



This document is funded by the European Union (ERDF, Interreg/Baltic Sea Region-P1.009) and Nordic Council of Ministers

IMPACT STUDY

The Baltic Sea Regional Bioeconomy Council

Realising the Bioeconomy in the Baltic Sea Region



Photo: NN.-norden.org

Study by Henning Klarlund, Roskilde University, for
Nordic Council of Ministers, June 2016

***Many thanks to the members of
the Baltic Sea Region Bioeconomy Council
and the region's many stakeholders
for their very valuable contributions to this impact study.***

The Baltic Sea Region Bioeconomy Council is composed of 15-20 leaders in development and implementation of enabling bioeconomy policies and initiatives in the Baltic Sea Region. The Council has members from local, regional, national, macro-regional and international governmental organisations, knowledge institutions and non-governmental organisations.

Contents

	Executive Summary	page	4
1.	Introduction	page	5
2.	Background	page	5
2.1.	Societal challenges related to the bioeconomy	page	6
2.2.	Action areas for realising the bioeconomy	page	7
2.2.1.	Bioeconomy Policies	page	8
2.2.2	Bio-based Business	page	8
2.2.3	R&D and Innovation	page	9
2.2.4.	Civil Society	page	9
2.2.5.	Outreach	page	9
2.3.	Bottlenecks and impact types	page	9
3.	Impact	page	10
3.1.	Impact types	page	11
3.2.	Value-chain	page	13
3.3.	Indicators and scoring	page	13
3.4.	Impact guide and checklist	page	15
4.	Impact study	page	17
4.1.	Stakeholder survey	page	17
4.2.	Impact relevance and bottlenecks	page	19
4.2.1.	Bioeconomy Policies impact relevance and nature	page	20
4.2.2	Bio-Based Business- impact relevance and nature	page	21
4.2.3.	R&D and Innovation - impact relevance and nature	page	22
4.2.4.	Civil Society - impact relevance and nature	page	23
4.2.5.	Outreach - impact relevance and nature	page	25
5.	Conclusion	page	26
6.	Recommendations	page	28

Executive summary

The bioeconomy is about economic, social and environmental sustainable development - it is about economic activities based on optimal utilization of maritime and terrestrial biological resources. In terms of economic sectors the bioeconomy includes production and consumption of **feed and food; biomaterials; and bioenergy**.

Five key persistent bottlenecks and action areas for realising the bioeconomy in the **Baltic Sea Region (BSR)** have been identified by the region's stakeholders: **Bioeconomy Policies; Bio-Based Business; R&D and Innovation; Civil Society and Outreach**.

The inherent complexity of bioeconomy actions and the subsequent need for cross cutting approaches and solution, calls for a greater variety of impacts. Usually the traditional socio-economic impact typologies **economic, social and environmental** are used when measuring or assessing impact. However, a more holistic and integrated approach applying a wider selection of impacts e.g. **Policy, Technology, Economy, Society, Science, Organisation, Training, Health, Environment, Symbolic, Culture** can offer new tools and methods for execution, planning purposes and evaluation, and the allocation of the necessary resources for realising the bioeconomy in the Baltic Sea Region in order to achieve the expected results, impacts and benefits to society embedding a value chain.

The **Baltic Sea Region** and its **Bioeconomy Council (BSR-BC)** coordinated by **Nordic Council of Ministers (NCM)** took initiative to this impact study in which a survey took place among the stakeholders in the Baltic Sea Region and its BSR-BC. **The survey shows that all the impacts are relevant to the bottlenecks, and that all impacts are considered to be of a mixed quantitative/qualitative nature.** This offers great relevance for future work on the pathways to impact and their implementation within bioeconomy and other complex challenges that require a holistic and cross-cutting yet specific approach.

Further, tools and methods are offered for execution and planning purposes, and the allocation of the necessary resources for realising the bioeconomy in the Baltic Sea Region in order to achieve the expected results, impacts and benefits to society while embedding a value chain. The value of BSR cooperation on advancing the bioeconomy will be to increase efficiency in effort, not least ensuring results and impact, thus contributing to the BSR Bioeconomy and the EU Strategy for the **Baltic Sea Region (EUSBSR)** of which the NCM is Horizontal Action Leader.

The key role of stakeholders within the quadruple helix (academia, government, industry and civil society) local, national and international should be to discuss, describe and implement the pathways leading towards concrete objectives, indicators, actions, results, impacts, assessments and ultimately to the sustainable benefits to society. Implementing pathways to impact and their assessment will consequently alter bioeconomy practices and influence future behavior in the field.

It is therefore recommended that the BSR-BC and NCM support the further developments of the impact tool and its associated indicators. To fully utilise the potential the knowledge exchange and the capacity building in this field should be promoted. These activities should also include RIS 3 – Regional Innovation Strategies for Smart Specialisation and partnerships and social innovation in this area, across the BSR interacting with other relevant instruments and programmes.

1. Introduction

A look at where the world is heading and what challenges and opportunities may lie ahead or beyond the longer-term horizon may serve as a useful point of departure for the identification of relevant impact types for the bioeconomy in the Baltic Sea Region (BSR). Thus, our future is being shaped by a multitude of powerful, highly complex and interconnected forces, that over 10-20 years give rise to big trends or megatrends that are – large-scale social, economic, political, environmental or technological changes. Though the changes are slow to form, they can exercise a profound and lasting influence on many if not most human activities, processes and perceptions. Examples are global population growth and urbanisation or the ageing of societies in many parts of the world; the warming of the planet and rising sea-levels or the acidification of our oceans and seas; the deepening of globalisation or the growing momentum of digitalisation, big data and bioengineering¹ all which will also impact and interact with realising the bioeconomy in the BSR.

Foresight studies and the associated scenarios are not predictions about the future but rather simulations of some possible futures and used to reveal the choices available and their potential consequences. It is therefore most relevant to making decisions and for the development of BSR at national, regional and local level over the next few decades.

The BSR stakeholders have agreed upon five bottlenecks in realising the bioeconomy in the BSR. The bottlenecks: Bioeconomy Policies; Bio-Based Business; R&D and Innovation; Civil Society and Outreach. Which have now become five action areas. This allows us to envision and influence at least some elements of our likely medium-to-long term future. To support the action areas and at the same time get valuable insights for decisions and the development of the complex bioeconomy in BSR, cross cutting approaches are necessary. In order to facilitate a focused approach and the possibility of influencing the development and the expected impacts and benefits to society, it is important to identify the relevant impacts for each of the five areas.

This study therefore aims to identify quantitative and qualitative impacts and their pathways that might be most relevant for addressing and overcoming the key persistent bottlenecks for realising the bioeconomy in the Baltic Sea Region: Bioeconomy Policies; Bio-Based Business; R&D and Innovation; Civil Society and Outreach. Usually the traditional socio-economic typologies are used when measuring or assessing impact. However, the inherent complexity of bioeconomy actions and the subsequent need for cross cutting approaches, calls for a greater variety of impact types e.g. Policy, Technology, Economy, Society, Science, Organisation, Training, Health, Environment, Symbolic, Culture.

2. Background - bioeconomy

The bioeconomy is about economic, social and environmental sustainable development - it is about economic activities based on optimal utilization of maritime and terrestrial biological resources. In terms of economic sectors the bioeconomy includes production and consumption of **feed and food; biomaterials; and bioenergy**. The bioeconomy is furthermore an approach that builds on a circular thinking; and an approach that aims to enable a transition from a fossil-based to a bio-based society.

¹ <http://ufm.dk/en/publications/2016/files/an-oecd-horizon-scan-of-megatrends-and-technology-trends-in-the-context-of-future-research-policy.pdf>

Thus the bioeconomy is complex – and it arises from a realisation that there is a need for an integrated response to a number of global mega-trends and the associated challenges²:

- Food security concerns arises from a fast growing global population and higher life expectancy giving rise to food and feed production and demand (according to FAO with a much as plus 70% by 2050).
- High dependence on fossil-based resources result is an increasing need for strengthening energy security and for diversifying the energy supply range.
- As a result demand for biological resources for bio-based products is increasing.
- Also on the increase are sustainability concerns (e.g. GHG emission reduction, moving towards a zero-waste society, environmental sustainability of primary production systems, increasing land use competition, etc.)

Other mega-trends of importance for the bioeconomy include a shifting weight of global economic activity towards Asia, falling trade barriers and transportation costs, and a continuation of the re-organisation of global value chains leading to increased specialization of locations around specific activities and functions. Also, the continued shift towards a knowledge driven economy will remain another key trend³.

Based on available data from a wide range of sources it is estimated that the European bioeconomy has an annual turnover of about € 2 trillion and employs more than 22 million people and approximately 9% of the total EU workforce ⁴.

2.1. Societal challenges related to the bioeconomy

Over all, establishing a bioeconomy in the Baltic Sea Region holds great potential: it can maintain and create economic growth and jobs in rural, coastal and industrial areas, reduce fossil fuel dependence and improve the economic and environmental sustainability of primary production and processing industries.

More specifically, addressing the comprehensively inter-connected societal challenges related to the bioeconomy calls for efforts to:

- Ensure responsible and participative governance.
- Engage the public to develop an understanding of the bioeconomy and its impacts and benefits

² <https://www.norden.org/da/nordisk-ministerraad/ministerraad/nordisk-ministerraad-for-fiskeri-havbrug-jordbrug-levnedsmidler-og-skovbrug-mr-fjls/arrangementer/workshop-on-realizing-the-bioeconomy-in-the-baltic-sea-region-1/draft-workshop-paper-ii-berlin-1h>

³ European Commission. 2013. Bioeconomy and sustainability: a potential contribution to the Bioeconomy Observatory. European Commission, Joint Research Centre, Institute for Environment and Sustainability.

