Bioökonomierat

Bioeconomy Policy (Part II)
Synopsis of National Strategies around the World

A report from the German Bioeconomy Council

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Abstract

In the past decade, bioeconomy has gained momentum as a new strategy for fostering innovation, sustainable development and green growth in more than 40 industrialized and emerging economies. In preparation for the first Global Bioeconomy Summit, to be held in Berlin on 24 – 26 November 2015, the conference committee decided to collect information on worldwide policy strategies fostering bioeconomy development. The main aim of this study is to contribute to the establishment of an international discussion and coordination platform for the future development of a global bioeconomy. For the first time, it seeks to document the state-of-the-art of current bioeconomy policies and the dynamics in bioeconomy policy-making around the globe. The report primarily provides an overview of the bioeconomy-related policy strategies in 45 countries. The summary demonstrates both the similarities and differences between political goals, approaches and priorities for bioeconomy development. Specifically, the report shines a light on the economic sectors prioritized in the policy strategies and the policy areas involved, including research and innovation, education and training, technology transfer and market development support.

Content

Introduction

In preparation for the first Global Bioeconomy Summit, to be held in Berlin on 24th – 26th November 2015, the conference committee decided to collect information on worldwide policy strategies fostering bioeconomy development. This work was carried out by the Secretariat of the German Bioeconomy Council. The Council is an independent advisory body to the German government. Building on an earlier report on bioeconomy policies in the G7[1] and other attempts to cover policy support for regional and international bioeconomy development[2], this study presents the first global overview of national bioeconomy-related policy strategies.

1 German Bioeconomy Council, 2015.
2 European Commission, 2015; International Energy Agengy, 2014; Global Bioenergy Partnership, 2011.

Understanding of Bioeconomy

For the purpose of this study, bioeconomy is defined as "the knowledge-based production and utilization of biological resources to provide products, processes and services in all sectors of trade and industry within the framework of a sustainable economic system"[3]. It is important to differentiate the bioeconomy from traditional primary production in agriculture, forestry and fishery[4]. The bioeconomy uses new scientific knowledge and emerging technologies for the development of biobased processes and the transformation of natural resources into sustainable products and services. In this respect, the bioeconomy encompasses the processing and services industries. It relates to the development and production of biological pharmaceuticals, bioplastics and composite materials, 2nd and 3rd generation biofuels, biobased chemicals, cosmetics and high-value foods. In the manufacturing and capital goods industry, new machinery and equipment are related to bioeconomy development, for example in the area of medical equipment and biosensors, precision farming and the construction of chemical plants. In the services sector, innovations are achieved by the application of biological knowledge, such as in environmental engineering, bioprospecting, bioinformatics or biomimetics. Moreover, the bioeconomy has not only a supply side but of equal importance is its demand side, i.e. consumer preferences and behavior in relation to products, services, life styles, attention to environmental consequences of consumption.[5]

3 German Bioeconomy Council, 2015.
4 Santana, Torres & Contini, 2012.
5 German Bioeconomy Council, 2014.

Aim: A Living Document

The main aim of this study is to contribute to the establishment of an international discussion and coordination platform for the future development of a global bioeconomy. The study is directed at policy makers, industry, research communities, and representatives of civil society. It mainly seeks to provide baseline information for future exchanges of experience, transnational learning and strategic cooperation in bioeconomy policy. However, the study intends to judge neither the degree of implementation of the strategies nor their effectiveness. Given the exploratory character of this paper and the dynamics of the worldwide development of the bioeconomy, the authors cannot guarantee the completeness and correctness of the information provided.

Therefore, the authors and the conference committee explicitly invite policy-makers and researchers to provide feedback on the correctness and completeness of the information provided. Given the fast and dynamic evolution of the bioeconomy worldwide, we consider this study to be a living document. Updated country profiles and related comments will be published on the websites of the Global Bioeconomy Summit and the German Bioeconomy Council. Any suggestions for revisions, or material about additional countries' bioeconomy strategies may be send to **info@biooekonomierat.de**.

Methodology

The study relies on Internet-based desk research and refers to publicly available government documents, such as publications from ministries, government agencies and affiliated research institutions. Secondary literature, e.g. from international organizations, has been used to crosscheck and complement background information. The list of references used is enclosed at the end of each country profile.

Given the geographic scope and the newness of the topic, the focus of this study is on top-level government strategies encouraging bioeconomy development. Such strategy documents typically elaborate the mid to long-term direction of policy support by defining a vision and overarching goals to be achieved. Strategy documents further highlight priority fields of action across different ministries and thematic areas. Sometimes, government strategies mention individual policy measures, such as laws or research funds, however, they do not usually provide a comprehensive and up-to-date overview of such measures.

In the absence of a holistic, dedicated bioeconomy strategy, the authors searched for policy strategies with a strong link to bioeconomy development. These strategies mainly refer to bioeconomy-related areas, such as biotechnology, bioenergy or biobased economy/industry. In the wider policy areas of research and innovation, green and blue growth or the agriculture/forestry/marine sectors, policy strategies were only considered if they prioritized bioeconomy or innovative, biobased approaches. The authors also considered regional government strategies on bioeconomy development.

Moreover, emphasis was put on the latest bioeconomy (-related) policies in the time period from 2005 to 2015. Preceding or earlier strategies were only mentioned if still referenced in recent government documents.

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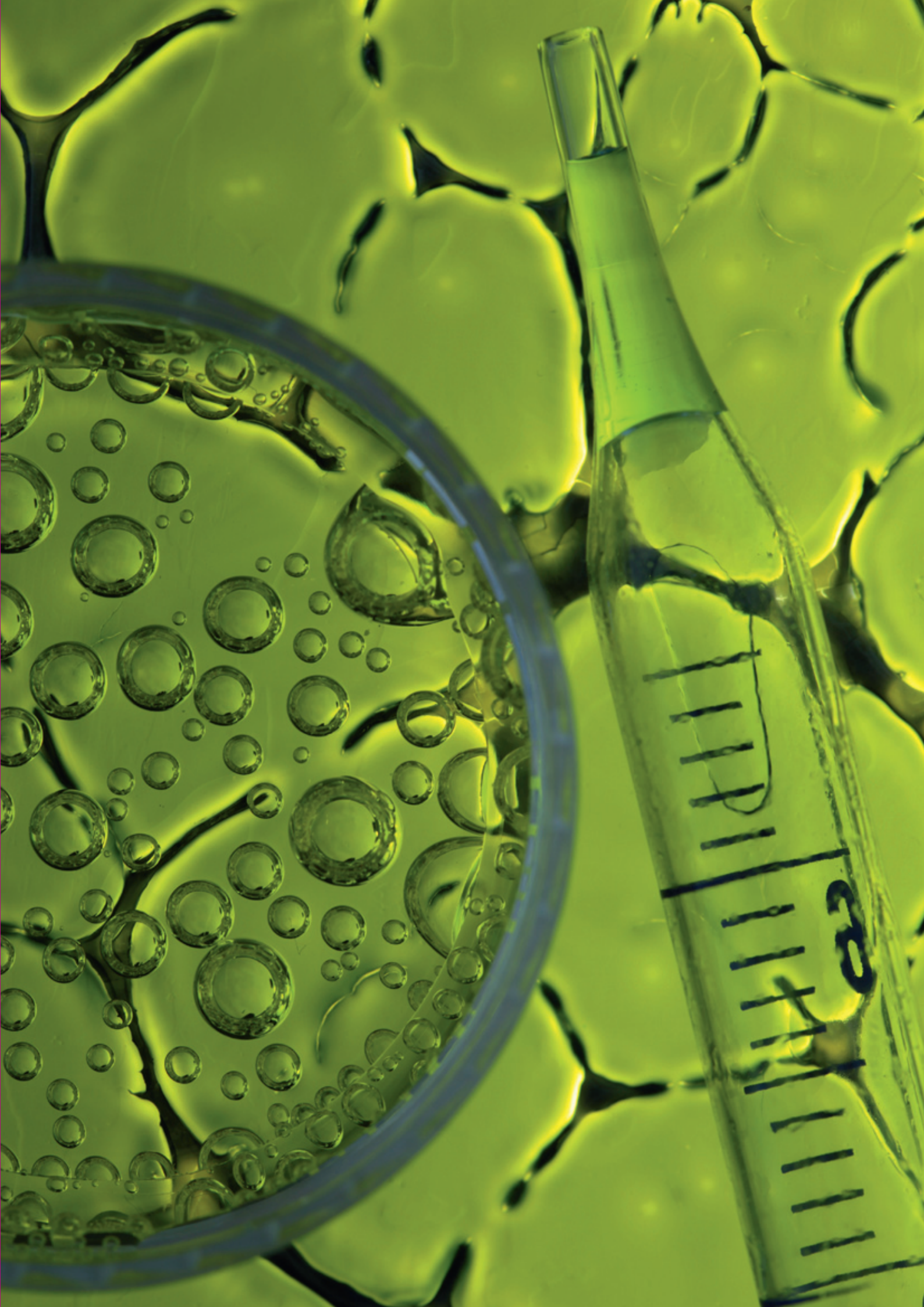


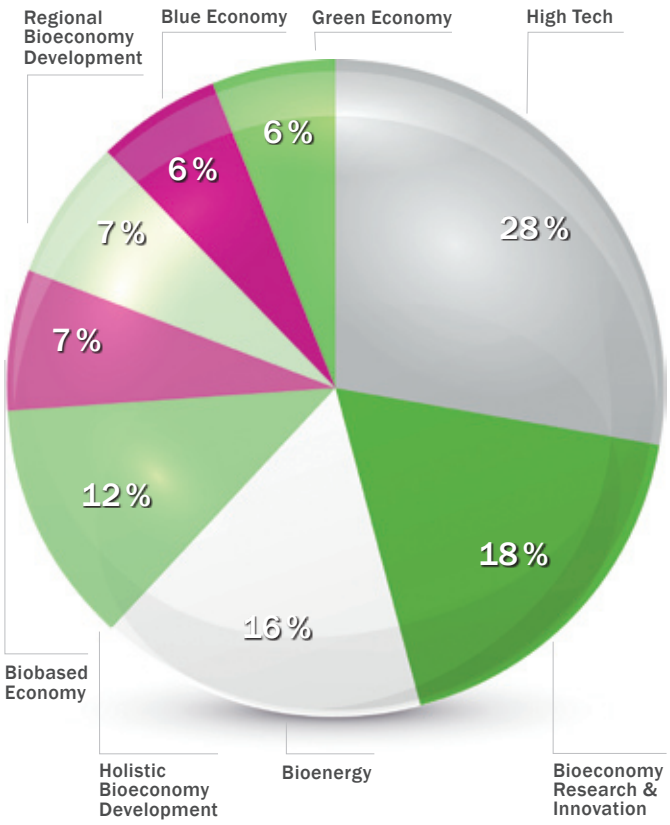
Bioeconomy Policies around the World

The following chapter presents for each continent an overview of the current dynamics in bioeconomy policy-making, followed by the respective country profiles. Each country profile describes the bioeconomy-related policy strategies identified alongside the political understanding, goals and approaches involved. Intercontinental countries have been assigned to the continent, which covers the majority of their territory. In this sense, Russia and Turkey are here assigned to Asia.

Overview

The study identifies 45 countries in total, which have developed national policy strategies with significant impact on bioeconomy development, eight of which could be classified as dedicated or holistic bioeconomy strategies (the European Union, Finland, Germany, Japan, Malaysia, South Africa, the USA and the West Nordic Countries). With regard to the other countries, the study identified further strategies which clearly refer to bioeconomy development. These strategies, however, do not adopt a holistic perspective but rather see bioeconomy development through the lens of specific policy areas. The report locates 19 high-tech (biotechnology and converging technologies) strategies and 11 bioenergy strategies on bioeconomy. Furthermore, the authors list 12 research and innovation strategies with a focus on bioeconomy topics and five strategies relating to the biobased economy. The study also identifies four green and four blue economy strategies with bioeconomy-related priorities. Finally, five regional bioeconomy strategies have been identified (see figure).

Figure: Which strategies are related to bioeconomy development?



Of the countries considered in this study, 18 directly use the terms “bioeconomy” or “biobased economy” in their strategy documents and 13 provide a definition of the bioeconomy.

Bioeconomy is still gaining in political importance. In Europe, Spain and Estonia published drafts of dedicated bioeconomy strategies in mid-2015. Similar efforts are underway in France, Norway, Austria and Iceland. In Italy, the Emilia Romagna region has invested strongly in bioeconomy development and the Basilicata region is seriously thinking about drafting the first Italian regional bioeconomy strategy. In Poland, a national bioeconomy panel was established in 2014. In Latin America, Brazil confirmed the importance of bioenergy in its decennial energy plan in 2014, the countries of the Southern Cone initiated a bioeconomy policy agenda in 2014 and a high-level regional meeting took place in Chile in fall 2015. In Asia, India issued a revised version of its comprehensive biotechnology strategy in 2014. Malaysia has initiated the third phase of its bioeconomy strategy which will focus on internationalization. In mid-2015, Australia endorsed a holistic Marine Science Strategy and Indonesia adopted its first Grand Agricultural Strategy. In Turkey, a high-level bioeconomy meeting was held in 2013 announcing the intention to develop a policy strategy. In Africa, South Africa released a dedicated bioeconomy strategy in 2013, Uganda a biomass energy strategy in 2014, Namibia defined a research and innovation strategy which strongly focuses on bioeconomy topics in 2015, and Tunisia is working on a biotechnology strategy.

The table presented in the Annex provides an overview of the different political approaches for promoting bioeconomy development which were identified in this study. For each country the table shows the policy perspective adopted when it comes to bioeconomy development. It then lists the national policy strategies identified in addition to their overarching goals and priorities. The countries were found to focus on specific economic sectors and on political interventions. These extend from research and innovation support to infrastructure investments and commercialization support, the introduction of demand-side instruments and changes in policy framework conditions.

Africa

Northern Africa, and specifically Egypt, is relatively advanced in terms of biosciences research and biotechnology applications. However, they have not issued any policy strategies in the past ten years. In Tunisia, however, the new government seems to prepare a biotechnology strategy. The development of bioeconomy policy strategies in sub-Saharan Africa is considerably influenced by the leadership of sub-regional partnerships in combination with international donor institutions. The Economic Community of West African States (ECOWAS) has, for example, promoted the development of bioenergy from Jatropha, which has been taken up by Nigeria, Mali and Senegal in their national biofuel strategies. The African Union encourages biotechnology development and biosafety policies. Via the New Partnership for Africa's Development (NEPAD), it co-finances the African Biosciences Initiative, which focuses on biodiversity science and technology, biotechnology and indigenous knowledge systems. The Eastern African countries Kenya, Uganda and Tanzania have adopted national biotechnology strategies. Donor organizations such as USAID, the Swedish SIDA or the Gates Foundation have funded biotechnology capacity building projects in the area. In Southern Africa, South Africa stands out with a dedicated bioeconomy strategy. Recently, Namibia has defined a pronounced research and innovation strategy integrating key issues for bioeconomy development. Mauritius takes a different path and developed a comprehensive Ocean Economy strategy in 2013.

Country	Perspective	Document Name
Kenya	High-Tech	"National Bioprospecting Strategy" (2011)
		"A National Biotechnology Development Policy" (2006)
Mali	Bioenergy	"Stratégie Nationale de Développement des Biocarburants en Mali" (2009)
		"Stratégie Nationale pour le Développment des Energies Renouvelables" (2006)
Mauritius	Blue Economy	"Ocean Economy" (2013)
Mozambique	Bioenergy	"Politica e Estrategia de Biocombustiveis" (2009)
Namibia	Research & Innovation	"National Programme on Research, Science, Technoloy and Innovation" (2015)
Nigeria	Bioenergy	"Biofuel Policy and Incentives" (2007)
Senegal	Bioenergy	"Lettre de Politique de Développement du Secteur de L'Energie" (2008, 2012)
		"National Biofuels Strategy" (2006)
South Africa	Holistic Bioeconomy Development	"The Bio-Economy Strategy" (2013)
Tanzania	High-Tech	"National Biotechnology Policy" (2013)
Uganda	Bioenergy	"Biomass Energy Strategy Uganda" (2014)
	High-Tech	"National Biotechnology and Biosafety Policy" (2008)
		"The Renewable Energy Policy For Uganda" (2007)

Kenya

1 Which bioeconomy-related policy strategies exist?

In Kenya, bioeconomy development is strongly related to biotechnology policy. With the "National Biotechnology Development Policy" (2006) the government formulated its vision to transform Kenya into a knowledge-based economy by fostering research, development and commercialization of modern biotechnological products. The strategy is in line with Kenya's "National Development Plan" (2002-2008), which strives to optimize the agricultural output through scientific and biotechnological interventions. In recent years, the government has further provided political guidance and support in the area of bioprospecting. With its **national strategy on bioprospecting** (2011) the government has undertaken first steps to capitalize on the countries rich biodiversity.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

3 Who is the author of the strategies?

The Kenyan Cabinet approved the "National Biotechnology Development Policy" in 2006. The strategy was prepared by the Kenya National Council for Science and Technology (NCST), a governmental advisory body, and is based on consultations across government authorities and business actors.

4 What are the key goals of the strategies?

With the "National Biotechnology Development Policy" (2006) the government aims at developing biotechnology and its safe application. Biotechnology should contribute to promoting economic growth, healthcare, as well as food and environmental security. By implementing the strategy, the country should become "a key stakeholder in the international biotechnology enterprise within a decade"[6].

While the national bioprospecting strategy (2011) was mainly developed to regulate illegal biopirating activities, Kenya's government has also recognized the economic potential of the countries biodiversity and, therefore, aims to generate wealth from the utilization of natural resources.

6 Republic of Kenya, 2006, p. 5

5 What are the priority areas of the strategies?

The "National Biotechnology Development Policy" generally comprises all biotechnological disciplines. In order to create an enabling environment for biotechnology development, the strategy paper focuses on promoting research and development, raising awareness on biotechnological innovations and encouraging investment and the creation of new businesses. The strategy further seeks to improve public health. Therefore, it specifically highlights medical applications of biotechnology, e.g. bioprospecting as opportunity to develop value added therapeutic products. Further priority is given to promote capacity building, national and international cooperation, as well as policy coherence in order to foster biotechnology development and commercialization. Therefore, A National Commission on Biotechnology should be established, which would be responsible for implementing the biotechnology policy and coordinating all policies on sustainable development that relate to biotechnology.

The national bioprospecting strategy (2011) put great emphasis on regulating bioprospecting activities. In this respect, the government seeks to evaluate the current regulatory framework and to enhance institutional capacity. In order to capitalize on the countries biodiversity, the strategy highlights the use of natural resources, e.g. for the production of medicines. Other intervention activities include the development of Kenya's research infrastructure by establishing centers of excellence, monitoring and assessing biodiversity, raising public awareness by developing a communication system and mobilizing investment.

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Mali

1 Which bioeconomy-related policy strategies exist?

In Mali, bioenergy development is specifically fostered by the National Energy Policy **"Politique Énergétique Nationale"** (2006), the National Strategy for Renewable Energies **"Stratégie Nationale pour le Développement des Energies Renouvelables"** (2006), and the **"National Strategy for the Development of Biofuels"** (2008).

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

3 Who is the author of the strategies?

The Ministry of Energy and Water Resources developed the National Energy Policy, the Renewable Energy Strategy and the Biofuel Development Strategy, which have been adopted by the government. In 2009, the National Agency for Bioenergy Development (Agence Nationale de Développement des Biocarburants ANADEB) was created to further guide and implement the biofuel strategy.

4 What are the key goals of the strategies?

Traditional bioenergy based on wood and charcoal is the main energy source in Mali. In order to protect forests, to "green" and modernize the traditional energy sectors and to advance rural electrification, the government has put emphasis on developing bioenergy for various uses from Jatropha oil. Furthermore, Jatropha plantations should not replace food production, but increase food security through the improvement of soil fertility. The energy policy explicitly foresees that environmental impacts have to be considered in the planning and evaluation of any new energy infrastructure.

5 What are the priority areas of the strategies?

Bioenergy development is focused on research and on developing the value-chains for Jatropha oil, from seed development and agro-industrial processing into biodiesel and ethanol to electrification projects. In 2011/12, the government in collaboration with UNDP and co-financing from the Global Environment Facility launched the Program for the Promotion of Jatropha in Mali ("Promotion de la production et de l'utilisation de l'huile de Jatropha comme biocarburant durable au Mali"). The program supports the development of sustainable production and utilization of Jatropha-based biofuels in order to substitute the use of fossil diesel and reduce greenhouse gas emissions. Rural development is fostered through decentralized production of Jatropha oil. Private investment in biofuels is encouraged if it respects ecological, social and sustainability criteria.

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Mauritius

1 Which bioeconomy-related policy strategies exist?

In 2013, the Mauritian government published a comprehensive **Roadmap on "Ocean Economy"**, which outlines how Mauritius will transform to become an Ocean Economy. The government integrated the vision of the Ocean Economy in its Government Program 2015–2019, with a clear economic and foreign investment focus. For this purpose, a new ministry has been created and the Mauritius Institute of Oceanography together with all other ocean related activities have been brought under the pursue of that Ministry.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

3 Who is the author of the strategies?

The Roadmap on Ocean Economy has been published by the Mauritius Board of Investment. The roadmap is the result of public consultations held with representatives of the private sector, local ocean specialists, international experts and researchers to assist the Government in evaluating the potential of the Mauritian Exclusive Economic Zone. A National Taskforce on Ocean Economy should be nominated to oversee the implementation of the Roadmap.

4 What are the key goals of the strategies?

The main objective of the Ocean Economy Roadmap is not related to bioeconomy. The strategy envisions that the ocean economy's contribution to GDP will double from a current 10.8 percent to 20 percent by 2020. It seeks to develop into a major hub in the region for petroleum products, container transshipment and value-added services such as logistics and marine services. Still, about half of the priority areas for development of the ocean economy can be attributed to bioeconomy.

