (**PESTLE**) analysis and indicators for inclusion in the bioeconomy concept paper.
 3. Work with stakeholders to **identify how the national bioeconomy strategy can contribute to national strategic objectives and the EGD**. This will help contribute to the vision, guiding principles and strategic objectives of the bioeconomy strategy.

(iii) Creating spaces for building collective bioeconomy awareness and leadership

The transition to sustainable and circular bioeconomies in MS will involve multiple actors, inside and outside of government, over extended time periods. To allow for such engagement, there is a need to develop spaces for engagement to identify, design and implement a bioeconomy vision.

Bioeconomy Engagement for Policy Design & Formulation Good Practices

- **Czech Republic:** The goal of the BIOEAST HUB CZ is to promote Bioeconomy development. It has more than 100 stakeholders as members including research institutions, technology platforms, SMEs and NGOs. The hub provides support for the inter-ministerial group and policy-makers. Currently, there is no political agenda for a Czech national bioeconomy strategy but the BIOEAST HUB CZ is developing a concept paper as a first step for the future national bioeconomy strategy and to support the development of a strategic research and innovation agenda.
- **Germany:** The German Bioeconomy Council is an Independent Advisory Group to the German Government. Its first tenure was 2009-2012, its second tenure 2013-2019, with its third tenure beginning in 2020. It has 20 members from science, industry, civil society and has produced approximately 30 reports and recommendations since 2012. It has also coordinated and developed the Global Bioeconomy Summits of 2015, 2018, 2020.
- **Austria:** Three responsible ministries: Sustainability and Tourism; Education, Science and Research; Transport, Innovation and Technology were identified and held regular inter-ministerial meetings to build momentum and continuous exchange for the

development of needs for the bioeconomy strategy development process. Leading decision-makers engaged in the whole process at the required points. The bioeconomy strategy development process also ensured engagement with relevant units in the responsible ministries to build awareness, discuss various interests and mitigate issues. The process was also supported by the establishment of an interdisciplinary advisory group and the undertaking of regional stakeholder consultation activities. The inter-ministerial group also identified fields of action for integrating bioeconomy with pre-existing priority areas and is in position to address proposed actions on bioeconomy lighthouse projects and on the development of the bioeconomy action plan.

Discussion:

The details of the design of national bioeconomies, and of the pathways towards sustainability and circularity, may not be clear at the outset. In fact, multiple bioeconomy development pathways may be possible and these will need to be researched, piloted, demonstrated, evaluated and scaled-up if appropriate. Additionally, Ministers often need a concept note/position paper to act on and gathering high level support can be difficult without one. Moreover, stakeholders may only get involved if they see indications of long-term high level ministerial and government commitment and investment. In this light, initial **engagement activities and spaces to hold such discussions** are needed to build knowledge and understanding of the bioeconomy in ministries, agencies and with stakeholders. Initially, informal groupings where volunteers, interested parties, international initiatives and experts contribute to bioeconomy strategy development significantly enrich the **quality of outcomes** and the **development of shared mindsets**. Inter-ministerial leadership is also extremely valuable in these processes cementing stakeholder involvement activities and helping to attract the necessary competences, investments, expertise and data from these communities. Overall, such activities will help find the mix of policy supports that enable new solutions to emerge and to be scaled up.

Actions:

- a) Informal **independent advisory groups, networks or hubs** should be set-up so as to communicate a strategic long-term bioeconomy vision that will steer government and its stakeholders by highlighting cross-sectoral, global and local benefits of bioeconomy strategy development.
- b) In the longer-term, the **establishment of formal platforms for engaging stakeholders, such as Bioeconomy Councils, Panels, and Forums** should be considered to ensure ongoing engagement and input for monitoring and evaluation of bioeconomy strategies and action plans.
- c) Development of **information events** and **education and training programmes** can be incorporated from the beginning of policy initiatives to gather broader support and engagement from policy-makers who are only beginning to learn and understand about the bioeconomy.
- d) Ensure that the Coordination & Support Actions *HORIZON-CL6-2021-GOVERNANCE-01-10: Raising awareness of circular and sustainable bioeconomy in support of Member States to develop bioeconomy strategies and/or action plans* and *HORIZON-CL6-2021-GOVERNANCE-01-04: Strengthening bioeconomy innovation and deployment across sectors and all governance levels* are harnessed by MS to build collective bioeconomy awareness and leadership.

4.2 Building Transformative Coalitions

(iv) Coordinating across government to support bioeconomy strategy design and development

The transition to sustainable and circular bioeconomies in MS may not fall neatly under the responsibility of a single government department. A key challenge is the need to build collective leadership capacity to innovate at the scale of the whole of government. This will take account of integrating bioeconomy with numerous policy domains such as enterprise, environment & climate, circular economy, agriculture, fisheries, forestry, economic affairs, research, innovation and education etc. Neither top-down nor bottom-up coordination and collaboration mechanisms alone are sufficient and engagement with key stakeholders should be ongoing.