⁴ Commission Staff Working Document, Innovating for Sustainable Growth: A Bioeconomy for Europe, 2012.

- Improve the availability and quality of information on bioeconomy products and processes, including their social, economic and environmental impacts and the related ethical concerns, and foster future-oriented multi-stakeholders dialogues.
- Facilitate the development and acceptability of regional and national bioeconomy strategies.
- Facilitate the flow from discovery to market applications and to speed up the innovation process through closer ties between activities throughout the research and innovation chain.
- Unlock the growth potential by including social innovation and social entrepreneurship resulting in new skills and practices etc.
- Contribute to increasing the number of innovative products and processes reaching the market, and increasing the number of new companies and new jobs created from trans-disciplinary research, innovation projects with access to risk willing capital and public procurement schemes.

The further development and shape of the bioeconomy will also depend on breakthroughs in basic and applied research in the biological sciences; commercial opportunities; and development of new business enabling regulations, other framework conditions, and business models. External factors – such as population and incomes, demographics and education, energy consumption, the availability and cost of key resources such as food and water, access to healthcare, and both supporting and competing technologies – will also play an important role. All these factors will influence the location and the size and types of markets for food, feed, fibre, fuel, plastics, fine chemicals, pharmaceuticals and other biotechnology products. Thus, collaboration across the Baltic Sea Region provides an opportunity to deal with these multiple trends and challenges.

This study relates to three workshops held in 2014 and 2015 under the initiative of the Nordic Council of Minister under the project “Realising the bioeconomy in the Baltic Sea Region” – which is a cooperation effort implemented within the framework of the Nordic Bioeconomy Initiative (NordBio) and the Action Plan for the European Union Strategy for the Baltic Sea Region.

Already the first workshop in Tallinn 26-27 March 2014 concluded on the importance of emphasizing on the translation of dialogue and policies into concrete actions and impact. The following workshops in Berlin and Warsaw aimed to go further and address the impact issues.

For the workshop in Berlin 18-19 September 2014 the paper “A Bioeconomy for the Baltic Sea Region – impact, engaging the private sector and financing cooperation”⁵ was presented and underlined the importance of impact and furthered the following initiatives in this field.

2.2. Action areas for realising the bioeconomy

To further facilitate and speed up the realisation of the bioeconomy in the Baltic Sea Region a three-year strategy and action plan was adopted during the third workshop in Warsaw on 4-5 March 2015 planned under an initiative by the Nordic Council of Minister.

The 2015-18 BSR Bioeconomy strategy and action plan⁶ aims to unlock key persistent bottlenecks in realising the bioeconomy. The five bottlenecks identified for action by the BSR stakeholders are visualised in figure 1.

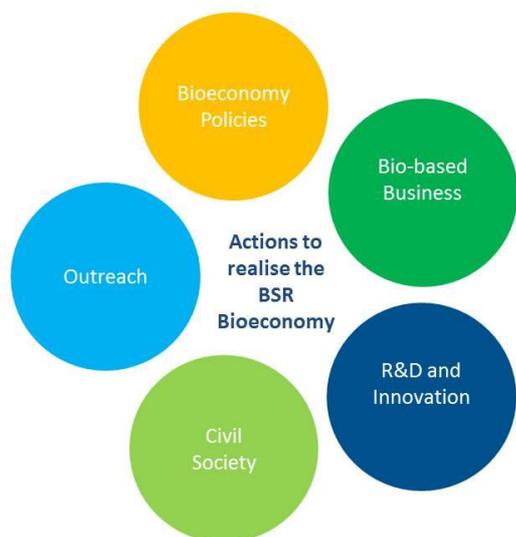


Figure 1. The five bottlenecks identified for action by the BSR-stakeholders

2.2.1. Bioeconomy policies

The bioeconomy is complex and cuts across sectors. Therefore the bioeconomy does not fit neatly into one specific policy area. Instead it must be addressed through efforts in different policy areas. Some regions and countries in the Baltic Sea Region have already holistic bioeconomy policies and strategies in place. Others are on the way to developing such policies and strategies. Yet in other countries and regions the bioeconomy is being pursued through sector policies, such as within agriculture, fishery, forestry, regional development, environment, research and innovation. Realising the bioeconomy calls for regions and countries to move beyond silos and sector policies and towards holistic policies and incentives.

2.2.2. Bio-based Business

The bioeconomy essentially calls for new ways of producing and consuming biological resources. Efforts are therefore needed to engage the private sector more in the bioeconomy such as through private sector dialogue and cooperation on bioeconomy and circular economy business solutions; efforts within the area of biorefineries to generate new value chains; public procurement incentives; and smart specialisation and business matchmaking activities that promote cross-overs and cross-fertilisation between, for example, biotechnology, life science, cleantech and circular economy business clusters.

⁵ <https://www.norden.org/da/nordisk-ministerraad/ministerraad/nordisk-ministerraad-for-fiskeri-havbrug-jordbrug-levnedsmidler-og-skovbrug-mr-fjls/arrangementer/workshop-on-realizing-the-bioeconomy-in-the-baltic-sea-region-1/draft-workshop-paper-ii-berlin-18-19-september>

⁶ http://bsrbioeconomy.net/resources/BSR_Bioeconomy_Strategy_and_Action_Plan_March_2015.pdf

2.2.3. R&D and Innovation

Research technology and innovation are key enablers to unlock the potential of the bioeconomy. There is a need for efforts that: improve the overview of leading knowledge and research institutions and their respective areas of excellence within the bioeconomy; investigate opportunities for smart specialisation through shared use of hard and soft test and demonstration infrastructures; fertilise the emergence of entirely new value chains resulting from new sector cross-overs; and encourage university-business linkages such as through macro-regional innovation consortia whereby companies and universities in the Baltic Sea Region collaborate to find bioeconomy solutions to business challenges by utilising and commercially activating university competences.

2.2.4. Civil Society

In essence civil societies – citizens – are the final consumers of all products and services, so any transition towards more sustainable consumption (and production) patterns goes hand-in-hand with the citizens of the Baltic Sea Region (literally) buying into the bioeconomy. Also, there is opportunity to engage with civil society as consumers through dialogue activities in connection with e.g. ‘People’s Meetings’ such as Almedalsveckan in Sweden, Folkemødet in Denmark, Arendal Week in Norway, Suomi Areena in Finland, and Arvamus festival in Estonia.

2.2.5. Outreach

Another key bottleneck to accelerating the transition towards the bioeconomy relates to its complexity and the relative novelty of the policy, research and business area. There is a great need for increasing awareness of the many opportunities afforded by the bioeconomy, e.g. through: story-telling, such as through short films; study tours to showcase on site how the bioeconomy is actually and practically being pursued in the Baltic Sea Region; and awards to raise attention about radical new innovations, new innovative partnerships or novel ways to engage with society and consumers.

2.3. Bottlenecks and impact types

The challenge of reducing the key persistent bottlenecks calls for an identification of the different types of impacts⁷ and their potential pathways that by action can help addressing and overcome the abovementioned key bottlenecks in order to realize the bioeconomy in the Baltic Sea Region.

As a first step and to contribute to further action an overview of a number of potentially important impact types are presented in the following.

⁷ Henning Klarlund “Research impact for global challenges”, Research Global February 2010.

3. Impact

Documenting and demonstrating impacts from addressing the bottlenecks is vital not only for making a case for the bioeconomy in the Baltic Sea Region and establishing the impacts added value, but also in helping the multi stakeholders take action and the policy-makers to make the right decisions in contexts of scarce budgets.

To encompass the wide variety of actions the relevant impact types chosen should help support the many different demonstrable and identified changes. Change being understood as a development, intervention, directly or indirectly, intended or unintended. As not all changes can easily be monitored, let alone be monitored or measured, because of their different nature and time frame. Most often the impacts fall in the categories of a quantitative and/or a qualitative nature. Over time and by following the many potential pathways to impact one will experience a mixed nature of quantitative/qualitative impacts.

Searching for a broad and inclusive impact definition that can cater for and interact with the BSR action areas and at the same time offer a specific and holistic approach to the challenges, the Research Excellence Framework (REF) which is the new system for assessing the quality (reach and significance) of research in UK higher education institutions and used in close to 7000 impact case studies assessing 154 UK universities, offers a very attractive definition, though it excludes academia in its definition⁸.

The following definition of impact is suggested:

Any effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life.

As the impact can affect many different target groups and stakeholders the effect, change or benefit should relate both to:

The activity, attitude, awareness, behaviour, capacity, opportunity, performance, policy, practice, process or understanding.

and

an audience, beneficiary, community, constituency, organisation or individuals in any geographic location

Impacts take place over time and could be immediate, intermediate or longer-term. The effect, change or benefit, therefore often depend on the timeframe and the activities and interactions in the value chain. Thus, knowledge exchange plays a crucial role in achieving the sought for impact. This is for example also the case for innovation, which requires new and better ways of working, thinking, and producing.