In the 2015–2019 work program, the government pursues the development of the ocean economy as an important industry to promote economic diversification, job creation and wealth generation.

5 What are the priority areas of the strategies?

The Ocean Economy Roadmap identifies seven priority areas, about half can be considered bioeconomy-related: fishing, seafood processing and aquaculture; marine pharmaceuticals, cosmetics, thalassotherapy and high-end aquaculture; marine services including marine biotechnology; and ocean knowledge. Particular attention is paid to lagoon aquaculture projects and so called "Deep Ocean Water Applications" for example in bioprospecting, the cosmetics and bottled-water industry.

The 2015–2019 Government Program sets mainly regulatory priorities when it comes to realizing the vision of the ocean economy. For example, a new Fisheries and Marine Resources Bill and a Marine Pollution Bill will be introduced in line with the International Maritime Organization Convention. The Program further highlights the government's active promotion of fossil fuel exploration while putting the fishermen community at the center of socio-economic development.

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Mozambique

1 Which bioeconomy-related policy strategies exist?

In Mozambique, biofuel development has known high-level political support since 2004/2005, when the President committed to a campaign on Jatropha planting for biofuel projects. In 2005, the government also established an inter-ministerial working group on biofuels to guide biofuel investment and production. The country initiated bilateral cooperation, trade and technology transfer agreements with other governments – specifically with Brazil, being a leader in biofuel development and lusophone partner country. Based on a study evaluating the potential benefits and risks of biofuel promotion, the Parliament adopted the proposed **National Biofuel Policy and Strategy** in 2009 by stressing the importance of the integrated principles for sustainable biofuel development. In 2013, the government proposed the corresponding regulations within the Mozambique Biofuel Sustainability Framework, which should ensure that biofuel development does not lead to land conflicts or threaten food security.

2 Is the term “bioeconomy” or “biobased economy” used in the strategy documents?

Yes	No
	✘

3 Who is the author of the strategies?

The National Directorate for New and Renewable Energies (DNER) in the Ministry of Energy led the development of the National Biofuel Policy and Strategy, which was advised by the Inter-Ministerial Biofuel Commission (CIB). With the approval of the strategy, a National Biofuels Council was created. It is responsible for monitoring the implementation of policies targeting the sector.

4 What are the key goals of the strategies?

The primary goal of the strategy is to reduce the country's dependence on imported fossil fuels and to increase energy security. Furthermore, the strategy seeks to contribute to the National Poverty Alleviation Agenda, by encouraging agricultural and industrial development as well as employment and income generation in Mozambique's rural areas.

5 What are the priority areas of the strategies?

The strategy focuses on fostering biofuel supply projects with international partners while ensuring that these commercial projects respect food security and sustainable development goals (through a regulatory framework). Moreover, it specifically highlights the need to achieve agricultural and industrial innovation by attracting investment in commercially proven technologies that are new to the country.

By carrying out a land-mapping exercise and fostering Jatropha as a feedstock, unused land should create value-added for rural communities.

The government further seeks to foster market development by setting blending mandates.

Finally, institutional capacities should be fostered by implementing the National Biofuel Council and a national biofuel program to support agricultural R&D and investment projects.

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Namibia

1 Which bioeconomy-related policy strategies exist?

Namibia adopted a first national policy on Research, Science and Technology in 1999 and enacted in 2004 the Research Science and Technology Act, which defines that once in every three years, the National Commission on Research, Science and Technology (NCRST) must prepare a national program for research, science and technology. In 2015, the Cabinet adopted the first such "**National Programme on Research, Science, Technology and Innovation**" for the period of 2014/15–2016/17. The program defines several bioeconomy-related priority areas for (public and private) investment in research and innovation, as well as an implementation program in accordance with the fourth National Development Plan.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

3 Who is the author of the strategies?

The program has been drafted by the National Commission on Research, Science & Technology after consultation with multiple stakeholders including ministries, the private sector, civil society, NGO's, research institutions, universities and development agencies.

4 What are the key goals of the strategies?

The innovation strategy was developed within the broader context of Namibia's Vision 2030, which sets out to become "a prosperous and industrialized Namibia, developed by her human resources, enjoying peace, harmony and political stability"[7]. Overall, research and technological innovation is seen key to achieving socio-economic development and to developing a knowledge-based economy. The document specifically highlights expected improvements in health, living standards, skills levels, economic value-added, food and water security and ecosystem management.

7 Republic of Namibia. NCRST, 2015, p.7.

5 What are the priority areas of the strategies?

In terms of thematic priorities, the innovation strategy defines sixteen intervention areas, of which the following can be considered directly related to bioeconomy development: health (biomedical research and engineering, natural products medicines); agriculture; fisheries; energy (biomass is mentioned); indigenous knowledge systems; biotechnology.

In the health sector, investment in biomedical research and engineering, drug discovery and natural products medicines is encouraged. Agri-technologies and agricultural biotechnologies are considered an important driver of productivity, product innovation and sustainable rural development. The improvement of value-chains and the reduction of pre- and post-harvest losses are also among the proposed initiatives. In the area of fisheries, the strategy balances initiatives fostering more sustainable ecosystems and innovation, e.g. inland aquaculture. With reference to energy security, the program foresees the development of an R&D program fostering renewable energies, including biomass.

The importance of documenting, protecting and utilizing indigenous knowledge for innovation is stressed throughout the program. A council for indigenous knowledge is established and a repository should be created. The strategy highlights that biotechnology does not equal genetically modified organisms, but encompasses a much wider range of useful techniques. Biotechnology research and development is promoted with a focus on water and food security. Furthermore, interdisciplinary research combining biotechnology with materials science, drug discovery, micro-electronics or laser technology is considered especially promising.

The "National Programme on Research, Science, Technology and Innovation" seeks to address several challenges in the national innovation system. It aims at increasing science and technology financing; building research capacities and technical skills; strengthening research and development infrastructure; creating an enabling policy and regulatory environment; promoting public understanding of science and technology as well as establishing and strengthening national, regional and international cooperation.

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Nigeria

1 Which bioeconomy-related policy strategies exist?

With a view to diversifying fuel feedstock and to encouraging agro-industrial development, the government of Nigeria released a national **"Biofuel Policy and Incentives"** in 2007.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

Biofuels are defined as fuel ethanol, biodiesel and other fuels made from biomass and used for transport, thermal and electricity generation.

3 Who is the author of the strategies?

The government mandated the Nigerian National Petroleum Corporation NNPC to develop the biofuel policy.

4 What are the key goals of the strategies?

The biofuel program should substitute imported fossil fuels and contribute to a “greener” fuel sector. For this purpose, the strategy seeks to involve the Nigerian petroleum industry in the broader development efforts of the country. By linking the energy sector with the agro-industrial sector (including biofuel companies), it seeks to promote job creation, rural and agricultural development as well as technology transfer.

5 What are the priority areas of the strategies?

The government identifies priorities in the area of market development (phase 1) and biofuel production (phase 2). Market development should be fostered through a mix of political measures, such as blending mandates, purchase guarantees, biofuel import facilitation, integration of biofuel in gas stations. Biofuel production support focuses on agricultural R&D, plantations and support to biofuel companies (e.g. pioneer status). Although biomass is defined broadly in the policy, the focus is mainly on first generation biofuels. Furthermore, the policy intends to create attractive framework conditions for foreign biofuel investors. Policy coherence and inter-ministerial coordination are also mentioned as important pillars of the strategy, specifically, the creation of a Biofuels Commission under the purview of the Ministry of Petroleum.

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Senegal

1 Which bioeconomy-related policy strategies exist?

In Senegal, bioeconomy-related strategies have mainly been identified in the field of energy policy. Since 2003, the national (renewable) energy policy has been defined in the **"Lettre de Politique de Développement du Secteur de l'Energie (LPDSE)"**, which has been regularly updated. The current policy letter covers the period 2012–2017. In 2006, the government launched a **"National Biofuels Strategy"**, which concentrated on developing Jatropha as a feedstock for bioenergy applications.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

3 Who is the author of the strategies?

The Ministry of Agriculture defined the Biofuel Strategy of 2006 in the context of the broader agricultural strategy "Retour Vers l'Agriculture" (REVA).

The Energy Sector Development Policy Letters are guided by the Ministry of Energy and adopted by the government. In 2013, the National Agency for Renewable Energy was created with the aim to foster alternative energies across all sectors of activity, specifically in agriculture, health, education and the livestock industry.

4 What are the key goals of the strategies?

The energy policy and the biofuel strategy have the aim to increase national energy security and improve the standard of living through diversification of energy sources.

5 What are the priority areas of the strategies?

The LPDSE 2008 put a strong emphasis on renewable energy in order to diversify the sources of energy and to promote decentralized energy provision in rural areas. In 2010, this led to two orientation laws on renewable energy and biofuels. In 2012, the LPDSE was updated with a renewed commitment to renewable energies and rural electrification. Whereas energy from biomass is mentioned as a key source besides solar and wind, the plan takes a "technology-neutral" approach, fostering the most suitable renewable solutions for rural electrification.

The biofuel program in particular focused on the cultivation of Jatropha as a cash crop, on modernizing agriculture and agro-industry as well as on the production of bioelectricity from local refineries.

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South Africa

1 Which bioeconomy-related policy strategies exist?

The government published the "South Africa Bio-Economy Strategy" (2013) to foster the transition towards a knowledge-based bioeconomy. Based on the experiences of two former initiatives, i.e. the "National Biotechnology Strategy" (2001) and the "Ten-Year Innovation Plan" (2008), the new strategy seeks to guide biosciences research and innovation investments, as well as decision-making within a high-level framework.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
✗	

The South African bioeconomy definition refers to "activities that make use of bioinnovations, based on biological sources, materials and processes to generate sustainable economic, social and environmental development"[8].

8 Republic of South Africa. DST, 2013, p.6.

3 Who is the author of the strategies?

South Africa's bioeconomy strategy was published by the Department of Science and Technology (DST) in 2013. Although the DST plays a crucial role in leading the implementation of the strategy, the policy was defined in an inter-agency effort. The Departments of Trade and Industry, Health, Agriculture, Forestry and Fisheries, and Environmental Affairs are involved by coordinating their research, development and innovation activities. The strategy also aims to involve relevant non-governmental stakeholders, such as industry, community-based organizations, not-for-profit companies, academia and science councils.

4 What are the key goals of the strategies?

Bioeconomy should become an important driver of the South African economy by 2030 in terms of share and growth contribution to gross domestic product (GDP).

The new strategy is not restricted to fostering the biotechnology sector but seeks to develop a comprehensive bioeconomy, which involves several cross-sectional technologies and knowledge areas. Information and communication technology (ICT), nanomaterial research and manufacture, bioentrepreneurship, social sciences as well as intellectual property management are specifically mentioned as important knowledge areas.

The South African bioeconomy strategy integrates both a technology push and market-pull approach, in order to enhance the country's socio-economic development. It specifically aims at developing a greener economy, which also strengthens the country's competitiveness. The creation and growth of novel industries should provide more sustainable jobs and enhance food security. Further goals mentioned in the strategy document relate to the alignment of scientific research with national priorities and regulations, as well as the improved public understanding of bioeconomy-related technologies.

5 What are the priority areas of the strategies?

In order to achieve these overarching objectives, the strategy seeks to improve the bioeconomy innovation capacity in South Africa. Training and education for scientists, engineers and technicians along bioeconomy value-chains is considered of highest priority to create a sufficient knowledge base. Furthermore, it is considered necessary to develop "technopreneurs" who convert diverse technologies into innovative biobased products. Education and training therefore should become integrated into research and innovation policies.

With regard to policy support for economic sectors, the Department of Science and Technology has defined agriculture, health and biobased industry as priority. In order to implement the strategy, the document refers to various funding programs, e.g. the Department of Higher Education and Training funding for academic institutions, as well as science-based innovation and patent support. Furthermore, the bioeconomy strategy defines that a Bio-Innovation Venture Capital Fund should be established as a mechanism to attract public and private capital. The fund would require about R2 billion (about EUR 150 million), of which R300 million to R400 million (15 to 20 percent) would be provided by the government over a period of three years.

Representing about 12 percent of GDP, the agro-industrial sector is considered as having the highest economic impact among the three bioeconomy-related sectors. In the agricultural sector, the bioeconomy strategy foresees to sustainably intensify agricultural production and processing. Biotechnology, including responsible genetic engineering, should generally help to improve the heat-resistance and drought-tolerance of crops and addressing the challenges of climate change, diminishing water resources and grazing land, as well as halting the loss of biodiversity. Optimizing energy crops is also considered important in order to foster the development of the biofuel industry. R&D support for agricultural biosciences and technologies is an integral part of the strategy. Furthermore, it is intended to strengthen autonomy in the development of animal vaccines and indigenous crops (such as fortified sorghum, rooibos and honey bush). The strategy also seeks to better capitalize on the country's biodiversity and capture niche consumer markets for natural products.

In the health sector, the strategy seeks to better respond to key challenges, such as child mortality, HIV and malaria infections. The development of South Africa's national system of health innovation includes three key interventions. Discovery and

bioprospecting play a major role in developing new drugs, vaccines, diagnostics, and medical devices (especially in TBC and HIV). This includes also exploring opportunities in indigenous knowledge systems. The largely informal market for natural and plant medicines should be developed. The strategy aims to replace up to 25 percent of current pharmaceutical ingredient imports within a decade of implementation. This requires capacity building in process engineering and manufacturing.

The strategy further focuses on support for research, development and innovation in biobased chemicals and industrial biotechnology. Improving the local capacity in industrial biotechnology, such as the local manufacturing of enzymes and biofuels, should increase the take up of environmentally more sustainable inputs and practices by South Africa's heavy industries. Given significant problems of water-scarcity, especially in dry areas, the strategy further promotes improvements in wastewater treatment.

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Tanzania

1 Which bioeconomy-related policy strategies exist?

In Tanzania, bioeconomy development is politically mainly promoted in the area of biotechnology. With the **"National Biotechnology Policy"** (2010) the government formulated a guiding framework to foster biotechnology and its applications. The strategy is based on the government's medium-term "National Strategy for Growth and Reduction of Poverty" (2005–2009; 2010–2015) and its vision for 2025 to encourage the country's economic transition from a predominantly subsistence agriculture to a "semi industrial" economy.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

3 Who is the author of the strategies?

In 2010, the Tanzanian Ministry of Communication, Science and Technology published the "National Biotechnology Policy". The strategy development process involved various stakeholders from business and civil society.

4 What are the key goals of the strategies?

Building on the "National Strategy for growth and Reduction of Poverty" (2005) the "National Biotechnology Policy" (2010) was mainly designed to foster food security and ensure food self-sufficiency. Biotechnology should contribute to increase the country's economic growth by strengthening the agricultural sector. Moreover, the strategy links the utilization of biotechnology and its applications with biosafety aspects.

5 What are the priority areas of the strategies?

The "National Biotechnology Policy" (2010) is largely focused on research, development and innovation in order to foster biotechnology and its commercialization. Therefore, it addresses several policy measures that concentrate on, e.g. coordinating the application of biotechnology and appropriate funding programs, promoting public-private partnerships that encourage business innovation, strengthening capacity building and national and international collaboration to ensure knowledge and technology transfer. Although the strategy is mainly agriculture-oriented, it should also identify priorities in the area of health, industrial production, trade and environmental protection. In this respect the strategy highlights, e.g. vaccines, diagnostic kits and new medicines, but also the development of technologies for biodiversity conservation.

The government further intends to establish an institutional framework that facilitates biotechnology development in Tanzania. By establishing a National Center of Excellence for Biotechnology and Genetic Engineering, biotechnological stakeholders should be coordinated and collaboration between them should be promoted. The strategy highlights the need for involving stakeholders from all economic sectors in order to implement biotechnology policies. It further puts emphasis on developing an action plan and the need for mechanisms to monitor and evaluate the implementation process.

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Uganda

1 Which bioeconomy-related policy strategies exist?

In Uganda, bioeconomy development is politically supported in the areas of bioenergy and biotechnology. In 2014, the government published the **"Biomass Energy Strategy"**, which points out the potential of biomass to contribute to energy security. The strategy is linked to the government's **"Renewable Energy Policy for Uganda"** (2007), which encourages bioenergy development in the transport sector and for power generation. In the long-term development strategy "Vision 2040" the government also highlights the importance of a sustainable supply of biomass.

With the **"National Biotechnology and Biosafety Policy"** (2008) the government created a framework to promote biotechnology innovations and their cross-sectorial applications, while regulating biosafety issues.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

3 Who is the author of the strategies?

In 2014, the Ministry of Energy and Mineral Development (MEMD) formulated the "Biomass Energy Strategy" in cooperation with the United Nations Development Program (UNDP). The strategy underwent a consultation process with various stakeholders.

In 2008, the Ministry of Finance, Planning and Economic Development (FPED) published the "National Biotechnology and Biosafety Policy". Various stakeholders from governmental and non-governmental institutions were involved in the strategy formulation process. The strategy process was initiated by the Uganda National Council for Science and Technology (UNCST), which has a key role in coordinating the implementation process of the strategy.

4 What are the key goals of the strategies?

The key goal of the "Biomass Energy Strategy" is to create added value from Uganda's large amount of biomass resources and to further promote the country's social and economic development by ensuring a constant biomass energy supply. The "National Biotechnology and Biosafety Policy" generally endorses Uganda's national goals to increase economic growth, improve healthcare and ensure food security, while protecting the environment and reducing poverty. Biotechnology should particularly contribute to modernizing the agricultural sector and promoting industrial production.

5 What are the priority areas of the strategies?

In order to develop the biomass energy sector, the "Biomass Energy Strategy" comprises policy initiatives in six key areas. Firstly, the strategy highlights the need for creating awareness on biomass for energy production. Developing a communication strategy, which specifically addresses end users, decision makers and potential investors, should contribute to encouraging discussions concerning biomass policies and should further generate public and private investment for biomass energy production. Secondly, the strategy emphasizes the development of a biomass information system, which should be used to monitor available biomass resources. Thirdly, it focuses on institutional aspects to improve regulatory measures for biomass utilization. Fourthly, in order to increase the biomass supply in all sectors, the efficient use of technologies should be fostered. Therefore, the strategy promotes stronger R&D on relevant technologies. Fifthly, it aims at encouraging innovative approaches to generate sustainable biomass resources. Lastly, emphasis is put on the promotion of innovative financing mechanisms.

The "National Biotechnology and Biosafety Policy" identifies several priority areas, such as training technical and academic experts and developing Uganda's R&D infrastructure in the area of food and agriculture, health, industry, environment and natural resources development. These initiatives should contribute to encouraging knowledge and technology transfer, establishing centers of excellence as well as public-private partnerships in biotechnology. A further key area of the strategy is the creation of public awareness and participation through, e.g. public campaigns that inform about potential benefits and risks of biotechnology and its applications. Moreover, the government seeks to capitalize on the countries rich biodiversity by encouraging bioprospecting of natural resources. Bioprospecting should lead to beneficial discoveries in the agriculture, health and industry sector. Furthermore, public and private investment should be generated to foster the commercialization of biotechnological technologies. Other key areas refer to the implementation of bioethical and biosafety standards, the integration of indigenous knowledge in the biotechnology development, as well as the promotion of national and international cooperation to benefit from emerging synergies.

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Americas

Policy strategies that refer to bioeconomy development in Middle and South America* are mainly characterized by promoting the capitalization of the countries' large amount of natural resources. Countries like Argentina, Brazil, Colombia, Mexico, Paraguay and Uruguay have defined their perspectives on the opportunities provided by the bioeconomy. Whereas Brazil and Argentina are among the leaders in bioenergy production and are among the top five users of genetically modified crops, others, like Colombia and Urugay, have taken first steps in the knowledge-based bioeconomy (bioprospecting, agricultural technologies).

Currently, the countries in Latin America do not share a common vision on bioeconomy. Bioeconomy is rather treated within the wider context of green growth, bioenergy or biotechnology strategies. A first attempt to establish a regional roadmap for bioeconomy development is provided by the ALCUE-KBBE project[9], a bi-regional platform, which promotes bioconomy-related collaboration. The platform is funded by the European Commission's 7th Framework Program for Research and Technology Development.

9 The FP7 project "Towards a Latin America and Caribbean Knowledge Based Based Bio-Economy in Partnership with Europe" (ALCUE-KBBE) has developed a strategic roadmap for bioeconomy development, which includes short to long-term objectives in the respective action plan.

Country*	Perspective	Document Name
Argentina	Research & Innovation	“Argentina Innovadora 2020” (2012)
Brazil	Bioenergy	“Plano Decenal de Expansão de Energia 2023” (2014)
	High-Tech	“PAISS” (2012)
	Green Economy	“Biotechnology Strategy” (2007)
Colombia	High-Tech	“Politica para el Desarrollo Commercial de la Biotecnología a partir del Uso Sostenible de la Biodiversidad” (2011)
Mexico	Bioenergy	“Estrategia Intersecretarial de los Bioenergéticos” (2009)
Paraguay	High-Tech	“Politica y Programa Nacional de Biotecnoloía Agroprecuaria y Forestal del Parauay” (2011)
Uruguay	High-Tech	“Plan Sectorial de Biotechnología 2011–2020” (2012)
		“Uruguay Agro inteligente 2010–2015” (2010)

* The G7 countries are covered by the report **“Bioeconomy Policy (Part I): Synopsis and Analysis of Strategies in the G7”.**

Argentina

1 Which bioeconomy-related policy strategies exist?

Although the government is hosting the annual symposium "Bioeconomía Argentina" to encourage the country's bioeconomy development, its does not have a dedicated bioeconomy strategy. Being among the leading Biodiesel producers, Argentina's political focus is on providing a supportive regulatory framework for biofuels production. Furthermore, bioeconomy is considered in the national innovation strategy **"Argentina Innovadora 2020"** (2012).

