



**International  
Advisory Council on  
Global Bioeconomy**

# **Designing Sustainability Governance for the Bioeconomy – a Global Expert Survey**



# Foreword

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The findings of this global expert survey reveal important dynamics in bioeconomy innovations and success stories as well as political strategies. We see that innovations in novel production systems, the waste sector, and health sector are increasingly valued as success stories. Most important factors identified as enabling these innovations are knowledge and technology, collaboration and partnerships, as well as a favorable national context. However, according to expert views the current transformation process toward a sustainable bioeconomy is embedded in a complex web of existing laws and standards and marked by uncoordinated governance efforts. The survey provides insights into how existing gaps in the governance framework at national and international levels can be closed in order to advance transformative change towards a sustainable bioeconomy. One of the most important conclusions we can draw from this survey is that even more intergovernmental cooperation and coordination at the international level is needed to provide enabling governance frameworks for bioeconomy development.

In preparation for the third Global Bioeconomy Summit 2020, the International Advisory Council on Global Bioeconomy once again commissioned this global expert survey to explore future bioeconomy development paths and identify appropriate political support measures.

The Global Bioeconomy Summit has become the leading event with a format to globally review and discuss emerging opportunities and challenges of the bioeconomy and develop visions for the future development of a sustainable bioeconomy among international key actors from governments, science and innovation, business and civil society. The global expert survey has become one of the signature outputs of the Global Bioeconomy Summit. The previous surveys attracted much attention and decisively shaped the global bioeconomy discussion.

We would like to thank all the experts who have participated in the survey and shared their views, and we gratefully acknowledge the contribution made by the authors.

Berlin, November 2020



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# Background

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The International Advisory Council on Global Bioeconomy (IACGB), an independent expert think tank (see <https://gbs2020.net/about/international-advisory-council/>), invited experts from all over the world to take part in a Global Expert Survey to explore questions on “How to transition towards a sustainable bioeconomy?” The survey aimed to assess the current state of the bioeconomy transition in different hemispheres and determine how to develop effective governance frameworks that further accelerate the transition to a sustainable bioeconomy. The aggregated results will be presented to political leaders; they will inspire discussions with representatives of the countries involved, and will feed into the debates at the Global Bioeconomy Summit 2020.

The expert survey was organized by Westfälische Wilhelms-Universität Münster (Prof. Dr. Thomas Dietz), Rheinische Friedrich-Wilhelms-University Bonn (Prof. Dr. Jan Börner), and BIOCOM AG on behalf of the International Advisory Council on Global Bioeconomy. The participants for this global survey were based in 49 different countries, most of which have established bioeconomy policy initiatives. Of-

ficials representing European Union institutions and international organizations were also included. The survey consisted of closed-ended and open-ended, mainly compulsory questions. It was conducted online between September and October 2020.

## Suggested citation

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# Executive summary

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The bioeconomy offers technology-based opportunities to promote economic growth and social progress and the promise to decouple development from increasing resource consumption and greenhouse gas emissions. However, to become a driver of sustainable change, the bioeconomy depends on effective governance frameworks at national and international levels. Effective governance frameworks for the bioeconomy need to assume two functions. First, they need to support bioeconomy companies to transform bio-based innovations into sustained economic success (**enabling governance**). Second, they must set regulatory boundaries for the bioeconomy to minimize potential conflicts among the complex set of goals of the Agenda 2030 for sustainable development (**regulatory governance**). This report is based on a survey of 282 global bioeconomy experts conducted in 2020 and partially re-surveyed experts (N=115) that participated in the first global expert study commissioned by the German Bioeconomy Council<sup>[1]</sup>. The study's aim was to determine future bio-economic development paths and to identify appropriate political support measures to enable and steer bioeconomic transformation.

**Reassessment of 2017 bioeconomy success stories:** 115 experts reassessed a selection of their responses to the 2017 survey. At hindsight, more than half of the resurveyed experts attached a medium to very low probability of success to innovations in the energy sector. Also, agricultural sector innovations were predominantly rated neutral or less optimistically. A different picture emerges especially for novel product and waste sector innovations, which, dominated by European experts were largely rated at high to very high probability of success. The same applies for health sector innovations.

**Reassessment of 2017 policy priorities:** Changes in the assessment of policy priorities are generally small. In 2020, on average less importance than in

2017 was attributed to almost all suggested policy measures. Still, experts attributed increasing importance to the removal of fossil fuel subsidies and the implementation of carbon taxes. Small increases in importance were also attached to bans on the use of fossil resource-based materials and regulations to protect biodiversity and ecosystem services. The largest drop in importance ratings was observed for social innovations, such as citizen science, tax incentives, private R&D. Improving access to capital for bio-based companies was also rated somewhat less important than in 2017, but still enjoys high absolute levels of priority among experts.

**Recent bio-based innovations:** Experts were asked to describe recent prominent and successful bio-based innovations in their country (or sector of operation). The largest share of successful innovations occurred in the chemical industry (24 %), the energy sector (19 %), the food industry (18 %) and the agricultural sector (17 %). As a separate sector, biotechnology accounted for 6% and the health & pharmaceutical sector for 5% of the successful innovations highlighted by experts. Asked about the three most important factors that enabled these innovations, experts emphasized “knowledge and technology” as the single most important success factor. Experts also frequently mentioned “collaboration and partnerships” as well as “a favorable national context” as relevant factors of success.

**Existing bioeconomy governance frameworks (enabling governance):** So far enabling governance predominantly targets the supply side of the bioeconomy. According to our global sample of experts, “support R&D activities” was the most frequently implemented policy measure followed by training & capacity building programs. Other frequently mentioned supply side-oriented support measures were legal Intellectual Property Right (IPR) frameworks, international agreements, and economic incentives for bio-based industries. The only potentially demand side-oriented policy measure that was

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[1] [https://gbs2018.com/fileadmin/gbs2018/Downloads/Bioeconomy\\_Global\\_Expert\\_Survey.pdf](https://gbs2018.com/fileadmin/gbs2018/Downloads/Bioeconomy_Global_Expert_Survey.pdf)

mentioned by more than half of the respondents was “awareness raising”, which can be classified as a comparatively soft policy instrument. Specific consumption taxes or subsidies to promote the consumption of bio-based products and services were reported only by a minority of experts. Hence, dominant models of enabling governance seem to favor support to the emergence of bio-based innovation, while the commercial success of bio-based products is mainly left to market forces.

**Existing bioeconomy governance frameworks (regulatory governance):** The majority of the experts (about 75%) stated that environmental regulations exist in their respective contexts, both at the national (minimum standards environmental) and the international level (international agreements). Similar frequencies (approx. 70%) were found for regulations on water and land use as well as on food markets, whereas regulations on bio-based innovations, whereas regulations on bio-based innovations, biodiversity access and benefit sharing, as well as minimums social standards were mentioned by little more than half of the respondents. Experts views thus suggest that current bioeconomic transformation processes are not taking place in a regulatory vacuum but are embedded in a web of existing laws and standards.

**Effectiveness of bioeconomy policy implementation:** The majority of experts gives medium to very low effectiveness scores to all enabling policy measures except “Promoting R&D for bio-based innovation”. As for the individual policies, expert responses suggest that implementation gaps are more pronounced for demand-side policies, such as economic incentives for consumers, awareness raising, and taxation than for supply-side measures, such as promoting R&D for bio-based innovation, economic incentives for bio-based industries/sectors, legal IPR frameworks, and training & capacity building. Implementation gaps are similarly, if not more, pronounced in experts’ assessments of regulatory policy measures. For all specific regulatory policies in the list, a majority of experts rated implementation effectiveness at “medium” to “very low”.

**Adequacy of bioeconomy policies:** Experts evaluated (1) the overall adequacy of existing policies to address challenges in the three main sustainability dimensions (economic, social, and ecological) and (2) the need for

intensified international cooperation and coordination. Only few experts “fully agree” that existing policies adequately address social, economic or ecological sustainable development goals. Clearly larger proportions of experts “somewhat” or “totally disagree” especially in terms of adequacy to address social and economic concerns. At the same time, experts widely agreed that more intergovernmental cooperation and coordination at international scale is needed to achieve bio-based economic growth sustainably.

**Expert solutions to overcome governance gaps at the national level:** Experts answered open-ended questions specifying potential solutions to overcome identified national-level barriers to sustainable bioeconomic transformation. Experts emphasized the demand for improved bioeconomy finance. Such finance should involve both improved business and government funded schemes and highlights the importance of public-private partnerships. Also, specific taxes are suggested, for example, to promote capital access for bioeconomy start-ups. Further suggestions include direct state involvement to support the commercialization of bio-based products. Governance actors should engage more in creating favorable conditions of the bioeconomy, for example, through direct investments and improved market institutions. Finally, experts recommend better involvement of stakeholders, improved inter-ministerial policy processes as well as better communication, cooperation and integration across stakeholder groups.

**Expert solutions to overcome governance gaps at the international level:** Experts demand stronger standards to regulate potential sustainability goal conflicts and more coordination of international politics on trade and development issues in order to provide more favorable conditions for sustainable bio-based transformation – especially under the impression of the COVID-19 pandemic. Capacity building and development efforts ought to be part of comprehensive bioeconomy strategies given global imbalances in institutional capacity and access to knowledge and technology. This could be achieved by enhanced bi-, tri-, and multilateral international activities for knowledge transfer and institution-building. Further, the experts expect that promoting green international finance schemes, that incorporate sustainability criteria, will boost bio-based transformation transformations at the global scale.



# 1 Bioeconomy – in need of governance?

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With the adoption of the 17 Sustainability Development Goals (SDGs) by the General Assembly of the United Nations (UN) in 2015, the international community has committed itself to a common vision of sustainable development that comprehensively combines economic, social and ecological development goals (Sachs 2015). The adoption of the SDGs was a breakthrough following decade-long international political development during which state leaders became increasingly aware that current human development pathways compromise planetary health.

Bioeconomy is considered one among various transformative strategies to achieve several SDGs in practice (Thrän und Moesenfechtel 2020; Biber-Freudenberger et al. 2020). The German Bioeconomy Council defines bioeconomy “as the production and utilization of biological resources - including knowledge - to provide products, processes and services in all sectors of trade and industry within the framework of a sustainable economy”<sup>[2]</sup>. Potential bioeconomic contributions to sustainable development include, for example, innovative and less resource-intensive agricultural technologies that increase global food security while decreasing environmental degradation (SDGs 2, 13 & 15). New circular economy models and biotechnological innovations could optimize resource consumption and reduce waste (SDGs 6, 11 & 12). As such, the bioeconomy offers numerous technology-based opportunities to promote economic growth and social progress while decoupling development from increasing resource consumption and greenhouse gas emissions.