⁸ <http://www.hefce.ac.uk/rsrch/REFimpact/>

Assessing the impacts is vital for building a convincing case and establishing the added value. The value of assessing, examining and documenting the socio-economic impact accruing from the bioeconomy is not an easy task. The assessment of socio-economic impacts faces a number of challenges, including difficulties in identifying and addressing all (potential) users and beneficiaries. Furthermore, one may encounter difficulties in applying counter-factual approaches and identifying causality. Adding to that the inherent complexity due to the multiplicity of impacts and their variable timeframes, not to mention the potential of unintended impacts might make it an even more difficult task. At the same time, there are growing concerns that existing indicators for impact measurement are not appropriate for assessing the socio-economic impacts emerging, while the definition of the socio-economic value of research and innovation itself is not straightforward⁹.

Consequently and to meet the abovementioned shortcomings and to further enhance the usability and the communication of impact, a number of more descriptive, diversified and specific impact types are needed. Further, since the bio-economy is cross-sectoral in nature and influenced by a wide range of interconnected global drivers and constraints, understanding and managing the bioeconomy, an integrated multi-dimensional approach and an integrated assessment and monitoring of the impact is required. It is thus important to discuss relevant and appropriate types of impact for realising the bioeconomy in the BSR.

Ensuring impact requires an emphasis first on the enablers and the inputs – be it e.g. human capital, intellectual property, natural capital, infrastructure, markets, financial capital and smart policies – and how these (through linkages, networks and interaction) can impact on e.g. R&D and innovation, training, technology, economy, environment, culture and society etc.

While Albert Einstein was quoted with “Not everything that can be counted counts, and not everything that counts can be counted” it is also true, that if one does not measure, one cannot manage, improve or optimize.

3.1. Impact types

Usually the traditional socio-economic typologies **economic, social and environmental** are used when measuring or assessing impact. However, the inherent complexity of bio-economy actions and the subsequent need for a more holistic and integrated and cross-cutting approach, calls for a greater variety of impact types e.g. Policy, Technology, Economy, Society, Science, Organisation, Training, Health, Environment, Symbolic, Culture¹⁰.

In discussing the implications for cooperation towards realising the bioeconomy in the Baltic Sea Region, new tools, methods for execution, planning purposes and evaluation, and the allocation of the necessary resources in order to achieve the expected results, impacts and benefits to society embedding a value chain the below list of impact types may serve as a checklist or tool for the five actions:

⁹ <http://www.oecd.org/dac/evaluation/dacriteriaforevaluatingdevelopmentassistance.htm>

¹⁰ Benoit Godin and Christian Doré, Measuring the Impacts of Science: Beyond the Economic Dimension, http://www.csiic.ca/PDF/Godin_Dore_Impacts.pdf

- **Policy impacts:** Influences how policy makers and policies act. It can provide evidence that influences policy decisions and can enhance citizens' participation in scientific, environmental, societal, economic and technological decisions.
- **Technology impacts:** Product, process, and service innovations, as well as technical know-how, are types of impacts that partly result from research activities. There are few indicators, other than patents, for properly assessing this dimension. Additional efforts on innovation surveys including both an analysis of outputs and impacts, as well as innovation activity itself, could potentially provide improved impact indicators.
- **Economy impacts:** These refer to the impact on an organisation's budgetary situation e.g. operating costs, revenues, profits, the sale price of products; on the sources of finance, investments and production activities; and on the development of new markets. At the aggregate level, they can also refer to economic returns, through either economic growth, productivity growth or job growth, of a given geographical unit.
- **Society impacts:** Research affects the welfare, behaviour, practices, and activities of people and groups, including their wellbeing and quality of life. It also concerns customs and habits: consumption, work, sexuality, sports, and food. Society impacts can contribute to changing society's views and modernize ways of doing business.
- **Scientific impacts:** Research results have an effect on the subsequent progress of knowledge, thanks to advances in theories, methodologies, models, and facts. They affect the formation and development of specialties, disciplines and training and can also affect the development of research itself, generating interdisciplinary, cross-cutting, and international research.
- **Organisation impacts:** These refer to the effects on the activities of institutions and organisations: planning, organisation of work, administration, human resources, etc.
- **Training impacts:** These are impacts of research on curricula, pedagogical tools, qualifications, entry into the workforce, etc.
- **Health impacts:** These relate to impacts on public health, e.g. life expectancy, prevention of illnesses, and the health-care system.
- **Environment impacts:** These concern management of the environment, notably natural resources and environmental pollution, as well as the impacts on climate and meteorology.
- **Symbolic impacts:** These are the gains in areas such as credibility due to e.g. undertaking R&D, or linked to universities or research institutions that offer gains in terms of potential clients, etc.
- **Culture impacts:** These relate to what people often call public understanding, but, above all related to four types of knowledge: know-what, know-why, know-how, and know who. In other words, these are the impacts on an individual's knowledge and understanding of ideas and reality, as well as intellectual and practical skills, attitudes, interests, values, and beliefs.

3.2. Value-chain

To support the pathways to impact process it can be helpful to look at the different elements or steps in the value chain from “input-to-benefit”. It is however important to remember that the value chain is not a straight line or limited by time. The value-chain approach articulates how, and by what mechanisms, planned activities eventually will affect the intended impacts and benefits. Whether the value chain is to be used for pathways to impact of pure planning reasons, it is important to look at both resources and results as mutual dependent elements.

The pathways to impact and optimally the benefits to society can be followed by the steps in the value chain. However, it is important to remember that there is no one size – fits all, and that in most cases a mixed method including quantitative and qualitative results and impacts should be applied when describing the achieved impacts.

Resources:

Inputs – assets, **financial and human resources**, communication, cooperation, *e.g. for establishing cross-sectoral/national multi stakeholder networks on how best to address benefits of multi-sectorial dimensions in order to drive the bioeconomy forward.*

Activities - workshop, research work, training, conference organizing, facility use, community and stakeholder engagement, *e.g. bench-marking, workshops, exchanging best practices etc.*

Results:

Outputs – findings, discoveries, publications, citations, patents, etc. *e.g. recommendations and guidelines for documented best practices.*

Transfers/Exchanges – engagement with end-users *e.g. train-the-trainers on best practices and dialogue, interaction with end-users for best implementation of recommendations.*

Outcomes – new/improved products, services, or processes *e.g. approved selection of new best practices of multi-sectorial dimensions and recommendations to be implemented.*

Impacts – achieved improvements, *e.g. coherent holistic policy and implementation of best practices and guidelines driving the bioeconomy forward.*

Benefits – to society, *e.g. a sustainable production and consumption of renewable biological resources and their conversion into food and feed, biomaterials and bioenergy through efficient and innovative technologies offering significant opportunities for innovations, economic growth, jobs and investments in new value chains.*

3.3. Indicators and scoring

Where applicable a set of SMART result and impact indicators (Specific, Measurable, Achievable, Realistic, Time-dependent) or key performance indicators (KPI) should ideally be identified and agreed upon from the project start and based on the specific expected impacts and benefits *e.g. growth in number of workplaces or societal well-being.*

With Einstein's quote in mind and the ambition of improving the realisation of the bioeconomy in the BSR it could be helpful to give scores to the impacts.

However, in trying to give a certain value or weight to the actual and relevant result it is important to have in mind, which may be not all result indicators are equally important at the same time. Or they can be difficult or hard to measure in quantitative terms because of their qualitative nature.

Never the less, the scores given are very dependent on the scale of measurement or the "ruler" in place. Consequently, and before giving scores one should know the key bottlenecks to be addressed and the expected impacts and benefits to be measured against.

The scores to be given could for example represent values from 0-5, with 5 being excellent, expressing how successfully the results of the different steps in the value chain from outputs-exchanges – outcomes – impacts and benefits address the target areas and bottlenecks.

Interpretation of the result scores

- 0.** The **results fail** to address the target areas and bottlenecks or cannot be assessed due to missing or incomplete information.
- 1. Poor.** The target areas and bottlenecks bottleneck are inadequately addressed, or there are serious inherent weaknesses.
- 2. Fair.** The results broadly address the target areas and bottlenecks, but there are significant weaknesses.
- 3. Good.** The results address the target areas and bottlenecks well, but a number of shortcomings are present.
- 4. Very Good.** The results address the target areas and bottlenecks very well, but a small number of shortcomings are present.
- 5. Excellent.** The results successfully address all relevant aspects of the target areas and bottlenecks. Any shortcomings are minor.

3.4. Impact guide and checklist

As the approach to the realisation of the bioeconomy in BSR and their related action areas can differ, the list of potential impact types in figure 2. can serve as a guide or checklist.