Whole of Government Bioeconomy Coordination Best Practice

- **France** established a national governance mechanism for the bioeconomy to coordinate and monitor its development and the implementation of the national bioeconomy action plan. The governance model was established with the creation of the Bioeconomy Cross-Sector Thematic Commission (CTI), established by decree in August 2019. This advocated the creation of working groups on specific themes. Four working groups were established on: Agricultural and agri-food methanization; Biofuels; Bio-sourced products; and Animal by-products. In addition to the CTI, a steering committee was set up when the action plan was initiated in February 2018 which provides administrative staff and professionals from the sector.
- **Italy** has put in place a formal bioeconomy cross-government working group involving the mobilisation of key individuals in the Ministry of Agriculture, Food, Forestry; the Ministry of Universities and Research; the Ministry for Economic Development; and the Ministry for Environment, Land, Sea with the help of the respective Director-Generals. This group also involves other stakeholders such as Regional Authorities, National Agencies, and Institutes & Clusters. The coordination board is nominated by the Presidency of the Council of Ministers every four years providing a stable structure. It meets monthly led by a Scientific Coordinator. It focuses on monitoring and promoting the national bioeconomy action plan which has defined outcomes and scenarios including flagship and supporting actions.
- **Hungary:** The bioeconomy is concurrently being developed through a non-mandated bottom-up process (inter-ministerial discussions, concept note and position paper) and through a mandated top-down whole of government approach involving engagement with the OECD on introducing circular economy and addressing waste management challenges. Developments on the circular economy are now being mirrored in all MS. In such cases, there is a clear need to develop aligned approaches regarding Circular Economy Development and bioeconomy development.

Discussion:

Long-term mechanisms for coordination across government, which are stable over time, are considered important by the MS. This is partly because developments in large complex systems, such as the bioeconomy, take time. Moreover, medium to long-term commitments to climate change goals or UN SDGs are well understood but this is less so the case for bioeconomy objectives. In this light, the EU and its MS governments therefore need to lengthen planning and investment horizons for bioeconomy strategies and action plans well beyond a single electoral cycle and long-term political commitment needs to be maintained, spanning multiple changes in government.

In addition, the evidence from MS feedback is that strategy development may need **to follow a phased development approach**. This could mean for example preparing **broad policy statements** to initially describe long-term goals and objectives, and following this up with more **detailed strategies and action plans**, outlining, for example, resources and deliverables. These options have helped MS use appropriate strategic instruments that reflects their individual level of maturity in bioeconomy development. In these processes, inter-governmental and stakeholder engagement and awareness-raising is complex, challenging and demands resources, but MS feedback has indicated that this is ultimately rewarding, resulting in greater levels of engagement, acceptance, long term commitment, investment and information dissemination.

Actions:

- a) Formal groups such as **inter-ministerial groups** with mandated members from different ministries and agencies are considered best practice and **should be established to allow for stability in coordination and communication** [33]. They also help to ensure long-term commitment to bioeconomy development that outlives electoral cycles and changes in government and its leadership, cabinet compositions or government programmes. The formal groups **should reflect the diversity of perspectives** needed to represent the transition to a sustainable and circular bioeconomy.
- b) Ministries and Agencies who formally engage in bioeconomy cross-government approaches should **develop their own internal ministerial or agency plan to develop the bioeconomy**. This should include establishing clear remits, responsibilities, capacities and mobilising adequate resources.
- c) **Undertake phased development** of bioeconomy strategy design & development. This can initially involve **incorporating bioeconomy elements into other established policies and strategies** e.g., integration initially in R&I [34] and circular economy strategies [35, 36]. It could then lead on to the development of a specific bioeconomy policy statement as a means of communicating a long-term initial high-level outlook. The development of more near-term bioeconomy strategies and action plans and their integration into other policy areas can then follow on from this. MS advocate starting **a mandated strategic approach** as soon as possible **that includes cross-government coordination and stakeholder engagement. Specific policy support for MS developing their first bioeconomy strategy** could also be considered.

(v) Identification of existing bioeconomy initiatives for building a coherent action plan

The identification of existing and on-going national bioeconomy initiatives is a first step towards developing a coherent action plan and to identifying disruptive lead innovators. These initiatives can serve as lighthouse projects, motivating case studies or learning environments.

Identification of lead projects & innovators Best Practice

- The European Commission's [Knowledge Centre for Bioeconomy](#) makes accessible policy-relevant knowledge resources, including publications, datasets, interactive visualisations, tools, definitions, news, events, etc. from different sources.
- The Bioeconomy Country dashboard [3] from the EC's Knowledge Centre for Bioeconomy also collects information on relevant innovation stakeholders (clusters, R&D centres, networks, technological platforms, SMEs, etc) at the national level.

- [The European Bioeconomy Library](#) is a transparent, readily available, user-friendly bioeconomy knowledge base platform.
- [The Bioeconomy.fi webpage](#) - is a place where you can find information, articles and news about Finnish bioeconomy.

