EUROPEAN COMMISSION / Research & Innovation / Food, Agriculture & Fisheries, & Biotechnology

Bio-based economy for Europe: state of play and future potential - Part 1

Report on the European Commission's Public on-line consultation

STUDIES AND REPORTS

EUROPEAN COMMISSION

Directorate-General for Research and Innovation
Directorate E - Biotechnologies, Agriculture and Food
Unit E.1 – Horizontal aspects

E-mail: RTD-BIO-ECONOMY@ec.europa.eu

European Commission
B-1049 Brussels
Tel. (32-2) 29-56872

EUROPEAN COMMISSION

Bio-based economy for Europe: state of play and future potential Part 1

Report on the European Commission's
Public on-line consultation

Open 17 February – 2 May 2011

Food,
Agriculture and Fisheries,
and Biotechnology
Knowledge-Based Bio-Economy **(KBBE)**

2011

Directorate-General for Research and Innovation
Food, Agriculture & Fisheries, & Biotechnology

EUROPE DIRECT is a service to help you find answers

to your questions about the European Union

Freephone number (*):

00 800 6 7 8 9 10 11

(*) Certain mobile telephone operators do not allow access to 00 800 numbers
or these calls may be billed

LEGAL NOTICE

Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use which might be made of the following information.

The views expressed in this publication are the sole responsibility of the author and do not necessarily reflect the views of the European Commission.

More information on the European Union is available on the Internet (http://europa.eu).

Cataloguing data can be found at the end of this publication.

Luxembourg: Publications Office of the European Union, 2011

ISBN 978-92-79-20652-8
doi 10.2777/67383

© European Union, 2011
Reproduction is authorised provided the source is acknowledged.

- **Data mining, graphic analysis and write-up by Dr. Felice Addeo, independent expert reviewer**
- **Special thanks go to the members of the Inter-service Group on the bio-based economy**

Contents

Executive summary 5

1. Structure of the report 9

2. Introduction 9

3. Results 11

3.1. Respondents' profile 11

3.1.1. Respondents answering as individuals 11

3.1.2. Respondents answering on behalf of an organisation or institution 12

3.1.3. Analysis of the whole sample 14

3.2. The European bio-based economy: potential benefits and risks 16

3.2.1. Potential benefits of the bio-based economy 16

3.2.2. Potential risks arising from an expansion of the European bio-based economy in the future 23

3.2.3. Need for further action to realise the full potential of the bio-based economy 30

3.2.4 Importance of European policy areas in terms of their potential/importance in building a sustainable bio-based economy 32

3.3. The European bio-based economy today 36

3.3.1. Perception of effectiveness of Research and Innovation in the European bio-based economy today 37

3.3.2. Barriers to a successful functioning of the European bio-based economy today 42

3.3.3. Participation of society and its acceptance of the European bio-based economy 47

3.4. A European strategy on a sustainable bio-based economy: advantages and possible future actions 51

3.4.1. Main advantages of the European strategy on a sustainable bio-based economy 52

3.4.2. Creating a coherent policy framework and fostering effective governance and coordination 57

3.4.3. Research actions for implementing the European bio-based economy 64

3.4.4. Actions to support the development of bio-based markets, economic growth and sustainable employment 68

3.4.5. Actions to better engage society and foster social innovation in the bio-based economy 74

4. A typology of attitudes towards the European bio-based economy.. 81

Executive summary

General information

- The online public consultation on 'Bio-based economy for Europe: state of play and future potential' was open from 22 February to 2 May 2011 ([1]). Two hundred and twenty-five replies were received by the deadline (197 were considered in the statistical analysis; 11 replies from the same respondent were excluded from the analysis; 17 respondents provided only general comments and did not answer the questionnaire).
- Organisations provided the majority of responses (69 %). Of the respondents, 31 % answered as 'individuals'. In terms of geographical distribution, respondents came from 22 EU Member States (no replies were received from Bulgaria, Cyprus, Lithuania, Malta or Slovakia) and, in a few cases, from associated and third countries (Brazil, Georgia, Norway, Switzerland, Turkey, Ukraine). Belgium (42 replies) was the most represented in this consultation, followed by Germany (23 replies), the Netherlands (17) and Italy (15).
- The private sector was the biggest contributor to this consultation (41.6 %) followed by academic sector (33.2 %).
- Respondents from Agriculture (22.2 %) were most active in the consultation, followed by Environment (13.2 %), Food and feed (12.9 %) and Industrial biotechnology (10.3 %).

Potential benefits of the bio-based economy

- Respondents share an optimistic vision of the potential benefits of the bio-based economy: more than 60 % (and often far more) of respondents think that each of the potential benefits suggested in the questionnaire can be achieved by 2020 or 2030. According to the vast majority of respondents (72.6 %), the reduction of waste and pollution is the potential benefit of bio-based economy that could be achieved in the short term (by 2020). There is also a strong consensus on the possible achievement in the short term of the provision of agricultural advisory services and/or knowledge transfer systems to farmers (66.0 %) and the increase in the use of bio-waste and other waste streams (64.0 %).

Potential risks from an expansion of the European bio-based economy in the future

- The majority of respondents agree that there are a number of important risks that need to be kept in mind when developing the bio-based economy. Major concern was expressed over the possible over-exploitation of natural resources and food security — in EU and third countries:
  - 'Food security and resources in developing countries put under pressure because of increased production for non-food use' (48.7 %);
  - 'Over-exploitation of natural resources and decreasing biodiversity' (43.1 %);
  - 'Increased deforestation due to food and non-food production' (31.0 %).

Need for further action to realise the full potential of the bio-based economy

- Overall, there is overwhelming support for the new European strategy and action plan to realise the full potential of the bio-based economy with actions taken at both EU and national/regional levels (81.7 %). In addition, 8.6 % of respondents suggest that the main focus should be on EU initiatives with 3.0 % thinking that the main focus should be on national initiatives.

([1]) http://ec.europa.eu/research/consultations/bioeconomy/consultation_en.htm

Rating of European policy areas in terms of their potential/importance in building a sustainable bio-based economy

- The most important policy areas in building the sustainable bio-based economy are Research and Innovation (92.4 %), Agriculture and rural development (85.8 %), Environmental (82.7 %), Energy (80.2 %) and Industry (71.1 %).
- The following are the views of different sectors concerning the most important areas:
  - Private: Industrial policy (81.7 %), Trade policy (54.9 %);
  - Public: Agriculture and rural development policy (92.9 %), Energy policy (89.3 %);
  - Academic: Research and Innovation policy (96.9 %), Health and consumer policy (64.6 %);
  - NGOs: Environment policy (95.5 %), Climate change policy (81.8 %), Maritime and fisheries policy (68.2 %).

Perception of effectiveness of Research and Innovation actions in the European bio-based economy today

- Major concern was expressed over the effectiveness of the current research and innovation actions. Only 27 % of all respondents think that research and innovation actions are effective both at EU and Member State levels. The view of nearly half of respondents, mostly from the Industrial biotechnology and Food and feed sectors, is that research and innovation actions are not sufficiently effective (47.9 %). Summing up, the most current insufficient/ineffective actions were considered to be:
  - ‘Providing a knowledge base for society expectations in the bio-based economy’ (41.6 %);
  - ‘Providing a knowledge base for addressing societal challenges faced by developing countries and emerging economies’ (41.1 %);
  - ‘Translating research into behavioural change’ (40.6 %).
- On the contrary, there is a good perception of the efficiency of the actions related to ‘Strengthening implementation of the European Research Area and improving coordination of national research programmes’ (34.0 %).

Barriers to a successful functioning of the European bio-based economy today

- Lack of policy coordination, foresight and finance are considered as the main barriers hindering the successful functioning of the bio-based economy today, including:
  - ‘Insufficient links between decision-makers and stakeholders from the bio-based economy sectors (e.g. Agriculture, Fisheries, Food, Non-food, Consumers)’ (75.6 %);
  - ‘Insufficient links between policies related to the bio-based economy’ (72.6 %);
  - ‘Lack of long-term horizon scanning/foresight and impact analysis in decision-making’
  - (69.0 %);
  - ‘Insufficient loans and/or venture capital for research/demonstration/technology development’ (62.4 %).
- Some barriers are perceived as less binding than others, such as:
  - ‘Lack of market and/or consumer demand for bio-based products’ (31.0 %);
  - ‘Current application of precautionary principle’ (28.4 %);
  - ‘Societal concerns/negative attitudes towards biotechnologies’ (27.4 %);
  - ‘Too much existing regulation’ (25.4 %).

Participation of society and the acceptance of the European bio-based economy

- Lack of general public information and understanding of the sustainable bio-based economy is seen as an important concern by respondents, especially in relation to benefits, costs and risks, ethical issues and the culture of sustainable consumption:
  - ‘Lack of tools for public dialogue on benefits, costs and risks of the bio-based economy’ (87.3 %);
  - ‘Lack of tools for addressing the ethical concerns of advanced technologies’ (81.2 %);
  - ‘Lack of education/incentives to encourage sustainable consumption patterns’ (80.7 %).

Main advantages of the European strategy on a sustainable bio-based economy

- The new European strategy on a sustainable bio-based economy received strong support in the public consultation: respondents perceive many advantages from its implementation, with the main advantages being ‘Strengthening the Research and Innovation base’ (63.5 %), ‘Securing a sufficient supply of food and biomass’ (56.9 %), ‘Supporting bio-based markets and the creation economic growth and high-skill jobs’ (52.8 %) and ‘Engaging with, and delivering benefits for, society (46.7 %)’.

Creating a coherent policy framework and fostering effective governance and coordination

- According to the vast majority of respondents (70 % or more), all the actions listed in the questionnaire need to be performed at both EU and national/regional levels. The actions most supported at both levels concern new actions on policy cooperation/coordination and financing:
  - ‘Foster interdisciplinary cooperation in the bio-based economy’ (86.8 %);
  - ‘Increase the level of Research and innovation funding’ (82.2 %);
  - ‘Strengthen links between existing funding instruments for the promotion of the bio-based economy’ (79.7 %).

Research actions for implementing the European bio-based economy

- There is wide agreement among respondents on the necessity of implementing intensively research actions to enforce the European bio-based economy, with the focus on:
  - ‘Industrial applications’ (78.2 %);
  - ‘Fostering industrial involvement in Research and Innovation projects’ (77.2 %);
  - ‘Securing a sufficient supply of food and biomass’ (76.6 %);
  - ‘The reduction of greenhouse gas emissions’ (76.1 %);
  - ‘Fostering the move towards a zero waste society’ (75.6 %);
  - ‘Integrated, sustainable agricultural, aquatic and ecosystem services’ (72.1 %).

Actions to support the development of bio-based markets, economic growth and sustainable employment

- There is a demand for actions at both EU and national/regional levels: ‘Improve access to finance for Research and Innovation’ is by far the action seen as the most necessary at both EU and national/regional levels (82.2 %), followed by ‘Propose incentives for industries trying to take innovative bioproducts to market’ (73.1 %) and ‘Further develop public procurement related to awareness-raising of bio-based products’ (70.1 %).

Actions to better engage society and foster social innovation in the bio-based economy

- Respondents are inclined to think that actions to better engage society and foster social innovation in the bio-based economy are necessary at both EU and national/regional levels. Most supported actions were:
  - ‘Enhance actions related to communication and dissemination of information on the advantages and risks of the bio-based economy’ (77.2 %);
  - ‘Improve information on bio-based products for consumers’ (70.6 %);
  - ‘Enhance actions to encourage healthier, sustainable consumption’ (70.1 %).

A typology of attitudes towards a European bio-based economy

- Finally, a typology of attitudes towards a European bio-based economy has been created in this report with the aid of multivariate techniques (a multiple correspondence analysis followed by a cluster analysis) and respondents were divided into those who strongly support the bio-based economy and see many benefits in the short term (68.5 %), those that support bio-based economy but see most of the benefits in the longer term (23.4 %) and sceptics (8.1 %).

1. Structure of the report

This report presents the statistical analysis and the content analysis of data collected with the help of the questionnaire published in relation to the public consultation 'Bio-based economy for Europe: state of play and future potential' (open 22 February to 2 May 2011 (http://ec.europa.eu/research/consultations/bioeconomy/consultation_en.htm). It provides a summary of views received from individuals, organisations and public authorities that could assist the Commission in shaping the strategy and action plan necessary to develop and promote a sustainable European bio-based economy.

Results are presented in tables and graphs and highlight the main trends in the overall opinion of respondents. Particular attention is paid to analysing how results may vary according to respondents' profile, sector and professional fields.

Three annexes accompany this report:

- Annex I includes the questionnaire used for the public consultation;
- Annex II lists all respondent's comments to open questions;
- Annex III presents general comments of respondents who chose not to provide their personal details and, therefore, were denied access to the questionnaire but were allowed to leave general comments.

2. Introduction

The open consultation was launched to support the preparation of a new strategy and action plan for the European bio-based economy by 2020. It was designed to collect the views of stakeholders active in the field and of public at large on the benefits, risks and concerns and potential of the bio-based economy today and in the future. It further sought to gather their opinions on future directions for governance, Research and Innovation actions, actions in relation to the promotion of bio-based industries and the involvement of the public.

The instrument used for the public consultation was a questionnaire designed with assistance of the Inter-Service Group (ISG) on a bio-based economy. The online version of the questionnaire was prepared using the Internet-based software package IPM (Interactive Policy Making), an Internet-based software package aimed at the creation, launch and analysis of replies of online questionnaires. The questionnaire was accompanied by the Specific Privacy Statement and a statement on the protection of personal data.

The public consultation was open for contributions between 17 February and 2 May 2011. Awareness about the opening of this consultation was raised through a number of sources, including the Directorate-Generals involved in the Inter-Service Group, Programme Committee, Advisory Group and National Contact Points.
All contributions received through this online questionnaire during the indicated period were analysed and used to generate the information found in this report.

The main topics addressed in the public consultation are shown in the concept map (Figure 1) ([2]).

([2]) A concept map is general sketch (or scheme) of the research; it could be seen as a way of representing relations among research concepts/dimensions. Specifically, it is a taxonomic diagram where each concept is connected to another and linked back to the original idea. Concept maps are a way to develop logical thinking and enhance meaningful learning in the sciences. Operationally, they are useful to identify measurable concepts (Marradi, 2007, pp. 203–204). A similar procedure of concept mapping is widely used in education as an informal process whereby an individual draws a picture of all the ideas related to some general theme or question, showing how these are related (Novak, Gowin, 1997; Novak, 1998; Jackson, Trochim, 2002).

Figure 1: Concept map of public consultation

As shown in Figure 1, the public consultation and, therefore, the analysis of the results presented in this report is made up of four main dimensions:

- *Respondents' profile*: information about respondents according to their type of profile to the consultation (individuals or on behalf of an organisation or institution), such as occupation, organisation sector, professional field, residence, workplace;
- *Evaluation* of a bio-based economy's potential benefits and risks perceived; rating the importance and the potential of the European policy areas in building a sustainable bio-based economy;
- *State of play:* how a bio-based economy is perceived today in Europe and what are the achievements to date in relation to Research and Innovation, governance and coordination and involvement of the society (availability of information tools and debate);
- *Future potential:* considerations about what policy interventions and actions are most suitable for developing a favourable ground for a sustainable bio-based economy in Europe; specifically, this part covers issues such as the advantages of a new European bio-based economy strategy; creation of a strong policy framework; actions to support economic growth of the bio-based economy; actions to engage society and to promote social innovation in the bio-based economy.

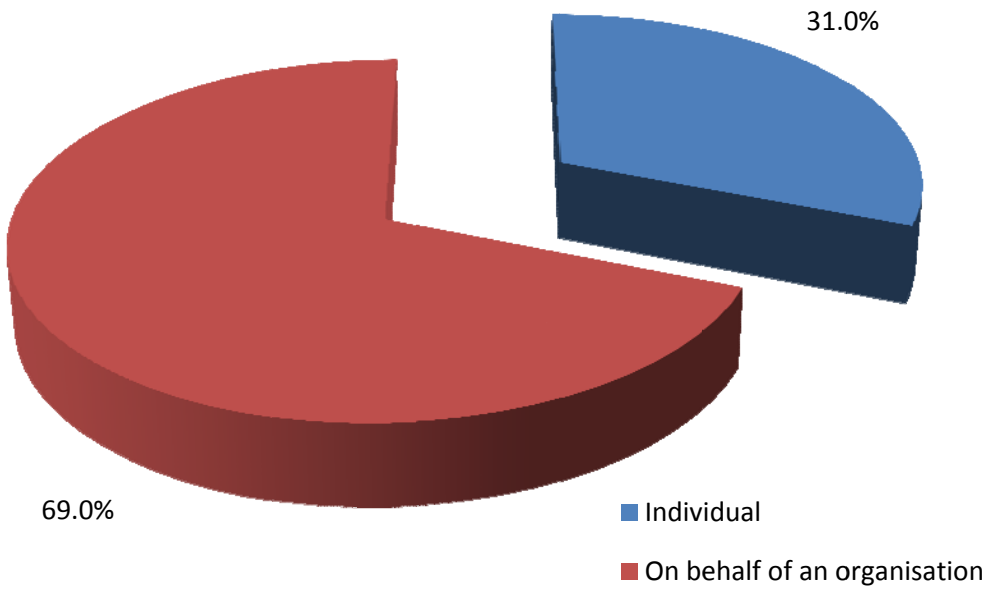
3. Results

3.1. Respondents' profile

The online public consultation on the 'Bio-based economy for Europe: state of play and future potential' was open from 22 February to 2 May 2011 ([3]). Two hundred and twenty-five replies were received by the deadline (197 were considered in the statistical analysis; 11 replies from the same respondent were excluded from the analysis; 17 respondents provided only general comments and did not answer the questionnaire).

In the first chapter, descriptive statistics of variables belonging to the respondents' profile are reported. Figure 2 presents the distribution of respondents who answered as 'Individuals' (31.0 %) and 'On behalf of an organisation or institution' (69.0 %).

Figure 2: Answers to question: "Are you answering as an individual or on behalf of an organisation or institution? (n = 197)"



In next three sections, the profile of respondents answering as 'Individuals' and 'On behalf of an organisation or institution' will be first analysed separately and then together.

3.1.1. Respondents answering as individuals

Sixty-one respondents replied as individuals. The majority of respondents answering as individuals worked for a research organisation or an academic institution (55.7 %); other respondents are almost equally divided among SMEs (9.8 %), public authorities at national level (9.8 %) and private companies other than SMEs (8.2 %).

Table 1: Answers to question: "If you are responding as an individual:"

([3]) http://ec.europa.eu/research/consultations/bioeconomy/consultation_en.htm

	Frequency	%
I work as a researcher/in a research organisation/academic	34	55.7
I work for an SME	6	9.8
I work for a public authority (national level)	6	9.8
I work for a private company (other than SME)	5	8.2
I am self-employed	3	4.9
I work for an NGO (other than consumer organisation)	3	4.9
I work for a public authority (local/regional level)	1	1.6
I work for an international organisation (e.g. UN, OECD)	1	1.6
Other	2	3.3
Total	61	100.0

Respondents were also asked to report their professional field. As they were allowed to provide up to two answers, in the analysis, their responses have been coded and treated as a multi-response variable ([4]).

As shown in Table 2, individuals came mainly from the agricultural field (27.2 %). The other most represented fields are: Environment (17.4 %), Food and feed (10.9 %) and Industrial biotechnology (9.8 %).

Table 2: The main professional fields of respondents answering as individuals (multi-response)

Professional field	Frequency	Case (%)	Responses (%)
Agriculture	25	41.0	27.2
Environment	16	26.2	17.4
Food and feed	10	16.4	10.9
Industrial biotechnology	9	14.8	9.8
Socioeconomics	7	11.5	7.6
Health	6	9.8	6.5
Energy and biofuels	3	4.9	3.3
Forestry	3	4.9	3.3
Chemicals	2	3.3	2.2
Fisheries and aquaculture	2	3.3	2.2
Transport	1	1.6	1.1
Other (non-pharmaceutical) biotechnologies	1	1.6	1.1
Other	7	11.5	7.6
Total	61	100.0	100.0

3.1.2. Respondents answering on behalf of an organisation or institution

The distribution of respondents answering on behalf of an organisation or institution appears more balanced than for individual replies (Table 3): 19.9 % of respondents represented an academic or research organisation; 16.2 % came from an industrial association or a chamber of commerce; 15.4 % work for a small or medium-sized enterprise and 13.2 % were from public authorities/administrations. There were fewer respondents from NGOs (11.8 %) and trans-European private companies (8.1 %).