Action areas and key persistent bottlenecks for realising the bioeconomy	Impact types	
Bioeconomy Policies	<ul style="list-style-type: none"> • Holistic policies and incentives • Sector policies 	<ul style="list-style-type: none"> • Policy <ul style="list-style-type: none"> ○ Policy-makers ○ Citizens ○ Public programs ○ National security
Bio-based Business	<ul style="list-style-type: none"> • New business opportunities • Engaging the private sector • Exhibiting bioeconomy and circular economy business solutions • New value chains • Innovative partnerships • Public procurement incentives • Smart specialization • Business matchmaking - promote cross-overs and cross-fertilisation 	<ul style="list-style-type: none"> • Health <ul style="list-style-type: none"> ○ Public health ○ Health systems • Environment <ul style="list-style-type: none"> ○ Management of natural resources and the environment ○ Climate and meteorology • Symbolic <ul style="list-style-type: none"> ○ Legitimacy/credibility/ visibility ○ Notoriety • Culture <ul style="list-style-type: none"> ○ Knowledge ○ Know-how ○ Attitudes ○ Values
R&D and Innovation	<ul style="list-style-type: none"> • Overview of leading knowledge and research institutions and their respective areas of excellence within the bioeconomy • Investigate opportunities for smart specialization • Shared use of hard and soft test and demonstration infrastructures • New value chains resulting from new sector cross-overs • Utilising and commercially activating university competences 	<ul style="list-style-type: none"> • Economy <ul style="list-style-type: none"> ○ Production ○ Financing ○ Investments ○ Commercialisation ○ Budget • Society <ul style="list-style-type: none"> ○ Welfare ○ Discourses and actions of groups • Science <ul style="list-style-type: none"> ○ Knowledge ○ Research activities ○ Training • Organisation <ul style="list-style-type: none"> ○ Planning ○ Work organization ○ Administration ○ Human Resources • Training <ul style="list-style-type: none"> ○ Curricula ○ Pedagogical tools ○ Qualifications ○ Graduates ○ Insertion into the job market ○ Fitness of training/work ○ Career ○ Use of acquired knowledge
Civil Society	<ul style="list-style-type: none"> • End users of all products and services • Dialogue activities 	
Outreach	<ul style="list-style-type: none"> • Awareness of the many opportunities e.g. <ul style="list-style-type: none"> ○ story-telling ○ study tours ○ awards • Innovative partnerships 	

Figure 2. An overview of the five key bottlenecks and action areas and their potentially related impact types.

As the results of a successful realisation of the bioeconomy to a large degree depend on meeting the expected impacts and benefits, they should ideally be described, communicated and planned for in a reverse order starting with “benefits” and ending with “inputs” following figure 3. This facilitates a more solid design of the assessment process and the evaluation activities along the value chain when executing from “inputs” and onwards to “benefits”.

		EXECUTION →						
VALUECHAIN		INPUTS	ACTIVITIES	OUTPUTS	EXCHANGES	OUTCOMES	IMPACTS	BENEFITS
		Assets, financial and human resources, communication, cooperation etc.	Research work, training, workshop, conference organizing, facility use, community and stakeholder engagement etc.	Discoveries, inventions, policy briefings, media, publications, citations, patents etc.	Engagement with end-users etc.	New/improved products, services, or processes etc.	Achieved improvements etc.	To society etc.
TARGET AREAS AND BOTTLENECKS	Bioeconomy Policies							
	Bio-Based Business							
	R&D and Innovation							
	Civil Society							
	Outreach							
		← PLANNING						

Figure 3. Execution and planning processes applying a value chain focusing on resources and results.

		EXECUTION →						
VALUE CHAIN		RESOURCES		RESULTS				
		INPUTS	ACTIVITIES	OUTPUTS	EXCHANGES	OUTCOMES	IMPACTS	BENEFITS
		Assets, financial and human resources, communication, cooperation etc.	Workshops, research, training, conference organizing, facility use, community and stakeholder engagement etc.	Findings, discoveries, inventions, policy briefings, media, publications, citations, patents etc.	Engagement with end-users etc.	New/improved products, services, or processes etc.	Achieved improvements etc.	To society etc.
	BIOECONOMY POLICIES	Financial and human resources for establishing crosssectoral/ national multi stakeholder networks on how best to address benefits of multi-sectorial dimensions in order to drive the bioeconomy forward.	Bench-marking workshops exchanging best practices	Recommendation and guidelines for documented best practices.	Engagement with end-users e.g. train-the-trainers on best practices and dialogue, interaction with end-users for best implementation of recommendations	Approved selection of new best practices of multi-sectorial dimensions and recommendations to be implemented	Coherent holistic policy and implementation of best practices and guidelines driving the bioeconomy forward	A sustainable production and consumption of renewable biological resources and their conversion into food and feed, biomaterials and bioenergy through efficient and innovative technologies offering significant opportunities for innovations, economic growth, jobs and investments in new value chains
		← PLANNING						

Figure 4. Example of execution and planning processes for Bioeconomy Policies applying a value chain focusing on resources and results.

4. Impact study

The importance of identifying relevant and appropriate types of impact is strongly supported by the Baltic Sea Region Bioeconomy Council (BSR-BC), the Nordic Council of Ministers, the Council of the Baltic Sea States (CBSS) and the European Strategy for the Baltic Sea Region (EUSBSR) and the many relevant stakeholders.

With the inputs from the Baltic Sea Region Bioeconomy Council (BSR-BC) coordinated by The Nordic Council of Ministers this impact study will identify which relevant quantitative and qualitative impact types and results that are necessary to address and unlock the key persistent bottlenecks for realising the bioeconomy in the Baltic Sea Region, thus facilitating the horizontal action “Sustainable Development and Bioeconomy” under the European Strategy for the Baltic Sea Region (EUSBSR) jointly with the Council of the Baltic Sea States (CBSS).

4.1. Stakeholder survey

During the spring 2016 a survey among the stakeholders in the Baltic Sea Region and its Bioeconomy Council (BSR-BC) was performed to have their opinion and suggestions on the relevance of the aforementioned impact types and their quantitative and qualitative nature in realising the bioeconomy in the Baltic Sea Region.

Out of 667 invited stakeholders for the survey, 32% or 213 persons responded to the survey and divided in two groups (figure 5 and 6) according to their whether they were responding as individual or on behalf an organization or institution etc.

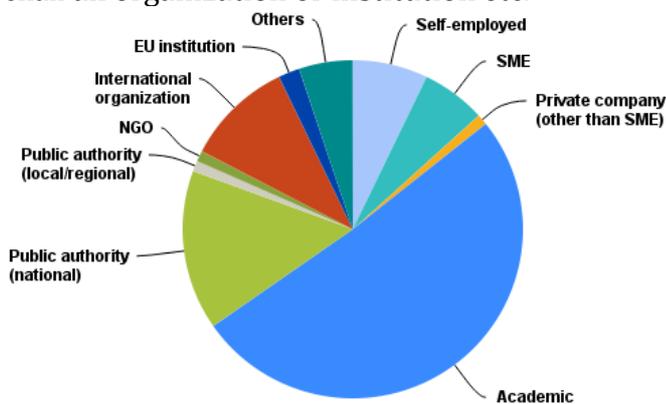


Figure. 5. The 46% who answered the survey as individual had the following distribution

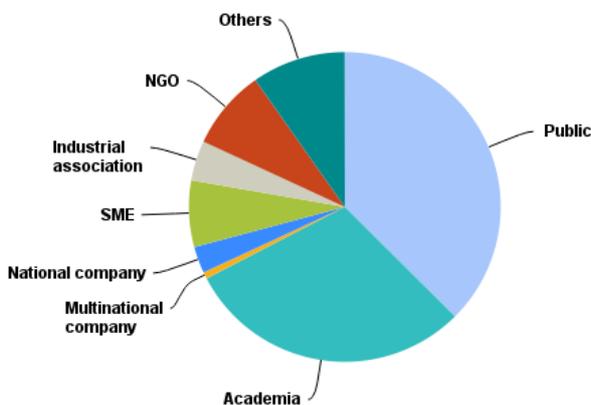


Figure. 6. The remaining 54% persons answered on behalf of an organization or institution etc.

Interestingly, as can be seen from figure 9. nearly half of the respondents or 42% saw themselves having most professional relevance to another sector than food and feed, bio-based non-food and bio-based energy.

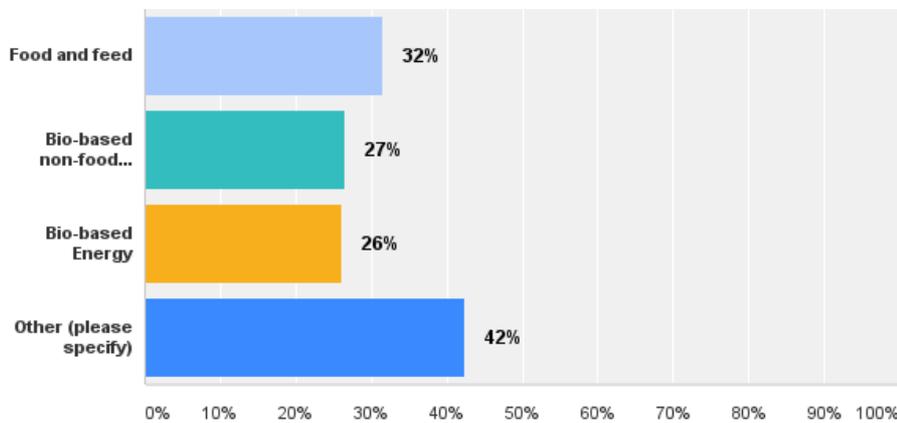


Figure 9. Respondents and sector relevance

4.2. Impact relevance to bottlenecks

As stated in the Working Paper no. 1 – The Baltic Sea Regional Bioeconomy Council, Finland and Germany have recently adopted holistic National Bioeconomy Strategies – implemented through inter-ministerial structures, and supported by national bioeconomy panels/councils¹¹.

Norway, Sweden and Iceland are currently drafting national bioeconomy strategies – and Estonia is currently planning the drafting of such a strategy.

Latvia is currently considering developing a bioeconomy strategy.