Moreover, within the European Commission's 7th Framework Program on Research and Innovation, the ALCUE-KBBE project was initiated, which aims at fostering interregional cooperation for developing the bioeconomy in Latin America and the Caribbean (LAC). In this context, Argentinian representatives played an important role in developing the roadmap on bioeconomy "Towards a Latin America and Caribbean Knowledge-Based Bio-Economy in Partnership with Europe" (2014).

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

The term "bioeconomy" is not directly mentioned, but is reflected by the plan's strategic interventions that intend to promote the country's research, technology and innovation landscape.

3 Who is the author of the strategies?

Argentina's innovation strategy (2012) was coordinated by the Policy and Planning Division of the Ministry of Science, Technology and Innovative Production. The strategy paper underwent a public consultation process with stakeholders from NGOs, research institutions and governmental authorities.

4 What are the key goals of the strategies?

"Argentina Innovadora 2020" represents the government's vision to foster research, technology and innovation by 2020. The strategy aims at exploiting the full potential of Argentina's research capabilities and promoting business initiatives. This should result in sustainable (biobased) product innovations that further increase the national competitiveness and quality of life.

5 What are the priority areas of the strategies?

The innovation strategy identifies six focal areas where innovation is needed, i.e. environment and sustainable development, social development, energy, industry and health and the agro-industry. Particularly the agro-industry is considered of crucial importance for the development of bioeconomy in Argentina. Within the agro-industry, innovative technologies such as biotechnology, ICT and nanotechnology, should support strategic development (Nucleos Socio Productivos Estratégicos) in the area of plant breeding and seed development, of food chains and processing and the development of biorefineries. Within the innovation strategy the government foresees the development of four biorefinery pilot plants close to feedstock production and processing areas.

Therefore, the strategy intends to promote the further development of agricultural and nutrition techniques in order to strengthen the country's sustainable crop production, e.g. through zero-tillage farming.

Additional development areas addressed in the innovation strategy include the improvement of new and traditional livestock breeding, the development of horticulture, and of the forest and timber industry, as well as new production and processing methods for marine bioresources.

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Brazil

1 Which bioeconomy-related policy strategies exist?

Brazil does not have a dedicated bioeconomy strategy. However, important sub-strategies fostering bioeconomy development have been launched since the 1970ies. In the wake of the oil crisis, Brazil started the first large-scale biofuel program in 1975 under the name "Próalcool".

Today, Brazil is a global leader in bioenergy; ethanol covers about a quarter of total fuel consumption. The current ten year energy plan **"Plano Decenal de Expansão de Energia 2023"** was adopted in 2014. It foresees a further increase in the use of biofuels as well as in electricity generation based on sugarcane bagasse and other agricultural residues.

Besides bioenergy, the government has encouraged and supported the development of the (agricultural) biotechnology sector. Brazil is amongst the largest producers of genetically modified crops in the world and has extensive experience in agricultural biotechnology. In 2007, the government presented a national policy for biotechnology **"Politica de Biotecnologia"**, which supports the comprehensive development of biosciences and biotechnology. However, the recent development of the biobased industry (e.g. bioplastics) is mostly industry driven. In 2011, the National Confederation of Industry (CNI) launched its agenda for stimulating innovation in Brazil, which defines the life sciences, biotechnology and biodiversity as key factors for success. Consequently, since 2012 the CNI has organized an annual "Bioeconomy Forum". In 2013, the document "Bioeconomy: An Agenda for Brazil" was published in collaboration with the Harvard Business Review.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

Government documents consider bioeconomy issues under the label of green economy, bioenergy development or biotechnology.

3 Who is the author of the strategies?

Bioenergy planning and strategies are under the responsibility of the Ministry of Mines and Energy. The ten-year energy plan has been subject to a multi-stakeholder consultation process.

The development of the biotechnology policy has been led by the Ministry for Development, Industry and Foreign Trade. The policy has been adopted by presidential notice and a "National Committee for Biotechnology" was formed to further develop and guide the implementation of the biotechnology policy in Brazil. The committee comprises representatives from more than twenty institutions and is formed by all national ministries and agencies in charge of public policies and projects regarding biotechnology.

4 What are the key goals of the strategies?

The promotion of bioenergy development mainly intends to reduce Brazil's dependency on foreign oil and to foster rural development and income. In recent years, the synergistic co-development of modern agricultural and industry (e.g. bioplastics) has become an important economic and social goal.

The biotechnology policy seeks to contribute to food security and health, strengthen Brazil's competitiveness in the bioindustries (including the healthcare sector) and to improve the national innovation system.

5 What are the priority areas of the strategies?

Over the years, the bioenergy strategy involved a bundle of measures, such as financial aids to producers, price setting, tax exemptions, blending quotas and consumer support for choosing ethanol-driven vehicles. Furthermore, the state invested in infrastructure for biofuel compatible filling stations. In 2003, the Brazilians launched the flexible-fuel-motor, which runs on the basis of fuel, ethanol or a blend of both. In 2004, the government initiated the program for the development and use of biodiesel. The most important instrument has been an obligatory blending quota for diesel starting in 2013. Additionally, the program includes a social component: a social label (Selo Combustível Social) should promote the purchase of edible oils from disadvantaged farmers from the north and northeast. The current energy plan foresees an increase in the use of biofuels (ethanol and biodiesel) as well as an increase in electricity generation from bagasse. With a view to business innovation support, the government via the Brazilian National Development Bank and the funding agency FINEP, launched the "PAISS" program in 2010. PAISS intends to co-finance business initiatives that focus on developing and commercializing innovation in the sugarcane-based biofuels and chemicals sectors. In 2013, a new edition of PAISS was launched to focus on agri-tech innovations in the ethanol sector. Key areas mentioned are transgenetic improvements, machinery and equipment as well as integrated systems.

With regard to the bioindustry, the biotechnology strategy aims at promoting product and process innovations. For this purpose it supports R&D projects, infrastructure (e.g. technology parks) and business development (e.g. through financial support to companies). Although the biotech policy addresses the full range of biotechnology applications, there is a focus on advancements in medical biotechnologies (including the wider healthcare sector), agricultural (including animal health) and biofuel applications.

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Colombia

1 Which bioeconomy-related policy strategies exist?

Colombia is home to about 10 percent of the world's biodiversity. The government has recognized the economic potential of the country's biological resources by putting considerable focus on fostering bioprospecting policies. With its strategy for the commercial development of biotechnology based on the sustainable use of biological resources (2011) (**"Politíca para el Desarrollo Commercial de la Biotecnología a partir del Uso Sostenible de la Biodiversidad"**) the government bundled already existing policies on biodiversity and biotechnology. Earlier governmental initiatives related to biodiversity are described by the "National Plan on Continental and Marine Biosprosecting" (2002) and the "National Productivity and Competitiveness Policy" (2008). Biotechnology has been identified as important driver of economic growth and social development by various preceding policy papers, including the "National Development Plan (2006–2010)", Colombia's "Vision 2019" (2006), the "Research and Innovation Policy" (2008) and the "National Science, Technology and Innovation Policy" from 2009.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

3 Who is the author of the strategies?

The biotechnology strategy was published by the National Council for Economic and Social Policy (Conpes), which acts as advisory body to the Colombian President. The council is composed of the Vice President, all Ministers, the Director of the Administrative Department of the President and the Director of the government agency Colciencias (Administrative Department of Science, Technology and Innovation).

4 What are the key goals of the strategies?

The strategy seeks to promote the commercial development of biotechnology, while advancing the sustainable, commercial use of biological resources. Biotechnology should contribute to economic growth and competitiveness by strengthening the country's domestic production base.

5 What are the priority areas of the strategies?

The strategy identifies bioprospecting capabilities as a key for further biotechnology development. In this respect, biotechnology should contribute to the creation of added value from marine bioresources. In order to foster bioprospecting activities in Colombia, the strategy focuses on enhancing the country's institutional capacity through, e.g. strengthening the role of the Intersectorial Commission for the Commercial Development of Biotechnology, which coordinates the strategy implementation and monitoring process. The strategy further seeks to develop instruments to attract public and private investment in order to create an enabling environment for entrepreneurship. By establishing funding mechanisms (including seed and start-up investment) the strategy intends to create incentives for technological innovation. Furthermore, it emphasizes the need to reduce regulatory barriers on the access of biological resources by adapting and reviewing the regulatory framework. Additionally, a national bioprosecting company will be founded, which would be responsible for initiating pilot and demonstration projects that could be adopted, especially by the cosmetics, food, diagnostics and bioindustry.

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Mexico

1 Which bioeconomy-related policy strategies exist?

By now, strategic policy support to bioeconomy development is focused on bioenergy development. With the national bioenergy strategy **"Estrategia Intersecretarial de los Bioenergéticos"** (2009) the government has set up guidelines for developing the Mexican biofuels industry. The strategy is linked to the "National Development Plan 2006–2012" and the law on the promotion and development of bioenergy (2008), which aims to diversify Mexico's energy mix.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

3 Who is the author of the strategies?

The bioenergy strategy (2009) was developed by the inter-ministerial Commission on Biofuels, which is composed of the ministries of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGRAPA); Energy (SENER); Environment and Natural Resources (SEMARNAT); Economics (SE); and Finance and Public Credit (SHCP).

4 What are the key goals of the strategies?

Bioenergy development is considered important to contribute to food and energy security, while reducing environmental pollution. Furthermore, the strategy aims at encouraging rural development by improving agricultural productivity and strengthening the country's agro-industry.

5 What are the priority areas of the strategies?

In order to promote the sustainable production of biofuel in Mexico, the strategy supports policy initiatives in four priority areas, i.e. promoting R&D on second generation biofuels, improving the infrastructure for biofuel development, fostering pilot and demonstration projects and creating new businesses. Additionally, the strategy provides political guidelines, e.g. to foster an enabling environment for increased investment and job creation, to monitor the availability and use of bioenergy crops, to create sustainability criteria and to protect the country's biodiversity.

As part of implementing Mexico's "National Strategy for Energy Transition and the Sustainable Use of Energy" (2011) the government established a support fund (FOTEASE), which seeks to encourage projects in the area of renewable energies. An example of one of these projects is the "Proyecto de Bioeconomia", which aims to contribute to the conservation, sustainable use and management of natural resources and their use in primary production (e.g. for biofuel production).

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Paraguay

1 Which bioeconomy-related policy strategies exist?

Although Paraguay does not yet have a national bioeconomy strategy, the government has provided political support in the area of biotechnology. Within the strategy "**Política y Programa Nacional de Biotecnologia Agropecuaria y Forestal del Paraguay**" (2011) the government set the cornerstone for developing the agricultural and forest biotechnology sector in Paraguay.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

3 Who is the author of the strategies?

The strategy on agricultural and forest biotechnology has been approved by the President of the Republic of Paraguay. The Ministry of Agriculture and Livestock guided the strategy development process. The strategy document was prepared by the Multisectoral Technical Group on Biotechnology and Biosafety (GTMSBB) in collaboration with the Inter-American Institute for Cooperation on Agriculture (IICA). The strategy drew on a draft developed in 2005 in cooperation with the Food and Agriculture Organization (FAO) and was discussed with various stakeholders from academia, business and civil society.

4 What are the key goals of the strategies?

The Paraguayan strategy on agricultural and forest biotechnology mainly seeks to capitalize on the country's rich biodiversity by boosting agricultural production and exports. Biotechnology should provide solutions to better cope with international challenges, such as climate change, the loss of biodiversity and the growing world population. Specifically, biotechnology should contribute to enhancing the country's competitiveness, while fostering rural development, combat poverty and ensuring food security.

5 What are the priority areas of the strategies?

In order to develop Paraguay's agricultural and forest biotechnology sector, the strategy comprises a set of political guidelines and an implementation plan. The plan provides a timetable and defines clear responsibilities for implementation. The strategy addresses two priority areas. The first key area of the strategy promotes knowledge and technology transfer through capacity building, international collaboration, and increased public and private investment in R&D. Also, strategic alliances between universities, centers of excellence and businesses are considered important. The second key area of the strategy focuses on promoting the effective use of technologies, both at national and international level, by providing a general information system on biotechnology and its applications, encouraging the creation of new businesses and placing biotechnology-related topics at the center of regional and international negotiations.

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Uruguay

1 Which bioeconomy-related policy strategies exist?

Although Uruguay does not have a dedicated bioeconomy strategy, the government supports bioeconomy development in mainly two policy areas, i.e. smart agriculture development and biotechnology. Over the past years, Uruguay has increasingly intensifying its commitment to develop high-tech farming techniques, which is also reflected in the government's strategy paper **"Uruguay Agro Inteligente 2010–2015"** (2010).

In 2011, the government published the biotechnology strategy **"Plan Sectorial Biotecnología 2011–2020"**. The strategy is linked to the industrial development strategy (2008), which identifies biotechnology as one of 14 priority sectors that should contribute to Uruguay's economic growth.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

In 2014, the term "bioeconomy" was introduced in the political discourse at the "BIO UY Forum", which was hosted by several ministries, public and private stakeholders. The Forum discussed the potential of biotechnology to contribute to sustainable development and competitiveness under the motto "From Biotechnology to Bioeconomy".

3 Who is the author of the strategies?

The strategy paper "Uruguay Agro Inteligente" was initiated by the Minister of Agriculture in 2010. Several public institutions, i.e. the National Meat Institute (INAC), the National Milk Institute (INALE), the National Institute of Colonization (INC), the National Agricultural Research Institute (INIA), the National Seed Institute (INASE), the National Viticulture Institute (INAVI), the Agriculture Planning Institute (IPA) and the Uruguayan Wool Secretariat, are responsible for implementing the strategy.

The sector plan on biotechnology (2011) was published by the "Gabinete Productivo", an interministerial committee, which is composed of the ministries of Industry, Energy and Mining; Agriculture and Fishing; Labour and Social Affairs, Economy and Finance; Tourism and Sport; Foreign Affairs; Transport and Public Works; and of the Department of Planning and Controlling. As a result of the industrial development strategy (2008), 14 sectorial councils[10] were set up in order to coordinate Uruguay's industrial policies. In this context, a sectorial council on biotechnology was established to improve the business climate for biotech companies.

10 The 14 councils are representing the following industry sectors: automobile, apparel, dairy, design, pharmacy, biotechnology/nanotechnology, metallurgy, chemistry, wood, meat, footwear/leather goods, naval, electronics and construction.

4 What are the key goals of the strategies?

The key goal of the agricultural strategy "Uruguay Agro Inteligente" is designed to strengthen the country's economic competitiveness, to foster social inclusion and to protect the country's environment.

The Uruguayan government has recognized the biotechnology sector as a driver for economic growth. Therefore, the overall goal of the sector plan from 2011 is to strengthen Uruguay's position in the international biotech market.

5 What are the priority areas of the strategies?

The "Uruguay Agro Inteligente" strategy is generally research-oriented in order to foster smart agriculture development. The strategy points out 19 political guidelines, five of which are considered to be particularly important. Firstly, the government emphasizes the need for expanded investment in niche markets. Secondly, the sustainable use of natural resources should be strengthened, e.g. through the development of satellite and drone systems that enable the monitoring of natural resource stocks. Thirdly, increased investment should also be promoted in adapting to climate change. Fourthly, the government seeks to foster the rural development in order to protect family farming. Lastly, the strategy emphasizes the need for policy coherence. Stronger research collaboration between public institutions should serve as a basis for developing future policies.

The sector plan on biotechnology does not focus on specific biotechnology applications. In fact, the strategy puts emphasis on strengthening the

whole sector by focusing on three key areas. Firstly, promoting regulatory measures and framework policies for biotechnology development should remove regulatory barriers that inhibit demand for biotechnology products. Secondly, the government seeks to foster capacity building through, e.g. training experts and raising awareness of the need for biotechnological innovations. Thirdly, the strategy paper emphasizes business innovation by, e.g. setting incentives for seed and venture capital investments, strengthening collaboration between research and industry, as well as stimulating the growth of new biotechnological businesses.

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Asia/Pacific

Some of the emerging economies in Asia are rated among the most innovative countries in the world. Therefore, it is not surprising to find bioeconomy development in policy strategies fostering high-tech, emerging industries and industrial innovation in Malaysia, South Korea, India, Japan and China*. Thailand and Sri Lanka, inspired by these policies, have also developed biotechnology and bioindustry strategies. In contrast, Australia and New Zealand are concentrateing more on further growth and value-creation in their important primary industries. Indonesia is also focused on agricultural value-chains but with a view to managing the supply of energy and food on the decentralized archipelago.

* The G7 countries are covered by the report **“Bioeconomy Policy (Part I): Synopsis and Analysis of Strategies in the G7”.**

Country	Perspective	Document Name
Australia	High-Tech	"National Marine Science Plan 2015–2025" (2015)
	Research & Innovation	"National Collaborative Research Infrastructure Strategy" (2013)
	Blue Economy	"Opportunities for Primary Industries in the Bioenergy Sector: National Research, Development and Extension Strategy" (2011) + Workplan (2014)
	Regional Bioeconomy Development	"Strategic Roadmap for Australian Research Infrastructure" (2011)
		"Building a Bioeconomy in South Australia" (2011–2015)
China	High-Tech	"Bioindustry Development Plan" (2012)
	Research & Innovation	"12th Five-year Plan (2011-2015) on Agricultural Science and Technology Development" (2012)
		"12th Five-year Plan for National Strategic Emerging Industries" (2012)
India	High-Tech	"National Biotechnology Development Strategy (Biotech Strategy II)" (2007, 2014)
Indonesia	Bioenergy	"Grand Agricultural Strategy" (2015)
	Biobased Economy	"National Energy Policy" (2014)
	Research & Innovation	
Malaysia	Holistic Bioeconomy Development	"National Biomass Strategy" (2nd version) (2013)
		"Bioeconomy Transformation Programme" (2012)
		"National Biomass Strategy 2020: New Wealth Creation for Malaysia's Palm Oil Industry" (2011)
		"National Biotechnology Policy" (2005 - 2020)
New Zealand	Bioenergy	"Biological Industries Research Fund" (2013)
	Biobased Economy	"Business Growth Agenda" (2012)
	Research & Innovation	"Bioenergy Strategy" (2010)
Russia	High-Tech	"Comprehensive Program for the Development of Biotechnology in Russia by 2020" (2012) and Roadmap (2013)
South Korea	High-Tech	"3rd Basic Plan for Science and Technology" (2013)
		"Strategy for Promotion of Industrial Biotechology" (2012)
		"Blue-Bio 2016 Plan" (2008)
		"2nd Framework Plan for Promotion of Biotechnology, Bio-Vision 2016" (2006)
Sri Lanka	High-Tech	"National Biotechnology Policy" (2010)
Thailand	High-Tech	"National Biotechnology Policy Framework" (2004–2011; 2012–2021)
	Bioenergy	"Alternative Energies Development Plan" 2012–2021
		"BioPlastics Roadmap" (2008)

Australia

1 Which bioeconomy-related policy strategies exist?

In Australia, there is no official national bioeconomy strategy but the government has provided political guidance and support in several thematic areas of the bioeconomy, specifically with regard to increasing the value added from agricultural, forest and marine resources. In terms of intervention focus, most bioeconomy-related policies can be characterized as R&D strategies. In 2013, the Australian government defined 15 strategic research priorities for the future, which also integrate key topics of the bioeconomy, for example in the areas of bioenergy, ecosystem monitoring and management, optimized food and health.

Biotechnology development has been especially encouraged by the national biotechnology policy (2000) and communication strategies raising the awareness of the importance and benefits of modern biotechnology for the agricultural sector (2008) and the industrial sector (2008). Moreover, in 2011 the Australian Government released two biorefinery scoping studies investigating the potential of tropical and temperate biomass value chains.

In the area of bioenergy development, several industry associations have published strategies and roadmaps[11] which, however, have not been officially adopted by public authorities. In 2011, the government agency Rural Industries Research and Development Corporation published a national innovation strategy fostering bioenergy development (**"Opportunities for primary industries in the bioenergy sector- national RD&E strategy"**). In order to further guide and implement this innovation strategy, a work plan was elaborated under the same name in 2014. With a view to fostering research capacities in key knowledge areas, such as the biosciences and biotechnology, the government developed the 2011 **"Strategic Roadmap for Australian Research Infrastructure"**. Following the Research Investment Plan published in 2012, support for important research infrastructure was identified as a key element and continued in the framework of the **"National Collaborative Research Infrastructure Strategy (2013–2016)"**.

In 2015, the Minister for Industry and Science launched the **"National Marine Science Plan 2015–2025"**, which focuses on developing the value added of the "blue economy", while protecting Australia's oceans and marine resources.

Besides these national innovation strategies, South Australia has issued a regional bioeconomy strategy **"Building a Bioeconomy in South Australia 2011–2015"**.

11 For example, "Bioenergy Australia Strategic Plan 2012–2015" (2012), "Bioenergy in Australia: Status and Opportunities" (2012), the "Australian Bioenergy Roadmap" (2008), or the "Clean Energy Australia Report" (2013).

2 Is the term “bioeconomy” or “biobased economy” used in the strategy documents?

Yes	No
✘	

Although the term “bioeconomy” is used, for example by the Department of Industry and the public research organization CSIRO, the above-mentioned national research and innovation strategies do not explicitly define or refer to bioeconomy. The South Australian bioeconomy strategy relates to the economic development opportunity arising out of biosciences.

3 Who is the author of the strategies?

The Rural Industries Research and Development Corporation, a national agency, authored the bioenergy innovation strategy and the associated workplan. The strategy and workplan are based on consultations across Australian government and regional agencies, industry and other stakeholders.

The Strategic Roadmap for Australian Research Infrastructure and the corresponding funding program (collaborative research infrastructure strategy) were led by the Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education.