([4]) Multi-response coding is necessary when the operational definition of a variable allows respondents to choose more than one answer to a single question. Hence, you have a multi-response variable. The distribution of a multi-response variable could show three different kinds of information: frequency (how many respondents choose each modality); % of cases (percentage of the respondents that choose each modality) and % of responses (percentage of the total number of responses contained in each category).

Table 3: Answers to question: "If you are responding on behalf of an organisation or institution:"

	Frequency	%
I represent an academic/research organisation or association of academic/research organisations	27	19.9
I represent an industrial association or a chamber of commerce (national/regional/local)	22	16.2
I represent a small or medium-sized enterprise (SME)	21	15.4
I represent a public authority/public administration	18	13.2
I represent an NGO/association of NGOs (excluding consumer association)	16	11.8
I represent a multinational or a trans-European private company	11	8.1
I represent a national private company (excluding SMEs)	1	0.7
I represent the retail sector	1	0.7
I represent a consumer association	1	0.7
Other	18	13.2
Total	136	100.0

The distribution of professional fields broadly mirrors that from respondents answering as individuals (Table 4): the most frequent professional field is Agriculture (20.0 %), followed by Food and feed (13.8 %), Environment (11.4 %), Industrial biotechnology (10.5 %) and Energy and biofuels (10.0 %).

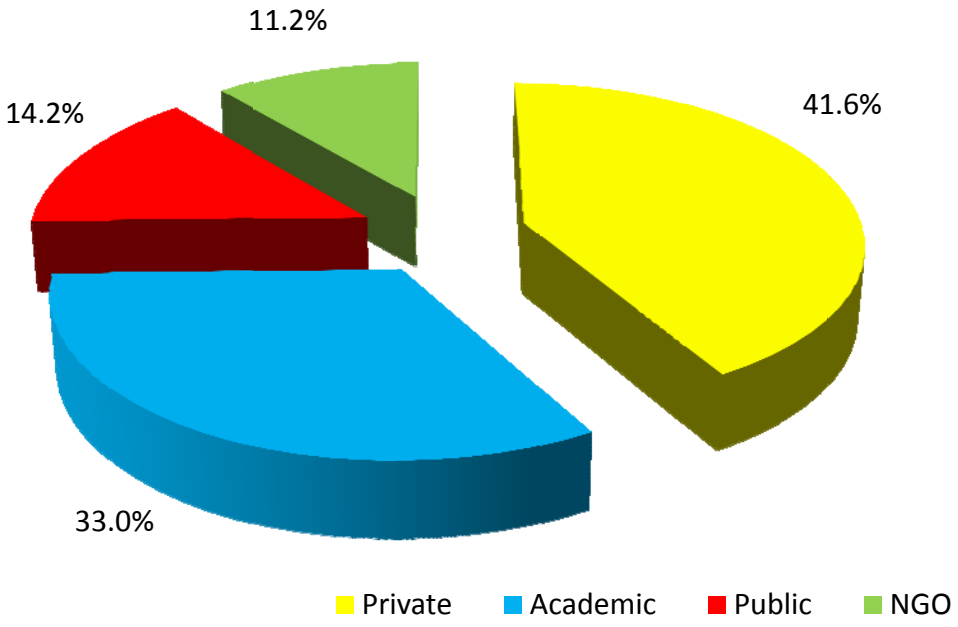
Table 4: The main professional fields of respondents answering on behalf of an organisation or institution (multi-response)

Professional field	Frequency	Case (%)	Responses (%)
Agriculture	42	30.9	20.0
Food and feed	29	21.3	13.8
Environment	24	17.6	11.4
Industrial biotechnology	22	16.2	10.5
Energy and biofuels	21	15.4	10.0
Forestry	18	13.2	8.6
Chemicals	12	8.8	5.7
Socioeconomics	10	7.4	4.8
Fisheries and aquaculture	7	5.1	3.3
Health	6	4.4	2.9
Transport	3	2.2	1.4
Other (non-pharmaceutical) biotechnologies	5	3.7	2.4
Other	11	8.1	5.2
Total	136	100.0	100.0

3.1.3. Analysis of the whole sample

As shown in the Figure 3, respondents (both individual responses and on behalf of organisations) came mainly from the Private (41.6 %) and Academic sector (33.2 %); followed by the Public sector and NGOs (respectively, 14.3 % and 11.2 %) ([5]).

Figure 3: Sector of the organisation in which the respondents worked (n = 197)



Agriculture is by far most represented professional field (22.2 %), followed by Environment (13.2 %), Food and feed (12.9 %) and Industrial biotechnology (10.3 %); respondents from other fields account for less than 10 % each (Table 5).

Table 5: The professional fields of respondents (whole sample)

Professional field	Frequency	Cases (%)	Responses
Agriculture	67	34.0	22.2
Environment	40	20.3	13.2
Food and feed	39	19.8	12.9
Industrial biotechnology	31	15.7	10.3
Energy and biofuels	24	12.2	7.9
Forestry	21	10.7	7.0
Socioeconomics	17	8.6	5.6
Chemicals	14	7.1	4.6
Health	12	6.1	4.0
Fisheries and aquaculture	9	4.6	3.0
Transport	4	2.0	1.3
Other (non-pharmaceutical) biotechnologies	6	3.0	2.0
Other	18	9.1	6.0
Total (n = 197; responses= 302)	302	100.0	100.0

([5]) To simplify the analysis, the sector in which respondents work is presented as one of four categories; private; academic, public or NGO.

In terms of geographical distribution, respondents came from 22 EU Member States (no replies were received from Bulgaria, Cyprus, Lithuania, Malta or Slovakia) and, in few cases, from associated and third countries (Brazil, Georgia, Norway, Switzerland, Turkey, Ukraine) ([6]).

Belgium (42 replies) is the most represented in this consultation, followed by Germany (23 replies), the Netherlands (17) and Italy (15).

Table 6: Geographical contributions

Country	Number of replies
Belgium	42
Germany	23
Netherlands	18
Italy	17
United Kingdom	15
Spain	12
France	12
Portugal	9
Sweden	8
Poland	6
Finland	6
Romania	2
Hungary	2
Greece	2
Estonia	2
Denmark	2
Czech Republic	2
Austria	2
Slovenia	1
Luxembourg	1
Latvia	1
Ireland	1
Other	11
Total	197

([6]) As there were no respondents from Bulgaria, Cyprus, Lithuania, Malta or Slovakia, these countries are not shown in the table.

3.2. The European bio-based economy: potential benefits and risks

Section 2 of the questionnaire included questions on the potential role of the European bio-based economy in the future. This section of the questionnaire contained four questions concerning the need for further actions, potential benefits of the bio-based economy, its potential risks and the importance of different European policy areas in building a sustainable bio-based economy.

3.2.1. Potential benefits of the bio-based economy

The first question of this section comprised 20 items referring to the potential benefits of the bio-based economy in the future (the full list and results are presented in Table 7). Respondents were asked to indicate what the potential benefits were and when they could reasonably be achieved (short term by 2020, medium term by 2030 or long term by 2050).

Overall, most of respondents agree that all benefits listed in the question could be achieved in the short/medium or long term (most doubts were cast on 'Sustainably increase production in, and market share of, aquaculture', only 18.8 % of 'Benefits in the short term' answers).

According to the vast majority of respondents (72.6 %), the reduction of waste and pollution is the potential benefit of bio-based economy that could be achieved in the short term (Figure 4). There is also a strong consensus on the potential benefits in the short term for the provision of agricultural advisory services and/or knowledge transfer systems to farmers (66.0 %) and an increase in the uses of bio-waste and other waste streams (64.0 %).

Other potential benefits receiving more than 50 % of 'Benefits in the short term' answers are:

- 'Support new bio-based industries and the greening of traditional industries' (56.9 %);
- 'Promote a shift to sustainable consumption and the reduction of waste in society' (52.8 %);
- 'Create sustainable growth and jobs in the bio-based economy' (52.3 %);
- 'Reinforce European leadership in the bio-based sciences' (50.5 %).

Respondents believe that the following benefits can be achieved but only in the medium term (by 2030):

- 'Provide adequate biomass supply chains' (50.8 %);
- 'Sustainably increase production in, and market share of, aquaculture' (42.6 %);
- 'Contribute to food and non-food security through sustainable practices in developing countries' (37.1 %);
- 'Improve the efficiency of ecosystem services' (37.1 %).

Even if 'short term' is always their modal category ([7]), the distribution of the remaining items (such as 'Reduce the pressures on natural resources', 'Contribute to meeting global commitments and goals') are interesting because the percentages of 'Long term' and 'Not relevant = never' total more than 15 %. This means that respondents appear slightly more dubious about the achievement of these benefits compared to the others discussed before.

The items with the highest percentage of 'Not relevant' answers are: 'Provide tangible consumer benefits from modern biotechnological products' (12.2 %) and 'Improve the supply of European sourced biofuels' (11.2 %).

The potential benefit receiving by far the greatest percentage of 'No opinion' answers is 'Sustainably increase production in, and market share of, aquaculture' (21.3 %).

([7]) 'Modal category' or 'Mode' is the most frequent response in a distribution of answers.

In general, ‘No opinion’ received at least 10 % of responses in four items:

- ‘Sustainably increase production in, and market share of aquaculture’ (21.3 %);
- ‘Improve the efficiency of ecosystem services’ (14.2 %);
- ‘Provide agricultural advisory services and/or knowledge transfer systems to farmers’ (12.7 %);
- ‘Promote a shift to healthy diets in society’ (12.2 %).

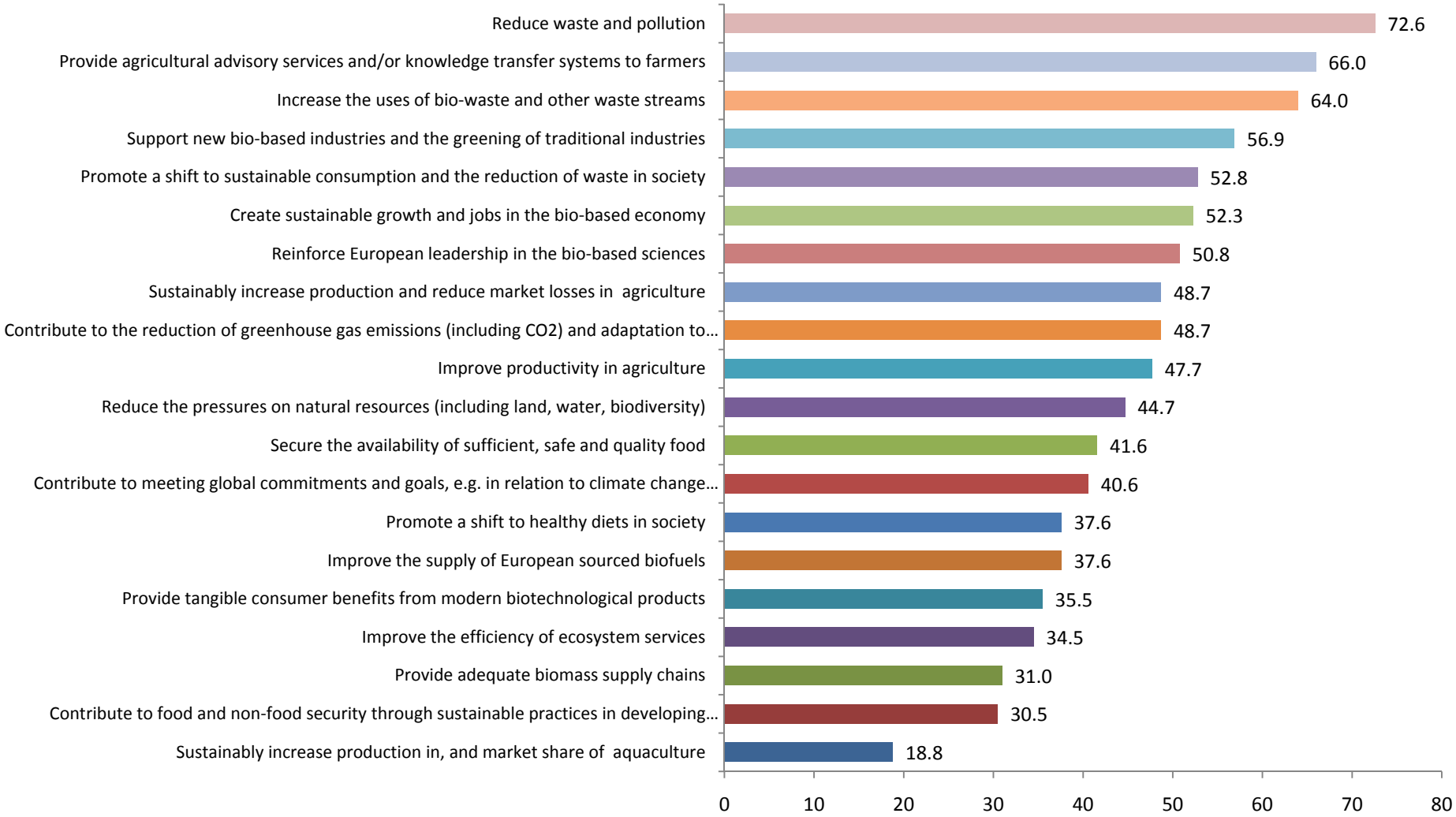
This could mean that some respondents might not have the necessary knowledge to answer the question or they don’t see those specific potential benefits achieved within the bio-based economy.

Generally speaking, respondents share an optimistic vision of the potential benefits of the bio-based economy: each suggested benefit received more than 60 % (and often far more) of the replies that that particular potential benefit to the bio-based economy can be achieved by at least 2030 (totalling the percentage of replies that agree on the ‘Benefits in the short term’ and ‘Benefits in the medium term’).

Table 7: Answers to question: "What are the potential benefits of the bio-based economy and when might they be achieved?"

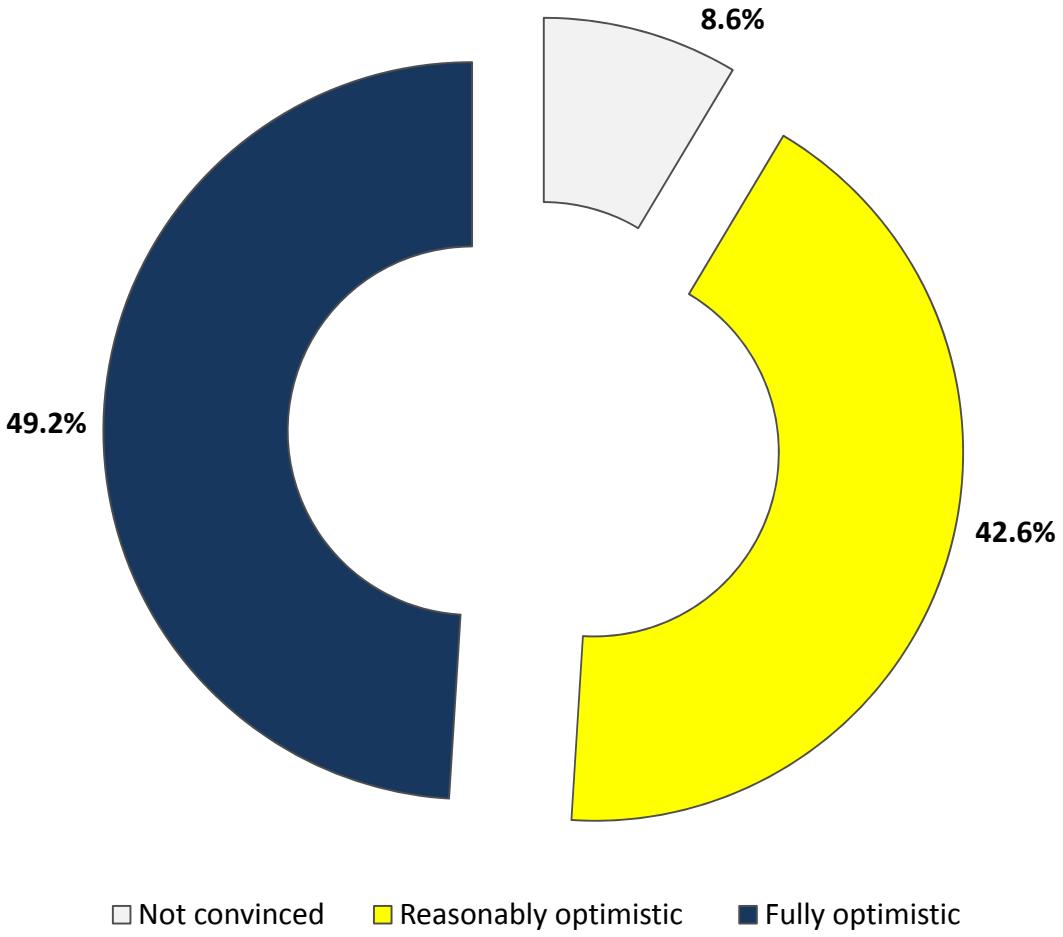
Potential benefit	In the short term (by 2020) (%)	In the medium term (by 2030) (%)	In the long term (by 2050) (%)	Not relevant (%)	No opinion (%)	Total (%)
Secure the availability of sufficient, safe and quality food	41.6	31.5	10.7	7.1	9.1	100.0
Contribute to food and non-food security through sustainable practices in developing countries	30.5	37.1	19.3	4.6	8.6	100.0
Reduce the pressures on natural resources (including land, water, biodiversity)	44.7	37.1	11.7	3.6	3.0	100.0
Support new bio-based industries and the greening of traditional industries	56.9	32.5	5.1	1.5	4.1	100.0
Reduce waste and pollution	72.6	21.8	2.0	2.0	1.5	100.0
Increase the uses of bio-waste and other waste streams	64.0	26.4	3.6	3.0	3.0	100.0
Improve the supply of European sourced biofuels	37.6	32.0	12.2	11.2	7.1	100.0
Contribute to the reduction of greenhouse gas emissions (including CO_2) and adaptation to climate change	48.7	34.0	10.7	4.6	2.0	100.0
Improve the efficiency of ecosystem services	34.5	37.1	10.2	4.1	14.2	100.0
Provide adequate biomass supply chains	31.0	50.8	8.1	4.6	5.6	100.0
Improve productivity in agriculture	47.7	34.5	3.0	6.6	8.1	100.0
Provide agricultural advisory services and/or knowledge transfer systems to farmers	66.0	15.7	2.0	3.6	12.7	100.0
Sustainably increase production and reduce market losses in agriculture	48.7	32.0	5.1	4.1	10.2	100.0
Sustainably increase production in, and market share of, aquaculture	18.8	42.6	9.1	8.1	21.3	100.0
Promote a shift to healthy diets in society	37.6	33.5	8.1	8.6	12.2	100.0
Promote a shift to sustainable consumption and the reduction of waste in society	52.8	33.5	8.6	1.5	3.6	100.0
Provide tangible consumer benefits from modern biotechnological products	35.5	34.5	11.2	12.2	6.6	100.0
Reinforce European leadership in the bio-based sciences	50.8	30.5	7.6	6.1	5.1	100.0
Create sustainable growth and jobs in the bio-based economy	52.3	38.1	4.6	3.6	1.5	100.0
Contribute to meeting global commitments and goals, for example in relation to climate change and the Millennium Development Goals	40.6	36.0	14.7	5.6	3.0	100.0

Figure 4: Potential benefits of the bio-based economy achievable in the short term (% of 'In the short term (by 2020)')



In order to synthesise all the information into in a single variable, an index combining respondents' answers was created. This index was named 'Attitude towards potential benefits of the bio-based economy' and it has three modalities: 'Fully optimistic' (most benefits achieved in the short and medium term), 'Reasonably optimistic' (most benefits achieved but only in the long term) and 'Not convinced' (benefits cannot be achieved in the suggested time frame or 'No opinion') (Figure 5).