Denmark has a national bioeconomy panel/council but not a bioeconomy strategy. Rather the bioeconomy in Denmark is being pursued through broader policy frameworks for growth, innovation and environment.

Lithuania and Poland also have no national bioeconomy strategies. Here the bioeconomy is currently being pursued through sector policies for agriculture, fishery, forestry, regional development, environment and innovation. However, in Poland regional considerations for developing more local bioeconomy strategies may fuel policy development activities also at the national level.

It therefore seems obvious in the context of the identified BSR bottlenecks to look into the relevance of new and complementary impact types to help support the realising the bioeconomy in the BSR and the abovementioned countries' strategies.

In the survey the invitees were asked to consider the relevance of the impacts (Policy, Technology, Economy, Society, Science, Organisation, Training, Health, Environment, Symbolic, Culture) to each of the five bottlenecks by one of the following characteristics:

¹¹ http://bsrbioeconomy.net/resources/2016_docs/Working_Paper_1_BSR_Council.pdf

- Not at all relevant
- Slightly relevant
- Fairly relevant
- Relevant
- Very relevant

Adding to that, the respondents were asked about their opinions on the quantitative and/or qualitative nature of the impact.

4.2.1. Bioeconomy Policies - impact relevance and nature

As touched upon earlier the bioeconomy is complex and cuts across sectors. Therefore the bioeconomy does not fit neatly into one specific policy area. Instead it must be addressed through efforts in different policy areas. Some regions and countries in the Baltic Sea Region have already holistic bioeconomy policies and strategies in place. Others are on the way to developing such policies and strategies. Yet in other countries and regions the bioeconomy is being pursued through sector policies, such as within agriculture, fishery, forestry, regional development, environment, research and innovation. Realising the bioeconomy calls for regions and countries to move beyond silos and sector policies and towards holistic policies and incentives. Therefore one of the bottlenecks or target areas is Bioeconomy Policies.

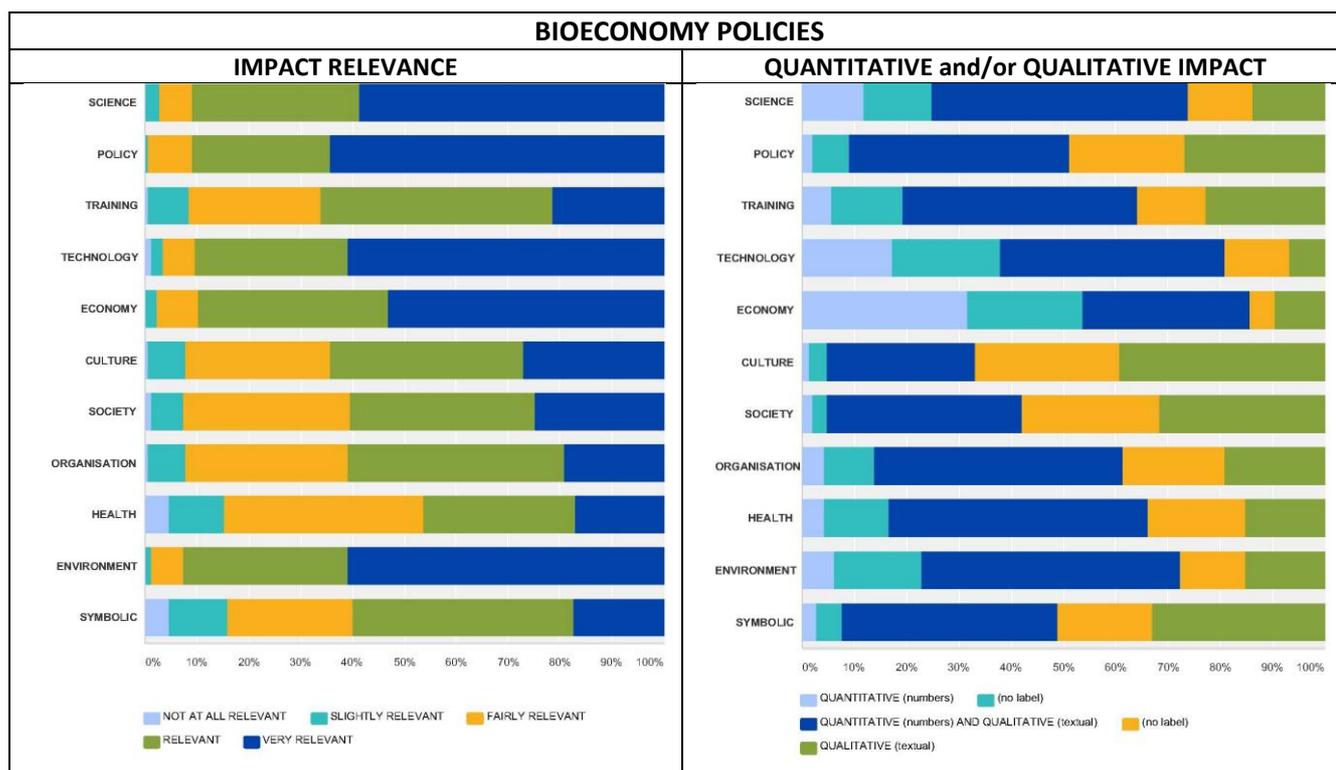


Figure 10. Respondents' rating of 11 impact types' relevance and quantitative and/or qualitative nature of the bottleneck and action area Bioeconomy Policies.

Observations:

In figure 10 the respondents rating of 11 impact types' relevance and quantitative and/or qualitative nature to the bottleneck and action area Bioeconomy Policies shows that the impacts **Environment, Policy, Technology, Science and Economy** in particular were considered to be **very relevant** to the bottleneck Bioeconomy Policies with more than a 50% share of the individual impact.

Interestingly, the “new” and less traditional impacts **Training, Culture, Society, Organisation and Symbolic** were considered **relevant** with more than 40% share of the individual impact.

Asked about the stakeholders’ opinions on the quantitative and/or qualitative nature of the impact the respondents found **Technology and Economy** to be a quantitative nature where as “softer” impacts like **Culture, Society and Symbolic** were found to be of a more qualitative nature. Except from **Economy and Culture** all the remaining impacts were in particular considered to be of a mixed quantitative/qualitative nature.

4.2.2. Bio-Based Business- impact relevance and nature

The bioeconomy essentially calls for new ways of producing and consuming biological resources. Efforts are therefore needed to engage the private sector more in the bioeconomy such as through private sector dialogue and cooperation on bioeconomy and circular economy business solutions; efforts within the area of biorefineries to generate new value chains; public procurement incentives; and smart specialisation and business matchmaking activities that promote cross-overs and cross-fertilisation between, for example, biotechnology, life science, cleantech and circular economy business clusters.

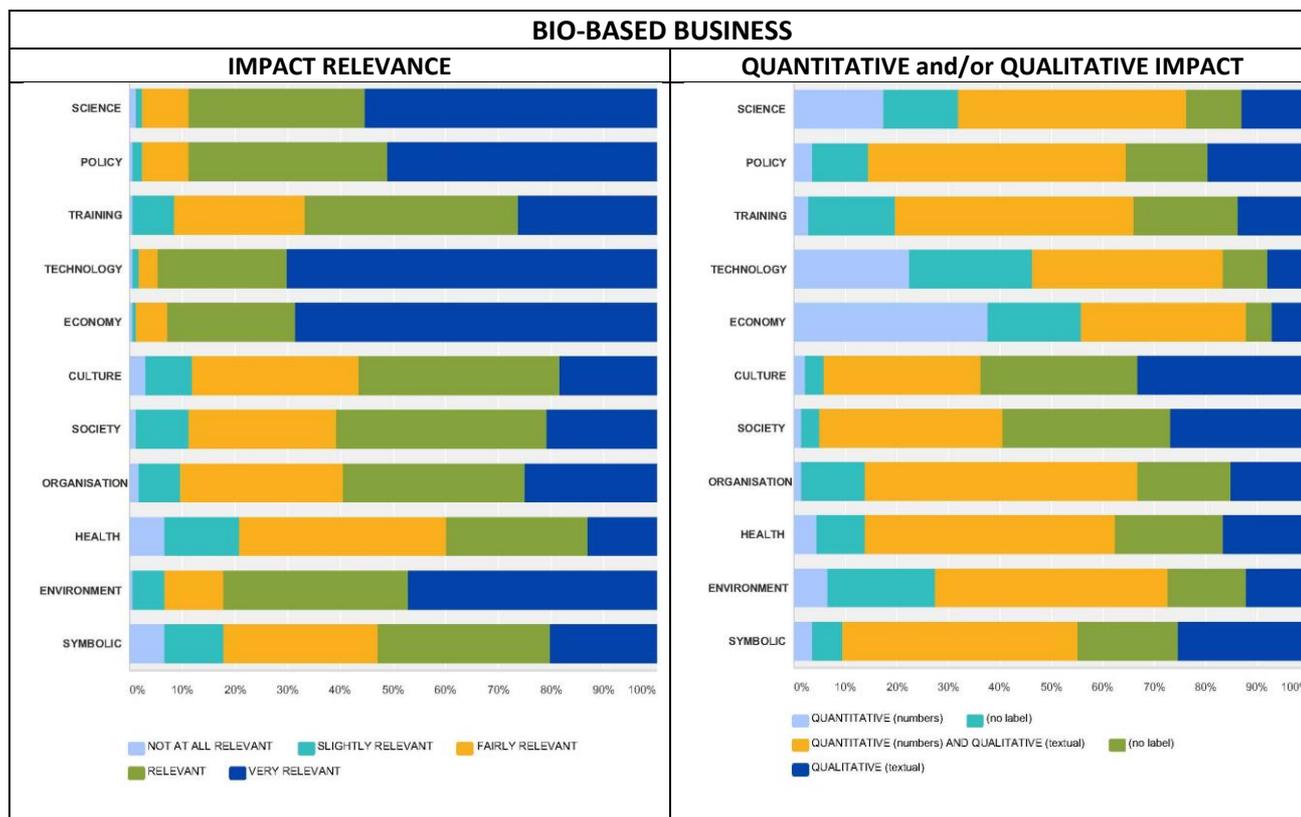


Figure 11. Respondents’ rating of 11 impact types’ relevance and quantitative and/or qualitative nature of the bottleneck and action area Bio-Based Business.