However, the sustainable use of innovative technology seldom comes about naturally. Contemporary economic production and consumption systems have grown over centuries and thus often exhibit so called path dependencies (Pierson 2000). While

broad industrial conversion to a bio-based economic basis may be efficient in the long-term, it requires massive investments in basic research and favorable economic conditions as well as infrastructure today. Many promising bio-based alternatives are far from competitive vis-à-vis conventional value chains. Amid inherently high uncertainty in complex transformation processes, businesses hesitate to make the required investments in bio-based production systems. Market forces alone will thus often not suffice to realize the vision of a bio-based and sustainable societal transformation (Dietz et al. 2018).

In addition, access to bioeconomic knowledge and technologies is highly unequal at the global scale (Bracco et al. 2018). Many emerging and developing countries have enormous bioeconomic potential, but lack the necessary technical expertise or capacities to turn potential into sustainable development. Knowledge and capacity gaps thus present another barrier to bio-based transformation. Last, but not least, shifting from fossil to bio-based feedstock can create conflicts between SDGs, for example, by increasing food prices or demand for converting natural ecosystems for agricultural uses (Meyfroidt et al. 2020). Clearly, new and more efficient technologies can alleviate such sustainability tradeoffs, but may be associated with so-called rebound effects. Rebound effects can diminish or even neutralize initial sustainability gains for example when efficiency gains lead to increases in consumption (Gillingham et al. 2016).

For the reasons laid out above, an effective governance framework is needed to create sufficient conditions for sustainable transformation. Governance is the process by which societies adapt their rules to new challenges (Sweet-Stone 1999). Governance has a substantial dimension (What are the

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[2] <https://bioekonomierat.de/en/bioeconomy/index.html>

rules?), a procedural dimension (How are the rules developed?), and a structural dimension (i.e., the procedural rules and institutions that determine rule-making, how the rules are implemented and enforced, and how conflicts over rules are resolved) (Dietz 2010). Societal adaptation of rules to new challenges can be spontaneous and informal at the level of social relationships and networks. However, societies also delegate governance functions to specialized institutions, which set and enforce the rules in formally organized procedures. Such institutions first and foremost include the state at local, regional, and national level, but may also include inter- and supranational organizations, as well as private standard setters, which together build an interacting and overlapping governance system of plural authorities (Lêwî-Faur 2014).

Bioeconomic transformation processes involve highly complex systems of interaction at the interface between humans and nature. Amid such complexity, no governance actor - neither state governments nor private standard setters - possess enough control to simply order the development of a sustainable bioeconomy by decree. Rather, the development of a sustainable bio-economy requires the synergistic cooperation of many different actors from science, business, politics and civil society, including changes in consumer behavior. Governance actors can assume two functions in these complex processes: On the one hand, governments in particular, can mobilize resources to create targeted incentives that promote sustainable bioeconomic innovations and facilitate their dissemination in the marketplace (**enabling governance**). On the other hand, both public and private governance actors can set regulatory boundaries for the bio-economy at points where it leads to conflicting goals with other SDGs

(**regulatory governance**), thereby creating a regulatory framework for the development of a sustainable bioeconomy.

Over the past two decades, more than 60 governments worldwide have declared bioeconomy as a central pillar of economic development in their national bioeconomy strategies (Thrän und Moesenteufel 2020). International institutions such as the European Union or the UN have also developed extensive bioeconomic strategy papers. All these strategies have in common that they combine both enabling and regulatory governance elements in varying degrees of intensity to promote the goal of a sustainable bioeconomy (Dietz et al. 2018). However, what have these strategies really achieved? Which bioeconomic success stories have resulted from their policies and which biotechnological fields have been developing more strongly than others? How well do existing governance frameworks of the bioeconomy regulate conflicting goals between SDGs and what can be done to improve their efficacy?

The literature on these questions is currently growing rapidly, but the contributions made so far often focus on individual or comparative case studies, which limits their use for general strategic policy advice. Here we adopt a global perspective in compiling the views on the current state of affairs in bioeconomy governance from experts around the world. Below we begin with the methodological design of the study. We then describe the research sample and present the results of the expert study. Finally, we summarize the results and derive policy recommendations for decision-makers in politics, business and civil society interested in designing suitable governance frameworks for sustainable bio-based transformation.

## 2 Methodology

In 2017, the BIOCOM AG conducted a first global expert study on behalf of the German Bioeconomy Council.<sup>[3]</sup> The study's aim was to determine future bioeconomic development paths and to identify appropriate political support measures that could enable bioeconomic transformation. The experts

who participated in the 2017 survey were asked which future bioeconomic success stories they expect and which technological fields they expect to determine the development of the bioeconomy in the future. Furthermore, they rated a number of policy support measures with respect to their ex-

**Table 1: Structure of the online questionnaire**

Topic	Type
Information on role, sector, country, association and organization	Combination of yes/no question, drop-down menus and short text boxes
<b>Section I: Follow-up questions: Future Opportunities and Developments in the Bioeconomy</b>	
Reassessing success stories	Predefined success stories from 2017 survey with a Likert scale from "very low" to "very high"
Reassessing promising technology fields	Predefined technology fields from 2017 survey with a Likert scale from "very low" to "very high"
Reassessing policy measures	Predefined policy measures with a Likert scale from "totally unimportant" to "very important", in comparison to answers from 2017
<b>Section II: Design of Governance-Frameworks for the Bioeconomy</b>	
Recent prominent bio-based innovation	Short questions for name, description, webpage and success factors
Assessment of existing policies	Predefined answer categories with a Likert scale from "very low" to "very high"
Personal perspective on social and bioeconomic conditions in own country/sector	Predefined categories with a Likert scale from "totally disagree" to "fully agree"
Barriers at the national level and international level	Predefined categories with a Likert scale from "very low importance" to "very high importance", with an extra option for "no knowledge" on the topic
Overcoming barriers (national and international)	Option to select two important barriers and provide a short text

[3] [https://gbs2018.com/fileadmin/gbs2018/Downloads/Bioeconomy\\_Global\\_Expert\\_Survey.pdf](https://gbs2018.com/fileadmin/gbs2018/Downloads/Bioeconomy_Global_Expert_Survey.pdf)

pected impact on the development of a sustainable future bioeconomy.

Three years later, we have surveyed a similar global group of experts including a subsample of respondents to the 2017 survey, who agreed to reassess their responses on selected questions from today's perspective. Given that more and more countries are now implementing their bioeconomy strategies, the focus of the second survey wave is actual bioeconomy governance at national and international levels. Specifically, we were interested in how effectively countries implement enabling and regulatory policy measures and what gaps experts identify in national and international bioeconomy governance. Table 1 summarizes the structure of the 2020 questionnaire.

Using the same online survey methodology and an updated global expert database, we reached out to over 5000 experts active in government, academia, private sector, and civil society. The survey used a series of closed and open-ended questions. It was mandatory for respondents to address all relevant questions, including information on the respondents' respective country, role, and sector of operation. The resurveyed experts were asked to reflect on their previous responses and report if their assessments had since changed. Table 1 provides a breakdown of the types of questions used in the survey. The complete questionnaire is included in the appendix.

To ensure consistency, the survey was designed and implemented with support by the BIOCOM AG using LimeSurvey – an open source, online tool. A group of five experts were involved in pretesting and refining the questionnaire. On September 7th 2020, experts received an E-mail invitation with a personalized link to the online survey and a one-month timeline to submit responses. We reminded experts three times to encourage participation and received a total of 282 complete responses by the deadline.

Data analysis was done using standard statistical software packages. For qualitative data analysis, we relied on content analysis and inductive coding to standardize open-ended survey questions. Words as well as contextually similar concepts were grouped and tabulated to extract relevant themes. These themes pertained, for example, to current bioeconomic trends and innovations, national and international policy measures, professional attitudes as well as governance mechanisms and gaps.

Most results are presented at aggregate global level, but some findings are better understood if interpreted at regional or other levels of aggregation. For example, we also grouped countries into four income groups: 'low-income', 'lower-middle-income', 'upper-middle-income', and 'high-income', based on World Bank classification<sup>[4]</sup>.

Data collection was carried out by BIOCOM AG in collaboration with the University of Bonn and University of Münster. The data analysis for this report was conducted by the two Universities

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[4] <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>

## 3 Survey results

### 3.1 Sample description

The final sample consisted of experts from 49 countries (Figure 1). The largest number of responses came from experts in the agricultural sector (29%) and the second largest from 'others' (20%). Further sectors in decreasing order are: biotechnology (18%), chemistry (8%), forestry (7%), energy (6%), fishery, food & nutrition and health & pharma at the same level (4%), and lastly, wood & paper manufacturing (1%). This sectoral distribution is consistent with the results from 2017, with minor variations in the total number of responses from each sector (Figure 2).

Only 12% of the responses came from policy makers and public officials, as compared to 22% in 2017. An additional 8% of responses came from actors involved in international policy making. Similar to the 2017 survey, the majority of 2020 respondents were researchers from public institutions. Another 10% responses were from the private sector, 10% from 'others', 8% from civil society and/or NGO representatives and lastly, 5% from researchers from the private sector (Figure 3).

The respondents were clustered based on their region and income of the country, based on World Bank data. Table 2 shows the distribution of the sample from each region and income category. From East and the Pacific, majority of the respondents were from high income countries (14) while the remaining respondents were from upper-middle-income countries (5). Conversely South Asian respondents (9) were all from lower-middle-income countries. For Europe and Central Asia 164 respondents were from high-income countries, while only two respondents came from upper-middle-income countries. Similarly, all North American respondents (24) were also from high-income countries. On the other hand, from Sub-Saharan Africa, respondents came from low-income (3), lower-middle-income (8) and upper-middle-income countries (11). Respondents from Latin America and the Caribbean were from lower-middle-income (10), upper-middle-income (25) and high-income (6) countries. One respondent did not report his/her country.