Discussion:

MS can use **various activities to identify existing bioeconomy actions or emerging ideas**. In most cases, these activities are not structurally organised. To collect information, policy-makers therefore may have to organise or participate in various *ad hoc* fora and events, to collect information, for instance through opportunities provided by various projects:

- Local participation in Horizon 2020 projects, in related webinars and in the development of group roadmaps and concept papers are useful approaches for MS to collect information and connect with local stakeholders. For this reason, many MS ministries actively participate in H2020 project activities.
- Discussions around CAP strategic planning provide an important opportunity to consult stakeholders on bioeconomy development.
- The work of BIOEAST initiative and the Horizon 2020 BIOEASTsUP project [37] also helps provide overviews of activity in each CEE MS, and the creation of the BIOEAST hubs.
- National technology platforms focusing on areas related to the bioeconomy, such as biotechnology, or agro-food industry also provide useful contact points.
- Other good examples can be identified in the EIP-AGRI activities that relate to agri-environmental and bio-based projects.

Actions:

- a) MS could use various activities funded through EAFRD, ERDF, Horizon 2020/Europe and national funding to identify existing bioeconomy actions. In this way, they can capture emerging ideas, collect information and connect with local stakeholders. Such activity will **yield valuable information through the diversity of perspectives, priorities and concerns**. It will also aid the **identification of lead innovators**² [38] who can play a major role in transforming value chains when they adopt new technologies and practices. In doing so, they can help disseminate innovative best practices which can have a significant impact developing the bioeconomy.
- b) Once engaged, the commitment to stakeholder relations could be reinforced through ongoing communication and information exchange. **Specific regional approaches can be helpful in engaging stakeholder as can targeted media campaigns**

² With renewing solid industry cluster, world-class competence and research, innovative technology, favourable & long-term policies and numerous growth opportunities, Finland offers unique platform for bio-based production & partnering - <https://www.businessfinland.fi/en/do-business-with-finland/invest-in-finland/business-opportunities/bioeconomy>

(vi) Establishing collaborative bioeconomy partnerships for co-investment

Bioeconomy developments by their very nature are highly collaborative endeavours. They require participation, expertise, and investment on the part of multiple actors. Increasingly, this involves government at policy level, the private sector, primary producers, and entrepreneurs at project level as well as civil society at a consultative level.

Good practice examples for establishing collaborative bioeconomy partnerships for co-investment

- In Finland [39], consultancy services for SMEs helped to boost the number of funded bioeconomy projects.
- The Latvian State Institute of Wood Chemistry's provided a good example how to proceed with different kind of funding from research towards a business case. The project started as a research funded activity EU funding (ERDF) was used in the beginning. The private sector participated in the second phase of ERDF-funded project where TRL level 4-6 was and a pilot scale technology demonstration were developed. The project is now examining if industry partners are interested in scaling up the innovation to TRL 7-8. It was noted a faster scale up could have been achieved if an industry partner was engaged from the start of the research activity.
- A National Bioeconomy Research Centre (BiOrbic [40]) was established in Ireland and follows a public-private partnership model of national, EU co-fund and industry funding sources.
- In the Netherlands, projects at different TRLs are funded by different instruments: R&I funding is provided up to demonstration projects and flagships (HE/BBI JU/CBE), then their upscaling is provided for through European Regional Development Funds (as part of Smart Specialisation Strategies – S3) or Cohesion Funds.
- In Estonia, the BBI JU co-funded flagship biorefinery; first-of-a-kind wood fractionation demo plant was established to produce high-quality lignin. Project SWEETWOODS [41] brings together nine European companies to revolutionise the wood industry.

Collaborative Partnerships Good Practice

- **The Piemonte Bioeconomy Technology Platform** in Italy is a good practice example of a regional policy model designed to support bio-based value chains targeting the promotion of large, strategic R&D projects within the S3 priority sectors of Green Chemistry/Clean Tech and Agrifood and focusing on their connection to the framework of a circular economy approach. The Platform aims to promote circular productive ecosystems at regional level by leveraging supply chains, thus enabling sustainable growth processes with low environmental impact and to set the basis for the long-term development of bioeconomy in the Region. The cluster has shown that technological platforms benefit from long-term, high level political commitment and engagement with stakeholders from an early stage of the process. The structure of Piemonte bioeconomy technological platform also aimed to ensure that a broad range of actors joined the platform (e.g., SME's, large companies, and research and development institutions). The projects were planned in such a way that funding was divided automatically between different participants (small companies, large companies and research and development institutions). The outcome of the cluster to date has been that citizens and companies are more aware of bioeconomy potential; that specific projects on bioeconomy value chains have been funded; and that project partnerships are evolving to become business/commercial partnerships. Efforts were considered to connect with EAFRD funding to engage primary producers, but these need to be further developed.

Discussion:

One clear factor facilitating the transformation of economies to sustainable and circular bioeconomies will be entrepreneurial activity [42, 43]. It was not clear in the MLE activities if bioeconomy strategies account for the role of entrepreneurship in driving bioeconomy transformation. Analysis indicates that most existing bioeconomy strategies identify the transformative potential of entrepreneurship. However, it is unclear if the strategies are effective with respect to achieving the goal of boosting this bioeconomy entrepreneurship.