Observations:

In figure 11 the respondents’ rating of 11 impact types’ relevance and quantitative and/or qualitative nature to the bottleneck and action area Bio-Based Business shows that the impacts particular the impacts **Technology and Economy** were considered to be **very relevant** to the bottleneck Bio-Based Business with more than a 60% share of the individual impact. In this respect, **Science, Policy and Environment** came second with around 50%.

Interestingly, the “new” and less traditional impacts **Training, Culture, Society, Organisation and Symbolic** were considered **relevant** with an average 40% share of the individual impact.

As with Bioeconomy Policies, the stakeholders opinions on the quantitative and/or qualitative nature of the impact the respondents found **Technology and Economy** to be a quantitative nature where as “softer” impacts like **Culture, Society and Symbolic** were found to be of a more qualitative nature. Except from **Economy and Culture** all the remaining impacts were in particular considered to be of a mixed quantitative/qualitative nature.

4.2.3. R&D and Innovation - impact relevance and nature

The third bottleneck Research technology and innovation are key enablers to unlock the potential of the bioeconomy. There is a need for efforts that: improve the overview of leading knowledge and research institutions and their respective areas of excellence within the bioeconomy; investigate opportunities for smart specialisation through shared use of hard and soft test and demonstration infrastructures; fertilise the emergence of entirely new value chains resulting from new sector cross-overs; and encourage university-business linkages such as through macro-regional innovation consortia whereby companies and universities in the Baltic Sea Region collaborate to find bioeconomy solutions to business challenges by utilising and commercially activating university competences.

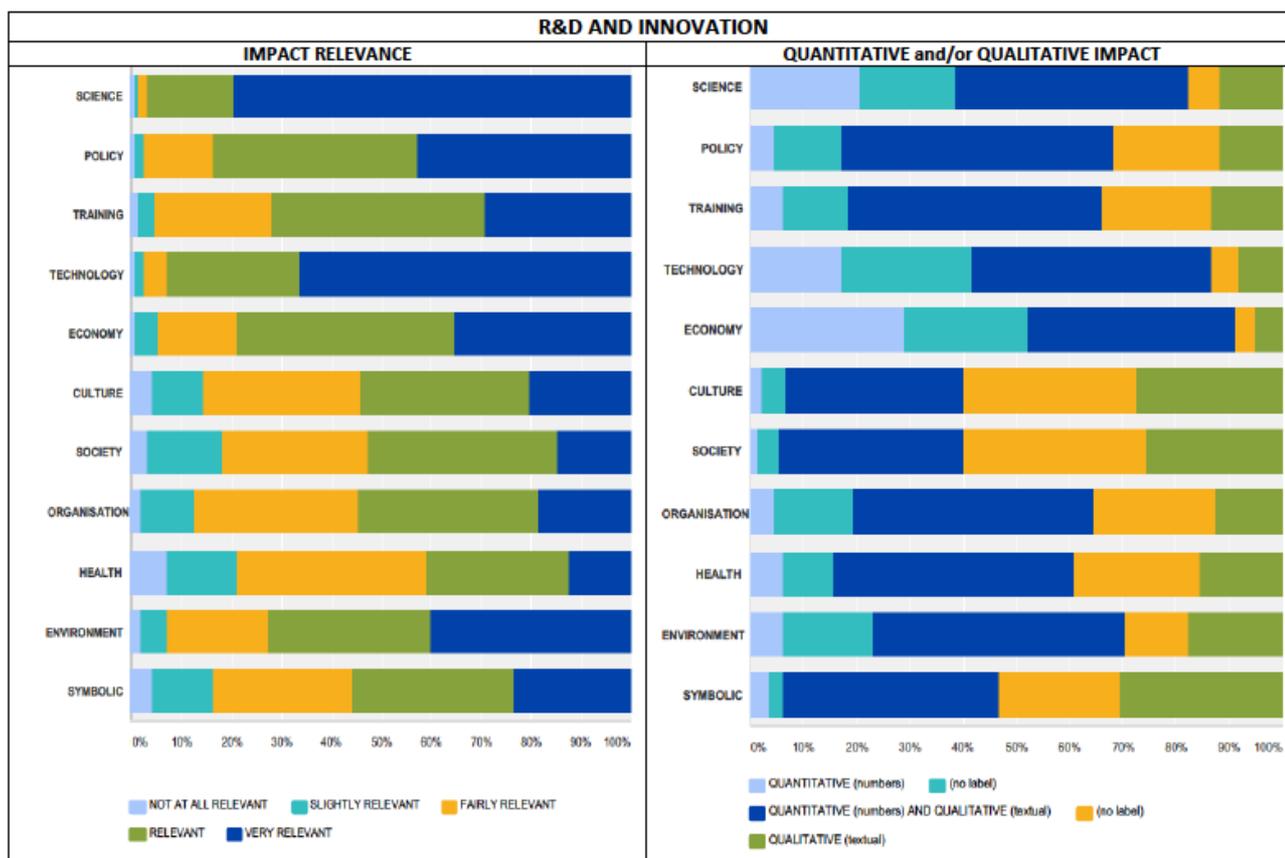


Figure 12. Respondents’ rating of 11 impact types’ relevance and quantitative and/or qualitative nature of the bottleneck and action area R&D and Innovation.

Observations:

In figure 12 the respondents rating of 11 impact types' relevance and quantitative and/or qualitative nature to the bottleneck and action area R&D and Innovation shows that the impacts **Science** and **Technology** were considered to be **very relevant** to the bottleneck **R&D and innovation** with 70-80% share of the individual impact. In this respect, **Policy and Environment** came second with around 40%.

Interestingly, the “new” and less traditional impacts **Policy, Training** and **Culture** but also **Economy** were considered **relevant** with an average 40% share of the individual impact.

For the R&D and Innovation impact, the stakeholders opinions on the quantitative and/or qualitative nature of the impact the respondents interestingly considered **Technology and Economy** to be of a mixed quantitative/qualitative nature. Whereas “softer” impacts like **Culture, Society and Symbolic** were found to be of a more qualitative nature. Except from **Science, Economy** and **Culture** all the remaining impacts were in particular considered to be of a mixed quantitative/qualitative nature.

4.2.4. Civil Society - impact relevance and nature

Civil Society is the fourth bottleneck. In essence civil societies – citizens – are the final consumers of all products and services, so any transition towards more sustainable consumption (and production) patterns goes hand-in-hand with the citizens of the Baltic Sea Region (literally) buying into the bioeconomy. Also, there is opportunity to engage with civil society as consumers through dialogue activities in connection with e.g. ‘People’s Meetings’ such as Almedalsveckan in Sweden, Folkemødet in Denmark, Arendal Week in Norway, Suomi Areena in Finland, and Arvamus festival in Estonia.