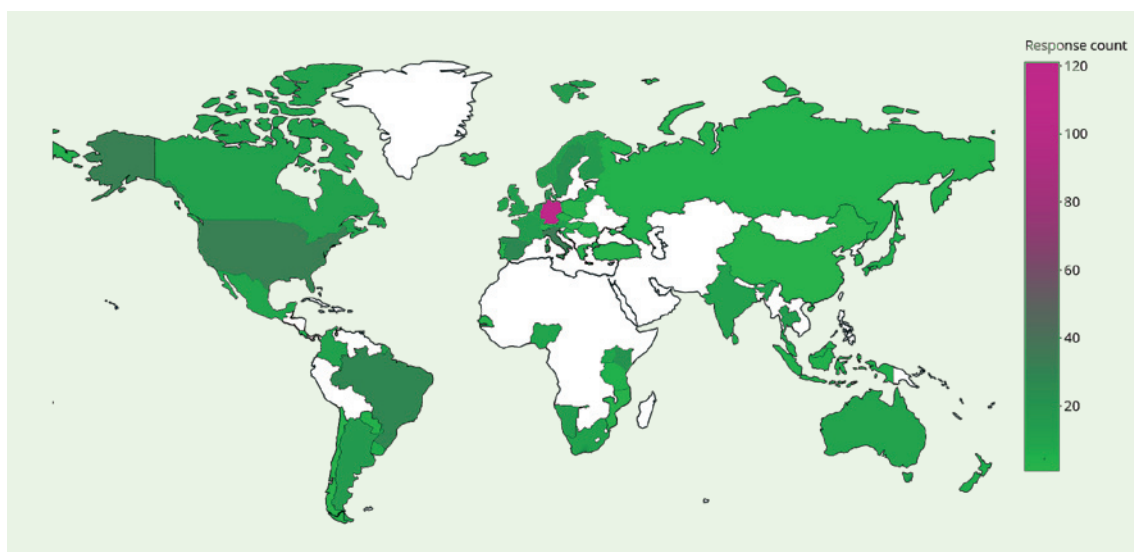


Figure 1: Number of respondents by country (2020 sample)

Table 2: Change in the sample composition from 2017 to 2020			
Region/ Level of income	2017	2020	Total
<b>East Asia and Pacific</b>	<b>37</b>	<b>19</b>	<b>56</b>
Upper-middle-income economies	21	5	26
High-income economies	16	14	30
<b>South Asia</b>	<b>10</b>	<b>9</b>	<b>19</b>
Lower-middle-income economies	10	9	19
<b>Europe and Central Asia</b>	<b>229</b>	<b>166</b>	<b>395</b>
Upper-middle-income economies	2	2	4
High-income economies	227	164	391
<b>Sub-Saharan Africa</b>	<b>26</b>	<b>22</b>	<b>48</b>
Low-income economies	5	3	8
Lower-middle-income economies	7	8	15
Upper-middle-income economies	14	11	25
<b>North America</b>	<b>19</b>	<b>24</b>	<b>43</b>
High-income economies	19	24	43
<b>Latin America and the Caribbean</b>	<b>61</b>	<b>41</b>	<b>102</b>
Low-income economies	1	0	1
Lower-middle-income economies	11	10	21
Upper-middle-income economies	43	25	68
High-income economies	6	6	12
<b>International</b>	<b>11</b>	<b>0</b>	<b>11</b>
<b>Not reported</b>	<b>4</b>	<b>1</b>	<b>5</b>
<b>Total</b>	<b>397</b>	<b>282</b>	<b>679</b>

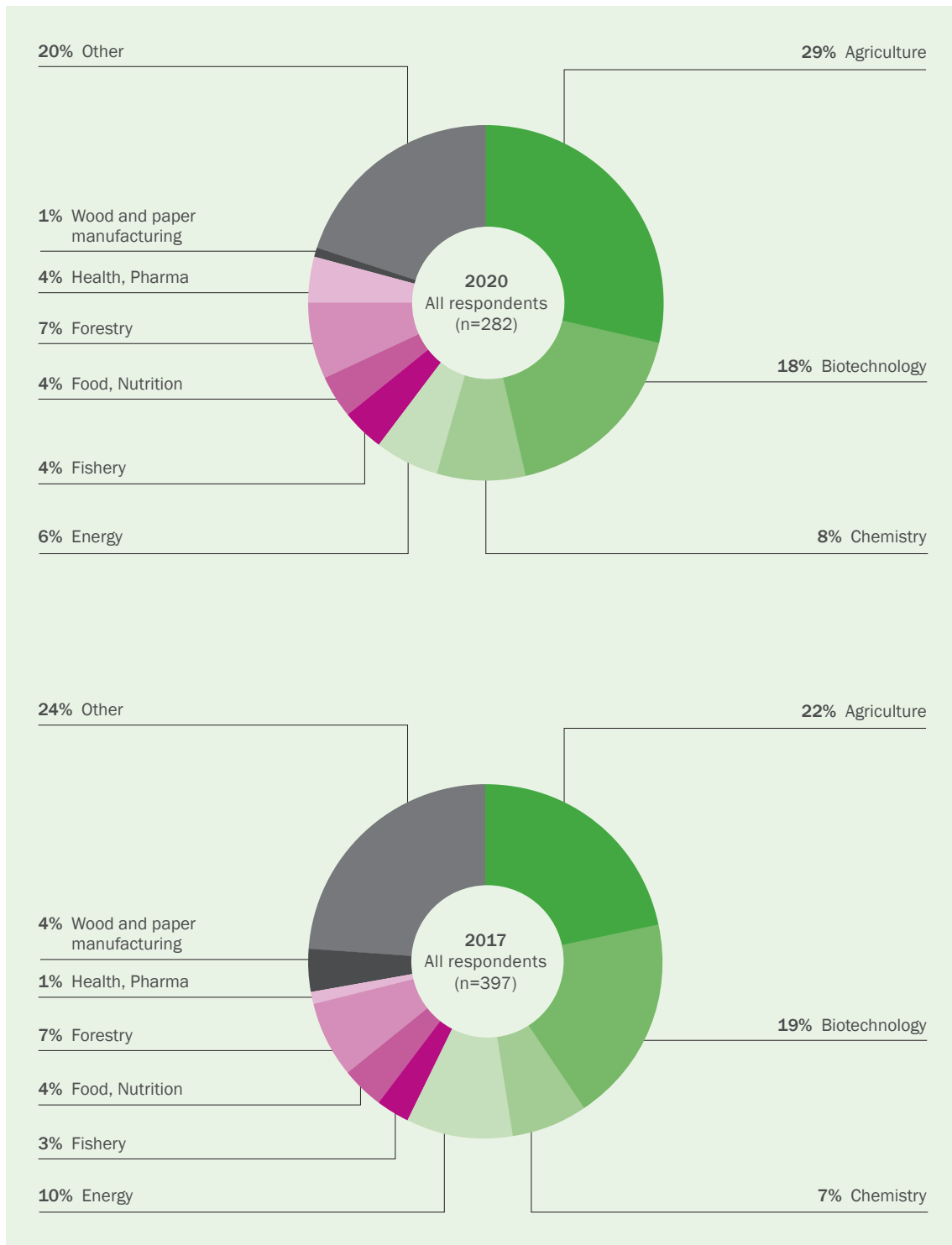


Figure 2: Respondents' sector of operation by survey waves in 2017 and 2020

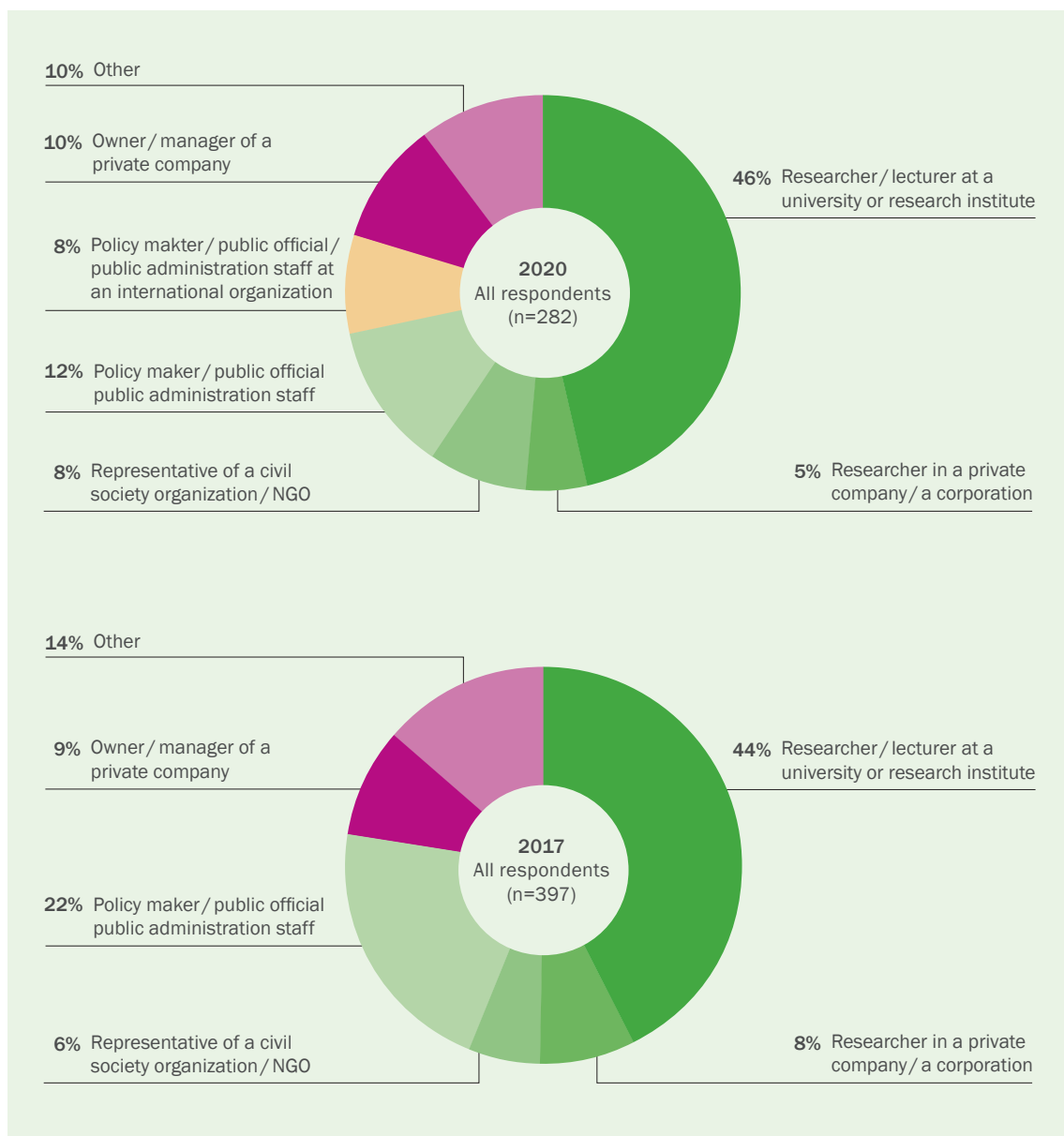


Figure 3: Respondents' roles by survey waves in 2017 and 2020



### 3.2 Reassessment of 2017 success stories and policy priorities

A total of 115 experts reassessed a selection of their responses to the 2017 survey. Experts had quite heterogeneous views on the probability of success when revisiting the probability of success of their preferred bioeconomy “success stories”. For example, at hindsight, more than half of the resurveyed experts attached a medium to very low probability of success to innovations in the energy sector, perhaps under the impression of chronically low prices for fossil fuel during the past decade. Also agricultural sector innovations were predominantly rated neutral or less optimistically.

