



---

# Bioeconomy Policy (Part III) Update Report of National Strategies around the World

**A report from the German Bioeconomy Council**



---

**Bioeconomy Policy (Part III)**  
**Update Report of National**  
**Strategies around the World**

**A report from the German Bioeconomy Council**

# Content

---

<b>Preface</b> .....	7
----------------------	---

---

<b>Introduction</b> .....	8
Understanding of Bioeconomy .....	9
Aim: A Living Document .....	9
Methodology .....	10

---

<b>Overview &amp; Emerging Policy Initiatives</b> .....	12
Overview .....	13
Macro-regional Policy Initiatives .....	13
Sub-regional Development .....	14
Industry-driven Initiatives .....	15

---

<b>Trending: Good Governance in the Bioeconomy</b> .....	16
Good Governance Principles .....	17
Accountability .....	17
Transparency .....	18
Participation in Strategy Formulation .....	19
Policy Coherence & Effectiveness .....	19
Fairness .....	20

---

---

<b>Update: Bioeconomy Policies around the World</b> .....	<b>22</b>
Africa .....	22
Americas .....	24
Argentina .....	26
Brazil .....	32
Canada .....	38
USA .....	42
Asia/Pacific .....	48
Australia .....	52
China .....	56
New Zealand .....	62
Thailand .....	66
Europe .....	72
France .....	76
Italy .....	82
Latvia .....	88
Norway .....	92
Spain .....	96
United Kingdom .....	102

---

<b>Summary &amp; Conclusions</b> .....	<b>108</b>
Understanding & Definition of Bioeconomy .....	109
The Regional Dimension of Bioeconomy .....	110
Bioeconomy & Innovation Agendas .....	110
Practical & Proposed Policy Measures .....	111
Resumé .....	115

---

<b>Annex</b> .....	<b>118</b>
--------------------	------------

---



## Preface

This report provides good news: bioeconomy has gained further momentum globally. At the beginning of 2018, almost 50 countries were pursuing bioeconomy development in their policy strategies. In the past two years, seven more countries have adopted dedicated bioeconomy policy strategies, mostly in Europe. In many countries, sub-regional bioeconomy strategies and policies have been developed to create synergies from local specialization. There has also been a notable increase in macro-regional and cross-border initiatives. A growing diversity of strategies is noted among the globally spreading bioeconomy. This dynamic development of bioeconomy has not been restricted to government policy-making. It is also reflected in the growing number of bioeconomy-related initiatives promoted by societal stakeholders, specifically research and business networks and NGOs.

In 2015, the international community adopted the UN Sustainable Development Goals and the comprehensive Paris Agreement on climate change (COP21). The G7 group of the leading industrialized countries further committed to becoming carbon-neutral by 2050. It was a landmark year for bioeconomy policy, too. In November 2015, we organized the first Global Bioeconomy Summit in Berlin to discuss how bioeconomy would contribute to achieving sustainable development and the Agenda 2030.

We, the chairs of the German Bioeconomy Council, see opportunities for bioeconomy to help reconcile humanity with nature and facilitate innovation in industries while generating promising employment

opportunities. Bioeconomy provides unique features and advantages, such as its contribution to ecosystem regeneration and the development of an economy based on renewability, carbon-neutrality, re-usability and multi-functionality. Nevertheless, the transition towards sustainable bioeconomy requires policy coordination and international collaboration in science.

In preparation for the second Global Bioeconomy Summit, to be held in Berlin on 19<sup>th</sup>–20<sup>th</sup> April 2018, the German Bioeconomy Council, organizer of the Summit, commissioned this update report on bioeconomy policy strategies around the world. Our experience from the two previous reports on national bioeconomy policy strategies from 2015 has shown that the demand for strategic dialogue on bioeconomy policies is immense. The report provides an overview of recent activities and emerging trends in bioeconomy policy-making globally, including a special chapter on governance. We hope this update, along with the previous reports, will stimulate international discussions and transnational learning as well as strategic cooperation among stakeholders.

Berlin, 9<sup>th</sup> April 2018



Prof. Dr. Joachim von Braun    Prof. Dr. Christine Lang  
*Chairs of the Bioeconomy Council*



# Introduction

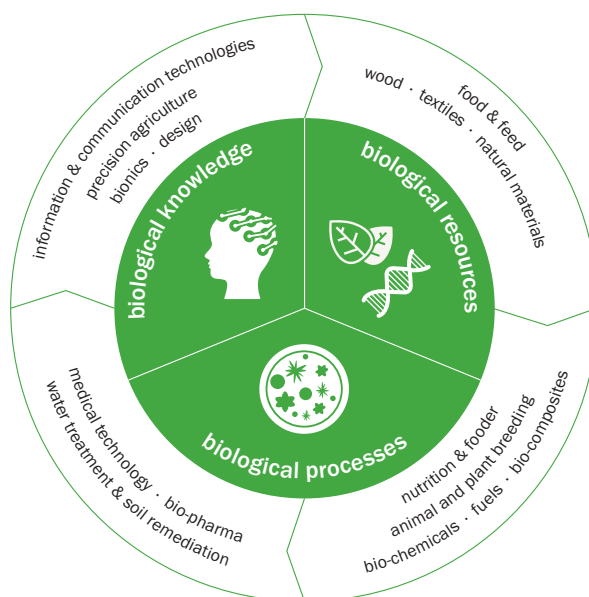
This study was conducted in preparation for the Global Bioeconomy Summit 2018. It presents an update of two previous reports on national bioeconomy policy strategies<sup>1,2</sup> assembled by the Secretariat of the German Bioeconomy Council. Since holding the first Global Bioeconomy Summit

in 2015, bioeconomy policy has gained further momentum globally. This report provides an overview of the latest policy documents and emerging trends and initiatives in bioeconomy policy.



## Understanding of Bioeconomy

Policy strategies and initiatives commonly refer to the terms bioeconomy, bioindustry or biobased economy. There is no common definition for the political concept of bioeconomy; furthermore, it is evolving over time. For the purpose of this report, bioeconomy has been defined in line with the Communiqué of the GBS2015 as “the knowledge-based production and utilization of biological resources, innovative biological processes and principles to sustainably provide goods and services across all economic sectors”<sup>3</sup>. The bioeconomy therefore encompasses the traditional bioeconomy sectors, such as agriculture, forestry, fisheries and aquaculture, as well as related processing and service industries, such as food, paper, textiles, building and construction, chemistry and bio-pharma. Key enabling and converging technologies, such as bio-, nano- and information technologies, are vitally important to the knowledge-based bioeconomy which uses biobased processes and principles in engineering and across industrial applications.



**The bioeconomy encompasses all sectors<sup>4</sup> of the economy.**

Source: German Bioeconomy Council (2016)

## Aim: A Living Document

By updating the previous reports, this edition aims to account for recent developments and emerging initiatives in the bioeconomy. The report is intended to provide a basis for international discussions on bioeconomy development among key stakeholders, such as policy makers, businesses, research communities and representatives from civil society. The authors hope the reports on bioeconomy policy will support the exchange of experience, transnational learning and strategic cooperation among stakeholders.

In a special chapter on good governance, the updated report particularly addresses the role of governments in promoting the transition to a sustainable bioeconomy. It further analyzes the broad bundle

of policy support measures proposed in recent bioeconomy(-related) policy strategies. However, the study is based on desk research only and can judge neither the degree to which the strategies are implemented 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. The authors therefore explicitly invite readers to provide feedback on the information provided in the report, which is considered a living document. Any suggestions, revisions or additional materials may be sent to [office@bioeconomycouncil.org](mailto:office@bioeconomycouncil.org).

## Methodology

The methodology of this study relies on Internet-based desk research which considers officially adopted policy strategies and roadmaps in the period from December 2015 to February 2018. The report's findings are based on publicly available government documents, such as publications from ministries, government agencies and affiliated councils, and research institutions. Secondary literature, e.g. from international organizations and networks, has been used to cross-check and complement background information. The list of references used is attached at the end of each chapter. In the absence of a holistic, dedicated bioeconomy strategy, the authors searched for policy strategies with a strong link to bioeconomy development. These mainly refer to research and innovation strategies or to emerging (bio)industry strategies. The authors also considered regional government strategies and macro-regional policy strategies on bioeconomy development.

Policy strategy documents are typically characterized by providing a medium- to long-term vision of bioeconomy development. In addition to considering the scope and the goals of bioeconomy strategies, the update report explores the key priorities as well as the qualitative and quantitative targets

involved. It further points out to what extent policy goals are translated into concrete measures and action plans. Comprehensive approaches to promoting bioeconomy development usually include a bundle of measures addressing the supply-side and demand-side of the economy<sup>5</sup>. On the supply-side, measures can be attributed to the categories of “promoting science, technology and innovation”; “infrastructure development”; “capacity building and education”; and “supporting commercialization”. Demand-side measures mostly relate to information campaigns and awareness building as well as to market stimulation by public lead-buyers and tax policies. Regulatory measures for improving the “framework conditions” can address the supply-side and the demand-side. Governments also increasingly propose measures to ensure “good governance”, which is why the authors added a special chapter on them, and also to support “international collaboration” in the bioeconomy.

At the end of each country profile, a table summarizes the policy measures for promoting bioeconomy development which are proposed in the strategy documents. In addition, an overview of all the measures identified in this report is presented in the table in Annex 1.

---

## REFERENCES

- 1 German Bioeconomy Council. (2015). Bioeconomy Policy (Part I): Synopsis and Analysis of Strategies in the G7. Available at [http://bioekonomierat.de/fileadmin/Publikationen/berichte/BOER\\_Laenderstudie\\_1\\_.pdf](http://bioekonomierat.de/fileadmin/Publikationen/berichte/BOER_Laenderstudie_1_.pdf) [06.03.18].
- 2 German Bioeconomy Council. (2015). Bioeconomy Policy (Part II): Synopsis of National Strategies around the World. Available at [http://bioekonomierat.de/fileadmin/Publikationen/berichte/Bioeconomy-Policy\\_Part-II.pdf](http://bioekonomierat.de/fileadmin/Publikationen/berichte/Bioeconomy-Policy_Part-II.pdf) [06.03.18].
- 3 International Advisory Council of the Global Bioeconomy Summit 2015. (2015). Communiqué. Available at [http://gbs2015.com/fileadmin/gbs2015/Downloads/Communique\\_final.pdf](http://gbs2015.com/fileadmin/gbs2015/Downloads/Communique_final.pdf) [27.02.18].
- 4 The products and sectors listed are for illustration purposes only and are not exhaustive.
- 5 Kahlenborn, W., Mewes, H., Knopf, J. et al. (2013). Treiber und Hemmnisse für die Transformation der deutschen Wirtschaft zu einer „Green Economy“. Available at <https://www.adelphi.de/de/publikation/treiber-und-hemmnisse-für-die-transformation-der-deutschen-wirtschaft-zu-einer-green> [09.03.18].





---

# Overview & Emerging Policy Initiatives

## Overview

The analysis indicates that the global upward trend in the development of bioeconomy policy has continued since 2015. In fact, more and more countries are deciding to develop holistic national bioeconomy strategies rather than strategies related to specific policy areas. Since 2015, governments in France, Italy, Latvia, Norway, Spain, Thailand, and in March 2018 also in Ireland have issued dedicated bioeconomy strategies. Taking this into account, 49 countries worldwide have now created policy strategies related to bioeconomy development, 15 of which, including the European Union and the West Nordic Countries, have developed dedicated bioeconomy policy strategies – with the trend rising. To the knowledge of the authors, Austria, Brazil, Colombia, Ecuador, Estonia, Iceland, Japan and the United Kingdom are in the process of preparing dedicated bioeconomy strategies and others, like Namibia, have indicated that they are preparing related strategies, i.e. with the focus on biotechnology development. Iran, Kenya and Namibia further have tasked Science, Technology and Innovation Committees working on bioeconomy policy. The bioeconomy is further receiving more and more attention at regional level.

In line with this development, the term bioeconomy has become more mainstream in policy papers and strategies globally. In general, bioeconomy strategies issued since 2015 seek to achieve the Sustainable Development Goals, with green growth as a key goal. Consequently, many documents refer to the “sustainable bioeconomy”. The definitions and the understanding of bioeconomy, however, still vary in

scope and focus. In parallel, new terms and concepts are emerging. In Finland and in Canada, for example, the concept of the (sustainable) “forest-based bioeconomy” has been defined. In the European Union, the bioeconomy has become closely linked with the circular economy concept. Many of the recent bioeconomy policy papers from European member states highlight the contribution of bioeconomy to circular economy approaches. Bioeconomy policy papers in anglo-saxon countries (like the UK, the USA and also New Zealand) but also in China relate more strongly to concepts of hightech innovation, such as synthetic biology, digitization and advanced manufacturing. In this regard, the term “industrialization of biology” has been coined, for example, in the United States. The UK has issued a “synthetic biology strategy” and in Germany terms like the “biologization of economy” or “biological transformation of industry” are emerging in policy papers.

The dynamic development of bioeconomy, however, is not restricted to national policy making. It is also reflected in the increasing number of bioeconomy-related initiatives promoted by public and private stakeholders, such as industry and research clusters. In some countries, stakeholders from business and industry are leading the promotion of bioeconomy development and strongly promote their country’s vision of bioeconomy. The following paragraphs address these emerging policy initiatives and show the extent to which bioeconomy has gained importance around the globe.

---

## Macro-regional Policy Initiatives

Besides national authorities, there is an increasing number of regions active in bioeconomy policy. In particular, macro-regional policy approaches have emerged among neighboring countries with similarities in their resource endowment and economic conditions. A substantial macro-regional initiative for bioeconomy development is, for example, underway in Eastern Africa supported by the Bioresources Innovations Network for Eastern Africa Development (Bio-

Innovate Africa). The program focuses on promoting bioinnovation policies that enable technology transfer and business development in Burundi, Ethiopia, Kenya, Rwanda, Tanzania and Uganda. The program is supported by the Swedish Development Agency (Sida).<sup>6</sup> In Latin America and the Caribbean, the regional commission of the United Nations (UN ECLAC) has organized macro-regional events on bioeconomy, which are intended to foster exchange on policy mak-

ing and successful private sector and research initiatives. By doing so, ECLAC strives to coordinate the various campaigns and initiatives already existing and to further develop joint bioeconomy policies and programs.<sup>7</sup> Coordination and collaboration among the leading bioeconomy countries, Argentina and Brazil have been initiated already before 2015 in the so called “Southern Cone Initiative” which included Uruguay and Paraguay.

As part of the European Union’s Cohesion Policy reform, European regions are encouraged to build on their comparative advantages and foster smart, sustainable and integrated economic growth with the help of the European Structural Investment Funds (ESIF).<sup>8</sup> Overall, the Funds make more than EUR 450 billion (around USD 550 billion) available for the period 2014-2020.<sup>9</sup> ESIF envisages providing financial support for macro-regional initiatives, such as the Central and Eastern European Bioregions Forum. The forum was established as a follow-up to the European Bioeconomy Congress 2016 in Lodz, where Central and Eastern European Regions and stakeholders from business, academia and civil society published the Lodz Declaration of Bioregions. The declaration presents a strategic document for bioeconomy development in local “biocommunities”, including biovillages, biocities and bioregions.<sup>10</sup> To date, regions from Poland (including Lodzkie, Mazowieckie, Pomorskie, Dolnośląskie, Małopolskie

and Wielkopolskie) and the Ukraine (including Win-nica) have already signed as members. Other regions from the Czech Republic, Slovakia, Hungary, Romania, Eastern Germany, the Ukraine, Finland and Belarus have been invited to join the forum.<sup>11</sup> The Central-Eastern European Initiative for Knowledge-based Agriculture, Aquaculture and Forestry in the Bioeconomy (BIOEAST) is further promoting a strategic vision for bioeconomy development in Eastern Europe, including countries like the Czech Republic, Hungary, Poland, Slovakia and Estonia, as well as in South East European countries like Bulgaria, Romania, Slovenia and Croatia.<sup>12</sup> In this macro-region, another initiative, the Danube-INCO.Net project, promotes the development of a macro-regional research, technology and innovation (RTI) strategy. The initial outcome of several strategy workshops and open innovation events was the publication of recommendations for the development of a Danube RTI-bioeconomy strategy in 2017.<sup>13</sup> In Northern Europe, the Nordic Countries (including Denmark, Finland, Norway, Sweden, the Faroe Islands, Greenland and Iceland) are currently developing a common Nordic bioeconomy strategy. It will build on experience already gained in a variety of sectors and will promote further cooperation on bioeconomy in all the Nordic countries.<sup>14</sup> Also in the Baltic Sea Region macro-regional bioeconomy cooperation is fostered. Informal policy dialogue is, for example, promoted by the Baltic Sea Region Bioeconomy Council.

---

## Sub-regional Development

Sub-regional bioeconomy strategies are developed in Argentina, Australia, Canada and in many European Union member states. The regional authorities primarily intend to create an appropriate policy framework for bioeconomy development, considering local specialization, challenges and opportunities. Especially in rural areas with a significant primary production sector, bioeconomy is expected to increase the value-added from local bioresources, to create jobs and increase income. Within the funding framework of ESIF, several sub-regions in the European Union have

also started to link bioeconomy development with their Research and Innovation Strategies for Smart Specialization (RIS3). They include, for example, the Central Hungarian region, Crete (Greece), Extremadura, Galicia and the Basque country (Spain), Haute de France (France), Lapland (Finland), Lodzkie (Poland), North Denmark, Norte (Portugal), Olomouc and South Bohemia (Czech Republic), Upper Austria, Värmland and Skåne (Sweden), Weser-Ems (Germany), West Romania, and Emilia Romagna (Italy).<sup>15</sup>

## Industry-driven Initiatives

Since 2015, more private stakeholders have become active in bioeconomy policy. This is the case in Japan, for example. The Japan Bioindustry Association (JPA) developed a Vision Document for the Japanese biobased industry. The Japanese bioindustry comprises the health and medical sector, environmental technologies, agriculture, fisheries and food processing. Key innovations are expected from advances in genome editing and synthetic biology. The JPA estimates that the future bioeconomy will contribute JPY 15 to 25 billion (around USD 142–237 million) to the GDP in 2030.<sup>16</sup>

Also in India, bioindustry associations are promoting bioeconomy development. In 2016, the Association of Biotechnology-Led Enterprises (ABLE) published an opportunity report, highlighting the economic growth potential of the Indian biotechnology industry. The report points out that the value of the Indian bioeconomy may amount to USD 100 billion by

2025.<sup>17</sup> ABLE also organized the first Indian bioeconomy conference (Bioeconomy Conclave) in 2016. Its aim was to bring together bioeconomy stakeholders from research, technology and business to discuss biotechnology's potential to create a sustainable bioeconomy in India.<sup>18</sup>

In Europe, the Bio-Based Industries Joint Undertaking (BBI JU), a EUR 3.7 billion-backed public-private partnership (around USD 4.5 billion), is taking a leading role in promoting bioeconomy development. Its focus is on fostering sustainable biomass and its efficient conversion into high-value biobased products. It supports the market development of biobased products and services and seeks to create bioeconomy-friendly policy framework conditions.<sup>19</sup> In December 2017, the Bio-based Industries Consortium (BIC) published the first overview of financing opportunities for biobased business projects and ventures in Europe.<sup>20</sup>

---

### REFERENCES

- 6 BioInnovate Africa Program. (2017). Available at <http://bioinnovate-africa.org> [08.11.17].
- 7 Aramendis, R. H., Rodríguez, A. G. & Krieger, L. A. (2018). El gran impulso ambiental en América Latina y el Caribe: oportunidades desde la bioeconomía. Santiago de Chile: Comisión Económica para América Latina y el Caribe.
- 8 European Commission. (2017). Smart Specialization Platform. Available at <http://s3platform.jrc.ec.europa.eu> [06.11.17].
- 9 European Commission. (2015). European Structural Investment Funds 2014-2020: Official texts and commentaries. Available at [http://ec.europa.eu/regional\\_policy/sources/docgener/guides/blue\\_book/blueguide\\_en.pdf](http://ec.europa.eu/regional_policy/sources/docgener/guides/blue_book/blueguide_en.pdf) [13.11.17].
- 10 Bioeconomy Congress EBCL 2016. (2016). Lodz Declaration of Bioregions. Available at <http://www.sureaqua.no/Sureaqua/library/Lodz%20Declaration%20of%20Bioregions,%202016.pdf> [07.11.17].
- 11 Siemaszko, A. (...). Mapping Horizon 2020 and ESIF priorities across Europe. Available at <http://s3platform.jrc.ec.europa.eu/documents/20182/205894/13.+A+SIEMASZKO.pdf/23daf57e-86dd-4e18-8a0a-5a3c3fb2b91a> [06.11.17].
- 12 Research Institute of Agricultural Economics. (2018). BIOEAST Vision Paper. Available at <http://bioeast.eu/article/bioeastvisionpaper23022018> [01.03.18].
- 13 Danube-INCO.NET. (2017). 10 Recommendations: Towards a Danube Region Bioeconomy Concept. Available at [https://danube-inco.net/object/document/18760/attach/10\\_Recommendations\\_for\\_Fostering\\_Bioeconomy\\_in\\_the\\_Danube\\_Region.pdf](https://danube-inco.net/object/document/18760/attach/10_Recommendations_for_Fostering_Bioeconomy_in_the_Danube_Region.pdf) [30.10.17].
- 14 Nordic Council of Ministers. (2017). New Nordic strategy for the bioeconomy. Available at <https://www.norden.org/en/theme/nordic-bioeconomy/nordic-bioeconomy-panel/new-nordic-strategy-for-the-bioeconomy> [02.11.17].
- 15 European Commission. (2016). Mapping of EU Member States'/regions' Research and Innovation Plans & Strategies for Smart Specialisation (RIS3) on Bioeconomy. Case Study Reports.
- 16 Japan Association of Bioindustries. (2016). Bioeconomy Vision of Japan for 2030: Bioindustry's Social Contribution to Enhance Adaptation to Changing World. Available at [https://www.jba.or.jp/jabex/pdf/2016/JABEX\\_vision\\_digest\(english160420\).pdf](https://www.jba.or.jp/jabex/pdf/2016/JABEX_vision_digest(english160420).pdf) [28.02.18].
- 17 Frost & Sullivan White. (2016). India Ripe for Biotech Industry Growth: Government Incentives, Investments Leading Transition to Bio-Economy. Available at [http://images.discover.frost.com/Web/FrostSullivan/FS\\_WP\\_CII%20India%20Biotech%20Road%20Map\\_052516\\_CAM-v2.pdf](http://images.discover.frost.com/Web/FrostSullivan/FS_WP_CII%20India%20Biotech%20Road%20Map_052516_CAM-v2.pdf) [09.11.17].
- 18 BioEconomy 2016 Conclave. (2018). Available at <http://www.bioeconomy.in> [08.11.17].
- 19 Bio-based Industries Joint Undertaking. (2018). About BBI. Available at <https://www.bbi-europe.eu/about/about-bbi> [19.02.18].
- 20 Biobased Industries Consortium. (2017). Access to EU financial instruments suitable for the implementation of large bio-based industry investments. Available at [http://biconsortium.eu/sites/biconsortium.eu/files/downloads/BIC\\_Financial\\_Instruments\\_web.pdf](http://biconsortium.eu/sites/biconsortium.eu/files/downloads/BIC_Financial_Instruments_web.pdf) [19.12.17].



## Trending: Good Governance in the Bioeconomy



## Good Governance Principles

Governments play a significant role in promoting sustainable bioeconomy development. By adopting bioeconomy(-related) policy strategies, they lay the foundations for policy support and investment. This enables pioneering research, facilitates the development of new and advanced technologies, supports the development of human resources, drives forward commercialization processes and addresses the demand-side. However, these policy strategies differ in many ways. They vary in scope and depth, pursue different objectives and address various actors who will play a decisive role in promoting bioeconomy development.

Coordination of the broad range of bioeconomy actors and their different interests poses a particular

and considerable challenge to bioeconomy development. As a result, the issue of good governance is receiving an increasing level of attention at conferences and workshops<sup>21</sup>, in political memoranda and in the publication of scientific papers<sup>22</sup>. It is noteworthy that the topic of coordinating social, political and economic stakeholder actions towards increased accountability, transparency, effectiveness and coherence, participation and fairness<sup>23</sup> is developing implicitly in national and international forums rather than explicitly at political level. With this in mind, the following paragraphs will show that principles of good governance are increasingly considered important for developing a sustainable bioeconomy.

---

## Accountability

With a view to accountability of bioeconomy development, an increasing number of governments worldwide (including Argentina, Australia, Brazil, Canada, China, France, Italy, Latvia, New Zealand, Spain, the UK and the USA) are promoting **measuring activities** in order to monitor new technologies (particularly new biotechnologies), biomass supply and demand, as well as biobased products and services and their economic, ecological and social impacts.

Other countries are promoting the **evaluation of policy programs** to account for their decisions and to integrate learning and feedback-cycles in bioeconomy policy making. The evaluation process of the Finnish bioeconomy strategy, for example, was launched in 2016. It is led by the Ministry of Employment and the Finnish Bioeconomy Panel. While indicators that were set out in the strategy document provide the basis for the evaluation, a public call for tender was launched for the evaluation project.<sup>24</sup> In Germany, the revision process for the bioeconomy research strategy is accompanied by a series of stakeholder workshops. The Ministry of Education and Research (BMBF) further commissioned the evaluation of the strategy which resulted in a report published in March 2017.<sup>25</sup> The German Bioeconomy Council contributed to the revision

process with recommendations for the further development of the bioeconomy research strategy.<sup>26</sup> The revision of the research strategy is foreseen for 2018. With regard to monitoring the implementation of the German bioeconomy policy strategy, the Ministry of Food and Agriculture (BMEL) released a progress report in late 2016.<sup>27</sup> In order to develop a sound monitoring system for the bioeconomy, three research projects have been commissioned by the government. The projects address different elements of a monitoring system, such as economic statistics data, the biomass resource base and sustainability, and a systematic modeling approach. First monitoring results are expected by 2019. Evaluation efforts are also carried out in Malaysia and in the European Union. In Malaysia, the public agency responsible for implementation of the bioeconomy strategy (Bioeconomy Corporation) published a progress report on the country's Bioeconomy Transformation Program (2012) in February 2017. The report highlights key achievements and showcases projects in the area of industrial, agricultural and medical/pharmaceutical biotechnology. Interestingly, the report quantifies the bioeconomy's contribution to gross national income, investments and job opportunities.<sup>28</sup> The European Commission has funded several activities to moni-

toring bioeconomy development in Europe under the “Bioeconomy Observatory” project led by its Joint Research Center (JRC). The results have been published in its Bioeconomy Policy Report in 2016 and information is publicly available on the JRC website<sup>29</sup>. In November 2017, the European Commission presented an expert review of the European bioeconomy strategy.<sup>30</sup> Consequently, the Commission announced the development of a strategy update and a revised action plan by the 3<sup>rd</sup> quarter of 2018.<sup>31</sup>

An increasing number of countries are also addressing the issue of accountability by establishing **dedicated bioeconomy advisory councils**. Most often, they represent public, private and civil society stakeholders and provide advisory services for bioeconomy policy development. Such panels have been nominated in Germany, Denmark and the European Union before 2015. Since then, a Nordic Bioeconomy Panel was created at the initiative of the Icelandic Presidency of the Nordic Council of Ministers in 2015. It is composed of representatives from official agencies, research institutions, private companies and civil society. The panel was initially launched to support the development of a common Nordic bioeconomy strategy.<sup>32</sup> It published a widely recognized report on 25 showcases of a Nordic bioeconomy including a set of criteria for a sustainable and innovative bioeconomy.<sup>33</sup> In addition to the Nordic Bioeconomy Panel, the Baltic Sea Region Bioeconomy Council was established to support macro-regional bioeconomy cooperation. Since 2016, the council has acted as an informal policy dialogue platform which aims at sharing policy practices and learning. Its members are from local, regional, national, macro-regional and international organizations, bioeconomy panels, knowledge institutions and non-governmental organizations.<sup>34</sup>

In Finland, a national Bioeconomy Panel was established in 2015. The initiative goes back to the Ministry of Employment and the Economy which sought support for implementing the national bioeconomy strategy. The panel’s aim is to facilitate a continuous dialogue between public authorities, research institutions, business and civil society. In addition to the panel, the Technical Research Centre of Finland (VTT), has set up a Bioeconomy Forum. The forum comprises representatives from associations, clusters, research institutes and ministries.<sup>35</sup> The European Commission has set up a new Bioeconomy Panel in 2016. The panel intends to ensure further stakeholder collaboration within the EU and also monitors the implementation of the bioeconomy strategy.<sup>36</sup> In November 2017, the Stakeholder Panel published a Manifesto which provides guidelines for developing a sustainable bioeconomy in Europe.<sup>37</sup> In Denmark, the Ministry of Environment and Food has set up a new Bioeconomy Council in 2017. Its members represent bioeconomy-related expertise from academia, business, associations and clusters. Also in 2017, a “Bioeconomy Federation” (FBN) was formed in the Netherlands. While developing a strategic bioeconomy agenda, it seeks to connect bioeconomy stakeholders, strengthen international cooperation and showcase successful bioeconomy stories. More than 70 members from companies, research organizations and NGOs have already joined the Federation. So far, the work of the organization has been financed on a crowd-funding basis. The Federation foresees the creation of a Scientific Council, a Council for Sustainability Issues and a student platform as the next steps.<sup>38</sup> In 2016, a national bioeconomy panel was formed in the Czech Republic at the initiative of the University of South Bohemia and the Technology Center (TC). Its 16 members are drawn from academia and various ministries. However, the panel has not yet been officially institutionalized.<sup>39</sup>

---

## Transparency

In order to increase the transparency of governmental activities, various countries encourage **public reporting and dialogue**. Countries such as Argentina, the European Union, Germany, Malaysia and the USA, for example, have published progress reports to highlight

the key achievements of political programs. Countries such as Austria, Germany, Greece, Finland, the European Union or the countries in Latin America and the Caribbean have also established information platforms to increase public awareness on bioeconomy.