Cross-sectoral collaboration is also important to establishing a successful bioeconomy. Developing a more sustainable circular bioeconomy typically requires efforts to establish new or to transform existing infrastructures. Yet feedback from MS experts has indicated that there are challenges in aligning primary producers, SMEs, large industry, and other stakeholders in bioeconomy related projects at national level. Additionally, bringing together multiple sectors, who are often unaccustomed to working together, to make collective investments also raises challenges. Attracting investment for these initiatives can be difficult since initial costs (e.g., for infrastructure and equipment) can be high whilst payback or break-even periods are typically long. **This requirement for major capital investment or alignment of previously non-aligned actors means that combined funding and financial innovation are crucial.**

In addition, state owned agencies/companies and bioeconomy clusters can play a very important role in bioeconomy development. Although new partnerships and initiatives are needed within the bioeconomy, the private sector may be reluctant to invest, since scale-up is a big challenge and market stimulation measures are lacking for new bio-based products and processes. Leveraging state owned agencies/companies engagement to aid the breakthrough of innovation and help engage stakeholders on topics that are not familiar to them and require piloting and demonstration could prove to be important to address bioeconomy development.

Actions:

- a) **Devising entrepreneurship supporting activities in the context of national bioeconomy strategy development should be considered.** This could include measures and initiatives that help sustainable bioeconomy rural and regional entrepreneurs to act as key agents for bioeconomy implementation.
- b) **There is a need to develop a coherent pathway for bioeconomy/bio-based/bio-innovation investment, at regional, rural, and national level including alignment with research, innovation and demonstration. Project development assistance (PDA)** could be explored by the Commission and the MS with the aim of supporting the building collaborative partnerships that can develop technical, economic, and legal capacity for bioeconomy project development in line with national strategies and action plans. The PDA could seek to promote experimentation and build transformative coalitions in a 'territorial cluster'³.
- c) **Clusters and State agencies/companies** could develop their own plans to facilitate bioeconomy strategic development to allow for alignment of their mandates and sectoral objectives with national and EU bioeconomy strategy goals and objectives.

³ A 'circular bioeconomy 'territorial cluster' is a socio-economic and environmental system composed of all relevant actors and dimensions to implement, demonstrate and facilitate the replication of at least one circular bioeconomy systemic solution. In this context, a systemic solution is a cross-sectoral demonstration project for the territorial deployment of a circular bioeconomy and climate-neutral economy.

4.3 Steering the Process

(vii) Developing linkages and pathways between bioeconomy policy, funding, national and EU strategic research, innovation and investment agendas, and rural and regional development

A mix of policies and funding instruments will be needed to enable multi-actor approaches, operating within ecological boundaries and the breakthrough of technological innovation in the creation of sustainable and circular bioeconomies. In this context, it is necessary for MS's to consider how to finance the implementation of their national bioeconomy strategies using national, EU and private funding. There are important opportunities available when mainstreaming the bioeconomy in the implementation of national instruments and the available European programmes and instruments, such as the Common Agricultural Policy, LIFE, Recovery and Resilience Funds, Just Transition Fund, Horizon Europe and the associated bio-based partnership, or EU Invest.

Research Infrastructure & Investment Good Practice

- CAPBIOBG is an impactful collaborative initiative aimed at boosting the regional innovation potential in Bioeconomy". It brings together the Agricultural University of Plovdiv (AUP) in partnership with Wageningen University, Wageningen Research, BiOrbic Bioeconomy SFI Research Centre Dublin, University College Dublin and the University of Bologna. The project deliverables will help strengthen the capacity of AUP to develop and implement research & innovation projects in bioeconomy value chains at regional, national, cross-border and international scale. It will promote systemic and integrated approaches for acquiring research knowledge and innovation in the field of Bioeconomy. Capacity building of AUP is another key project goal to establish the institution as a regional knowledge centre on Bioeconomy. An additional objective is boosting multi-actor and multi-disciplinary collaboration in research & innovation as a key precondition for implementing regional strategies on bioeconomy in Bulgaria and at AUP.

Mainstreaming the bioeconomy through the Recovery & Resilience Fund

- **Estonia** has requested a total of €982.5 million in grants under the RRF. The Estonian plan is structured around six pillars including the: the green transition in enterprises ("Green leaf") which has a focus and a funding allocation in relation to the bioeconomy. Projects in the plan cover the entire lifetime of the RRF until 2026. The plan proposes measures in six of the seven European flagship areas and will fund not only investments but also expertise (project development assistance – PDA) to improve the implementation of investments.

Discussion:

MS reported positive developments in integrating bioeconomy into national strategic research and innovation agendas including some agendas that cover TRL 1-9 [43]. Additionally, development of bioeconomy research infrastructure (e.g. research centres, technology centres and regional clusters) at a national level was also recognised as beneficial for national bioeconomy development. These initiatives have helped foster national bioeconomy research capacity by combining regional resources with technological areas such as microbial production, enzyme technology, green chemistry and advanced physical and chemical processing.

However, **state aid rules still represent a significant national barrier** in providing support for demonstration projects and flagship biorefineries. Challenges were also reported in developing bioeconomy multi-actor approaches. These result from difficulties with rules of different national funding sources, e.g. national research, innovation, rural and regional development funds, which often prevents the alignment of sectors within the

bioeconomy value chain. Structuring and mobilisation of the bioeconomy could be accelerated at national, regional (NUTS 2 and NUTS 3) levels and at a rural level including community led local development (LEADER) levels. This could be facilitated by the development of combined funding instruments that would support not only research, innovation and development but also use rural, regional, recovery and just transition funds to support deployment of innovation and collaboration amongst bioeconomy actors.