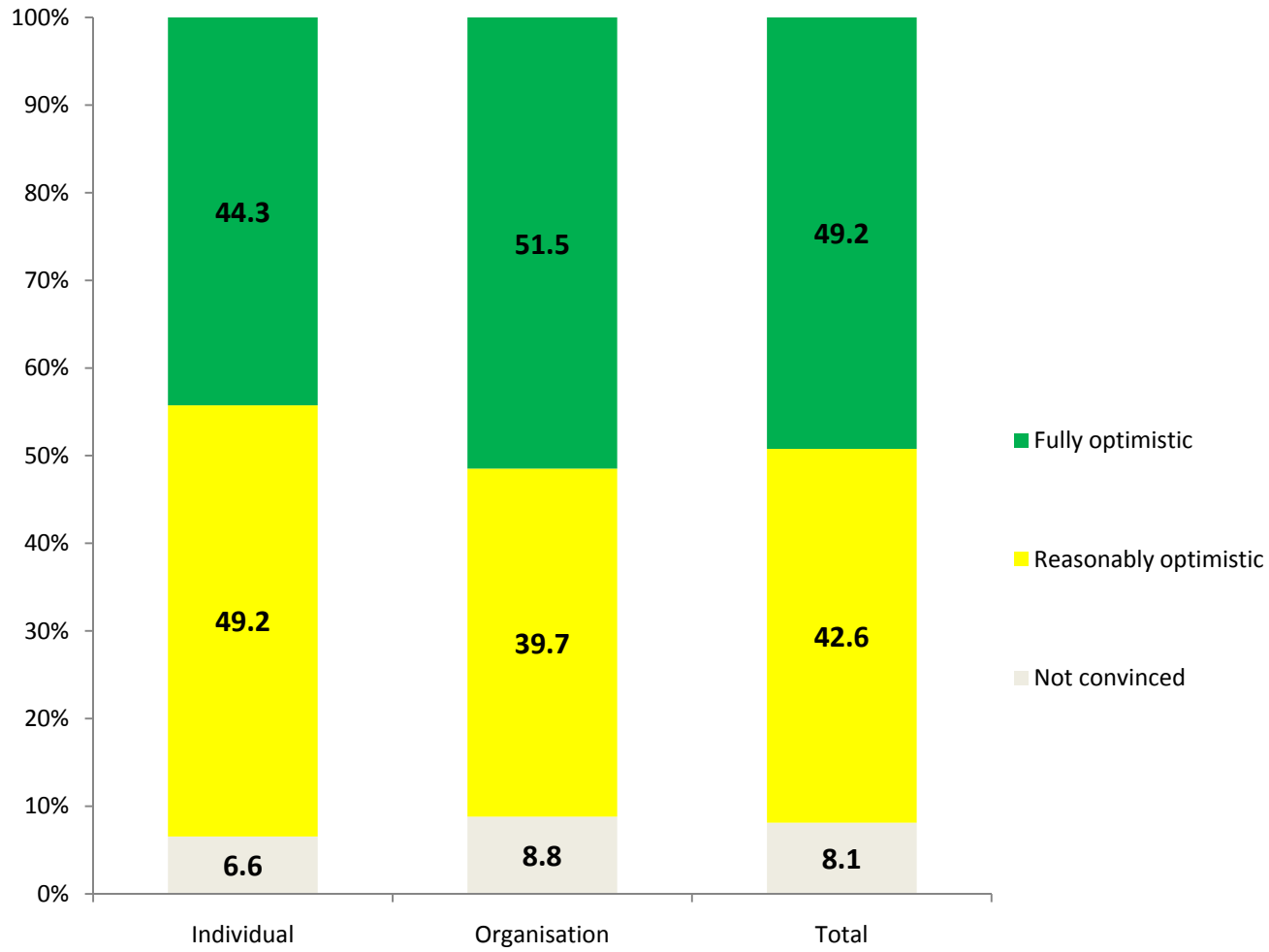
Figure 5: Attitude towards potential benefits of the bio-based economy (n = 197)



Respondents are broadly divided between a fully optimistic attitude and a reasonably optimistic one, with the former overcoming the latter (49.2 % fully v 42.6 % reasonably). A 'Not convinced' attitude was only assumed by 8.6 % of respondents. This result enforces what has been said before: the majority believes that the bio-based economy offers many benefits in the future and that many of those benefits can be achieved in the short term.

There were, however, significant differences between the views of those replying individually and those replying on behalf of organisations (Figure 6): respondents answering on behalf of an organisation tend to be more towards a fully optimistic attitude (51.5 %), while those answering as individuals are more inclined to be reasonably optimistic about when the potential benefits can be achieved (49.2 %).

Figure 6: Attitude towards potential benefits of the bio-based economy by respondents' profile



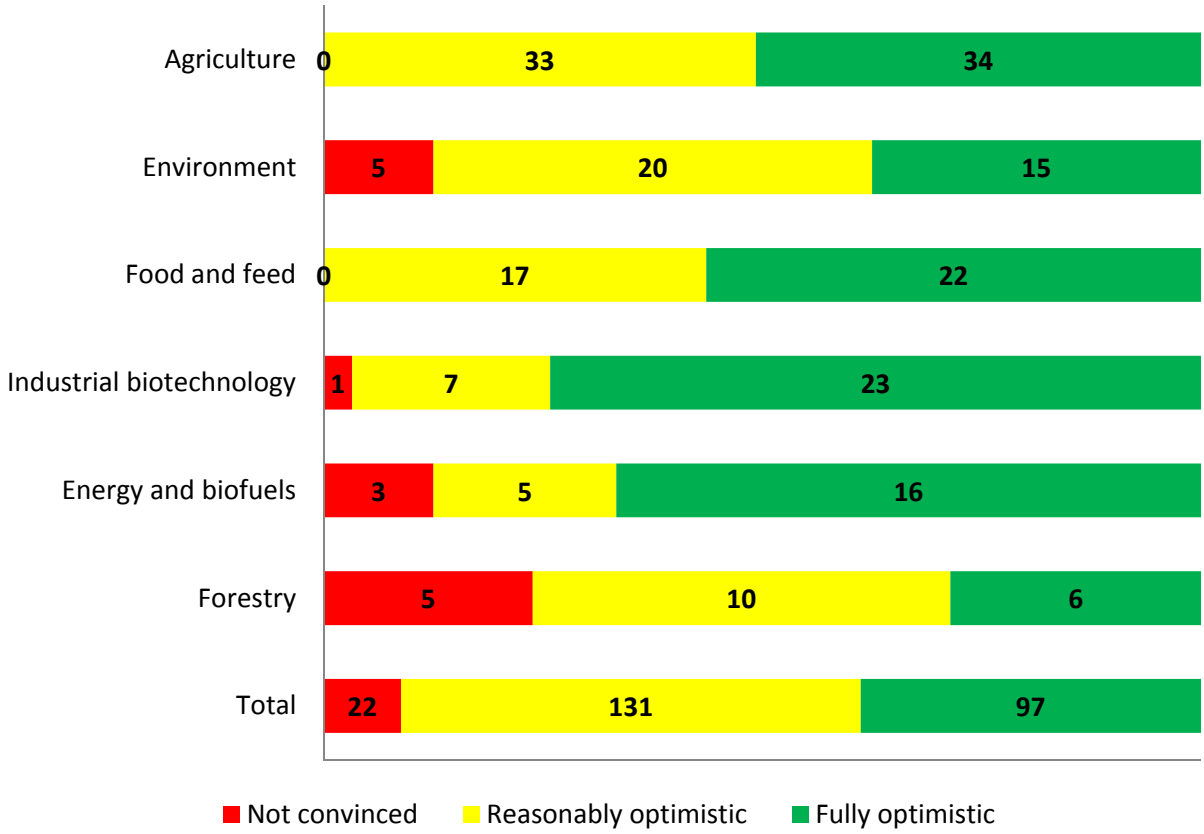
Different trends emerge if one considers the index by sector (Table 8): individuals from the public and private sectors are more likely to take a fully optimistic attitude (60.7 % and 51.2 %respectively), while respondents from NGOs are less convinced about the potential benefits of a bio-based economy (22.7 %).

Table 8: Attitude towards potential benefits of the bio-based economy by sector

Attitude	Private (%)	Public (%)	Academic (%)	NGOs (%)	Total (%)
Not	7.3	3.6	6.2	**22.7**	11.7
Reasonabl	41.5	35.7	50.8	31.8	46.2
Fully	**51.2**	**60.7**	43.1	45.5	42.1
Total	100.0	100.0	100.0	100.0	100.0

Figure 7 shows that respondents from the Industrial biotechnology, Energy and biofuels, Food and feed and Agriculture sectors appear to have a more fully optimistic attitude towards the potential benefits of a bio-based economy. The Environment and Forestry sectors tend to be more reasonably optimistic; however, these two sectors also have the greatest quota of 'Not convinced' respondents.

Figure 7: Attitude towards potential benefits of the bio-based economy by professional field (multi-response) (count; fields with more than 20 answers; 'Total' refers to responses)



Some respondents added comments to the statements presented in the main question: with the aid of content analysis, textual comments were categorised according to different topics and the answers recoded with the distribution shown in Table 9 ([8]).

Table 9: Answers to question: "What are the potential benefits of the bio-based economy and when might they be achieved?"

Open answer topics	Frequency
Biomass issues (increase use of biomass)	23
Improve sustainability	22
Reduce dependency on impacts of raw materials	17
Enhance ecosystem impact	14
Foster social innovation	13
Improve agricultural production	12
Smart storage of carbon	12
Biofuels (increase use of)	10
Improve productivity in European forestry	10
Clarify definition of bio-based economy	7
Benefits for developing countries	7
Reduce waste	7
Sustainability of agriculture	7
Consumers' health	6
Productivity improvement	6

([8]) Note that the same procedure has been applied to all the open questions presented in this report.

Contribute to innovation	5
Increase employment	5
Food security	5
Improve trade policies	4
Foster competitiveness	3
Offer more coherent framework linking bio-based economy sectors, policies and stakeholders	3
Create cross-sectoral framework	2
Offer advantages for rural development	2
Bring economic benefits	1
Total	203

Generally, respondents pointed out several additional benefits of the bio-based economy. A few examples are provided:

- ‘Biomass issues (increase use of biomass)’:
  [1] ‘Biomass can become one of the most important renewable energy sources in regions with significant agricultural production’ (*On behalf of an organisation, NGOs, Environment*);
- ‘Improve sustainability’:
  [2] ‘It [the bio-based economy] must be developed so that it encourages sustainable development’ (*On behalf of an organisation, Academic, Agriculture*);
- ‘Reduce dependency on impacts of raw materials’:
  [3] ‘Reduce the dependency on oil by domestic production of bio-based fuels and chemicals, replace petrochemicals by bio-based chemicals, including novel functionalities’ (*On behalf of an organisation, Private, Industrial biotechnology and Chemicals*);
- ‘Enhance ecosystem impact’ and ‘Foster social innovation’:
  [4] ‘Improving sustainability, minimising ecological impacts and ensuring long-term social development’ (*On behalf of an organisation, NGOs, Agriculture, Food and feed*).

However, some respondents called for the need to clarify the definition of the bio-based economy:

- [5] ‘The lack of a clear definition of the bio-based economy makes it difficult to be clear about the benefits and risks associated with it’ (*On behalf of an organisation, Academic, Agriculture and Environment*);
- [6] ‘Most of benefits are relevant provided that the definition of the bio-based economy is clarified’ (*On behalf of an organisation, Public, Chemicals, Environment*).

3.2.2. Potential risks arising from an expansion of the European bio-based economy in the future

The next question (composed of the nine statements shown in Table 10) surveyed what respondents think about the potential risks that European bio-based economy developments might cause in the future and which should be taken into account carefully when preparing a new European strategy and action plan. Respondents were requested to answer using a five-point Likert scale ranging from ‘Extremely important’ to ‘Least important’.

‘Food security and resources in developing countries put under pressure because of increased production for non-food use’ is by far the most significant potential risk: 48.7 % of respondents think of it as ‘Extremely important’, followed by the risk of ‘Over-exploitation of natural resources and decreasing biodiversity’ (43.1 %) and ‘increased deforestation due to food and non-food production’ (31.0 %).

Other items perceived as having a lower potential risk are ‘Increase of agricultural pollution and greenhouse gas emissions’ (fairly important, 32.0 %), ‘Increased land prices (fairly important, 26.9 %) and ‘Difficulties in achieving the energy-climate targets for renewable energy due to lack of biomass supply’ (fairly important, 26.9 %).

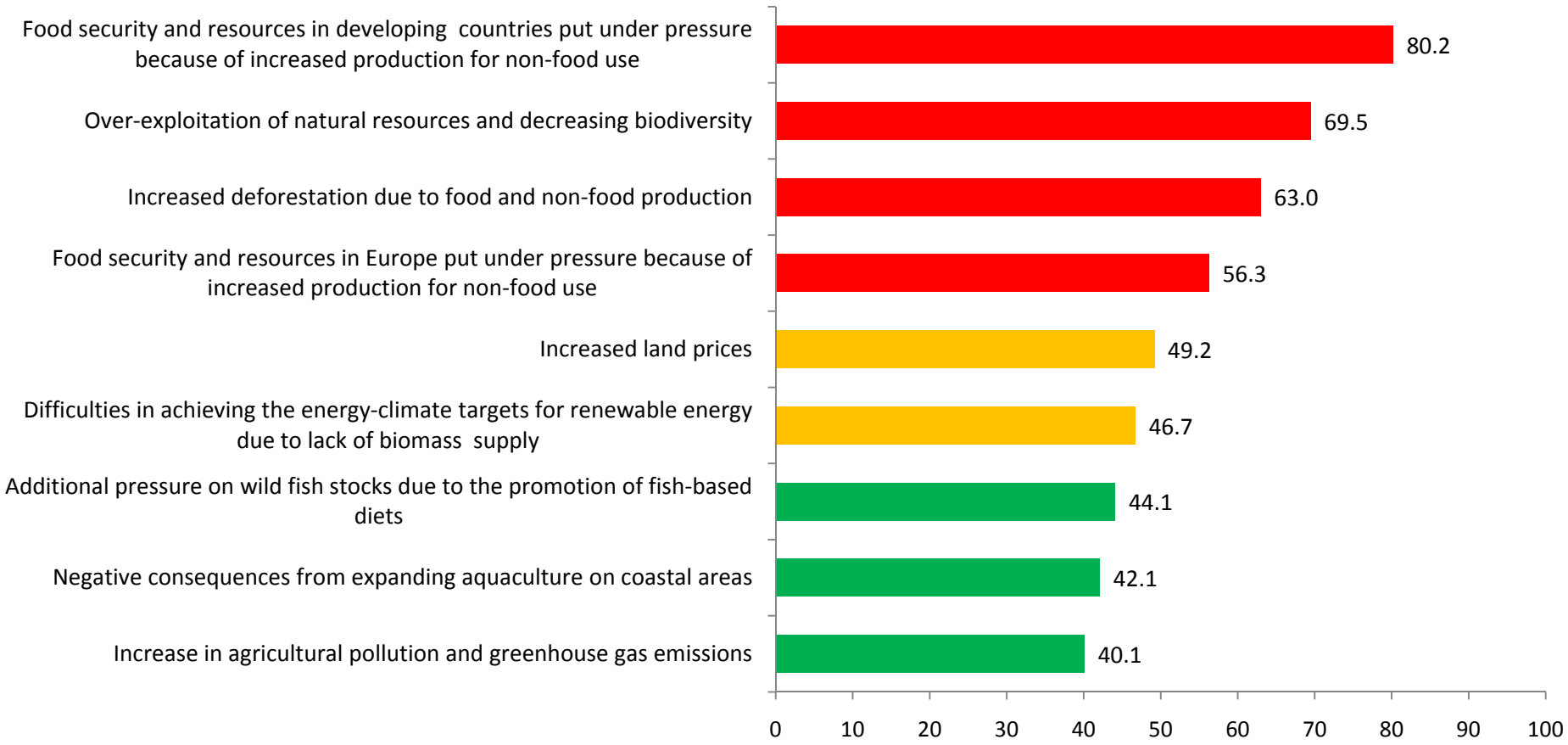
Finally, it is important to highlight that two items received a significant percentage of ‘No opinion’ answers: ‘Additional pressure on wild fish stocks due to the promotion of fish-based diets’ (20.8 %) and ‘Negative consequences from expanding aquaculture on coastal areas’ (19.8 %).

In order to simplify the interpretation of the results, ‘Extremely important’ and ‘Quite important’ answers have been totalled for each item with the results shown in Figure 8. Generally speaking, ‘Over-exploitation of natural resources’ and food-related topics are seen as the most important potential negative consequences from an expansion of the European bio-based economy in the future and need to be addressed carefully.

Table 10: Answers to question: "Some potential risks might be foreseen from an expansion of the European bio-based economy in the future — Rank each potential risk in order of importance (five-point Likert scale)"

Potential risk	Extremely important (%)	Quite important (%)	Fairly important (%)	Slightly important (%)	Least important (%)	No opinion (%)	Total (%)
Food security and resources in Europe put under pressure because of increased production for non-food use	22.8	33.5	23.9	12.2	6.1	1.5	100.0
Food security and resources in developing countries put under pressure because of increased production for non-food use	48.7	31.5	8.6	7.1	1.5	2.5	100.0
Increased land prices	13.7	35.5	26.9	13.7	5.6	4.6	100.0
Over-exploitation of natural resources and decreasing biodiversity	43.1	26.4	18.3	7.1	4.1	1.0	100.0
Difficulties in achieving the energy-climate targets for renewable energy due to lack of biomass supply	13.2	33.5	26.9	12.7	9.1	4.6	100.0
Increased deforestation due to food and non-food production	31.0	32.0	13.7	14.7	6.1	2.5	100.0
Increase of agricultural pollution and greenhouse gas emissions	18.3	21.8	32.0	13.2	10.7	4.1	100.0
Negative consequences from expanding aquaculture on coastal areas	15.2	26.9	21.3	13.2	3.6	19.8	100.0
Additional pressure on wild fish stocks due to the promotion of fish-based diets	21.8	22.3	19.3	12.2	3.6	20.8	100.0

Figure 8: Potential risks from an expansion of the European bio-based economy in the future ('Extremely important' and 'Quite important' (%))

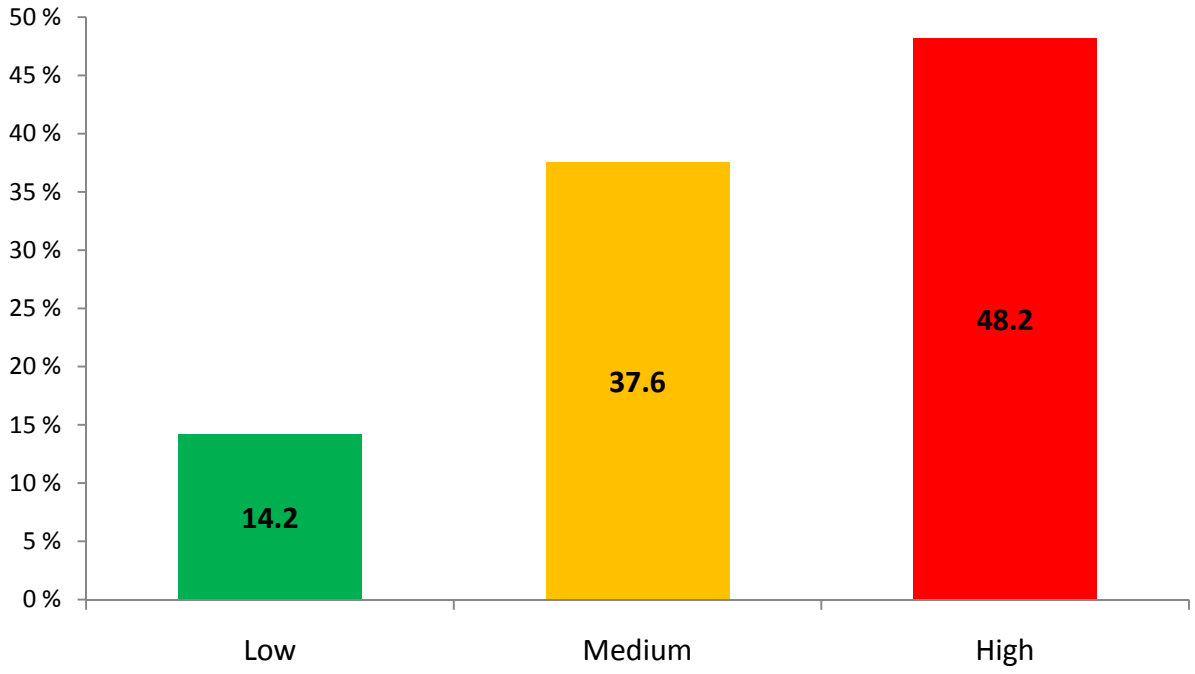


= 'Extremely important' and 'Quite important' total more than 50 %; = 'Extremely important' and 'Quite important' total between 50 % and 45 %; = 'Extremely important' and 'Quite important' total less than 45 %.