## Participation in Strategy Formulation

When it comes to the process of strategy formulation, the analysis of policy papers shows that most of the countries have adopted a participatory approach involving industry and civil society representatives as well as the public in general. In fact, almost all of the countries examined launched a **public consultation process** in order to involve key stakeholders and create a shared vision of bioeconomy. The consultation process often includes stakeholder conferences, workshops or online surveys and aims at integrating

public feedback into a final strategy document. **Multi-stakeholder dialogue** (e.g. in the form of regional, national or international policy forums) is generally rated as very important for ensuring mutual learning and inclusive participation in the bioeconomy. Countries such as Argentina, Australia, the UK, Italy, Ireland and the United States have commissioned a **foresight report** to identify country-specific opportunities and challenges in bioeconomy development.

---

## Policy Coherence & Effectiveness

This review of policy strategies indicates that **inter-ministerial collaboration** and **federal-state cooperation** is considered critical for bioeconomy policy, specifically in terms of policy coherence and effectiveness. For example, bioeconomy strategies in Argentina, Australia, Italy, Spain, Thailand and the United States propose to establish inter-governmental working groups in addition to exchanges of personnel and memoranda of understanding among governmental authorities. In Ireland, for example, an inter-ministerial working group was established in late 2016. It is chaired by the Department of the Prime Minister and aims primarily at reconciling bioeconomy-related activities and identifying opportunities for a national policy strategy.<sup>40</sup> In Austria, a sub-working group on bioeconomy has evolved as part of the inter-ministerial working group on climate change and resource

scarcity.<sup>41</sup> Policy coherence related to bioeconomy is also a topic in Germany. Inter-ministerial collaboration and coherence is addressed by an inter-ministerial working group. In 2017, the German Bioeconomy Council has initiated an informal network of federal and regional bioeconomy initiatives. A first collection of bioeconomy policy and research initiatives in the federal states and regions has been published on the public information platform [www.biooekonomie.de](http://www.biooekonomie.de).<sup>42</sup>

In order to foster **inter-regional coordination** and **best practices**, some countries (including the Nordic European countries, countries in Eastern Europe and Eastern Africa as well as countries in Latin America and the Caribbean) further organize regular regional bioeconomy events and symposia.

## Fairness

**International collaboration** in the bioeconomy is not a major topic in most policy strategies. Even if the need for bi- and multi-lateral cooperation is often mentioned (e.g. to promote R&D cooperation), substantially less importance is attached to issues relating to the good governance principle of fairness. This includes, for example, discussions on how to harmonize international trade and policy frameworks, promote capacity building, knowledge sharing and

technology transfer between industrialized and developing countries, encourage private investment in developing countries and foster international monitoring activities. The global interconnectedness of the bioeconomy with respect to trade in biomass resources, to global industrial value chains and transfer of technologies has hardly been addressed in policy strategies so far.

---

### REFERENCES

- 21 Von Braun, J. (2017). Governance of the Bioeconomy. Paper presented at the European Workshop on Bioeconomy, Paris, France, 28-29 June 2017.
- 22 E.g. Devaney, L., Henchion, M. & Regan, Á. (2017). Governance in the Bioeconomy. *EuroChoices*, 6(2), pp 41–46.
- 23 The initial set of principles of good governance was developed by the United Nations Development Program and published in its report on “Governance and Sustainable Human Development” in 1997. On this basis, Devaney et al. listed a selection of good governance principles relevant to future bioeconomy governance in 2017.
- 24 Davies, S. et al. (2016). Promoting stakeholder engagement and public awareness for a participative governance of the European bioeconomy: Case studies of national bioeconomy strategies in Finland and Germany. Available at [http://www.bio-step.eu/fileadmin/BioSTEP/Bio\\_documents/BioSTEP\\_D3.1\\_Case\\_studies\\_of\\_national\\_strategies.pdf](http://www.bio-step.eu/fileadmin/BioSTEP/Bio_documents/BioSTEP_D3.1_Case_studies_of_national_strategies.pdf) [07.11.17].
- 25 Hüsing et al. (2017). Evaluation der „Nationalen Forschungsstrategie BioÖkonomie 2030“: Wirksamkeit der Initiativen des BMBF – Erfolg der geförderten Vorhaben – Empfehlungen zur strategischen Weiterentwicklung. Available at [http://www.isi.fraunhofer.de/isi-wAssets/docs/t/de/publikationen/Evaluation\\_NFSB\\_Zusammenfassung.pdf](http://www.isi.fraunhofer.de/isi-wAssets/docs/t/de/publikationen/Evaluation_NFSB_Zusammenfassung.pdf) [06.11.17].
- 26 German Bioeconomy Council. (2016). Recommendations of the German Bioeconomy Council: Further Development of the “National Research Strategy BioEconomy 2030”. Available at [http://bioekonomierat.de/en/publications/?tx\\_rsmpublications\\_pi1%5Bpublication%5D=110&tx\\_rsmpublications\\_pi1%5Baction%5D=show&tx\\_rsmpublications\\_pi1%5Bcontroller%5D=Publication&cHash=e65e9847b8870c6c13771194f8d78bbe](http://bioekonomierat.de/en/publications/?tx_rsmpublications_pi1%5Bpublication%5D=110&tx_rsmpublications_pi1%5Baction%5D=show&tx_rsmpublications_pi1%5Bcontroller%5D=Publication&cHash=e65e9847b8870c6c13771194f8d78bbe) [02.11.17].
- 27 BMEL. (2016). Fortschrittsbericht zur Nationalen Politikstrategie Bioökonomie. Available at [https://www.bmel.de/SharedDocs/Downloads/Broschueren/fortschrittsbericht-bioekonomie.pdf?\\_\\_blob=publicationFile](https://www.bmel.de/SharedDocs/Downloads/Broschueren/fortschrittsbericht-bioekonomie.pdf?__blob=publicationFile) [02.03.18].
- 28 Malaysian Bioeconomy Corporation. (2017). Bioeconomy Transformation Programme: Opportunities and Incentives. Available at <http://www.sbc.org.my/media-centre/downloads/seminar-on-commercialisation-of-research/421-bioeconomy-transformation-programme-opportunities-and-incentives/file> [07.11.17].
- 29 Joint Research Center. (2016). JRC Science for Policy Report: Bioeconomy Report 2016. Available at <http://publications.jrc.ec.europa.eu/repository/bitstream/JRC103138/kjna28468enn.pdf> [09.03.18].
- 30 European Commission. (2017). Review of the 2012 European Bioeconomy Strategy. Available at [https://ec.europa.eu/research/bioeconomy/pdf/review\\_of\\_2012\\_eu\\_bes.pdf](https://ec.europa.eu/research/bioeconomy/pdf/review_of_2012_eu_bes.pdf) [13.12.17].
- 31 European Commission. (2018). Roadmap: Update of the 2012 Bioeconomy Strategy. Available at [https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2018-975361\\_en](https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2018-975361_en) [02.03.18].
- 32 Nordic Council of Ministers. (2017). Nordic Bioeconomy Panel. Available at <https://www.norden.org/en/theme/nordic-bioeconomy/nordic-bioeconomy-panel> [30.10.17].
- 33 Nordic Council of Ministers. (2017). 25 Nordic bioeconomy cases for sustainable change. Available at <https://www.norden.org/en/news-and-events/news/25-nordic-bioeconomy-cases-for-sustainable-change> [30.10.17].
- 34 Nordic Council of Ministers. (2017). BSR Bioeconomy Council. Available at <http://bsrbioeconomy.net/council.html> [09.11.17].
- 35 Davies, S. et al. (2016). Promoting stakeholder engagement and public awareness for a participative governance of the European bioeconomy: Case studies of national bioeconomy strategies in Finland and Germany. Available at [http://www.bio-step.eu/fileadmin/BioSTEP/Bio\\_documents/BioSTEP\\_D3.1\\_Case\\_studies\\_of\\_national\\_strategies.pdf](http://www.bio-step.eu/fileadmin/BioSTEP/Bio_documents/BioSTEP_D3.1_Case_studies_of_national_strategies.pdf) [19.03.18].
- 36 European Commission. (2016). Policy: The Bioeconomy Stakeholder Panel. Available at <http://ec.europa.eu/research/bioeconomy/index.cfm?pg=policy&lib=panel> [09.11.17].
- 37 European Bioeconomy Stakeholder Panel. (2017). European Bioeconomy Stakeholders MANIFESTO. Available at [http://ec.europa.eu/research/bioeconomy/pdf/european\\_bioeconomy\\_stakeholders\\_manifesto.pdf](http://ec.europa.eu/research/bioeconomy/pdf/european_bioeconomy_stakeholders_manifesto.pdf) [13.12.17].
- 38 Federatie Bio-economie Nederland (2017). Werkprogramma. Available at <http://www.bio-economie.nl/werkprogramma/> [30.10.17].
- 39 Cudlinova, E. & Sakellaris, G. (...). A bioeconomy initiative in Czech Republic. Paper presented at (...) [http://www.innovhub-ssi.it/c/document\\_library/get\\_file?uuid=d447aeee-41dd-40e3-85bf-e86d8824c5cf&groupId=11660](http://www.innovhub-ssi.it/c/document_library/get_file?uuid=d447aeee-41dd-40e3-85bf-e86d8824c5cf&groupId=11660)
- 40 Department of the Taoiseach. (2017). Submissions invited on developing Ireland’s Bioeconomy. Available at [https://www.taoiseach.gov.ie/eng/News/Government\\_Press\\_Releases/Submissions\\_invited\\_on\\_developing\\_Ireland%E2%80%99s\\_Bioeconomy.html](https://www.taoiseach.gov.ie/eng/News/Government_Press_Releases/Submissions_invited_on_developing_Ireland%E2%80%99s_Bioeconomy.html) [27.10.17].
- 41 Bioeconomy Austria. (2017). Bioökonomie-FTI-Strategie: Dialogforen 2016. Available at <http://www.bioeconomy-austria.at/news/bioekonomie-fti-strategie-dialogforen-2016/> [19.12.17].
- 42 Bioökonomie.de (2017). Politik & Strategie in den Bundesländern. Available at <https://bioekonomie.de/bioekonomie-deutschland> [09.11.17].



# Africa



Many bioeconomy-related policy initiatives have emerged in Africa in recent years. Influenced by the leadership of sub-regional organizations and collaboration with international partners, bioeconomy policies have been promoted in sub-Saharan Africa. The German Government, for example, supports the BiomassWeb project in Ethiopia, Ghana, Kenya and Nigeria, which aims to increase productivity and efficiency across the whole system of producing, processing and trading biomass.<sup>43</sup> Western African countries like Nigeria, Mali and Senegal focus on fostering bioenergy policies, and in Eastern Africa, the Swedish Development Agency Sida supports the development of bio-innovation policies in Burundi, Ethiopia, Kenya, Rwanda, Tanzania and Uganda. Countries such as Kenya and Mauri-

tius have also started to focus on bioprospecting policies in order to benefit from their unique biodiversity and on commercializing knowledge about traditional bioresources. Since 2015, however, no further bioeconomy policy strategies have been adopted in Africa. South Africa still stands out due to its dedicated bioeconomy strategy. Recently, Namibia indicated that it proposed to prepare a bioeconomy-related strategy with the focus on biotechnology. In addition, Namibia and Kenya have tasked STI Committees working on bioeconomy policy.

---

<sup>43</sup> Center for Development Research University of Bonn. (2018). BiomassWeb. Available at <http://biomassweb.org> [19.03.18].

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 Développement 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, Technology 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)	

! See also the previous reports on "Bioeconomy Policy (Part I & II)" | <http://bioekonomierat.de/en/publications>

# Americas



In recent years, the concept of bioeconomy has clearly gained importance in Latin America and the Caribbean. Bioeconomy is promoted particularly as an alternative model for sustainable development and green growth. The continent's mega biodiversity offers great potential for biomass production and utilization. Even if there are no dedicated national bioeconomy policy strategies as yet, countries such as Argentina, Brazil, Colombia and Ecuador have already announced their willingness to prepare appropriate policy papers. Furthermore, Brazil and Argentina are among the leaders in bioenergy production and are among the top five users of genetically modified crops. Colombia, Paraguay and Uruguay have already taken first steps in the knowledge-based bioeconomy (bioprospecting, agricultural

technologies). In addition, macro-regional bioeconomy development is increasingly driven by the United Nations regional commission (UN ECLAC), which organizes joint events to promote exchange on policy making and successful private sector and research initiatives. By doing this, ECLAC's intention is to better align existing initiatives and to further develop joint bioeconomy policies and programs.

Interestingly, the focus of Northern American bioeconomy policies has changed in recent years. Although earlier policy papers promoted a more holistic view of bioeconomy and dealt with bio-tech and high-tech innovation across all economic sectors, the vision of bioeconomy is now more bioresources-driven (particularly by agriculture and forestry).



Country*	Perspective	Document Name
Argentina	Holistic Bioeconomy Development	“Bioeconomía Argentina” (2017)
		“Plan Provincial de Bioeconomía” (2016)
	Regional Bioeconomy Development	“Argentina Innovadora 2020” (2012)
	Research & Innovation	
Brazil	Research & Innovation	“Estratégia Nacional de Ciência, Tecnologia e Inovação 2016 – 2019” (2016)
	Bioenergy	“Plano Decenal de Expansão de Energia 2023” (2014)
	High-Tech	“PAISS” (2012)
	Green Economy	“Biotechnology Strategy” (2007)
Canada	Forestry	“A Forest Bioeconomy Framework for Canada” (2017)
Colombia	High-Tech	“Política 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	“Política y Programa Nacional de Biotecnología Agropecuaria y Forestal del Parauay” (2011)
Uruguay	High-Tech	“Plan Sectorial de Biotecnología 2011–2020” (2012)
		“Uruguay Agro inteligente 2010–2015” (2010)
USA	Bioenergy & Bioproducts	“Strategic Plan for a Thriving and Sustainable Bioeconomy” (2016)
	Research & Innovation	“Strategy for American Innovation” (2015)
	Agriculture	“The Farm Bill” (2014)
	Holistic Bioeconomy Development	“The Bioeconomy Blueprint” (2012)

! See also the previous reports on “Bioeconomy Policy (Part I & II)” | <http://bioekonomierat.de/en/publications>



# Argentina

## 1 Which bioeconomy-related strategies have been developed since 2015?

In 2017, the Argentinian government published the position paper “**Bioeconomía Argentina**” which presents a roadmap for promoting bioeconomy development in Argentina.<sup>44</sup> Following this, the “Program on Promoting the Bioeconomy” was presented in August 2017. It highlights the need to develop policy strategies and actions as a requirement for further bioeconomy development.<sup>45</sup>

The need for bioeconomy-related policies had also been emphasized in the past by several opportunity reports; for example, in the report led by the civil association Bolsa de Cereales (2015), which focused

on the importance of the energy and food sector for the Argentinian bioeconomy.<sup>46</sup> The foresight study “*Biotecnología argentina al año 2030*” (2016) recommended developing biotechnology policies to encourage applications in pharmaceutical and food production and to contribute to environmental protection.<sup>47</sup>

At regional level, the province of Buenos Aires is a pioneer in developing bioeconomy policies as it published the first “**Plan Provincial de Bioeconomía**” in December 2016.<sup>48</sup>

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

Yes No



According to the position paper “*Bioeconomía Argentina*” (2017), the bioeconomy encompasses the production and utilization of goods and services based on biological resources, processes and principles. The policy paper places bioeconomy development within the circular economy concept and highlights its contribution to social development and poverty reduction.

The regional plan of the province of Buenos Aires (2016) focuses particularly on biomass resources and their industrial utilization for food, bioenergy, biomaterials and biopharmaceuticals.

### 3 Who is the author of the strategy?

At governmental level, the Argentinian bioeconomy policy is mostly driven by the Ministry of Agro-Industry (MINAGRO) and the Ministry of Science, Technology and Productive Innovation (MINCYT). The “Bioeconomía Argentina” document, for example, was developed by MINAGRO and its internal bioeconomy

working group. It is based on several meetings and workshops held with different units of the ministry.

The regional bioeconomy strategy of 2016 was published by the Ministry of Agro-industry of Buenos Aires.

### 4 What are the key goals of the strategies

The bioeconomy policy paper addresses the grand societal challenges (such as food and energy security) and the need to contribute to sustainable and inclusive development in Argentina. It particularly aims at increasing economic growth and employment while reducing dependency on fossil resources and mitigating climate change. The document also places strong emphasis on regional and rural development.

The main mission of the Buenos Aires regional bioeconomy strategy is to promote more sustainable agribusiness in the province. Bioeconomy is seen as a new engine for regional and rural development, while fostering environmental protection and mitigating climate change.

### 5 What are the priority areas of the strategies?

The Ministry of Agro-industry identified several priority areas for future bioeconomy development in Argentina. With a view to regional development, the strategy proposes to reinforce comparative advantages, specifically when it comes to producing and using local bioresources. This should be facilitated by sustainable intensification practices and appropriate institutional frameworks. In order to ensure future food security in Argentina, the position paper envisages improving the efficiency of the supply chain and increasing the nutritional quality of foods.

the food industry. With a view to growth and added value from the country’s bioresources, the government sees potential in establishing large-scale biorefineries to produce higher value bioproducts. Bioeconomy innovations, in precision agriculture for example, and circular economy approaches are considered important for improved resource management, in particular water resources. Converging technologies, e.g. the combination of biotechnology and ICT, have been identified as promising tools for contributing to the priority areas mentioned.

Another priority is that of expanding the sustainable energy supply from biomass. The document stresses the importance of developing new feedstock resources, such as non-food crops, residues from forestry and agriculture, and side-streams from

The focus of the Buenos Aires regional bioeconomy plan is clearly economic. Biotechnology is highlighted as key for innovation in the area of animal production and plant breeding.

## 6 Is there a dedicated action plan with quantitative targets?

Yes No  
X

The position paper (2017) presents the government's intention to promote bioeconomy development in Argentina but it does not include quantitative strategic medium- or long-term goals.

The strategy of Buenos Aires provides short-term (2017), medium-term (2017-2019) and long-term (2030) measures. Nevertheless, it emphasizes the need to develop more detailed action plans.

## 7 Which measures/instruments are used to promote the strategies?

The position paper of 2017 pursues a holistic approach to supporting bioeconomy development. With this in mind, it outlines a broad set of policy measures on the supply- and demand-side of bioeconomy. In order to promote innovation, the policy document mainly proposes to strengthen public R&D and technology development (e.g. omics technologies) through collaborative efforts. For example, by strengthening local research centers and their cooperation with centers of excellence abroad. It also focuses on fostering cooperation between public and private stakeholder, e.g. through public-private partnerships.

With respect to the promotion of infrastructure, the policy paper puts emphasis primarily on regional and local investments and highlights the development of large-scale biorefineries.

The document further highlights the need for education and capacity-building measures. For example, the first academic online seminar on bioeconomy was launched in 2017 as a result of a joint initiative by the Ministry of Agro-industry, the Ministry of Science, Technology and Productive Innovation and the civil association Bolsa de Cereales. It addresses students, professionals and manufacturers who are interested in bioeconomy and provides an introductory set of modules related to converging technologies, sustainable biomass production, as well as the transformation of biomass into bioenergy, food, biomaterials and biopharmaceuticals. It also addresses issues of social and environmental sustainability.<sup>49</sup>

Commercialization should be mainly fostered by improving the translation of research into marketable products and by providing financial support for startups, e.g. through the provision of venture capital. The policy paper also seeks to promote a supportive business environment, by implementing tax deductions for example. In the period from 2017 to 2019, the regional bioeconomy strategy of Buenos Aires plans to provide access to capital for biobased companies, particularly for small and medium-sized companies (SMEs). SMEs should also be supported with business management training courses.

In terms of demand-side instruments, the policy paper promotes measures to increase awareness of the bioeconomy. The document also proposes the introduction of standards and certifications, the consideration of biobased products in public procurement and a public communication campaign to develop the market for biobased products.

Measures related to the promotion of bioeconomy-friendly framework conditions focus on reviewing and harmonizing biotechnology and bioenergy policies. The document particularly stresses support for legalizing and regulating advanced biotechnologies and their applications. Independently of the position paper, Argentina was one of the first countries to adopt a regulatory framework dealing with "Innovative Biotechnology or New Breeding Techniques" in 2015. The law provides a case by case assessment of genetic modifications.<sup>50</sup> In addition, Argentina collaborated strongly with Brazil in order to standardize regulation on new breeding techniques.<sup>51</sup>

The roadmap envisages closer cooperation between MINAGRO, MINCYT and the National Agricultural Technology Institute (INTA) in order to develop technological scenarios and observe opportunities and needs for investment. Attention is also given to integrating bioeconomy policy in sustainable development strategies and policies. The document further emphasizes the regional dimension of bioeconomy by supporting the development of regional policy strategies.

Several measures seek to ensure good governance in the transition to a biobased economy. The government proposes to increase monitoring and measuring activities, including the implementation of an integrated information and observatory system. The focus is also on establishing a mechanism for inter-ministerial cooperation. A joint bioeconomy initiative between the Ministries of Agro-industry (MINAGRO); Science, Technology and Productive Innovation (MINCYT) and the Ministry of Production (MINPROD) resulted in an agreement which was signed in June 2017. It encourages joint bioeconomy-related activities and the coordination of regional initiatives and stakeholders. It further intends to boost innovation by developing financial instruments, promoting public-private partnerships, training programs, and international cooperation. The first meeting of the inter-ministerial working group was held in 2017. The members highlighted the need to establish a national bioeconomy council to promote a national bioeconomy strategy.<sup>52</sup>

The Argentinian Ministry of Science, Technology and Productive Innovation has further promoted bioecono-

my symposia in the regions of Cuyo, Centro Pampeana Norte y Sur, NEA, Patagonia and NOA since 2013. The regional symposia primarily seek to encourage collaboration for rural bioeconomy development and to promote the creation of public-private alliances.<sup>53</sup> For example, as a result of the bioeconomy symposium held in the NOA region, representatives announced a resolution for establishing a permanent regional forum on bioeconomy in 2015. It is also worth mentioning that the Argentinian government published a progress report on the Argentinian innovation strategy (2012) in 2015. In this strategy, the bioeconomy was associated with the development of the agro-industry sector. The public funding volume for projects in the agro-industry sector amounted to around USD 200 million between 2012–2015. Measures related to the promotion of innovation concentrated mainly on establishing laboratories, seed banks, pilot and demonstration facilities, technology development centers, and technology parks.<sup>54</sup>

The regional bioeconomy strategy of Buenos Aires envisages mapping regional biomass resources as well as measuring the economic relevance of the provincial bioeconomy in 2017. Bilateral and multilateral cooperation are considered highly relevant to mainstream bioeconomy in the sustainable development debate. For example, the government participates in the FAO Working Group on Sustainable Bioeconomy, the Biofutures Platform, and the International Bioeconomy Forum. A further focus is on harmonizing international trade agreements to overcome trade barriers, i.e. by reducing tariffs on biobased products.

## REFERENCES

- 44 Argentinian Ministry of Agro-industry. (2017). Bioeconomía Argentina: Visión desde Agroindustria. Available at [http://www.agroindustria.gob.ar/sitio/areas/bioeconomia/\\_archivos/000000\\_Bioeconomia%20Argentina.pdf](http://www.agroindustria.gob.ar/sitio/areas/bioeconomia/_archivos/000000_Bioeconomia%20Argentina.pdf) [15.11.17].
- 45 Bioeconomía Argentina. (2017). Programa de Fomento de la Bioeconomía. Available at <http://www.bioeconomia.mincyt.gob.ar/programa-de-fomento-de-la-bioeconomia/> [08.08.17].
- 46 Trigo, E. et al. (2015). The Argentinean bioeconomy: scope, present state and opportunities for its sustainable development. Available at <http://www.bolsadecereales.com/ver-bioeconomia-580> [15.11.17].
- 47 UBATEC S.A. & Argentinian Chamber of Biotechnology Biotecnología. (2016). Biotecnología argentina al año 2030: Llave estratégica para un modelo de desarrollo tecno-productivo. Available at <http://www.mincyt.gob.ar/estudios/biotecnologia-argentina-al-ano-2030-llave-estrategica-para-un-modelo-de-desarrollo-tecno-productivo-12530> [01.02.17].
- 48 Sarquis, L. (2016, December). Plan Provincial de Bioeconomía. Paper presented at the Simposio de Bioeconomía Región Centro Pampeana Sur <http://www.bioeconomia.mincyt.gob.ar/wp-content/uploads/2017/01/14-Leonardo-Sarquis.pptx> [15.11.17].
- 49 Bioeconomía Argentina. (2017). Curso virtual "Introducción a la Bioeconomía Argentina". Available at <http://www.bioeconomia.mincyt.gob.ar/curso-virtual-introduccion-a-la-bioeconomia-argentina/> [20.11.17].
- 50 USDA Foreign Agricultural Service. (2016). Argentina - Annual Biotechnology Report. Available at [https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Agricultural%20Biotechnology%20Annual\\_Buenos%20Aires\\_Argentina\\_12-27-2016.pdf](https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Agricultural%20Biotechnology%20Annual_Buenos%20Aires_Argentina_12-27-2016.pdf) [15.11.17].
- 51 Orozco, P. (2018). Argentina and Brazil merge law and science to regulate new breeding techniques. Available at <http://news.agropages.com/News/NewsDetail--25256-e.htm> [05.01.18].
- 52 Bioeconomía Argentina. (2017). Primera Reunión del Consejo Nacional de Bioeconomía. Available at <http://www.bioeconomia.mincyt.gob.ar/se-realizo-la-primera-reunion-del-comite-interministerial/> [15.11.17].
- 53 Bioeconomía Argentina. (2017). Bioeconomía Argentina. Available at <http://www.bioeconomia.mincyt.gob.ar/bioeconomia-argentina/> [15.11.17].
- 54 Ministry of Science, Technology and Productive Innovation. (2015). Plan en Acción: Argentina Innovadora 2020. Available at <http://www.mincyt.gob.ar/informes/plan-en-accion-argentina-innovadora-2020-11634> [16.02.18].

Table 1: Important measures for promoting the bioeconomy in Argentina

Key points	Policy measures	Concrete implementation
Promoting innovation	Public R&D funding	
	Stimulating private sector R&D	e.g. Public-private partnerships, regional technology innovation funds and sectoral funds (FONARSEC)
Supporting infrastructure & capacity building	Biorefinery demo plants	
	Funding for R&D facilities (e.g. laboratories, technology development centers and technology parks)	
	Pilot and demonstration facilities	
	Training programs	e.g. academic online seminar on bioeconomy
Supporting commercialization	Research transfer	e.g. establishing research transfer centers, territorial “antennas” for technical support and five sectoral technology councils acting as advisory bodies in the area of agro-industry, energy, health, environment and climate change
	Access to capital for biobased companies	e.g. venture capital for start-ups and SMEs
	Tax incentives for biobased companies	e.g. interest rate subsidies
Supporting the demand-side	Market development	
	Public procurement policies	
	Public communication strategy, standards and certifications for biobased products	
Ensuring bioeconomy-friendly framework conditions	Regional bioeconomy strategies	
	Policies for sustainable development	
	Review of policies supporting biotechnology development	
	Review of regulatory framework for bioenergy	
Promoting Good Governance	Monitoring and measuring	Integrated information and observatory system Mapping of regional biomass resources
	Policy coherence	Inter-ministerial cooperation between MINAGRO, MINCYT and MINPROD: agreement on joint initiative
	National Bioeconomy Council	
Enhancing international collaboration in the bioeconomy	Bilateral and multilateral cooperation	FAO Working Group on Sustainable Bioeconomy, the Biofutures Platform and the International Bioeconomy Forum
	Harmonizing international trade	Reducing tariffs on biobased products





# Brazil

## 1 Which bioeconomy-related strategies have been developed since 2015?

In Brazil, the government has encouraged bioeconomy development for more than five decades with several policy strategies and laws. The main focus has been on promoting biotechnology and biofuel development.<sup>55</sup> However, dedicated national or regional bioeconomy strategies have not been adopted so far.

In 2016, the government published a revised **National Strategy for Science, Technology and Innovation**, detailing policy support for the medium-term (2016-2019). The STI strategy includes the bioeconomy as one of the priority sectors for Brazil.<sup>56</sup>

In the context of COP22 in Marrakesh (2016), the Brazilian government launched the Biofuture Platform, involving 20 signatory countries and 13 international organizations. This multilateral effort seeks to foster international policy dialogue and collaboration for a low carbon bioeconomy, particularly in the transport sector. In November 2017, the member states adopted a Vision Statement entitled “**Scaling-up the low carbon bioeconomy: an urgent and vital challenge**“.<sup>57</sup>

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

Yes No

X

In the new STI strategy of 2016, the term bioeconomy refers to “the generation of innovative products and services based on the country’s natural resources and ecosystem services.”<sup>58</sup> This definition clearly goes beyond bioresources and includes innovation gained from understanding nature and biological principals.

The Biofuture Platform uses the term “expanded bioeconomy”, which is defined “as a set of economic activities related to the invention, development, production and use of biological products and/or processes for the production of renewable energy, materials and chemicals”<sup>59</sup> and must be based on sustainable practices to ensure unequivocal carbon savings and to avoid any other detrimental environmental, social or economic impacts.



### 3 Who is the author of the strategy?

The STI-Strategy was published by the Ministry of Science, Technology and Innovation (MCTI) in May 2016. It underwent a public consultation process

as well as a broad dialogue with stakeholders from industry.

### 4 What are the key goals of the strategies

With the revised STI strategy (2016), the government seeks to continue its efforts to join the leading countries in STI development worldwide. This should go hand in hand with the generation of wealth, employment and income while reducing social inequalities and regional asymmetries. The strategy seeks to provide innovative solutions for societal challenges, including water, food and energy security as well as urbanization and climate change. It further aims to contribute to sustainable growth and development and to increase the competitiveness of the national bioeconomy.