Actions:

- a) **Strategic Research, Innovation, Infrastructure and Investment Agendas should be developed between EU MS**, e.g. with activities beginning in the SCAR SWG Bioeconomy and other research networks, to support bioeconomy development at national and pan-European level. In the short term, MS could consider the development of national research and innovation programmes on bioeconomy including specific national calls on bioeconomy related research and innovation.
- b) **Develop Bioeconomy Deployment Funding Pathways including use of Regional (Smart Specialisation) and Rural (CAP Strategic Plans including Local Development Strategies) plans & funds.** The pathways should be developed collaboratively by MS and seek to support multi-actor approaches and the provision of competitive funding opportunities for demonstration and flagship projects. Pathway development should consider multiple funding routes and the role of project development assistance to align e.g. CAP, ERDF, RRF and Just Transition funding amongst others. In addition, state aid [44, 45] barriers, industrial strategy developments including on strategic value chains [46] as well as Important Projects of Common European Interest (IPCEI) [47] should be examined.
- c) **Invest in research support infrastructures** (e.g. curation of enzyme databases, bio-repositories, microbiome support systems, research & technology centres, clusters, pilot biorefineries) as the shortest and most cost-effective route for strengthening the development of the EU bioeconomy.

(viii) Addressing the concerns and resistance of incumbent industries and patterns of behaviour of citizens and consumers

The transition to a sustainable and circular bioeconomy will require primary production and bio-based industries to replace old practices, technologies, their processing energy sources and to develop zero-waste approaches. Such fundamental change may raise concerns and meet with resistance on the part of incumbent industries, communities and workers whose market share, profits, jobs or livelihoods may be at risk. Such fundamental change may also raise concerns related to bioeconomy development and ecological boundaries with both concerned stakeholders and media. The transition to a sustainable and circular bioeconomy will also require changes in behaviour on the part of individuals including primary producers, consumers [48] and society [31]. Such changes can foster resistance in the form of psychological opposition to new infrastructure, technologies, practices, bio-based products and services.

Understanding and addressing such concerns and resistance is a key role of policy. Communication activities including engagement and activities with objective stakeholders, students and the media [49] are essential in order to raise awareness of the bioeconomy and its products and services and their economic, environmental and societal benefits. MS feedback indicates that this could be done from the very start of consideration of bioeconomy strategy and action plan development to achieve the best possible outcome for all stakeholders.

Stakeholder Engagement Good Practice

- **Ireland:** Bioeconomy Ireland Week [50] is an annual week-long event held each October to highlight and raise awareness of Ireland's rapidly emerging bioeconomy. The celebration is a collaboration of events involving industry, local communities,

primary producers, researchers and students throughout Ireland. As part of the Bioeconomy Ireland Week 2020, Teagasc, in collaboration with the Department of Agriculture, Food and Marine (DAFM), MTU, University College Dublin, Trinity College Dublin, Bord Iascaigh Mhara, the Irish Bioeconomy Foundation, and BiOrbic presented a series of maps [51] on the bioeconomy to highlight its relevance for a wide range of stakeholders across many sectors.

- **France:** A key stakeholder engagement activity in France is promoting the bioeconomy to the public via les Trophées de la bioéconomie [52]. This award was created in 2018 to reward bio-based products and bioeconomy projects. Trophies are awarded in 3 categories: bioenergy, bio-sourced materials and plant-based chemistry. This activity involves strong inter-ministerial coordination including each year, the organization of juries at both regional and national levels, involving the presence of representatives of the 4 ministries involved in the bioeconomy, both locally and centrally (agriculture and forestry, ecological transition, economy and research).
- **Bio-based Industries Consortium & EU MS:** The Bio-based Innovation Student Challenge Europe (BISC-E) [53] is a Europe-wide student competition recognising excellence in the emerging bio-based sector. BISC-E seeks to raise awareness and involve students in the transition towards a bio-based economy building a proactive bioeconomy community from an early age.

Discussion:

When the bioeconomy initially emerges as a policy in MS, interested and mandated stakeholders are generally positive about bio-based innovation and related policy and industrial activity. When the bioeconomy becomes further mainstreamed into broader economy-wide policies or requires development of infrastructure, more objective stakeholders including media outlets engage and important concerns are likely to be raised.

Stakeholders' concerns may include: potential threats to biodiversity and areas of environmental sensitivity, the cost of investing in, the location or the consequential life cycle analysis associated with 'first-of-a-kind' infrastructure and technologies. Other issues mentioned were: the feasibility/desirability of 1:1 substitution of bio-based for fossil based materials; a contagion effect resulting from previously unpopular policies (e.g. on biofuels); and the ability to count on and be rewarded for carbon emissions reductions. An additional aspect which arose was a resistance to engaging in the bioeconomy due to lack of identification of any benefit for communities already struggling with income inequality and social changes (e.g. people and brain drain, ageing society). As such, it is crucial to make the connection between bioeconomy development and the delivery of economic, societal and environmental benefits in countries with emerging bioeconomies.