Combining respondents' views on each statement, an index was built to synthesise this set of items. The result was an index of potential risk perception of European bio-based economy expansion, whose categories are 'High' (prevalence of 'Extremely important' and 'Quite important' answers), 'Medium' (majority of 'Fairly important' answers) and 'Low' (prevalence of 'Slightly important' or 'Least important' answers).

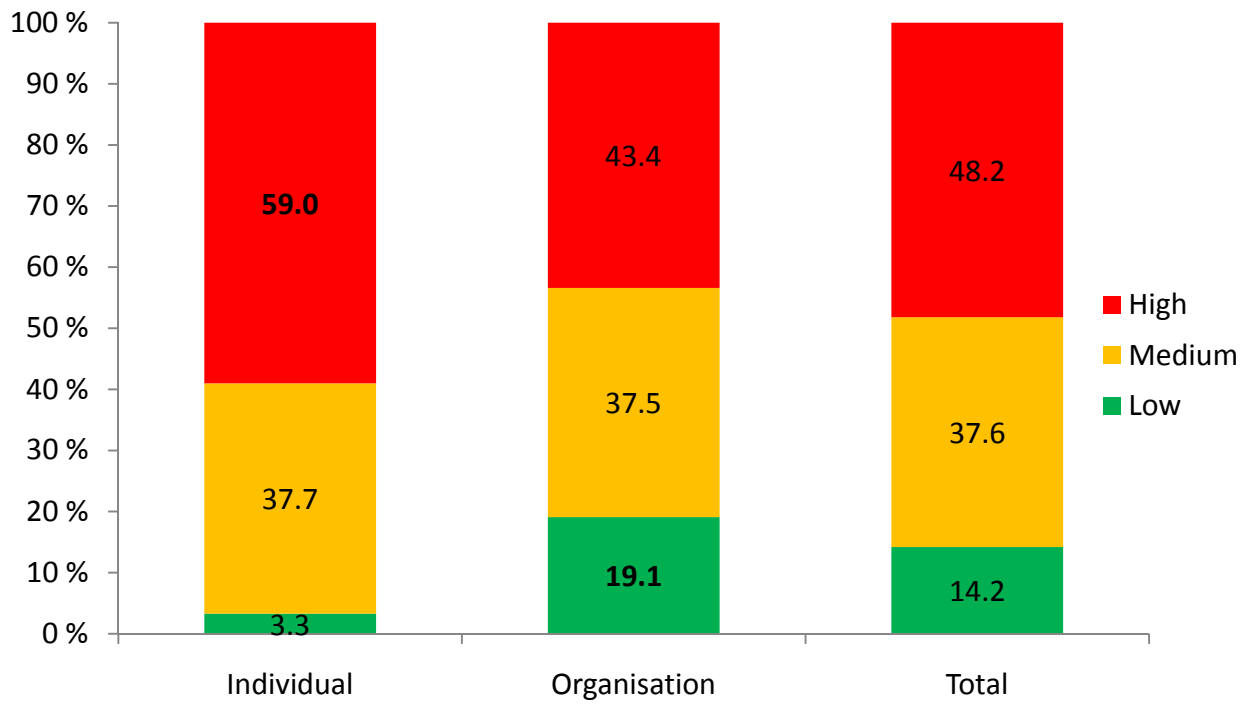
The majority of respondents fall into a 'High' index value (48.2 %), which means that they see important potential negative consequences that need to be addressed carefully in the future development of the bio-based economy (Figure 9).

Figure 9: Potential risk perception of European bio-based economy expansion



Cross-tabulation analysis between this index and some aspects related to respondent profile shows some noteworthy results. Individuals appear to be more worried about the potential risks of bio-based economy expansion than those who took part in the consultation on behalf of an organisation (Figure 10):

Figure 10: Potential risk perception by respondents' profile



The perception of the potential risks of the expansion of the bio-based economy appears to be associated with the sector that respondents represent (Table 11): respondents working for NGOs (72.7 %) and for academic institutions (53.8 %) are more concerned than those from private organisations (37.8 %).

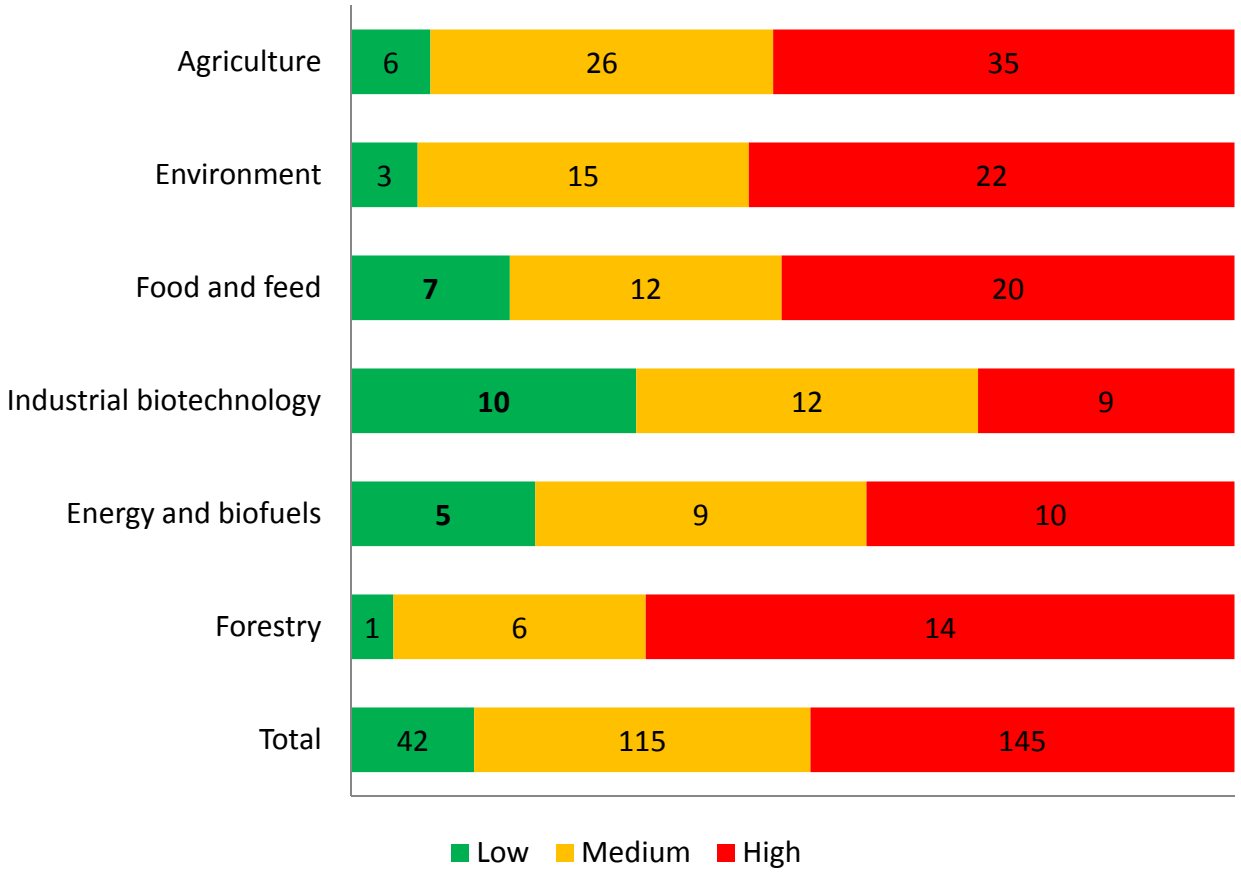
Table 11: Potential risk perception by sector

Risk	Private (%)	Public (%)	Academic (%)	NGOs (%)	Total (%)
Low	**23.2**	14.3	6.2	4.5	14.2
Medium	39.0	39.3	40.0	22.7	37.6
High	**37.8**	46.4	**53.8**	**72.7**	48.2
Total	100.0	100.0	100.0	100.0	100.0

The results of the index values by professional fields (Figure 11) show that respondents from the Industrial biotechnology, Energy and biofuels and Food and feed fields are more likely to perceive lower risks in comparison with the other professional fields (e.g. Forestry).

Figure 11: Potential risk perception by professional field (multi-response)

(count; fields with more than 20 answers; 'Total' refers to responses)



Respondents provided a number of additional comments to the main question. Most of these could be classified under the general category of 'Potential risks for a sustainable development', for example:

— 'Threats to sustainability':
  [7] 'There is a high risk that political incentives to produce bio-energy and biofuels from primary wood resources harms European competitiveness and release more CO_2' (*On behalf of an organisation, Academic, Forestry*);
— 'Increased pollution':
  [8] 'Increased agricultural pollution due to intensified agro-practices' (*On behalf of an organisation, Private, Forestry*);
— 'Deforestation':
  [9] 'Increased deforestation due to food and agricultural non-food production is a high risk on a global but not on a European level' (*On behalf of an organisation, Private, Forestry*).

Other important topics dealt with biomass and biofuels issues, usually showing a critic view:

— [10] 'Biomass should only be expected to play a very small role in a future 100 % renewable energy mix' (*On behalf of an organisation, NGOs, Environment*);
— [11] 'In my opinion, the use of biofuels, should be strongly limited and the same applies to the aquaculture *and intensive farming that lack efficiency and waste* precious resources' (*Individual, Public, Environment, Health*).

Finally, there were also some comments focusing on the need to refine the term 'Bio', for example:

— [12] 'Using the term "biological" (or "bio"), would not have a clear impact on the organic market and consumer trust. Using this term for food products would violate the legal basis

of the labelling of organic products' (*On behalf of an organisation, NGO,* Agriculture, *Food and feed*).

Table 12: Potential risks from an expansion of the European bio-based economy in the future

Open answer topics	Frequency
Threats to sustainability	15
Biomass issues	13
Increased pollution	13
Harming European competitiveness	12
Biofuels issues	11
Disagreement with the bio-based economy concept in general	11
Policy issues	10
Industrialisation of agriculture	8
Negative impacts on third countries	8
Deforestation	7
Incorrect use of 'bio' definition	6
Bringing benefits only to private sector	6
Enhancing economic problems	5
GMO risks	4
Lack of coordination among bio-based economy actors	4
Food security issues	5
Need for development of a hierarchy of use	2
Over-exploitation of resources	2
Over-population	2
Limits to bio-based economy concept	1
Risk of losing innovation initiatives	1
Lack of raw materials	1
Negative impacts on biodiversity	1
Total	148

3.2.3. Need for further action to realise the full potential of the bio-based economy

The next question asked if there was a need for further actions to realise the full potential of the bio-based economy. According to the vast majority of respondents (81.7 %), new initiatives are necessary and they should be taken at both EU and national/regional levels; fewer think that these actions should be performed only at EU level (8.6 %), or only at national level (3.0 %) (Table 13). There are also some respondents that are in disagreement with need for further action in general (4.6 %).

Table 13: Answers to question: "Is there a need for further action to realise the full potential of the bio-based economy?

	Frequency	%
Agree, but the initiatives should be taken at both EU and national/regional levels	161	81.7
Agree, but the main focus should be on EU initiatives	17	8.6
Agree, but the main focus should be on national initiatives	6	3.0
Neither agree or disagree	1	0.5
Disagree	9	4.6
I don't know	3	1.5
Total	197	100.0

There were significant differences between the answers from those replying as individuals and from those replying on behalf of organisations: similar views also emerge regardless of the professional field.

Disagreement with the new strategy and action plan came only from respondents working for NGOs (five answers) and private organisations (four answers). In these cases, respondents were given the opportunity to justify their disagreement by leaving a comment (seven different comments were received).

The analysis of these textual comments shows that these respondents disagreed with the need for further actions not because they think that further initiatives are not necessary but, on the contrary, because they criticised some aspects and the concept of the bio-based economy.

These are the different positions expressed by respondents. Some respondents think that the bio-based economy should take more into account the potential consequences of its actions on ecosystem:

- [13] 'Current bio-energy policy is developed without properly analysing the negative impacts it will create and is already creating on biodiversity, local communities, etc. There are serious questions to be raised about the so-called climate benefits of bio-energy. How can further action be taken to realise the bio-based economy in this context? Moreover, what is full potential?' (*On behalf of an organisation, NGO, Forestry*);
- [14] 'The question is not whether we will move to a bio-based economy: this is a logical consequence of running out of fossil resources. The question is how to do this and what do we need to do to avoid further ecological collapse and instead to effectively protect the resource base of this new economy' (*On behalf of an organisation*, *NGO*, *Environment*);
- [15] 'The further action is needed not only to promote a bio-based economy but also to support its growth with firm measures and actions to reverse the degradation of ecosystems and to halt their over-exploitation' (*On behalf of an organisation*, *NGO*, *Environment*).

Others focused more on economic issues, claiming the need for incentives for SMEs [16] or criticising European policies [17]:

- [16] 'I don't see any action at the level of very small companies except calls for proposals that are too complex for us. The best incentive at the national level is to reduce taxes on salaries and increase the proportion of public procurements going to SMEs and innovative solutions. Innovation is not a driver in most of the national administrations dealing with day to day issues' (*Individual, Private, Agriculture*);
- [17] 'The knowledge-based bio-economy (KBBE) has been the wrong focus. The EU followed policies adopted in the United States in the late 1980s which claimed investment in genetics and biotechnology would secure competitiveness. Enormous amounts of public money have been wasted without delivering any benefits' (*On behalf of an organisation*, *NGO*, *Environment, Health*).

Finally, some respondents challenged the concept of the bio-based economy itself:

- [18] 'There is no need for promotion of a bio-based economy. Bio food will always be for a yuppie minority, to the detriment of the masses, in particular in the developing world' (*Individual, Private, Transport*);
- [19] 'I don't really like the idea of a bio-based economy. I like an IT society more. I like bio-things to be just natural things. Of course, there are some exceptions, but *they should be that: exceptions, not the mainstream.* I know there is a huge economic potential for bio-based materials and stuff like that, but I care more about the well-being for me and for Mother Earth' (*Individual, Private, Socioeconomics*).

3.2.4 Importance of European policy areas in terms of their potential/importance in building a sustainable bio-based economy

The last question in this section concerns the evaluation of the role of the different European policy areas in the development of the bio-based economy.

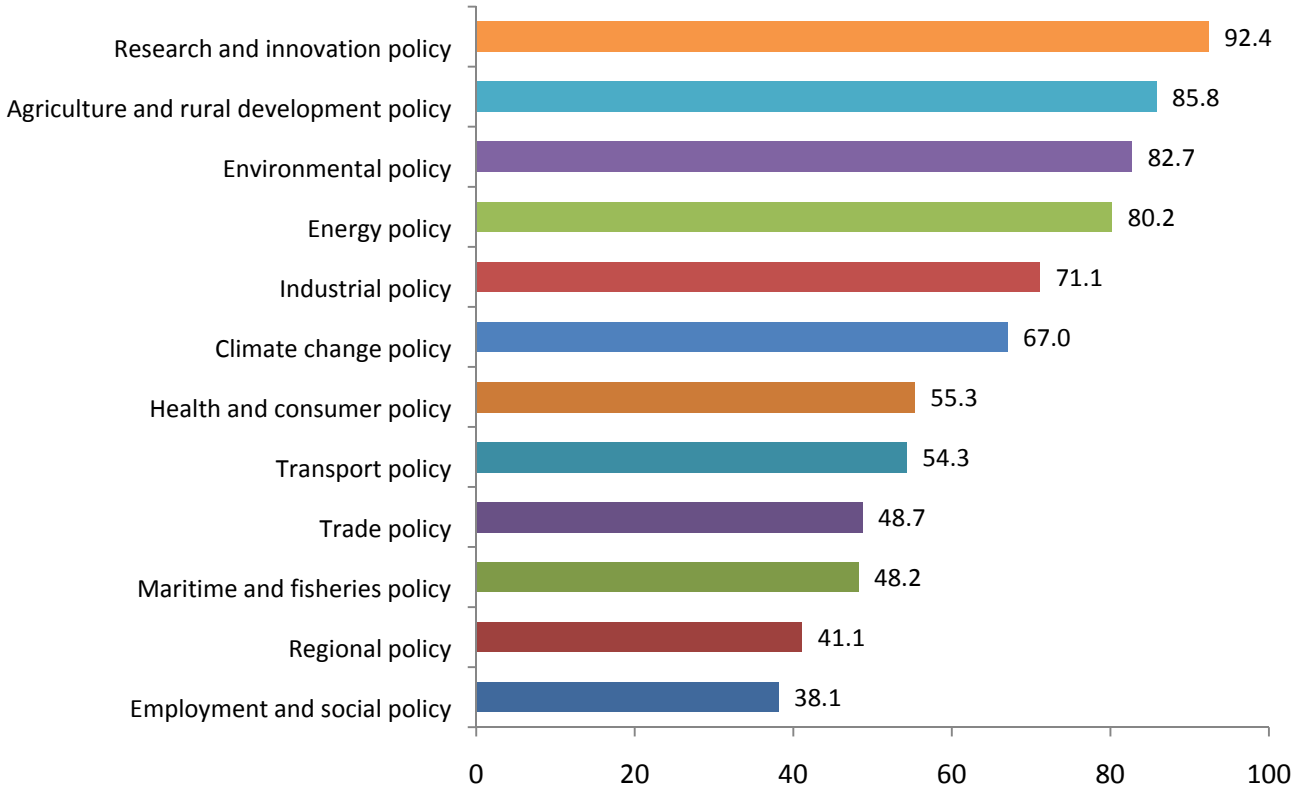
Respondents were asked to rate, on a three-point scale ranging from 'Very important' to 'Not important', the importance of selected European policy areas in building a sustainable bio-based economy (Table 14).

Table 14: Answers to question: "How would you rate European policy areas in terms of their potential/importance in building a sustainable bio-based economy?"

Policy	Very important (%)	Less important (%)	Not important (%)	No opinion (%)	Total (%)
Agriculture and rural development	85.8	10.2	1.5	2.5	100.0
Environmental	82.7	13.7	1.0	2.5	100.0
Industrial	71.1	21.8	3.0	4.1	100.0
Climate change	67.0	28.4	2.5	2.0	100.0
Maritime and fisheries	48.2	34.5	3.0	14.2	100.0
Transport	54.3	37.1	3.0	5.6	100.0
Energy	80.2	15.2	1.0	3.6	100.0
Health and consumer	55.3	30.5	8.6	5.6	100.0
Trade	48.7	42.1	5.6	3.6	100.0
Regional	41.1	43.7	11.2	4.1	100.0
Employment and social	38.1	43.1	13.7	5.1	100.0
Research and Innovation	92.4	5.1	1.0	1.5	100.0

Figure 12 shows that, to different degrees, all policy areas are seen relevant and important in building the bio-based economy. The most important policy areas, however, are Research and Innovation (92.4 %), Agriculture and rural development (85.8 %), Environment (82.7 %), Energy (80.2 %) and Industrial (71.1 %).

Figure 12: Ranking of European policy areas rated 'Very important' (%)



Generally, those responding on behalf of an organisation show a higher percentage of 'Very important' answers than those answering as individuals: the only exceptions are Maritime and fisheries, Transport, Regional and Employment and social policies (Table 15, % in bold).

Table 15: European policy areas rated 'Very important' by respondents' profile

Policy	As individuals (%)	On behalf of an organisation (%)
Agriculture and rural development	82.0	87.5
Environmental	82.0	83.1
Industrial	63.9	74.3
Climate change	54.1	72.8
Maritime and fisheries	**54.1**	45.6
Transport	**57.4**	52.9
Energy	78.7	80.9
Health and consumer	52.5	56.6
Trade	42.6	51.5
Regional	**42.6**	40.4
Employment and social	**42.6**	36.0
Research and Innovation	90.2	93.4

There are also differences in opinion according to respondent profile (Table 16, % in bold): respondents from the private sector consider Industrial policy (81.7 %) and Trade policy (54.9 %) as the most important in building the bio-based economy. While respondents from the public sector consider Agriculture and rural development policy (92.9 %) and Energy policy (89.3 %) as the most important, respondents from academia consider Research and Innovation policy (96.9 %) and Health and consumer policy (64.6 %) as those most crucial while those from, or representing, civil

society organisations rate Environmental policy (95.5 %) and Climate change policy (81.8 %) as the top two.