The Biofuture Platform Vision Statement defined six goals for a low-carbon bioeconomy, such as increasing the contribution of sustainable modern bioenergy to final energy demand and increasing the share of sustainable biofuels in transport fuel usage, including sea and air transport. In addition, member countries seek to increase and measure carbon savings from biofuel production relative to fossil fuels and to improve the overall competitiveness of biofuels. Another goal is to significantly increase investment in R&D and specifically in advanced, flexible biorefineries.

### 5 What are the priority areas of the strategies?

The National Strategy on STI identifies 11 strategic sectors, one of which represents the bioeconomy. The focus is still on developing innovative technologies and biobased processes for the conversion of bioresources into biofuels, biocomposites and other higher value biobased products. Biotechnology development is expected to contribute to more sustainable industrial processes in general. It should also increase resource efficiency, for example by enabling the use of agro-industrial and urban wastes for industrial products, while reducing environmental impacts.

The strategy further emphasizes the need for more sustainable production and use of natural resources. It therefore seeks to increase STI efforts to foster the conservation, recovery and restoration of ecosystems and environmental services. Other bioeconomy-related priority sectors identified in the strategy document include water, food, energy, climate, health, as well as cross-sectoral topics, such

as enabling and converging technologies, and the digital economy and society. Brazil is one of the global leaders in bioenergy and biofuel production. With this in mind, the strategy promotes the sustainable production of bioenergy and biofuels while ensuring the country's competitiveness in this area. The development of advanced biofuels, e.g. for the aviation industry, is also supported.

In the water sector, for example, the strategy aims at sustainable resource management. It also highlights the importance of harnessing the potential of national fisheries and aquacultures in national and marine waters in order to cope with challenges like food security.

With a view to the agrifood business, the strategy intends to improve the agrifood systems to achieve water, energy and food security. It highlights the promotion of agro-ecological and organic production systems, but also of automation and precision

agriculture. It also recognizes the development and cultivation of climate-resistant crops as important.

In the health sector, the focus is on promoting biopharmaceuticals but also on strengthening knowledge in the area of neurosciences and biotechnology applications with long-term benefits for public health.

The STI strategy highlights the importance of digitalization and its related opportunities for advanced manufacturing, e.g. in the areas of Big Data, cloud computing, sensor development and the Internet of Things. In this respect, it also stresses the importance of enabling and converging technologies, including nanotechnology, biotechnology, ICT and neuroscience for contributing to greening the Brazilian economy.

## 6 Is there a dedicated action plan with quantitative targets?

Yes No

X

The STI strategy of 2016 sets out concrete actions for each of the priority themes. It further foresees the elaboration of dedicated STI action plans, i.e. on bioeconomy and biomes, water and oceans, food, renewable energies and biofuels, health etc.

The Biofuture Vision Statement proposes to compile and analyze recent bioeconomy data and reports in order to devise an action plan outlining targets and detailed actions and to develop a reporting mechanism to track progress.

## 7 Which measures/instruments are used to promote the strategies?

The STI strategy of 2016 seeks to foster public research and technology development in many bioeconomy related fields, such as automation and precision agriculture, agricultural biotechnology and plant breeding, biofuels, marine biotechnology, personalized medicine and biopharmaceuticals. Increased funding for STI should be ensured by revitalizing public funds (such as the National Fund for Scientific and Technological Development (FNDCT) which provided around USD 1 million in 2016<sup>60</sup>) and their funding capacity. The strategy further aims to strengthen the USD 22.7 billion-backed (2015) Company Innovation Plan (Inova Empresa Plan), which encourages the combination of credit finance with non-refundable grants and equity financing.<sup>61</sup> Other financing sources mentioned include international development and cooperation programs (e.g. Horizon2020 and bilateral initiatives). The strategy document underlines the promotion of research networks, e.g. in the area of biotechnology and biodiversity. In view of this, the National Institutes of

Science and Technology (INCT) Program should be supported as it plays an important role in mobilizing researchers and stimulating cutting-edge research. Besides this, the strategy intends to encourage cooperation projects between academia and business through public-private partnerships and increased international collaboration.

R&D infrastructure is supported by increasing funding for universities, higher education facilities and research institutes. This also involves establishing multi-user R&D facilities and equipment, such as research vessels, internationally certified laboratories, as well as test and demonstration facilities.

Capacity building is seen as necessary, including training courses for professionals in entrepreneurship, innovation management, technology transfer and intellectual property rights. In connection with this, the strategy emphasizes public programs that should receive further promotion, including the Hu-

man Resources Training Program in Strategic Areas (RHAE) and the National Program for Access to Technical Education and Employment (Pronatec). In addition, inter-agency programs (such as the Casadinho Program<sup>62</sup> and the New Boundaries Program<sup>63</sup> (PRO-CAD)), and inter-institutional master's (MINTER) and doctoral programs (DINTER) should be launched.

The STI strategy proposes several measures fostering knowledge and technology transfer as well as business innovation. Multi-user platforms that advance the development and scaling-up of projects are considered necessary. Universities should be encouraged to share existing laboratories with companies in order to conduct applied research activities.<sup>64</sup> In addition, the public funding mechanism should be modernized to encourage company start-ups and risk capital investment.

Bioeconomy-friendly framework conditions should be ensured primarily by reviewing the regulatory framework. This includes, for example, modernization of the patenting process and intellectual property rights.

The STI strategy additionally emphasizes the need for increased international collaboration in the bioeconomy. The focus is mainly on scientific cooperation initiatives, such as the Science without Borders Program (CeF) designed to attract foreign students and researchers of STEM disciplines (including biotechnology, sustainable agricultural production, etc.) to Brazil. Public study-abroad scholarships should further support the internationalization of Brazil's higher education institutions.

With a view to promoting a low-carbon bioeconomy and the Biofuture Platform, in December 2017 the Brazilian government adopted a new national biofuels policy, referred to as the RenovaBio program. The program aims to support the demand for sustainable biofuels by introducing mandatory blends for biofuels and biofuels certification schemes and establishing "decarbonization credits" for biofuel producers.<sup>65</sup>

---

## REFERENCES

- 55 German Bioeconomy Council. (2015). Bioeconomy Policy (Part II): Synopsis of National Strategies around the World. Available at [http://bioekonomierat.de/fileadmin/international/Bioeconomy-Policy\\_Part-II.pdf](http://bioekonomierat.de/fileadmin/international/Bioeconomy-Policy_Part-II.pdf) [19.07.17].
- 56 Ministry of Science, Technology and Innovation. (2016). Estratégia Nacional de Ciência, Tecnologia e Inovação (2016-2019). Available at <http://www.mcti.gov.br/documents/10179/1712401/Estrat%C3%A9gia+Nacional+de+Ci%C3%AAncia%2C%20Tecnologia+e+Inova%C3%A7%C3%A3o+2016-2019/0cfb61e1-1b84-4323-b136-8c3a5f2a4bb7> [25.07.17].
- 57 Biofuture Platform. (2017). Biofuture Platform. Available at <http://biofutureplatform.org/about/> [21.11.17].
- 58 Translated from Portuguese.
- 59 Biofutures Platform. (2017). Vision Statement: "Scaling-up the low carbon bioeconomy: an urgent and vital challenge". Available at <http://biofutureplatform.org/wp-content/uploads/2017/11/Biofuture-Platform-Vision-Statement-Final.pdf> [12.03.18].
- 60 Pacheco, C. A. (2016). O FNDCT e a Reforma do Financiamento de CT&I. Available at [https://eventos.rnp.br/sites/default/files/activity/activity-presentation/painel1\\_pacheco.pdf](https://eventos.rnp.br/sites/default/files/activity/activity-presentation/painel1_pacheco.pdf) [22.11.17].
- 61 OECD. (2016). G20 Innovation Report 2016: Report prepared for the G20 Science, Technology and Innovation Ministers Meeting. Available at <https://www.oecd.org/china/G20-innovation-report-2016.pdf> [28.07.17].
- 62 The Casadinho Program aims to support collaboration between graduate programs of university centers of excellence and emerging graduate programs in less developed regions.
- 63 The New Boundaries Program seeks to decrease regional discrepancies by consolidating young graduate programs in the North, Center-West and Northeast.
- 64 Biotechnology Industry Organization. (2016). Building the Bioeconomy 4<sup>th</sup> Edition: National Biotechnology Industry Development Strategies Globally. Available at [http://www.pugatch-consilium.com/reports/BIO\\_2017\\_report\\_US.pdf](http://www.pugatch-consilium.com/reports/BIO_2017_report_US.pdf) [25.07.17].
- 65 L.O. Baptista. (2017). A federal statute establishes the National Biofuel Policy – RenovaBio. Available at <http://news.baptista.com.br/news/Texto.aspx?Texto=2249> [01.03.2018].

Table 2: Important measures for promoting the bioeconomy in Brazil

Key points	Policy measures	Concrete implementation
Promoting innovation	Public R&D funding	Revitalizing public funding, e.g. the National Fund for Scientific and Technological Development (FNDCT) Company Innovate Plan (Inova Empresa Plan) International funding (e.g. Horizon2020, bilateral initiatives)
	Research networks	National Institutes of Science and Technology (INCT) Program
	Stimulating private sector R&D	e.g. public-private partnerships
Supporting infrastructure & capacity building	Investment for R&D facilities and equipment	Infrastructure support programs, e.g. Profina Program
	Test and demonstration projects	
	Investment for capacity building	e.g. Human Resources Training Program in Strategic Areas (RHAE), National Program for Access to Technical Education and Employment (Pronatec) Inter-agency programs Inter-institutional master's (Minter) and doctoral programs (Dinter)
Supporting commercialization	Knowledge and technology transfer	
	Establishing multi-user scaling-up platforms	
	Modernizing the funding mechanism	
	Encouraging company start-ups and risk capital investment	
Supporting the demand-side	National biofuels policy RenovaBio	e.g. mandatory blends for biofuels, biofuels certification schemes and "decarbonization credits" for biofuels producers
Ensuring bioeconomy-friendly framework conditions	Reviewing the regulatory framework	Modernizing the patenting process and intellectual property rights
Enhancing international collaboration in the bioeconomy	International exchange of scientists	Science without Borders Program



# Canada



1

## Which bioeconomy-related strategies have been developed since 2015?

The Canadian government has not yet developed a dedicated national bioeconomy strategy.<sup>66</sup> In fact, bioeconomy development in Canada is dominated by regional approaches.<sup>67</sup> For example, the provinces of Sarnia and Ontario have focused on the development of biobased chemicals, while Drayton Valley and Alberta promote woody biomass production, and Winnipeg and Manitoba concentrate on biocomposite promotion.<sup>68</sup> The first federal policy approach to bioeconomy development was launched in 2017

with the adoption of a strategy paper named “**A Forest Bioeconomy Framework for Canada**”.<sup>69</sup>

After the election of the new government in 2017, the Ministry of Environment and Climate Change further published a regulatory framework for the world’s first national clean fuels standard, which promotes the country’s clean-tech economy and the development of lower carbon fuels.<sup>70</sup>

2

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

Yes No

X

The strategy’s understanding of bioeconomy refers particularly to all economic activities that focus on converting forest-based resources into traditional forest products (such as pulp, paper and lumber) and into new high value products and services (including biofuels, biochemicals and advanced build-

ing materials). In this respect, the strategy document highlights the knowledge-based, circular, competitive and innovative character of the bioeconomy which contributes to the sustainable production and utilization of bioresources.

### 3 Who is the author of the strategy?

The Forest Bioeconomy Framework was published by the Canadian Council of Forest Ministers (CCFM) which is composed of 14 federal, provincial and territorial forest ministers. Established as a forum for promoting cooperation across the forest sector, the CCFM invited more than 350 stakeholders from business, academia, indigenous groups and pub-

lic authorities to take part in the strategy development process. A public engagement campaign was launched in 2016 to collect visions for the future Canadian bioeconomy. The campaign encompassed a series of stakeholder dialogue events as well as an online survey and feedback loops.

### 4 What are the key goals of the strategies

The strategy's main goal is economic. The government seeks to increase the competitiveness of the Canadian forestry sector by promoting start-ups, new supply chains, new technologies and advanced manufacturing as well as the commercialization of innovative products. The bioeconomy is further seen as a means of contributing to rural development, specifically to job creation and the inclusion of in-

igenous people. The forest-based bioeconomy is considered important for achieving a low-carbon, highly innovative and sustainable future for Canadian society, and for coping with global challenges like climate change and energy security.

### 5 What are the priority areas of the strategies?

The focus of the Bioeconomy Framework is on the innovative use of non-traditional wood resources, for example from sustainably managed wood plantations, forest-industry residues or co-products, and non-merchantable trees (including trees killed by

natural disturbances). Biorefinery development is therefore highlighted for maximizing the value of biomass.

### 6 Is there a dedicated action plan with quantitative targets?

Yes No

X

## 7

**Which measures/instruments are used to promote the strategies?**

The forest bioeconomy strategy proposes a wide range of support measures. With regard to the promotion of innovation in the forest sector, the focus is on R&D into new ways of using forest biomass (including cellulose, hemicellulose and lignin). Collaboration among key stakeholders (including governments, forest-based businesses and indigenous people) and across sectors (particularly the agricultural sector) will be fostered by public-private partnerships. The strategy document seeks to leverage indigenous knowledge and indigenous bioproducts to foster innovation. The strategy supports continued public funding for existing innovation programs, such as FPInnovations and the National Research Council.

With a view to bioeconomy infrastructure development, the strategy document seeks to support cooperative and regional approaches to bioeconomy development. It highlights, for example, the establishment of a bioeconomy hub. This should bring together various stakeholders, with the aim of ensuring continuous learning from best practices. Access to bioeconomy-related networks and laboratories as well as the development of technology-driven business clusters are also considered important. The federal innovation budget also includes substantial support for innovative business clusters and networks. With this in mind, the Forest Products Association of Canada (FPAC) and its partners submitted a bioeconomy supercluster proposal. The cluster is named the “BioDesign Super Cluster” and will focus on a circular approach to maximizing the value of biomass feedstock. The cluster was designed to connect nationwide industry players and stakeholders and to facilitate knowledge transfer.<sup>71</sup> The strategy further supports building green infrastructure and green spaces (so-called urban forests) to foster low-carbon and healthy communities.

Capacity building is primarily supported by training programs in engineering, biobased technology, and forestry skills. The government also intends to support the placement of more bioeconomy graduates in the forest sector.

Commercialization is supported by measures improving access to capital for biobased companies, including debt and equity financing. Tax incentives (such as accelerated capital cost allowances, etc.) for forest bioeconomy ventures are also considered important for strengthening their competitiveness against fossil-based businesses.

The government also intends to support market development with the help of demand-side instruments, such as standards and certification schemes for sustainably produced bioproducts (e.g. lignin, pellets, and cellulose nanocrystals). Promoting updated building codes and standards will increase the share of wood in construction. Demand for biobased products should be further stimulated by outreach and marketing activities, including science-based communication and information campaigns, and the introduction of procurement strategies and programs.

The strategy emphasizes the promotion of bioeconomy-friendly framework conditions. For example, the Canadian government confirms its commitment to carbon pricing policies, which are intended to enter into force by 2018. The focus is also on improving policy coherence among existing initiatives.

In addition, there will be support for measuring and monitoring activities, such as life-cycle analysis and biomass data collection. In connection with this, the strategy also provides a first set of indicators for monitoring the progress made towards achieving a low-carbon forest bioeconomy in Canada. This includes indicators for measuring the contribution of biobased products and forest-based activities to the Canadian economy. It also highlights indicators for quantifying the value of forest ecosystem goods and services in addition to indicators that measure the forest bioeconomy’s contribution to the reduction of greenhouse gas emissions.



Table 3: Important measures for promoting the bioeconomy in Canada

Key points	Policy measures	Concrete implementation
Promoting innovation	Public R&D	e.g. public innovation programs (FPInnovations and the National Research Council)
	Considering indigenous knowledge & traditional bioproducts	
	Stimulating private sector R&D	e.g. public-private partnerships
Supporting infrastructure & capacity building	Bioeconomy hub	
	Access to networks and laboratories	
	Cluster development	
	Urban greening projects	e.g. urban forests & green urban spaces
	Training programs e.g. in engineering, biobased technology, and forestry skills	
Supporting commercialization	Access to capital for biobased companies	e.g. debt and equity financing
	Tax incentives	e.g. accelerated capital cost allowances
Supporting the demand-side	Standards and certifications	Certification schemes for sustainably produced biomass feedstock
		Updating building codes and standards
	Marketing	Communication and information campaigns
	“Green” procurement strategies and programs	
Ensuring bioeconomy-friendly framework conditions	Carbon pricing	
	Policy coherence	
Promoting Good Governance	Measuring and monitoring	Indicator development
		Life-cycle analysis
		Biomass data collection, management and communication

## REFERENCES

- 66 Renewable Matter. (2016). Biomass is the Engine of the Canadian Bioeconomy. Available at [http://www.renewablematter.eu/art/239/Biomass\\_is\\_the\\_Engine\\_of\\_the\\_Canadian\\_Bioeconomy](http://www.renewablematter.eu/art/239/Biomass_is_the_Engine_of_the_Canadian_Bioeconomy) [30.09.16].
- 67 Birch, K. (2016). Emergent Imaginaries and Fragmented Policy Frameworks in the Canadian Bio-Economy. *Sustainability* 2016, 8, 1007, doi:10.3390/su8101007.
- 68 IL BIOECONOMISTA. (2016). Murray McLaughlin, Bioindustrial Innovation: Canada is working on a bioeconomy strategy. Available at <https://ilbioeconomista.com/2016/06/14/murray-mclaughlin-bioindustrial-innovation-canada-is-working-on-a-national-bioeconomy-strategy/> [14.06.16].
- 69 Canadian Council of Forest Ministers Innovation Committee. (2017). A Forest Bioeconomy Framework for Canada. Available at <http://www.ccfm.org/pdf/CCFM%20Bioeconomy%20Framework%20-%20Discussion%20Paper%20-%20Feb2017.pdf> [29.09.17].
- 70 Biofuels Digest. (2017). Top 10 Trends driving the Canadian advanced bioeconomy. Available at <http://www.biofuelsdigest.com/bdigest/2017/05/01/great-leaf-forward-the-top-10-trends-driving-the-canadian-advanced-bioeconomy/> [03.05.17].
- 71 Canadian Biomass Magazine. (2017). Bio-based solutions for a low-carbon economy in Canada. Available at <https://www.canadianbiomassmagazine.ca/regulations/advancing-bio-based-solutions-for-a-low-carbon-economy-in-canada-6287> [20.10.17].

# USA



1

## Which bioeconomy-related strategies have been developed since 2015?

In 2015, the U.S. government renewed the federal “**Strategy for American Innovation**”. The document particularly highlights the need for investing in new technologies to develop future U.S. industries, such as the bioeconomy.<sup>72</sup>

Interestingly, the focus of the U.S. bioeconomy policy has changed in recent years: from a more holistic view of bio- and high-tech innovation across all economic sectors as portrayed in the 2012 Bioeconomy Blueprint, towards a more agricultural and bioresources-based vision. Building on a series of opportunity reports named “**Billion-ton Report**” (2005,

2011, 2016)<sup>73</sup>; an inter-agency vision to sustainably produce one billion tons of biomass by 2030 was adopted. The implementation of this billion-ton strategy is documented in the “**Federal Activities Report on the Bioeconomy**” which was published in February 2016 and provides an overview of publicly funded bioeconomy activities.<sup>74</sup> Consequently, in December 2016, the government adopted the “**Strategic Plan for a Thriving and Sustainable Bioeconomy**”<sup>75</sup>. The policy strategy intends to provide a framework for biomass-derived product development in the United States.

2

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

Yes No

X

The term bioeconomy is used in the innovation strategy (2015). The Federal Activities Report (2016) describes it as “global industrial transition of sustainably utilizing renewable aquatic and terrestrial biomass resources in energy, intermediate, and final products for economic, environmental, social, and national security benefits”.

The Strategic Plan for a Thriving and Sustainable Bioeconomy (2016) follows the newer direction of U.S. bioeconomy development and reflects a vision of a future clean energy economy rather than one of a holistic bioeconomy. The bioeconomy is defined as the “sustainable use of domestically produced renewable biomass for fuels, products, and power”.

### 3 Who is the author of the strategy?

The renewed Strategy for American Innovation was published by the National Economic Council and the White House Office of Science and Technology Policy in 2015.

The Federal Activities Report on the Bioeconomy can be seen as a multi-department vision. It was published in February 2016 by the Biomass Research and Development Board which is responsible for coordinating research and development activities concerning biobased energy and products across federal departments and agencies. The Biomass R&D Board is composed of representatives of the Department of Energy, Agriculture, Interior, Transportation, Defense, and the Environmental Protection Agency, the National Science Foundation, and the Office of Science and Technology Policy.

The Department of Energy (DOE) has been a key player in U.S. bioeconomy policy in recent years. Its Bioenergy Technologies Office (BETO), for example, developed the Strategic Plan for a Thriving and Sustainable Bioeconomy in 2016. The Department of Energy also initiated and commissioned the publication of the “Billion-ton Report” which estimates the amount of biomass available for future industrial applications. The 2016 report concludes that when combining all potentially available biogenic resources, such as agricultural and forestry resources, municipal and solid waste and algae production, more than one billion dry tons of biomass will be available by 2040.

### 4 What are the key goals of the strategies

The updated innovation strategy (2015) generally aims for economic growth and shared prosperity. Innovation should ensure the country’s long-term economic competitiveness by promoting strategic areas which will nurture future industries, create new jobs and increase the country’s productivity.

The “Billion Ton Bioeconomy Vision” and the Strategic Plan of 2016 are oriented towards sustainable development goals, specifically job creation, rural

development, optimal land use, energy security and the reduction of greenhouse gas emissions. The Billion-Ton Vision implies “tripling the size of today’s bioeconomy by 2030”. It seeks to remove existing barriers for an expanding bioeconomy and aims to increase diversity in the energy mix. In terms of bioenergy promotion, the strategic plan specifically targets the development of biofuels for the transport sector where other renewable energy sources are more difficult to apply.

**5 What are the priority areas of the strategies?**

The innovation strategy of 2015 identifies several strategic areas, such as the bioeconomy, that are supposed to have an enormous impact on the U.S. economy in the future. Specifically, they are expected to create entirely new industries and to contribute to strategic objectives, such as clean energy. Public R&D investment is considered highly relevant for the National Nanotechnology Initiative, the Materials Genome Initiative, the National Robotics Initiative and the Big Data Research and Development Initiative.

The Strategic Plan for a Thriving and Sustainable Bioeconomy (2016) seeks to leverage domestically produced biogenic resources for new industrial ap-

plications and renewable energy. The strategy highlights the importance of respecting the three pillars of sustainability. In this context, it particularly addresses four key areas: 1) enhancing the bioenergy value proposition by developing and demonstrating innovative and integrated value chains; 2) mobilizing the nation’s biomass resources by reducing costs and risks associated with feedstock quality and volume; 3) cultivating end-use markets and customers, for example in the heavy transport sector; 4) expanding stakeholder engagement and collaboration to address cultural and social barriers linked to bioenergy adoption and utilization.



**6 Is there a dedicated action plan with quantitative targets?**

Yes No  
X

None of the strategy papers contains a dedicated action plan; however the Strategic Plan for a Thriving and Sustainable Bioeconomy (2016) provides a set

of short-, medium- and long-term success indicators and milestones for measuring progress on the activities proposed.



**7 Which measures/instruments are used to promote the strategies?**

The renewed innovation strategy emphasizes the implementation of multi-disciplinary research activities. The strategy promotes fundamental research at universities, e.g. in the area of genomic research on bioenergy feedstock crops and unique microbes for bioproducts. Furthermore, the establishment of industry-led consortia intends to facilitate private investment in pre-competitive research. The Strategic Plan of 2016 seeks to promote innovation through public R&D support for conversion technologies, process intensification and performance improvements. Private investment should be motivated by public-private partnerships and the development of opportunity reports. The Federal Activities Report on Bioeconomy (2016) lists all relevant and existing

agency programs that promote bioeconomy development. With regard to the promotion of innovation, for example, it highlights funding for targeted research and technology development, national laboratories, research consortia and public-private partnerships to develop and transform biomass resources into commercial biofuels, bioproducts and biopower.

With regard to measures promoting infrastructure, the innovation strategy (2015) highlights support for building state-of-the art digital infrastructure. The Bioeconomy Strategic Plan (2016) emphasizes the development of pilot and integrated demo-scale facilities for innovative technologies and biomass supply chains. The Federal Activities Report on Bio-

economy (2016) further mentions support for multi-user facilities for researchers from universities, national laboratories and private institutions. In order to promote the biofuels infrastructure, for example, it emphasizes the Biofuels Infrastructure Partnership which provides around USD 100 million in grants to increase the number of fuel pumps nationwide that supply renewable fuels to American drivers.

The innovation strategy of 2015 proposes several capacity building measures, including education and training programs for both students and educators. In addition, the strategy plan supports formal and informal education and vocational training in STEM (science, technology, engineering and mathematics). Bioeconomy education and information programs are further proposed for policy makers at all levels of government. The bioeconomy vision document of 2016 also underlines the need to mobilize and develop a qualified workforce for the bioeconomy. It focuses on training programs for professionals and technical students and pledges support for career path information for high school students. Furthermore, career awards, ranging from USD 300,000–400,000 for 3 years, are intended to support early careers and tenure-track positions in the area of sustainable energy, biochemical engineering, process and reaction engineering etc.

The Strategic Plan for a Thriving and Sustainable Bioeconomy (2016) intends to push commercialization by developing smaller and short-term markets for biofuels and bioproducts. This should be facilitated by funding commercial-scale biorefineries and manufacturing facilities for biobased products. Domestic and international marketing programs will support U.S. producers of food, fiber and specialty crops by providing market reports, economic analysis and outreach activities.

BETO's Strategic Plan (2016) proposes several demand-side instruments. Public awareness of bioeconomy should be raised by a communication strategy and by establishing an expert stakeholder network to hold workshops and conferences. It also discusses pricing measures for fuels and sustainability requirements. The Federal Activities Report on Bioeconomy (2016) also emphasizes standards and certification schemes, including the Renewable Fuel Standard Program and the BioPreferred

Program. The latter, for example, promotes mandatory biobased product purchasing requirements for federal government agencies as well as voluntary bioproduct certification and labeling.

BETO's policy plan and the Federal Activities Report (2016) seek to improve the business conditions for biobased products. They propose a review of the regulatory framework with a view to developing and using new biobased products as well as alternative biogenic resources, such as waste and CO<sub>2</sub>.

Good Governance should be promoted by monitoring and measuring activities, including sustainability indicators and standards for feedstock valuation. Other measures highlighted by the innovation strategy (2015) are the exploration of ethical, legal and social implications of emerging technologies and the development of standards. With a view to policy coherence and capacity building, BETO's Strategy Plan (2016) supports jointly funded intra- and inter-agency working groups, personnel exchanges and memoranda of understanding between government authorities. The Federal Activities Report (2016) also emphasizes increased inter-agency collaboration to fully leverage governmental expertise. In this respect, for example, it highlights a Bioeconomy Federal Strategy Workshop which was organized by the Biomass R&D Board and was aimed at sharing information on existing agency programs and activities, identifying processes for working together and building a national federal government coalition to coordinate agency efforts.

International collaboration in the bioeconomy should be further enhanced through the U.S.' active membership in the Global Alliance for Climate-smart Agriculture (GACSA), a partnership of countries and international organizations committed to mitigating greenhouse gases in agricultural systems. It focuses on providing support for research and monitoring, data standardization and outreach activities. Also the U.S' engagement in the Global Bioenergy Initiative should be fostered by jointly developing international sustainability criteria and indicators.