Actions:

- a) **Methodologies for engaging stakeholders including concerned citizens, industries, workers, consumers and students should be developed and implemented for their continuous involvement in bioeconomy implementation and monitoring.** This could include the creation of dedicated bioeconomy 'weeks' and 'days' which ideally would be developed together with updated online information about local bioeconomy planned developments and seasonal events. It could also involve use of open innovation funding that target users, civil society, communities and other actors in projects.
- b) **Visions, targets and missions for aligning the bioeconomy with the EGD and SDGs should be developed.** Such a consideration would frame a sustainable and circular bioeconomy as offering opportunities for innovation, jobs and economic development in regions as well as environmental and climate benefits. The presentation of this opportunity would also identify the bioeconomy's limiting factors and enable stakeholders to understand its ecological limits. In addition, it should be clearly outlined that a sustainable and circular bioeconomy is only feasible with not only changes in

consumption such as resource and energy efficiency but also reduction and changes in consumption patterns in line with resource sufficiency.

(ix) Encouraging diffusion of bio-based knowledge, innovation & technological advances to support rural, coastal and regional development

EU bioeconomy research and innovation has largely been focused to date on fostering the development and market up-take of new technologies as a means of boosting economic growth, employment and national and EU competitiveness. In the transition to carbon neutral economies systems, however, relevant agro-ecological practice and bio-based innovation and technologies are now available and diffusion of such practice, technology and knowledge is considered an equally important issue.

Innovation & Change Management Good Practice: BioeconomieREVIER – Transition from Coal to Sustainable Bioeconomy

- **BioökonomieREVIER** [54] represents a German region undergoing structural change and a just transition from a lignite-linked economy to developing a sustainable bioeconomy as part of a regional response to transition. The approach seeks to build on strengths in relation to natural conditions, resources, presence of strong bio-based industries, the potential for new green jobs and the opportunity to develop a Bioeconomy integrated science and training region. The structural change will be facilitated by profiling and alignment of: innovation and focus labs; multiple stakeholders; and all levels of education; and participation processes with society. Innovation & change management processes will inform and integrate feedback from all stakeholders including mapping out of activities, identifying gaps and implementing actions to cross link sectors, industry and policies and address the gaps in education, training and skills. The key to successful development has been to approach the demand in the region from a bottom-up perspective and to integrate regional challenges and opportunities with global challenges and opportunities.

Education Good Practice

- **The vision for the European Bioeconomy University** [55] is to create Europe's leading intellectual institution for tackling the enormous environmental, economic and societal challenges of the 21st century by a) covering the entire spectrum of bioeconomy dimensions; b) providing an internationally unique and competitive model for a theme-based, system- and future-oriented university that focuses on inter- and transdisciplinary as well as sectoral and European collaboration and c) taking university collaboration to a higher level of joint strategy development and to a new governance model, based on shared beliefs and longstanding cooperation.

Linking bioeconomy, CAP and agri-digitalisation good practice

- **Spain** has been very successful in combining Horizon 2020 Societal Challenge 2 & Bio-Based Industries Joint Undertaking projects. In addition, the bioeconomy has been recognised as a central part of the current Spanish CAP Rural Development programmes for the period 2014-2020. Bioeconomy related CAP measures in this period have included knowledge transfer, advisory services, cooperation, investments, farm and business development, basic services and forest investments. For example, under Cooperation EIP-AGRI, 31 bioeconomy related operational groups were financed to the value of €3.1 million. Additionally, in the 2020 EIP-AGRI call a budget of €1.8 million was allocated for innovative bioeconomy projects. In the preparations for the CAP Strategic Plan, bioeconomy funding opportunities are being considered in relation to bioeconomy and eco-schemes, sectoral programmes, investments, cooperation including EIP-AGRI & LEADER, knowledge exchange and the farm advisory service. A strong focus will also be placed on the digital transformation of the agri-food and

forestry sector and rural areas including addressing knowledge gaps and reducing labour intensity.

Discussion:

The efficient sharing of pre-competitive knowledge generated through the EU bioeconomy research and innovation public-private partnership can be broadened even further. Knowledge sharing of non-proprietary biorefinery relevant platform technologies is already available in the public domain, such as the *EU Biorefinery Outlook to 2030* study [11]. If diffused, this could have the effect of stimulating entrepreneurship and supporting rural and regional development across Europe. With new approaches to knowledge sharing, the vision of an efficient, participatory “copy and paste” approach, and sharing of the non-proprietary biorefinery or technological part, could become a reality. Such developments could facilitate and accelerate the responsible use of the biological resources in Europe, creating societal, environmental and business value at the same time.

This means that policy-makers need to pay attention to barriers to institutional and individual behavioural change and need to provide appropriate education, training and skills opportunities and offering possibilities for cooperation amongst key stakeholders to up-take technologies in place-based locations. In this respect, the CAP Agricultural Knowledge & Innovation System (AKIS) seeks to bring about regular and structural interplay between information, knowledge, advice, innovation, training, education and research. A prototype AKIS approach tailored for the bioeconomy, to support engagement by primary producers and farm and rural economy innovation intermediaries and entrepreneurs, would help EU MS integrate bioeconomy into their CAP Strategic Plan.