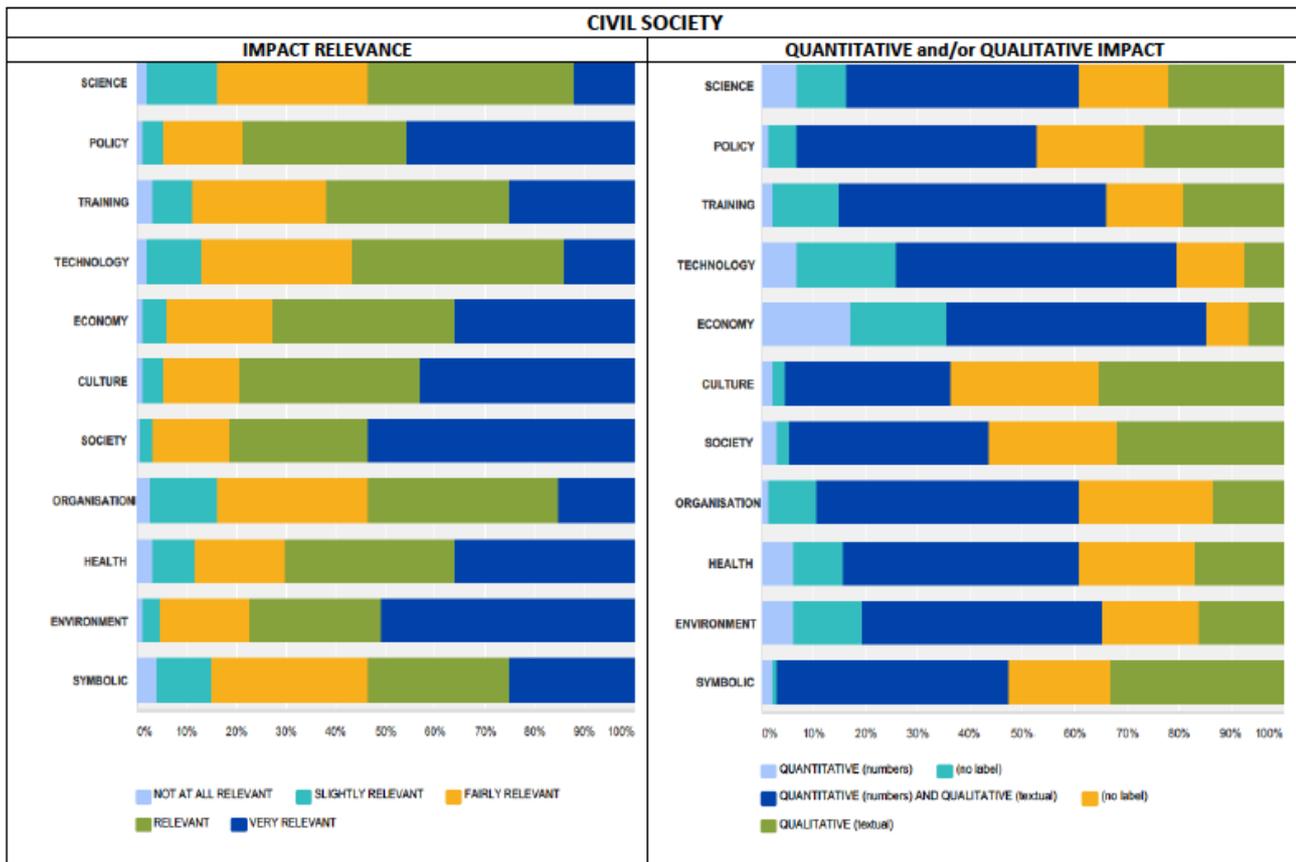


Figure 13. Respondents’ rating of 11 impact types’ relevance and quantitative and/or qualitative nature of the bottleneck and action area Civil Society.

Observations:

In figure 13 Respondents’ rating of 11 impact types’ relevance and quantitative and/or qualitative nature of the bottleneck and action area Civil Society shows that the impacts **Policy, Culture, Society** and **Environment** were considered to be **very relevant** to the bottleneck Civil Society with 50% share of the individual impact. In this respect, **Economy** and **Health** came second with around 40%.

Interestingly, the “new” and less traditional impacts like **Science, Training** and **Organisation** were considered to be **relevant** with an average 40% share of the individual impact.

For the R&D and Innovation impact, the stakeholders’ opinions on the quantitative and/or qualitative nature of the impact the respondents interestingly considered **Technology** and **Economy** to be of less quantitative nature as compared to the three former bottlenecks all the remaining impacts were in particular considered to be of a mixed quantitative/qualitative nature.

4.2.5. Outreach - impact relevance and nature

Outreach is the fifth bottleneck. A key bottleneck to accelerating the transition towards the bioeconomy relates to its complexity and the relative novelty of the policy, research and business area. There is a great need for increasing awareness of the many opportunities afforded by the bioeconomy, e.g. through: story-telling, such as through short films; study tours to showcase on site how the bioeconomy is actually and practically being pursued in the Baltic Sea Region; and awards to raise attention about radical new innovations, new innovative partnerships or novel ways to engage with society and consumers.

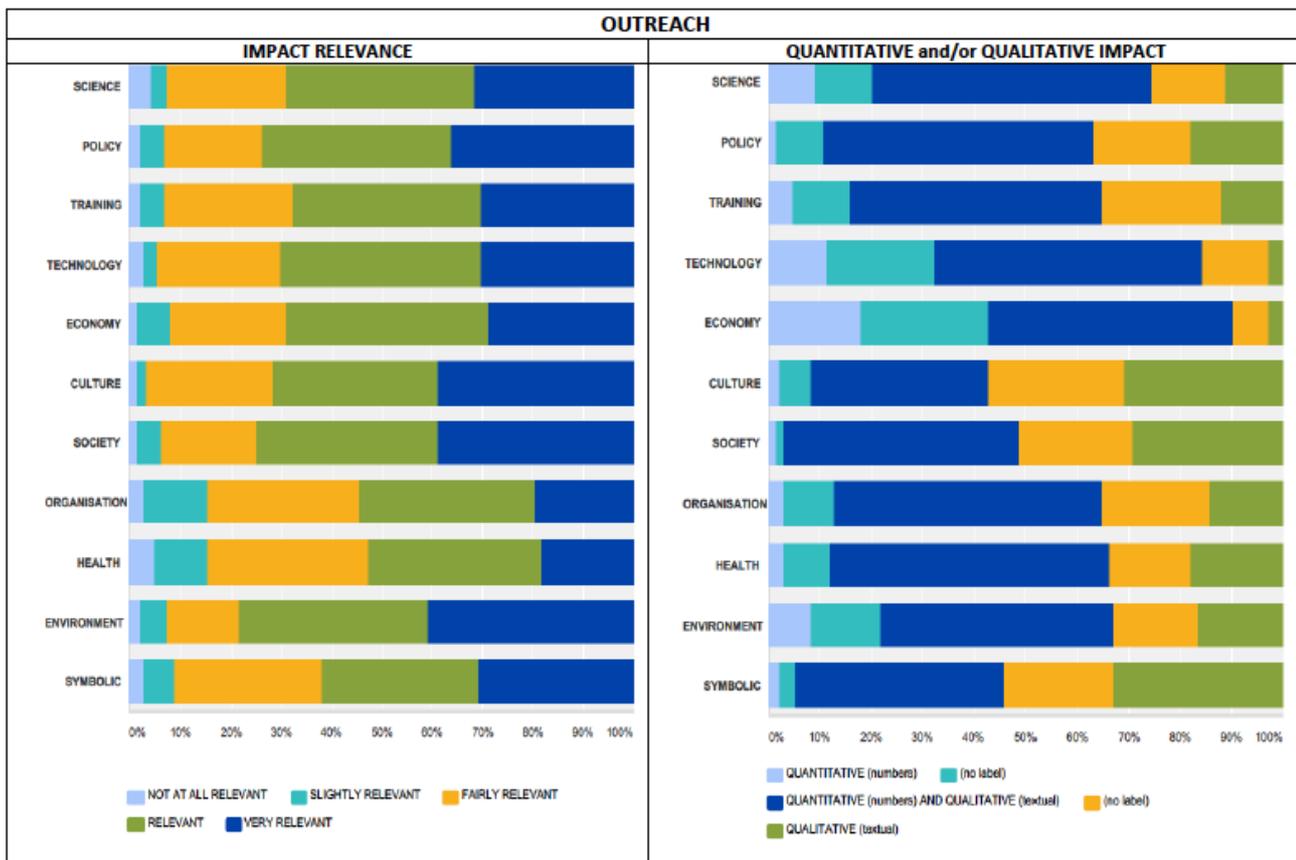


Figure 14. Respondents' rating of 11 impact types' relevance and quantitative and/or qualitative nature of the bottleneck and action area Outreach.

Observations:

In figure 14 Respondents' rating of 11 impact types' relevance and quantitative and/or qualitative nature of the bottleneck and action area Outreach shows that the impacts **Culture**, **Society** and **Environment** were considered to be **very relevant** to the bottleneck Outreach with 40% share of the individual impact. Interestingly there was quite a uniform distribution of around 40% among the rest of the very relevant impacts with Organisation and **Health at the lower end** with around 30%.

Concerning the distribution of **relevant** impacts there was an almost uniform percentage of 30%. For the Outreach impact, the stakeholders opinions on the quantitative and/or qualitative nature of the impact the respondents interestingly considered **Technology and Economy** to be of less quantitative nature as compared to the bottlenecks Bioeconomy Policies, Bio-Based Business and Civil Society. All the remaining impacts were in particular considered to be of a mixed quantitative/qualitative nature.

5. Conclusion

Taking stock of the observations lead to the following conclusions: The bottlenecks and action areas **R&D and innovation** and **Bio-Based Business** the impacts Science and Technology and Economy were highest rated on very relevant followed by Policy and Environment in the same category.

The respondents also found that for the actions **Bioeconomy Policies** an even wider range of impacts the impacts Environment, Policy, Technology, Science and Economy were considered to be very relevant with more than a 50% share of the individual impact.

The same percentage applies for **Civil Society** and the impacts **Policy, Culture, Society and Environment**. This was almost also the case for **Outreach** with 40% share of the individual impact.

Looking at the relevance of the 11 impacts across the five bottlenecks or action areas based on the total number of responses, it appears from figure 15 that the relevance falls into three major groups in the category “very relevant”.

1. **Science, Policy, Technology, Economy and Environment** with scores of 47%.
2. **Training, Culture, Society and Symbolic** with scores between 25%-30%.
3. **Organisation and Health** with scores of 20%.

That said, interestingly the impacts Organisation and Health have high over all scores in the categories “Relevant” and “Fairly relevant” with a total percentage of 68% and 63% respectively.

The general picture is therefore, that all 11 impact types are of relevance to the five action areas.

Concerning the respondents views on the quantitative and/or qualitative nature of the 11 impacts, the overall picture from figure 16 is that most respondents see all the impacts as predominantly being of a mixed quantitative and qualitative nature with 50% for the highest percentage for **Organisation** and closely followed by **Health, Science, Policy, Training and Technology**.