Table 4: Important measures for promoting the bioeconomy in the USA

Key points	Policy measures	Concrete implementation
Promoting innovation	Public R&D	Plants Engineered to Replace Oil (PETRO) Program
		Transportation Energy Resources from Renewable Agriculture (TERRA) Program
		Physical Biosciences and Photosynthetic Systems programs
		National Laboratories and competitive grants to academic institutions
		Biomass Research and Development Initiatives
		Clean Water State Revolving Fund (CWSRF): funding for projects that produce biofuels and biopower from treatment of municipal wastewater
	Plant Genome Research Project	
	Technology development	e.g. Advanced Research Projects Agency-Energy (ARPA-E) awards (funding and technical assistance for energy researchers)
	Stimulating private sector R&D	e.g. industry-led consortia, public-private partnerships
	Open innovation	Hackathons, accelerators & online innovation marketplaces
	Opportunity reports	
Supporting infrastructure & capacity building	Establishing next-generation digital infrastructure	
	Grants for increasing the number of renewable fuel pumps	Biofuels Infrastructure Partnership
	Cluster development	
	Multi-user facilities	
	Integrated scale-up and demonstration facilities	
	Training and educational programs	
	Support for career path information	e.g. career awards
Supporting commercialization	Market development for biofuels and bioproducts	e.g. feasibility testing of biofuels in locomotives
	Domestic and international marketing programs for U.S. producers of food, fiber and specialty crops	incl. market reports, economic analysis, outreach, etc.
	Commercial-scale biorefineries and manufacturing facilities for biobased products	Biorefinery, Renewable Chemical, and Biobased Product Manufacturing Assistance Program (incl. loan guarantees)
		Repowering Assistance Program
		Advanced Biofuel Payment Program

Key points	Policy measures	Concrete implementation
<b>Supporting the demand-side</b>	Increasing public awareness for biorefineries, biofuels and bioproducts	Communication strategy
	Establishment of a stakeholder network that organizes conferences and workshops on bioeconomy	
	Increase in petroleum-derived fuel prices	
	Sustainability requirements for biomass feedstocks	
	Fuel certifications and standards	Farm to Fly 2.0 Initiative Renewable Fuel Standard Program Vehicle Corporate Fuel Economy standards
	Mandatory biobased product purchasing requirement for federal government agencies	BioPreferred program
	Voluntary bioproduct certification and labeling	
<b>Ensuring bioeconomy-friendly framework conditions</b>	Reviewing the regulatory framework	Federal Coordinated Framework for the Regulation of Biotechnology National regulations on waste management (e.g. Resource Conservation and Recovery Act) Regulation of industry and municipal wastewater discharges
	National standards to address carbon pollution from existing fossil-fuel fired power plants	Clean Power Plan
<b>Promoting Good Governance</b>	Monitoring and measuring activities	Developing sustainability indicators Developing standards for feedstock valuation Air, Climate, and Energy Research Program
	Intra- and interagency collaboration	Bioeconomy Federal Strategy Workshop
	Impact analysis on national bioeconomy policies	
<b>Enhancing international collaboration in the bioeconomy</b>	International monitoring	Global Alliance for Climate-smart Agriculture (GACSA) Global Bioenergy Initiative

## REFERENCES

- 72 The White House. (2015). A Strategy for American Innovation. Available at [https://obamawhitehouse.archives.gov/sites/default/files/strategy\\_for\\_american\\_innovation\\_october\\_2015.pdf](https://obamawhitehouse.archives.gov/sites/default/files/strategy_for_american_innovation_october_2015.pdf) [25.01.2017].
- 73 U.S. Department of Energy. (2016). 2016 Billion-ton Report: Advancing Domestic Resources for a Thriving Bioeconomy. Available at [https://energy.gov/sites/prod/files/2016/12/f34/2016\\_billion\\_ton\\_report\\_12.2.16\\_0.pdf](https://energy.gov/sites/prod/files/2016/12/f34/2016_billion_ton_report_12.2.16_0.pdf) [04.12.17].
- 74 Biomass Research and Development Board. (2016). Federal Activities Report on the Bioeconomy. Available at [https://energy.gov/sites/prod/files/2016/02/f30/farb\\_2\\_18\\_16.pdf](https://energy.gov/sites/prod/files/2016/02/f30/farb_2_18_16.pdf) [25.01.2017].
- 75 U.S. Department of Energy. (2016). Strategic Plan for a Thriving and Sustainable Bioeconomy. Available at [https://www.energy.gov/sites/prod/files/2016/12/f34/beto\\_strategic\\_plan\\_december\\_2016\\_0.pdf](https://www.energy.gov/sites/prod/files/2016/12/f34/beto_strategic_plan_december_2016_0.pdf) [25.01.2017].

# Asia/Pacific



In addition to Japan and Malaysia, Thailand also adopted a national bioeconomy roadmap in 2017. Bioeconomy development in Asia is generally strongly oriented towards high-tech and industrial innovations, as reflected by bioeconomy-related policy strategies in China, India, Russia, South Korea and Sri Lanka. In Australia, the federal state of

Queensland has recently adopted a dedicated roadmap for bio-industry development. In contrast, New Zealand continues to concentrate on further growth and value-creation in the primary industries.



Country	Perspective	Document Name
Australia	High-Tech	“Queensland Biofutures 10-Year-Roadmap and Action Plan” (2016)
	Blue Economy	“National Marine Science Plan 2015–2025” (2015)
	Research & Innovation	“National Collaborative Research Infrastructure Strategy” (2013)
	Bioenergy	“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	Research & Innovation	13 <sup>th</sup> FYP for Science, Technology and Innovation (2016)
	High-Tech	13 <sup>th</sup> FYP for Strategic Emerging Industries (2016)
		13 <sup>th</sup> FYP on Bioindustry Development (2016)
		“12 <sup>th</sup> FYP on Bioindustry Development” (2012)
		“12 <sup>th</sup> FYP (2011-2015) on Agricultural Science and Technology Development” (2012)
	“12 <sup>th</sup> FYP for National Strategic Emerging Industries” (2012)	
India	High-Tech	“National Biotechnology Development Strategy (Biotech Strategy II)” (2007, 2014)

See further policy strategies on the next page →

Country	Perspective	Document Name
Indonesia	Bioenergy	"Grand Agricultural Strategy" (2015)
	Biobased Economy	"National Energy Policy" (2014)
	Research & Innovation	
Japan	Bioenergy	"Strategic Energy Plan" (2014)
	Research & Innovation	"National Science and Technology Strategy" (2013)
	Holistic Bioeconomy Development	"Biomass Industrialization Strategy" (2012)
		"National Strategy and Action Plan for Biodiversity 2012-2020" (2012)
		"National Plan for the Promotion of Biomass Utilization" (2010)
"Biomass Nippon Strategy" (2002)		
Malaysia	Holistic Bioeconomy Development	"National Biomass Strategy" (2 <sup>nd</sup> 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	Research & Innovation	"Primary Sector Science Roadmap – Te Ao Turoa" (2017)
	Bioenergy	"Biological Industries Research Fund" (2013)
	Biobased Economy	"Business Growth Agenda" (2012)
		"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	"3 <sup>rd</sup> Basic Plan for Science and Technology" (2013)
		"Strategy for Promotion of Industrial Biotechnology" (2012)
		"Blue-Bio 2016 Plan" (2008)
		"2 <sup>nd</sup> Framework Plan for Promotion of Biotechnology, Bio-Vision 2016" (2006)
Sri Lanka	High-Tech	"National Biotechnology Policy" (2010)
Thailand	Holistic Bioeconomy Development	"Bioeconomy Roadmap" (2017)
		"National Biotechnology Policy Framework" (2004–2011; 2012–2021)
	High-Tech	"Alternative Energies Development Plan 2012–2021"
	Bioenergy	"BioPlastics Roadmap" (2008)



# Australia



1

## Which bioeconomy-related strategies have been developed since 2015?

Even though the Australian Government has not yet developed a holistic national bioeconomy strategy, it provides support for bioeconomy-related research and development. In 2015, it announced a new set of national science and research priorities which integrate key topics of the bioeconomy, including food, soil and water, energy and advanced manufacturing research.<sup>76</sup>

Apart from these national efforts, bioeconomy development in Australia is very much characterized by regional approaches. In 2015, a major initiative was launched by the Federal State of Queensland that adopted the AUD 1 billion (around USD 780

million) **“Queensland Biofutures 10-Year-Roadmap and Action Plan”** (2016).<sup>77</sup> It is part of the regional “Advance Queensland” initiative under which the Department of State Development is commissioned to develop roadmaps for emerging and promising industries, such as advanced manufacturing, biomedical/life science and the bioindustry. The Biofutures initiative particularly seeks to foster knowledge and technology transfer by promoting collaboration among entrepreneurs and researchers from universities and public organizations. In this respect, the Biofutures Roadmap expresses the State’s vision for bioindustry development until 2026.

2

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

Yes

No

X

The policy strategy does not use the term “bioeconomy” as such. In the Queensland Roadmap, the term “biofutures” relates to bioindustry, more specifically

to a strong and sustainable industrial biotechnology and bioproducts sector.

### 3 Who is the author of the strategy?

The Biofutures Roadmap was published by the Queensland Department of State Development in 2016. It is based on a foresight report which assess-

es input and feedback from business and industry representatives active in industrial biotechnology and the biobased products sector.

### 4 What are the key goals of the strategies

The Biofutures Roadmap of 2016 mainly seeks to promote Queensland's future economic development by supporting the industrial biotechnology and biobased products sector. Investment in these high-value and knowledge-intensive industries is expected to increase economic growth and create

new jobs, particularly in rural areas and regional centers.<sup>78</sup> By greening the State's economy, Queensland also seeks to achieve environmental and climate-protection goals, e.g. a low-carbon footprint of manufacturing.

### 5 What are the priority areas of the strategies?

Queensland's Biofutures Roadmap indicates that in the short term, development of biofuels from agricultural resources will be the key priority, as the market for transport fuels is already well established. In the long term, the policy paper pursues a diversification strategy. The development of other biobased products, such as biochemicals, bioplastics or composite

biomaterials is expected to evolve in parallel with advancements in process and technology development. In this respect, the Roadmap highlights alternative bioresources for industrial development, such as forestry and algae feedstock, organic and biogenic waste resources.

### 6 Is there a dedicated action plan with quantitative targets?

Yes No

X

The Biofutures Roadmap of Queensland includes an action plan which focuses on three areas of policy support: 1) promoting specific industry development initiatives; 2) identifying and promoting investment opportunities; and 3) providing strong government

leadership. Implementation of the actions pursued should result in a sustainable and export-oriented industrial biotechnology and bioproducts sector worth AUD 1 billion by 2026 (around USD 780 million).

## 7

## Which measures/instruments are used to promote the strategies?

As part of the AUD 518 million (around USD 399 million) “Advance Queensland” initiative<sup>79</sup>, the Biofutures Roadmap concentrates mainly on policy interventions supporting innovation and commercialization in the bioindustry, including demand-side measures. With regard to support for innovation and commercialization in the bio-industry, over three years the State of Queensland intends to invest AUD 20 million (almost USD 15 million) in four key measures<sup>80</sup>: AUD 5 million (around USD 4 million) will be provided for the Biofutures Industry Development Fund, mainly for early stage funding for industrial biotechnology-focused projects and for financing a Research Chair of Advanced Biofuels.<sup>81</sup> An additional AUD 3 million (around USD 3 million) will be invested in the Biofutures Acceleration Program for the development of new commercial-scale biorefinery projects in Queensland.<sup>82</sup> With the AUD 5 million (around USD 4 million) Biofutures Commercialization Program, the Government of Queensland aims to promote pilot and demonstration projects for improved technologies and processes. These should boost cooperation among bioindustry experts, public

research institutes and businesses.<sup>83</sup> USD 4 million is basically provided to develop the Biofutures industry in Queensland and should stimulate further investment and R&D in industrial biotech and bioproducts.

With respect to fostering market uptake and demand, the Roadmap proposes a specific public procurement policy for bioproducts. The roadmap also provides for the development of a marketing and communication campaign. Cooperation with the Australian federal government on fuel quality standards should be strengthened with a view to supporting biofuel development.

In terms of good governance measures, the Roadmap envisages the establishment of a Biofutures Cabinet Committee and a Biofutures Interdepartmental Committee with the intention of promoting interdepartmental collaboration and policy coherence. At the end of 2016, an “Industry Envoy” was appointed to advise the government on implementation of the roadmap.<sup>84</sup>

## REFERENCES

- 76 Australian Government. (2017). Science and Research Priorities. Available at <http://science.gov.au/scienceGov/ScienceAndResearchPriorities/Pages/default.aspx> [07.02.17].
- 77 Queensland Government. (2016). Queensland Biofutures 10-Year Roadmap and Action Plan. Available at <http://www.statedevelopment.qld.gov.au/resources/plan/biofutures/biofutures-10yr-roadmap-actionplan.pdf> [06.02.17].
- 78 O'Hara, I. M. & Glenn, D. (2017). The Economic Case for Bioeconomy Development in Australia. *Industrial Biotechnology*, 2017, 13(2): 65-68.
- 79 The Government of Queensland intends to invest AUD 518 million over four years to create the knowledge-based jobs of the future.
- 80 Queensland Government. (2017). Queensland Biofutures 10-Year Roadmap and Action Plan. Available at <http://advance.qld.gov.au/our-vision/roadmaps/biofutures.aspx> [28.04.17].
- 81 Queensland Government. Department of State Development. (2016). Biofutures Industry Development Fund. Available at <http://www.statedevelopment.qld.gov.au/industry-development/biofutures-industry-development-fund.html> [28.04.17].
- 82 Queensland Government. Department of State Development. (2017). Biofutures Acceleration Program. Available at <http://www.statedevelopment.qld.gov.au/industry-development/biofutures-acceleration-program.html> [28.04.17].
- 83 Queensland Government. (2017). Biofutures Commercialization Program. Available at <http://advance.qld.gov.au/uni-researchers/biofutures-commercialisation-program.aspx> [28.04.17].
- 84 Queensland Government. Department of State Development. (2016). Biofutures Queensland. Available at <http://www.statedevelopment.qld.gov.au/industry-development/biofutures-queensland.html> [28.04.17].

Table 5: Important measures for promoting the bioeconomy in Australia

Key points	Policy measures	Concrete implementation
Promoting innovation	Public R&D funding	Advance Queensland Initiative: grants to research organizations
	Research fellowships	Advance Queensland Initiative: financial support for post-doctoral industry research projects
Supporting infrastructure	Biorefinery demo plants	Biofutures Acceleration Program
	Pilot and demonstration projects	Biofutures Commercialization Program
Supporting commercialization	Knowledge and technology transfer	Advance Queensland Initiative
	Angel and venture capital investment	Business Development Fund
	Investment in industrial biotech and bioproducts	Biofutures Queensland
Supporting the demand-side	Fuel quality standards	Queensland Biofuel Mandate: sales quota for ethanol-blended regular unleaded petrol and biobased diesel
	Awareness creation	Marketing and communication campaign
	Public procurement	Queensland Government bioproduct procurement policy
Promoting Good Governance	Advisory	Appointment of Biofutures Industry Envoy
	Inter-ministerial cooperation	Biofutures Interdepartmental Committee
		Biofutures Cabinet Committee
	Monitoring and evaluation activities	Australian Biomass for Bioenergy Assessment

# China



## 1 Which bioeconomy-related strategies have been developed since 2015?

In China, political interest in the bioeconomy relates strongly to the promotion of biotechnology development. Appropriate policies have already been promoted since the 1980s and have made a major contribution to helping China become one of the leading biotechnology players worldwide.<sup>85</sup> For example, biotechnology development was a prominent topic in the 11<sup>th</sup> and the 12<sup>th</sup> Five-Year Plan for Economic and Social Development (FYP) and the related

sub-plans.<sup>86</sup> And the latest **13<sup>th</sup> FYP (2016)** also highlights biotechnology as an engine for sustainable development.<sup>87</sup> Development of the biobased economy is further promoted by various sub-plans, including the **13<sup>th</sup> FYP for Science, Technology and Innovation (2016)**<sup>88</sup>, the **13<sup>th</sup> FY Development Plan for Strategic Emerging Industries (2016)**<sup>89</sup> and, more specifically, by the **13<sup>th</sup> FYP on Bioindustry Development (2016)**<sup>90</sup>.

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

Yes No

X

While the overarching 13<sup>th</sup> FYP uses the term biotechnology, the 13<sup>th</sup> FYP on Bioindustry Development uses the term bioindustry to describe a new Chinese economic paradigm. Based on global bioeconomy developments, the plan defines opportunities for Chinese socio-economic development. Bioindustry is mentioned as the most influential industry of the 21<sup>st</sup>

century. In the Chinese context, it particularly covers the health sector (including biopharma and biomedicine<sup>91</sup>), agriculture, manufacturing and bioenergy. Furthermore, it includes the field of environmental technologies and biotechnology services, including research and development, contract manufacturing, public technical services, etc.<sup>92</sup>



### 3 Who is the author of the strategy?

Policy development in China is characterized by a top-down approach. The 13<sup>th</sup> Five Year policy documents were prepared by governmental authorities. After a consultation process by the Central Committee of China's Communist Party, the 13<sup>th</sup> Five-

Year-Plan for Economic and Social Development was approved by the National People's Congress for the period from 2016 to 2020. Following this, the Chinese State Council published the related sub-plans during the second half of 2016.

### 4 What are the key goals of the strategies

The overall goal of the 13<sup>th</sup> Five-Year-Plan for Economic and Social Development is to promote a "moderately prosperous society". The policy strategy pursues an innovation-driven approach to ensure continued economic growth, increased standards of living and good quality of life. With this plan, the government intends to move up the value chain and make China a "world powerhouse of scientific and technological innovation" by 2050. The strategy

also highlights the need to better balance economic growth and environmental protection.

The 13<sup>th</sup> FYP on Bioindustry Development particularly seeks to guide China towards becoming a leading bioindustry player in the world.

### 5 What are the priority areas of the strategies?

Innovation in agriculture and food production remains a key priority. In the area of bioenergy, the focus is on promoting non-food biomass for electricity, biofuels and heating. For example, the 13<sup>th</sup> FYP on Bioindustry Development highlights the use of non-food resources, such as agricultural residues and non-edible oils, cellulose, and algae resources, to produce biodiesel and bioethanol.

The strategy plans further emphasize the promotion of environmental and recycling technologies to improve water and soil quality, foster circular production, reduce carbon emissions and protect biodiversity. For example, the 13<sup>th</sup> FYP on Bioindustry Development focuses on increasing R&D for microbial remediation technologies as well as for recycling nutrients from waste water.

As the biopharma and the biomedicine sector already represent an important part of Chinese bioindustry, the focus of the 13<sup>th</sup> development plans is on fostering biopharmaceutical R&D (including new drugs, antibiotics and vaccines, but also marine-derived pharmaceuticals). With regard to the biomedicine sector, the plans also seek to promote innovative medical devices, techniques and drugs that take into account traditional Chinese medicine. Information and communication technologies should further contribute to establishing databases and knowledge bases of ancient writings on traditional Chinese medicine.

Other central topics of the sub-plans include the promotion of advanced manufacturing technologies (including bionic production, artificial intelligence, carbon capture, biobased 3D-printing, bioinformatics and biosensors) and the development of applications combining several key technologies, such as nanotechnology, biotechnology and ICT.

## 6 Is there a dedicated action plan with quantitative targets?

Yes No  
X

The 13<sup>th</sup> development plans include a series of actions but do not provide a dedicated action plan. However, the strategy documents foresee the development of several action plans concerning such issues as promotion of ecosystem conservation, climate change mitigation, advanced agricultural production, biofuels development, digitization, etc.

Each of the strategy documents further contains a set of quantitative targets. For example, the 13<sup>th</sup> FYP for Science, Technology and Innovation targets

increasing the R&D share of GDP, the revenue of high-tech enterprises and the number of patents filed. More specifically, the 13<sup>th</sup> FYP on Bioindustry Development seeks, amongst other things, to increase bioindustry's share of GDP to 4% and to raise annual sales of biotechnological products to CNY 10 billion (around USD 1.6 billion) by 2020. It further aims to reduce annual carbon dioxide emissions by 100 million metric tons by promoting the development of bioenergy.

## 7 Which measures/instruments are used to promote the strategies?

The 13<sup>th</sup> development plans provide a holistic approach to encouraging bioeconomy-related development in China. With a view to promoting industrial innovation, the 13<sup>th</sup> FYP for STI mainly fosters public-private cooperation for demonstration projects relating to biobased products and materials. The sub-plan further highlights the promotion of interdisciplinary and multi-disciplinary research, e.g. in the area of “omics” research and big data or for the advancement of gene editing technologies. It also emphasizes the need to create gene banks and molecular breeding platforms to encourage the exchange of ideas and information among the research community. One of the priority areas identified by all the FYPs of 2016 is biotechnology and its application in various sectors. The sub-plans put emphasis on crop breeding technologies. Precision agriculture practices are mentioned as important for improving efficiency, quality and safety. With a view to ecological, nutritional and health impacts, the government supports public R&D for biological feed additives (such as enzymes, amino acids, vitamins, probiotics, etc.) as well as for biopesticides.

Infrastructure measures mentioned in the strategy documents relate to the establishment of new laboratories, study centers, platforms and networks for fostering biotechnology development. In particular,

the aim should be to improve innovation capability and competitiveness in the regions by developing industrial clusters and building transregional innovation networks and consortia. In connection with this, the government intends to establish the cities of Beijing and Shanghai as Science and Innovation Hubs.

Training and education measures are given high priority in the plans. They emphasize further implementation of the National Medium and Long Term Development Planning of Biotechnology Talents (2010–2020), which focuses on business management trainings for biotech professionals and entrepreneurs, as well as special training support for young researchers. The government seeks to promote more school-enterprise cooperations and biotech companies are to be encouraged to establish postdoctoral positions. Implementation of the policy papers is supported by several talent promotion plans and projects, including the “1000-Talent Plan”, the “Promotion Plan for Innovative Talents” and the “Development Plan for Outstanding Young Talents”, which seek to create appropriate conditions to attract international talents to China.<sup>92</sup>

With regard to the promotion of commercialization of biobased solutions and products, the 13<sup>th</sup> Five-Year-

Plan for Economic and Social Development seeks to attract private capital investment (including foreign capital) for sustainable development projects, for example in the area of green urbanization, clean and new energy, circular economy, ecological farming, and forestry. The government proposes to further develop the green bonds markets. It supports the establishment of green industry funds as well as green stock indices. The policy plan also mentions tax incentives for companies that invest in high-priority areas (including bio-tech). These include super deductions for R&D costs, exemptions from VAT, reduced corporate tax rates and special tax rates for technology transfer. The 13<sup>th</sup> FYP on Bioindustry Development focuses on international market development by establishing overseas R&D centers, production facilities, and sales networks. It also aims to promote international mergers and acquisitions.

Demand-side instruments mentioned in the 13<sup>th</sup> FYP on Bioindustry Development refer to subsidies for biofuels and biobased products, public procurement policies for biobased products, as well as the promotion of national and international standards and product certifications.

Bioeconomy-friendly framework conditions identified in the 13<sup>th</sup> development plans concentrate particularly on reviewing the regulatory framework, e.g. for intellectual property rights and the introduction of genetically modified products.

The strategy documents also focus on measures related to good governance. They particularly highlight the need for fostering policy coherence. More specifically, the 13<sup>th</sup> FYP on Bioindustry Development stresses increased monitoring and evaluation activities, including the monitoring of new biotechnologies. It also mentions, however, the establishment of a national information platform on biomass resources in order to promote their efficient production and utilization.

Finally, international collaboration should be enhanced mainly by international and inter-governmental cooperation, i.e. by endorsing the co-financing of joint R&D projects and implementing bilateral and multilateral science and technology agreements.

---

## REFERENCES

- 85 Austrian Embassy Beijing. (2016). *Wissenschaft und Technologie in China*. Available at <http://www.austria-scitech-china.at/wp-content/uploads/2016/10/OSTA-Beijing-Wissenschaft-und-Technologie-in-China-2016-FINAL.pdf> [07.02.17].
- 86 German Bioeconomy Council. (2015). *Bioeconomy Policy (Part II): Synopsis of National Strategies around the World*. Available at [http://bioekonomierat.de/fileadmin/international/Bioeconomy-Policy\\_Part-II.pdf](http://bioekonomierat.de/fileadmin/international/Bioeconomy-Policy_Part-II.pdf) [19.07.17].
- 87 National Development and Reform Commission. (2016). *The 13<sup>th</sup> Five-Year Plan for Economic and Social Development of the People's Republic of China (2016-2020)*. Available at <http://en.ndrc.gov.cn/newsrelease/201612/P020161207645765233498.pdf> [24.11.17].
- 88 Ministry of Science and Technology of the People's Republic of China. (2016). *“十三五”国家科技创新规划*. Available at [http://www.most.gov.cn/mostinfo/xinxifenlei/gjkjgh/201608/t20160810\\_127174.htm](http://www.most.gov.cn/mostinfo/xinxifenlei/gjkjgh/201608/t20160810_127174.htm) [10.02.17].
- 89 The Chinese State Council. (2016). *“十三五”国家战略性新兴产业发展规划*. Available at [http://www.gov.cn/zhengce/content/2016-12/19/content\\_5150090.htm](http://www.gov.cn/zhengce/content/2016-12/19/content_5150090.htm) [24.11.17].
- 90 National Development and Reform Commission. (2016). *“十三五”生物产业发展规划*. Available at <http://www.ndrc.gov.cn/zcfb/zcfbghwb/201701/W020170112411581437678.pdf> [24.11.17].
- 91 OECD. (2016). *G20 Innovation Report 2016 – Report prepared for the G20 Science, Technology and Innovation Ministers Meeting*. Available at <https://www.oecd.org/china/G20-innovation-report-2016.pdf> [09.08.17].
- 92 Wang, R., Cao, Q., Zhao, Q. & Li, Y. (2018). *Bioindustry in China: An overview and perspective*. *New BIOTECHNOLOGY*, 40(2018), 46-51.

Table 6: Important measures for promoting the bioeconomy in China

Key points	Policy measures	Concrete implementation
Promoting innovation	Public R&D	e.g. center for genetic engineering application Gene bank e.g. molecular breeding platform
	Stimulating private sector R&D	e.g. public-private partnerships
Supporting infrastructure & capacity building	Investment for R&D facilities and equipment	Laboratories, platforms and networks
	Cluster development	
	Transregional innovation networks and consortia	
	Science and Innovation Hubs (Beijing and Shanghai)	
	Training and education	National Medium and Long Term Development Planning of Biotechnology Talents (incl. business management trainings for biotech professionals, training support for young researchers, school-enterprise cooperation etc.)
Supporting commercialization	Encouraging private capital	Developing green bonds markets and green guarantee mechanisms Green industry funds
	International market development	Establishing overseas R&D centers, production facilities and sales networks Overseas mergers and acquisitions
	Tax incentives	e.g. deduction of R&D costs and exemptions from VAT for biobased companies, reduced corporate tax rates and special tax rates for technology transfer
Supporting the demand-side	Subsidies for biofuels and biobased products	
	Public procurement policy for biobased products	
	National and international standards and certifications	
Ensuring bioeconomy-friendly framework conditions	Reviewing the regulatory framework	e.g. on intellectual property rights and the introduction of genetically modified products
Promoting Good Governance	Monitoring and measuring activities	National information platform on biomass resources Monitoring new technologies
	International and inter-governmental cooperation	Co-financing joint R&D projects Bilateral and multilateral science and technology agreements

ANALYSIS...



WORLD

WORLD

SCA



# New Zealand

## 1 Which bioeconomy-related strategies have been developed since 2015?

In June 2017, the New Zealand Government published the bioeconomy research strategy “**Primary Sector Science Roadmap – Te Ao Turoa**”<sup>93</sup>. The Roadmap is based on the National Statement of

Science Investment 2015–2025 and provides a 10 to 20-year outlook for future science needs and opportunities for further developing New Zealand’s bioeconomy.

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

Yes No

X

The term bioeconomy is prominently used in the strategy document and is defined as the “set of economic activities relating to the invention, development, production and use of biological products

and processes“. New Zealand’s bioeconomy policy thus focuses mainly on innovations in the primary sector, including agriculture, forestry, fisheries and aquaculture.

## 3 Who is the author of the strategy?

The Ministry for Primary Industries initiated the development of the bioeconomy research strategy. The strategy development process was accompanied by several stakeholder workshops. A dedicated Working Group and a Strategic Advisory Committee were also

established to support elaboration of the strategy. In June 2017, the Ministry for Primary Industries published the final strategy document which is also supported by the Minister of Science and Innovation and the Prime Minister’s Chief Science Advisor.

## 4 What are the key goals of the strategies

The main goal of the bioeconomy science roadmap is to promote sustainable growth for New Zealand. The strategy document recognizes increasing global challenges, such as climate change and environmental protection, but also seeks to respond to changes

in global trade, consumer demand and technology development. It therefore strives for a more diversified and resilient economy to enhance the country's competitiveness.



## 5 What are the priority areas of the strategies?

The bioeconomy science roadmap prioritizes promoting knowledge and innovation in primary production and product development. The strategy highlights the need for sustainable and effective resource protection and management. Bioprospecting activities and precision management practices in particular are intended to contribute to an improved understanding of ecosystem services and natural resources and facilitate their efficient and sustainable utilization. At the same time, public research should also focus on understanding the long-term external effects of the primary sector's activities and on promoting innovations in biosecurity. Further public R&D investment targets innovations in genetics in order to improve breeding systems, increase plant, animal and human health and advance nutrient, soil and water management.

The prominent role of indigenous knowledge for promoting innovations in the primary sector is characteristic for the strategy document. Indigenous knowledge and solutions, particularly relating to sustainable land and water management, should be integrated into public science and research. Indigenous approaches should also be considered in the development of new food, fiber and biomaterial products.

The strategy aims to promote higher value products and services from biogenic resources, such as new wood products, biofuels, biopharmaceuticals, biomedicines and advanced biomaterials. In this context, biorefinery development is mentioned as being highly important. Particular emphasis is also placed on novel food resources, such as plant-based proteins and synthetic foods, aimed at fostering alternative meat products. The application of new technologies (including advanced engineering, nanotechnology, sensor technology, 3D-printing, automation, robotics, artificial technology, etc.) is considered vital for increasing efficiency in production and processing while also reducing environmental effects. The role of digital technologies is also highlighted in connection with this.

In addition, the strategy focuses on the demand-side. It highlights, for example, the need for increased research in social science. Understanding of consumer behavior and preferences is therefore seen as a prerequisite for the successful transition to a bioeconomy. It also proposes to explore the cultural and social perception of bioeconomy, especially with regard to new technology developments.

## 6 Is there a dedicated action plan with quantitative targets?

Yes No  
X

## 7 Which measures/instruments are used to promote the strategies?

To promote the implementation of the bioeconomy science roadmap, the document addresses various stakeholders, including scientists and research teams, science and research institutions, industry research organizations, primary sector business and enterprises, indigenous people as well as funding agencies and policy-makers. The strategy suggests a comprehensive set of measures to promote primary sector development. Funding for these measures is provided, for example, by public science funds, state sector organizations, public science and R&D funds with industry/non-governmental contributions in addition to industry organizations and business.

The strategy seeks to increase public R&D investment in science and research organizations and also to support partnerships with indigenous people and the private sector (e.g. public-private partnerships). Newer approaches, such as citizen science, should also be considered.

With regard to infrastructure development, the strategy particularly focuses on expanding the research infrastructure (including the provision of research vessels and high-performance computers) and on promoting the digital infrastructure, e.g. for big data applications.

The strategy recognizes the challenges of building a highly skilled workforce for the bioeconomy. Capacity building measures encourage interdisciplinary, cross-sectoral and inter-cultural approaches. Skills in engineering and technology are considered just as

important as skills in leadership, marketing management and commercialization. Better integration of indigenous knowledge and approaches also requires improved language skills, cultural awareness and mutual learning.