A different picture emerges especially for novel product and waste sector innovations, which, dominated by European experts were largely rated at high to very high probability of success. The same applies for health sector innovations. For all other innovation categories mentioned in the 2017 survey, no clear pattern arose or sample sizes were too small to be informative.

Finally, we asked the resurveyed sample of experts to re-evaluate the same set of policy measures they

rated in 2017 in terms of their importance to promote “market success” of the bioeconomy today. Changes in assessments are generally small, ranging from 0.04 to 1.10 points on the Likert scale. Strikingly, however, we find on average less importance than in 2017 being attributed most policy measures. Exceptions are policy measures that promote bioeconomy via discouraging fossil resource use and policies that reduce potential (environmental) sustainability risks associated with bioeconomic transformation. Specifically, experts attribute increasing importance to the removal of fossil fuel subsidies and the implementation of carbon taxes. Small increases in importance were also attached to bans on the use of fossil resource-based materials and regulations to protect biodiversity and ecosystem services. The largest drop in importance ratings was observed for social innovations, such as citizen science, tax incentives, private R&D, and improving access to capital for bio-based companies. We note that these average changes can mask quite substantial differences in assessments at regional scale and that negative changes do not necessarily preclude high absolute importance.

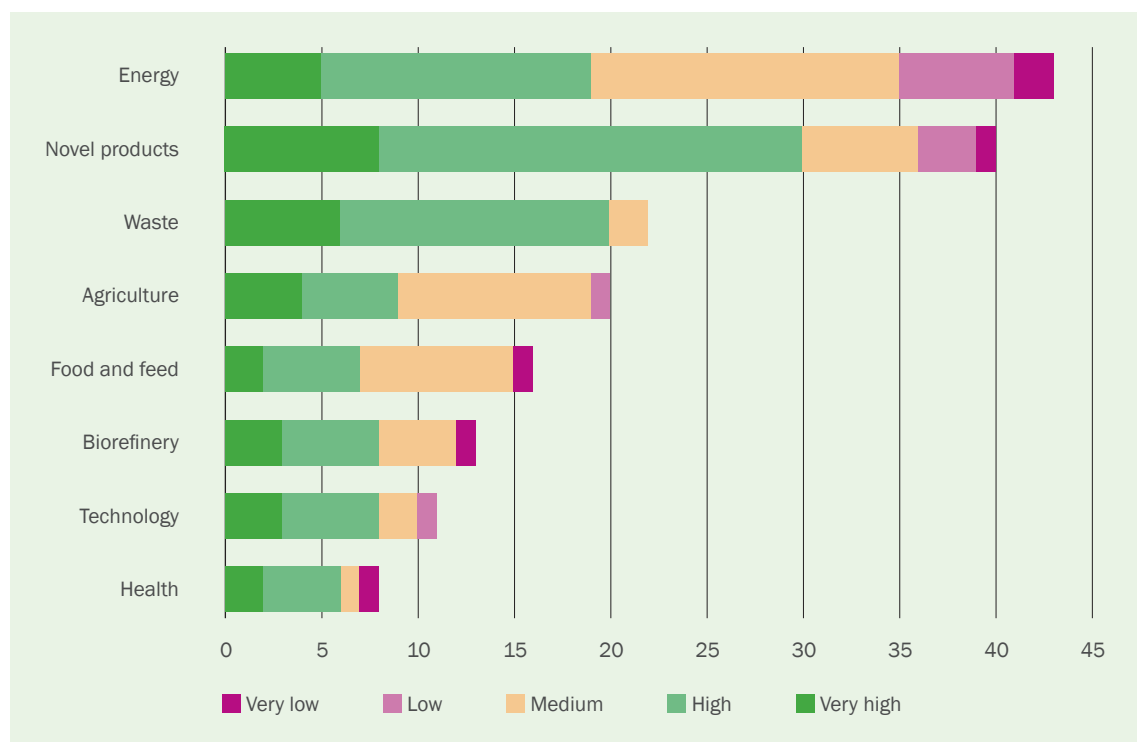


Figure 4: Reassessment of “2017 bioeconomy success stories”

Table 3: Reassessment of policy measures to promote bioeconomic transformation (N=115)			
Policy measures	2020 mean	2017 mean	Change in perception 2020–2017
<b>a) promoting innovation</b>			
Social innovation, e.g. open innovation, citizen sciences	5.27	6.37	–1.10
Private R & D	5.81	6.15	–0.34
Traditional knowledge and low-tech innovations	4.70	4.95	–0.24
Public private partnerships	5.71	6.03	–0.32
<b>b) Supporting infrastructure and capacity building</b>			
Capacity building, e.g. trainings for professionals	5.75	5.91	–0.17
Bioeconomy education programs (incl. masters and doctoral programs)	5.62	5.83	–0.22
Pilot and demonstration facilities	6.14	6.32	–0.18
Cluster development	5.83	5.63	0.21
<b>c) Supporting commercialization</b>			
Access to capital for bio-based companies	5.90	6.24	–0.34
Export promotion policy	4.68	4.85	–0.17
Development and marketing efforts, e.g. feasibility studies	5.37	5.84	–0.47
Subsidies for (increased) production and use of renewable resources	5.24	5.49	–0.24
<b>d) Supporting the demand side</b>			
Certification and labels explaining a product's life cycle impact, e.g. footprint	5.48	5.62	–0.14
Consumer information and communication campaigns	5.60	5.92	–0.32
Tax incentives	5.57	5.91	–0.35
Ban of fossil-based products, e.g. plastic bags	5.56	5.45	0.10

**Table 3: Reassessment of policy measures to promote bioeconomic transformation (N=115)**

Policy measures	2020 mean	2017 mean	Change in perception 2020–2017
<b>e) Ensuring conditions that encourage the bioeconomy</b>			
Removal of fossil fuel subsidies	6.01	5.80	0.21
Carbon tax	5.87	5.63	0.23
Regulations on biodiversity protection and ecosystem regeneration	5.64	5.60	0.04
Circular economy regulations (recycling quotas, use of by-products, eco-design, life-cycle assessment of patents)	5.77	5.87	–0.10
<b>f) Promoting good governance</b>			
Inter-ministerial and inter-regional cooperation	5.74	5.94	–0.20
Monitoring and measuring activities	5.65	5.78	–0.13
Public reporting and multi-stakeholder dialogue	5.43	5.73	–0.30
Learning and adaptive policy	5.63	5.70	–0.07
Bioeconomy advisory council	5.40	5.37	0.03
<b>g) Improving international collaboration in the bioeconomy</b>			
Harmonization in international trade and policy frameworks	5.77	5.81	–0.04
Knowledge sharing between industrialized and developing countries	5.88	6.08	–0.20
Private investment in developing countries	5.57	5.62	–0.04
International monitoring, e.g. satellite tracking	4.96	5.15	–0.19

### 3.3 Bioeconomy Networks

Understanding social and professional networks can help to understand how knowledge and opinions on the bioeconomy disseminate within and across regions. Hence, we asked experts about the nature of professional networks they or their organizations engage in. Over 49% of respondents reported memberships in one or more networks. The word cloud in Figure 5 summarizes the most common topics of these networks with variations in font size reflecting the frequency of topics mentioned in the network labels. Agriculture, biotechnology, and research & innovation (i.e. knowledge generation) are the most frequently mentioned focus areas of these networks. The majority of organizations or individuals engage in international rather than national networks.



Figure 5: Main types of identified bioeconomy networks

### 3.4 Recent bio-based innovations

Anticipating future bio-based transformation pathways can help to optimally design enabling and regulating governance frameworks. Early-stage innovation processes can indicate the direction of such pathways. We thus asked our global sample of experts to describe a recent (past five years) prominent and successful bio-based innovation in their country (or sector of operation). Figure 6 depicts the sectoral distribution of answers. The

largest share of successful innovations occurred in the chemical industry (24 %), the energy sector (19 %), the food industry (18 %) and the agricultural sector (17 %). The biotechnology sector accounted for 6% and the health and pharmaceutical sector for 5% of the successful innovations highlighted by experts, including improved diagnostic solutions for rapid COVID-19 testing in the developing world.