So even with **Economy** and **Technology** and to a certain extent **Science** which are traditionally being seen as quantifiable, it is however important to mention that they have a lower score for their quantifiable nature. Actually, they are rather seen as a mixture of a quantitative and qualitative nature. At the latter end of the spectrum, qualitative impacts, is also where we find a high score from the **Culture, Society and Symbolic** impacts. Thus, it is striking that all impacts are considered to be of a mixed quantitative/qualitative nature.

The conclusion is that 9 out 11 impacts are either very relevant or relevant to the 5 action areas, while the remaining 2 (**Health and Organisation**) also demonstrate high scores on relevance. Further, all impacts are found to be of a predominantly mixed quantitative/qualitative nature. This study has identified a broad range of highly relevant quantitative and qualitative impacts and their pathways that might be most appropriate addressing the key persistent bottlenecks for realising the bioeconomy in the BSR.

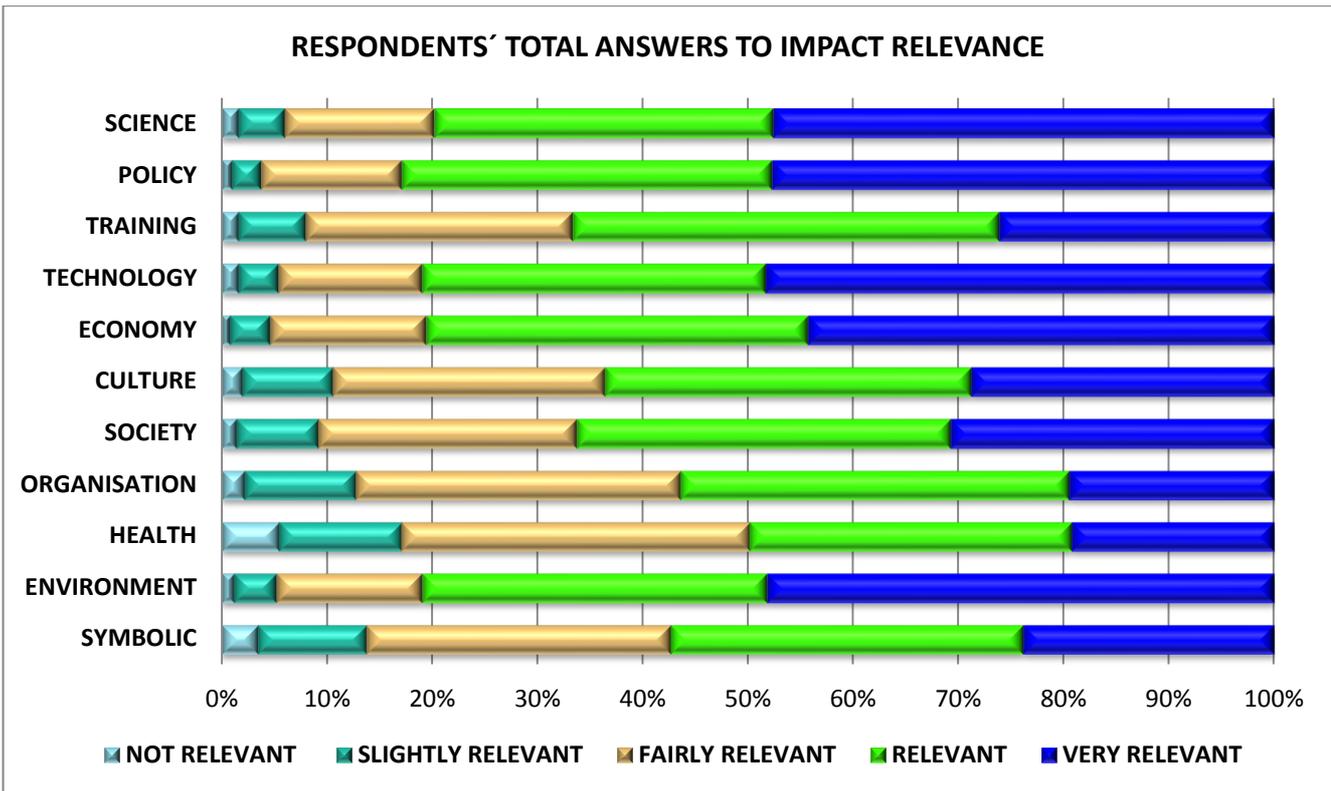


Figure 15. Respondents' total answers to the relevance of the 11 impact types.

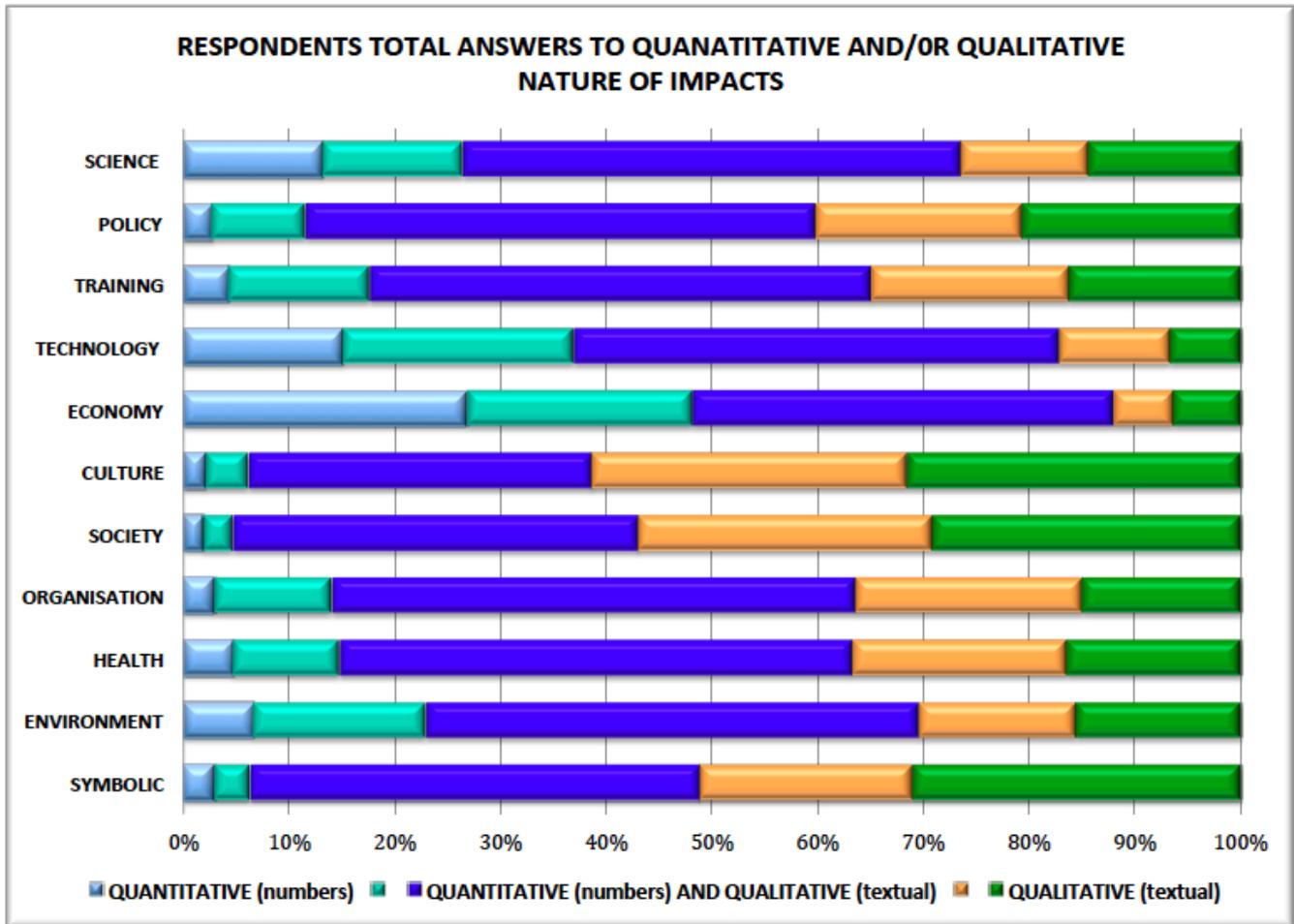


Figure 16. Respondents' total answers to quantitative and/or qualitative nature of impacts

6. Recommendations

This impact study, its survey and the conclusion offers great relevance for future work on the pathways to impact and their implementation within bioeconomy and other complex challenges that require a holistic and cross-cutting yet specific approach. Further, tools and methods are offered for execution, planning and evaluation purposes, and the allocation of the necessary resources for realising the bioeconomy in the Baltic Sea Region in order to achieve the expected results, impacts and benefits to society embedding a value chain.

The value of BSR cooperation on advancing the bioeconomy will be to increase efficiency in effort, not least ensuring results and impact. The key role of stakeholders within the quadruple helix (business, research, public administration and civil society/users) local, national and international should be to discuss, describe and implement the pathways leading towards concrete objectives, indicators, actions, results, impacts and ultimately to the benefits to society.

It is therefore recommended that the BSR-BC and NCM support the further developments of the impact tool and its associated indicators. To fully utilise the potential the knowledge exchange and the capacity building in this field should be promoted. These activities should also include RIS 3 – Regional Innovation Strategies for Smart Specialisation and partnerships and social innovation in this area, across the BSR interacting with other relevant instruments and programmes.