Demand-side instruments emphasized include the development of labels and certifications for biobased products. Consumer awareness of bioeconomy should be strengthened by effectively communicating research findings and by science-based marketing activities for biobased products.

In order to ensure bioeconomy-friendly framework conditions, the strategy looks at international protocols and standards for intellectual property. In connection with this, mechanisms relating to IP rights should also be developed to protect indigenous assets and resources. The strategy further focuses on fostering global data policies, including data access and security mechanisms, and an open data commons policy. It highlights the need to develop legislation for the use and application of new genetic technologies.

The Roadmap also provides measures for promoting good governance. This includes, for example, monitoring and evaluating the strategy implementation which should result in the development of best practices. A new Roadmap Steering Group, composed of stakeholders from industry, science, indigenous and governmental organizations, should be established for this purpose.

### REFERENCES

- 93 Ministry of Primary Industries. (2017). Primary sector science roadmap – Te ao tūroa. Available at <https://www.mpi.govt.nz/news-and-resources/science-and-research/primary-sector-science-roadmap-te-ao-turoa/> [12.03.18].



Table 7: Important measures for promoting the bioeconomy in New Zealand

Key points	Policy measures	Concrete implementation
Promoting innovation	Public R&D	Global Research Alliance
		Primary Growth Partnership
		Strategic Science Investment Fund
		Endeavour Fund
		National Science Challenge
Supporting infrastructure & capacity building	Expanding the research infrastructure	Provision of research vessels and high-performance computers
	Promoting the digital infrastructure	
	Interdisciplinary, cross-sectoral and inter-cultural skills training	
Supporting the demand-side	Labels and certifications for biobased products	
	Science-based marketing activities for biobased products	
	Effective communication of research findings	
Ensuring bioeconomy-friendly framework conditions	International protocols and standards for intellectual property	
	Fostering global data policies	
	Legislation for the use and application of new genetic technologies	
Promoting Good Governance	Monitoring and evaluation of the strategy implementation	Establishing a Roadmap Steering Group



# Thailand

## 1 Which bioeconomy-related strategies have been developed since 2015?

The Thai government actively promotes the country's transition to a value-based, innovative, and technology-driven economy. The bioeconomy plays a key role in this transition process, which is reflected, for example, in the announcement of the **Thailand 4.0 program (2015)**.<sup>94</sup> This innovation strategy identifies 10 future industries that will drive economic development. Among them are five existing industries that are expected to be subject to substantial innovation, for example agriculture and food. Five new industries are envisioned in this strategy. The bioeconomy is considered as one of these new S-curve industries and includes biofuels & biochemicals.<sup>95</sup>

To accelerate bioeconomy development in Thailand, the National Reform Assembly Steering Committee published a reform proposal in March 2016, which suggests placing the bioeconomy on the national agenda and developing a dedicated national policy strategy. These recommendations were taken into account by key industrial and policy stakeholders who drafted a dedicated **Bioeconomy Roadmap** in 2017.

Bioeconomy development in Thailand is also promoted by related policy strategies, such as the **Alternative Energy Development Plan (AEDP)**<sup>96</sup>, for which the government has published a revised version for the period from 2015 to 2036.

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

Yes No

X

According to the roadmap document of 2017, the term bioeconomy mainly covers the economic sectors of bioenergy, biochemicals, food and feed for the future, as well as biopharmaceuticals.<sup>97</sup>

### 3 Who is the author of the strategy?

The Thailand 4.0 strategy was developed under the patronage of the Prime Minister in 2015. The Bioeconomy Roadmap (2017) was drafted by a high-level public-private partnership, known as the Pracharath Collaboration, which was set up to implement the Thailand 4.0 strategy. The Pracharath Collaboration steering committee is co-chaired by the Deputy Prime Minister of Thailand and the Chairman of the Thai Chamber of Commerce. The effort was led by the Working Group on New S-Curve Development

under the auspices of the Ministry of Industry and the PTT Global Chemical Public Company Limited. The document was published in January 2017, when 23 partners from the government, public research and industry came together to sign a Memorandum of Understanding to kick off the collaboration on bioeconomy. The Ministry of Energy and the Ministry of Science and Technology were involved in this ceremony. The roadmap is expected to be approved by the new cabinet in early 2018.

### 4 What are the key goals of the strategies

The Thailand 4.0 strategy (2015) envisages facilitating the so-called 4<sup>th</sup> industrial revolution, which is characterized by the aggregation of physics, digital and biological technologies. The strategy seeks to develop 10 future industries which will form the basis of a knowledge-based economy and boost the country's competitiveness. Sustainable and, in particular, inclusive social development are key goals of the strategy.

The Bioeconomy Roadmap (2017) was defined to achieve the goals of the Thailand 4.0 strategy. More specifically, Thailand is to become a bio hub in the Association of Southeast Asian Nations (ASEAN) and the world – implying that Thailand will become a center of bioeconomy innovation and a key player in global bioeconomy value chains.

### 5 What are the priority areas of the strategies?

Thailand is one of the world's leading suppliers of agricultural products (including cassava, sugarcane, rice, soybean, peanut and palm oil). In order to maintain the country's competitiveness in food and agriculture, the Thailand 4.0 strategy highlights the need to further improve agricultural production and efficiency via innovation and the adoption of new technologies.

The strategy generally highlights the business potential resulting from advancements in the area of biotechnology. This is specified by the Bioeconomy Roadmap of 2017 which concentrates on biorefinery development based on local feedstocks. Moreover, Thailand aims to become a hub for producing biopharmaceuticals, functional foods and advanced vaccines in the ASEAN region.

6

## Is there a dedicated action plan with quantitative targets?

Yes No

X

The Thailand 4.0 document (2015) sets out a series of quantitative targets. For example, the strategy aims to boost the R&D expenditure to 4% of GDP and increase the economic growth rate to 5 – 6% within five years. Social disparity is set to be reduced by around 23% by 2032. It also aims to place at least five Thai universities amongst the world's top 100 higher education institutions within 20 years.<sup>98</sup>

The Bioeconomy Roadmap (2017) includes a dedicated 10-year action plan which foresees an overall investment of THB 365 billion (around USD 11.8 billion)<sup>99</sup>, which will be co-financed by stakeholders in the private and public sector over three project periods. The first project phase (2017-2018) is budgeted at THB 51 billion (around USD 1.6 billion). The funding in the second project phase (2019-2021) is planned to raise THB 182 billion (around USD 5.9 billion) and in the third project phase (2022-2026) THB

132 billion (around USD 4.3 billion).<sup>100</sup> The Bioeconomy Roadmap also includes several quantitative targets. For example, it is expected that the share of agriculture in GDP will double within 10 years. The added value of sugar cane should increase to THB 3 million (around USD 97,000) per year and the added value of cassava should increase to THB 1 million (around USD 32,000) per year. The sugarcane and cassava industries are expected to create more than 300,000 and 500,000 new jobs respectively within 10 years. In addition, the roadmap intends to increase the investment in biopharmaceuticals to THB 100 billion (around USD 3.2 billion) and the export of biopharma products to THB 75 billion (around USD 2.4 billion) in the next decade. Targets have also been set for reducing carbon dioxide emissions resulting from the burning of fossil fuels and for creating 20,000 new jobs in R&D.

7

## Which measures/instruments are used to promote the strategies?

The Bioeconomy Roadmap and Strategy 4.0 propose a bundle of measures to enhance R&D capacities and to develop a knowledge-based bioeconomy. The strategy documents emphasize the shared responsibility for increasing public and private investment in research and innovation. The Thailand 4.0 strategy highlights the importance of establishing regional innovation hubs, for example in the area of agriculture and food. In terms of concrete projects, the bioeconomy roadmap envisages the establishment of a so-called “Biopolis” - following the Singaporean example. Its aim is to bring together major research institutes to create a center of excellence in bioeconomy experimentation. It is considered very important to forge national and international research networks and this should be supported by setting up a research fund. Public R&D will additionally focus on promoting modern farming practices and applying advanced technologies, such as precision farming, genotyping and tissue culture technologies.

Moreover, the roadmap proposes to promote R&D in the fields of vaccines, stem cell technology and functional foods. With regard to the latter, the emphasis is on evaluating the impact of functional ingredients on human health, discovering new functional food components and developing appropriate diets.<sup>101</sup>

Regarding the promotion of infrastructure development, the Thailand 4.0 strategy emphasizes the importance of developing clusters in 18 provinces. The Bioeconomy Roadmap envisages the establishment of biorefinery complexes in the districts of Khon Kaen, Nakhon Ratchasima, Kamphaeng Phet and Udon Thani. Sugarcane and cassava have been identified as feedstocks for producing bioenergy, biobased chemicals (including 1,4-butanediol, bovine serum albumin and lactic acid) and bioplastics, such as polylactic acid (PLA) and poly-butylene succinate (PBS).

Measures mentioned in the context of promoting capacity building include, for example, a national capacity building program that should be set up to reform the Thai education and learning system. This will involve training courses for teachers and lecturers and the improvement of curricula and learning methods. The strategy also seeks to support “smart farmers” by means of study and career support funds.

In order to promote commercialization, the Thailand 4.0 strategy highlights the need to provide incentives to angel and venture investors. Startups will be supported by business plan competitions and the establishment of a Startup Stock Exchange that provides a regulated marketplace for selling ownership shares to investors. Besides this, the strategy aims to connect farmers and SMEs by setting up a trade register to stimulate domestic business relations. Within the Thailand 4.0 strategy, the government introduced the Investment Promotion Act B.E. 2520 and drafted the National Competitiveness Enhancement for Targeted Industries Act. These legislative measures are designed to attract further investment for the 10 future industries, including the bioeconomy. In addition, the Bioeconomy Roadmap proposes tax incentives for biobased companies.

The Bioeconomy Roadmap also names demand-side instruments, such as the consideration of biobased products in public procurement rules and fixed prices for biodiesel and biopower.

The policy strategies additionally list several measures to ensure bioeconomy-friendly framework conditions. The Bioeconomy Roadmap proposes reviewing the regulatory framework, e.g. for food and drug approval and for intellectual property rights.

With regard to good governance measures, the roadmap recognizes the need for establishing a bioeconomy committee which is chaired by the Prime Minister and will provide policy guidance for promoting the bioeconomy in Thailand. The document further highlights the importance of enhancing policy coherence by better aligning the numerous existing policies and initiatives.

---

## REFERENCES

- 94 Division of Research Administration and Educational Quality Assurance. (2015). *พิมพ์เขียว Thailand 4.0 โมเดลขับเคลื่อนประเทศไทยสู่ความมั่นคง มั่งคั่ง และยั่งยืน*. Available at <http://www.libarts.up.ac.th/v2/img/Thailand-4.0.pdf> [28.11.17].
- 95 Vongkusolkrit, I. (2016, August). *Public-Private Collaboration: A New Sustainable Growth Path*. Paper presented at (...) Available at [https://www.set.or.th/th/news/thailand\\_focus/files/2016/lsara.pdf](https://www.set.or.th/th/news/thailand_focus/files/2016/lsara.pdf) [28.11.17].
- 96 See German Bioeconomy Council. (2015). *Bioeconomy Policy (Part II): Synopsis of National Strategies around the World*. Available at [http://bioekonomierat.de/fileadmin/international/Bioeconomy-Policy\\_Part-II.pdf](http://bioekonomierat.de/fileadmin/international/Bioeconomy-Policy_Part-II.pdf) [19.07.17].
- 97 Sirisaengtaksin, A. (2017, February). *The update of bioeconomy roadmap*. Paper presented at AGBIO 2017. Available at <http://agbio2017.com/program/schedule/> [31.07.17].
- 98 Bhumiratana, S. (2016, January). *Bioeconomy in the Context of Thailand*. Paper presented at Thai-German Bioeconomy Conference: Cooperation Opportunities for a Sustainable Bioeconomy. Available at <http://www.biotech.or.th/Bioeconomy2016/images/document/6%20SB%20Chaingmai.pdf> [01.08.17].
- 99 Exchange rate on November 28, 2017 (1 USD = 32.5945 THB)
- 100 PTT Global Chemical. (2017, January 23). “Pracharath” collaboration advances “Bioeconomy”, a driving force to revitalize investment and innovation while strengthening the national economy. [Press release] Retrieved from <http://www.pttgcgroup.com/en/news/press/4546/1/pracharath-collaboration-advances-bioeconomy-a-driving-force-to-revitalize-investment-and-innovation-while-strengthening-the-national-economy> [31.07.17].
- 101 Thailand Board of Investment. (2017): *Thailand's Bioeconomy Industry*. Available at [http://www.boi.go.th/upload/content/BOI-brochure%202017-BioEconomy-20170517\\_84245.pdf](http://www.boi.go.th/upload/content/BOI-brochure%202017-BioEconomy-20170517_84245.pdf) [31.07.17].

Table 8: Important measures for promoting the bioeconomy in Thailand

Key points	Policy measures	Concrete implementation
Promoting innovation	National and international research networks	
	Center of Excellence "Biopolis"	
	Public R&D	Establishing a research fund
	Stimulating private sector R&D	e.g. public-private partnerships
Supporting infrastructure & capacity building	National Capacity Building Program	
	Training courses for "smart farmers"	e.g. career support funds
	Bioeconomy curricula	
	Regional innovation hubs	
	Biorefinery complexes	
Supporting commercialization	Access to capital for biobased companies	Startup Stock Exchange Incentives for angel and venture investors Investment Promotion Act B.E. 2520 Draft for National Competitiveness Enhancement for Targeted Industries Act
	Tax incentives	
	Market development	e.g. developing a database on trade
	Public Procurement for biobased products	
	Price setting	Defining the purchase rate for biodiesel and biopower
Ensuring bioeconomy-friendly framework conditions	Reviewing the regulatory framework	Reviewing the approval process for food and drugs Reviewing the framework for intellectual properties rights
	Promoting Good Governance	Establishing a Bioeconomy Committee



# Europe



The European Commission laid the foundation for national bioeconomy policy development by presenting the European Bioeconomy Strategy in 2012. Since 2015, six new dedicated bioeconomy policy strategies have been adopted in France, Italy, Latvia, Norway and Spain, and in March 2018 also in Ireland. In addition, Austria, Estonia, Iceland and the UK have already announced that they will

prepare dedicated bioeconomy policies. Most of the recently published strategy documents, however, focus on the production and utilization of bioresources. High-tech approaches are found to a greater extent in Germany and the UK, where the focus is more on biosciences and the “biologization of the 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)
European Union	Holistic Bioeconomy Development	"Innovating for Sustainable Growth: A Bioeconomy for Europe" (2012)
Finland	Holistic Bioeconomy Development	"The Finnish Bioeconomy Strategy" (2014)
France	Holistic Bioeconomy Development	"A Bioeconomy Strategy for France" (2017)
	High-Tech	"Stratégie nationale de transition écologique vers développement durable" (2014)
	Research & Innovation	"France Europe 2020" (2013)
		"The new face of Industry in France" (2013)
Germany	Holistic Bioeconomy Development	"National Policy Strategy on Bioeconomy" (2013)
"National Research Strategy BioEconomy 2030" (2010)		
Ireland	Holistic Bioeconomy Development	"National Policy Statement on the Bioeconomy" (2018)
	Blue Economy	"Harnessing Our Ocean Wealth" (2012)
	Green Economy	"Delivering our Green Potential" (2012)
	Research & Innovation	"Towards 2030" (2008)
Italy	Holistic Bioeconomy Development	"Bioeconomy in Italy: A unique opportunity to reconnect economy, society and environment" (2017)
Latvia	Holistic Bioeconomy Development	"Latvian Bioeconomy Strategy 2030 (LI-BRA)" (2017)
Lithuania	High-Tech	"National Industrial Biotechnology Development Programme" (2007-2010)

See further policy strategies on the next page →

Country*	Perspective	Document Name
<b>Netherlands</b>	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)
<b>Norway</b>	Holistic Bioeconomy Development	“Familiar resources – undreamt possibilities” (2016)
	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)
<b>Portugal</b>	Blue Economy	“Estratégia Nacional para o Mar” (2013–2020)
<b>Spain</b>	Regional Bioeconomy Development	“Extremadura 2030” (2017)
	Holistic Bioeconomy Development	“Horizon 2030” (2016)
<b>Sweden</b>	Research & Innovation	“Swedish Research and Innovation Strategy for a Bio-based Economy” (2012)
<b>United Kingdom</b>	High-Tech	UK Synthetic Biology Strategy Plan “Biodesign for the Bioeconomy” (2016)
	Circular Economy	“Building a high value bioeconomy: opportunities from waste” (2015)
		“Biorefinery Roadmap” Scotland (2015)
	Bioenergy	“Science and Innovation Strategy for Forestry” (2014)
		“Agri-tech Industrial Strategy” (2013)
		“High-value Manufacturing Strategy” (2012)
		“UK Bioenergy Strategy” (2012)
		“Natural Environment White Paper” (2011)
“UK Biomass Strategy”(2007)		
<b>West Nordic Countries (Iceland, Greenland, Faroe)</b>	Holistic Bioeconomy Development	“Future Opportunities for Bioeconomy in the West Nordic Countries” (2014)



# France



## 1 Which bioeconomy-related strategies have been developed since 2015?

As one of Europe's largest agricultural producers and exporters, host of one of the world's biggest biorefineries and responsible for establishing the large "Industries & Agro-Ressources" (IAR) Competitiveness Cluster, France has a long tradition in bioeconomy development and policy support.<sup>102</sup>

On publishing the dedicated national bioeconomy strategy "**A Bioeconomy Strategy for France**"<sup>103</sup> in 2017, the government laid the foundations of a policy for long-term bioeconomy development.

In March 2017, also the Economic, Social and Environmental Council (CESE), a constitutional consultative assembly, presented its proposals for a sustainable bioeconomy within the document "Vers

une bioéconomie durable"<sup>104</sup>. It highlights environmental and societal challenges of the bioeconomy which would require, e.g. the adoption of new ways of sustainable production and consumption.

In June 2017, the public research institutes INRA and Irstea hosted a European workshop on bioeconomy which was attended by more than 300 European and international bioeconomy experts. As a result of the event, recommendations on bioeconomy-related research and development were published. They focus on promoting multi-disciplinary and multi-sector cooperation, modeling the externalities of the bioeconomy, implementing bioeconomy-related policies, etc.

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

Yes No



The term "bioeconomy" was not widely used in France as the biobased economy was discussed more within the context of a green economy or industrial ecology.<sup>105</sup> When the dedicated bioeconomy strategy was developed in 2017, the term bioeconomy became visible in the political process. In the French context, the bioeconomy encompasses

" (...) the whole range of activities linked to the production, use and processing of bioresources". The strategy further highlights the circular economy component of the bioeconomy. In this respect, the focus is on closing the loop, i.e. by reusing and recycling biobased resources.

### 3 Who is the author of the strategy?

The development of the bioeconomy strategy dates back to an inter-ministerial initiative in 2015. Four ministries were involved in the strategy process, including the Ministry of Ecology, Sustainable Development and Energy; the Ministry of National Education and Research; the Ministry of the Economy, Industry and the Digital Sector; and the Ministry

of Agriculture, Agrifood and Forestry. The strategy development process was further facilitated by various stakeholder workshops at national and regional level. The strategy document was officially adopted in January 2017. Two months later, a strategic committee on bioeconomy was established to support its implementation.

### 4 What are the key goals of the strategies

By developing a dedicated national bioeconomy strategy, the French government primarily seeks to promote sustainable economic growth in France. More specifically, it strives for increased employment, an improved balance of trade and interna-

tional competitiveness. The strategy also promotes a self-sufficiency argument by fostering regional and rural development, food sovereignty and independence from fossil fuel imports.

### 5 What are the priority areas of the strategies?

The French bioeconomy strategy focuses on innovations in primary industries which are intended to contribute to the sustainable and efficient production and utilization of bioresources. This includes, for example, promoting sustainable resource management practices (including precision farming) and adopting innovative crop production systems (e.g. organic farming, agroecology and agroforestry). Reclaiming uncultivated land and abandoned farmland in addition to maritime and aquatic areas also aims to increase the mobilization of biomass resources. In this respect, the strategy prioritizes the utilization of waste resources and residues from primary industries, as well as urban and industrial wastes, e.g. for energy production. The action plan published in 2018 also highlights the development of new value chains, e.g. based on animal by-products.

A special characteristic of the strategy is its emphasis on the bioeconomy's local dimension and the conversion of locally produced biomass into high-value biobased products, such as food and feedstuffs, chemicals, biomaterials and bioenergy. At the same time, further biorefinery development and

the integration of physical, chemical and biological processes and technologies (including nanotechnology, biotechnology, and ICT) aims to ensure sustainable and efficient conversion of biomass resources. Here, for example, the emphasis is on state-of-the-art bioenergy obtained from wood and organic waste resources. Ligno-cellulosic resources are also considered important for chemical applications in the pharmaceutical and food industries.

Another characteristic of the strategy is the prominent role and involvement of society, which is seen as a prerequisite for successful transformation to a bioeconomy. Here, for example, the strategy document identifies changing trends in consumer diets, which require investigation by conducting further research into consumer behavior and preferences. The strategy also highlights new and alternative food resources, e.g. from the sea, which should be identified to ensure the future protein supply. Furthermore, special consideration will be given to oversea regions and their huge deposits of biological resources. In this respect, the focus is on identifying oversea bioresources and evaluating their potential for industrial use.

## 6 Is there a dedicated action plan with quantitative targets?

Yes No

X

A dedicated action plan was published in February 2018. It is a result of a stakeholder consultation process and provides measures for promoting bioeconomy development in the period from 2018 to 2020. The plan addresses five areas of action, including the improvement of knowledge, the raising of public awareness on bioeconomy and biobased products,

the promotion of the demand and supply side, the sustainable production and utilization of biobased resources as well as new financing mechanisms.<sup>106</sup> The strategy does not set out a concrete budget for implementing the measures proposed.



## 7 Which measures/instruments are used to promote the strategies?

The French bioeconomy strategy pursues a comprehensive approach to fostering bioeconomy development. When promoting innovation, the focus is mainly on increasing public and private R&D investment. The French government has been providing funding for bioeconomy-related research and innovation programs since 2010. For example, the “Future Investments” funding program, which focuses on promoting cutting-edge technology, has entered its third funding phase. Over a period of ten years, it will provide EUR 1.5 billion (USD 1.8 billion) for infrastructure, research and training in the area of biotechnology, agricultural science, bioinformatics and nanobiotechnology.<sup>107</sup> In addition, the national research agency INRA will continue its funding for the eight interdisciplinary meta-programs, which center on agriculture, nutrition and the environment. The meta-programs are supported by 30% of INRA’s budget for a period from 2010 to 2020. 2018 saw the launch of a ninth meta-research program on organic farming and food.<sup>108</sup> In 2015, the European Center for Biotechnology and Bioeconomy (CEBB) was established. The center’s mission is to promote multi-disciplinary research for the sustainable production of biological resources, to foster biorefinery development and the agro-food industry. As the CEBB is situated nearby the Bazancourt-Pomacle biorefinery plant it directly links academic research and its transfer into economic production.<sup>109</sup> Beyond this, public R&D will concentrate on better understanding photosynthesis, metabolism, and environmental interactions. Advances in genetics are considered

promising for increasing the overall efficiency of production systems and for facilitating their adaptation to climate change. Innovation partnerships between stakeholders in the primary sector and the chemical industry should also be encouraged.

Support for infrastructure development concentrates in particular on the funding of shared R&D facilities and on biorefinery development. Developing and supporting clusters is also highlighted, with the aim of creating synergies between the agrifood and industrial sectors.

The government considers it extremely important to educate and train the workforce for the future bioeconomy. The focus here is on inter-disciplinary education and capacity building, including technical and vocational training as well as life-long learning opportunities. By establishing the European Center for Biotechnology and Bioeconomy, the scientific and technical expertise of AgroParisTech, CentraleSupélec, the NEOMA Business School and the University of Reims Champagne-Ardenne has been leveraged. In this respect, also the support for bioeconomic-relevant chairs and academic programs (e.g. in the area of biotechnology, biomaterials and green chemistry) has been increased.

Measures related to promoting commercialization concentrate in particular on bringing biobased products to the market. The emphasis is therefore on increased marketing efforts, e.g. by showcas-

ing biobased products from around the world on the [www.agrobiobase.com](http://www.agrobiobase.com) website. This website provides information on product origin and the product's environmental benefits. At the same time, it provides a B2B platform for developing the market for biobased products. Other tools mentioned to promote commercialization are, i.e. demonstration platforms, living labs and feasibility studies. The action plan of 2018 highlights also the need to facilitate access to capital for biobased companies and to raise awareness of potential investors, such as banks, business angels, pension funds, investment funds etc. The Biobased-Industries Consortium (BBI) should be increasingly taken into account to finance public-private bioeconomy projects. All measures proposed to foster commercialization will be specified within the development of a "Grand Investment Plan".

The strategy document also stresses the need to strengthen the demand side of the bioeconomy, i.e. by raising awareness of biobased products through standards, certifications and labels (e.g. a dedicated label for biobased products). The strategy draws attention to the review of the French law on public procurement, which will take also biobased characteristics into account. In addition, favorable taxation, subsidies and price setting measures (e.g. by means of a regulated purchase price for the electricity produced using by biogas and biomethane) will incentivize the use of biofuels. The action plan of 2018 addresses the demand-side by proposing several measures. It, for example, foresees the establishment of a bioeconomy website which provides information, i.e. on R&D projects and success stories for the general public and bioeconomy professionals. It also mentions the development of an exhibition concept which will showcase the bioeconomy in everyday life, and the setting up of a bioeconomy award which honors successful projects and companies. As a flagship project the action plan

highlights the building of a biobased Olympic village for the Olympic Games in 2024, which could showcase biobased materials in construction, e.g. wood, hemp, flax fiber etc.

Promoting policy coherence at regional, national and EU level is considered critical for bioeconomy development. In order to create bioeconomy-friendly framework conditions, the strategy proposes regulations fostering the use of biofuels and biobased, compostable plastic bags, but also regulations supporting the use of biobased innovation in the construction sector (e.g. using hemp materials in construction). The government also sets out to develop a national biomass strategy (SNMB) aimed at sustainable biomass production and utilization.

With a view to good governance, the strategy plans to nominate a national bioeconomy council which would be composed of stakeholders from industry, NGOs, academics and research institutes as well as local, regional and national decision-makers. The policy document also highlights the need to encourage multi-stakeholder dialogues (especially at local level) to promote outreach and participation. Monitoring biomass resources, e.g. by strengthening the national resource observatory (ONRB), is also prioritized.

The strategy also emphasizes international collaboration in the bioeconomy. France intends to actively engage in bioeconomy-related discourses conducted on international policy and research fora, e.g. within the European Union, the Organization for Economic Cooperation and Development (OECD), the International Energy Agency, the United Nations Environment Program and the UN Food and Agriculture Organization. The strategy highlights the French commitment to the Paris climate agreement by stressing the bioeconomy's potential contribution to mitigating climate change.

Table 9: Important measures for promoting the bioeconomy in France

Key points	Policy measures	Concrete implementation	
Promoting innovation	Public R&D	Establishing inter-disciplinary INRA meta-programs in the area of food, ecology and agriculture Future Investments Program European Center for Biotechnology and Bioeconomy (CEBB)	
	Stimulating private sector R&D	e.g. Public-Private Partnerships (IMPROVE: European platform for the valorization of proteins)	
	Open innovation platforms	e.g. agroecology farm 112	
Supporting infrastructure & capacity building	Funding for shared R&D facilities		
	Biorefinery demo plants		
	Cluster development	e.g. the competitive cluster program	
	Technical, vocational training	e.g. Campus des Métiers et Qualifications	
	Academic programs (e.g. in the area of biotechnology, biomaterials and green chemistry)	European Center for Biotechnology and Bioeconomy (CEBB)	
	Life-long learning opportunities		
Supporting commercialization	Development and marketing of biobased products	e.g. showcasing biobased products from around the world on the website <a href="http://www.agrobiobase.com">www.agrobiobase.com</a> Feasibility studies	
	Demonstration platforms and living labs		
	Facilitate access to capital for biobased companies	Funding from the Biobased-Industries Consortium (BBI) Development of a “Grand Investment Plan”	
Supporting the demand-side	Standards, certifications and labels on biobased products	e.g. AFNOR X85A and CEN TC411 standardization committees, dedicated label for biobased products	
	Biobased public procurement	e.g. Reviewing Article 144 of the Energy Transition Law on Green Growth (LTECV), which will take also biobased characteristics into account	
	Price setting	Regulated purchase price for the electricity produced using biogas and biomethane	
	Communication and information measures		Establishment of a bioeconomy website Development of an exhibition concept “bioeconomy in everyday life” Setting up of a bioeconomy award
			Building a biobased Olympic village for the Olympic Games in 2024 Annual conference on bioeconomy
		Communication campaign Open doors in biobased companies, e.g. as part of a Bioeconomy Week	



Key points	Policy measures	Concrete implementation
<b>Ensuring bioeconomy-friendly framework conditions</b>	Policy coherence	
	Regulations for the use of biofuels	
	Regulations for the use of biobased, compostable plastic bags	
	Regulations for improved building performance	Regulations for the use of hemp in building and construction, e.g. by combining standard mineral products and labeled plant granulates
	Developing a national biomass strategy (SNMB)	
<b>Promoting Good Governance</b>	Establishing a national bioeconomy council	
	Monitoring biomass resources	Strengthening the National Biomass Observatory (ONRB)
	Establishing a political steering group which will be targeted to further implement the bioeconomy strategy and action plan	
<b>Enhancing international collaboration in the bioeconomy</b>	Engagement in international fora, e.g. within the EU, OECD, IEA, UNEP and UNFAO	

## REFERENCES

- 102 German Bioeconomy Council. (2015). Bioeconomy Policy (Part I) – Synopsis and Analysis of Strategies in the G7. Available at [http://bioekonomierat.de/fileadmin/Publikationen/berichte/BOER\\_Laenderstudie\\_1\\_.pdf](http://bioekonomierat.de/fileadmin/Publikationen/berichte/BOER_Laenderstudie_1_.pdf) [15.02.17].
- 103 Republic of France. (2017). A Bioeconomy Strategy for France: Goals, issues and forward vision. Available at <http://agriculture.gouv.fr/telecharger/88386?token=d7ce1762548787efcf4c17968b81895e> [01.02.18].
- 104 Economic, Social and Environmental Council (CESE). (2017). Vers une bioéconomie durable. Available at <http://www.lecese.fr/travaux-publies/vers-une-bioeconomie-durable> [22.02.18].
- 105 German Bioeconomy Council. (2015). Bioeconomy Policy (Part I) – Synopsis and Analysis of Strategies in the G7. Available at [http://bioekonomierat.de/fileadmin/Publikationen/berichte/BOER\\_Laenderstudie\\_1\\_.pdf](http://bioekonomierat.de/fileadmin/Publikationen/berichte/BOER_Laenderstudie_1_.pdf) [05.02.18].
- 106 République Française. (2018). A Stratégie Bioéconomie pour la France: Plan d'action 2018-2020. Available at <http://agriculture.gouv.fr/une-strategie-bioeconomie-pour-la-france-plan-daction-2018-2020> [01.03.18].
- 107 French National Research Agency. (2018). Investments for the Future. Available at <http://www.agence-nationale-recherche.fr/en/about-anr/investments-for-the-future/> [22.02.18].
- 108 INRA. (2018). INRA Metaprogrammes. Available at <http://metaprogrammes.inra.fr/en> [22.02.18].
- 109 CEBB. (2017). Qui sommes nous. Available at <http://cebb-innovation.eu> [22.02.18].