The National Marine Science Plan was prepared by the National Marine Science Committee, which includes Australian Government marine science agencies, representatives of state and territory governments, and marine science researchers and organizations.

The South Australian Government via its business catalyst BioSA defined the regional bioeconomy strategy.

4 What are the key goals of the strategies?

The Bioenergy R&D Strategy is largely focused on establishing value chains from sustainable biomass feedstock supply to suitable (nearby) bioenergy conversion paths. The Research Infrastructure Strategic Roadmap intends to increase the competitiveness of Australia’s researchers in core capability areas, e.g. –omics research, which have been identified as crucial to transformimg Australian industries, to optimizing food and health and to becoming environmentally sustainable. Furthermore, the country should become an attractive destination for international research projects and collaborations.

The marine science plan sets out how marine science capabilities can support the development of a sustainable blue economy[12]. In this respect the plan highlights the most significant development and sustainability challenges for the blue economy, including food and energy security, protecting biodiversity, sustainable coastal urban development, climate variability, and marine sovereignty and security. It further specifically highlights the need to provide unbiased knowledge about economic development decisions for environmentally sensitive areas.

The South Australian strategy seeks to leverage local expertise in the biosciences to develop new markets and increase the region’s exports of innovative bioscience products and services. The bioscience sector is considered key to fostering innovation in several key sectors of the region, such as medical diagnostics, wine, agriculture and renewable energy.

12 The plan defines Australia’s “marine estate” as Australia’s oceans, seas, seabed, coasts, close catchments, traditional sea country, and the living and non-living resources they contain within Australia’s full confirmed marine jurisdiction.

5 What are the priority areas of the strategies?

The national Bioenergy RD&E Strategy identifies three priority areas for innovation: feedstock identification and availability, supply logistics, and sustainability. The 2014 work plan builds on these work areas and addresses their convergence by adding a fourth priority: integrated supply chains and industry development, with a special focus on regional applications. Stakeholder consultations identified integrated supply chains as key to Australia providing a developmental pathway for many of the innovation activities foreseen in the strategy. Additionally, the 2011 Strategic Roadmap for Australian Research Infrastructure supported several bioeconomy-related facilities and networks, specifically in the fields of integrated biological discovery, biological collections, biotechnology for advanced materials and industrial purposes as well as next-generation biofuels.

The National Collaborative Research Infrastructure Strategy (2013), the subsequent funding program, continues the support to many of these research facilities through to 2016. The Marine Science Strategy outlines so-called "10-year steps to success". The priority research areas are: setting-up scientific decision-support tools for policy and industry; building an oceanographic modeling system; developing national marine baselines and long-term monitoring programs; industry and government partnerships; marine science training in order to become more quantitative and cross-disciplinary; investing in research vessels; carrying out marine eco-system exploration, mapping and monitoring; fostering national collaborations.

The South Australian Bioeconomy Strategy is clearly business-oriented and identifies three strategic elements of intervention. Firstly, ensuring access to risk capital. Secondly, providing critical infrastructure, e.g. for clusters. And thirdly, offering business development assistance and marketing assistance to new businesses.

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China

1 Which bioeconomy-related policy strategies exist?

In China, the political interest in the biobased economy is strongly linked to biotechnology development. China's research and technology landscape is one of the most complex and diversified in the world. The High-Tech R&D Program (863-Program), which was launched in 1986, is considered as the key impulse for Chinese biotechnology development. Today, biotechnology is promoted in the **Medium and Long-Term Plan for the Development of Science and Technology** as well as in the **12th Five-Year Development Plan for National Strategic Emerging Industries**. End of 2012, the State Council published the corresponding **"Plan for Development of Bioindustry"**. With regard to bioenergy, China has been leading the production of bioethanol and nearly half the fuel demand is covered by biofuels. With the exception of biobased jet fuels, however, the importance of biofuel development in biotechnology science and policy has been reduced in favor of other industrial uses of biomass.

With a view to agricultural innovations, specifically the **"12th Five-Year Plan for National Agriculture and Rural Economic Development"** and the "12th Five-year Plan (2011–2015) on Agricultural Science and Technology Development" can be considered guiding policies for bioeconomy development.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
✘	

The term "bioeconomy" has been used in the 11th Five-Year Plan for National Strategic Emerging Industries. In the 12th Five-Year Plan, "bioindustry" is used more frequently.

3 Who is the author of the strategies?

The Central Committee guides the national efforts to develop China into a global biotechnology player. The State Council (Science, Technology and Education "Lead Group") coordinates the innovation policy and publishes the five-year plans. Besides the Ministry for Science & Technology, also the Ministries for Agriculture, for Industry and Information Technology, for Education, Land Use and Resources as well as the Chinese Academy of Sciences also have their own budgets for science and technology programs.

4 What are the key goals of the strategies?

The Five-Year Development Plan for National Strategic Emerging Industries (2012) has been developed with a view to fostering sustainable growth, economic upgrading and strengthening of domestic demand. The biosciences should specifically foster "indigenous industrial innovations". Another important goal of the plan is "smart urbanization" in China's fast growing megacities.

The "Plan for Development of Bioindustry" responds to key societal challenges, such as healthy aging, food security, energy supply and environmental improvements. In terms of sustainable growth, China should double the added value generated by the bioindustry as a percentage of GDP by 2015 compared to 2010. Between 2011 and 2015, bioindustry is set to create one million jobs, increase life expectancy by one year, reduce child mortality by 12 percent and cut harmful emissions by 10 percent. With regard to biobased materials, the plan envisages producing three million metric tones of biobased polymers by 2015.

5 What are the priority areas of the strategies?

The Five-Year Development Plan defines seven strategic emerging industries, i.e. energy-saving and environmental industries, next-generation information technology industries, biotechnology industry, advanced equipment manufacturing, a new energy industry, new materials industry in addition to the electric car industry. By 2020, these industries together should contribute to 15 percent of GDP. Biotechnology will be promoted across these diverse application areas. Besides biotechnology, bioeconomy-related issues are also addressed in some of the other strategic industry programs, for example in energy efficiency, environmental technologies and innovative materials. The plan defines twenty key projects, which include biomedicine, plant breeding and also the development of biobased materials. The budget for the plan has been indicated at USD 1.7 trillion.

Biotech innovations should be fostered with more than USD 10 billion. End of 2012, the State Council published the corresponding "Plan for Development of Bioindustry". The emerging bioindustry comprises biomedicine, agriculture, bioenergy and biobased industries. The plan focuses on the development and dissemination of new drugs, new crop varieties, green planting techniques, biofuel and biomass power generation, green biotech and biobased products.

Another key focus area of the Chinese bioeconomy is agricultural innovation with a view to ensuring food security. Agricultural biotechnology and specifically GMOs are promoted in a support program which was launched in 2008 for the following fifteen years. The "Agricultural Science & Technology Innovation Program", which runs from 2013–2025, should increase the efficiency of political support for agricultural innovations. The program encourages international cooperation, capacity building and upgrading of research infrastructures. It comprises eight "discipline clusters" that comprise practically the full breadth of agri-sciences from crop science to agri-technology and agro-economics.

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India

1 Which bioeconomy-related policy strategies exist?

The Indian strategy on bioeconomy is largely defined by its biotechnology policy.

After the **"Biotechnology Development and Innovation Strategy"** of 2007, the government has released the updated **"Biotechnology Strategy II"** in January 2014. For the first time, the strategy underwent a public consultation.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
✗	

Bioeconomy is defined as "translating life sciences knowledge into socially relevant eco- friendly and competitive products"[13].

13 Albrecht & Ettling, 2014.

3 Who is the author of the strategies?

The strategy was developed under the guidance of the Department for Biotechnology, DBT in the Ministry for Science and Technology. However, inter-ministerial coordination, especially with the Ministry for Agriculture, should be increased. Policy coherence, specifically in the regulatory framework, is also identified as an issue of high relevance in the future. In view of strategy implementation, the "Biotechnology Industry Research Assistant Council (BIRAC)" has been created under the purview of the Department of Biotechnology.

4 What are the key goals of the strategies?

Bioeconomy development should provide opportunities for modernizing the scientific landscape, especially by accelerating innovation processes and promoting interdisciplinary and cross-sectoral projects. India specifically seeks to leverage the enormous potential of its well-educated, large population. The biotech industry should become a competitive driver of growth, following the example of the IT industry. The 2014 strategy seeks to promote a high-performing R&D infrastructure as well as the commercialization of innovative products emerging from a "strong bioeconomy".

5 What are the priority areas of the strategies?

The Indian strategy covers the full breadth of biotechnology applications. While the previous strategy focused largely on pharmaceutical biotechnology, the updated strategy also promotes bioenergy, nano-biotechnology as well as biobased environmental technologies and production processes. Interestingly, it contains a full chapter on Nutrition and Food Security.

In the energy sector, the policy defines a target share of 20 percent biodiesel in its fuel mix by 2025, but seeks to avoid a conflict between food and fuel production. In this respect, the strategy highlights lignocellulosic ethanol produced from agricultural and forestry residues, as well as biofuels from algae. In the area of food security, the strategy largely targets (bio)fortification of food crops to address nutrient deficiencies, such as iron deficiency. The idea is to develop special food products that can address moderate and acute child malnutrition. Furthermore, new processing techniques, including nanotechnology applications, should extend the shelf-life of foods. With regard to agricultural applications, India is cultivating genetically modified cotton varieties. It is continuing its testing of genetically modified food products, although none are currently authorized for commercial purposes. The country is planning further research into transgenic crops capable of resisting biotic and abiotic stresses.

The strategy emphasizes the value chain approach which requires the involvement of all relevant stakeholders alongside new ways of financing, cooperating and training. It will be mostly implemented via financial support programs, for example, the "Biotechnology Industry Partnership Program (BIPP)".

Additionally, the strategy foresees infrastructure and institutional support, such as the creation of regional Technology Development Centers, e.g. bioincubators. Biotechnology-related school, university and postgraduate education measures are another area of intervention.

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Indonesia

1 Which bioeconomy-related policy strategies exist?

In Indonesia bioeconomy development is politically fostered mainly in two areas, i.e. bioenergy and agro-industry. Bioenergy is encouraged as an important renewable energy source in the **National Energy Policy** which was significantly updated in 2014. With the **"Grand Strategy of Agricultural Development 2015–2045"** the government formulated its first long-term agricultural and rural development plan which seeks to respond to the great societal challenges and trends.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

The agricultural strategy uses a term that is translated as "agricultural bioindustry".

3 Who is the author of the strategies?

The newly created Directorate General of New Renewable Energy and Energy Conservation in the Ministry of Energy and Mineral Resources is responsible for bioenergy development.

The Ministry of Agriculture has led the formulation of the Grand Strategy.

4 What are the key goals of the strategies?

Bioenergy development is considered important for contributing to Indonesia's energy autonomy, to economic growth, ecological sustainability and improved health in rural areas.

The agricultural strategy seeks to ensure food security, mitigate climate change and conserve valuable national resources while contributing to economic growth and inclusive development. Primary agricultural production is still the largest employer in the country (about 30 percent of the workforce). With a view to a biobased economy, the plan formulates the vision to transition to "a sustainable agricultural bioindustry system to produce diversified healthy foods and high value-added products from tropical agriculture and maritime resources for food sovereignty and farmers' welfare". The foundation for a sustainable agricultural bioindustry should be laid in the period 2013–2015 and further strengthened by 2019.

5 What are the priority areas of the strategies?

The priority areas for bioenergy are biofuels, bioenergy from waste, and power plants. With regard to ensuring sustainable feedstock, the policy wants to limit the export of biomass residues and to develop integrated bioenergy production (bioenergy power plants) based on domestic agricultural and municipal waste. Biofuel development is fostered with the help of blending mandates for fossil fuels which apply to transportation and industry as well as to electricity generation. In order to manage environmental and social effects of bioenergy development, the government has developed sustainability standards for bioenergy, e.g. the Indonesian Sustainable Palm Oil Standard.

The agricultural development strategy focuses on upgrading and the transition from primary agriculture to an integrated agricultural bioindustry based on local resources, sustainable (small-scale) agriculture and the creation of a favorable infrastructure for bio-businesses. The plan also encourages the development of sustainable bioeconomy in rural villages throughout the country. A comprehensive policy mix is proposed in the Strategic Plan for 2015–2019, extending from increasing crop yields, fostering clusters and capacity development to marketing and sustainability monitoring.

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Malaysia

1 Which bioeconomy-related policy strategies exist?

Malaysia has been the first country in South-East Asia to develop a holistic policy strategy fostering the development of bioeconomy. In Malaysia, the term bioeconomy is strongly related to industrial upgrading and the application of biotechnology. In 2005, the government launched the comprehensive "National Biotechnology Policy". Political support for biotechnology applications is defined in three consecutive stages, with a focus on capacity building in phase 1 (2005–2010), on commercialization of R&D in phase 2 (2011–2015) and on internationalization in phase 3 (2016–2020). With respect to fostering commercialization and industry uptake, the Prime Minister launched a private-sector-focused "**Bioeconomy Transformation Programme**" in 2012.

Moreover, in 2013, the "**National Biomass Strategy 2020**" was updated. While the first edition of the National Biomass Strategy (2011) focused on agricultural biomass valorization (mainly palm oil), the second edition explores the development of higher added value (downstream opportunities) from the country's biological resources in general, with special consideration for residues.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
✘	

Bioeconomy comprises the production of renewable resources and their conversion into food, feed, chemicals, energy and healthcare products by applying biotechnology and combining innovative technologies.

3 Who is the author of the strategies?

The “National Biotechnology Policy” and the “Bioeconomy Transformation Programme” have been developed under the guidance of the Ministry of Science, Technology and Innovation (MOSTI) and endorsed by the government. BiotechCorp, under the purview of MOSTI, has been nominated as the single implementation agency. Through the transformation program, the private sector is also participating in policy making, e.g. by jointly setting national goals for the application of biotechnology in the core sectors and by defining how structural conditions can be improved.

The National Innovation Agency developed the National Biomass Strategy in a multi-stakeholder process with other government agencies, businesses and research organizations.

4 What are the key goals of the strategies?

Biotechnology is considered a key driver of future growth and should help transform Malaysia into a knowledge economy by 2020. In particular, biotechnology might enhance competitiveness in sectors where Malaysia is strong, such as in plantations and manufacturing, but it should also contribute to developing new business, for example from traditional medicine and food products. The Biomass Strategy outlines the goals for creating additional value from biological resources and for developing new industries.

The “Bioeconomy Transformation Programme” was set up to maximize the commercial opportunities of Malaysian biobased industries and to make them the key drivers of bioeconomy development.

5 What are the priority areas of the strategies?

The national biotechnology policy mainly seeks to provide a favorable innovation environment specifically stimulating the agricultural, industrial and healthcare biotech sectors. Besides innovation in these areas, the policy supports technology development, training and education, financial infrastructure and an enabling regulatory framework. With a view to internationalization, the government establishes a global marketing strategy and facilitates international collaboration.

The “Bioeconomy Transformation Programme” mainly supports so-called “trigger projects” in the priority biotech sectors. It also integrates the other sectors along bioeconomy value chains, such as agriculture, forestry, fisheries, chemicals and renewable energy. In order to implement the program, BiotechCorp has developed bio-accelerator platforms, which focus on community development, technological innovation and bio-entrepreneurship. With regard to technology development and inter-

nationalization, the government created a certification for qualified biotechnology companies in the priority sectors. Companies awarded the "BioNexus" status are granted fiscal incentives, legal advisory services and other privileges.

The biomass strategy mainly outlines the economic potential as well as the technological opportunities and challenges linked to developing higher value-added businesses based on biomass. It sums up that besides the government facilitation and incentives provided, e.g. the Biomass Task Force, many private and public sector initiatives will be needed to develop new technologies into commercially viable options.

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New Zealand

1 Which bioeconomy-related policy strategies exist?

In New Zealand the "traditional" bioeconomy, i.e. the primary sector and the food industry, contributes to more than two thirds of exports and is a key pillar of the economy. Although New Zealand does not have a specific bioeconomy strategy, the biobased economy clearly plays a very important role in the competitiveness strategy "**Business Growth Agenda**" which was adopted in 2012. In this regard, a specific innovation strategy for the primary sector and the biological industries was released in the form of the "**Biological Industries Research Fund**" (2013).

While other renewable energies, mainly water and geothermal, are much more important for the country, New Zealand's "**Energy Strategy 2011–2021**" encourages bioenergy research and development with a focus on forest-based bioenergy and biofuels.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

With a view to the biobased economy, the policy documents refer to primary industry and bioindustries.

3 Who is the author of the strategies?

The Ministry of Business, Innovation and Employment coordinates the Business Growth Agenda together with the Treasury and is also responsible for innovation strategies targeting the biological industries ("The Biological Industries Research Fund"). The Ministry for Primary Industries also contributes to the innovation strategy, with the "Primary Growth Partnership" for example.

4 What are the key goals of the strategies?

The "Business Growth Agenda" seeks to increase productivity, innovativeness and export performance. Its goal is to double New Zealand's exports in real terms by 2025, and to leverage the contribution of the primary sector by innovating higher-value products. Business innovation spending should be increased to at least 1 percent of GDP. Competitiveness should be further improved through stronger international collaboration in research and development activities, specifically with China and Singapore.

The biological industries innovation strategy pursues two main goals: 1) improving the primary sector's competitiveness and sustainability and 2) developing high-value food and industrial biological applications, including bioenergy.

5 What are the priority areas of the strategies?

The "Business Growth Agenda" comprises policy initiatives in six priority areas, i.e. building export markets, building capital markets, building innovation, building skilled and safe workplaces, building infrastructure and building natural resources.

"The Biological Industries Research Fund" bundles several innovation support programs along bioeconomy value chains. Export growth should be fostered by enhancing productivity and sustainability in the primary industries and by developing higher-value products from renewable resources. In particular, the development of innovative processed food products and seeds is considered important. Furthermore, the investment plan supports business innovation in the biological industries, new approaches to risk management as well as market development and internationalization. Among the different innovation support programs, the National Science Challenges are a new instrument of "mission-led" science investment. They concentrate on key societal challenges identified in a multi-stakeholder process, many of which are bioeconomy topics, and are interdisciplinary by definition. The first National Science Challenge was launched in 2014 and focused on High-Value Nutrition. "The Primary Growth Partnership" is another innovative support program. It fosters public-private partnerships between government and industry that invest in long-term R&D projects to increase the market success of the primary industries, for example the development of biofuels from forest waste.

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Russia

1 Which bioeconomy-related policy strategies exist?

With regard to political bioeconomy strategies, Russia puts a focus on biotechnology development. With a view to catching up with "World Bioeconomics", in 2012 the Russian government endorsed a **"Comprehensive Program for the Development of Biotechnology – BIO2020"**. Consequently, it approved a corresponding implementation roadmap in 2013.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
✘	

The policy documents use a term that is translated as "bioeconomics".

3 Who is the author of the strategies?

Several, mostly scientifically-staffed technology platforms are actively involved in bioeconomy policy. The most prominent are "Bioindustry and Bioressources -Biotech 2030", "Bioenergetics" und "Medicine of the Future". These platforms have significantly contributed to developing the "BIO 2020" program. On the government side, the Ministry for Economic Development is the lead agency. However, an inter-ministerial working group, consisting of the Ministry for Economic Development, the Ministry of Industry and Trade, the Ministry of Agriculture, the Ministry of Natural Resources and the Environment, has been nominated to harmonize the measures and instruments for implementation of the strategy. The "BIO 2020" strategy has been formally adopted by the Russian Government.

4 What are the key goals of the strategies?

In Russia, bioeconomy, nanoindustry and IT are considered the basis for modernization and the creation of post-industrial economics. Bioeconomy should contribute to increasing the industrial added value and leverage the country's vast resources in terms of land and biomass (specifically forest-based). The comprehensive program for the development of biotechnology seeks to close the gap in biotech development compared to other industrialized nations and to reduce the high import dependence on foreign biotech products. The program envisages that biotechnology will contribute 1 percent of GDP in 2020 and 3 percent in 2030. Besides industrial innovation, the strategy also expects positive impacts in terms of sustainability, job growth and rural development. Moreover, in view of the recent trade sanctions, bioeconomy should improve the country's self-sufficiency in food and medicines.

5 What are the priority areas of the strategies?

The strategy promotes biotechnology as a cross-cutting technology but also defines priority applications: bioenergy, agri-food biotechnology, industrial biotechnology, biomedicine, pharmaceuticals, forestry products, environmental technologies and marine biotechnology. Although the program includes the creation of genetically modified plants and animals, the roadmap does not foresee the introduction of genetically engineered organisms. In fact, the share of agricultural biotechnology within the implementation roadmap is smaller than in the comprehensive program and limited to the (technological) development of biofuels, medicinal plants, veterinary vaccines and enzymes.

The roadmap for implementing the strategy focuses largely on upgrading of the biotechnology infrastructure and promotion of the bioindustry. Hence, it supports the creation of demonstration plants, technology centers, biobased clusters, etc. By 2020, specific support programs for SMEs should be implemented. The activities and specifically the development of biorefinery plants in regional clusters, for example in Tartastan, Omsk, Tambov, Chuvash or Pushino, are seen very positively and are supported. Interestingly, the roadmap does not detail any biotechnology research funding and programs. However, it stipulates that biotechnology-related promotion programs of important state organizations', such as Rusnano (nanotechnologies), Skolkovo (high-tech), VEB (development bank), RFTR (technology promotion) and RVK (Russian venture capital fund), should be coordinated. In terms of priority products and applications, the roadmap has a broad scope and extends from biobased chemicals, over pulp and paper to functional nutrition. Bioenergy development is considered for the generation of heat and electricity.