Actions:

- a) The BBI-JU and Circular Bio-based Europe could develop a **knowledge exchange methodological approach** that would tailor activities to end-user needs. This would help develop knowledge transfer plans to support the systematic diffusion of a biomass conversion technology toolbox in Europe; creating societal, environmental and business value at the same time.
- b) **Education, training and skills development should be considered from the start and incorporated into MS bioeconomy strategies and/or action plans.**
 1. A good starting point is to consider how transitioning away from a fossil-carbon economy will impact existing livelihoods and workforces and to **understand the skills that will be needed to enable a transition**. If possible, all stakeholders should be involved in identifying these needs.
 2. Education and training at all levels are needed in the bioeconomy together with both top-down and bottom-up approaches.
 - i. A broad range of people need to be involved in identifying training and education needs within the bioeconomy. These include schools, training boards, and skills forum, and schoolbook publishers, providers of continuous professional development, chambers of commerce, city authorities, technical institutes, industry, universities and citizens, amongst other. In particular, collaborative efforts in shaping ongoing bioeconomy education and training, bringing together key stakeholders are effective and these should be undertaken at the very initial stage of bioeconomy strategy development.
 - ii. For **early-stage education and training** levels (primary and secondary level education (7-18 yrs) a broad introduction [56, 57] to the relevance of the bioeconomy and its potential benefits could be explored.
 - iii. For **further (apprenticeships, certificates, diplomas) and higher education training (B.Sc/M.Sc)** in particular focus areas, such as

engineering or business and an additional qualification in bioeconomy, could be considered. Courses that study the entire value chain for bio-based products [58] giving professionals the opportunity to deal with the environmental, social and economic dimensions of the bioeconomy from a micro and a macro level perspective, including innovation, entrepreneurship, institutions and policies should be made available. Additionally, integration of leading MS universities with the European Bioeconomy University network should be developed.

- c) The CAP proposes that EU MS develop their National Agriculture (and Rural Development) Knowledge and Innovation System (AKIS). **A Horizon Europe coordination and support funding opportunity could be offered to develop prototype AKIS activities** for Knowledge Exchange, Farm Advisory Services, EIP-AGRI, LEADER and CAP Networks **to facilitate up-take of bioeconomy opportunities** by primary producers, rural economy entrepreneurs and industry in collaborative ventures. This could possibly include technological development emerging from the BBI-JU and Circular Bio-based Europe biomass conversion toolbox.
- d) Reconfiguring bioeconomies in EU MS could seek to go beyond individual innovations or technological 'silver bullets' and promote synergies between multiple innovations. In this light, **MS could seek to align bioeconomy innovation with other green economy developments** including on e.g. nature-based solutions, renewable energy, circular economy and digitalisation at a rural and regional level.

(x) Evaluating and gauging progress to help steer development of sustainable, circular bioeconomies

Throughout bioeconomy strategy design, development and implementation stages, evaluation will increasingly play a crucial role in gauging progress and steering developments towards the goal of a sustainable and circular bioeconomy. To ensure sustainability, as bio-based innovation and its market uptake develops, stakeholders must be willing to re-evaluate choices made on an ongoing basis, and to reorient policy, practice, technology choices and regulatory approaches as new information and innovation becomes available.

Policy Evaluation Good Practice:

- The EU Bioeconomy Monitoring System which is a JRC-led action of the EU Bioeconomy Strategy was first released in November 2020, within the European Commission's [Knowledge Centre for Bioeconomy](#); the monitoring system is being continuously updated and improved [59].
- The German Bioeconomy Monitoring involves three pillars. The Thünen Institute, commissioned by the Federal Ministry of Food and Agriculture, has developed material flow accounts of present and future flows of biomass ranging from the primary production to the initial steps of industrial treatment and further on to final goods; bioeconomy monitoring on a sectoral base; and integrated sustainability assessment [60]. As the second pillar, a consortium led by the IFO Institute worked on key economic indicators. This pillar measured the contribution of the bioeconomy to the German economy and its effects on employment, value added, innovation and potential barriers or trade-offs [61]. This pillar was financed by the Federal Ministry for Economic Affairs and Energy. The research consortium SYMOBIO (Systematic Monitoring and Modelling of the Bioeconomy) [62], funded by the German Federal Ministry of Education and Research (BMBF), forms the third pillar and developed a systemic monitoring and modelling of the bioeconomy in Germany, taking into account national and international aspects, as part of the concept of "bioeconomy as societal change". It delivered a comprehensive sustainability assessment of the German Bioeconomy based on five global footprints [63]. In 2020, a common "Pilot report" of the three pillars was

presented to the public [64]. The next, “consolidating phase” of the monitoring will start at the end of 2021.

Discussion:

Policy evaluation and monitoring practices are emerging and will continue to evolve in the context of bioeconomy development and the transition to a climate neutral economy by 2050 [64, 65].

In transitioning to a sustainable and circular bioeconomy, policy-makers face the challenge of developing a vision of what a future such bioeconomy will look like, including what practices and technologies are likely to play important roles and e.g. what infrastructures, training and skills and financing will be required. The management of this transition needs to ensure that the delivery of essential services from e.g. the energy, food and manufacturing systems continues during this transition. This will mean that careful management of the transition is needed to moderate against risks that may arise.