# Italy



1

## Which bioeconomy-related strategies have been developed since 2015?

In recent years, bioeconomy development in Italy has been pioneered by companies in green chemistry and by some regional clusters. In November 2016, the Italian Agency for Territorial Cohesion published the draft of a first dedicated bioeconomy strategy for public consultation on its website. It was officially presented by the Ministry for Economic Development at the Ecomondo 2016 fair.<sup>110</sup> In April 2017, the Italian government officially adopted the revised strategy document entitled **“Bioeconomy in Italy: A unique opportunity to reconnect economy, society and environment”**.<sup>111</sup>

At regional level, the Conference of Regions and Autonomous Provinces of Italy has developed a common position paper on bioeconomy development. More than 20 regions have collaborated on defining strategic positions in the area of marine bioeconomy, agri-food and biobased industries. Regional bioeconomy development will be co-funded primarily by European funds targeting the Research and Innovation Strategies for Smart Specialisation (RIS3).<sup>112</sup>

2

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

Yes No

X

In the Italian context, bioeconomy development concentrates on increasing the added value from the primary production sectors. According to the strategy document, bioeconomy encompasses the integration of “the sustainable production of renewable biological resources and the conversion of these resources and waste streams into value-added products such as food, feed, biobased products and bioenergy”. The latest strategy document has

responded to the increasing importance of the circular economy concept in EU policy. The revised policy paper consequently refers to a transition towards a circular bioeconomy which reflects a vision “where the production and use of renewable bioresources and their conversion into value-added products is part of a circular system that will make businesses more economically viable and sustainable in the long term.”

### 3 Who is the author of the strategy?

Preparation of the strategy development was led by the Italian Presidency of the Council of Ministers and is thus based on a broad interministerial effort which involved the following ministries and agencies: the Ministry for Economical Development, the Ministry of Agriculture, Food and Forestry, the Ministry for Education, University and Research; the Ministry of the Environment, Land and Sea; the Committee of Italian Regions; the Agency for Territorial Cohe-

sion; and the Italian Technology Clusters for Green Chemistry and AgriFood. In November 2016, a public consultation process was initiated which addressed bioeconomy stakeholders and citizens who were asked to provide input to the strategy draft. The resulting feedback and comments were analyzed and discussed in a series of workshops and were then incorporated into the final strategy document which was published in April 2017.

### 4 What are the key goals of the strategies

On a global scale, the bioeconomy strategy addresses Italy's response and contribution to the great societal challenges, such as food security for an increasing world population, climate change and critical ecosystem resilience. Domestically, the strategy clearly envisions increasing Italy's competitiveness

through innovation and promoting green growth. Its primary aim is to reduce dependence on fossil fuels and non-renewables. Positive rural and coastal development, while preventing biodiversity loss and protecting ecosystems, are considered key objectives of the bioeconomy strategy.

### 5 What are the priority areas of the strategies?

For years, Italian bioeconomy development has been led by stakeholders in the chemical industry who are pursuing the transition to green or plant-based chemistry. Pioneering companies in this field develop and produce biomaterials and bioproducts by bringing together chemical, agricultural and environmental expertise. Furthermore, several biobased innovation centers and clusters play an active role in the development of bioindustry.<sup>113</sup> Consequently, the national bioeconomy strategy considers agriculture, forestry and the agri-food sector as well as the marine bioeconomy and biobased industries as the core sectors of "an integrated Italian bioeconomy ecosystem". The strategy seeks to create networks among different bioeconomy sectors and their value chains, to increase the efficiency and sustainability of biobased value chains and to generate value from local biodiversity and circular economy approaches. It also aims to promote sustainable bioeconomy in the wider Mediterranean area.

The document emphasizes that the bioeconomy strategy is considered part of the implementation process of both the National Smart Specialization Strategy<sup>114</sup> and the Italian National Strategy for Sustainable Development. Within the framework of the National Smart Specialization Strategy, Italy has designed strategic plans for the agrifood and biobased industry. More than other European countries, the Italian bioeconomy strategy considers integration with EU-funded R&I as well as structural and smart specialization interventions.

Government support for the agricultural and forestry sector will concentrate on boosting more sustainable and resilient primary production, e.g. by exploring the sustainability potential of different agricultural and forestry models (including climate-smart agriculture and forestry, precision farming, ecological intensification, agroecology, etc.) and by examining the role of urban and peri-urban agriculture. In the

forestry area, the strategy generally emphasizes the need to improve forest management. It highlights the importance of modernizing the timber industry to develop new products and expand the use of high-tech wood-based materials, e.g. in the construction sector. With regard to the development of biobased industry, the strategy focuses on producing next generation biofuels and bioplastics, developing biopharmaceuticals and cosmetics, promoting biobased building materials, and increasing the production of biofertilizers, biolubricants and essential amino acids for feed production.

Looking at marine bioeconomy, the strategy particularly recognizes that the Mediterranean region faces huge environmental challenges, but it also sees opportunities for blue growth and jobs. The Italian government has already initiated several projects

(such as the PRIMA and the BLUEMED initiatives) for promoting sustainable water management and food systems in the Mediterranean region.

In addition, the national strategy highlights the need for better coordination between regional, national and EU policies and initiatives. It emphasizes the role of the Italian regions in social and economic development. Regional approaches are critical for implementing circular economy activities and for improving environmental resilience and adaptation to climate change. In this respect, the promotion of key enabling technologies, such as industrial and environmental biotechnologies, 'omics' and big data, digitization and precision farming, is considered vitally important.



6

## Is there a dedicated action plan with quantitative targets?

Yes

No

X

The bioeconomy strategy includes several actions which are based two overarching goals: Italy's bioeconomy turnover should increase from EUR 250 billion (2015) (around USD 300 billion)<sup>115</sup> to EUR 300 billion by 2030 (around USD 360 billion). The entire bioeconomy sector<sup>116</sup> should account for more than 2 million jobs by 2030.

The actions proposed mainly define the key topics for the R&I agenda and for some support measures that have been derived from a comprehensive analysis of challenges and opportunities for the Italian Bioeconomy. The strategy also defines a set of concrete indicators for monitoring the strategy's implementation process. These indicators are based on the EU key performance indicators (KPI) and the sustainability indicators proposed by the EU initiative<sup>29,117</sup>

The indicators relate to biomass availability, productive structure, employment structure, human capacity, innovation, investment, demographics, markets, ensuring food security, managing natural resources, reducing dependence on non-renewable resources, coping with climate change, and enhancing economic growth.

The final strategy document announces the development of a dedicated action plan with implementation timetables. The implementation process is scheduled to start in the course of 2017. However, at the time of writing this report no detailed action plan has been published.

## 7

**Which measures/instruments are used to promote the strategies?**

The Italian strategy provides a bundle of support measures to foster bioeconomy development. In the field of research and innovation, the strategy seeks to leverage existing support and publicly funded programs at EU, national and regional level. This will be realized by mainstreaming bioeconomy issues in the Cohesion Policy Funds and by providing direct funding grants and tax incentives. Public investments should concentrate on improving resource management, i.e. by implementing farming and forestry systems to improve soil fertility and water quality, and by increasing photosynthesis capacity and carbon dioxide sequestration. The focus of R&I investments should rely on creating value from local biodiversity, resources and circularity. This also relates to the conversion of abandoned land and industrial sites (e.g. former chemical complexes). Future R&I investments should further focus on the sustainable exploitation of marine resources (such as seaweed, phytoplankton, by-products and side products from fishery and aquaculture) for food, fine chemicals and energy, while protecting the marine environment and biodiversity. In order to encourage the development of a sustainable and competitive agrifood sector, the R&I agenda further focuses on improving food safety and security, and promoting healthy diets, e.g. by developing smart nutrition solutions, identifying consumer preferences and behavior, and identifying alternative food resources (including insects and algae) and novel food microbes. It also stresses the need to increase efficiency in food production, e.g. by considering the potential of food (processing) wastes for biochemicals and biofuels.

The strategy underlines the social dimension of bioeconomy and the importance of education, training and societal participation. Cross-disciplinary education and professional training measures are considered necessary not only to increase awareness but also to develop a skilled workforce for the bioeconomy. The range of measures proposed encompasses new technical programs for schools, academic bioeconomy courses and post-graduate education in bioeconomy. In January 2017, the first

European masters program in “Bioeconomy in the Circular Economy” was launched in Milan and Turin, Bologna and Naples. This masters program represents a public-private partnership between four Italian universities, three industrial partners and an Italian banking group.<sup>118</sup>

Measures related to infrastructure development concentrate on investing in R&D facilities, technology clusters, demonstration plants and test beds to promote the scaling-up of process technologies and new biobased products.

Bioeconomy-friendly framework conditions should be ensured by aligning EU, national and regional policies and activities. This includes, for example, reviewing regulations designed to facilitate and support the development and commercialization of biobased products and the industrial use of wastes and residues.

The strategy aims to stimulate demand for biobased products and services by implementing measures such as standard-setting, labeling, green public procurement and communication campaigns. Life cycle thinking and ecodesign approaches are to be promoted. A methodological framework is to be developed for companies to communicate cost-benefit analyses of biobased products, which should help to better demonstrate the comparative advantages to buyers. Consumer information and communication are listed as important measures for increasing public awareness.

With regard to good governance, a permanent bioeconomy working group should be established to support the strategy implementation process and to ensure better stakeholder coordination. The strategy proposes to nominate representatives from ministries, relevant public agencies and the national technological clusters. The latter should be supported to provide dialogue platforms for academia and business.

Table 10: Important measures for promoting the bioeconomy in Italy

Key points	Policy measures	Concrete implementation	
Promoting innovation	Public R&D	Cohesion Policy Funds National Smart Specialization Strategy Horizon2020, e.g. PRIMA and BLUEMED Initiative	
	Stimulating private sector R&D	Industry 4.0 Plan: financial support for enterprises, i.e. through tax credits on R&D investments, etc.	
Supporting infrastructure & capacity building	Cross-disciplinary education and professional training	Technical programs for schools Academic bioeconomy courses: e.g. first European masters program in "Bioeconomy in the Circular Economy" Post-graduate education	
	Investment for R&D facilities	e.g. biobased R&D Center in Piedmont, Lombardy, Veneto, Emilia Romagna, Tuscany, Umbria, Campania, Puglia, Basilicata, Sardinia	
	Cluster development	e.g. Cluster SPRING National Technology Agrifood Cluster CL.A.N. Italian Technology Cluster "Intelligent Factories" Blue Growth Cluster Energy Cluster	
	Pilot and demonstration plants	e.g. pilot plants in Piedmont, Lombardy, Veneto, Emilia Romagna, Tuscany, Umbria, Campania, Puglia, Basilicata, Sardinia	
	Biorefinery plants	e.g. industrial and flagship biorefinery plants in Piedmont, Emilia Romagna, Veneto, Umbria, Lazio, Campania, Sardinia	
	Supporting the demand-side	Standard-setting and ecolabel development for biobased products	
		Consumer information and communication	
Reviewing the law on biobased public procurement		Environmental Annex to the Stability Law 2014 Green Public Procurement (GPP) National Action Plan (NAP) National Program for Waste Reduction: considers the target of a 50% share of green purchase by the public sector, specific measures for minimizing food waste, valorization of agro-industry byproducts, etc.	

Key points	Policy measures	Concrete implementation
<b>Ensuring bioeconomy-friendly framework conditions</b>	Circular economy regulations	EU Circular Economy Package
	Review of regulations promoting biobased products	
	GHG emission reduction and renewable energy share	National Energy Strategy & National Plan for Climate and Energy EU Climate Change Strategy
	Biodiversity conservation	National Biodiversity Strategy
	Improving the environmental status of Italian marine waters	National Marine Strategy
<b>Promoting Good Governance</b>	Monitoring and measuring activities	Indicators for monitoring the strategy's implementation process
	Inter-ministerial cooperation and inter-regional cooperation	
	Public reporting and stakeholder dialogue	Permanent bioeconomy working group

## REFERENCES

- 110 Bonaretti, P. et al. (2016). Bioeconomy in Italy: A unique opportunity to reconnect economy, society and environment. Consultation draft. Available at [http://www.agenziacoessione.gov.it/opencms/export/sites/dps/it/documentazione/NEWS\\_2016/BIT/EN.pdf](http://www.agenziacoessione.gov.it/opencms/export/sites/dps/it/documentazione/NEWS_2016/BIT/EN.pdf) [13.02.17].
- 111 Bonaretti, P. et al. (2017). Bioeconomy in Italy: A unique opportunity to reconnect the economy, society and the environment. Available at [http://www.agenziacoessione.gov.it/opencms/export/sites/dps/it/documentazione/S3/Bioeconomy/BIT\\_v4\\_ENG\\_LUGLIO\\_2017.pdf](http://www.agenziacoessione.gov.it/opencms/export/sites/dps/it/documentazione/S3/Bioeconomy/BIT_v4_ENG_LUGLIO_2017.pdf) [27.11.17].
- 112 Conference of the Italian Autonomous Regions. (2016). Documento delle regioni e delle province autonome di posizionamento sulla bioeconomia in attuazione della strategia nazionale di specializzazione intelligente (SNSI). Available at <http://www.regioni.it/download/conferenze/485361/> [27.11.17].
- 113 Bonaccorso, M. (2017a). Industrial Renaissance. Renewable Matter 14/2017. Available at [http://www.renewablematter.eu/art/291/Industrial\\_Renaissance](http://www.renewablematter.eu/art/291/Industrial_Renaissance) [20.02.17].
- 114 The definition of strategies for smart specialization (RIS3) is the ex-ante conditionality for the use of European Structural and Investment Funds.
- 115 Exchange rate of November, 27 2017 (1 USD = 0,83760 EUR)
- 116 The entire Italian Bioeconomy sector includes agriculture, forestry, fisheries, food and beverages production, paper, pulp and tobacco industry, textiles from natural fibers, leather, pharmaceuticals, biochemicals and bioenergy.
- 117 Bonaretti, P. et al. (2017). Bioeconomy in Italy: A unique opportunity to reconnect the economy, society and the environment. Available at [http://www.agenziacoessione.gov.it/opencms/export/sites/dps/it/documentazione/S3/Bioeconomy/BIT\\_v4\\_ENG\\_LUGLIO\\_2017.pdf](http://www.agenziacoessione.gov.it/opencms/export/sites/dps/it/documentazione/S3/Bioeconomy/BIT_v4_ENG_LUGLIO_2017.pdf) [27.11.17].
- 118 Bonaccorso, M. (2017b). In Italy starts the first edition of the first Master in Bioeconomy in the Circular economy. Available at <https://ilbioeconomista.com/2017/01/24/in-italy-starts-the-first-edition-of-the-first-master-in-bioeconomy-in-the-circular-economy/> [24.01.17].

# Latvia



## 1 Which bioeconomy-related strategies have been developed since 2015?

At the end of 2017, the Latvian government published a **dedicated national bioeconomy strategy 2030 (LI-BRA)**<sup>119</sup>. The strategy was developed in compliance with the Latvian Sustainable Develop-

ment Strategy 2030 and the National Development Plan 2014-2020 and is also strongly aligned with the European Union's bioeconomy strategy of 2012.

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

Yes No

X

According to the Latvian strategy, the bioeconomy encompasses the sustainable utilization of renewable natural resources (including plants, animals, micro-organisms, etc.) for producing food, feed, industrial products and energy. The strategy highlights the importance of the life sciences and converging technologies (such as biotechnology, nanotechnol-

ogy and ICT) for producing more sustainable and environmentally-friendly products, and also completely new products. The strategy specifically emphasizes that the term bioeconomy also refers to the promotion of biobased services, for example, in the construction, catering or accommodation sectors.

## 3 Who is the author of the strategy?

The strategy development process was led by the Latvian Ministry of Agriculture and is characterized by broad stakeholder involvement. Thus, representatives from associations, research institutions and the inter-ministerial steering group (composed of

the Ministry of Agriculture, Ministry of Economics, Ministry of Environmental Protection and Regional Development, Ministry of Education and Science, Ministry of Welfare) have been invited to provide input to the bioeconomy strategy.



## 4 What are the key goals of the strategies

The strategy is aligned with the UN Sustainable Development Agenda 2030. It highlights the potential of bioeconomy to contribute particularly to ending hunger and ensuring food security (SDG 2), ensuring access to energy for all (SDG 7), promoting sustainable economic growth (SDG 8), ensuring sustainable consumption and production (SDG 12), combating climate change (SDG 13), preserving and sustainably using the oceans, the seas and their resources (SDG

14) and protecting, restoring and sustainably using terrestrial ecosystems. The strategy specifically focuses on the promotion of rural development and the creation of local jobs and increased per capita incomes. Furthermore, the government seeks to reduce Latvia's dependence on fossil fuels by developing innovative, higher value-added biobased products and services.

## 5 What are the priority areas of the strategies?

The Latvian bioeconomy strategy concentrates on the sustainable production and utilization of biobased resources. It specifically targets businesses in the primary industries (including agriculture, forestry and fisheries) and in manufacturing, such as the food and feed industry, the wood industry, the chemical and pharmaceutical industry and also the textile industry. It highlights, for example, the promotion of innovative plant and animal breeding technologies, sustainable resource management practices and improved land use efficiency. The strategy further emphasizes the need for increased public R&D on environmental protection (particularly with respect to soil fertility, water and air quality), climate resistant crops and tree species, organic farming and animal health and welfare.

The Latvian government lists the blue bioeconomy as another priority area for exploring untapped marine bioresources (such as sea grass, mussels and algae) for the production of chemicals and pharmaceuticals, and also innovative, higher value food products (such as functional foods). The strategy highlights the promotion of sustainable fisheries and aquaculture as a prerequisite.

Biorefinery development should contribute to producing advanced biofuels (e.g. from cellulose), platform chemicals, biodegradable plastics and biobased surfactants based on vegetable oils, fats, sugar, algae and waste. In addition, the strategy document points to circular bioeconomy approaches for preventing waste at all stages of the value chain.

## 6 Is there a dedicated action plan with quantitative targets?

Yes No

X

There is no dedicated action plan yet but its development is envisaged by the strategy document. The strategy defines a range of quantitative targets for bioeconomy development. For example, employment in the bioeconomy should increase by 128,000 em-

ployees by 2030. The added value of biobased products should increase up to at least EUR 3.8 billion (around USD 4.7 billion) by 2030 and the value of bioeconomy-related exports should be boosted to at least EUR 9 billion (around USD 11 billion) by 2030.

## 7

**Which measures/instruments are used to promote the strategies?**

The Latvian bioeconomy strategy pursues a comprehensive approach to fostering bioeconomy development. In order to promote innovation, it particularly stresses the need for increased public R&D investment. For example, a National Research Program on Bioeconomy should be established to guide long-term R&D activities. The strategy also prioritizes cooperation between public and private actors, mainly in the form of public-private partnerships. In addition, public R&D activities should be coordinated by a Strategic Bioeconomy Research Alliance, an initiative set up in 2014, which unites 14 research institutions from agriculture, food and forestry. The government also envisages public support and co-financing for pilot and demonstration projects.

Measures related to infrastructure development focus mainly on investment in the research infrastructure but also on investment in the logistics infrastructure, such as roads, ports, warehouses, business parks, etc.

The development of the future bioeconomy will depend heavily on a highly-qualified workforce. The Latvian bioeconomy strategy therefore highlights the promotion of measures related to capacity building and education, including interdisciplinary and multi-disciplinary training and education programs as well as higher education and life-long learning opportunities. At the same time, the strategy emphasizes further training courses to improve entrepreneurial and business skills.

With regard to supporting commercialization, the bioeconomy strategy focuses on promoting knowledge transfer and creating business-friendly framework conditions, e.g. by reducing administrative burdens in business, incentives for local entrepreneurship

and also by means of stable tax policies. In addition, export promotion policies (e.g. in the form of export credit guarantees) and marketing efforts are considered important.

Public procurement policies targeting wood for the construction of public buildings, organically certified products, environmentally-friendly packaging or locally produced products are proposed as demand-side instruments. Moreover, public awareness of biobased products should be increased by means of dedicated information and education campaigns, and by adopting internationally recognized certification schemes and labels (e.g. FSC, PEFC, SBP).

Among the measures mentioned for ensuring bioeconomy-friendly framework conditions are regulations for sustainable forestry and agriculture (e.g. land use policies based on functional land use principles). The government also seeks to provide a level playing field for biobased business and to ensure fair competition among actors. The strategy highlights the need for increased cooperation among law enforcement agencies aimed at controlling the business of small producers and traders so as to avoid price distortions, especially in the area of unprocessed food.

The strategy proposes several measures to promote good governance in the bioeconomy. Monitoring of the Latvian bioeconomy will also play an important role in the future. International cooperation is encouraged between national and international research projects, particularly with countries in the Baltic Sea region and other EU member states. The aim is also to foster trade agreements with countries in Africa and Asia.

**REFERENCES**

- 119 Ministry of Agriculture of the Republic of Latvia. (2017). Tiesību aktu projekti. Available at <http://tap.mk.gov.lv/mk/tap/?pid=40433525&mode=mk&ate=2017-12-19> [13.03.18].

Table 11: Important measures for promoting the bioeconomy in Latvia

Key points	Policy measures	Concrete implementation
Promoting innovation	Public R&D investment	National Research Program on Bioeconomy
	Stimulating private sector R&D	e.g. public-private partnerships
	Coordination of public R&D activities	Strategic Bioeconomy Research Alliance
Supporting infrastructure & capacity building	Investment in the research infrastructure	
	Investment in roads, ports, warehouses, business parks	
	Foreign and public investment for pilot and demonstration projects	
Supporting commercialization	Promoting knowledge transfer	
	Reducing administrative burdens in business	
	Incentives for strengthening local entrepreneurship	
	Stable tax policies	
	Export promotion policies	e.g. export credit guarantees
	Marketing efforts	
Supporting the demand-side	Public procurement policies	Wood for construction of public buildings, organically certified products, environmentally-friendly packaging or locally produced products
	Internationally recognized certification schemes and labels	e.g. FSC, PEFC, SBP
	Information and education campaigns	
Ensuring bioeconomy-friendly framework conditions	Regulations for sustainable forestry and agriculture	e.g. land use policies
Promoting good governance	Monitoring the Latvian bioeconomy	
Enhancing international collaboration in the bioeconomy	International research cooperation with countries in the Baltic Sea region and other EU member states	
	Trade agreements with countries in Africa and Asia	

# Norway



## 1 Which bioeconomy-related strategies have been developed since 2015?

The Norwegian government initiated the development of a dedicated bioeconomy strategy in March 2015. Over a period of about 18 months, the government led a consultative, multi-stakeholder process which involved a national conference as well as a series of international expert workshops and regional meetings. Furthermore, industry representatives,

research institutions and NGOs were given the opportunity to provide written input to a draft version of the strategy. In November 2016, the Government published the resulting bioeconomy strategy under the title “**Familiar resources – undreamt possibilities**”.<sup>120</sup>

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

Yes No

X

Bioeconomy is defined as the “sustainable, effective and profitable production, extraction and use of renewable, biological resources for food and feed, health products, energy, industrial materials, chemicals, paper, textiles and numerous other prod-

ucts”<sup>121</sup>. The strategy paper explicitly highlights the goal of sustainable development and its economic, environmental and social dimensions which need to be respected by bioeconomic activities in order to meet the need of future generations.

## 3 Who is the author of the strategy?

The bioeconomy strategy was developed by inter-ministerial collaboration led by the Ministry of Trade, Industry and Fisheries. Other ministries involved include the Ministry of Agriculture and Food; the

Ministry of Climate and Environment; the Ministry of Education and Research; the Ministry of Petroleum and Energy; and the Ministry of Foreign Affairs.<sup>122</sup>

## 4 What are the key goals of the strategies

The Norwegian bioeconomy strategy seeks to lay the foundations for a common understanding of bioeconomy and its national opportunities and challenges. It clearly pursues economic goals, such as the creation of wealth and employment, and improvement of the

country's competitiveness. Bioeconomy should contribute to sustainable development, specifically to a more circular and environmentally-friendly, low-emission economy.

## 5 What are the priority areas of the strategies?

The strategy focuses on four priority areas: 1) cooperation across sectors, industries and thematic areas, 2) developing markets for biobased products, 3) sustainable production of biological resources, 4) efficient use and profitable processing of biological resources. The strategy specifically addresses goal conflicts and opportunities to minimize them, for example by minimizing waste and optimizing efficiency of use. In this respect, biorefinery development in the food and wood industry is considered

a promising route in Norway. In addition to the four priority areas, the strategy emphasizes the promotion of key enabling technologies (including biotechnology, nanotechnology and ICT) to facilitate the development of new biobased processes, products and services, such as the microbial production of biopharmaceuticals and food ingredients, and the anaerobic fermentation of biogas.

## 6 Is there a dedicated action plan with quantitative targets?

Yes No

X

The bioeconomy strategy has not yet been translated into a dedicated action plan. However, the Norwegian Research Council has been commissioned to develop such an action plan together with the public I&R agency Innovation Norway and the Industrial Development Corporation of Norway (SIVA). The plan should propose how work will be coordinated between relevant institutions and instruments within and across government agencies. The government

also intends to set up a dialogue platform for industry and research stakeholders. The plan should further define suitable measures for promoting bioeconomy R&D, demonstration, pilot and scale-up plants, as well as internationalization efforts. The strategy paper covers a period of 10 years and will be assessed by a mid-term evaluation (audit) after five years.

## 7

**Which measures/instruments are used to promote the strategies?**

The Norwegian strategy focuses largely on domestic issues of bioeconomy development. With a view to promoting innovation, the strategy supports public R&D and encourages innovation projects along the bioeconomy value chain. Innovations in agriculture, forestry and fisheries/aquaculture are considered necessary to achieve climate-resistant plants and improvements in soil fertility/quality. The strategy points to further R&D requirements in livestock farming, such as improved feed, cage technology, breeding methods and vaccine production. The government intends to provide funding for bioeconomy research centers and to coordinate the respective research programs and grant schemes. In order to strengthen dialogue and innovation activities across disciplines and geographic areas, the strategy proposes support for networking activities and the establishment of public-private partnerships. Biodiversity mapping is supported to make production and extraction activities in the primary industries more sustainable.

The government seeks to support infrastructure development by the co-financing of test and demonstration facilities that can be shared by several companies and R&D institutions. Cluster development is encouraged to increase cooperation across sectors, industries and thematic areas.

Commercialization and the efficient use and value-oriented processing of biobased resources should be supported by public certification schemes and subsidies for sustainable forestry.

Demand-side measures are considered necessary to stimulate markets for biobased products, e.g. by developing product and labeling standards and certification systems. Publicly funded information campaigns, education materials and product labeling should further raise awareness of biobased products. The public sector should serve as a role model and use its purchasing power to leverage market demand, e.g. by implementing suitable public procurement practices and by constructing biobased buildings.

Norway already has many years of experience in environmental taxation in line with the country's climate policy. In this context, the government proposes several regulatory improvements to create a level playing field for biobased products, for example taxes or quota for fossil-based products to account for negative environmental and climate effects. In addition, regulatory changes are considered necessary to promote circular economy approaches and the use of residues, e.g. in the field of waste water treatment. With a view to sustainable production and extraction of biological resources, the strategy intends to develop new regulations for the harvesting and exploitation of microalgae, to revise bioprospecting regulations, and to adapt legislation to promote investments in sustainable fisheries.

International collaboration in the bioeconomy is stimulated by Norwegian participation in the EU Framework Program for R&I and the country's OECD membership.