Table 16: European policy areas rated 'Very important' by sector

Policy	Private (%)	Public (%)	Academic (%)	NGOs (%)
Agriculture and rural development	78.0	**92.9**	90.8	90.9
Environmental	79.3	75.0	86.2	**95.5**
Industrial	**81.7**	60.7	67.7	54.5
Climate change	70.7	60.7	60.0	**81.8**
Maritime and fisheries	36.6	50.0	55.4	**68.2**
Transport	48.8	46.4	61.5	**63.6**
Energy	76.8	**89.3**	81.5	77.3
Health and consumer	52.4	50.0	**64.6**	45.5
Trade	**54.9**	42.9	43.1	50.0
Regional	39.0	35.7	44.6	**45.5**
Employment and social	30.5	35.7	**49.2**	36.4
Research and Innovation	92.7	89.3	**96.9**	81.8

Answers seem to be moderately associated with the professional field (Table 17, highest percentage per row is highlighted in bold): Agriculture and rural development policy is seen as the most crucial by those in the agricultural field; Energy policy is rated 'Very important' by all respondents from the Energy and biofuels and Forestry fields; Health and consumer policy is most emphasised by respondents from the Food and feed sector.

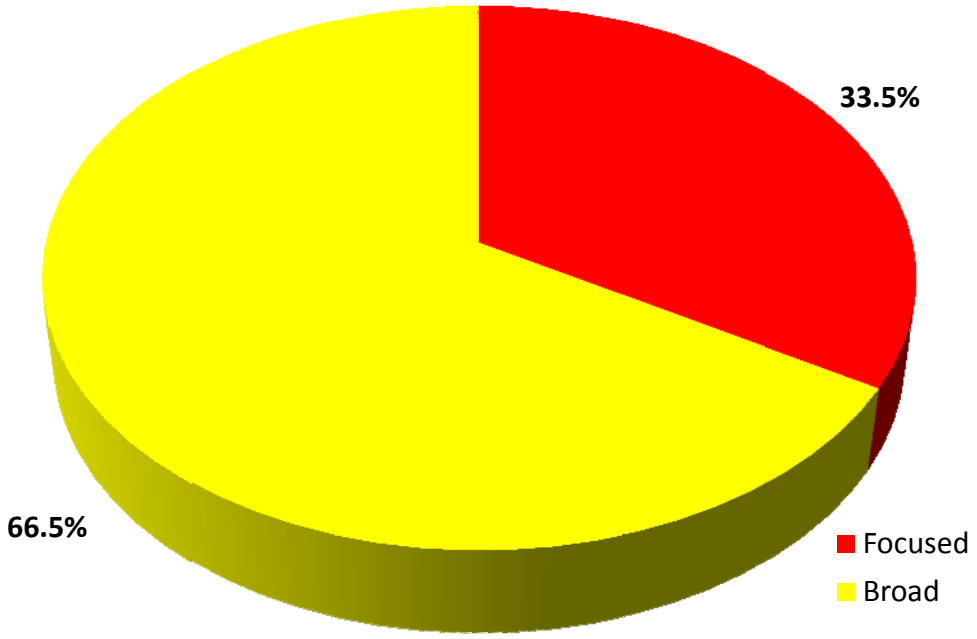
Table 17: European policy areas rated 'Very important' by professional field

Policy	Agriculture (%)	Environ-ment(%)	Food and feed (%)	Industrial biotechno-logy (%)	Energy and biofuels (%)	Forestry (%)
Agriculture and rural development	**92.5**	85.0	89.7	90.3	79.2	90.5
Environmental	83.6	85.0	84.6	**96.8**	91.7	71.4
Industrial	68.7	45.0	66.7	83.9	83.3	**95.2**
Climate change	71.6	57.5	71.8	**77.4**	70.8	71.4
Maritime and fisheries	50.7	60.0	**61.5**	45.2	41.7	33.3
Transport	55.2	45.0	64.1	45.2	**66.7**	57.1
Energy	76.1	72.5	76.9	87.1	**100.0**	**100.0**
Health and consumer	62.7	52.5	**69.2**	54.8	50.0	47.6
Trade	53.7	35.0	48.7	51.6	54.2	**61.9**
Regional	49.3	35.0	**53.8**	25.8	41.7	47.6
Employment and social	43.3	40.0	**56.4**	22.6	29.2	38.1
Research and Innovation	94.0	90.0	**97.4**	93.5	95.8	95.2

An index has been created combining respondents' answers: in this way, it is possible to analyse the propensity for having a focused or a broad view of the importance of the European policy areas in building a sustainable bio-based economy. More specifically, a focused view means that respondents think there is a small group of policy areas that are important in building a sustainable bio-based economy. On the contrary, a broad view means that many (if not all) policy areas have

been considered as 'Very important' ([9]). The majority of respondents (66.5 %) tend to have a view that many different policy areas should be brought together to build a strong bio-based economy (Figure 13).

Figure 13: View of the importance of policy areas in building a sustainable bio-based economy



There is no significant difference between the responses of those replying individually or on behalf of organisations and between those from different professional fields. However, different results emerge from cross-tabulation by sectors (Table 18): respondents from public organisations are more inclined to have a focused view (pulling the efforts together in only a few selected policies), while those working in academic areas have a vision of many policy areas having a role in building the bio-based economy.

Table 18: View of the importance of policy areas by sector

View	Private (%)	Public (%)	Academic (%)	NGOs (%)	Total (%)
Focused	36.6	**50.0**	21.5	36.4	33.5
Broad	63.4	50.0	**78.5**	63.6	66.5
Total	100.0	100.0	100.0	100.0	100.0

As for previous questions, respondents were able to add comments to the main question (Table 19). In these comments, the need for a coherent bio-based economy framework was the most highlighted, for example:

— [20] 'There is a clear need to coordinate all the above listed policies. The bio-economy cannot be seriously applied if not involving all of them at once'(*Individual, NGO, Agriculture*);
— [21] 'Policies must be better coordinated and evidence-based. Policies must have a longer perspective' (*On behalf of an organisation*, *Public*, *Agriculture and Environment*).

([9]) 'Focused view' means that respondents have rated as 'Very important' less than six policy areas; 'Broad view' means that respondents have rated as 'Very important' six or more policy areas.

Table 19: The importance of European policy areas in terms of their potential/importance in building a sustainable bio-based economy

Open answer topics	Frequency
Coherent bio-based economy framework	27
Sustainability	14
Forestry policy (woody biomass)	9
CAP	8
Industrial policy (improvement)	8
External relation policy	6
Rural development	6
Economic policy	4
European development policy	4
Environment policy (protection of resources)	4
Biofuel issues	2
Education policy	2
Feedstock policy (optimisation)	2
Competition policy	2
Biotechnology policy	1
European policy for food safety and food quality	1
Policy related to housing	1
Regional policy	1
Policy regulating wastes	1
Total	103

A few examples of the most frequently highlighted issues:

- ‘Sustainability’:
  [22] ‘Sustainability must become the overarching principle in ALL EU POLICY AREAS’ (*Individual, NGO, Agriculture, Fisheries and aquaculture*);
- ‘Forestry policy’:
  [23] ‘The Forestry policy area is one of the most important policies at Member State level as well at EU level in building a sustainable bio-based economy’ (*On behalf of an organisation, Private, Forestry*);
- ‘CAP and rural development’:
  [24] ‘CAP and rural development plans are crucial for the development of the bio-economy’ (*On behalf of an organisation, NGOs, Agriculture, Food and feed*);
- ‘Improvement of industrial policy’:
  [25] ‘Current policies are focused too much on R&D and are not driving industrial implementation in the EU’ (*On behalf of an organisation, Private, Industrial biotechnology*).

3.3. The European bio-based economy today

Section 3 of the questionnaire looked at the state of play of the bio-based economy. This section contained three questions, respectively surveying the perception of the effectiveness of Research and Innovation in the European bio-based economy today; the presence of barriers to a successful functioning of the European bio-based economy today; and the evaluation of the participation of society and its acceptance of the European bio-based economy.

3.3.1. Perception of effectiveness of Research and Innovation in the European bio-based economy today

The first question looked at the state of play of Research and Innovation in the European bio-based economy. Respondents were asked to evaluate actions (11 actions were listed, Table 20) in terms of their effectiveness at EU, national or both levels.

All the actions listed in the question but one were considered 'Not effective' at both EU and national levels by the relative majority of respondents, such as:

- 'Providing a knowledge base for society expectations in the bio-based economy' (41.6 %);
- 'Providing a knowledge base for addressing societal challenges faced by developing countries and emerging economies' (41.1 %);
- 'Translating research into behavioural change' (40.6 %).

In only one case is the percentage of 'Effective at both EU and national levels' category higher than the 'Not effective' category: 'Strengthening implementation of the European Research Area and improving coordination of national research programmes' (34.0 %).

According to respondents, there are some actions that are more effective at EU level than national: 'Translating research recommendations into policy' (21.8 %), 'Enhancing cooperation at a global scale for addressing global challenges' (22.8 %), 'Providing a knowledge base for addressing European societal challenges' (23.4 %).

However, 'Translating research into innovative marketable products and new farming/production practices' is considered by far more effective at national level than at EU (20.8 %).

'Providing an innovation base for production and distribution systems' is the statement which received by far the highest percentage of 'No opinion' answers (26.4 %). Generally, over 10 % of respondents have 'No opinion' on all actions but one (Translating research recommendations into policy): this means that there is a general lack of knowledge about the effectiveness of Research and Innovation actions.

It is possible to synthesise the results by calculating the total percentages (see the last row of Table 20): 33.9 % is the average for 'Not effective' answers, with 25.8 % for 'Effective at both EU and national levels'. 'Effective but only at EU level' and 'Effective but only at national level' have lower averages (respectively 15.2 % and 10.0 %), while the 'No opinion' category shows a remarkable average of 15.2 %.

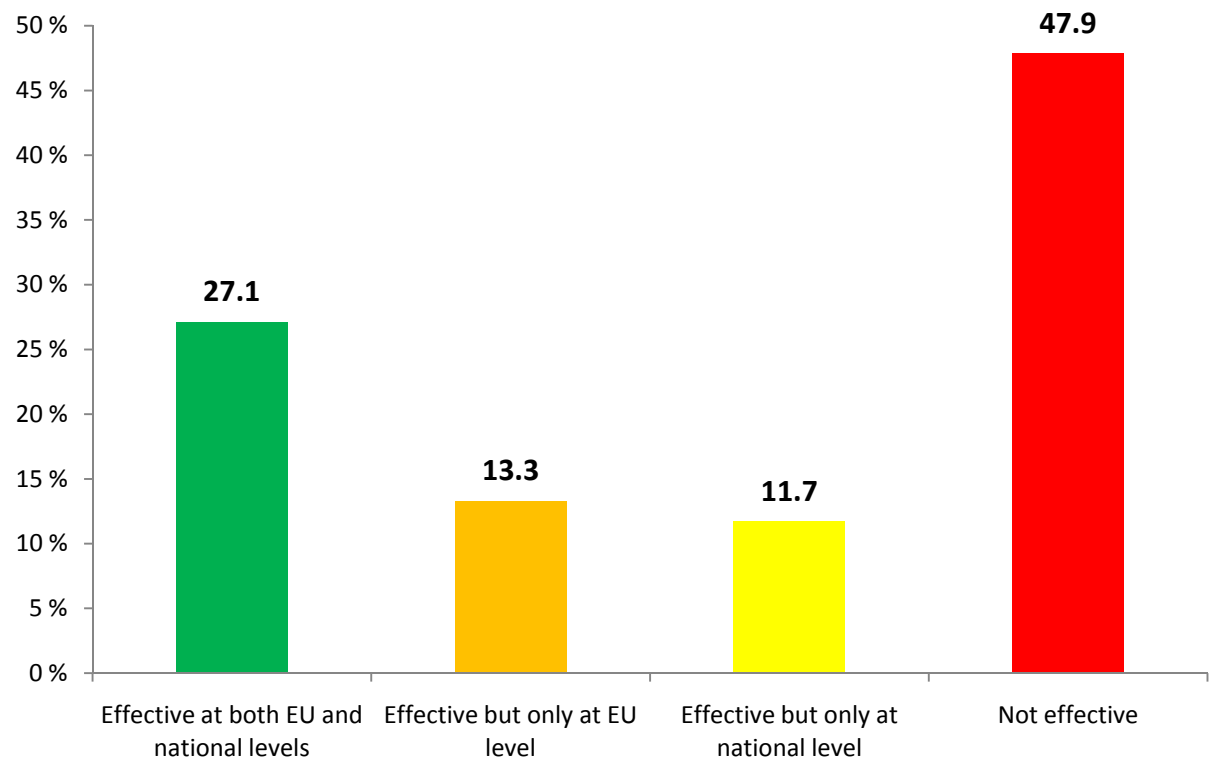
Table 20: Answers to question: "How do you perceive Research and Innovation in the European bio-based economy today?"

Research and Innovation area	Effective at both EU and national levels (%)	Effective but only at EU level (%)	Effective but only at national level (%)	Not effective (%)	No opinion (%)	Total (%)
Strengthening implementation of the European Research Area and improving coordination of national research programmes	34.0	26.9	6.6	18.8	13.7	100.0
Providing a knowledge base for addressing European societal challenges	27.4	23.4	4.6	**33.0**	11.7	100.0
Providing a knowledge base for addressing societal challenges faced by developing countries and emerging economies	19.3	15.2	5.1	**41.1**	19.3	100.0
Enhancing cooperation at a global scale for addressing global challenges	26.9	22.3	3.0	**34.5**	13.2	100.0
Translating research recommendations into policy	24.9	21.8	8.6	**35.5**	9.1	100.0
Providing an innovation base for production and distribution systems	21.8	10.7	14.2	26.9	**26.4**	100.0
Development of a standard life cycle analysis of products and processes	26.4	13.7	13.2	31.5	15.2	100.0
Translating research into innovative marketable products and new farming/production practices	28.4	4.6	20.8	**35.5**	10.7	100.0
Translating research into behavioural change (e.g. a shift towards healthier diets and more sustainable consumption patterns)	19.8	8.1	14.2	40.6	17.3	100.0
Providing a knowledge base for society expectations in the bio-based economy	25.4	12.7	6.6	41.6	13.7	100.0
Ensuring the availability of required skills through adequate education and training	29.9	7.6	12.7	**33.5**	16.2	100.0

An index named 'Effectiveness of Research and Innovation actions' was created to measure the general perception of the effectiveness of Research and Innovation actions ([10]).

The majority of respondents perceive Research and Innovation actions in the European bio-based economy today as mainly not effective (47.9 %): on the contrary, one quarter of responses suggests that actions are effective at both levels (27.1 %). Remaining respondents are almost equally split between effectiveness perceived only at national level (11.7 %) or only at EU level (13.3 %) (Figure 14).

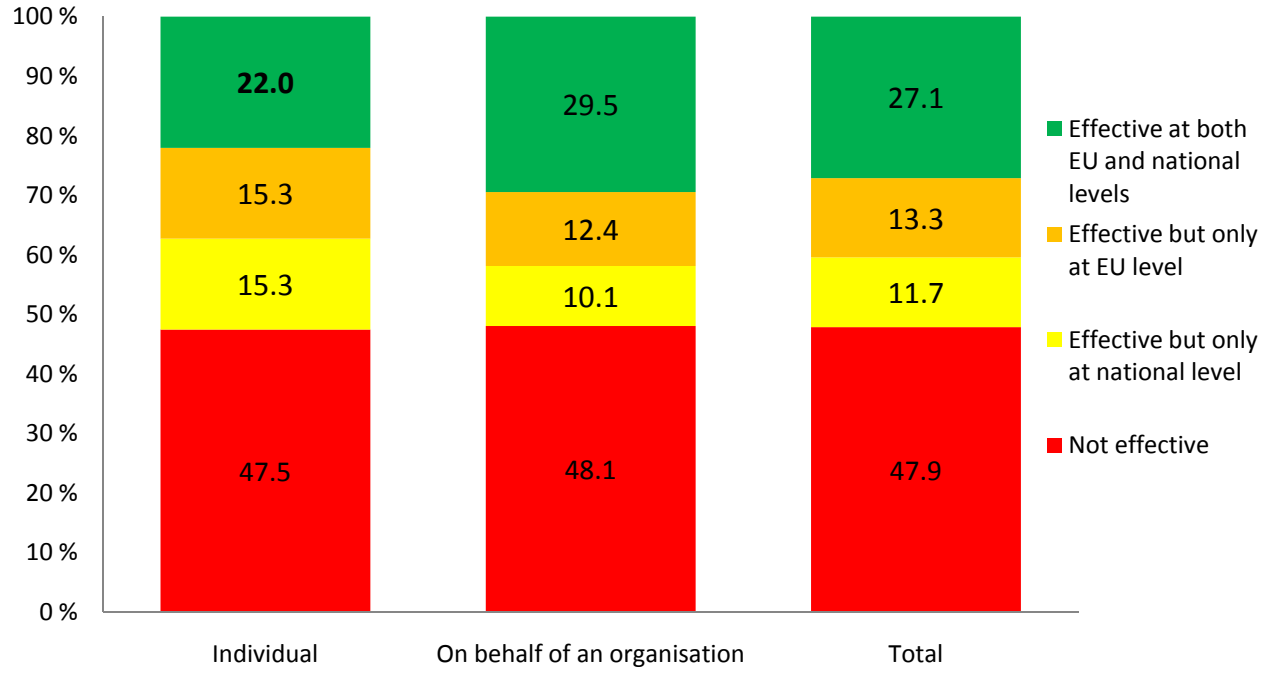
Figure 14: Effectiveness of Research and Innovation actions



Respondents answering as individuals seem to be more sceptical about the effectiveness of Research and Innovation actions at both EU and national levels than those answering on behalf of organisations (Figure 15).

([10]) This was achieved by reducing the response categories of each item to three modalities and then combining respondents' answers in a index with three modalities: 'Not effective' (majority of 'Not effective'), 'Effective at one level' (majority of 'Effective but only at EU level' or 'Effective but only at national level'), 'Effective at both levels' (majority of 'Effective at both EU and national levels').

Figure 15: Effectiveness of Research and Innovation actions by respondents' profile



The perception of Research and Innovation appears to also vary by sector (Table 21): respondents from public organisations are more likely to think that current actions are 'Effective at both levels' (35.7 %) while those from the private sector (49.4 %) and, above all, NGOs (63.2 %) seem to be more pessimistic. The percentage of respondents that think that actions are 'Effective but only at EU level' is higher among those from the academic sector (18.8 %).

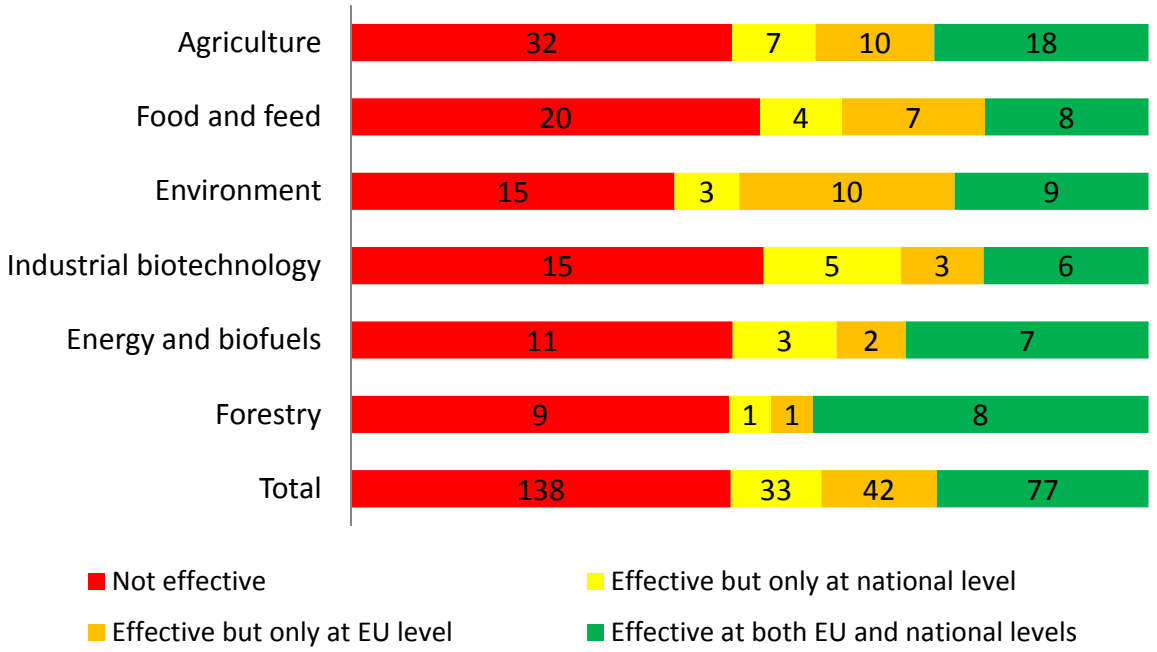
Table 21: Effectiveness of Research and Innovation actions by sector

Sector / *Effectiveness of Research and Innovation*	Private	Public	Academic	NGOS	Total
Not effective	**49.4**	42.9	43.8	**63.2**	47.9
Effective but only at national level	13.0	10.7	12.5	5.3	11.7
Effective but only at EU level	10.4	10.7	18.8	10.5	13.3
Effective at both EU and national levels	27.3	**35.7**	25.0	21.1	27.1
Total	100.0	100.0	100.0	100.0	100.0

There are also variations in opinion between professional fields (Figure 16): respondents from Industrial biotechnology and Food and feed tend to give a more negative evaluation of the effectiveness of Research and Innovation. Respondents from the Environment field are more likely to believe in the effectiveness of Research and Innovation actions at EU level, while those from the Forestry and Energy and biofuels fields seem more confident in the effectiveness at both levels.