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South Korea

1 Which bioeconomy-related policy strategies exist?

In 2008, as one of the first countries in Asia the government published the "Low Carbon, Green Growth Strategy" which focused on the reduction of greenhouse gas emissions and the development of green innovation and technologies. Renewable energies, including bioenergy, have been considered important for reducing emissions and were subject to considerable infrastructure investments under the Five-Year Green Growth Plan (2009–2013). However, the current Second National Basic Energy Plan 2014–2035 mainly defines a stronger reliance on nuclear power.

Biotechnology, biobased materials and chemistry have been gaining momentum in recent years. In 2006, the "**2nd Framework plan for Promotion of Biotechnology**" (**"Bio-Vision 2016"**) was adopted with clear targets for the biotech industry and the development of a bioeconomy. The second stage of this biotechnology promotion framework was initiated in 2012. The second stage specifically embraces bioindustries and the pharmaceutical market. In the area of bioindustries, the Ministry of Trade, Industry and Energy subsequently released a separate **"Strategy for promotion of industrial biotechnology"** (biochemistry) in December 2012.

Since 2013, the new administration has reinforced the political focus on innovativeness. The **"3rd Basic Plan for Science and Technology"** was accordingly designed to achieve Korea's vision of becoming a "creative economy" which is based on excellence in thirty designated key technologies. Besides the guiding Ministry of Science, ICT and Future Planning, the Ministries of Trade, Industry and Energy, of Agriculture, Food and Rural Affairs and of Oceans and Fisheries have also developed plans to foster the required innovation in their fields of competence. One example is the "Plan of Economic Innovation in Agriculture".

South Korea is additionally a leader in marine biotechnology policy. In 2008, the government issued the **Blue-Bio 2016 Plan**, a comprehensive support strategy for marine biotechnology. In 2012, as part of its effort to systemically develop marine biotechnology, it enacted the "Preservation, Management, and Utilization of Marine Bioresources Act".

2 Is the term “bioeconomy” or “biobased economy” used in the strategy documents?

Yes	No
✘	

In Korea the term “bioeconomy” generally relates to the biosciences, medical biotechnology and the health sector. For a few years, however, bioenergy, green chemistry and bio-electronics have also been attributed to the bioeconomy.

3 Who is the author of the strategies?

The cabinet approved the Green Growth Strategy and the National Basic Energy Plan. After the change of government in 2013, the importance of a green growth strategy was confirmed.

The government formulated “Biovision 2016” in 2006 for a period covering ten years and published the second stage plan of Bio-Vision in 2012. The Ministry of Science, ICT and Future Planning was created in 2013 and since then has coordinated the innovation strategies relating to the vision of establishing a “creative economy”. Biotechnology is one of the key technologies considered important. The National Science and Technology Council is responsible for developing the relevant Basic Plans for Science and Technology.

The Ministry for Land, Transport and Maritime Affairs issued the “Blue-Bio 2016 Plan”. Since its creation in 2012, the Ministry of Oceans and Fisheries has had responsibility for marine biotechnology and the blue economy.

4 What are the key goals of the strategies?

As a global industrial player, South Korea seeks to become more competitive in the biobased economy and to enter promising growth markets in this field. In the context of the “creative economy” strategy, the Korean government has continued its strong support for new technologies, especially for IT and biotechnology, which are expected to have multiplier effects and create new markets. For example, the “Plan of Economic Innovation in Agriculture” seeks to transform agriculture into a “6th industry” which uses IT and biotechnology and by means of which farmers also become integrated producers of higher-value products and service providers, e.g. ecotourism.

“Bio-Vision 2016” aims to provide Koreans with a “healthy life” and to develop a “prosperous bioeconomy”. The main economic goal is to become one of the leading seven nations in biotechnology by 2018. The industrial biotechnology plan also sets quantitative targets, such as to become one of the top five biochemistry locations by 2020. Biobased chemicals should reach a market share of 10 percent domestically and 5 percent globally. The support measures should contribute to creating 43,000 jobs by 2020 and to reducing the CO_2 emissions by about 10 percent.

The Blue-Bio 2016 Plan defines the overall objective of becoming one of the leading seven nations in marine biotechnology and of developing an array of marine-inspired industrial and healthcare innovations. The plan defines four intervention objectives as the sustainable development of a blue-economy, specifically the sustainable use of marine organisms, the construction of a responsible marine society, the implementation of a rich marine economy based on a healthy marine ecosystem.

5 What are the priority areas of the strategies?

The “creative economy” strategy in general focuses on further increasing R&D expenditure for key technologies, also from private companies, on reforming the R&D system and on promoting interdisciplinary technology combinations in creative industries, for example combining brain-, nano- and biosciences.

The “Bio-Vision 2016” strategy seeks to promote an efficient and coordinated management of R&D support programs, infrastructure investments and support systems for the bioindustry, bioclusters including technology innovation centers, and the training of world-class experts. The Ministry of Science, ICT & Future Planning (MISP) funds a majority of biotechnology-related R&D.

The “Industrial Biotechnology Plan” supports technology transfer and market development. It promotes cross-sectoral alliances between large and smaller companies, mainly from the chemical and the life sciences industries. Furthermore, it tries to generate synergies by building and providing common infrastructure for these industries. In the area of market development, it encourages the development of standards to ensure global compatibility and a preferred procurement program for biobased materials.

The marine biotechnology strategy “Blue-Bio 2016” sets priorities in R&D promotion as well as in developing the relevant innovation system including infrastructure. For example, an International Marine Science Research and Support Center with a special focus on developing the creative marine biotechnology industry was inaugurated on Jeju Island in 2015. Research and development support targets the discovery and production of marine organisms as well as the development of innovative marine-based materials and the conservation of the marine ecosystem.

In the agricultural sector, the government focuses on modernization to establish a high value-added industry based on IT and biotechnology. Priorities further include developing a highly trained workforce, expanding exports and making rural communities attractive for the young and well-qualified.

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Sri Lanka

1 Which bioeconomy-related policy strategies exist?

Inspired by innovation-driven biotechnology policies in South and South-East Asia, the Sri Lankan Cabinet of Ministers enacted the **"National Biotechnology Policy"** in 2010. This policy complements the second revision of the National Science and Technology Policy from 2009, and represents the first policy statement targeting innovation in biotechnology and encouraging its cross-sectoral application.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

The term "bioeconomy" seems not be used in policy discussions. However, promoting bioindustries and added value from sustainable biological resources is central to the biotechnology policy framework.

3 Who is the author of the strategies?

The strategy was developed jointly by the National Science Foundation (NSF) and its National Committee on Biotechnology together with the National Science and Technology Commission (NASTEC) by means of an extensive consultation process with experts and the public.

4 What are the key goals of the strategies?

The strategy seeks to “enhance the quality of life of all Sri Lankans in terms of health, food security, a clean environment and socio-economic development through ethical, effective and safe use of biotechnology”[14]. Although agricultural biotechnology plays a central role, the strategy addresses all types of biotechnologies that increase the added value from biological resources.

14 Democratic Socialist Republic of Sri Lanka. Ministry of Science and Technology, 2009, p.7.

5 What are the priority areas of the strategies?

The National Policy comprises a wide range of political support measures, such as awareness creation, education, R&D support, support for commercialization and regulatory improvements. Important crosscutting tasks are to engage the public in biotechnology, train experts and create centers of excellence as well as ensure policy coordination and guided implementation (via the National Biotechnology Council).

With regard to fostering the biobased industries, the strategy highlights food production, health care and industrial biotechnology. Biotechnology should further enhance bioenergy development and promote clean energy. Finally, the policy framework stresses the importance of the sustainable use of biodiversity for biotechnology and bioprospecting. For each priority area (“thrust”), the policy framework details a set of measures to be taken (“strategies”).

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Thailand

1 Which bioeconomy-related policy strategies exist?

Bioeconomy development in Thailand is politically driven by the **"Biotechnology Development Policy Framework"** (2012). The framework provides a holistic view of biotechnology as a knowledge-based industry with diverse applications across the medical, agricultural, aquatic, and industrial fields. Bioplastics are specifically fostered as a new biobased industry via the **"National BioPlastics Roadmap"** (2008).

With regard to renewable energies, the Thai government developed the "**Alternative Energy and Development Plan (AEDP)**" 2012–2021 which supports bioenergy and biofuels based on the country's vast agricultural feedstock, specifically by-products and residues. Biomass accounts for approximately 80 percent of Thailand's renewable energy, representing over 10 percent of the country's total energy consumption.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

3 Who is the author of the strategies?

The National Science Technology and Innovation Policy Office (STI) cooperated with the National Center for Genetic Engineering and Biotechnology (BIOTEC) in formulating the second National Biotechnology Policy Framework which was adopted by the Thai government in 2012 and spans a period of ten years. The National Innovation Agency (NIA) defined the "BioPlastics Roadmap" which was approved by cabinet in 2008.

The AEDP is developed by the Department of Alternative Energy Development and Efficiency in the Ministry of Energy.

4 What are the key goals of the strategies?

The government is stimulating innovation in and applications of biotechnology in order to make Thailand a center for biotechnology in Asia while transitioning to a more technology and knowledge-based economy. Specifically, the strategy aims at increasing competitiveness by advancing science and technology in areas where Thailand has a comparative advantage and/or strong capacity, such as in agriculture, food processing or plastics production. Furthermore, biotechnology should increase wealth and the quality of life by strengthening economic, social, health and environmental security and promoting lifelong learning. Biotechnology is also recognized as fostering sustainable development and green growth. Finally, the government also seeks to strengthen autonomy in strategic sectors, such as energy and healthcare.

The Alternative Energy and Development Plan (AEDP) foresees that renewables should cover 25 percent of total energy consumption by 2021. Bioenergy should reduce dependency on foreign oil and decrease greenhouse gas emissions. The AEDP is to be reviewed and developed for the period 2015–2036.

5 What are the priority areas of the strategies?

The National Biotechnology Policy Framework is directed towards strategic innovation planning and seeks to motivate private-sector investment in R&D, technology transfer and application, as well as the development of experts and a qualified workforce ("intellectual capital"). In order to foster technology transfer and foreign direct investment, the government not only supports R&D infrastructure but also grants a mix of investment and tax incentives for innovative biotech projects. The framework targets the central bioeconomy sectors, in particular agriculture and food, medicine and public health, bioenergy and biobased industry. The "National BioPlastics Roadmap" is in the second phase (2011–2015) which focuses on market development and environmental management. Support is provided in the areas of R&D (platform technologies), development of biomass supply chains and investment incentives.

The AEDP strongly encourages the use of biomass, in particular agricultural residues and by-products, for energy generation. The plan also fosters the production of ethanol from home-grown sugar cane and cassava as well as an increase in biodiesel blending mandates from B5 in 2012 to B10 in 2019. The "Biotechnology Policy Framework" highlights in this respect that the expansion of bioenergy and biofuel production must not be in conflict with food production. It therefore promotes R&D in next generation biofuels and the use of alternative feedstock (residues, cellulose, algae). Moreover, by 2021, the government aims to realize a threefold increase in biogas supply above current production. Such growth should be based on available raw materials such as waste generated by livestock farming, agriculture and food processing, and households.

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Europe

In Europe, the European Union can be seen as the key driver of national bioeconomy policy strategies. The support for bioeconomy development goes back to 2005 when Janez Potocnik, the former EU Commissioner for Research, Science and Innovation, presented the concept of a knowledge-based bioeconomy. During the Presidency of the EU Council in 2007, Germany enhanced the concept and highlighted the importance of biological resources as primary feedstock and biorefineries as important production facilities. In 2012, the European Union presented its first dedicated bioeconomy strategy with a focus on developing new technologies and processes, developing markets and competitiveness and fostering close collaboration between policy makers and stakeholders. Additionally, the Horizon 2020 program (2014–2020) provided the basis for further development of national research and innovation strategies in Europe*. To date, three holistic bioeconomy strategies have been developed in Europe (Finland, Germany, the West Nordic Countries). Most European countries, however, focus on research and innovation strategies that relate significantly to bioeconomy issues. Furthermore, bioeconomy in European countries is often treated within the wider context of green or blue growth strategies, and most recently with strategies focusing on the circular economy.

Country*	Perspective	Document Name
Austria	Research & Innovation	"Research, Technology and Innovation Strategy for Biobased Industries in Austria" (2014)
		"Policy Paper on Bioeconomy" (2013)
Belgium	Regional Bioeconomy Development	"Bioeconomy in Flanders" (2014) and Action Plan
Denmark	Green Economy	"Growth Plan for Water, Bio and Environmental Solutions" (2013)
		"Growth Plan for Food" (2013)
Finland	Holistic Bioeconomy Development	"The Finnish Bioeconomy Strategy" (2014)
Ireland	Blue Economy	"Harnessing Our Ocean Wealth" (2012)
	Green Economy	"Delivering our Green Potential" (2012)
	Research & Innovation	"Towards 2030" (2008)
Lithuania	High-Tech	"National Industrial Biotechnology Development Programme" (2007-2010)
Netherlands	Green Economy	"Groene Groei: voor een sterke, duurzame economie" (2013)
	Biobased Economy	"Groene Groei – Van Biomassa naar Business" (2012)
		"Framework memorandum on the Biobased Economy" (2012)
		Green Deal Program (2011)
Norway	Research & Innovation	"Research Programme on Sustainable Innovation in Food and Bio-based Industries" (2012 -2022)
	High-Tech	"National Strategy for Biotechnology" (2011)
		"Marine Bioprospecting- a Source of New and Sustainable Wealth Growth" (2009)
Portugal	Blue Economy	"Estrategía Nacional para o Mar" (2013–2020)
Sweden	Research & Innovation	"Swedish Research and Innovation Strategy for a Bio-based Economy" (2012)
West Nordic Countries (Iceland, Greenland, Faroe)	Holistic Bioeconomy Development	"Future Opportunities for Bioeconomy in the West Nordic Countries" (2014)

* The G7 countries and the EU are covered by the report **"Bioeconomy Policy (Part I): Synopsis and Analysis of Strategies in the G7".**

Austria

1 Which bioeconomy-related policy strategies exist?

In recent years, the Austrian government has taken several steps to develop bioeconomy-related policies which are predominantly research-oriented. Based on a comprehensive **policy paper on bioeconomy** (2013), published by BIOS Science Austria and the Austrian Union for Agricultural Research (ÖVAF), the political commitment to supporting a bioeconomy research initiative was laid down in the coalition agreement of 2013. One year later, the government published the **Research, Technology and Innovation Strategy (RTI Strategy) for Biobased Industries** (2014). Furthermore, an inter-ministerial working group submitted an RTI Status Quo Report in 2015 in order to evaluate current bioeconomy-related RTI activities in Austria. The report defines relevant research areas and is used to elaborate a comprehensive national RTI Strategy on Bioeconomy.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
✗	

The bioeconomy definition used in the policy paper (2013) refers to the German definition of bioeconomy and encompasses "the knowledge-based production and use of renewable resources, in order to provide products, processes and services in all areas of the economy, within the framework of an economic system that is viable for the future"[15].

15 Austria. Ministry of Agriculture, Forestry, Environment and Water Management, 2013, p. 1. (see also BMELV, 2013, p. 15.)

3 Who is the author of the strategies?

Bioeconomy-related policies in Austria are mainly driven by the Ministry of Transport, Innovation and Technology, which published the RTI Strategy for Biobased Industries in 2014. The current RTI Status Quo Report (2015) was prepared by an inter-ministerial working group, composed of the

Ministries of Transport, Innovation and Technology (BMVIT); Agriculture, Forestry, Environment and Water Management (BMLFUW); Science, Research and Economy; and the Austrian Federal Chancellery. The report recently underwent an online consultation process with various stakeholders from science and research, technology and innovation.

4 What are the key goals of the strategies?

The RTI Strategy for Biobased Industries (2014) aims at further developing biobased industry in Austria by promoting research, technology and innovation projects. In this respect the strategy seeks to strengthen the regional added value and to reduce its dependence on natural resources which are usually imported.

5 What are the priority areas of the strategies?

The RTI Strategy (2014) addresses the Austrian food, chemicals, pharmaceuticals, and timber industry in particular. In this context, it highlights their development potential with respect to raw material extraction, product development and processing methods. The strategy prioritizes the following product groups: insulation and building products, biogenic composite materials, biopolymers, biobased bulk chemicals, biofuels, biogenic fertilizers, as well as biobased specialty products, such as enzymes and pharmaceutical products. In addition, innovation initiatives are intended to focus on processing methods, i.e. fermentation, gasification and pyrolysis of biomass, timber processing and new biorefinery concepts, such as the use of grass and algae.

In order to promote biobased industry, the strategy provides explicit recommendations for actions that focus on developing integrated concepts for the efficient use of biomass and on assessing biobased products and their economic and ecological impact. Furthermore, the biobased industry sector's competitiveness and presence in Austria should be strengthened, for example, by setting up a stakeholder platform. Finally, the strategy emphasizes the need for further research, e.g. on microorganisms, and collaboration with traditional industries.

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Belgium

1 Which bioeconomy-related policy strategies exist?

Belgium as a whole has not yet developed a national bioeconomy strategy. Instead, bioeconomy policies in Belgium vary by region.

Although bioeconomy is treated within the wider context of green economy in the Walloon region, no bioeconomy-related strategies have been established yet.

The situation is different in Flanders, where the Flemish government published its first memo of a bioeconomy strategy, "**Bioeconomy in Flanders**", in 2014. In this memo, the Flemish government describes its vision and strategy for a sustainable transition to bioeconomy in Flanders.

The Flemish government has additionally adopted several initiatives for bioeconomy development. This includes, the "New Industry Policy" of 2011, embedding the program "New Factory of the Future" in the Flanders Innovation Hub for Sustainable Chemistry. Bioeconomy was also addressed in the "Flemish Materials Program" of 2012 as part of Flanders' sustainable materials management.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
✗	

Bioeconomy encompasses "all activities associated with the production of biomass and the various ways in which this biomass and its residual streams are subsequently used"[16]. In this respect, bioeconomy includes both the traditional sectors and also the more technology-oriented areas in addition to the end-user/consumer and the logistics sector. The Flemish definition of "biobased economy" refers more to the conversion and processing of biomass than to biomass production.

16 Flanders. Department of Environment, Nature and Energy, 2014, p. 9.

3 Who is the author of the strategies?

The "Bioeconomy in Flanders" memo was developed by the Interdepartmental Working Group for the Bioeconomy (IWG) which was set up to develop a Flemish strategy for bioeconomy. The IWG is composed of various ministries and government agencies, such as the Flemish Institute for Technological Research (VITO) and the Public Waste Agency of Flanders (OVAM). The memo of 2014 represents the initial outcome of the IWG's work which is based on various consultations with stakeholders from business, civil society and research institutions.

4 What are the key goals of the strategies?

The Flemish government's aim with the memo of 2014 is to contribute to developing a long-term strategy for bioeconomy in Flanders by 2030. The Flemish bioeconomy is seen as a contribution to green growth, job creation and further development of a circular economy. In this respect, Flanders seeks to become one of the most competitive bioeconomy regions in Europe by 2030. It should be characterized by a top innovation and research landscape.

5 What are the priority areas of the strategies?

The memo focuses mainly on promoting bioeconomy-related innovations in Flanders. In order to create an enabling framework, the IWG identified five priority areas. Firstly, the memo seeks to foster policy coherence, e.g. by removing regulatory barriers and promoting cooperation and coordination in all relevant policy areas. Secondly, the strategy paper highlights capacity building, research and innovation as cornerstones for further bioeconomy development. In this context, it focuses on the training of experts, on valorization and demonstration projects, and on business model innovation. Furthermore, scientific research on optimum resource allocation for food, materials and energy should be promoted to avoid conflicting goals in the future. Thirdly, the efficient and sustainable use of biomass should be encouraged, e.g. by developing sustainability criteria, implementing regular assessments of biomass demand and supply for the bioeconomy, and focusing on locally produced biomass. Fourthly, the document emphasizes market development and awareness creation to further strengthen the region's competitiveness. Lastly, international and interregional cooperation should be fostered to encourage knowledge and technology transfer.

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Denmark

1 Which bioeconomy-related policy strategies exist?

Denmark does not have a dedicated national bioeconomy strategy yet. The government's commitment to bioeconomy is framed by the **"Growth Plan for Foods"** and the **"Growth Plan for Water, Bio and Environmental Solutions"** (2013). One of the key measures of the latter was the appointment of the National Bioeconomy Panel (NBP) which has been mandated as the advisory body to support the government's ambition to transform Denmark into a leader in bioeconomy. In 2014, the NBP published a statement, **"Denmark as growth hub for a sustainable bioeconomy"**, which does not constitute a strategy as such but provides recommendations for the government to promote Danish bioeconomy development.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
✗	

Although the term is used in the "Growth Plan for Foods", the definition of bioeconomy in the "Growth Plan for Water, Bio and Environmental Solutions" strongly relates to "biobased solutions".

The NBP's definition of bioeconomy refers to an economy "in which the basic building blocks used for the production of energy, chemicals and materials originate from renewable biological resources, including plants and animals"[17].

17 Denmark. The National Bioeconomy Panel, 2014, p.1.

3 Who is the author of the strategies?

Both growth plans were published by the Danish Ministry of Business and Growth in 2013. The plans are based on recommendations of the Growth Team for water, bio and environmental solutions and the Growth Team for foods. These teams are composed of experts from business and were set up as advisory bodies to contribute to the government's business and growth policy.

The position paper "Denmark as growth hub for a sustainable bioeconomy" (2014) was published by the National Bioeconomy Panel which is composed of 27 experts from industry, research, NGOs, as well as key organizations and authorities. The panel is chaired by the Danish Ministry of Food, Agriculture and Fisheries and is further administratively supported by the Ministries of Environment; Business and Growth; Climate, Energy and Building, and Higher Education and Science.

4 What are the key goals of the strategies?

Both plans from 2013 are designed as growth strategies which should contribute to increasing economic growth, employment and exports. Furthermore, the plans seek to create new business opportunities and strengthen the competitiveness and innovativeness of Danish enterprises in the relevant industry sectors.