**REFERENCES**

- 120 Norwegian Ministry of Trade, Industry and Fisheries. (2016). Kjente ressursar – uante muligheter: Regjeringens bioøkonomistrategi. Available at [https://www.regjeringen.no/contentassets/32160cf211df4d3c8f3ab794f885d5be/nfd\\_biokonomi\\_strategi\\_uu.pdf](https://www.regjeringen.no/contentassets/32160cf211df4d3c8f3ab794f885d5be/nfd_biokonomi_strategi_uu.pdf) [17.02.17].
- 121 Norwegian Ministry of Trade, Industry and Fisheries. (2016). Familiar resources – undreamt of possibilities: The Government's Bioeconomy Strategy. Available at [https://www.regjeringen.no/contentassets/32160cf211df4d3c8f3ab794f885d5be/biokonomi-eng-kortversjon\\_uu.pdf](https://www.regjeringen.no/contentassets/32160cf211df4d3c8f3ab794f885d5be/biokonomi-eng-kortversjon_uu.pdf) [29.11.17].
- 122 Bardalen, A. (2016, August). The Norwegian bioeconomy strategy – structural changes and green shift in the economy. Presented at (...). Available at [http://www.norden.lv/Uploads/2016/08/26/1472194554\\_.pdf](http://www.norden.lv/Uploads/2016/08/26/1472194554_.pdf) [17.02.17].

Table 12: Important measures for promoting the bioeconomy in Norway

Key points	Policy measures	Concrete implementation
Promoting innovation	Support for networking activities Public R&D	
Supporting infrastructure & capacity building	Funds for test and demonstration facilities Cluster development Biorefinery demo plants	e.g. Bioenergy Program: increased development of small-scale biorefineries
Supporting commercialization	Certification schemes and subsidies for environmentally-friendly forestry Establishment of a new investment company	
Supporting the demand-side	Standards, labeling and certification for biobased products Biobased procurement policies Consumer information and communication campaigns	
Ensuring bioeconomy-friendly framework conditions	Reviewing the political framework Taxes and quotas on fossil based products	Development of a strategy for landing and use of residual waste from the fisheries Revising fertilizer regulations Ensuring regulations for depositing, storage and spreading of organic fertilizers/waste Development of a White Paper on waste policy and the circular economy Evaluation of existing regulations Development of bioprospecting regulations Development of regulations and resource management regimes for the cultivation, harvesting and exploitation of macroalgae
Enhancing international collaboration in the bioeconomy	International R&D cooperation	Norwegian participation in the EU Framework Program for Research and Innovation, bilateral cooperation, Norwegian participation in the OECD

# Spain



1

## Which bioeconomy-related strategies have been developed since 2015?

In 2016, the Spanish government adopted the first national bioeconomy strategy. The document title “**Horizon 2030**” reflects the government’s goal to develop a sustainable Spanish bioeconomy in the coming 15 years.<sup>123</sup>

At regional level, bioeconomy development is promoted by the governments of Andalucía and Ex-

tremadura. In the case of Extremadura, bioeconomy policy is treated under the umbrella of the green and circular economy. In this context, in 2017 the regional government announced the “**Extremadura 2030**” policy strategy which targets various bioeconomy-related topics.<sup>124</sup> At the time of writing this report, a first draft of a dedicated Andalusian bioeconomy strategy had already been published.<sup>125</sup>

2

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

Yes No

X

The national bioeconomy strategy defines bioeconomy as “the set of economic activities based on products and services, generating economic value, making efficient and sustainable use of resources of biological origin as fundamental elements.” The definition covers the production and commercialization of food, forestry products, bioenergy and other biobased products by means of physical, chemical, biochemical and biological processes. The strategy highlights the “food-first-principle” and

environmental sustainability as they key goals of the bioeconomy.<sup>126</sup>

In the Extremaduran strategy document, the term bioeconomy relates strongly to the definition which is used by the European Union. In this respect, it refers to the set of economic activities based on biological resources and processes. The strategy clearly integrates the emerging political concepts of sustainable development, bioeconomy and circular economy.



### 3 Who is the author of the strategy?

The first initiative for a national bioeconomy strategy was taken by the Ministry of the Economy and Competitiveness and the Ministry of Agriculture, Food and the Environment in early 2014. A working group, composed of private and public experts and chaired by the Secretary of State for Research, Development and Innovation (SEIDI), was set up to elaborate a first strategy draft. From this point, the document underwent public consultation, addressing more

than 200 key experts identified through a survey, as well as public feedback. The strategy was finalized and adopted in March 2016.

The Extremadura 2030 strategy is also based on a broad stakeholder consultation process initiated in 2017. The strategy document was finally published by the government of Extremadura.

### 4 What are the key goals of the strategies

The national bioeconomy strategy, and also the Extremaduran policy strategy, each have two elements: From a global perspective, they address the great societal challenges Spain is already facing, including climate change and global food security. In the regional and national context, the strategies intend to increase competitiveness and boost economic

growth by promoting innovative technologies and the internationalization of biobased companies. Moreover, Spain seeks to develop a diversified and more environmentally sustainable economy in which bioeconomy is seen to contribute specifically to rural development and stronger territorial cohesion.

### 5 What are the priority areas of the strategies?

From the beginning, the national bioeconomy strategy document explicitly emphasizes that the transition to a sustainable bioeconomy will be driven by innovations in the biosciences and digitization. The strategy builds strongly on the competency and economic importance of the agri-food and forestry sectors to promote more sustainable production and lead bioeconomy development. In this respect, new technologies and innovation should contribute to improving the efficiency of productive, organizational and logistics processes. For example, cropping systems should be improved by sustainable intensification practices and “omics” technologies as well as precision farming tools. New processing, packing, conservation and cold chain technologies should help to reduce waste throughout the supply chain while also improving the nutritional quality of traditional and new functional products. In the forestry sector, the strategy stresses the implementation of sustainable resource management systems. Knowl-

edge gained in the field of genetics and genomics should contribute to increasing the sector’s productivity. In doing so, the useful life of traditional wood products (e.g. construction, packaging, furniture etc.) should be extended. The strategy promotes the development of high-tech materials, such as wood composites, to increase added value as well as material efficiency.

The strategy document seeks to foster positive spillover effects from the primary sector to bio-innovation in other industrial sectors. For example, by supporting biorefining projects, using residues and by-products from agriculture and the food industry, in order to develop a range of new biomaterials and bioproducts (including biolubricants, bioplastics, food additives, cosmetics, solvents, chemicals, etc.). Advances are also anticipated in the bioenergy field, in particular by developing new ways of synthesizing biofuels through the use of thermochemical or biochemical

technologies and of using alternative feedstocks, especially organic waste and residues. Furthermore, the Spanish strategy targets the promotion of marine biotechnology and development of the blue bioeconomy, which uses a variety of marine compounds (such as enzymes, polymers, carbohydrates, etc.) to obtain pharmaceuticals, chemicals and other bioproducts. Great potential is also attributed to the production of biomass from non-conventional sources (such as algae and microorganisms). Spain has been impacted by hot weather conditions and seasonal droughts. Consequently, the policy paper stresses that bioeconomy development can only be based on the efficient and sustainable use of water resources, i.e. by promoting adequate water management and water reuse across sectors.

The Extremadura 2030 policy strategy seeks to strengthen regional specialization in the agri-food,

forestry and wood processing, clean energy, green tourism and health sectors. It calls for improved resource management, i.e. by means of reuse and recycling technologies as well as sustainable water management practices. Agro-ecological practices are further considered important for promoting green agriculture. In addition, the strategy aims at encouraging new business models for the “4<sup>th</sup> industrial revolution” which are based particularly on circular approaches but also on integrating physics, digital and biological technologies.

Both strategies highlight the importance of the bioeconomy’s social dimension and underline the need for public engagement. In particular, the acceptance of new and innovative technologies would create the basis for further bioeconomy development.<sup>127</sup>

6

## Is there a dedicated action plan with quantitative targets?

Yes No

X

On adoption of the strategy in 2016, the government also published a first action plan.<sup>128</sup> It provides a budget estimate for research and innovation funding composed of European Union funds (H2020), general state administration funds and regional administration funds. In 2016, the available funds were estimated to add up to EUR 230 million (around USD

290 million). The strategy document plans for a total bioeconomy budget of EUR 1.1 billion (around USD 1.4 billion) up to 2020. The strategy document proposed the publication of annual action plans at the beginning of each financial year. In 2017, however, the government did not publish an annual plan and thus had to extend the plan of 2016.

7

## Which measures/instruments are used to promote the strategies?

Spain takes a comprehensive approach to developing the regional and national bioeconomy. The Spanish strategy defines a mix of public R&I programs funded e.g. under Horizon2020 and RIS 3, which provide EUR 570 million (around USD 704 million). It further specifies the support for new multidisciplinary alliances which will be funded e.g. under Horizon2020, the State Scientific and Technical Research and Innovation Plan and further innova-

tion programs in the context of Rural Development Programs (PDR), providing around EUR 696 million (around USD 860 million). Successful public-private partnership models will be analyzed to develop a database of best practices for bioeconomy-related public research projects. The Extremaduran strategy further foresees the establishment of an open innovation platform in order to increase networking activities among stakeholders. It also stresses the

role of regional research centers and the University of Extremadura for promoting innovation.

The government promotes clusters and IT platforms, including campuses of excellence, to build up a state-of-the-art bioeconomy infrastructure and to enhance networking activities among stakeholders. Co-funding by the private sector is considered important in these activities, e.g. when it comes to pilot and demonstration plants.

With respect to measures promoting capacity building, both strategies place emphasis on new training and education programs that answer the needs of the private sector, such as bioeconomy curricula in universities. The policy document also highlights the need for train-the-trainer programs to ensure the professional management of research projects at universities. In terms of fostering public awareness and further education, the strategy supports the development of tools and materials for self-learning, including open access platforms.

The government seeks to mainstream commercialization support for biobased products in existing policies and measures of the ministries, and in the activities of the trade promotion agencies. The strategy also supports communicating and demonstrating the various success stories of biobased innovations and their positive effects (including increased productivity and job creation) to foster awareness in the business community.

Another package of measures relates to promoting bioeconomy development on the demand-side, including the organization of an annual bioeconomy conference for which the action plan 2016 of the bioeconomy strategy foresees a budget of EUR 10,700 (around USD 13,000). In order to raise awareness

of the bioeconomy, the strategy stresses the need for creating stakeholder dialogue platforms and designing a communication strategy. The strategy also highlights the development of a public procurement policy and labeling systems to increase demand for biobased products.

Both policy strategies highlight the need for improving the regulatory framework conditions to provide incentives for bioeconomy development and remove barriers. This should be achieved, for example, by identifying and overcoming legal and administrative hurdles in order to bring biobased products to the market. The Extremaduran strategy further focuses on aligning existing public policies and developing new policies incentivizing the use of waste, circular economy approaches, sustainable forestry management, etc.

The Spanish bioeconomy strategy seeks to foster good governance in the bioeconomy, notably by forming a Spanish Bioeconomy Observatory, which includes a Bioeconomy Strategy Monitoring Group, composed of representatives from ministries and autonomous communities. A Strategy Management Committee, composed of representatives from the Strategy Monitoring Group, a Technical Scientific Support Group and the Technological Networks Group will monitor and reinforce the implementation of support measures.

With a view to international collaboration, the government seeks mainly to increase cooperation and exchange with other EU member states and with the Latin American countries active in bioeconomy development. Furthermore, the strategy stresses the importance of international monitoring activities and seeks to contribute to such efforts.

Table 13: Important measures for promoting the bioeconomy in Spain

Key points	Policy measures	Concrete implementation
Promoting innovation	Public R&D	H2020, RIS 3
	Multidisciplinary alliances	
	Stimulating private sector R&D	e.g. public-private partnerships
	Open innovation platforms	
Supporting infrastructure & capacity building	Training and education programs	Professional training courses, training courses at universities and secondary/primary schools, trainings for management and investment, training courses for financing bioeconomy-related projects etc.
	Bioeconomy curricula for schools and universities	
	Train the trainer programs	
	Pilot projects and demonstration plants	
	Cluster development	
	Regional research centers	
Supporting commercialization	Market development	Exports and internationalization with the help of existing policies and measures of ministries, Export and Investment Spain (ICEX) and the Industrial Technological Development Center (CDTI)
	Knowledge and technology transfer	Establishment of technological platforms and campuses of excellence
	Marketing measures: Demonstrating and communicating the value of biobased innovations	
Supporting the demand-side	Program for social awareness and dialogue	Communication strategy Designing a program for social disclosure and dialogue
	Standardization and certification for biobased products	
	Biobased public procurement	
	Labeling system	Labels for biobased products as part of EU policy
	Stakeholder platforms	Organization of a Spanish conference on bioeconomy, forums, meetings, etc.

Key points	Policy measures	Concrete implementation
Ensuring bioeconomy-friendly framework conditions	Reviewing the policy framework	Circular economy regulations
Promoting Good Governance	Spanish Bioeconomy Observatory	Monitoring Group Spanish Bioeconomy Strategy Management Committee
	Multi-stakeholder dialogue	Online platforms (e.g. Vet+i, IDI+A, Agripa, etc.)
Enhancing international collaboration in the bioeconomy	International monitoring activities	
	Cooperation and exchange with EU Member States and Latin American countries	

## REFERENCES

- 123 Spanish Ministry of Economy, Industry and Competitiveness. (2015). The Spanish Bioeconomy Strategy: Horizon 2030. Available at <http://bioeconomia.agripa.org/download-doc/102159> [04.04.17].
- 124 Junta de Extremadura. (...). Marco Regional de Impulso a la Economía Verde y Circular en Extremadura. Available at [http://extremadura2030.com/wp-content/uploads/2017/03/marco\\_070617\\_v\\_f\\_sin-anexos.pdf](http://extremadura2030.com/wp-content/uploads/2017/03/marco_070617_v_f_sin-anexos.pdf) [21.08.17].
- 125 Government of Andalucía. (2018). The Andalucía Bioeconomy Strategy. Available at <http://www.juntadeandalucia.es/organismos/agriculturapescajdesarrollorural/areas/politica-agraria-comun/desarrollo-rural/paginas/the-andalusia-bioeconomy-strategy.html> [16.02.18].
- 126 Lainez, M. (2016, March). La estrategia española de bioeconomía. Paper presented at Curso de Bioeconomía: Gestión y Financiación de Proyectos de Bioeconomía. Available at <http://agripa.org/download-file/63823-105857> [04.04.17].
- 127 Bonaccorso, M. (2017). Sustainable Ambition: Dossier Spain. Available at [http://www.renewablematter.eu/art/306/Sustainable\\_Ambition](http://www.renewablematter.eu/art/306/Sustainable_Ambition) [18.04.17].
- 128 Spanish Ministry of Economy, Industry and Competitiveness. (2015). The Spanish Bioeconomy Strategy: Horizon 2030. The 2016 Action Plan. Available at <http://bioeconomia.agripa.org/download-doc/102157> [04.04.17].



# United Kingdom

1

## Which bioeconomy-related strategies have been developed since 2015?

In 2016, the UK government initiated a process to develop a dedicated bioeconomy strategy. As a first step, it commissioned the preparation of the opportunity report “Evidencing the Bioeconomy”, which outlines prospects for growth and increased productivity related to the biobased economy.<sup>129</sup> In December 2016, the Department for Business, Energy & Industrial Strategy published a joint call for evidence, together with five industry sector leadership councils, to collect input from the country’s bioeconomy stakeholders. The corresponding survey included questions relating to the definition, opportunities and challenges of the bioeconomy. The results are expected to provide input for the strategy document, which is anticipated for 2018.

Two major policy documents have been published by the government since 2015.<sup>130</sup> First, the parliamentary-driven policy report on “**Building a high value**

**bioeconomy: opportunities from waste**”.<sup>131</sup> Second, the **UK Synthetic Biology Strategy Plan “Biodesign for the Bioeconomy”**, which was adopted in 2016.<sup>132</sup> The latter is based on the Synthetic Biology Roadmap of 2012 in which synthetic biology has been identified as one of the government’s “eight great technologies” of the future.

At regional level, Scotland is very active in promoting industrial biotechnology policies. In this respect, the country published a “**Biorefinery Roadmap**”<sup>133</sup> in 2015 which resulted from the National Plan for Industrial Biotechnology “Towards a Greener, Cleaner 2025” (2012).

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

Yes No



The waste strategy (2015) defines bioeconomy as “the economic activity derived from utilizing biological resources or bioprocesses to produce products such as food, feed, materials, fuels, chemicals, biobased products and bioenergy”. The term “biobased” is used to describe “products derived wholly or in part from biological resources”.

According to the UK Synthetic Biology Strategy Plan (2016), synthetic biology lies at the innovative heart of the bioeconomy. The policy plan highlights the

pioneering role of synthetic biology in improving manufacturing processes, developing more sustainable materials, chemicals, energy and food, and in contributing to environmental protection.

The term bioeconomy is also used in the Scottish Biorefinery Roadmap (2015). More specifically, biorefining is considered important for empowering the Scottish bioeconomy as it provides the technical basis for converting biomass into materials, chemicals, fuels and energy.

## 3 Who is the author of the strategy?

The Synthetic Biology Strategy Plan (2016) was developed by the Synthetic Biology Leadership Council (SBLC) which is composed of representatives from government authorities, academics and industry. The council was established as a steering board aiming at implementing the original roadmap of 2012. It is supported by the Department for Business, Energy and Industrial Strategy (BEIS) and is jointly chaired by the minister and a representative from industry or academia. As part of the strategy revision, the SCLC initiated a public consultation process as well as an online survey to encourage relevant input from stakeholders.

The waste strategy (2015) is based on the recommendations of the House of Lords Science and Technology Select Committee<sup>134</sup> which were published previously. It underwent a public consultation

process to collect input and feedback from stakeholders. It was managed by a previously established cross-governmental working group, which comprised representatives from the Departments for Environment, Food and Rural Affairs (Defra); Business, Innovation and Skills (BIS); Energy and Climate Change (DECC); and Transport (DFT). Further members of the working group are the Department for Communities and Local Government (DCLG), as well as the Knowledge Transfer Network (KTN) and the Biotechnology and Biological Sciences Research Council (BBSRC).

Even though the Scottish Biorefinery Roadmap (2015) represents an industry-led initiative, the document is a result of the collaboration between industry, academia and government authorities. It was published by Scottish Enterprise and Chemical Science Scotland.

## 4 What are the key goals of the strategies

The three policy papers share strategic economic goals, such as stimulating sustainable economic growth, creating jobs and strengthening the country’s productivity and competitiveness. The UK waste strategy (2015) further seeks to reduce environmen-

tal pollution and greenhouse gas emissions by promoting a circular economy. The Scottish Biorefinery Roadmap aims at encouraging sustainable manufacturing processes and developing innovative products with a reduced environmental footprint.

5

## What are the priority areas of the strategies?

The UK Synthetic Biology Strategy Plan (2016) prioritizes promoting the transfer of knowledge and technologies from research to industry in order to produce more sustainable materials, chemicals and energy. Links between synthetic biology and digitization are expected to stimulate new business and markets.

The waste strategy (2015) seeks to leverage biogenic residues and waste as a resource for high value products. It highlights the need to develop key enabling technologies, including biotechnology, anaero-

bic digestion, biocatalysis, algal cultivation, chemical processing and thermochemical processing.

The Biorefinery Roadmap for Scotland (2015) concentrates on second and higher generation biorefinery concepts which do not use feedstocks that compete with food and feed supply chains. The roadmap identifies three potential feedstocks: co-products and residues of the timber value chain; household waste, commercial and industrial waste; and macroalgae.

6

## Is there a dedicated action plan with quantitative targets?

Yes No

X

The Biodesign strategy (2016) aims at achieving a GBP 10 billion (around USD 14 billion) market for synthetic biology by 2030. The strategy document includes concrete recommendations and actions, just like the Scottish Biorefinery Roadmap (2015), which even involve short-, medium- and long-term

activities. In contrast, the UK waste strategy (2015) encompasses only qualitative targets. For example, it is envisaged that the UK will become a major exporter of process technologies and business models, and a location of choice for global investment by 2030.

7

## Which measures/instruments are used to promote the strategies?

It is noteworthy that all three policy strategies provide a comprehensive approach to fostering bioeconomy development. Regarding the promotion of innovation, the Synthetic Biology Strategy Plan (2016) encourages R&D into platform technologies and biological information and control systems. This should guarantee a flexible response to rapid technology development in the field of extensive automation, software and genome editing and should further ensure their successful commercial application. The strategy also highlights the importance of standards for responsible research and innovation. The UK waste strategy (2015) proposes public R&D support in the field of biotechnologies and biorefineries, which should be provided by the UK Research

Councils and the country's innovation agency (Innovate UK). The Scottish government intends to grant R&D support for biorefinery development and specifically to encourage the formation of public-private consortia in this area. The Research Councils are tasked with proposing alternative R&D funding mechanisms for such endeavors. The action plan also includes a review of pilot and demonstration facilities and the development of feasibility studies. All three strategy plans support infrastructure investments, e.g. for demonstration facilities. The government also seeks to provide state-of-the-art digital information infrastructure to ensure effective communication among all synthetic biology stakeholders.



With regard to capacity building, the Synthetic Biology Strategy Plan (2016) highlights the establishment of so-called “Skills Schools” which should offer industry-relevant training courses to students and post-docs. Furthermore, a newly established advisory body linked to the SBLC should provide guidance to all educational levels. The strategy plan considers the establishment of a synthetic biology education fund to finance scientific and business skills programs. The policy plan also aims to foster the participation of citizens and the interested public in synthetic biology. It supports, for example, the promotion of do-it-yourself biocommunities, citizen science projects and also novel multidisciplinary collaborations between synthetic biologists, designers, artists and social scientists. The waste strategy (2015) and the Scottish Biorefinery Roadmap (2015) also aim at developing training programs (including apprenticeships, masters and post-doctoral programs) and specialist training courses. Both strategies also highlight the need to assess currently available funding for training and education, and to develop alternative funding mechanisms.

To support commercialization of products from synthetic biology, the Biodesign Strategy (2016) proposes multi-stakeholder partnerships. These could involve individual businesses and knowledge transfer organizations, business-led “technology sandpits”, showcase events and a “proof of concept” fund. Furthermore, the strategy plan highlights venture-capital-backed competitive accelerator schemes as important tools for future business development. In order to support the up-scaling of biobased processes, the document stresses the establishment of specific funding tools (such as “competitive and graduated support funds”) and access to critical scale-up facilities. Commercialization should also

be supported by agreeing on international technical standards in synthetic biology. The UK waste strategy (2015) targets commercialization by promoting partnerships and networks (e.g. BBSRC Networks in Industrial Biotechnology and Bioenergy), guaranteeing access to process and demonstration plants as well as providing funding opportunities. In this regard, the government will explore funding options provided by the Green Investment Bank for the UK recycling and reprocessing market. R&D tax credits are proposed as concrete measures to support biobased businesses. The Scottish Biorefinery Roadmap (2015) additionally emphasizes the need for market research on biobased products.

The demand-side instruments of the three strategies concentrate primarily on awareness creation. The focus is on providing the public with adequate information on technology development and fostering communication activities.

In addition, the policy strategies highlight the importance of measures that ensure bioeconomy-friendly framework conditions. They consider, for example, a review of the regulatory framework in order to ensure policy coherence. In this regard, the Synthetic Biology Strategy Plan (2016) announces the establishment of an SBLC-specific working group.

Measures related to good governance concentrate mainly on monitoring and measuring activities, including the mapping of biogenic resource streams through data sharing platforms.

Overall, international coordination and partnerships are valued as highly important, especially in respect of international standards in synthetic biology.

---

## REFERENCES

- 129 Bauen, A. et al. (2016). Evidencing the Bioeconomy: An assessment of evidence on the contribution of, and growth opportunities in, the bioeconomy in the United Kingdom. Available at <https://www.bbsrc.ac.uk/documents/1607-evidencing-the-bioeconomy-report/> [24.11.17].
- 130 Burrows, P. (2016). The Bioeconomy: fueling a greener future. Paper presented at EuroScience Open Forum 2016. Available at <http://www.esof.eu/files/ESOF2016/ESOF2016-Session-Presentations/Thebioeconomy-fuellingagreenerfuture.pdf> [08.06.2016].
- 131 Department for Business, Innovation & Skills. (2015). Building a high value bioeconomy: opportunities from waste. Available at [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/408940/BIS-15-146\\_Bioeconomy\\_report\\_-\\_opportunities\\_from\\_waste.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/408940/BIS-15-146_Bioeconomy_report_-_opportunities_from_waste.pdf) [08.06.2016].
- 132 Synthetic Biology Leadership Council. (2016). Biodesign for the Bioeconomy: UK Synthetic Biology Strategic Plan 2016. Available at [https://connect.innovateuk.org/documents/2826135/31405930/BioDesign+for+the+Bioeconomy+2016+DIGITAL+updated+21\\_03\\_2016.pdf/d0409f15-bad3-4f55-be03-430bc7ab4e7e](https://connect.innovateuk.org/documents/2826135/31405930/BioDesign+for+the+Bioeconomy+2016+DIGITAL+updated+21_03_2016.pdf/d0409f15-bad3-4f55-be03-430bc7ab4e7e) [31.05.2016].
- 133 Chemical Science Scotland. (2015). The Biorefinery Roadmap for Scotland. Available at [https://www.sdi.co.uk/~media/sdi\\_2013/sectors/chemical%20sciences/biorefineryroadmapforscotland.pdf?la=en](https://www.sdi.co.uk/~media/sdi_2013/sectors/chemical%20sciences/biorefineryroadmapforscotland.pdf?la=en) [08.06.2016].
- 134 House of Lords Science and Technology Committee. (2015). Third Report Waste or resource? Stimulating a bioeconomy. Available at <https://publications.parliament.uk/pa/ld201314/ldselect/ldstech/141/14102.htm> [28.02.18].

Table 14: Important measures for promoting the bioeconomy in the UK

Key points	Policy measures	Concrete implementation
Promoting innovation	Public R&D	e.g. advance chassis characterization Development of smart biological information and control systems Innovative technologies and biorefineries
	Responsible research and innovation (RRI)	Development of appropriate standards for RRI
	Mapping of resources streams	Developing data sharing platforms Feedstock analyses on wood, wastes/co-products and macro-algae
	Financial support for academic research	UK Research Councils, Innovate UK: thematic competition programs, energy program
	Technology appraisals regarding synthetic biology, biotransformations and integrated bioprocesses	
	Consortia building	
Supporting infrastructure & capacity building	Effective digital information infrastructure	Development of efficient and use-friendly software
	Investment for the development of demonstration facilities	
	Education, training & capacity building	Establishment of the multi-disciplinary synthetic biology Centres for Doctoral Training (CDTs) Establishing a working group to develop a synthetic biology teaching framework and commission resources Developing training mechanisms (incl. apprenticeships, masters and post-doc programs)
		Establishment of a synthetic biology education fund
		Working group on developing a Skills School provision for synthetic biology students and postdocs

Key points	Policy measures	Concrete implementation
Supporting commercialization	Business development	e.g. accelerator schemes
	Technology transfer	Industry collaboration through knowledge transfer organizations (such as the Knowledge Transfer Network)
		Business led technology sandpits
		Showcase events
		Mentorship from experienced industrialists
Investment in entrepreneurship		'Proof of concept' fund to catalyse new research partnerships
		Establish venture capital-backed seed fund competitions
Up-scaling		Investment readiness programs
		Establish a competitive and graduated support fund
		Undertake a study to determine whether or not there is the need for a significantly scaled-up and world class resource investment to train and empower researchers, in academia and industry
	Market research on biobased products	Capital investment or loan-guarantee program
Supporting the demand-side	Awareness creation	Providing adequate information on technology development
		Communication activities
	Standards & best practices	Developing international agreed technical standards (e.g. in relation to data formats, process automation procedures and tools, and component characterisation)
Ensuring bioeconomy-friendly framework conditions	Policy coherence	Establishing a SBLC working group to share experience of developing adaptive regulatory systems
		Identifying opportunities for standards to contribute to more adaptive regulatory systems
	Supportive environment	R&D tax credits
Promoting Good Governance	Review of IP regulations	The SBLC should continue to review, refine and act upon IP-related recommendations developed from on-going workshops
		Development of formal standards
Enhancing international collaboration in the bioeconomy	International R&D Partnerships	Developing standards, common values and best practices



# Summary & Conclusions

The analysis shows that the global trend towards developing bioeconomy policies has continued since 2015. Worldwide, 49 countries have published policy strategies related to bioeconomy development, 15 of which have developed dedicated bioeconomy policy strategies. The chapter on emerging policy initiatives at the beginning of this report describes the dynamic development of

and various approaches to promoting bioeconomy in parallel with national policy making. However, bioeconomy policy strategies differ significantly with regard to their priorities and the measures proposed. These differences and similarities are summarized in the following section.

## Understanding & Definition of Bioeconomy

While bioeconomy-related strategies published before 2015 used different terms and definitions, such as biobased economy, bio-industry or green economy, the term “bioeconomy” has clearly prevailed in recent years. Furthermore, almost all of the documents analyzed in this report provide an explicit definition of bioeconomy and emphasize its transformative character. Even if the scope and content of the relevant definitions varies, most strategies focus on the **production and utilization of biological resources** to generate high-value biobased products. Interestingly, the provision of services based on biological resources, processes and principles plays a less significant role and is only mentioned by a few countries such as Argentina, Brazil, Canada, Latvia and Spain.

What is new, however, is that countries such as Brazil, the EU, France, Italy, Latvia, New Zealand, Spain, the United Kingdom and the United States increasingly emphasize the **blue bioeconomy**. They highlight the potential of marine resources (such as algae, seaweed, by-products from fisheries and aquaculture) and marine compounds (including enzymes, polymers and carbohydrates) as alternative feedstock for biobased products.

It has also been shown that only a few countries link bioeconomy development directly to **digitization**. Only Brazil, China, New Zealand, the Spanish region of Extremadura and the UK highlight the potential arising from combining both digital and biological technologies for modernizing existing industries and businesses and for developing completely new sustainable industries and business models. Thailand and the Extremadura region further describe the integration of physics, circular, digital and biological technologies using the term “**4<sup>th</sup> industrial revolution**”, which will facilitate an Industry 5.0. The strategy papers of Argentina, Brazil, China, France, Italy, Latvia, New Zealand, Norway, Spain, the UK and the United States mention the importance of **converging technologies**, such as biotechnology, nanotechnology, the ‘omics’ technologies and ICT, to facilitate the development of innovative biobased processes, products and services but they still remain generally vague.