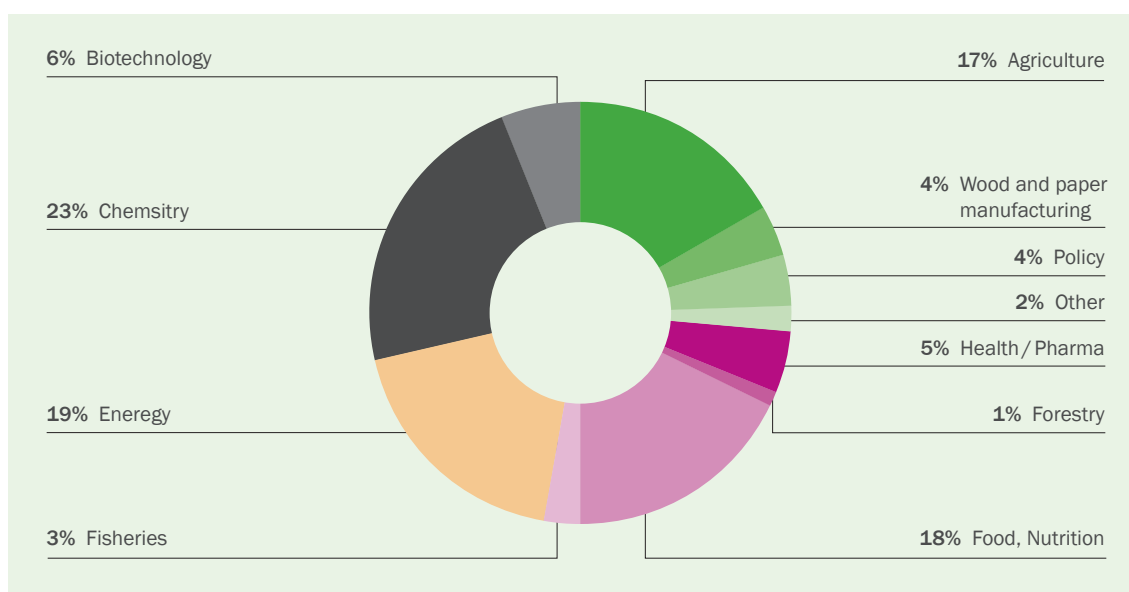


Figure 6: Main sectors of identified recent and successful bioeconomic innovations

Asked about the three most important factors that enabled these innovations, experts emphasized “knowledge and technology” as the single most important success factor (Figure 7). This reaffirms the established view of bioeconomy as a knowledge-intensive development paradigm that depends on technological innovations and their diffusion among entrepreneurs at both national and global scales. Experts also frequently mentioned “collaboration and partnerships” as well as “a favorable national context” as relevant factors of success, confirming

the view that knowledge exchange and transfer as well as strong support structures are needed to leverage technological development for sustainable change.

“Timely market decisions based on local and international contexts”, the fourth most frequently mentioned success factor, emphasizes the importance of *windows of opportunities*, such as changes in national policy or international market conditions, for bio-based innovation processes.

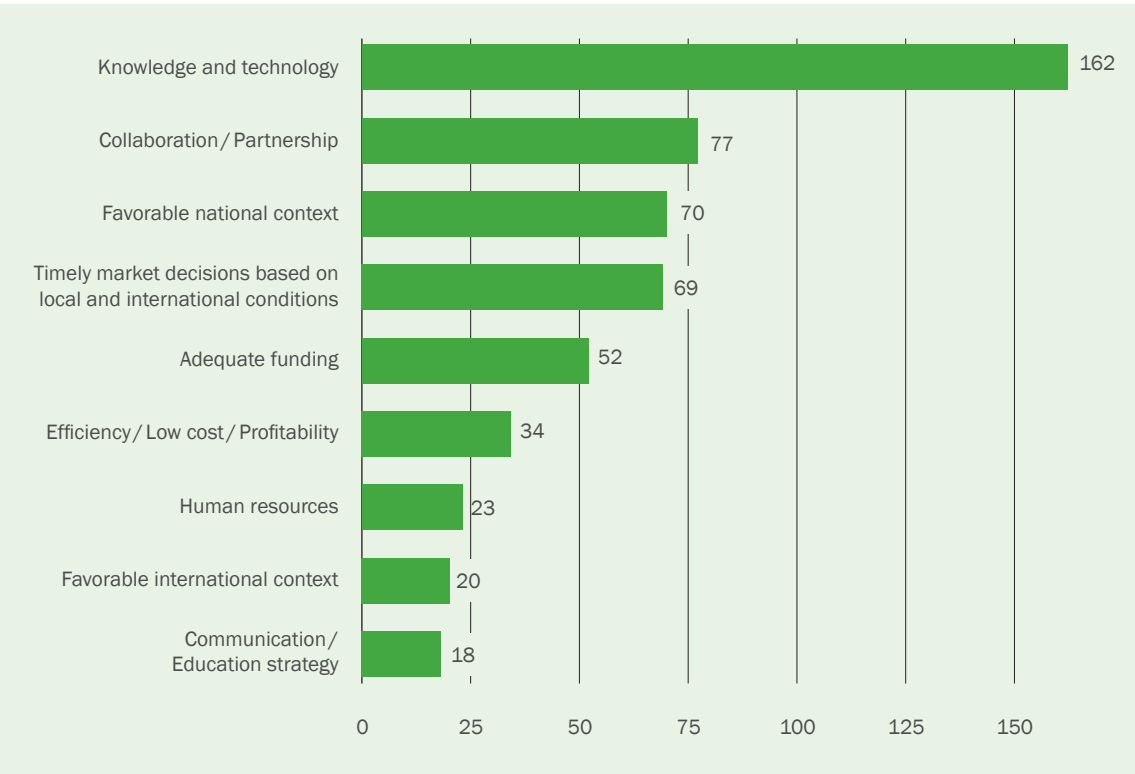


Figure 7: Factors of success of bio-based innovations

Three selected success stories from different world regions are documented in Table 4 to exemplify the type of bio-based innovations reported by experts.

**Table 4: Selected innovation “success stories”**

Success Story	Country
Bio-Circular-Green Economic Model or BCG has been introduced by the research community and promoted by the Thai government as a new economic model for inclusive and sustainable growth. The BCG model capitalizes on the country’s strengths in biological diversity and cultural richness and employs technology and innovation to transform Thailand to a value-based and innovation-driven economy.	Thailand
Bio-mi Ltd. is a small and medium-sized research and development company, dedicated to the production of final and semifinal thermoplastic materials and products used for the production of primary and secondary packaging and agricultural products. Our main activities comprise of advanced engineering of new bio-based and sustainable plastic materials and solutions. Apart from developing new bio-based building blocks and materials, Bio-mi Ltd. provides services of consulting, advising and education in the field of transforming plastics and other advanced materials.	Croatia
This is a new concept of liquid microbiological inoculant, which contains a species of nitrogen-fixing and growth-promoting bacteria described as <i>Nitrospirillum amazonense</i> . Widely used in the cultivation of Brazilian soybeans, the technology of biological nitrogen fixation using a bacterial inoculant is now on the market to increase the productivity of sugarcane.	Brazil

### 3.5 Existing bioeconomy governance frameworks

#### Enabling governance

We argued above that bioeconomic transformation hinges on effective enabling governance frameworks to unfold its potential. Inspired by national bioeconomy strategies, we identified concrete enabling policy measures and asked about their status of implementation in our experts' respective contexts. Our results suggest that so far enabling governance predominantly targets the supply side of the bioeconomy. According to our global sample of experts, "support R&D activities" was the most frequently implemented policy measure followed by training & capacity building programs. Other frequently mentioned supply side-oriented support measures were legal Intellectual Property Right (IPR) frameworks, international agreements, and economic incentives for bio-based industries.

The only potentially demand side-oriented policy measure that was mentioned by more than half of the respondents was "awareness raising", which can be classified as a comparatively soft policy instrument. Specific consumption taxes or subsidies to promote the consumption of bio-based products and services were reported only by a minority of experts. Perhaps surprisingly, this picture is relatively homogeneous across world regions with "awareness raising", "international agreements", and "training & capacity building" playing a somewhat larger role in Sub-Saharan Africa and Latin America than in other regions.

Hence, dominant models of enabling governance seem to favor support to the emergence of bio-based innovation, while the commercial success of bio-based products is still mainly left to market forces.

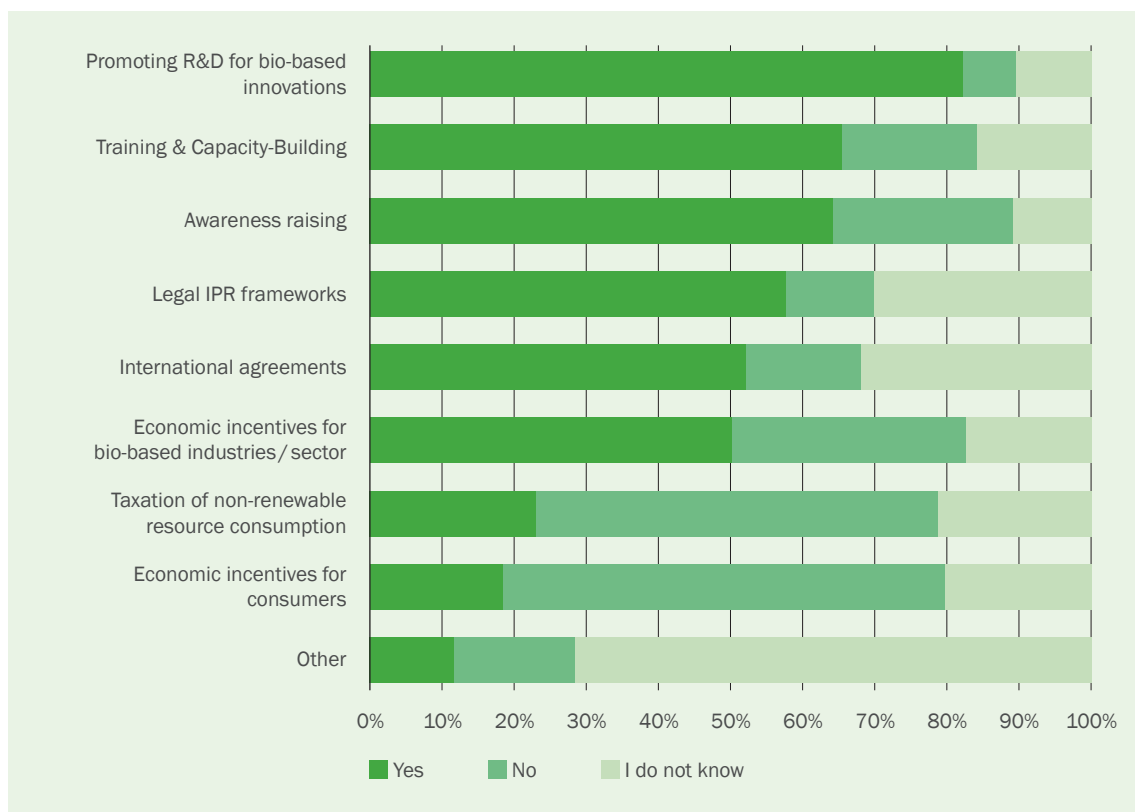


Figure 8: Implemented bioeconomy support measures

### Regulatory governance

Regulatory frameworks are needed to steer bioeconomy transformation processes towards sustainable outcomes. Potential risks associated with bio-based production have been identified in basically all major sustainability dimensions suggesting the need to design both social and environmental safeguards with high context-specificity in order to minimize tradeoffs between individual SDGs.