The role of evaluation in the transition of national bioeconomies to sustainable and circular systems will differ in a number of respects from existing evaluation models where value for money and the effective use of resources are two well-established goals. The relatively limited experience from EU MS on the development of national bioeconomy monitoring systems is that evaluation involves building on current monitoring systems in relation to biomass resources and the role of such resources in an economy. It also involves placing a greater emphasis on research experimentation on monitoring and modelling, learning from experience, and an increased requirement for multidisciplinary inputs [60, 66].

Overall, this means that evaluation will need to measure the challenge of implementing a mix of policies that enable bio-based innovation to break through to the marketplace and play a role in creating new sustainable and circular systems. For this approach to become deeply embedded within the policy design and implementation process, a more diverse set of systemic evaluation metrics and modelling [67] needs to be devised and monitored.

Actions:

Policy evaluation and monitoring activities for bioeconomy strategy design, development and implementation needs to evolve. It needs to not only capture traditional metrics but also integration of these into all stages of the policy cycle to generate continuous learning and to guide progress and manage risk. The following actions are proposed based on the feedback on good practices received during the MLE:

- a) **Individual MS are encouraged to offer national research opportunities to develop bioeconomy monitoring and evaluation approaches**, and to build capacity with a focus on the: ecological boundaries; biological resource base and its sustainability; economic and GHG emission reduction indicators for monitoring the progress of the bioeconomy; and systemic monitoring and modelling of the bioeconomy.
- b) **Examine the development of scientifically robust metrics and performance benchmarks** to inform future policy and business choices, as well as to promote the consideration of sustainability aspects throughout the whole innovation chain (from basic research to development of innovative solutions and market deployment) and across the entire bio-based ecosystem (from biomass sourcing to industrial processing, production and consumption).
- c) **A Horizon Europe coordination and support action opportunity could be considered to facilitate EU MS to work together to develop a bioeconomy monitoring and evaluation system** to support bioeconomy strategy design, development and implementation at national level/in their countries. This should also include consideration of how to align with JRC guidance on monitoring the EU Bioeconomy Monitoring System implemented by the JRC.

5 Conclusion

The drive for the EU and its MS to develop sustainable, circular bioeconomies reflects the need, as expressed in the EGD, for more integrated policy approaches that are long-term in character.

The Bioeconomy Strategies currently in place in EU MS highlight a shift from sectoral approaches to an integrated systemic focus, for example by recognising the interlinkages between environment, economy and society. They also emphasise the required transformation of the economy and society based on new objectives to contribute to net-zero emissions and become circular and digital in line with long-term framings and targets of 2030 and 2050. They seek to address multi-dimensional objectives including themes such as jobs, competitiveness, sustainability and rural and regional development. They focus on the inclusion of diverse societal actors and the creation of stakeholder platforms. Increasingly they are underpinned by the adoption of transitions thinking, including particularly emphasis on the role of innovation in different policy areas related to the bioeconomy.

There is now a major need to ensure the strategic development of the bioeconomy and bio-based industries in those parts of the EU where suitable conditions for bioeconomy activities are found, but where insufficient investment, innovation, infrastructure or knowledge capacity currently exists. Overall, bioeconomy development will be needed to effectively address and deliver on the implementation of the European Green Deal and on the post-Covid 19 recovery.

In this light, the MLE has identified **10 key policy messages**, underpinned by a sound public governance and systems transition approach **to start, build or steer bioeconomy strategy and/or action plan design, development, implementation and evaluation**.

The findings of the MLE should be shared widely beginning with MS cross-government bioeconomy policy implementation groups, the European Bioeconomy Policy Forum, States Representative Group of the Bio-based Industries JU (soon to be Circular Bio-based Europe) and the SCAR Bioeconomy Strategic Working Group, as well as with a broader stakeholder community including the relevant EU Councils e.g. Competitiveness & Agri-Fish and the Committee of the Regions. The tasks and actions identified in this MLE could be considered by these coordination and support groups for their implementation, in particular **to help enable 'policy support for the development of Strategies and Action plans for the deployment of bioeconomies in EU MS'**.

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The bioeconomy can be a catalyst for sustainable systemic change and transition, tackling key economic, societal and environmental challenges faced by EU Member States (MS). For bioeconomy transitions to occur there is a need for policy to support interactions among multiple actors, including businesses, users, scientific communities, policy-makers, social movements and interest groups. Bioeconomy transitions will also involve the need to choose between alternative visions of the future and how to get there, pointing to the importance of public engagement to foster consultation and deliberation. In this light, bioeconomy transitions will also involve the need to prepare for unexpected consequences and new emerging issues which implies a need for both exploratory, analytical approaches (e.g. horizon scanning), as well as adaptive governance. In this context, targeted national bioeconomy strategies and/or action plans are necessary both to aid the addressing of the European Green Deal (EGD) but also to develop benefits and opportunities for rural, coastal, regional and urban areas in each MS. Based on the feedback from experts in the Mutual Learning Experience (MLE), and taking into account the principles of good governance and systems transition approaches, 10 Key Policy Messages have been identified to help guide national bioeconomy strategy and/or action plan development.

Studies and reports



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