In December 2015, the European Commission adopted a new circular economy strategy to promote resource efficiency across industries and member states. Consequently, bioeconomy and the use of biological resources have been increasingly linked to this **circular economy concept**. Practically all of the European bioeconomy(-related) strategies published since 2015 highlight the compatibility of the concepts and the contribution of bioeconomy to circular economy approaches (including Finland, France, Italy, Latvia, Norway, Spain and the UK). The Italian bioeconomy strategy even introduces the term “circular bioeconomy”. The EU also uses this term in its present roadmap for preparing an update of the bioeconomy strategy and action plan of 2012. In Argentina and Canada, the circular economy concept has also received considerable attention within bioeconomy-related policy strategies. Regardless of terminology, all the countries analyzed in this report seek to reduce waste and increase value from biological resources, in particular by using residues, by-products and waste as feedstock for innovative biobased products. The intention is to increasingly use feedstock that does not compete with food and feed supply chains in order to prevent a conflict of aims.

It is worthwhile mentioning that all the newer policy strategies are aligned with meeting the **UN Sustainable Development Goals**. In particular, they pursue increased domestic economic growth, competitiveness and employment while protecting the environment and fostering social inclusion. With respect to the increasing global trend of urbanization, all the policy strategies analyzed focus on regional and rural development to avoid marginalization processes. At the same time, they aim to cope with major societal challenges, such as climate change, food and energy security, and loss of biodiversity. Oil-importing countries with huge biomass resources further seek to reduce their dependence on fossil fuels, while industrialized countries with fewer biological resources aim to take advantage of the possibilities arising from advanced biosciences and the biologization of the economy.

A relatively new development can also be observed in Argentina, Brazil, China, France, Italy, Latvia, New Zealand, Norway, Spain, Thailand and the United States where innovations in bioeconomy are considered increasingly important for improving **human health**. Innovations in the agri-food sector, for example, should ensure the nutritional quality of foods and food safety while promoting long-term benefits for human health. In this context, R&D for functional foods and healthy diets is fostered. Alternative food resources, such as insects and algae, are also considered promising in countries such as Thailand, France and Italy in order to meet the future supply

of protein. Another emerging trend in bioeconomy policy strategies is the support for biopharmaceuticals (including discovery, antibiotics and vaccines in addition to marine-derived pharmaceuticals) and for precision and personalized medicine (in the policy strategies of China, New Zealand, Thailand and the United States). In China, the focus is also on promoting innovative biomedicines that combine traditional Chinese medicine approaches with the use of information and communication technologies to facilitate data collection and evaluation.

---

## The Regional Dimension of Bioeconomy

The regional dimension of bioeconomy has gained greater importance in recent years. The chapter on emerging policy initiatives shows that countries with similarities in their resource endowment and economic conditions increasingly pursue joint initiatives to foster bioeconomy development. This results in efforts to develop **macro-regional policy strategies and initiatives** in Central and Eastern Europe, the Nordic countries, Eastern Africa and countries in Latin America and the Caribbean. There has also been a substantial increase in **sub-regional bioecon-**

**omy initiatives** initiated by federal states, regional authorities and municipalities. Regions may find it easier to specialize and focus on their comparative advantages in order to create higher value from local resources. The bioeconomy is seen as a means of promoting rural development, creating employment opportunities and improving the regional innovation system. This regionalization can be observed increasingly across Europe (in Germany, Spain, France, Italy and Finland for example), North and Latin America, and South East Asia.

---

## Bioeconomy & Innovation Agendas

The analysis indicates that most of the policy strategies provide a dedicated innovation agenda to promote bioeconomy development. In this respect, **sustainable development** is a key goal of all the innovation agendas analyzed. To increase competitiveness and to reduce the ecological footprint, it is considered important to **efficiently and sustainably use biobased resources** and also to reduce waste. The strategies therefore focus on promoting R&D on new and improved biobased products. Many countries consider **biorefinery development** as important for converting biobased resources into innovative products. It is equally important to develop new **resource alternatives for industrial**

**use**, such as organic waste and residues and by-products from agriculture, forestry and fishery. The innovation agendas analyzed differ in range and scope. Countries rich in bioresources such as Argentina, Brazil, Canada, France, Italy, Latvia, New Zealand, Norway, Spain, Thailand and the United States promote **innovations in their primary industries**, including agriculture, forestry, fisheries and aquaculture, to ensure sustainable production and long-term resource availability. Consequently, R&D in sustainable intensification, climate-smart agriculture and forestry, precision agriculture and livestock farming are considered extremely promising. Policy strategies in Argentina, Brazil, China, France, Latvia,

New Zealand, Spain, Thailand and the United States also highlight the potential of genetic improvements to increase yields and the quality of crops, while the Italian and French documents also include enhancing the photosynthetic capacity of plants. As a prerequisite for the sustainable production of any bioresources, most of these countries support R&D for the purpose of **ecosystem conservation, recovery and restoration**. They emphasize the need to improve resource management by using environmental and cascading technologies to increase soil fertility, water and air quality, etc. Besides sustainable forest management practices, agro-ecological and organic farming approaches are also considered important in Brazil, France, Italy, Latvia, and Spain while newer concepts of urban greening and urban

farming receive special attention in the Canadian and the Italian bioeconomy strategy.

Some countries analyzed, such as Brazil, China, Latvia, New Zealand, Spain, the UK and the USA, go beyond the use of bioresources and also promote a more **technology-driven innovation agenda** by additionally focusing on emerging technologies and industries. The strategies envisage that the transition to a sustainable bioeconomy will be based on **bioscience innovation** (including genome editing, bioinformatics, biosensors and neurosciences, etc.) and the **utilization of biological knowledge** to develop advanced manufacturing processes in the fields of bionics, artificial intelligence, carbon capture, 3D-printing, etc.

---

## Practical & Proposed Policy Measures

The following section points out the role of governments in promoting the transition to a knowledge-based bioeconomy by analyzing the political commitment and measures proposed in recent bioeconomy(-related) strategies.

In general, the policy strategies analyzed in this report are not limited to defining broad goals and visions for the bioeconomy. Some of them, such as Australia, China, Italy, Latvia, Thailand and the UK, also provide concrete **quantitative targets** for bioeconomy development. These targets range from increasing the bioindustry share of GDP or annual sales of biotech products, to raising the general bioeconomy turnover and creating more bioeconomy-related jobs. Generally speaking, most of the countries analyzed still prefer to define qualitative targets. Only Spain and Thailand provide **concrete budget targets** within their bioeconomy policy strategies by listing funding opportunities and dividing them into concrete funding phases.

Interestingly, many of the recent strategy papers so far lack a corresponding **action plan or roadmap**. Only Australia (Queensland), France, Spain and Thailand provide a dedicated action plan to support the strategy's implementation. Others at least lay the foundation for action plans (e.g. Brazil, China, Italy

Latvia and Norway) or for a set of concrete policy measures to be implemented by the government. Generally, the proposed measures focus on both the demand and supply side. Public investment in bioeconomy development typically includes science, technology and innovation funding; infrastructure development; capacity building and education; commercialization support; demand-side instruments; regulatory activities; measures for good governance and support for international collaboration in the bioeconomy. In the following section, the report summarizes trends, differences and specific features of policy measures defined in recent policy strategies.

### Promoting Innovation

**Public R&D funding** is widely considered a key measure for enhancing the innovation ecosystem for the bioeconomy. In this respect, recent policy strategies specifically highlight the importance of promoting links between fundamental and applied research and supporting multidisciplinary research alliances. The governments of Brazil, Canada, France, Italy, Latvia, Spain, Thailand and the UK, for example, use the instruments of R&D grants, competitions and public funds. Support for public R&D should be

further facilitated by leveraging public funding at regional, national and supra-national level. The promotion of **public-private partnerships** also appears highly relevant in almost all the countries analyzed to ensure jointly-funded innovation projects. Interestingly, the Thai Bioeconomy Roadmap is the result of a high-level public-private partnership which will be also co-financed by stakeholders in the private and public sector. In general, several countries underline the need for increased **private R&D**, e.g. in the form of industry-led consortia that should facilitate investment in pre-competitive research. The establishment of **research networks** and **centers of excellence**, which aim to ensure continuous stakeholder cooperation and dialogue, is also mentioned several times. It is worth noting that so far only a few countries (such as Canada, China and New Zealand) have focused on fostering **innovations based on traditional knowledge** and **low-tech and social innovations** (France, New Zealand, Spain and the USA) which include open innovation platforms and citizen science approaches.

## Supporting Infrastructure

With respect to the promotion of infrastructure development, the priority of almost all the countries analyzed is relatively straightforward. In addition to fostering **multi-user pilot and demonstration facilities**, establishing **biorefinery demo plants** is rated most relevant. The Thailand Bioeconomy Roadmap, for example, envisages the establishment of biorefinery complexes based on sugarcane and cassava feed-stocks for producing high-value biobased products. The development of **bioeconomy hubs, networks and clusters** is also considered important (in Canada, China, France, Italy, Norway, Spain, Thailand and the USA) for bringing together stakeholders, ensuring learning from best practices and encouraging regional innovation ecosystems. In the Asian countries in particular, the concept of a so-called “Biopolis” is gaining increasing importance. Its aim is to bring together major research institutes to create a center of excellence in bioeconomy experimentation. It is interesting that only the policy documents of New Zealand, UK and the United States explicitly mention promoting the **digital infrastructure**.

## Supporting Capacity Building

Countries around the world are facing the challenge of developing a skilled workforce for the bioeconomy of the future. Several countries have already established bioeconomy-related education and capacity building programs. As a pioneer, the University of Hohenheim in Germany established the first interdisciplinary master’s program in bioeconomy in 2015.<sup>135</sup> The University of Munich recently announced the establishment of an integrative research center in Straubing where research and teaching will concentrate on biobased resources, sustainability and bioeconomy. In connection with this, ten new degree programs will be set up and six new professorships on bioeconomy will be appointed.<sup>136</sup> In Greece, the University of Piraeus and the National and Kapodistrian University of Athens have developed a master’s program on “Bioeconomics”.<sup>137</sup> In the Czech Republic, the University of South Bohemia has established an interdisciplinary bioeconomy course for postgraduates. In addition to getting a theoretical and basic background in bioeconomy, students are encouraged to work on an actual case study with industry partners.<sup>138</sup> In France, the European Center for Biotechnology and Bioeconomy has been established in 2015. By this, the support for four bioeconomic-relevant chairs and academic programs (e.g. in the area of biotechnology, biomaterials and green chemistry) has been increased. In Italy, the first European master’s program in “Bioeconomy in the Circular Economy” was launched in 2017. It is a public-private partnership between four Italian universities, three industrial partners, and an Italian banking group. The Lodz Declaration on a European Bioeconomy Education Platform was announced within the Poland Congress on Bioeconomy in November 2017. The platform is intended to foster exchange between multi-disciplinary bioeconomy education programs to build a skilled working force for the new generation.<sup>139</sup>

The support for education and capacity building measures is also deeply rooted in the bioeconomy (-related) strategies published recently, including Argentina, Brazil, Canada, China, France, Italy, Latvia, New Zealand, Spain, Thailand, the UK and the United States. Measures mentioned for promoting capacity development include publicly-funded **training courses for professionals** in entrepreneurship, innovation



management, technology transfer and IP rights; new training programs that relate to the needs of the private sector; and **promoting the career path of graduates** by connecting them with industry and business. **Tools and materials for self-training** are also mentioned as being highly important in Spain and the UK, for example. In Argentina, the first academic online seminar on bioeconomy started in 2017. It addresses students, professionals and also manufacturers who are interested in bioeconomy and provides an introductory set of modules related to bioeconomy issues.

With respect to bioeconomy-related education, the strategies mainly prioritize the establishment of **inter-disciplinary academic bioeconomy courses** (including master's and doctoral programs). Further measures proposed by the policy documents analyzed include **bioeconomy programs for schools, postgraduate education** to improve both technical and soft skills, **life-long learning opportunities** and **education programs for policy-makers** at all levels of government, although these efforts are frequently only in their infancy.

## Supporting Commercialization

The most relevant approach to supporting commercialization efforts is seen as guaranteeing **access to capital for biobased companies**. This applies, for example, to the policy documents of Argentina, Australia, Brazil, Canada, China, France, Latvia, Norway, Thailand and the UK. Promoting debt and equity financing, early-stage funding, incentives for angel and venture investors as well as the general modernizing of funding mechanisms are all considered highly relevant. However, the development of green bond markets and green guarantee mechanisms, green industry funds and green stock indices is also rated promising in China, for example. All the strategy papers, however, lack the provision of concrete measures on how to facilitate this access to public and private capital. In particular, it remains unclear as to what extent the general measures proposed will also stimulate private actors to increasingly invest risk and venture capital. Furthermore, the strategy documents do not provide any concrete information on public funding opportunities. In contrast, the European Commission demonstrated how

this issue could be tackled at the end of 2017. The Commission announced the establishment of a Bioeconomy Investment Platform with up to EUR 100 million (around USD 123 million) backing to improve access to finance for bioeconomy companies in Europe. The platform's financial support will be based on the EU budget. It further strives to mobilize additional public and private investment for bioeconomy development.<sup>140</sup> Information on existing funding opportunities is often still lacking. As a pioneer, the European Investment Bank and the Biobased Industry Consortium published first overviews of European financial instruments in 2017. The reports show to what extent different financial instruments can be used to promote bioeconomy-related projects and corporate financing.

The strategy documents of Argentina, Australia, Brazil, China, France, Italy, Latvia, New Zealand, Spain, the UK and the United States additionally mention measures, such as **knowledge and technology transfer**, increased **marketing efforts**, **access to scale-up facilities** and **policies facilitating increased export and internationalization**, in order to promote commercialization. The governments of Argentina, Canada, China, Latvia, Thailand and the UK consider **tax incentives for biobased companies** important to enable them to enter the market. These include accelerated capital cost allowances, deduction of R&D costs, exemption from VAT, reduced corporate tax rates and special tax rates for technology transfer. Interestingly, only a few countries, such as China and Norway, highlighted **subsidies for the increased production and use of renewable resources**.

## Supporting the Demand-Side

To stimulate demand for biobased products and services, most of the countries, including Argentina, Australia, Canada, China, France, Italy, Latvia, Norway, Spain and Thailand, mention the introduction of **public procurement policies** as highly promising. Proposed measures range from introducing standards for biobased public procurement to reviewing the present regulatory framework on public procurement. In addition, the promotion of **certification schemes** (e.g. for sustainably-produced biomass) and **standards and labels** indicating a product's life cycle impact should aim to attract greater attention

to biobased products and services. This includes updating building codes and standards to increase the share of wood (in Canada, Latvia and Norway) or hemp (in France) in construction. In contrast, relatively few countries mentioned **tax incentives for customers, bans on fossil-based products** (such as plastic bags) or the **introduction of fuel quality standards** as being important.

As the bioeconomy is still relatively unknown within the public arena, creating awareness of bioeconomy is actually at the very top of the strategies' agendas. The recently published French action plan reflects this, for example. Unfortunately, most of the strategies remain vague with regard to the promotion of concrete measures. Even if they underline the need for **consumer information and communication**, there are no specific projects or measures foreseen to design communication strategies or concepts to communicate the benefits of biobased products and services to customers or to address media work.

It is worthwhile mentioning that in recent years **online platforms** have become established as a useful tool for providing information on bioeconomy. In Finland<sup>141</sup>, Austria<sup>142</sup> and Germany<sup>143</sup>, for example, exclusive websites on bioeconomy have been launched to provide information about recent developments in bioeconomy, to publicize upcoming events and outline national and international policies. In Greece, the Greek Bioeconomy Forum was established in 2017. It mainly seeks to address and inform decision-makers on policy and business.<sup>144</sup> In Finland, the government has set up a communication support group to promote the implementation of the bioeconomy strategy. The group is composed of representatives from ministries and consultancies and is responsible for online communication

activities, including websites and social media.<sup>145</sup> Besides providing an online information platform, the EU-funded BioStep project sought to promote participative engagement by organizing stakeholder workshops, conferences, living labs and exhibitions on bioeconomy.<sup>146</sup> In addition, the European Commission launched the Bioeconomy Knowledge Center in July 2017. The website provides data and relevant publications on bioeconomy in the member states to ensure better knowledge-sharing.<sup>147</sup> Similar activities were undertaken in Latin America and the Caribbean where an online platform, known as the CELAC Bioeconomy Observer, was established to strengthen regional cooperation on bioeconomy.<sup>148</sup>

## Regulatory Measures, Specifications & Standards

The analysis shows that most of the countries highlight the need to create bioeconomy-friendly framework conditions. These claims, however, remain relatively vague. Only very few countries, for example, emphasize the importance of **reviewing and harmonizing the regulatory framework**. While countries such as Argentina, China, New Zealand and the USA focus more on reviewing regulations governing new biotechnologies, countries such as Italy, Norway, Spain and the USA focus on reviewing circular economy regulations (especially regarding the use of waste and residues for higher value applications). Brazil, China, New Zealand and Thailand also highlight the need to review the policy framework for intellectual property rights. Interestingly, only a few countries (Canada, New Zealand and Norway) mention carbon taxing, bioprospecting regulations and global data policies.

## Resumé

While only few years ago, political support for the bioeconomy was driven mainly by the search for renewable resources as a substitute feedstock for fossil fuels, recent policy strategies also focus on the valorization of bioresources and innovative solutions for sustainable development, including climate protection and the circular economy.

Globally, the term “bioeconomy” has become more mainstream in recent years. Compared to 2015, most of the countries analyzed in this report provide explicit definitions of bioeconomy in their policy papers. These definitions, however, and thus the delineation of which activities and areas form the bioeconomy, vary in scope and depth. Most countries focus on the production and utilization of biological resources (often summarized as biomass) in value chains to generate added value in the primary sector and for downstream industry. Even in industrialized countries, bioeconomy is often driven by ministries responsible for agriculture, forestry, fisheries, rural development or economics and less by ministries for industry and innovation or RTD. Since the last Global Bioeconomy Summit at the end of 2015, one important trend may be noted: achievement of the UN Sustainable Development Goals is increasingly becoming an overarching topic both in the dedicated and the bioeconomy-related strategies, policies and action plans.

With a view to innovation policy, only a few countries discuss or prioritize the opportunities arising from key enabling technology trends and biological knowledge. Digitization and the convergence of key technologies play a decisive role in innovation agendas of the G20.<sup>149</sup> In connection with this, the term “4<sup>th</sup> or next industrial revolution” has gained attention in at least some of the latest bioeconomy policy papers. The knowledge-based bioeconomy is seen as closely related to present key technology trends in industry, e.g. in the fields of synthetic biology, big data techniques, additive manufacturing and the Internet of Things, nanomaterials, and artificial intelligence. However, its transformative potential across industry and service sectors remains undervalued. The same applies to the potential of environmental technologies to regenerate ecosystems and maintain biodiversity. At the same time, nature conser-

vation and, more recently, the notion of preserving natural capital have also been gaining in importance in policy documents.

With about 50 countries active in bioeconomy policies, there is substantial public support for R&D, governance and business projects. In some countries, private stakeholders from business and industry have also become increasingly active in bioeconomy policy. Nevertheless, more international collaboration and coordination will also be required to leverage private funding and to create synergies in areas of common interest, such as sustainable intensification in agriculture, food security and healthy nutrition, bioeconomy monitoring, biodiversity protection and ecosystems or sustainable urbanization (Biocities). International collaboration is mentioned as important in most policy strategies, but it broadly lacks implementation beyond bilateral research cooperation. As yet there is still no measurable or visible effort to identify and agree on joint global flagship projects, such as fighting plastics and waste in oceans, to name but one example. Furthermore, bioeconomy is still not integrated in global or multilateral policy forums for sustainable development and climate protection. Since holding the GBS2015, a few multilateral initiatives have been launched: 1) An International Working Group for Sustainable Bioeconomy was set up by the UN FAO in 2016 to work on common principles of good governance for a sustainable bioeconomy and to propose a set of indicators; 2) With a view to international climate policy, the government of Brazil launched the multilateral Biofuture Platform during COP22 in Marrakech. At COP23, 20 signatory countries and relevant international organizations formally agreed to develop common targets for biofuels and a low-carbon bioeconomy, and to devise an action plan to achieve them; 3) In 2016, the EU Commission launched the “International Bioeconomy Forum”, a platform for multilateral R&D collaboration in areas of common interest. The microbiome was identified as a first topic for multilateral cooperation among the member countries and may pave the way to arriving at joint global bioeconomy-inspired flagship projects.

Recently, however, there have been interesting moves towards extending more international coop-

eration to non-high-tech areas relevant to the bioeconomy. The promotion of education and training, funding and communication, the so-called soft skills, is an encouraging sign for the further successful implementation of bioeconomies worldwide.

So far, the global bioeconomy policy community does not have a permanent forum or platform for organiz-

ing policy dialogue and collaboration. A multilateral bioeconomy policy platform of this type would also be able to represent bioeconomy issues in global forums for sustainable development and climate policy and, by facilitating an intensified exchange of best practices and experiences, it might also help to make up for the deficiencies described above.

---

## REFERENCES

- 135 University of Hohenheim. (2017). Bioeconomy Master. Available at <https://www.uni-hohenheim.de/en/bioeconomy-masters> [08.11.17].
- 136 Technical University of Munich. (2017). Campus Straubing for Biotechnology and Sustainability. Available at <https://www.tum.de/nc/en/about-tum/our-university/locations/campus-straubing/> [20.12.17].
- 137 University of Piraeus. (2017). Bioeconomics. Available at <http://www.unipi.gr/unipi/en/oik-spoudes-en/metapt-spoudes-en/bioeconomics.html> [08.11.17].
- 138 Bioeconomy Initiative - University of South Bohemia. (2017). Available at <https://bei.jcu.cz/bioeconomy-course> [08.11.17].
- 139 Department of Digitalization, Department of Analysis and Development of Systems of the Marshal's Office of the Lodz Region. (2017). LODZ Declaration on a European Bioeconomy Education Platform. Available at <http://bioeconomy.lodzkie.pl/en/platforma-bioregionow/> [19.12.17].
- 140 Science | Business. (2017). Financing the Circular Bioeconomy: Structuring an Investment Platform to Improve Access to Finance in Europe. Available at <https://sciencebusiness.net/events/financing-circular-bioeconomy-structuring-investment-platform-improve-access-finance-europe> [22.12.17].
- 141 Ministry of Employment and the Economy, Ministry of Agriculture and Forestry & Ministry of the Environment. (2018). Bioeconomy.fi. Available at <http://www.bioeconomy.fi/facts-and-contacts/> [09.03.18].
- 142 Bioeconomy Austria: <http://www.bioeconomy-austria.at> [27.10.17].
- 143 Bioökonomie.de: <https://bioeconomie.de/en> [27.10.17].
- 144 Greek Bioeconomy Forum. (2017). Available at <http://bioeconomyforum.gr> [08.11.17].
- 145 Davies, S. et al. (2016). Promoting stakeholder engagement and public awareness for a participative governance of the European bioeconomy : Case studies of national bioeconomy strategies in Finland and Germany. Available at [http://www.bio-step.eu/fileadmin/BioSTEP/Bio\\_documents/BioSTEP\\_D3.1\\_Case\\_studies\\_of\\_national\\_strategies.pdf](http://www.bio-step.eu/fileadmin/BioSTEP/Bio_documents/BioSTEP_D3.1_Case_studies_of_national_strategies.pdf) [07.11.17].
- 146 Biostep Consortium. (2017). Biostep. Available at <http://www.bio-step.eu/biostep/about-biostep/> [10.11.17].
- 147 European Commission. (2017). Bioeconomy Knowledge Center. Available at <https://biobs.jrc.ec.europa.eu> [10.11.17].
- 148 Argentinian Ministry of Science, Technology and Productive Innovation. (2016). CELAC Bioeconomy. Available at <http://www.celacbioeconomy.org/test/index.php> [10.11.17].
- 149 OECD. (2016). Science, Technology and Innovation Outlook 2016. Available at <http://www.oecd.org/innovation/oecd-science-technology-and-innovation-outlook-25186167.htm> [09.03.18].



## Annex – Overview of Practical & Proposed Measures for Promoting Bioeconomy Development

Key points	Practical and proposed policy measures	Americas			
		Argentina	Brazil	Canada	USA
Promoting innovation	Public R&D	×	×	×	×
	Traditional knowledge and low-tech innovations			×	
	Stimulating private sector R&D (e.g. through public-private partnerships)	×	×	×	×
	Social innovation (e.g. open science, citizen science)				×
	Research networks, consortia, CoE etc.	×	×	×	×
Supporting infrastructure	bioeconomy hubs, networks, cluster			×	×
	Investment for R&D facilities and equipment	×	×	×	×
	Investment in the digital infrastructure				×
	Urban greening projects			×	
	Pilot and demonstration facilities	×	×		×
	Biorefinery demo plants	×	×	×	×
Supporting capacity building & education	Capacity building (e.g. trainings for professionals)	×	×	×	×
	Bioeconomy education programs (incl. masters and doctoral programs)	×	×		×
Supporting commercialization	Access to capital for biobased companies	×	×	×	
	Tax incentives for biobased companies	×		×	
	Knowledge and technology transfer	×	×		
	Access to scale-up facilities		×		×
	Export promotion policy				
	Development and marketing efforts (e.g. feasibility studies)				×
	Subsidies for (increased) production and use of renewable resources				
Supporting the demand-side	Biobased public procurement policy	×		×	
	Certification and labels on a product's life cycle impact (e.g. foot print)	×	×	×	×
	Consumer information and communication campaigns	×		×	×
	Price setting				×
	Tax incentives				
	Fuel quality standards		×		
	Ban of fossil based products, e.g. plastic bags				



Key points	Practical and proposed policy measures	Americas			
		Argentina	Brazil	Canada	USA
Ensuring bioeconomy-friendly framework conditions	Removal of fossil fuel subsidies				
	Policies for sustainable development	✗			
	Review of IP regulations		✗		
	Bioprospecting regulations				
	Global data policies (e.g. open data commons policies)				
	Review and harmonization of biotechnology policies	✗			✗
	Regulations for sustainable biomass production & utilization				
	Regulatory framework for bioenergy	✗	✗		
	Carbon tax			✗	
	Circular economy regulations (recycling quotas, use of by-products, eco-design, life-cycle assessment of patents)				✗
	Regulations for the use of biobased materials in construction			✗	
Development of regional bioeconomy policy strategies	✗				
Promoting Good Governance	Inter-ministerial and inter-regional cooperation	✗			✗
	Monitoring and measuring activities	✗	✗	✗	✗
	Evaluation of policy programs	✗			✗
	Public reporting and multi-stakeholder dialogue	✗			✗
	Learning and adaptive policy				
	Level-playing field for biobased businesses				
Enhancing international collaboration in the bioeconomy	Bioeconomy advisory council	✗			
	Harmonization in international trade & policy frameworks	✗			
	Knowledge sharing between industrialized and developing countries				
	Private investment in developing countries				
	International monitoring, e.g. satellite tracking				
	Inter-regional policy dialogue	✗			
	bi- and multilateral cooperation	✗			✗
	International R&D cooperation		✗		



Asia/Pacific				Europe					
Australia	China	New Zealand	Thailand	France	Italy	Latvia	Norway	Spain	UK
							X		
	X	X	X						
		X					X		
	X	X							
				X		X	X		
				X					
					X		X	X	
				X		X	X		
X			X		X			X	
X	X	X		X	X	X		X	X
		X							
				X	X			X	
						X	X		
				X					
								X	
	X			X		X	X	X	
	X					X	X		X





## About the Bioeconomy Council

The Bioeconomy Council advises the Federal Government on the implementation of the “National Research Strategy Bioeconomy 2030” and the “National Policy Strategy on Bioeconomy” with the aim of creating optimum economic and political framework conditions for a biobased economy. The Bioeconomy Council is an independent, voluntary advisory body. Its 17 members cover a broad spectrum of the bioeconomy with their expertise. They identify important fields of action for policy development, search for ways and means towards sustainable solutions and present their findings in a global context. The Council conducts an open dialogue with the general public to stimulate interest in biobased applications and to discuss their contribution to a more sustainable life style. It also provides recommendations on how to support education and training as well as research and development. In this respect, the Council’s activities are aligned with both long-term objectives and current political requirements. Documents download and further information in English is available at [www.bioekonomierat.de/english.html](http://www.bioekonomierat.de/english.html)

---

## About this report

Authors of this study are Christin Fund, Beate El-Chichakli and Christian Patermann.

Beate El-Chichakli and Christin Fund are staff at the Secretariat of the German Federal Government’s Bioeconomy Council. Christian Patermann is the former European Commission program director for “Biotechnology, Agriculture and Food”. He provided also first-hand information, advice and guidance regarding the scope and the relevance of the material gathered. Furthermore, the study benefited from a critical review by Joachim von Braun and Christine Lang, Co-Chairs of the German Bioeconomy Council.

---

## Imprint

Published by the Office of the Bioeconomy Council,

Dr. Beate El-Chichakli, c/o BIOCUM AG, Lützowstrasse 33–36, 10785 Berlin

Production editor: Benjamin Röbig

Design: Sven-Oliver Reblin

Pictures from fotolia.com: tomertu (Title), Raman Maisei (flags), jktu\_21 (world map), losw (5 globes at continental overview), Destina (p 6), Delphine Debressy (p 21)

Pictures from istockphoto.com: PeopleImages (p 8), AzmanJaka (p 11), MsLightBox (p 12), querbeet (p 16), fotografixx (p 31), matteodestefano (p 37), aluxum (p 51), SergeyNivens (p 61), busypix (p 71), kontrast-fotodesign (p 75), ALotOfPeople (p 108), pidjoe (p 117)

Berlin, April 2018