The majority of the experts surveyed (about 75%) stated that environmental regulations exist in their respective contexts, both at the national (minimum standards environmental) and the international level (international agreements). Similar frequencies (approx. 70%) were found for regulations on water

and land use as well as on food markets, whereas regulations on bio-based innovations, biodiversity access and benefit sharing, as well as minimum social standards were mentioned by little more than half of the respondents.

Experts views thus suggest that current bioeconomic transformation processes are not taking place in a regulatory vacuum. A number of laws and standards already exist that implicitly or explicitly refer to the regulation of bio-based transformation processes. Again, expert assessments are quite homogenous across world regions, except for regulations on food markets and access and benefit sharing, which were mentioned more frequently by experts from low income economies.

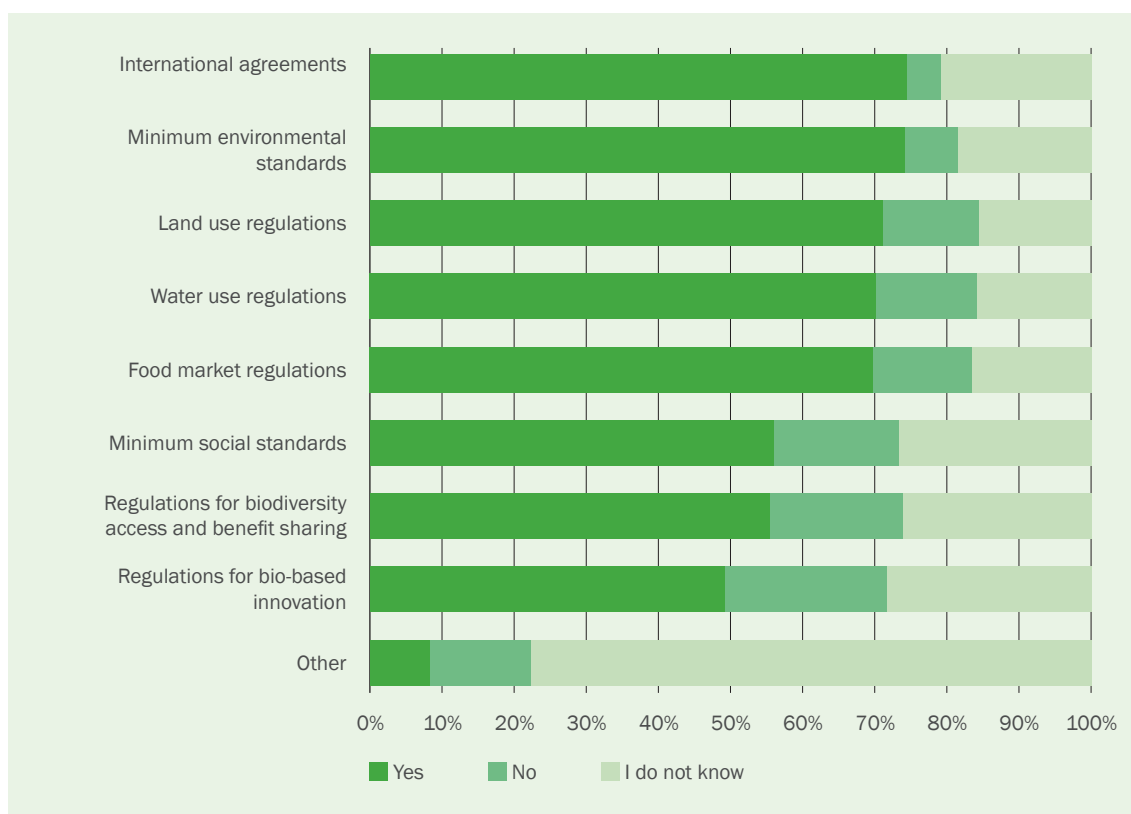


Figure 9: Implemented bioeconomy regulatory measures

## 3.6 Effectiveness of policy implementation

The mere existence of bioeconomy-related policy measures, as documented above, does not preclude governance gaps. We thus also asked experts to rate the effectiveness of policy implementation and summarize responses below following the same structure. Table 5 compares effective-

ness ratings between the two governance types and across world regions, suggesting marginally higher effectiveness for enabling governance. Figure 10 below refers to enabling policy measures and Figure 11 synthesizes effectiveness ratings for regulatory policies.



**Table 5: Average effectiveness of implemented support and regulatory governance measures**

Region	Enabling measures	Regulatory measures
Europe and Central Asia	0.52	0.25
East Asia and Pacific	0.49	0.11
North America	0.39	-0.04
Latin America and the Caribbean	0.24	0.20
Sub-Saharan Africa	0.07	0.04
South Asia	-0.17	-0.24

*Note: very ineffective=-2, medium=0, very effective=2*

### Enabling governance

Strikingly, the majority of experts attests medium to very low effectiveness scores to all enabling policy measures except “Promoting R&D for bio-based innovation”. This indicates potentially significant gaps between policy formulation and implementation on the ground. As for the individual policies, expert

responses suggest implementation gaps are more pronounced for demand-side policies, such as economic incentives for consumers, awareness raising, and taxation than for supply-side measures, such as promoting R&D for bio-based innovation, economic incentives for bio-based industries/sectors, legal IPR frameworks, and training & capacity building.

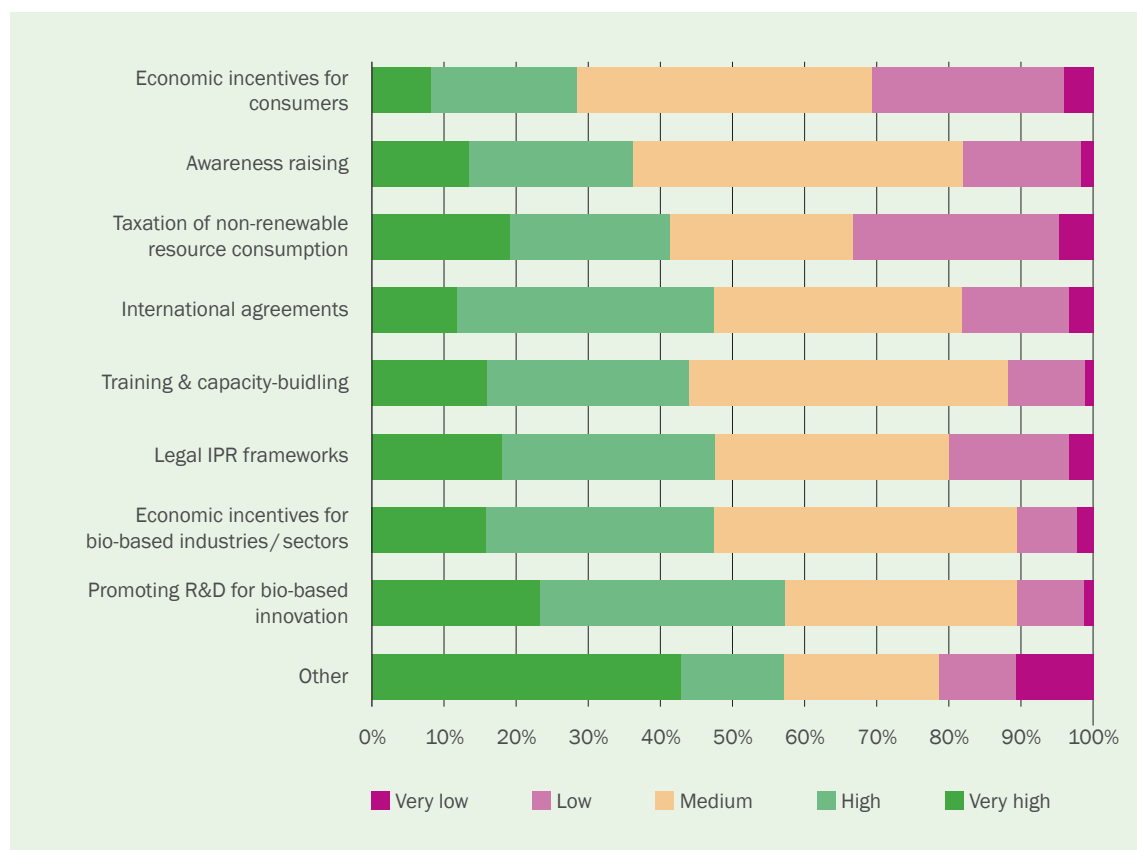


Figure 10: Effectiveness of the implemented bioeconomy support measures

### Regulatory governance

Implementation gaps are similarly, if not more, pronounced in experts' assessments of regulatory policy measures. For all specific regulatory policies in the list, a majority of experts rated implementation effectiveness at "medium" to "very low". On average, no regulatory policy stands out as particu-

larly effective, whereas effectiveness ratings are marginally higher for Europe and Central Asia than for South Asia and Sub-Saharan Africa (Table 5).

Hence, improving regulatory effectiveness would appear as another major challenge to be addressed in future bioeconomy policy-making.