The NBP's statement from 2014 identifies general opportunities for Denmark associated with bioeconomy. These include, for example, lowering dependence on fossil fuels, increasing resource efficiency, promoting exports of technology, enhancing value creation and complementing food production.

5 What are the priority areas of the strategies?

The "Growth plan for water, bio and environmental solutions" defines 40 initiatives within five action fields. Bioeconomy is specially targeted under the action field of biobased solutions. The plan highlights Denmark's strength in industrial biotechnology and the potential of Denmark's agricultural sector concerning the production of biomass. Furthermore, biofuels are considered as a future market for Danish technology suppliers. In order to strengthen the country's biobased industry sector, the growth plan seeks to further develop the European market for biobased products by means of public-private partnerships for example.

Within the "Growth Plan for Foods" (2013), bioeconomy mainly refers to the action field of sustainable and resource-efficient food production. In this respect, the plan focuses on the efficient use and sustainable production of biomass which should be the basis for increased food production. More

specifically, the plan highlights the sustainable use of marine resources by focusing on using unwanted by-catches for the production of energy, pharmaceuticals or cosmetics. Further emphasis is put on developing new business models that concentrate on processing food wastes and residuals. Additionally, new technologies, e.g. for smart packaging, should contribute to reducing waste, water and energy in the food industry.

The NBP also highlights the importance of new bioeconomic value chains that should be strengthened by promoting biorefineries. Research, technology and know-how development should ensure support for these interventions.

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Finland

1 Which bioeconomy-related policy strategies exist?

In 2014, Finland published its first comprehensive policy strategy on bioeconomy, **"The Finnish Bioeconomy Strategy – Sustainable growth from bioeconomy".**

The strategy paper was preceded by three documents published by the Finnish Innovation Fund, Sitra. All three documents can be seen as milestones on the path toward the development of a Finnish bioeconomy strategy. The Natural Resource Strategy of 2009 was developed to promote the sustainable and innovative use of natural resources by addressing six key areas, of which one is covered by bioeconomy. Alongside economic and ecological aims, the document "Distributed Bio-Based Economy – Driving Sustainable Growth" of 2011 also pursues social aims which are intended to help face the challenges of climate change and the scarcity of natural resources. The paper further presents a vision of a nearly autarkic Finnish society in respect of nutrients, food and energy. Within the report, "Sustainable Bio-economy: Potential, Changes and Opportunities for Finland" (2011), Sitra highlights the importance of bioeconomy in relation to sustainable food production and the replacement of fossil natural resources.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
✘	

The Finnish bioeconomy definition refers to "an economy that relies on renewable natural resources to produce food, energy, products and services"[18].

18 Finland. Ministry of Employment and the Economy, 2014, p. 6

3 Who is the author of the strategies?

The Finnish bioeconomy strategy of 2014 was developed under the responsibility of the Ministry of Employment and the Economy, and in cooperation with the Prime Minister's Office and other ministries, including the Ministries of Agriculture and Forestry; Environment; Education and Culture; Social Affairs and Health, and Finance. The public VTT Technical Research Centre and the Finnish Innovation Fund Sitra were also involved in this project. The strategy development was preceded by stakeholder consultations with regional representatives and economic operators.

4 What are the key goals of the strategies?

The Finnish bioeconomy strategy has been designed as a growth strategy and therefore envisages sustainable bioeconomy solutions as drivers for Finnish well-being and competitiveness. Given this vision, the document contains four strategic goals. Firstly, the strategy aims to create a competitive operating environment for the bioeconomy by promoting a climate favorable to investment and entrepreneurship. In order to coordinate the various stakeholders in the bioeconomy sector, a national bioeconomy panel should be appointed. Secondly, the strategy targets the generation of new bioeconomy businesses which should be promoted, for example, by means of new funding solutions, and exemplary pilot and demonstration projects. Thirdly, the creation of a strong bioeconomy competence base should be fostered by means of expanded research and the training of experts. Fourthly, the strategy aims to ensure the accessibility and sustainability of biomass. These key goals were specified by numerous measures which do not, in fact, mention concrete quantitative targets but should contribute to an increased bioeconomy output of up to EUR 100 billion by 2025. Additionally, it should create about 100,000 new jobs.

5 What are the priority areas of the strategies?

As Finland is home to a vast number of forests, the core element of the country's bioeconomy is the forestry industry. According to the strategy, the forestry industry has great potential to contribute to economic growth in Finland, such as by strengthening the timber market or the diversification of wood products. Wood is also of particular importance for energy purposes. For example, wood-based transport fuel is increasingly used in Finland.

Another focal area of the Finnish bioeconomy strategy is industrial biotechnology. The strategy highlights the possibilities that arise from Finnish expertise in biotechnology, in the health sector for example, by developing health technologies and pharmaceutical research.

Interestingly, the Finnish bioeconomy strategy underlines the importance of water as the prerequisite for a successful bioeconomy. Clean water

is mentioned as a critical resource which is commonly used within the bioeconomy. Therefore, improved technologies for water efficiency and water recycling are needed. The Finnish forestry industry is already leading by example in this area by developing and using processes with low water consumption.

The Finnish bioeconomy strategy focuses, alongside products, on services and their importance for the value chain. By reflecting emerging trends related to increasing service intensity, services (such as nature tourism) are seen as new business opportunities.

Based on the assumption that the Finnish bioeconomy will increase in the future and therefore more biomass resources will be needed, the strategy also focuses on evaluation methods. This represents a first attempt to measure bioeconomy activities related to sustainability.

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Ireland

1 Which bioeconomy-related policy strategies exist?

Ireland has not yet developed a national bioeconomy strategy. The Irish government states that the country is only at the beginning of its bioeconomy development. However, the government has recognized the country's potential for bioeconomy and has taken first steps in promoting the capitalization of Ireland's large quantity of natural resources. In 2008, the national advisory body for agriculture and food, Teagasc, published the foresight report **"Towards 2030 – Teagasc's role in Transforming Ireland's Agri-Food Sector and the Wider Bioeconomy"**. In 2014, the government demonstrated further ambitions for promoting an Irish bioeconomy by funding the two-year project "**A Bio Economy for Ireland - An Evaluation of Development Opportunities, Policies and Initiatives Shaping Ireland's Transformation to a Sustainable Low Carbon Bioeconomy" (Bio-Éire)**.

Until 2012, bioeconomy was predominantly treated within the wider context of green and blue economy. An earlier government initiative related to green economy is covered by the comprehensive policy statement **"Delivering our Green Potential"** (2012) in which the government committed itself to developing a bioeconomy strategy as part of a broader green economy strategy. With the strategy paper "Harnessing our Ocean Wealth" (2012), the government formulated an integrated marine roadmap for developing the Irish blue economy.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
✗	

The policy statement "Delivering our Green Potential" (2012) understands bioeconomy as "the sustainable production of renewable biological resources and their conversion – and that of waste streams – into feed, food and biobased products such as bioplastics, biofuels and bioenergy"[19].

19 Ireland. Government of Ireland, 2012, p. 35.

3 Who is the author of the strategies?

The first initiative regarding bioeconomy was taken by Teagasc with its report "Towards 2030" of 2008. In recent years, the Department of the Irish Prime Minister has mainly guided bioeconomy as part of a wider green and blue economy strategy. Its commitment resulted in the policy statement of 2012. The ocean strategy (2012) was prepared by the Marine Coordination Group (MCG) which was set up to coordinate marine policies. The group is composed of representatives from all departments responsible for marine affairs.

Building on the government's commitment to develop a national bioeconomy strategy, the Bio-Éire project was drawn up in December 2014 to update the priority areas of Ireland's bioeconomy and to identify new opportunities to boost Ireland's GDP, exports and employment. The project is implemented by a multidisciplinary research team.

4 What are the key goals of the strategies?

Teagasc's "Towards 2030" (2008) report envisions the agri-food sector as a key element of the Irish bioeconomy by 2030. Bioeconomy is seen as contributing toward coping with future challenges, such as food and energy security. Bioeconomy should further help to achieve social goals, including better public health, improved food products and enhanced rural development. The report assumes that the Irish gross output value of the food sector will double from EUR 20 billion to EUR 40 billion by 2030. Teagasc's report contains a plan for strategic and short-term actions which should be implemented by Teagasc itself. Within this action plan Teagasc intends to contribute to the ongoing national policy debate.

By developing a green economy strategy, the Irish government aims to strengthen growth, competitiveness and employment in Ireland. More specifically, the policy statement "Delivering our Green Potential" (2012) aims at identifying business opportunities for companies which could result from green economy.

With the ocean strategy (2012), the Irish government seeks to strengthen sustainable growth and to optimize the economic benefit from marine resources. In this respect, the strategy aims to increase the turnover from the marine sector to EUR 6.4 billion by 2020. Furthermore, the marine sector should contribute 2.4 percent to GDP by 2030.

5 What are the priority areas of the strategies?

The focus of Teagasc's "Towards 2030" report is generally on strengthening the agriculture and food sector. Research and innovation should play a crucial role in underpinning growth in the bioeconomy. Therefore, the report puts emphasis on strengthening knowledge capacity by means of education and training. The core element of the report was the first attempt to identify future priority areas of the Irish bioeconomy which highlighted four central pillars. Firstly, food production and processing should be an integral part of the future Irish bioeconomy with emphasis on grass-based production. Secondly, by

2030 the Irish bioeconomy will focus on food innovations that have positive effects on human health. Thirdly, it emphasizes the promotion of so-called agri-environmental products and services and, associated with this, the farmer's role in contributing to high environmental quality. Fourthly, the future Irish bioeconomy will focus on the innovative use of crops and the forestry sector in order to produce feedstock for energy and bioprocessing.

The strategy paper "Delivering our Green Potential" highlights various key areas of Ireland's future green economy. Bioeconomy is mentioned as a research area which should be promoted by means of expanded investment in public research institutions. The strategy points out key areas of the Irish bioeconomy, including the agri-food and fisheries sector, as well as forestry and biopharmaceuticals.

With a view to bioeconomy, the ocean strategy puts emphasis on using marine resources for renewable energy and health applications. In this respect, marine biotechnology is considered as key enabling technology for the production of drugs, enzymes, biomaterials and also functional ingredients for healthy food. The strategy further focuses on developing Ireland's research infrastructure, e.g. by establishing clusters on research and innovation.

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Lithuania

1 Which bioeconomy-related policy strategies exist?

In Lithuania, the government supports bioeconomy development mainly in the area of biotechnology. In 2006, the government approved the **"National Industrial Biotechnology Development Programme"** (2007–2010). Even though the program was not pursued any further due to the financial crisis, it was relaunched for the period from 2011 to 2013.

Biotechnology is also considered a key area in Lithuania's **"Programme on the Implementation of the Priority Areas of Research and (Socio-Cultural) Development and Innovation (Smart Specialization) and their Priorities"** (2014) which is linked to the country's "Innovation Development Programme" (2014–2020).

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

3 Who is the author of the strategies?

The "National Industrial Biotechnology Development Programme" was approved by the Ministry of Economy in 2006. The government Agency for Science, Innovation and Technology (MITA) is responsible for implementing the program.

The smart specialization program (2014) was developed under the guidance of the Ministry of Education and Science and is implemented by the Research and Higher Education Monitoring and Analysis Center (MOSTA).

4 What are the key goals of the strategies?

While the national biotechnology program (2011–2013) mainly seeks to strengthen Lithuania's high-tech industry, it also aims to reduce the country's dependence on imported, fossil fuels. Furthermore, it aims to increase added value for agricultural and forestry products.

The smart specialization program (2014) promotes economic growth and the contribution of "high added-value, knowledge-intensive and highly-qualified-labor-intensive economic activities"[20] to the GDP.

20 Lithuania. Ministry of Education and Science, 2014.

5 What are the priority areas of the strategies?

The biotechnology program (2011–2013) mainly focuses on technology development in order to process local biomass resources. It stresses the importance of biotechnology for producing bioplastics, second-generation biofuels, biopharmaceuticals and animal drugs, in addition to biobased materials. Further priority is put on environmental biotechnology, on initiating pilot and demonstration projects, and on promoting infrastructure investment and the commercial use of side products and waste products.

Biotechnology received attention in the smart specialization program (2014) under the priority area of "agro-innovation and food technologies".

The program contains an action plan which emphasizes the sustainable use of agro-biological resources and the need for safe food. Functional food is considered important for improving public health and well-being. In this respect, the action plan highlights the promotion of technology development and R&D investment, the creation of knowledge-intensive businesses and clusters, and the commercialization of R&D results by promoting cooperation between research and business. The action plan further encourages the development of biorefinery plants.

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The Netherlands

1 Which bioeconomy-related policy strategies exist?

Bioeconomy development in The Netherlands is politically guided by the **"Framework Memorandum on the Bio-based Economy"** (2012). The framework paper complements the innovation contract on the bio-based economy, **"Groene Groei: Van biomassa naar business"** (2012). This biobased business strategy is a result of the government's 2011 innovation strategy (**"To the Top"**) which identified the bioeconomy as a common theme across several top sectors[21]. Six of the nine top sectors consequently agreed to pursue the transition to a Dutch biobased economy.

In 2013, the Dutch government published the green growth strategy, **"Groene Groei: voor een sterke, duurzame economie"**, which explicitly considers the biobased economy as a means of replacing fossil fuels with renewable biomass.

21 Top sectors identified by the innovation strategy "To the Top" are agro-food, horticulture and seed stock, high-tech materials and systems, energy, logistics, creative industries, life sciences, chemicals and water.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
✗	

The framework memorandum (2012) defines the biobased economy as "green or sustainable economy which uses resources from living nature (including biomass and renewable resources)".

22 The Netherlands. The Cabinet, 2012, p.2.

3 Who is the author of the strategies?

The Dutch Ministry of Economic Affairs generally coordinates bioeconomy policy. The "Framework Memorandum on the Biobased Economy" was published by the Dutch cabinet as a shared vision of the biobased economy. In 2012, the government also developed the innovation contract "Groene Groei: Van biomassa naar business" in cooperation with industry and research organizations. The Top Consortium for Knowledge and Innovation (TKI) "Biobased Economy", which involves about 100 stakeholders from industry, academia, government authorities and NGOs, is responsible for implementing the contract.

The Ministries of Economic Affairs; Foreign Trade and Economic Development; and Housing, and the Central Government Sector developed the green growth strategy in 2013.

4 What are the key goals of the strategies?

The "Framework Memorandum on the Biobased Economy" (2012) stresses the opportunities offered by a biobased economy for coping with societal challenges, such as climate change, energy security and resource scarcity. It also seeks to increase income and employment in The Netherlands. The term biobased economy thus refers to an economy that is based on renewable raw materials.

The key goals of the innovation contract "Groene Groei: Van biomassa naar business" are to strengthen competitiveness and create new business by establishing inter-sectoral alliances.

The green growth strategy of 2013 aims to strengthen international competitiveness while reducing environmental impacts and dependence on fossil fuels. In order to achieve green growth, the government committed itself to promoting market incentives and appropriate laws that will strengthen innovation in the area of bioeconomy. The government further promotes interdisciplinary collaboration between stakeholders, including business actors, NGOs, and research institutions.

5 What are the priority areas of the strategies?

In order to promote the transition to a biobased economy, the framework memorandum prioritizes the efficient use of biomass. Emphasizing the concept of "co-production", linked to biorefineries as key technology, should ensure the optimized use of biomass for food, industrial products and energy. The framework encourages research and development in this area (in 2008, the Dutch Ministry of Agriculture, Nature and Food Quality had already initiated the development of a roadmap on biorefineries.) By initiating various public-private partnerships, the government further seeks to build on the country's expertise in biotechnology, food chemistry, agri-food, chemistry and logistics (especially ports). Sustainability of resource use is also recognized as an essential prerequisite of the biobased economy so that the development of sustainability criteria is supported.

The innovation contract focuses on six work packages in the period from 2012 to 2016, i.e. biobased materials, bioenergy and biochemicals, integrated biorefineries; optimized cultivation and biomass production; recovery and recycling of water, nutrients and soil; and economy, policy and sustainability. The Dutch government's com-

mitment to promoting a biobased economy is also reflected in so-called green deals, which support the biobased business sector by improving the framework conditions.

Within the green growth strategy (2013), the biobased economy is mentioned as one priority area of future green economy activities. The strategy integrates the goals of the preceding strategy papers. It particularly promotes R&D and demonstration projects aimed at the cascading use of biomass.

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Calorie
Chart
Grainy bread
180 kcal
Cottage cheese
100 kcal
Ham
126 kcal
Banana
95 kcal
Egg
155 kcal
Hazelnuts
650 kcal

Norway

1 Which bioeconomy-related policy strategies exist?

The Norwegian government has issued several strategic documents addressing key areas of bioeconomy development. The publication of a holistic dedicated bioeconomy strategy is underway and expected for end of 2015. Although extensive, political support has been concentrated on research policies. In order to bundle scientific competencies related to bioeconomy and biobased industries, the Norwegian Institute of Bioeconomy Research (NIBIO) was created in 2015 by merging the country's most important agricultural and forestry research institutes. In terms of sectoral focus, biotechnology and marine bioindustries play a key role in bioeconomy-related policy strategies.

Norway is one of the pioneers of fostering the sustainable use of marine resources and developing innovative marine bioindustries. In 2009, the government released the **"Marine Bioprospecting Strategy"** as well as the **"Strategy for an environmentally sustainable Norwegian aquaculture industry"**.

In 2011, the **"National Strategy for Biotechnology"** (2011–2020) defined a more comprehensive development path for biotechnological innovation and commercialization across biotechnology sectors. A broader vision of an innovation-driven "biobased society" was presented in 2012 with the release of the **"Research Programme on Sustainable Innovation in Food and Biobased Industries"** (BIONÆR).

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
✗	

The biotechnology strategy (2011) mentions that aquaculture especially would be an important part of the future Norwegian bioeconomy. The BIONÆR program defined bioeconomy as encompassing "all sustainable production and processing of biological resources for food, health and fiber products, industrial products and energy"[23].

23 The Research Council of Norway, (2013), p. 5.

3 Who is the author of the strategies?

The Ministries of Agriculture and Food, and Trade, Industry and Fisheries are responsible for developing the Norwegian bioeconomy strategy in an inter-ministerial and multi-stakeholder process.

The Research Council of Norway published the BIONÆR strategy (2012). The Council is mainly funded by the Ministry of Education and Research and the Ministry of Trade and Industry.

Whereas the aquaculture strategy (2009) was mainly developed by the Ministry of Fisheries and Coastal Affairs, the bioprospecting strategy (2009) and the biotechnology strategy (2011) are the result of inter-ministerial collaboration. Important stakeholders from research and business were also involved.

4 What are the key goals of the strategies?

Norway's strategies on marine bioindustries (2009) generally seek to promote economic growth (especially in rural areas) and industry development. The biotechnology strategy was defined with a view to job creation, increasing competitiveness and addressing grand societal challenges. More specifically, biotechnology should contribute to food safety as well as to "greening" of the industry and energy sectors .

The BIONÆR strategy (2012) aims to strengthen the level of profitability and sustainability of value chains in the primary industries. This also includes the seafood sector and marine resources. The strategy highlights the need to build capacities in bioresource management and biobased industry.

5 What are the priority areas of the strategies?

The bioprospecting strategy (2009) is clearly oriented towards innovation and commercialization. The strategy especially seeks to strengthen the pharmaceutical and processing industries (including oil and gas, food, feed and biofuels). Besides infrastructure investment, such as establishing a national marine biobank, and promoting capacity development and start-ups, it also supports regulatory measures facilitating bioprospecting.

While Norway's aquaculture strategy (2009) largely refers to an industry development strategy, it integrates environmental aspects of sustainable farming. In this respect, the strategy encourages the development of technical requirements and standards for sustainable aquaculture. It emphasizes the prevention of genetic changes in characteristics of wild fish stocks and the prevention of diseases affecting fish stocks. Furthermore, the strategy highlights the utilization of marine by-products as feedstock and the introduction of special protected areas for aquacultural activities. In addition, the strategy seeks to strengthen international cooperation in order to ensure sustainable fisheries.

The biotechnology strategy (2011) identifies eight priority areas which are classified into four thematic focus areas and four crosscutting issues. Thematic priorities are aquaculture, agri-business, environmental engineering and production (including biorefining), as well as the health sector. In this respect, strategic elements of intervention include

the promotion of basic research and technology development, initiating demonstration and upscaling projects, and fostering capacity development. Enhanced collaboration between research and industry should be promoted, for example, by establishing “research communities” which would identify the industries’ need for biomass from agriculture and the marine sector. The government’s commitment to creating an enabling framework for biotechnology development further results in promoting regulatory measures. Crosscutting areas emphasized by the strategy are international cooperation, investment for infrastructure and research, and promoting industry development while considering ethical and social aspects.

The BIONÆR strategy (2012) fosters private-sector contribution to long-term research activities. By supporting innovation in key enabling technologies (such as biotechnology, ICT and nanotechnology), the government intends to create new opportunities for using renewable resources in industrial products. The strategy refers to five overall priority areas which should be taken into consideration by research activities. These include closing material cycles to use biomass efficiently while respecting environmental, social and economic aspects of sustainability. Furthermore, research should be interdisciplinary and should contribute to value creation through market orientation, innovation and efficiency. Food production represents a further priority area in order to ensure food security and the production of safe and healthy food.

The strategy paper refers to the entire bioeconomic value chain, including feedstock, primary production, processing, marketing and consumption, in addition to service-based value creation.