Figure 16: Effectiveness of Research and Innovation actions by professional field (multi-response)

(count; fields with more than 20 answers; 'Total' refers to whole sample responses)



The analysis of the information provided as additional comments to the question showed other research and innovation actions that, according to respondents, should be included in order to improve the effectiveness of the bio-based economy (Table 22).

Table 22: Perception of effectiveness of Research and Innovation in the European bio-based economy today

Issues raised in comments	Frequency
Widen innovation concept (not only technological)	14
Raise consumer awareness	13
Networking —increase stakeholder involvement	13
Foster behavioural change	10
Lifecycle analysis approach development	8
Agro-ecology approach in agri-food research	6
Promote knowledge transfer	6
Need for reducing carbon emissions	5
Sustainability	5
Foster social involvement	5
Change the top-down approach	4
Maintain European competitiveness	2
Sustain holistic approach	2
Assist developing countries	2
Carry out research on informed policymaking	3
Biomass issues	1
Financing	1
Industrial implementation	1
Lack of multi-goal and multi-criteria oriented assessment systems	1
Agriculture adaptability to growing demand	1
Total	103

Some examples of the issues raised are:

- ‘Widen innovation concept (not only technological)’:
  [26] ‘Innovation often is seen only as technological innovation’ (*On behalf of an organisation, NGOs, Agriculture, Food and feed*);
- ‘Raise consumer awareness’:
  [27] ‘Provide the possibility for EU citizens to decide on their food and recall food sovereignty not effective at all’ (*Individual, Public, Environment, Health*);
- ‘Increase stakeholder involvement’:
  [28] ‘Increased stakeholder involvement and protagonism should be aimed to avoid a top-down approach’ (*On behalf of an organisation, Academic*, *Agriculture*);
- ‘Foster behavioural change’:
- [29] ‘Translating research into behavioural change (e.g. consumption patterns)’ (*On behalf of an organisation, Academic*, *Forestry*).

3.3.2. Barriers to a successful functioning of the European bio-based economy today

The second question surveyed potential obstacles to the European bio-based economy development today. Respondents were asked to evaluate potential barriers to a successful functioning of the European bio-based economy (the full list of 21 potential barriers is given in Table 23). The two barriers considered by far the most significant at EU and national levels concern the lack of links between the actors of the bio-based economy (Table 23): ‘Insufficient links between decision-makers and stakeholders from the bio-based economy sectors’ (75.6 %) and ‘Insufficient links between policies related to the bio-based economy’ (72.6 %). Other important barriers are related to foresight activities: ‘Lack of long-term horizon scanning/foresight and impact analysis in decision-making’ (69.0 %) and financing: ‘Insufficient loans and/or venture capital for research/demonstration/technology development’ (62.4 %). Generally, all the possible barriers listed in the questionnaire received percentages higher than 40 %: respondents are aware that there are many significant obstacles and, probably, they recognise that a lot has to be done to remove them in order to ensure the successful implementation of the European bio-based economy (Figure 17).

However, some barriers are perceived as less binding than others, with a percentage of ‘Not significant’ answers higher than 25 %, such as:

- ‘Lack of market and/or consumer demand for bio-based products’ (31.0 %);
- ‘Current application of the precautionary principle’ received a high percentage of ‘Not significant’ (28.4 %) answers and also a high number of ‘No opinion’ answers, 24.4 %);
- ‘Societal concerns/negative attitudes towards biotechnologies’ (27.4 %);
- ‘Too much existing regulation’ (25.4 %).

There were also seven items with a considerable quota of ‘No opinion’ answers (higher than 15 %) suggesting that some barriers are not really clear in the mind of respondents, especially regarding the ‘Production of industrial raw materials from bio-waste not included in organic waste regulations’ (36.5 % of respondents had no opinion).

Table 23: Answers to question: "What do you consider to be the main barriers that are preventing successful functioning of the European bio-based economy today?

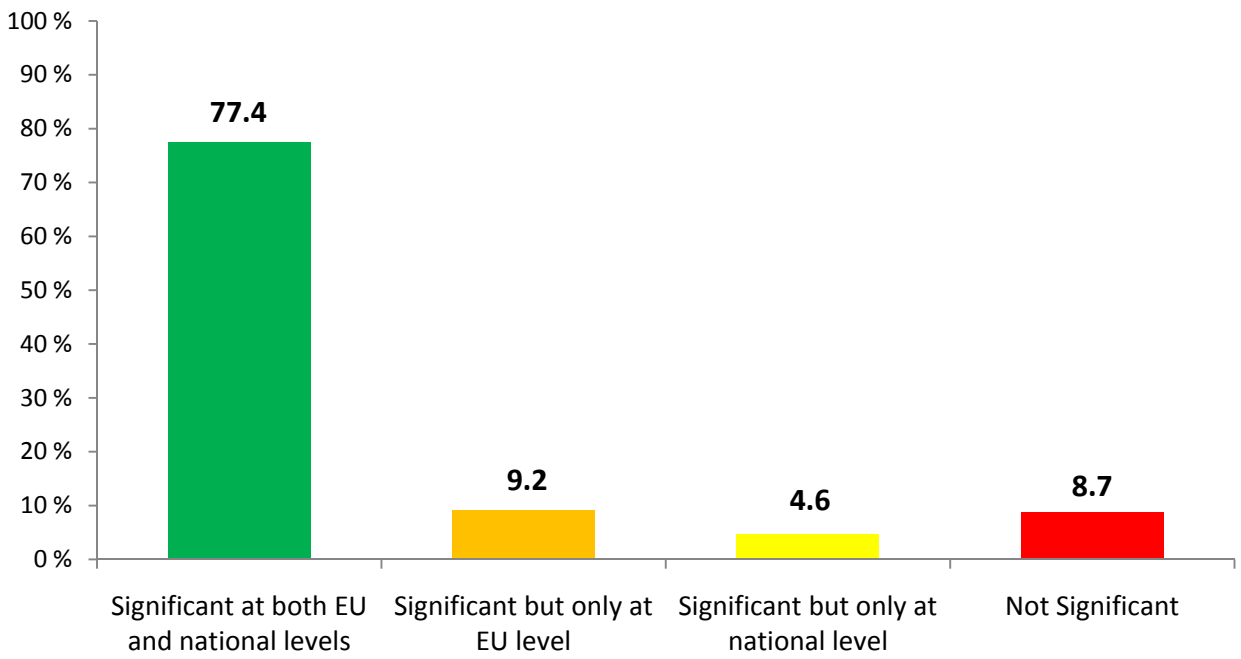
Main barriers preventing the successful functioning of the European bio-based economy	Significant at both EU and national levels (%)	Significant but only at EU level (%)	Significant but only at national level (%)	Not Significant (%)	No opinion (%)	Total (%)
Insufficient links between decision-makers and stakeholders from the bio-based economy sectors (e.g. Agriculture, Fisheries, Food, Non-food, Consumers)	75.6	5.1	5.1	10.7	3.6	100.0
Insufficient links between policies related to the bio-based economy	72.6	11.2	5.6	6.1	4.6	100.0
Difficulties related to implementation of sectoral and horizontal EU policies	59.9	14.7	8.6	6.6	10.2	100.0
Lack of long-term horizon scanning/foresight and impact analysis in decision-making	69.0	5.6	6.6	12.7	6.1	100.0
Cost and complexity of patenting in Europe	45.7	12.2	7.6	18.3	16.2	100.0
Gaps in regulation	55.8	3.0	6.6	22.8	11.7	100.0
Too much existing regulation	47.7	4.6	10.2	25.4	12.2	100.0
Insufficient implementation of existing regulations	40.6	7.1	18.3	21.3	12.7	100.0
Inadequate level of standards/certification/labelling	47.7	16.2	6.1	19.8	10.2	100.0
Insufficient loans and/or venture capital for research/demonstration/technology development	62.4	4.1	11.7	9.6	12.2	100.0
Insufficient availability of venture capital for business ventures	54.8	2.5	12.7	12.7	17.3	100.0
Public procurement rules not promoting the use of renewable materials/bio-based products	54.8	5.1	11.7	16.8	11.7	100.0
Lack of adequate infrastructures and supply chains	51.3	2.5	11.7	19.8	14.7	100.0
Heavy burden of administration impeding SMEs	47.7	3.0	17.3	11.7	20.3	100.0
Lack of market and/or consumer demand for bio-based products	46.7	2.0	13.2	31.0	7.1	100.0
Negative impacts of incentives towards biofuels on the price of raw materials for bio-based products	45.7	6.1	8.6	21.3	18.3	100.0
Production of industrial raw materials from bio-waste not included in organic waste regulations	40.1	6.6	7.6	9.1	36.5	100.0
Current application of precautionary principle	39.6	2.5	5.1	28.4	24.4	100.0
Lack of agreement on sustainability criteria	58.4	11.2	5.1	17.8	7.6	100.0
Skills gaps	42.6	1.0	16.8	21.3	18.3	100.0
Societal concerns/negative attitudes towards biotechnologies	52.3	1.5	10.7	27.4	8.1	100.0

Figure 17: Barriers preventing the successful functioning of the European bio-based economy today (significant at both EU and national levels (%)

Summing up, respondents perceive that there are many significant barriers, at both EU and national levels, which could hamper the successful functioning of the European bio-based economy. In particular, the main barriers refer to the lack of integrated frameworks and weak links between stakeholders, sectors and policies.

An index of perception concerning barriers has been created combining respondents' answers in four modalities: 'Barriers not significant', 'Barriers significant but only at EU level', 'Barriers significant but only at national level' and 'Barriers significant at both levels'. As could be expected, the vast majority see barriers as significant at both levels (77.4 %) (Figure 18).

Figure 18: Perception of barriers



There are no remarkable differences between the views of respondents from different professional fields, while cross-tabulation analysis shows differences in views among those from different types of organisation (Table 24): respondents from the private sector tend to recognise more the presence of barriers at both levels, while those from the public sector are more likely to perceive barriers significant at one level or not significant at all.

Table 24: Barriers perception significance by sector

Sector	Not significant (%)	Significant but only at national level (%)	Significant but only at EU level (%)	Significant at both EU and national levels (%)	Total (%)
Private	7.4	1.2	6.2	**85.2**	100.0
Public	**14.3**	**14.3**	**14.3**	57.1	100.0
Academ	6.3	4.7	10.9	78.1	100.0
NGOs	**13.6**	4.5	9.1	72.7	100.0
Total	8.7	4.6	9.2	77.4	100.0

A number of comments were provided to this question, especially pointing to issues related to the lack of information and communication: these are summarised in Table 25.

Table 25: Barriers to the successful functioning of the European bio-based economy today

Open answer topics	Frequency
Lack of knowledge transfer	13
Lack of communication	10
Lack of links between the bio-based economy actors and policies	11
Inefficient application of sustainability criteria	5
Lack of focus on the Forestry sector	5
Lack of incentives	5
Lack of regulations	4
Reluctance to change	3
Biofuel targets	3
Barriers at national level	2
Lack of competitiveness	2
Lack of a permanent access to renewable raw materials at world market price conditions	2
Lobbying power of traditional industries	2
Unclear definitions (bio, bio-based economy, etc.)	2
The precautionary principle is not sufficiently applied	2
Lack of consumers awareness raising activities	2
Conflicting energy and waste policies	1
Barriers related to international competition	2
Lack of expertise in innovative research	1
Lack of research into alternatives approach of technology use	1
Lack of societal involvement	1
Lack of structures and measures to implement research results in the market	1
Need for increasing activities in food safety	1
Need for increasing consumer health activities	1
Need for paradigm shift	1
Need for shift from top-down approach to peer-to-peer approach	1
Total	84

Examples of the comments provided include:

- ‘Lack of knowledge sharing:
  [30] ‘The multifunctional and multidisciplinary nature of a bio-based economy are a great strength but can also be a weakness, presenting problems in sharing and communicating knowledge between researchers, producers, consumers and other stakeholders’(*On behalf of an organisation, Public*, *Agriculture, Forestry*);
- ‘Lack of communication’:
  [31] ‘Lack of clear communication’ (*Individual, Academic, Environment*);
- ‘Lack of links between the bio-based economy actors’:
  [32] ‘Insufficient links between decision-makers and stakeholders is the problem’ (*On behalf of an organisation, NGOs*, *Energy and biofuels*).

3.3.3. Participation of society and its acceptance of the European bio-based economy

Effective information and public debate are one of the key points to promote consensus in society over the sustainable bio-based economy and the last question looked at the involvement of society and its acceptance of the European bio-based economy today. Respondents were asked to rate, on a four-point Likert scale ranging from 'Very good' to 'Poor', the availability of information tools and existing debate about the European bio-based economy's benefits and risks. Eight statements were provided (Table 26).

Results show a rather negative tendency: each item was rated 'Fair' or 'Poor' by more than 60 % of respondents. Considering 'Poor' and 'Fair' responses together, the most problematic issues ('Fair' and 'Poor' higher than 80 %) raised by respondents were:

- 'Lack of tools for public dialogue on benefits, costs and risks of the bio-based economy' (87.3 %);
- 'Lack of tools for addressing the ethical concerns of advanced technologies' (81.2 %);
- 'Lack of education/incentives to encourage sustainable consumption patterns' (80.7 %).

In other words, there is a lack of information on the sustainable bio-based economy in society and especially on the benefits, costs and risks, ethical issues and the culture of sustainable consumption.

In this question, two statements received a remarkable share of 'No opinion' answers: 'Availability and quality of information on current and future health impacts' and 'Education/incentives to encourage a shift to healthier diets', both sharing the same percentage (14.2 %).

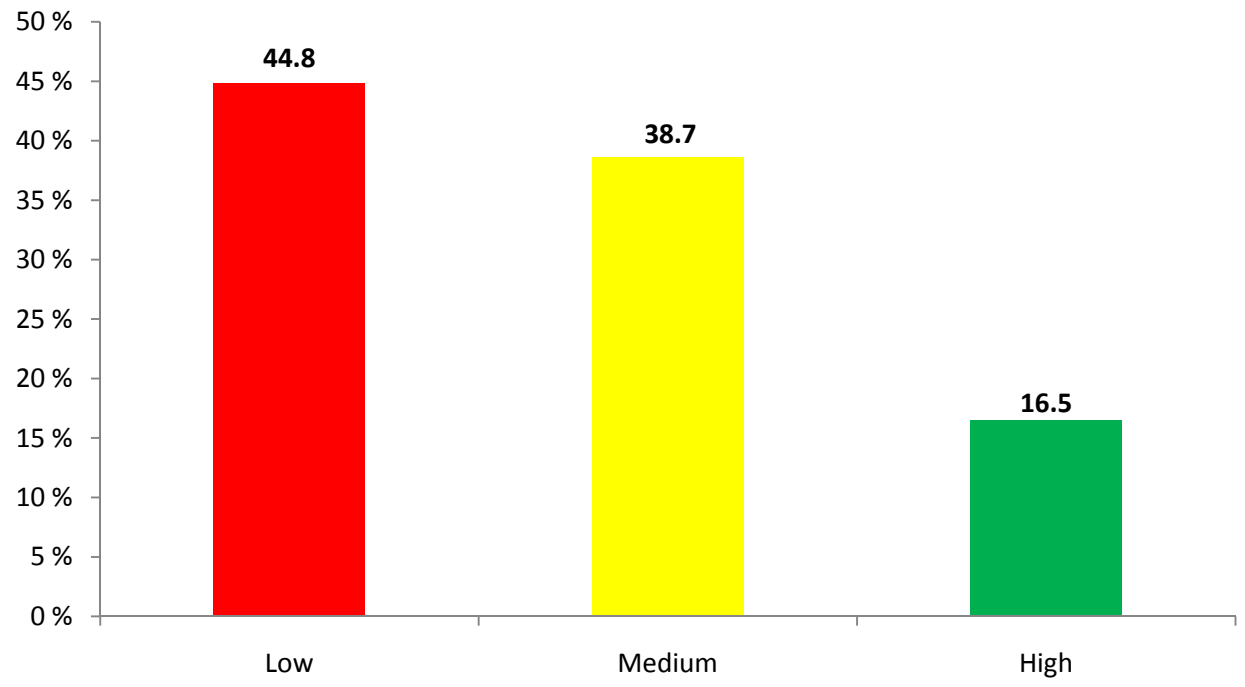
Table 26: Answers to question: "How do you perceive the participation of society and its acceptance of the European bio-based economy?"

Perception	Very good (%)	Good (%)	Fair (%)	Poor (%)	No opinion (%)	Total (%)
Availability and quality of information on current and future environmental impacts	4.1	19.3	42.6	31.5	2.5	100.0
Availability and quality of information on current and future health impacts	3.0	18.8	31.5	32.5	14.2	100.0
Availability and quality of information on current and future availability of natural resources	3.6	17.8	37.1	38.1	3.6	100.0
Availability and quality of information on available bioproducts	2.0	16.8	23.4	51.3	6.6	100.0
Education/incentives to encourage a shift to healthier diets	4.6	18.3	35.0	27.9	14.2	100.0
Education/incentives to encourage sustainable consumption patterns	3.6	10.2	33.5	47.2	5.6	100.0
Tools for public dialogue on the benefits, costs and risks of the bio-based economy	2.0	5.1	25.4	61.9	5.6	100.0
Tools for addressing the ethical concerns of advanced technologies	3.6	6.1	21.8	59.4	9.1	100.0

All the information was synthesised into a single index measuring the degree of society's involvement. The index was named 'Society's involvement in the European bio-based economy' and has three modalities: 'Low', 'Medium and 'High'.