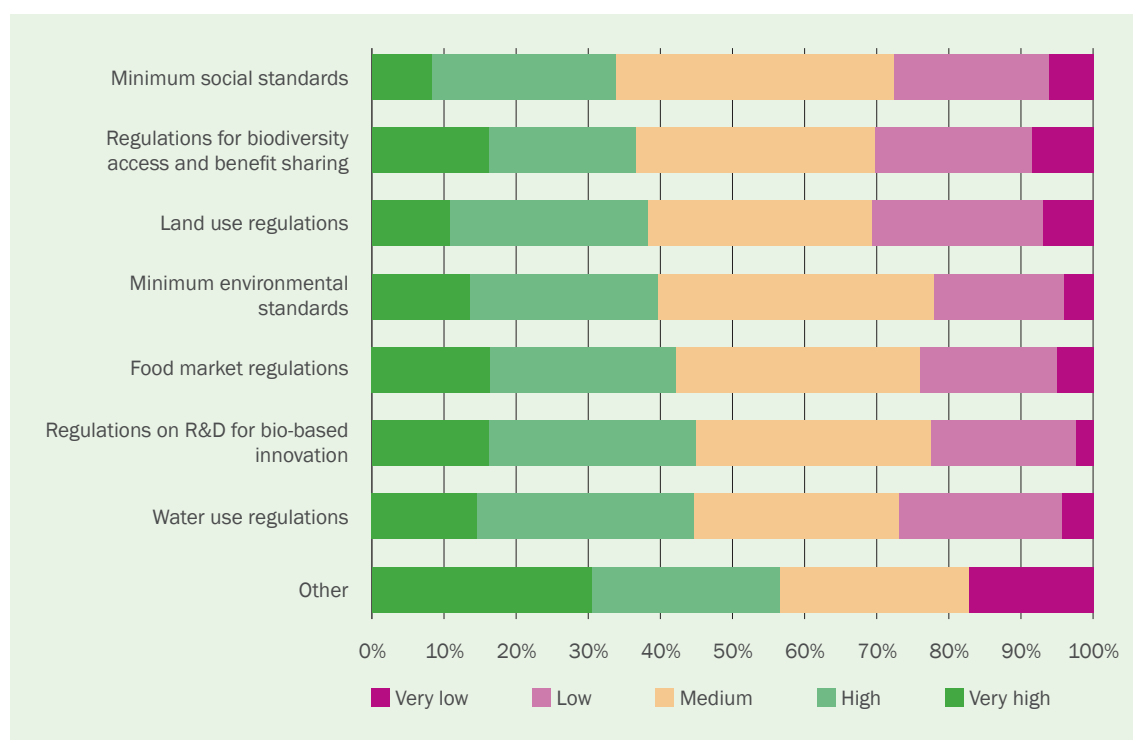


Figure 11: Effectiveness of implemented bioeconomy regulatory measures

### 3.7 Adequacy of bioeconomy policies

To further contextualize the responses discussed in the previous two sections we asked the experts to evaluate (1) the overall adequacy of existing policies to address challenges in the three main sustainability dimensions (economic, social, and ecological) and (2) the need for intensified international cooperation and coordination (Figure 12).

Only few experts “fully agree” that existing policies adequately address social, economic or ecological sustainable development goals. Clearly larger proportions of experts “somewhat” or “totally dis-

agree” especially in terms of adequacy to address social and economic concerns. At the same time, experts widely agreed with the statements that more intergovernmental cooperation and coordination at international scale is needed to achieve bio-based economic growth sustainably.

In sum, a large number of bioeconomy-relevant policies are in place worldwide, but the experts in our global sample cast doubt on whether this is enough to put emerging bioeconomies on a safe track towards a sustainable future.

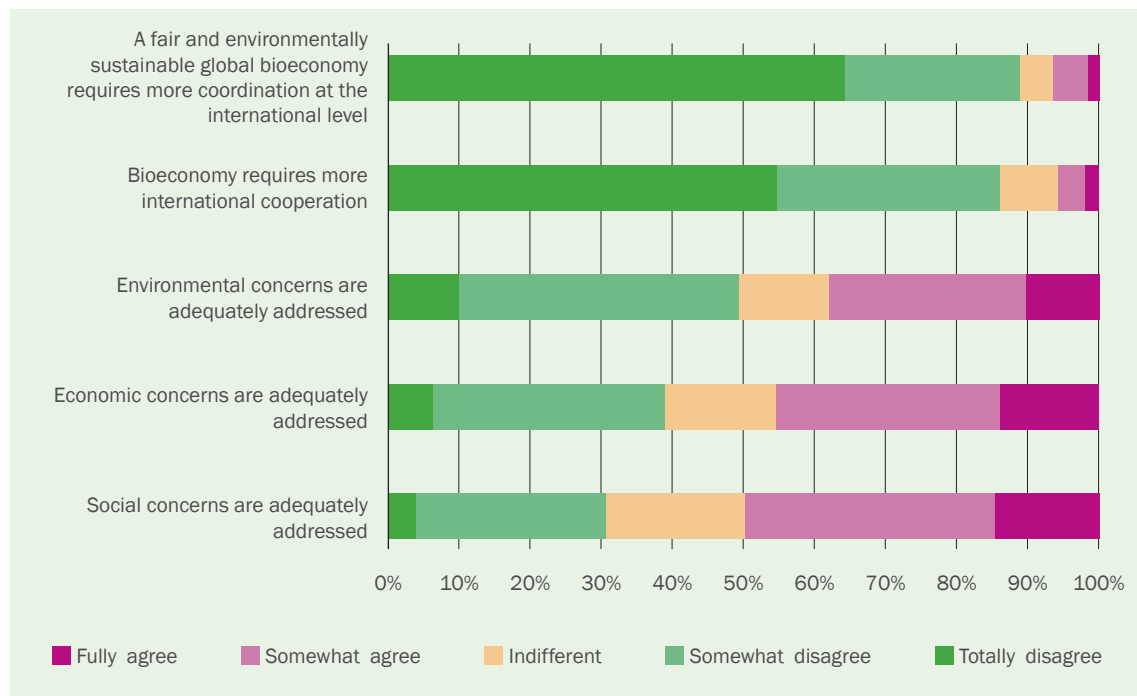


Figure 12: Do bioeconomy policies address the main pillars of sustainable development?

### 3.8 Improving bioeconomy governance

#### Bioeconomy governance gaps at the national scale

To identify entry points for policy action we asked experts to rate the importance of predefined potential barriers to sustainable bio-based transformation (Figure 13). The barrier that received the highest percentage of very high and high ratings refers to the lack of capital for start-up companies in the bioeconomy. Somewhat lower, but still high importance was attached to the “lack of commercialization success”. In comparison to these two comparatively significant barriers, the surveyed experts rated “lack of experimental spaces”, “lack of bioeconomy related R&D”, “lack of access to existing technology and knowledge”, and “lack of

capacity building and education” as comparatively less important. “Lack of bioeconomy related legal frameworks” and “limited infrastructure” were considered relatively important, but less so than the barriers highlighted above.

This pattern indicates that existing bioeconomy governance frameworks may be capable of initiating bio-based innovation processes, but lack the ability to support sustained economic success beyond early stages of transformation.

Underscoring the need to coherently align policies to enable sustainability transformations, experts

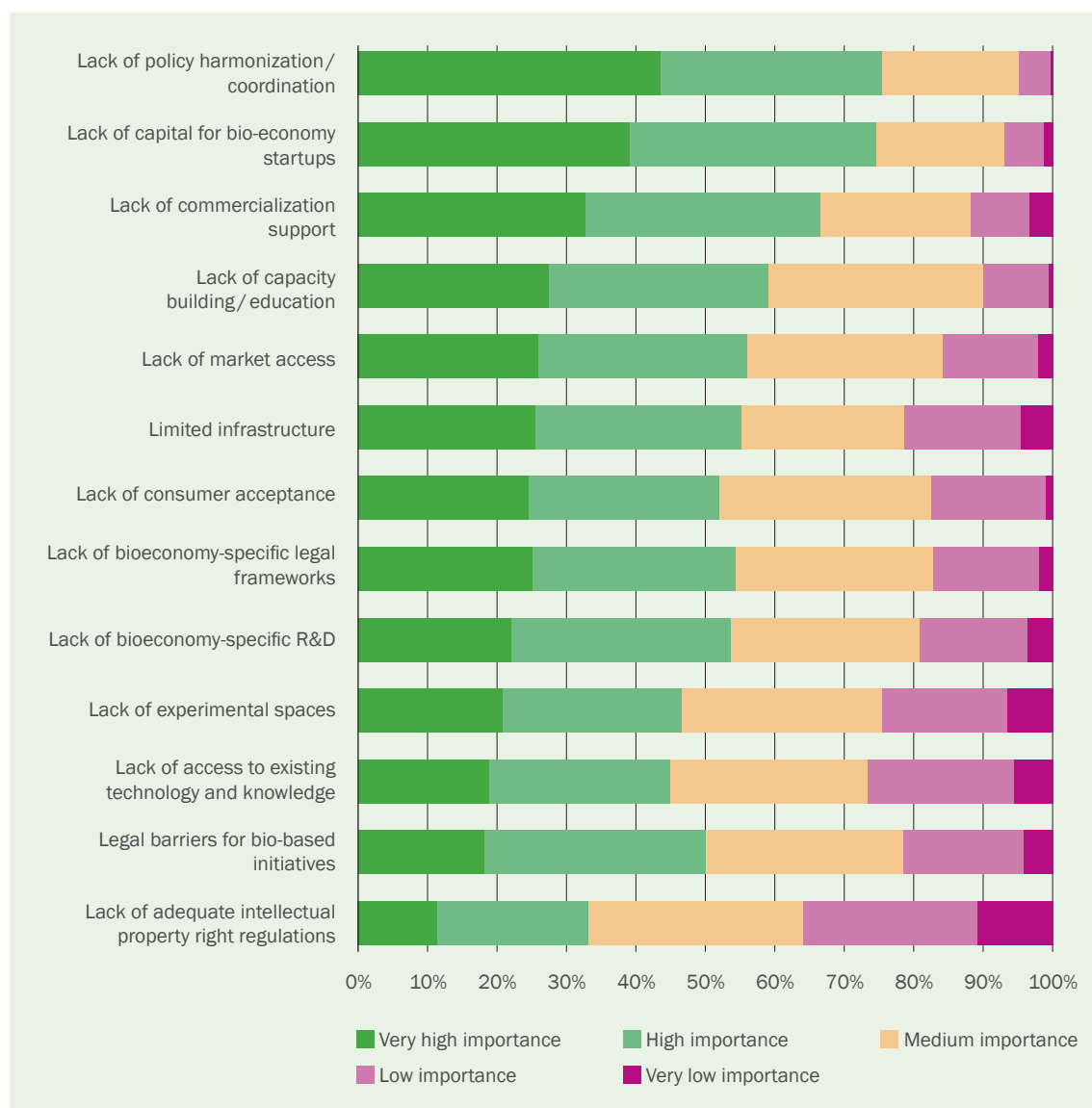


Figure 13: Importance of identified national governance gaps (“I don’t know” < 15%, not shown)







# 4 Highlights and Outlook

The descriptive analysis of responses to the 2020 survey of global bioeconomy experts commissioned for the Global Bioeconomy Summit provides a snapshot of the current state of implementation of bioeconomy strategies at the global scale. Experts views from 49 countries suggest that the global bioeconomy needs more effective governance frameworks at national and international levels in order to become a driver of sustainable development. Major governance gaps and suggested expert solutions are summarized in Table 6.