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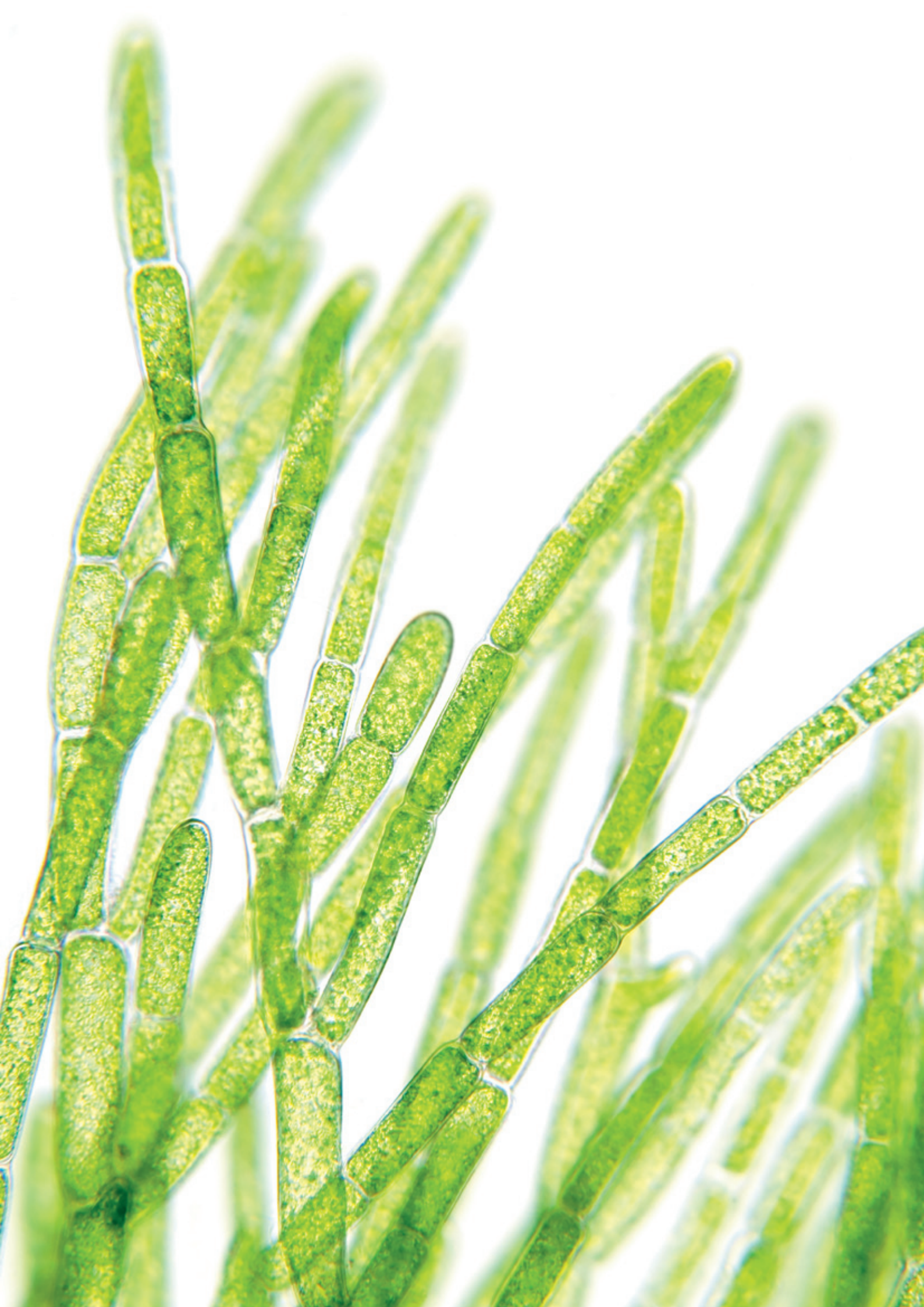

Portugal

1 Which bioeconomy-related policy strategies exist?

Although Portugal does not have a dedicated bioeconomy strategy, bioeconomy plays an important role in **"The National Ocean Strategy"** (2013–2020) and the associated action plan. The strategy is based on Portugal's first ocean strategy of 2006.

Blue economy policies in Portugal are generally linked to higher-level EU policies, such as the "Integrated Maritime Policy" (2007), the "Europe 2020" strategy (2010), and the "Blue Growth" agenda from 2012.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
	✘

3 Who is the author of the strategies?

In 2014, Portugal's ocean strategy was published by the Ministry of Agriculture and the Sea. The strategy underwent a public consultation process in which civil society has been involved.

4 What are the key goals of the strategies?

With “The National Ocean Strategy” (2014), Portugal should become one of the leading maritime nations in the world. Therefore, the strategy aims at valorizing the ocean and its related coastal areas by setting up sectoral and cross-sectoral projects. In this respect, the strategy seeks to increase economic growth and generate employment. More specifically, Portugal’s ocean economy should contribute up to 50 percent of the GDP by 2020.

5 What are the priority areas of the strategies?

The strategy (2014) identifies five strategic elements of interventions, three of which can be considered as bioeconomy-related, i.e. aquaculture, blue biotechnology and blue energy. The strategy considers both onshore and offshore aquaculture. Shellfish farming and the promotion of productivity-enhancing technologies should both contribute to developing the aquaculture industry in Portugal. With respect to marine biotechnology, the strategy intends to foster R&D and its application in the pharmaceutical, medical and cosmetic industry. Blue energy mainly relates to the development of algae cultures as feedstock for biofuels production.

The associated action plan strongly focuses on ocean research, exploitation and preservation. In particular, it seeks to create an enabling framework for national and international investment in all ocean economy-related sectors. It further concentrates on scientific and technological capacity development.

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Sweden

1 Which bioeconomy-related policy strategies exist?

In late 2012, the Swedish government introduced the bill on "Research and Innovation" (2012/13:30) which defines priority areas of Swedish research and innovation policies including biomass. The bill is based, among other things, on the "**Swedish Research and Innovation Strategy for a Biobased Economy**". At the same time, the strategy represents the government's research-oriented commitment to developing a Swedish bioeconomy.

2 Is the term "bioeconomy" or "biobased economy" used in the strategy documents?

Yes	No
✘	

The term bioeconomy is considered equivalent to biobased economy and refers to an economy based on the sustainable production of biomass and the creation of added value for biomass materials.

3 Who is the author of the strategies?

The "Swedish Research and Innovation Strategy for a Biobased Economy" (2012) was developed by the Swedish Research Council (Formas) in cooperation with the Swedish Governmental Agency for Innovation Systems (Vinnova) and the Swedish Energy Agency. Formas is mainly funded by the Ministry of Education and Research and acts as a research and advisory body.

4 What are the key goals of the strategies?

The Swedish research and innovation strategy (2012) aimed to identify research gaps and provide an analysis of Swedish prerequisites for bioeconomy development. The strategy targets a sustainable Swedish society which is based on raw materials and products from biomass. Bioeconomy should enable growth while reducing climate effects and the use of fossil raw materials.

5 What are the priority areas of the strategies?

In order to develop a bioeconomy in Sweden, the research and innovation strategy of 2012 identifies four strategic research areas which should be expanded in the future. It particularly highlights the central role of universities and research institutes in supporting appropriate research activities. Firstly, the strategy aims to replace fossil fuels by means of increased biomass production, while focusing, secondly, on the creation of smarter products by further refining biomass. The main emphasis is placed on efficient use of biomass by using by-products and waste products. Thirdly, research should also focus on how the consumption patterns of consumers and producers might change in the future. Fourthly, research should reflect policy instruments as well as the environmental and socio-economic consequences of increased biomass production. The strategy proposes several measures to foster Sweden's transition to a bioeconomy. The measures include promoting cross-industry collaboration on research and development, and supporting small and medium-sized companies with business development.

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West Nordic Countries

1 Which bioeconomy-related policy strategies exist?

The Nordic Council of Ministers has developed a bioeconomy strategy for the West Nordic countries, including Iceland, Greenland and the Faroe Islands. The document, **"Future Opportunities for Bioeconomy in the West Nordic Countries"**, was published in 2014. The Nordic Council of Ministers is composed of government representatives from Denmark, Finland, Iceland, Norway and Sweden. Greenland, the Faroe Islands and Åland are current autonomous member states of the Council. The Council was founded in 1971 as a forum for Nordic governmental cooperation.

Interestingly, the continental member states have already developed a national bioeconomy strategy or have committed to developing one. In contrast, the non-continental member states (Iceland, Greenland and the Faroe Islands) have decided to develop a macro-regional bioeconomy strategy because of the similarities in their economies. Marine bioresources represent the countries' competitive advantage and bioeconomy must also account for a large proportion of the countries' GDP.

The bioeconomy strategy of the West Nordic countries is related to previous Nordic initiatives. In 2014, Iceland initiated the NordBio program during its presidency of the Nordic Council of Ministers. Within the program, a group of national experts was set up to discuss Nordic projects related to bioeconomy. The aim of the group is to establish a Nordic Bioeconomy Panel in 2015 which will consist of the Nordic Council's member states and autonomous member states. One of the panel's priorities will be the creation of a Nordic Bioeconomy Strategy. In 2012, the Nordic Joint Committee for Agriculture and Food Research (NKJ) published the Nordic Bioeconomy Initiative which targeted the creation of a common Nordic policy platform. The initiative goes back in turn to the Nidaros Declaration (2012) of the Nordic Council of Ministers which addressed green growth including bioeconomy in the Nordic Region.

2 Is the term “bioeconomy” or “biobased economy” used in the strategy documents?

Yes	No
✘	

The definition of bioeconomy in the document emphasizes the cascaded use of biological resources, their by-products and waste in different sectors.

3 Who is the author of the strategies?

During its chairmanship of the Nordic Council of Ministers in 2014, Iceland took the lead in intensifying the council’s bioeconomy commitment. The Icelandic government initiated the NordBio program and also the bioeconomy strategy of the West Nordic countries which was finally published by Matís, an Icelandic state-owned advisory body.

4 What are the key goals of the strategies?

The bioeconomy strategy of the West Nordic countries aims at boosting green growth and creating added value through the sustainable use of natural resources. The strategy identifies opportunities for using underutilized local bioresources. By providing four main actions, the strategy document also intends to contribute to the political agenda of the region. Firstly, a West Nordic Bioeconomy Panel should be created, composed of academia, industry, economic actors, NGOs and policy institutions. The panel will act as an advisory body and identify key issues and opportunities for the region related to bioeconomy. Secondly, the strategy aims to establish an interdisciplinary center of excellence which focuses on issues relevant to the region, such as bioeconomy, socio-economic aspects, rural development and energy production. The center should further bundle existing local and national expertise and knowledge by creating a virtual knowledge network. Thirdly, the strategy paper targets the launch of the project “Arctic bioeconomy II – Biotechnology”. The project will focus on value creation by means of biotechnology and its applications. Fourthly, a program focusing on blue bioeconomy should be developed since marine bioresources represent the region’s unique feature. The intention is to enable the commercialization of marine bioresources by establishing a central marine raw materials biorefinery and demonstration plant, as well as strengthening the aquaculture industry.

5 What are the priority areas of the strategies?

In order to create added value, the strategy focuses on the fishing industry since it represents a large part of the region's GDP. Opportunities for value creation are seen in strengthening fish stocks and the aquaculture industry. Knowledge transfer from the Faroe Islands could contribute to promoting aquaculture activities in Iceland and Greenland. The strategy highlights the need for utilizing synergy effects from the fishing industry and biotechnology to create further added value. Biomass from fish waste and macro-algae will become increasingly important as biorefinery feedstock for producing energy carriers or chemicals.

Within the agricultural sector, the strategy highlights opportunities for value creation by means of expanded research on such subjects as soil conservation, grazing pressure and new crop variants. As the region faces harsh weather conditions, further efforts for adapting crops to the unique environment should be promoted. Therefore, the strategy recommends establishing a proper research center which will support efforts in this area. Further areas of interest in the strategy paper include the possibility of attracting young educated people by creating a center of excellence. Nature tourism based on ecosystem services will also provide opportunities for avoiding brain drain by creating new jobs.

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Summary and Conclusions

The analysis carried out for this report reveals that 45 countries worldwide, including the European Union, have issued policy strategies related to bioeconomy development. Among them, eight have defined comprehensive, dedicated bioeconomy strategies. Overall, most strategies have been worked out with a view to responding to the grand challenges of society and to balancing several, partly conflicting, key goals, such as achieving energy and food security, improving public health, combating climate change, conserving biodiversity, fostering economic growth and competitiveness. However, the political motivations, perspectives and priorities differ significantly between these countries and within regional zones. The following paragraphs summarize the commonalities, differences and specific features identified in the broad range of bioeconomy-related policy strategies explored by this study.

Political Motivation and Goals

The source of political motivation for promoting bioeconomy development varies according to a country's resource endowment, specialization and economic development track. Oil importing countries with huge biomass resources often strive for higher independence and seek to increase the added value of their biological resources. Industrializing countries with a significant share of rural population and primary industry jobs also consider bioeconomy development as a means of fostering rural development and social inclusion. Industrialized countries with fewer biological resources and a smaller share of primary industry jobs focus more on the opportunities arising from an industrialization of biology and on creating added value from the biosciences. Across most countries, bioeconomy development is motivated by meeting the grand societal challenges, such as climate change mitigation, food security and sustainable resources management. Besides these overarching international goals, modern bioeconomy should also contribute to conservation in the country and to improving the ecological balance of industrial production. With the exception of China, the emerging trend of mega-urbanization, and related questions such as food security, are hardly addressed.

Understanding and Definition of Bioeconomy

The terms "bioeconomy" or "biobased economy" are directly used in the government strategies of about 40 percent of the countries considered in this study. Only about one third of the strategy documents integrate an explicit definition of bioeconomy. This shows that the understanding of bioeconomy differs both in scope and in direction. Some governments see the biosciences as the basis of the bioeconomy and have a strong focus on the application of biotechnology in the health sector, for example the USA, India, South Africa and South Korea. Other strategies are more strongly related to the "traditional" bioeconomy, i.e. the primary industries. Bioeconomy is thus defined as encompassing agriculture, forestry and the marine economy and should result in new biomass value chains. This understanding prevails in countries such as Brazil, Canada, Finland and New Zealand. A third group of definitions has a stronger focus on emerging industries and high-tech development. This applies, for example, to the Netherlands, China, Malaysia, Thailand, Japan and Russia.

Policy Coherence and Sustainable Bioeconomy Development

More than half of the policy documents considered in this study pursue the aim of creating an enabling policy framework for bioeconomy development. These policy strategies seek to verify the usefulness of existing regulatory measures, adopt new regulations and generally to foster policy coherence. In this respect, more than half of the countries investigated have set up inter-ministerial working groups and policy advisory bodies. Overall, policy makers in industrialized and developing countries are increasingly applying a participatory, multi-stakeholder process to consider input from a broad knowledge base and to foster a society "buy-in". Some countries have established dedicated Bioeconomy Councils or Panels, which inform and advise on the strategy as well as the implementation process. The authors identified such councils in the EU, Denmark, Poland and Germany.

The sustainability element of bioeconomy is being considered particularly in the more recent

policy documents. For example, Indonesia, Brazil, Uruguay, Mexico, Mali and Mozambique mention the development and application of sustainability criteria to biomass production. Other countries highlight the monitoring and assessment of biomass supply and demand (Belgium), but also the impact measurement of bioeconomy development (Finland). However, the majority of strategy papers do not define how the contribution of bioeconomy to sustainable development (as defined in the goals of most strategies) would be measured. With the exception of the EU and its Bioeconomy Observatory, the policy strategies do not propose specific mechanisms or approaches to monitoring and managing conflicting goals, such as between food security and industrial development, or between intensification of biomass production and ecological sustainability.

Political Approaches

Worldwide, the authors have identified eight countries (including the European Union) with dedicated bioeconomy policy strategies. The governments adopt a holistic perspective and concentrate on leveraging the full potential of renewable biomass and bioinspired processes across all economic sectors. Dedicated bioeconomy strategies have been released in the European Union, Finland, Germany, Japan, Malaysia, the USA, South Africa and the West Nordic Countries.

The rest of the global bioeconomy policy landscape is rather “diverse” with different models of support for bioeconomy development. The study identifies different types of policy strategies with a significant impact on bioeconomy development. These relate to research and innovation strategies with a focus on bioeconomy issues, to green or blue economy strategies, bioenergy strategies and high-tech (biotechnology) strategies. The study further finds several holistic regional bioeconomy policy strategies, specifically in Australia (South Australia), Belgium (Flanders), Canada (British Colombia, Alberta, Ontario), Germany (Baden-Württemberg, North Rhine-Westphalia) and the United Kingdom (Scotland).

Economic Sector Focus

In terms of economic sector focus, the identified policies can be clustered in three broad groups. Countries rich in biomass, such as Brazil, Malaysia, Argentina, Finland, Mauritius, Norway, Thailand, Indonesia and New Zealand, concentrate on developing higher added value from their primary industries (agriculture, forestry, marine). Furthermore, a few countries also seek to benefit from the breadth of biological resources (biodiversity) by promoting bioprospecting and industrial applications. The research has identified such policies in South Africa, Colombia, Norway and Thailand. Countries still dealing with energy and food security issues aim more at becoming more self-sufficient by improving productivity and innovativeness in these sectors. Examples are Paraguay, Uganda, Kenya, Tanzania and Mozambique. A third group of countries, rather independent of their resource endowment, seeks to develop high-tech sectors and to stimulate emerging industries. The Netherlands, China, India, Australia, France, Germany, the UK and South Korea could be attributed to this group.

Biotechnology and Converging Technologies

Biotechnology is broadly considered a key enabling technology or one of the emerging technologies with a wide and high-value range of applications. Biotechnology is at the core of bioeconomy development. Among the countries explored, fifteen

have adopted a national biotechnology strategy. Whereas the G7 as well as China, India and Russia consider biotechnology as a crosscutting technology fostering innovations across many industry sectors, other countries focus more on its application in particular areas. Brazil, for example, focuses on agricultural and biofuel technologies. South Korea and Malaysia prioritize medical and chemical industry applications. Finland and Denmark concentrate on the industrial use of biotechnological processes, while Lithuania puts priority on environmental biotechnology. Paraguay has developed a national biotechnology strategy to foster agricultural and forestry innovations. Some countries exclusively promote marine biotechnology (Ireland, Norway, Portugal, Colombia, Mauritius).

Biobased Industries and Biorefining

The countries with a dedicated bioeconomy strategy generally promote the establishment of new biobased value chains and processes across all economic sectors (EU, Finland, Germany, Japan, Malaysia, South Africa, USA, Western Nordic Countries).

In the other countries, the agri-food industry plays a key role in bioeconomy-related policy strategies. On the one hand, countries seeking to become more self-sufficient, promote the introduction of modern food technologies and the development of food products that are adapted to local conditions and needs. Typical examples are: China, India, Indonesia, Namibia, Paraguay and Tanzania. On the other hand, many countries try to further increase the competitiveness and innovativeness of their established food industry, such as Argentina, Australia, Ireland, New Zealand, the Netherlands, the USA, Uruguay and Thailand.

The chemical industry (including plastics) and biorefining are further core elements of bioeconomy transformation. Argentina, Australia, Brazil, India, China, Russia, Thailand and many European countries (such as Austria, France, Lithuania, the Netherlands, Norway) have set priorities in the biobased chemistry and biorefining areas. Given the required geographical proximity of feedstock and refining, it is also a topic that seems very suited to regional bioeconomy development. The strategies for Flanders, Scotland and South Australia focus on biobased chemistry and biorefineries.

Another important industry sector for bioeconomy development is wood processing, specifically the pulp and paper industry. Innovative cellulosic products might provide new business opportunities for the struggling sector. Canada, Finland and other northern European countries have set priorities in this field.

In many countries, bioeconomy development is also strongly related to the health care sector, and biobased pharmaceuticals. This is specifically the case in India, Russia and South Korea. But also Austria, Ireland, Lithuania, Portugal and Norway identify pharmaceuticals as a priority area for bioeconomy development.

Renewable Energy and Bioenergy

Whereas bioenergy is considered as a field of industrial application in most bioeconomy-related strategies, about one third of the countries analyzed have adopted dedicated bioenergy development strategies. In this respect, the focus of most bioenergy strategies is on biofuels. Against the backdrop of the debate on goal conflicts between energy and food security, priority is increasingly given to R&D on non-food feedstock (see above) and on biotech innovations enabling 2nd and 3rd generation biofuels (Japan, Thailand, Denmark, Indonesia, West Nordic Countries, Portugal and India). Interestingly, bioenergy strategies hardly address the shortcomings in the traditional bioenergy sectors, such as firewood, and the huge health and ecological improvements that could be achieved by means of modern technologies and products.

Regardless of the existence of a dedicated bioenergy or biofuel policy strategy, the most common instruments for encouraging market development of biofuels are so called blending quotas and biofuel mandates. About 40 countries and the EU have adopted such regulations to enforce the use of biofuels in the transport sector[24]. Brazil is probably the country with the most holistic support for bio-

fuel development. It has a long history of promoting the development of sugar cane value chains, bioethanol and biodiesel R&D, the adoption of flexi-fuel cars, and the expansion of biofuel gasoline infrastructure. However, China, Malaysia, the USA, India and some African countries (Mozambique and Nigeria) also seek to encourage the production of bioethanol and/or diesel by implementing a mix of demand-side instruments, including tax and import tariff exemptions, purchase guarantees and/or fixed prices.

24 A complete overview of "Biofuel Mandates Around the World: 2015" is provided by the Biofuelsdigest.com http://www.biofuelsdigest.com/bdigest/2014/12/31/biofuels-mandates-around -the-world-2015

Political Intervention Focus

Research and Innovation

Countries with a dedicated bioeconomy strategy (e.g. South Africa, Malaysia, Japan, USA, EU) have additionally defined and implemented comprehensive research and innovation strategies. These include research support programs, upgrading of national bioeconomy R&D infrastructure (e.g. by establishing centers of excellence, databases or collections), promotion of interdisciplinary networks (e.g. through clusters, alliances), promotion of new business models (such as public-private partnerships), training and education measures, building of pilot and demonstration plants for biorefining and strengthening of international R&D collaboration. In this respect, the EU Horizon2020 program, for example, seeks to leverage national research and innovation strategies and to foster international research cooperation.