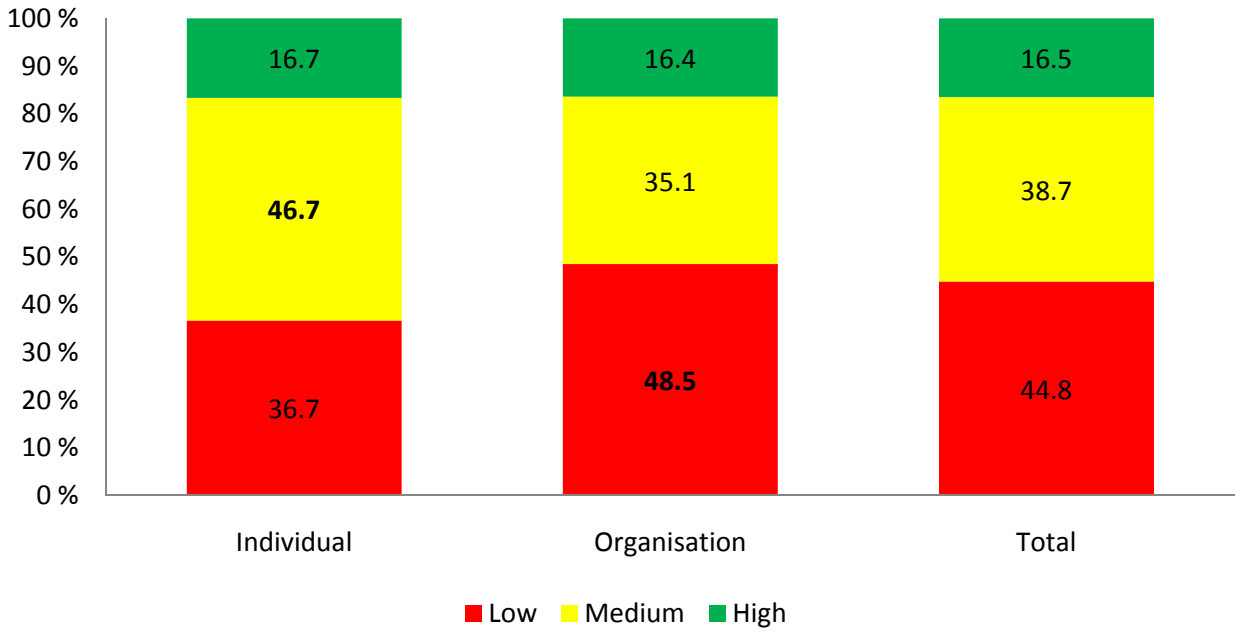
The relative majority of respondents (44.8 %) think that the participation of society is not to a sufficient extent, while fewer (16.5 %) consider, on the contrary, that society's involvement is high.

Figure 19: Society's involvement



The cross-tabulation analysis among this index and the respondents' profile (individual organisation, sector and professional fields) gave some interesting results. Respondents replying on behalf of an organisation tend to think that there is a lesser involvement of society than people answering as individuals (Figure 20).

Figure 20: Society's involvement by respondents' profile



Respondents working in the academic sector are more likely to perceive a high degree of society's participation, while those from, or representing, civil society organisations tend to think that society's involvement is too low (Table 27).

Table 27: Society's involvement by sector

Sector	Low (%)	Medium (%)	High (%)	Total (%)
Private	45.0	43.8	11.3	100.0
Public	39.3	42.9	17.9	100.0
Academic	45.3	31.3	**23.4**	100.0
NGOs	**50.0**	36.4	13.6	100.0
Total	44.8	38.7	16.5	100.0

The results of cross-tabulation analysis by professional field are not quite as significant, except for the fact that respondents from the Industrial biotechnology field are more likely to be present in the 'Low' value of the society's involvement index, while those from the Energy and biofuels field are situated more in the 'High involvement' value.

As well as the opinions expressed above, respondents provided a number of additional comments concerning the participation of society in, and its acceptance of, the European bio-based economy pointing to several aspects in the open comments: these are summarised in Table 28.

Table 28: Participation of society and its acceptance of the European bio-based economy

Open answer topics	Frequency
Need to promote civil society participation in research	18
Lack of availability and quality of information	13
Need for new education opportunities	12
Need to support sustainable consumption patterns	11
Need for raising consumer awareness	10
Existing tools are not used efficiently	10

Lack of incentives	6
Need for better definition of 'bio'	5
Need to change the top-down approach	5
Need for more research for informed policymaking	5
(Influence of) private companies	1
Lack of knowledge sharing	1
Need for paradigm shift	1
Total	98

Some examples of most frequently raised issues in relation to civil society's participation in research are:

- [33] 'Civil society participation in research can help to address societal needs as a driver and provide a sustainable development vision' (*On behalf of an organisation, Academic*, *Agriculture, Environment*);
- [34] 'Civil society participation in research is clearly lacking and should be strengthened' (*On behalf of an organisation, Academic*, *Agriculture*);
- *[35] 'Participation of socie*ty *to create a bio-based economy* is very poor' (*On behalf of an organisation, Private, Industrial biotechnology*).

Another important topic dealt with the problem of knowledge sharing; in particular, respondents reinforced the concept that there is a lack of availability and quality of information about bio-based Economy:

- [36] 'Society is often misled about the real benefits of biotechnologies through misinformation campaigns not based on real data' (*On behalf of an organisation, NGOs, Energy and biofuels*).

Ideas were also raised for the following additional actions:

- 'Need for education opportunities and lack of incentives':
  [37] 'education and incentives necessary' (*on behalf of an organisation, Private*, *Forestry*);
- 'Need to support sustainable consumption patterns':
  [38] 'Participation by civil society organisations in KBBE issues can be more effective within initiatives developing production alternatives which have a low environmental impact, societal needs as a driver and a sustainable development vision' (*on behalf of an organisation, Public, Agriculture, Forestry*);
- 'Need for raising consumer awareness':
  [39]'Awareness-raising actions are necessary to better inform consumers and policymakers on the actual impacts of using this technology' (*On behalf of an organisation, Private, Environment*).

Finally, respondents also highlighted the non-efficient use of existing tools:

- [40] 'Tools for public dialogue are available but efficient implementation needs to be developed and supported' (*On behalf of an organisation, Academic*, *Forestry*).

3.4. A European strategy on a sustainable bio-based economy: advantages and possible future actions

The last section of the questionnaire looked to the future potential of the European strategy and action plan on a sustainable bio-based economy. This section called for respondents' views on the policy interventions and actions necessary for developing a favourable situation for the sustainable bio-based economy in Europe. Specifically, this dimension is articulated in five questions covering the possible advantages of the European-wide bio-based economy strategy; actions required to create a coherent policy framework; research actions needed to implement the European

bio-based economy; actions to support bio-based industries; actions to engage society and to promote social innovation in the bio-based economy.

3.4.1. Main advantages of the European strategy on a sustainable bio-based economy

The first question surveyed the main advantages of the European strategy on a sustainable bio-based economy. Respondents were invited to express their views on each item of a list of potential advantages of the European strategy (nine statements were provided in the question, the list is given in Table 29), using a four-point Likert scale ranging from ‘Strongly disagree’ to ‘Strongly agree’.

Over 80 % of respondents showed agreement with the potential advantages of future actions (‘Strongly agree’ and ‘Agree’ totalled). Respondents strongly support a new European strategy and action plan for a sustainable bio-based economy and perceive many advantages in its implementation (Table 29). However, considering that the results are heavily spread to the positive side, it could also be useful to distinguish between a strong and moderate agreement. Figure 21 reports the items by percentage of ‘Strongly agree’ and ‘Agree’ responses.

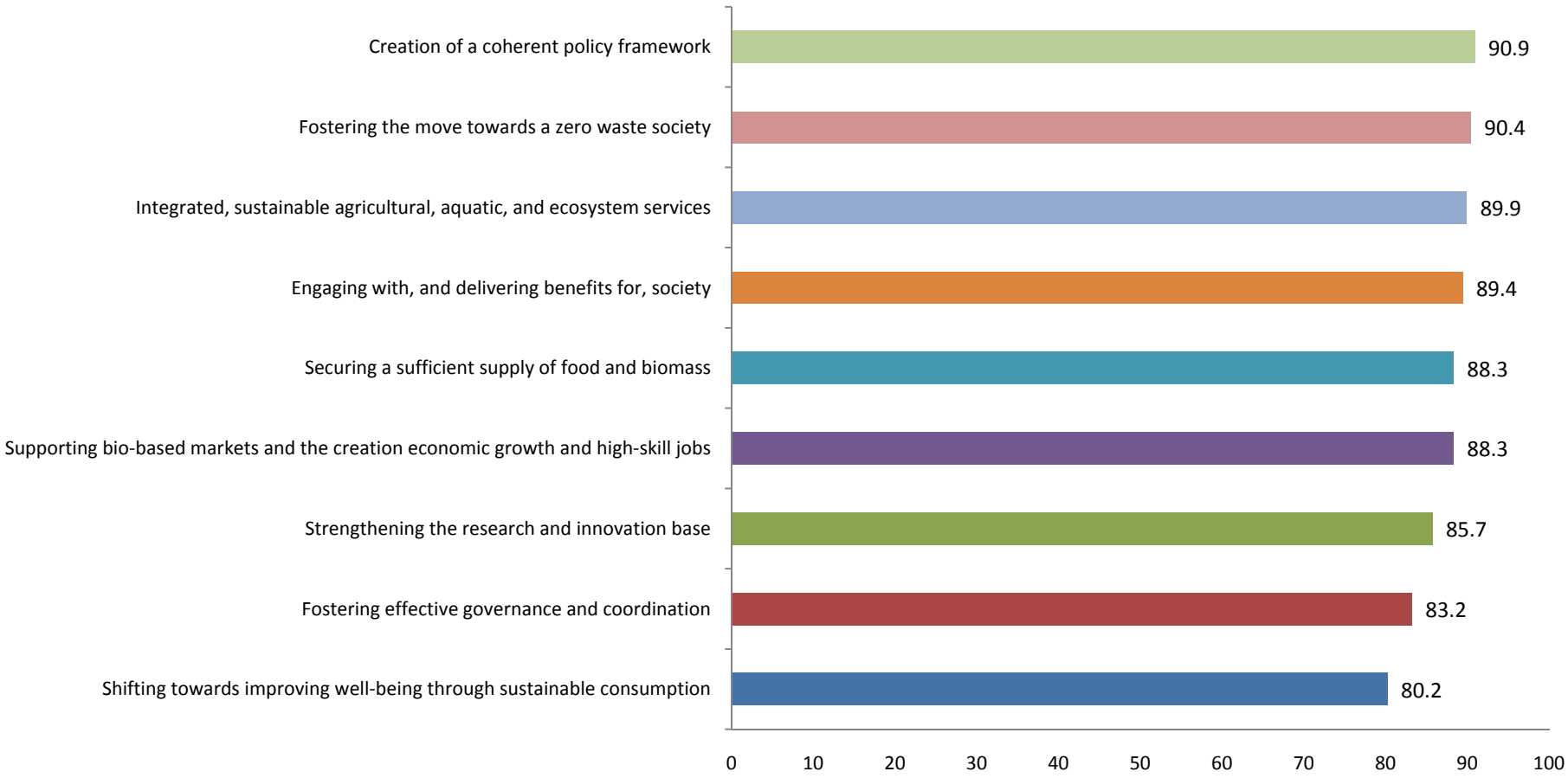
According to respondents, the main advantages of the European strategy are:

- ‘Creation of a coherent policy framework’ (90.9 %);
- ‘Fostering the move towards a zero waste society’ (90.4 %);
- ‘Integrated, sustainable agricultural, aquatic and ecosystem services‘(89.9 %);
- ‘Engaging with, and delivering benefits for, society‘(89.4 %).

Table 29: Answers to question: "In your opinion, what will be the main advantages of the European strategy on a sustainable bio-based economy?"

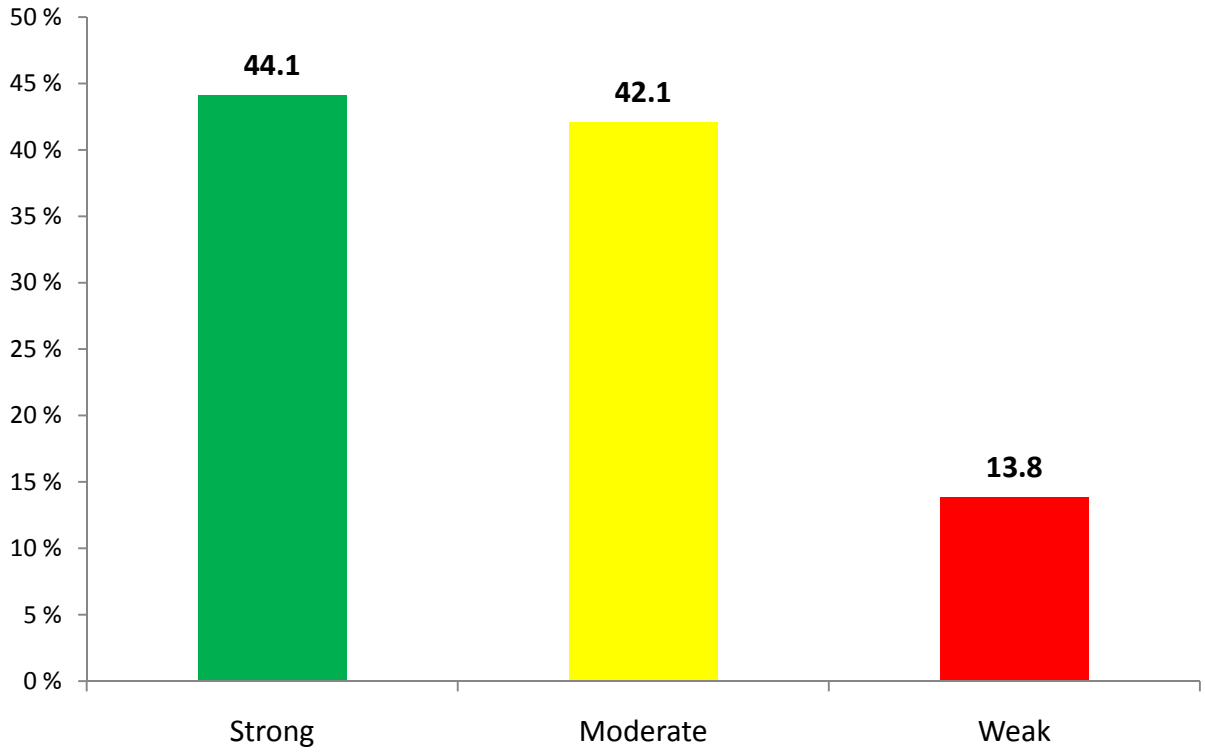
Advantage	Strongly disagree (%)	Disagree (%)	Agree (%)	Strongly agree (%)	Don't know (%)	Total (%)
Securing a sufficient supply of food and biomass	2.0	5.1	32.5	56.9	3.6	100.0
Integrated, sustainable agricultural, aquatic and ecosystem services	1.5	3.0	45.2	43.1	7.1	100.0
Fostering the move towards a zero waste society	2.5	8.1	42.6	43.1	3.6	100.0
Shifting towards improving well-being through sustainable consumption	2.0	10.2	47.2	36.0	4.6	100.0
Fostering effective governance and coordination	2.5	9.6	51.3	28.9	7.6	100.0
Creation of a coherent policy framework	3.0	4.1	45.2	43.1	4.6	100.0
Strengthening the research and innovation base	1.5	4.1	26.9	63.5	4.1	100.0
Supporting bio-based markets and the creation economic growth and high-skill jobs	2.0	5.1	37.1	52.8	3.0	100.0
Engaging with, and delivering benefits for, society	2.0	2.5	44.2	46.7	4.6	100.0

Figure 21: Main advantages of the European strategy on a sustainable bio-based economy (‘Strongly agree’ and ‘Agree’ (%))



All the items were subsequently combined in a single index measuring the degree of agreement towards the European strategy on a sustainable bio-based economy (Figure 22). This index has three modalities: 'Strong' (majority of 'Strongly agree' answers), 'Moderate' (majority of 'Agree' answers) and 'Weak' (majority of 'Disagree' and 'Strongly disagree' answers).

Figure 22: Agreement towards the European strategy on a sustainable bio-based economy



Respondents are broadly divided into two almost equal groups: those having high expectations of the new European strategy on a sustainable bio-based economy (44.1 %) and those showing a moderate agreement (42.1 %). Fewer respondents (13.8 %) think that the potential advantages of the European strategy on a sustainable bio-based economy are weak (Table 30).

Bivariate analysis shows no significant differences between views of individuals and of those replying on behalf of organisation. The private sector seems to be more confident (48.1 %) while respondents from NGOs are more likely to judge the advantages of the new European strategy as 'Moderate' (50.0 %) or 'Weak' (18.2 %).

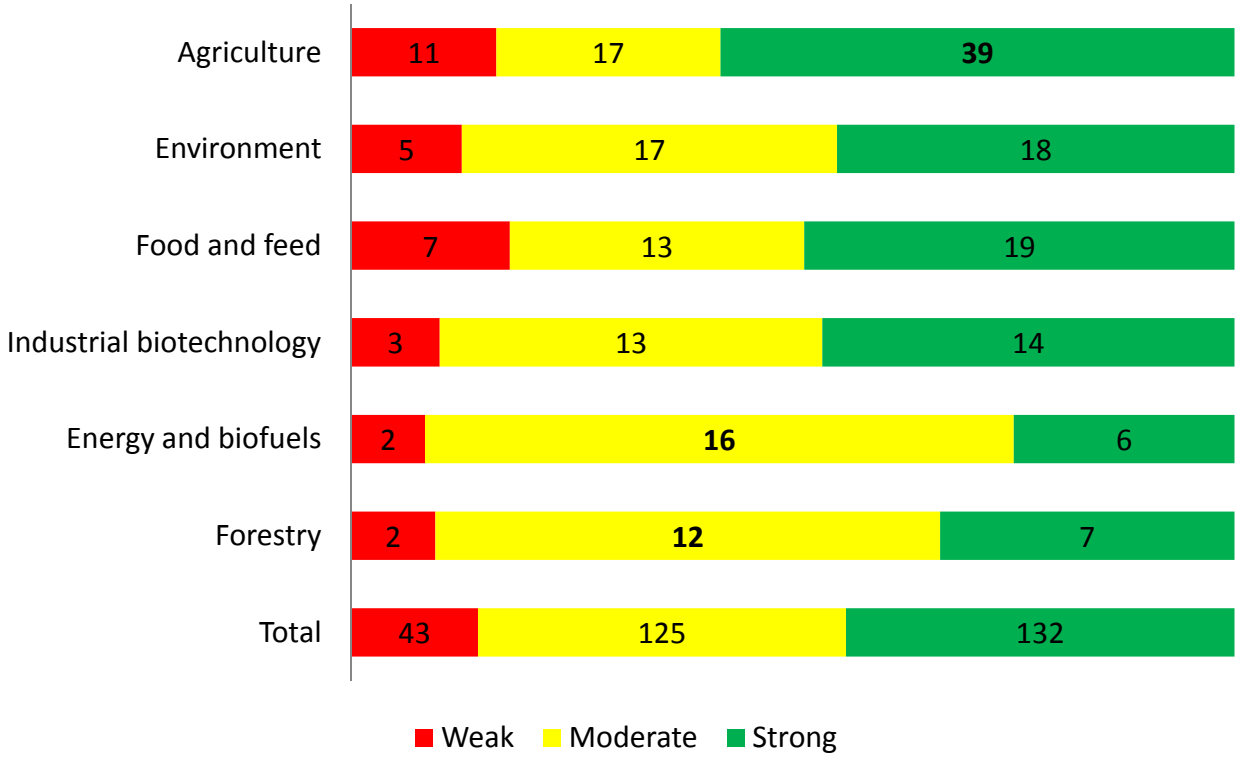
Table 30: Agreement towards the European strategy on a sustainable bio-based economy (column %)

Agreement	Private (%)	Public (%)	Academic (%)	NGOs (%)	Total (%)
Weak	13.6	10.7	14.1	**18.2**	13.8
Moderate	38.3	42.9	43.8	**50.0**	42.1
Strong	**48.1**	46.4	42.2	31.8	44.1
Total	100.0	100.0	100.0	100.0	100.0

The respondents from the Agricultural field show higher support of the new European strategy and, on the contrary, those from the Energy and biofuels and Forestry sectors tend to show more moderate agreement (Figure 23).

Figure 23: Agreement towards the European strategy on a sustainable bio-based economy by professional field (multi-response)

(count; fields with more than 20 answers; 'Total' refers to whole sample responses)



Additional comments provided by respondents to this question covered a wide range of topics. Many respondents pointed out to the need to address Forestry sector issues, for example:

— [41] 'As the forest-based sector has an important role in the European bio-based economy, we would like this sector to be explicitly addressed' (*On behalf of an organisation, Academic*, *Forestry*).

In the comments, it was suggested that one of the main advantages of the European strategy is the promotion of synergies between bio-based economy actors:

— [42] 'The EU can be a very important player if cooperation will be secured and supported' (*On behalf of an organisation, Private*, *Food and feed, Energy and biofuels*).

Many comments highlighted the advantages of the European strategy on a sustainable bio-based economy in creating benefits for economy [43], market growth [44] and society [45]:

— [43] 'Focus on the KBBE will create jobs, growth and better management of land and water resources' (*On behalf of an organisation, Public*, *Agriculture, Environment*);
— [44] 'The benefits of bio-based products to the common market' (*On behalf of an organisation, Public, Socioeconomics*);
— [45] 'It will enable a high level of wellness to be reached by all society while decreasing our impact on other economies and lands' (*Individual, NGOs, Agriculture*).