**Enabling governance** mechanisms need to support bioeconomy entrepreneurs and business at broad

scales to transform bio-based innovations into sustained economic success. Dominant models of enabling bioeconomy governance focus on supporting the emergence of bio-based technologies and early innovation phases, but market conditions for commercial success often remain unfavorable, including due to incoherent policy incentives.

Only few experts “fully agreed” that existing bioeconomy policies adequately address social, economic or ecological development goals. Hence, global and cross-sectoral policy coordination is needed for **regulatory governance** mechanisms to more effectively promote bioeconomic growth and

Table 6: Summary of governance gaps and expert solutions	
Governance gaps	Expert solutions
National Level	
Lack of capital for start-up companies in the bioeconomy	improved private sector and government funded schemes, public-private partnerships, specific taxes to support the bioeconomy
Lack commercialization support	Direct investments by the state, improved economic order
Lack of policy coordination and harmonization	Better involvement of stakeholders, better alignment of inter-ministerial policy processes, better communication, cooperation and integration among all stakeholders and clusters
International Level	
Lack of binding international laws and regulations	Stronger standards to regulate potential goal conflicts, better coordinated international politics on trade and development issues
Unequal distribution of institutional capacities between different countries.	Web of bi- and trilateral international activities for knowledge transfer and institution building
Unequal distribution of knowledge and technology	Green international finance schemes



minimize risks of adverse outcomes in social and environmental sustainability domains.

At international scale, expert opinions point to the lack of binding laws and regulations, unequal distribution of knowledge and technology access, and regional imbalances in institutional capacities. Experts thus widely agreed that more inter-governmental cooperation and coordination at international scale is needed to achieve bio-based economic growth sustainably.

In closing, we note that expert opinions on the complex bioeconomy governance issues raised in this survey inevitably reflect existing knowledge gaps in the emerging research field on “sustainability transformations”. This includes, for example, our limited ability to measure and monitor progress in bioeconomic transformations, lack rigorous empirical evidence on complex cause-effect relationships

between transformation drivers and outcomes, and unanswered questions on transformation governability. As a result, experts from the same region and professional background may disagree, for example, on the effectiveness and adequacy of policy measure (see section 3.6). Addressing these knowledge gaps requires innovative transdisciplinary research approaches to provide a systematic evidence base on what works and what does not work in enabling and regulating bioeconomic transformation. Methodological innovation is needed to leverage opportunities, such as new data sources and artificial intelligence. Digital opportunities exist not only for technology development, but also for social science to improve methods that establish causal relationships between drivers and outcomes bioeconomic change. Transdisciplinary approaches are needed to anticipate future innovation trends, understand business opportunities or constraints, and effectively communicate at the science-policy interface.

# Annex: Online Expert Questionnaire

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## Questionnaire

### Global Bioeconomy Expert Survey 2020

Dear Expert,

We herewith kindly ask you as an expert on bioeconomy to take part in a **Global Expert Survey on future trends and developments in the bioeconomy**. The global expert survey is one of the signature outputs of the Global Bioeconomy Summit, which will be held fully virtual from the **16th – 20th of November 2020**.

The survey results will be presented to a global audience at the **Global Bioeconomy Summit 2020**. The Global Bioeconomy Summit has become the leading event with a format to globally review and discuss emerging opportunities and challenges of the bioeconomy and develop visions for the future development of a sustainable bioeconomy among international key actors from governments, science and innovation, business and civil society. The surveys of the two previous Global Bioeconomy Summits (**GBS2015** and **GBS2018**) have attracted much attention and have decisively shaped the global bioeconomy discussion.

Participating in the survey gives you the opportunity to explore, together with experts from around the world, the question on **“How to transition towards a sustainable bioeconomy?”**. The aim of the survey is to assess the current status of the bioeconomy transition in the different hemispheres (*How far have we come?*) and to support the development of effective governance frameworks that further accelerate the transition to a sustainable bioeconomy (*What needs to be done next?*).

The survey takes about **20 minutes** to complete. Please answer the survey by **October 4<sup>th</sup>, 2020**. You will of course receive a pre-publication of the results. **When answering the survey, you can navigate backward and forward between questions. You can leave the survey at any time and return to it at your own convenience. Clicking ‘next’ or ‘previous’ or ‘resume later’ saves your answers.**

Commissioned by the **International Advisory Council on Global Bioeconomy**, the expert survey is conducted by the Center for Development Research (ZEF), the University of Münster and BIOCOM AG. Your personal data will be treated with strict confidentiality. All results will be presented in such a way that it will be impossible to identify individual respondents. If you have any questions about the survey, please contact the project coordinators Prof. Dr. Jan Börner (e-mail: jborner@uni-bonn.de – phone +49-228-73-1873) or Prof. Dr. Thomas Dietz (e-mail: thomas.dietz@uni-muenster.de – phone +49 251 83-24910)

Thank you on behalf of the International Advisory Council on Global Bioeconomy for taking part in the survey. We highly appreciate your participation.

Yours sincerely,

Prof. Dr. Christine Lang                      Prof. Dr. Dr. h.c. Joachim von Braun  
Co-Chairs of the International Advisory Council on Global Bioeconomy

## A. Background questions

\* = Compulsory questions

\* 1. Are you engaged in research, development, business or policymaking related to the bioeconomy?

☐ yes

☐ no

\* 2. Are you a member of a formal/governmental bioeconomy advisory council?

☐ yes

☐ no

\* 3. Which of the following best describes your role?

❗ Choose one of the following answers

☐ researcher/lecturer at a university or research institution

☐ policy maker/public official/public administration staff at a national agency

☐ policy maker/public official/public administration staff at an international organization

☐ owner/manager of a private company

☐ researcher in a private company/a corporation

☐ representative of a civil society organization/NGO

☐ other, please specify .....

\* 4. Which is your main sector of operation?

❗ Choose one of the following answers

☐ agriculture

☐ biotechnology

☐ forestry

☐ health, pharma

☐ fishery

☐ food, nutrition

☐ energy

☐ wood and paper manufacturing

☐ chemistry

☐ other, please specify .....

5. a) Which country are you based in?

Please choose ...

5. b) Please choose from which perspective you will answer this questionnaire?

Please choose ...

☐ country i am based in

☐ general perspective from my main sector of operation

☐ another country (please specify) .....

\* 6. Are you part of any formal network(s) or larger association(s) working on bioeconomy?

☐ yes

☐ no

[illegible]

[illegible]

## f) Promoting Good Governance

	totally unimportant		neutral		very important	
Inter-ministerial and inter-regional cooperation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Monitoring and measuring activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Public reporting and multi-stakeholder dialogue	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Learning and adaptive policy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bioeconomy advisory council	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## g) Improving international collaboration in the bioeconomy

	totally unimportant		neutral		very important	
Harmonization in international trade and policy frameworks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Knowledge sharing between industrialized and developing countries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Private investment in developing countries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
International monitoring, e.g. satellite tracking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## B. Recent bio-based innovations

**8. Please shortly describe a prominent and successful bio-based innovation\* in your country (or sector of operation) in the past five years. \* We define “successful bio-based innovation” as any institutional or technological trend that generates benefits for people or the environment by managing or relying on biological resources, principles, or processes**

a) Name or label of the innovation (max. 200 characters):

.....

b) Short description (max. 500 characters):

.....

c) Weblink (if available):

.....

**9. What were the three most important factors that enabled the success of the innovation? (200 characters limit each):**

a. ....

b. ....

c. ....

## C. Assessment of existing policies

\* 10. a) Which of the following bioeconomy support measures exist in your country (or sector of operation)?

	Yes	No	I do not know
Promoting R&D for bio-based innovation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Economic incentives for bio-based industries/sectors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Economic incentives for consumers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Awareness raising	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Training & Capacity-Building	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Taxation of non-renewable resource consumption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Legal Intellectual Property Rights frameworks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
International agreements (e.g. on trade, technology transfer)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other(s), specify below	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

\* 10. b) Which of the following regulatory measures for the bioeconomy exist in your country (or sector of operation)?

	Yes	No	I do not know
Land use regulations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Water use regulations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Regulations on R&D for bio-based innovation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Food market regulations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Regulations for biodiversity access and benefit sharing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Minimum standards (social)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Minimum standards (environmental)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
International agreements (e.g. environmental treaties)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other(s), specify below	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

\* 11. From the perspective of your country (or sector of operation), please indicate your agreement or disagreement with the following statements.

	Totally disagree	Somewhat disagree	Indifferent	Somewhat agree	Fully agree
Economic concerns are adequately addressed by policies for the bioeconomy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Social concerns are adequately addressed by policies for the bioeconomy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Environmental concerns are adequately addressed by policies for the bioeconomy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bioeconomic growth requires more international cooperation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A fair and environmentally sustainable global bioeconomy requires more coordination at the international level	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

✳ 12. a) From the perspective of your country (or sector of operation), how important are the following barriers at the national level in constraining a thriving bioeconomy?

[illegible]

✳ 13. a) From the perspective of your country (or sector of operation), how important are the following barriers at the international level in constraining a thriving bioeconomy?

[illegible]



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## About the International Advisory Council on Global Bioeconomy (IACGB)

The IACGB was initially formed to support the Global Bioeconomy Summit 2015 and has been maintained and extended since. The IACGB is composed of about forty high-level policy experts and drivers of the bioeconomy in all hemispheres. IACGB members act in their personal capacity as experts and do not represent an official government or organizational position. The members combine a broad range of expertise and backgrounds and they are actively involved in different international bioeconomy-related policy and research fora. While currently being an informal mechanism, the IACGB has gained credibility and legitimacy as an expert think tank and are actively working to develop further in the coming years. The IACGB is significantly involved in the development of the GBS2020 plenary agenda and workshop program to ensure its global spirit and its non-commercial nature. The IACGB develops and approves policy recommendations on how to promote the development of a sustainable bioeconomy globally. These recommendations have been summarized in the Communiqués of GBS2015 and GBS2018 and new recommendations will be published during GBS2020. Furthermore, IACGB members act as important multipliers and take the GBS messages and the policy recommendations to other global and international bioeconomy networks and policy fora. Documents download and further information is available at <https://gbs2020.net>

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