While basic and applied research on key enabling technologies is encouraged by almost all the countries in order to foster innovation in bioeconomy-related areas, some nations limit their support to research strategies. A prominent example is Australia. Ten of the countries featured in this study, have developed specific research and innovation strategies with a priority on bioeconomy-related areas, such as biobased industries, bioenergy, biosciences or agriculture/forestry/marine innovations. In these strategies, interdisciplinary cooperation between universities, research institutes and business plays an important role. Key research topics include new technologies on water treatment (Finland, the Netherlands), new bioeconomy value chains (Denmark), smart agriculture (Uruguay), transgenetic crops (India), biomedicines and drug discovery (Namibia), processing methods (Austria and New Zealand), and environmental (Lithuania) and marine biotechnology (Australia, South Korea, Denmark and Portugal).

Education and Training

One of the key concerns of almost all bioeconomy-related policy strategies is the development of expertise and institutional capacity. Bioeconomy is complex and involves interdisciplinary knowledge. While countries like Finland, France, Malaysia, Uruguay, Sri Lanka, Thailand and South Africa foster the training of experts, others, like Austria, Germany and South Korea, also promote stakeholder platforms and cross-sectoral alliances as the basis for interdisciplinary exchange. In India, France and the US, for example, specific measures related to the improvement of education in schools and universities are part of bioeconomy-related strategy documents. Some regional strategies, for example in Flanders or in Baden-Württemberg, have developed specific educational programs in bioeconomy.

Technology Transfer and Commercialization

Nearly all countries seek to achieve a higher rate of successful applications of scientific discoveries and findings. Fostering links between science and business should contribute to more successful adoption of research findings and to the development of interesting products, processes or market innovations. The promotion of public-private partnerships and innovation clusters (often related to pilot and demonstration plants) has gained popular-

ity especially among industrialized countries. Some emerging countries, like China and Malaysia, also initiate technology transfer via efforts to "win back" or involve their expatriate research community. With a view to fostering commercialization and market development, attracting private (also foreign) investment is a key concern of all country strategies. Tax incentives, business support and access to research capacities are among the proposed interventions. With regard to encouraging start-ups, the G7 countries and also Finland, Ireland, Colombia, Mexico, Uruguay, Kenya, Nigeria and Mali provide seed financing and investment support. Countries like Indonesia, Malaysia, Denmark and New Zealand also define measures targeting international marketing and market development. As part of these efforts, standards and certifications for biobased products are introduced, e.g. in South Korea, Malaysia, Norway and Indonesia.

Societal Change

Bioeconomy-related policy strategies not only focus on economic growth and job creation but also pursue the aim of social development (e.g. Colombia). Emerging countries like Brazil, Indonesia and South Africa put further emphasis on social inclusion and strengthening rural communities. Industrialized countries explicitly emphasize the transformation of society by establishing a "biobased society" (Norway) or a "sustainable society" (Sweden). In this respect, many policy strategies acknowledge that consumption choices and patterns need to change. However, most do not develop these issues further and remain limited to information and awareness campaigns (consumer education).

Resumé

Although the policy strategies identified in this study clearly relate to bioeconomy and sustainable development, the majority of them do not define and/or use the term "bioeconomy" itself. Where it is used, the definitions and scope of the bioeconomy concept vary. Under these circumstances and due to a lack of regional and global formalization of the concept of a biobased economy, it is not surprising that utilization of its full potential remains to be tapped. Nevertheless, during important multilateral negotiations and agreements in 2015, bioeconomy issues have and will be discussed, for example at the Global Forum for Food and Agriculture ("The growing demand for food, raw materials and energy"), the G 7 meeting ("Decarbonization", "Resource Efficiency", "Food Security", "Resistance to Antibiotics"), the G20 meeting, the Post-2015 Development Agenda (Sustainable Development Goals), the World Forestry Congress, the COP21 and the World Trade Organization ministerial conference. However, due to a lack of institutionalization and international coordination, it is not possible for bioeconomy to be strategically represented in an appropriate way in these multilateral policy processes and meetings.

The impact of national and regional bioeconomy strategies would be considerably increased if there were a move towards a global initiative.

The fact that many countries have already adopted strategies on bioeconomy, bioenergy, marine/agricultural/forestry innovations and biotechnology is encouraging. It is now time to connect and highlight the full potential of a more systematic and systemic use of biological resources. Bioeconomy can contribute significantly to achieving sustainable development, to adapting and mitigating climate change and to optimizing a circular economy. Such international political approaches fostering sustainable bioeconomy development could be discussed in the form of a Global Bioeconomy Platform.

Annex - Overview of Bioeconomy-related Policy Strategies around the World

	Country/ Region	Perspective	Bioeconomy Strategies	Strategy Goals	Priority Areas of the Strategy: Target Sectors	Priority Areas of the Strategy: Policy Interventions
Africa	Kenya	High-Tech	• National Bioprospecting Strategy (2011) • A National Biotechnology Development Policy (2006)	Economic growth Wealth creation Health, food and environmental security	Agriculture, health care	Promoting innovation Infrastructure Commercialization Demand-side instruments Policy framework conditions
	Mali	Bioenergy	• Stratégie Nationale de Développement des Biocarburants en Mali (2009) • Stratégie Nationale pour le Développement des Energies Renouvelables (2006)	Energy and food security Forest conservation Greening and modernizing the energy sector	Agriculture, energy	Promoting innovation Infrastructure Commercialization Demand-side instruments
	Mauritius	Blue Economy	• Ocean Economy (2013)	Economic growth Job creation Wealth creation	Fisheries, aquaculture, food, cosmetics, health care, marine services	Commercialization Policy framework conditions
	Mozambique	Bioenergy	• Politica e Estrategia de Biocombustiveis (2009)	Energy and food security Job creation Income generation Poverty reduction	Agriculture, energy	Promoting innovation Commercialization Policy framework conditions
	Namibia	Research & Innovation	• National Programme on Research, Science, Technology and Innovation (2015)	Socio-economic development Wealth creation Competitiveness Food, energy, health and water security Ecosystem management	Agriculture, energy, fisheries, health care	Promoting innovation Infrastructure Commercialization Demand-side instruments Policy framework conditions
	Nigeria	Bioenergy	• Biofuel Policy and Incentives (2007)	Substitution of fossil fuels Job creation Rural and agricultural development Technology transfer	Energy, agro-industrial and petroleum sector	Promoting innovation Commercialization Demand-side instruments Policy framework conditions
	Senegal	Bioenergy	• Lettre de Politique de Développement du Secteur de L'Energie (2008, 2012) • National Biofuels Strategy (2006)	Energy security Wealth creation	Energy, agro-industry	Infrastructure Commercialization
	South Africa	Holistic Bioeconomy Development	• The Bio-Economy Strategy (2013)	Economic growth Food security Job creation Competitiveness	Agriculture, chemicals, health care	Promoting innovation Infrastructure Commercialization
	Tanzania	High-Tech	• National Biotechnology Policy (2010)	Economic growth Poverty reduction Food security	Agriculture, health care	Promoting innovation Infrastructure Commercialization Policy framework conditions
	Tunisia		• A national biotechnology strategy is under development.			

	Country/ Region	Perspective	Bioeconomy Strategies	Strategy Goals	Priority Areas of the Strategy: Target Sectors	Priority Areas of the Strategy: Policy Interventions
Africa	Uganda	Bioenergy High-Tech	• Biomass Energy Strategy Uganda (2014) • National Biotechnology and Biosafety Policy (2008) • The Renewable Energy Policy For Uganda (2007)	Energy, health and food security Competitiveness Economic growth Poverty reduction Environmental conservation	Agriculture, agro-industry, health care	Promoting innovation Infrastructure Commercialization Demand-side instruments Policy framework conditions
Americas	Argentina	Research & Innovation	• Argentina Innovadora 2020 (2012)	Competitiveness Quality of life	Forestry, marine sector, horticulture, agro-industry, chemicals	Promoting innovation
	Brazil	High-Tech Bioenergy Green Economy	• Plano Decenal de Expansão de Energia 2023 (2014) • PAISS (2012) • Biotechnology Strategy (2007)	Economic growth Energy, food and health security Rural development Income generation Competitiveness	Energy, health care	Promoting innovation Infrastructure Commercialization Demand-side instruments
	Canada	High-Tech Biobased Economy Regional bioeconomy development	• Growing Forward 2 (biomass) (2013) • The Canadian Biotechnology Strategy (CBS) (2005) • British Columbia Bio-Economy (2011) • BioEconomy Alberta Network • Ontario Bioproduct Strategy (2004)	See G7 Report (German Bioeconomy Council, 2015)		
	Colombia	High-Tech	• Politica para el Desarrollo Commercial de la Biotecnología a partir del Uso Sostenible de la Biodiversidad (2011)	Economic growth Increasing domestic production Competitiveness	Energy, agro-industry, cosmetics, health care	Promoting innovation Commercialization Policy framework conditions
	Mexico	Bioenergy	• Proyecto de Bioeconomia (2010) • Estrategia Intersecretarial de los Bioenergéticos (2009)	Food and energy security Reducing environmental pollution Job creation Rural development	Energy, agro-industry	Promoting innovation Infrastructure Commercialization Demand-side instruments
	Paraguay	High-Tech	• Politica y Programa Nacional de Biotecnología Agroprecuaria y Forestal del Parauay (2011)	Grand societal challenges Rural development Poverty reduction Competiveness Food security	Agriculture, forestry	Promoting innovation Infrastructure Commercialization Demand-side instruments
	Uruguay	High-Tech	• Plan Sectorial de Biotechnología 2011–2020 (2012) • Uruguay Agro Inteligente 2010–2015 (2010)	Environmental conservation Social inclusion Economic growth Competitiveness	Agriculture	Promoting innovation Infrastructure Commercialization Demand-side instruments Policy framework conditions
	USA	Holistic Bioeconomy Development	• Farm Bill (2014) • National Blueprint Bioeconomy (2012)	See G7 Report (German Bioeconomy Council, 2015)		

Annex

Asia/Pacific

Country/ Region	Pers- pective	Bioeconomy Strategies	Strategy Goals	Priority Areas of the Strategy: Target Sectors	Priority Areas of the Strategy: Policy Interventions
Australia	High-Tech Reseach & Innovation Blue Economy Regional Bioecono- my Devel- opment	• National Marine Science Plan (2015–2025) • National Collaborative Research Infrastruc- ture Strategy (2013) • Opportunities for Primary Industries in the Bioenergy Sector: National Research, De- velopment and Exten- sion Strategy (2011) + Workplan (2014) • Strategic Roadmap for Australian Research Infrastructure (2011) • Building a Bioeconomy in South Australia (2011–2015)	Grand societal challenges Competitiveness Market development Sustainable blue growth	Energy, agriculture, marine sector, health care	Promoting innovation Infrastructure Commercialization Policy framework conditions
China	High-Tech Reseach & Innovation	• Bioindustry Develop- ment Plan (2012) • 12th Five-year Plan (2011–2015) on Agri- cultural Science and Technology Develop- ment (2012) • 12th Five-year Plan for National Strategic Emerging Industries (2012)	Food, health and energy security Sustainable growth Job creation Competitiveness Smart urbanization	Agriculture, energy, chemi- cals, health care	Promoting innovation Infrastructure Commercialization
India	High-Tech	• National Biotechnology Development Strategy (Biotech Strategy II) (2007, 2014)	Economic growth Competitiveness Food security	Agriculture, forestry, energy, health care	Promoting innovation Infrastructure Commercialization
Indonesia	Bioenergy Biobased Economy Research & Innovation	• Grand Agricultural Strategy (2015) • National Energy Policy (2014)	Economic growth Energy, health and food security Inclusive development Ecologic sustainability	Energy, agro-industry	Promoting innovation Infrastructure Commercialization Demand-side instruments
Japan	Holistic Bioecono- my Devel- opment	• Biomass Industrializa- tion Strategy (2012) • Biomass Strategy (2009)	See G7 Report (German Bioeconomy Council, 2015)		
Malaysia	Holistic Bioecono- my Devel- opment	• National Biomass Strategy (2nd version) (2013) • Bioeconomy Transfor- mation Programme (2012) • National Biomass Strategy 2020: New Wealth Creation for Malaysia's Palm Oil Industry (2011) • National Biotechnology Policy (2005–2020)	Economic growth Competitiveness	Agriculture, for- estry, fisheries, energy, chemicals	Promoting innovation Infrastructure Commercialization Demand-side instruments Policy framework conditions

	Country/ Region	Perspective	Bioeconomy Strategies	Strategy Goals	Priority Areas of the Strategy: Target Sectors	Priority Areas of the Strategy: Policy Interventions
Asia/Pacific	New Zealand	Bioenergy Biobased Economy Research & Innovation	• Biological Industries Research Fund (2013) • Business Growth Agenda (2012) • Bioenergy Strategy (2010)	Competitiveness Grand societal challenges	Agriculture, forestry, energy, agro-industry	Promoting innovation Infrastructure Commercialization
	Russia	High-Tech	• Comprehensive Program for the Development of Biotechnology in Russia by 2020 (2012) + Roadmap (2013)	Competitiveness Job creation Rural development Food and health security	Forestry, marine sector, energy, agro-industry, health care	Promoting innovation Infrastructure Commercialization
	South Korea	High-Tech	• 3rd Basic Plan for Science and Technology (2013) • Strategy for promotion of industrial biotechnology (2012) • Blue-Bio 2016 Plan (2008) • 2nd Framework Plan for Promotion of Biotechnology, Bio-Vision 2016 (2006)	Sustainable economic growth Health security Competitiveness	Energy, marine sector, chemicals, health care	Promoting innovation Infrastructure Commercialization Demand-side instruments
	Sri Lanka	High-Tech	• National Biotechnology Policy (2010)	Health and food security Competitiveness Clean environment Socio-economic development	Agriculture, energy, agro-industry, health care	Promoting innovation Infrastructure Commercialization Demand-side instruments Policy framework conditions
	Thailand	High-Tech Bioenergy	• National Biotechnology Policy Framework (2004–2011; 2012–2021) • Alternative Energies Development Plan 2012–2021 • BioPlastics Roadmap (2008)	Health, energy and environmental security Competitiveness Wealth creation Lifelong learning Green growth	Agriculture, energy, agro-industry, chemicals incl. bioplastics, health care	Promoting innovation Infrastructure Commercialization
	Turkey		• A national bioeconomy strategy is under development – no further information			
Europe	Austria	Research & innovation	• Research, Technology and Innovation Strategy for Biobased Industries in Austria (2014) • Policy Paper on Bioeconomy (2013) • A status-quo-report on bioeconomy-related FTI activities was published in 2015, which serves as a basis for the elaboration of a holistic FTI-strategy on bioeconomy.	Reducing import dependency Competitiveness	Agro-industry, chemicals, timber industry, health care	Promoting innovation Commercialization Demand-side instruments

Annex

	Country/ Region	Perspective	Bioeconomy Strategies	Strategy Goals	Priority Areas of the Strategy: Target Sectors	Priority Areas of the Strategy: Policy Interventions
Europe	Baltic Sea Region		• EU Strategy for the Baltic Sea Region (EUSBSR)“ (2009) and Action Plan incl. Bioeconomy (2015) • Bioeconomy Development is lead by the Nordic Council of Ministers, e.g. Study on the potential of bioeconomy for the region: A Bioeconomy for the Baltic Sea Region (2014).			
	Belgium	Regional Bioeconomy Development	• Bioeconomy in Flanders (2014) + Action Plan	Economic growth Competitiveness Job creation Circular economy	Agriculture, forestry, fisheries, energy, agro-industry, chemicals	Promoting innovation Infrastructure Commercialization Demand-side instruments Policy framework conditions
	Denmark	Green Economy	• Growth Plan for Water, Bio and Environmental Solutions (2013) • Growth Plan for Food (2013)	Economic growth Job creation Competitiveness Resource efficiency Grand societal challenges	Energy, agro-industry, cosmetics, chemicals, health care	Promoting innovation Commercialization
	Estonia		• A dedicated bioeconomy strategy is under development.			
	European Union	Holistic Bioeconomy Development	• Innovating for Sustainable Growth: A Bioeconomy for Europe (2012)	See G7 Report (German Bioeconomy Council, 2015)		
	Finland	Holistic Bioeconomy Development	• The Finnish Bioeconomy Strategy (2014)	Economic growth Job creation Competitiveness Wealth creation	Forestry, wood processing sector, health care	Promoting innovation Infrastructure Commercialization Policy framework conditions
	France	High-Tech Biobased Economy	• The new face of industry (2014) • Les usages non alimentaires de la biomasse (2012) • Investissement Avenir (2010) • A dedicated bioeconomy strategy is under development (expected end 2015).	See G7 Report (German Bioeconomy Council, 2015)		

Europe

Country/ Region	Perspective	Bioeconomy Strategies	Strategy Goals	Priority Areas of the Strategy: Target Sectors	Priority Areas of the Strategy: Policy Interventions
Germany	Holistic Bioeconomy Development Research & Innovation Regional Bioeconomy Development	• National policy strategy bioeconomy (2014) • The Bioeconomy Strategy of the state NRW (2013) • Bioeconomy – Baden Würtemberg's path towards a sustainable future (2013) • National research strategy bioeconomy 2030 (2010)	See G7 Report (German Bioeconomy Council, 2015)		
Great Britain	High-Tech Bioenergy Research & Innovation Regional Bioeconomy Development	• Eight bioscience research institutes have founded the National Institutes of Bioscience NIB (2015) • The Biorefinery Roadmap for Scotland (2015) • Agri-Tech Strategy (2014) • UK Bioenergy Strategy (2012) • UK Cross-Government Food Research and Innovation Strategy (2010)	See G7 Report (German Bioeconomy Council, 2015)		
Ireland	Research & Innovation Green Economy Blue Economy	• Harnessing Our Ocean Wealth (2012) • Delivering our Green Potential (2012) • Towards 2030 (2008) • In preparation of a bioeconomy strategy, the Task Force 2014 elaborates a potential analysis of the bioeconomy and an action plan.	Econmic growth Job creation Competitiveness Rural development Grand societal challenges	Forestry, fisheries, marine sector, agro-industry, health care	Promoting innovation Infrastructure Commercialization
Italy		• A dedicated bioeconomy strategy is under development.	See G7 Report (German Bioeconomy Council, 2015)		
Lithuania	High-Tech	• National Industrial Biotechnology Development Programme (2007–2010)	Economic growth Competitiveness Grand societal challenges	Energy, chemicals incl. bioplastics, health care	Promoting innovation Infrastructure Commercialization
Netherlands	Green Economy Biobased Economy	• Groene Groei: voor een sterke, duurzame economie (2013) • Groene Groei – Van Biomassa naar business (2012) • Framework memorandum on the Biobased Economy (2012) • Green Deal Program (2011)	Economic growth Job creation Income generation Grand societal challenges	Energy, chemicals	Promoting innovation Commercialization Policy framework conditions

Annex

	Country/ Region	Pers- pective	Bioeconomy Strategies	Strategy Goals	Priority Areas of the Strategy: Target Sectors	Priority Areas of the Strategy: Policy Interventions
Europe	Norway	Research & Innovation High-Tech	• Research Programme on Sustainable Innovation in Food and Bio-based Industries (2012–2022) • National strategy for biotechnology (2011) • Marine Bioprospecting – a source of new and sustainable wealth growth (2009) • Merger of the major bioeconomy-related research institutes into the Norwegian Institute of Bioeconomy Research NIBIO (2015) • A dedicated bioeconomy strategy is under development (expected end 2015)	Establishing a "Biobased society" Competitiveness Economic growth Job creation Grand societal challenges	Agriculture, forestry, energy aquaculture, agro-industry, health care	Promoting innovation Infrastructure Commercialization Demand-side instruments Policy framework conditions
	Poland		• A national bioeconomy panel was established in 2014.			
	Portugal	Blue Economy	• Estratégía Nacional para o Mar (2013–2020)	Ocean valorization Economic growth Job creation	Aquaculture, energy, cosmetics, health care	Promoting innovation Infrastructure Commercialization
	Spain		• A dedicated bioeconomy strategy is under development (expected in October 2015).			
	Sweden	Research & Innovation	• Swedish Research and Innovation Strategy for a Bio-based Economy (2012)	Econmic growth Grand societal challenges Sustainable society	Biobased industries	Promoting innovation Infrastructure Commercialization Demand-side instruments Policy framework conditions
	West Nordic Countries (Iceland, Greenland, Faroe)	Holistic Bioeconomy Development	• Future Opportunities for Bioeconomy in the West Nordic Countries (2014) • Iceland and Faroe Islands have committed to develop a national bioeconomy strategy	Economic growth Competitiveness Grand societal challenges	Agriculture, fisheries, energy, aquaculture	Promoting Innovation Infrastructure Commercialization Policy framework conditions

About the Bioeconomy Council

In 2009, the German Federal Ministry of Education and Research (BMBF) and the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) established the Bioeconomy Council as an independent advisory committee to the German Federal Government. In 2012, the Council has been newly nominated for a second four-year term. The 17 members represent industry, society and science and their expertise covers the full spectrum of the bioeconomy value chain. The Council is mainly tasked with providing advice on how to foster the development of a sustainable bioeconomy in Germany and in a global context. For this purpose it engages in political and scientific dialogue, publishes position statements and promotes the future vision of the bioeconomy to broader society. The activities of the council are oriented both towards long-term objectives as well as day-to-day policy requirements. Documents download and further information in English is available under www.bioekonomierat.de/english.html

About this report

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