The comments to this question are summarised in Table 31.

Table 31: Main advantages of the European strategy on a sustainable bio-based economy

Open answer topics	Frequency
Address Forestry sector issues	8
Promote synergy between bio-based economy actors	8
Create benefits for economy	6
Create benefits for market growth	6
Create benefits for society	6
Ensure more efficient use of resources	6
Foster sustainability	6
Foster multiple uses of resources	5
Create new opportunities for employment	4
Create benefits for developing countries	3
Ensure sustainability in biofuels	3
Ensure independence from raw materials and fossil fuel	3
Promote sustainable biomass production	3
Promote regional development	2
Protect consumer health	2
Clarify definition of the bio-based economy	1
Foster environment protection	1
Ensure food security	1
Foster rural development	1
Implement subsidiary principle	1
Implement the precautionary principle	1
Improve knowledge transfer	1
Opening up public debate	1
Remove barriers	1
Foster rural development	1
Total	81

3.4.2. Creating a coherent policy framework and fostering effective governance and coordination

The next question aimed at surveying to what extent new actions are considered necessary and at what level ('At both EU and national/regional', 'Only at EU level' or 'Only at national/regional level') in order to develop a policy framework and to promote effective governance and coordination. According to respondents, all the actions listed in the question (12 actions were suggested, listed in Table 32) need to be implemented at both EU and national/regional levels: percentages received by this response category were very high, sometimes far higher than 70 %.

The actions most needed at both levels are:

- 'Cooperation/coordination':
  'Foster interdisciplinary cooperation in the bio-based economy' (86.8 %), 'Provide a coordination mechanism for all relevant policy domains related to the bio-based economy' (78.2 %) and 'Further develop the European Research Area and coordinate EU/national/regional research agendas' (77.7 %);
- 'Financing':
  'Increase the level of research and innovation funding' (82.2 %) and 'Strengthen links between existing funding instruments for the promotion of the bio-based economy' (79.7 %).

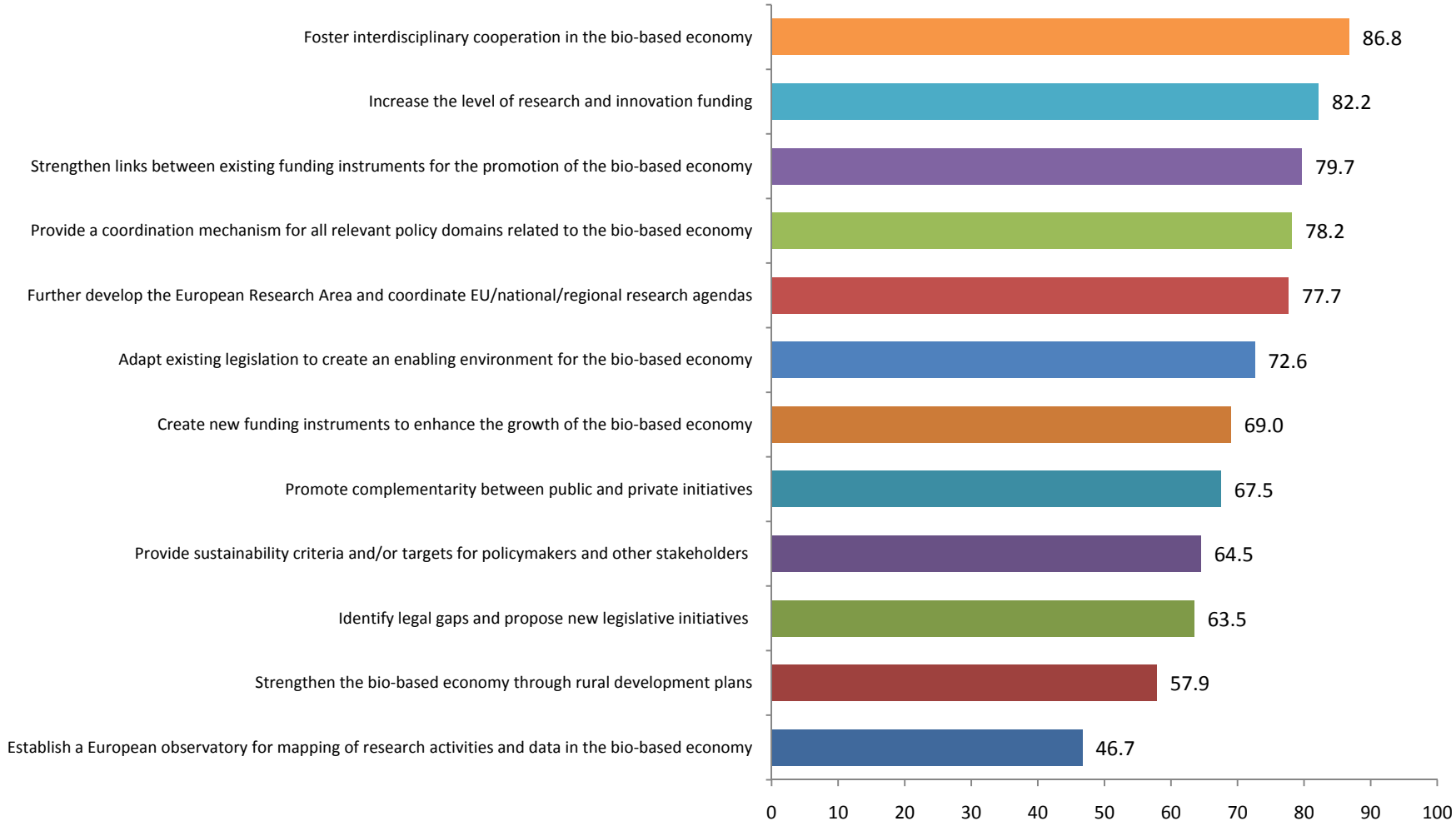
A less supported action needed at both EU and national/regional levels is ‘Establish a European observatory for mapping of research activities and data in the bio-based economy’ (46.7 %). This item also has the strongest characterisation as an action needed but only at EU level (28.9 %) (Figure 24).

Table 32: Answers to question: "In your opinion, what are the actions necessary to create a coherent policy framework and foster effective governance and coordination?"

Action	Action needed at both EU and national/ regional levels (%)	Action needed but only at EU level (%)	Action needed but only at national/ regional level (%)	No further actions required (%)	No opinion (%)	Total (%)
Provide a coordination mechanism for all relevant policy domains related to the bio-based economy	78.2	10.2	1.0	2.5	8.1	100.0
Strengthen links between existing funding instruments for the promotion of the bio-based economy	79.7	5.6	3.6	8.1	3.0	100.0
Create new funding instruments to enhance the growth of the bio-based economy	69.0	8.6	6.1	10.7	5.6	100.0
Further develop the European Research Area and coordinate EU/national/regional research agendas	77.7	11.7	1.0	5.6	4.1	100.0
Establish a European observatory for mapping of research activities and data in the bio-based economy	46.7	28.9	0.5	14.2	9.6	100.0
Strengthen the bio-based economy through rural development plans	57.9	4.1	18.8	10.7	8.6	100.0
Promote complementarity between public and private initiatives	67.5	3.6	15.2	6.1	7.6	100.0
Adapt existing legislation to create an enabling environment for the bio-based economy	72.6	6.6	7.6	8.1	5.1	100.0
Identify legal gaps and propose new legislative initiatives (e.g. in relation to wastes)	63.5	14.7	5.1	6.1	10.7	100.0
Provide sustainability criteria and/or targets for policymakers and other stakeholders (e.g. in relation to wastes)	64.5	13.7	5.6	6.1	10.2	100.0
Increase the level of research and innovation funding	82.2	5.6	3.0	5.6	3.6	100.0
Foster interdisciplinary cooperation in the bio-based economy	86.8	3.6	2.0	3.0	4.6	100.0

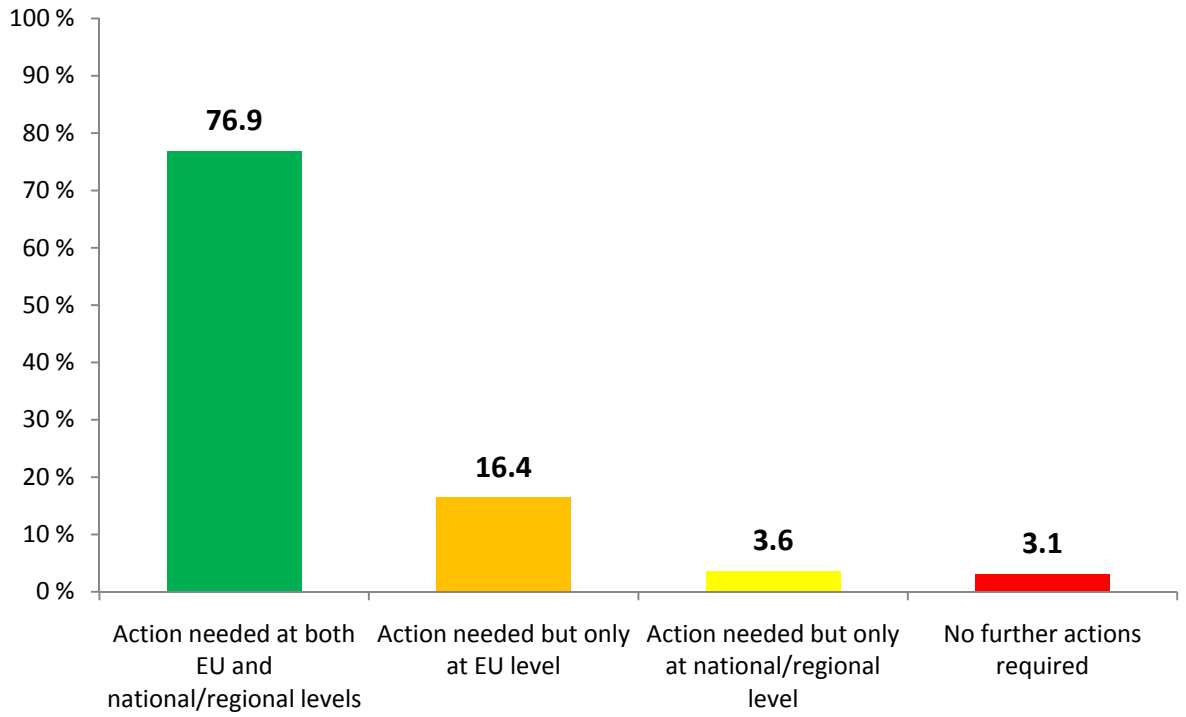
Figure 24: Actions to create a coherent policy framework and foster effective governance and coordination

(% of Action needed at both EU and national/regional levels)



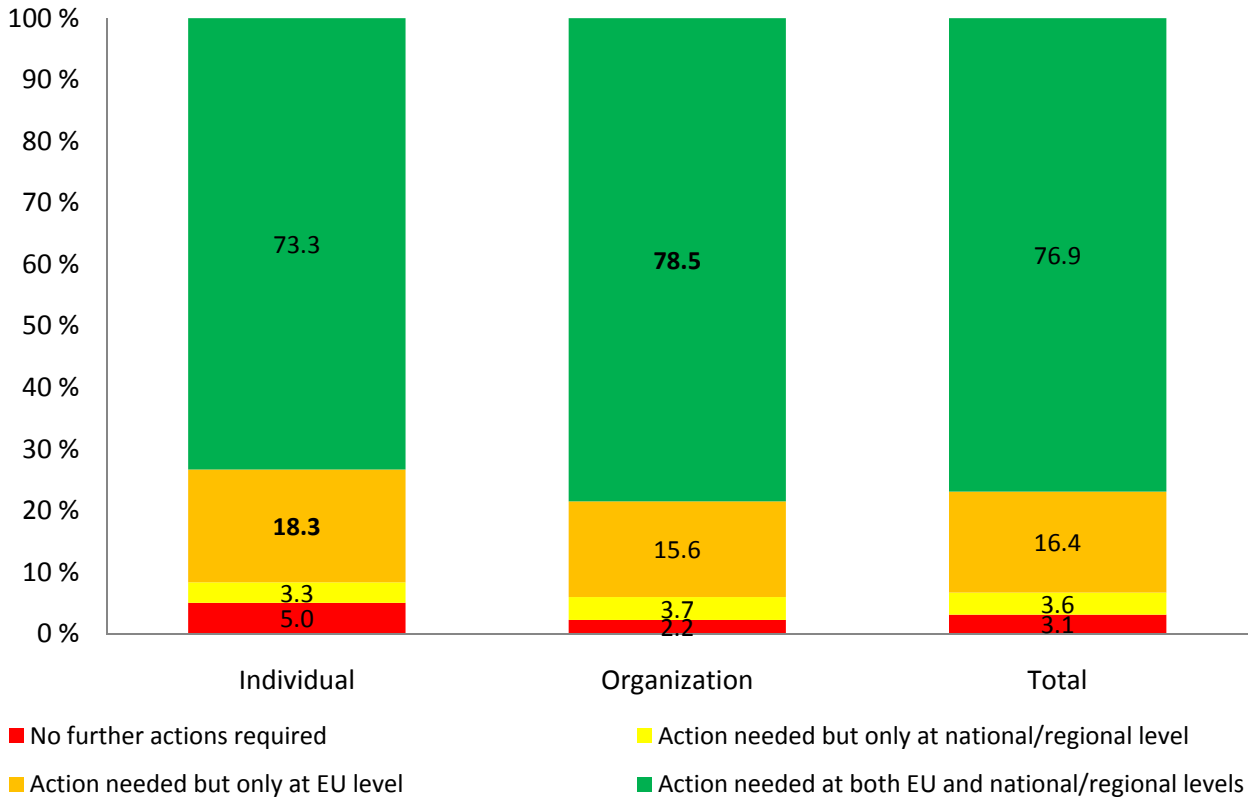
An index measuring the overall need for policy framework actions has been created: the vast majority (76.9 %) believe that many actions are needed at both levels to create a coherent policy framework and foster effective governance and coordination (Figure 25).

Figure 25: Need for actions to create a coherent policy framework



Respondents on behalf of an organisation are more likely to perceive the need for further actions at both levels than those replying as individuals (Figure 26).

Figure 26: Need for actions to create a coherent policy framework (Individual replies v Organisations)



Cross-tabulation analysis by sector shows that actions needed at both levels are more supported by respondents from the private sector, while the public and academic sectors tend to suggest that more actions are needed only at EU level. On the other hand, respondents from NGOs suggest that actions are more needed at 'National/regional levels'.

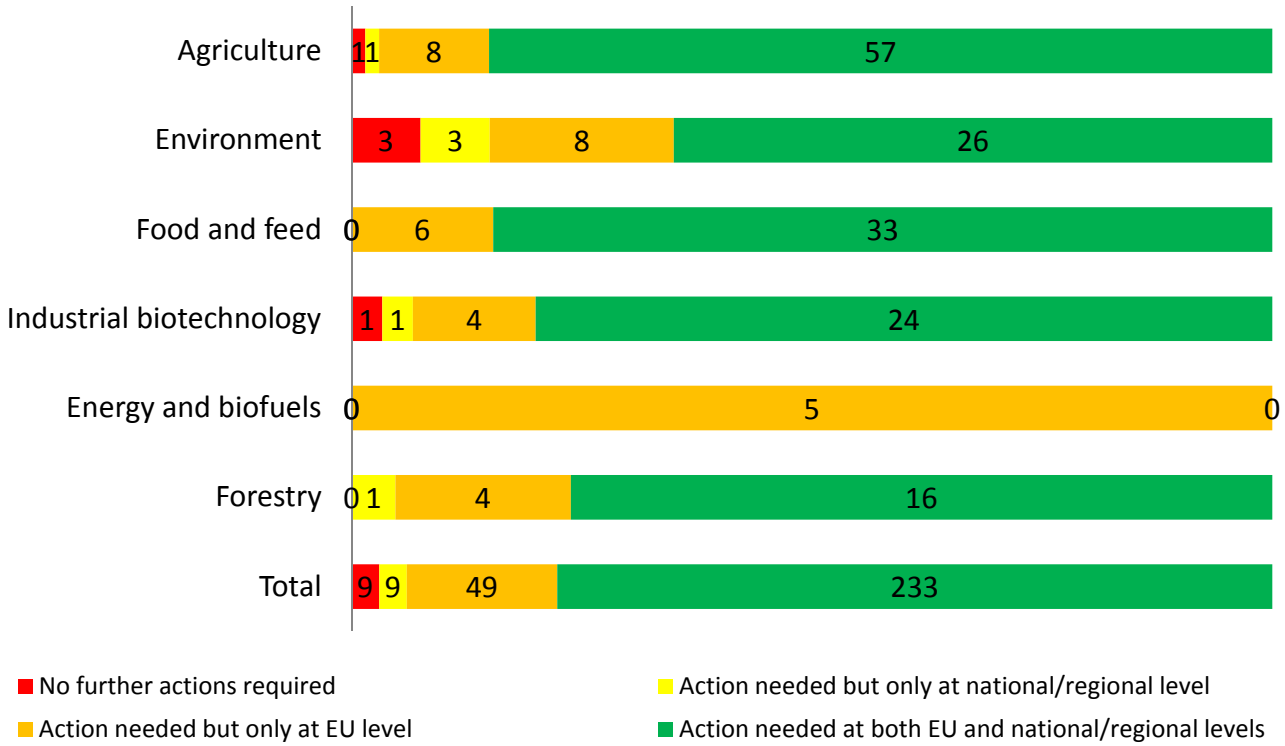
Table 33: Need for actions to create a coherent policy framework by type of organisations

Action	Private (%)	Public (%)	Academic (%)	NGOs (%)	Total (%)
Action needed at both EU and national/regional levels	**81.5**	71.4	78.1	63.6	76.9
Action needed but only at EU level	9.9	**25.0**	**20.3**	18.2	16.4
Action needed but only at national/regional levels	3.7		1.6	**13.6**	3.6
No further actions required	4.9	3.6		4.5	3.1
Total	100.0	100.0	100.0	100.0	100.0

Finally, there were some significant differences in views depending on professional field (Figure 27): respondents from the Environment field seem more likely to suggest that actions are necessary at EU level only, while those from the Agriculture and Food and feed fields argue for the need for actions at both levels. It is important to point out that all respondents from Energy and bio-fuels argue that further actions are necessary at EU level.

Figure 27: Need for actions to create a coherent policy framework by professional field (multi-response)

(count; fields with more than 20 answers; 'Total' refers to whole sample responses)



A number of respondents included additional comments to this question which are summarised in Table 34.

Table 34: Creating a coherent policy framework and fostering effective governance and coordination

Open answer topics	Frequency
Foster synergies between bio-based economy actors	24
Improve existing regulations	10
Improve knowledge transfer	7
Revise waste policy	5
Protect ecosystems	4
Support sustainability criteria	4
Address Forestry sector issues	3
Enhance more efficient use of materials	3
Need for policy addressing soil issues	3
Foster economic growth	2
Increase funding	2
Promote local markets	2
Support rural development	2
Ensure impact assessment	1
Implement lifecycle analysis	1
Ensure compatibility with economic growth	1
Promote education policy	1
Promote Information and Communication Technology (ICT) research	1
Promote international research cooperation	1
Protect consumer health	1

Raise consumer awareness	1
Support technology development	1
Total	80

Some comments addressed the need for synergy between bio-based economy actors:

- [46] 'A coherent policy framework that delivers to a sustainable and growing bio-economy has to include all policies, such as the CAP and regional, environmental, energy, employment and research policy' (*On behalf of an organisation*, *NGOs*, *Agriculture, Food and feed*);
- [47] 'Create a connection between European agricultural policies, environmental and energy policies, and research policy' (*Individual, Academic, Food and feed, Health*);
- [48] 'There is high need for harmonisation and coherence of all policies in order to reach a sustainable and growing bio-economy' (*Individual*, *NGOs*, *Agriculture*).

Other comments highlighted the necessity to improve existing regulations:

- [49] 'A sound regulatory framework to protect and preserve ecosystems and to halt their over-exploitation should be the most important priority' (*On behalf of an organisation*, *NGO*, *Environment*);
- [50] 'Priority lies with adopting regulatory and other instruments that have shown their worth in protecting ecosystems' (*On behalf of an organisation*, *NGO*, *Environment*).

3.4.3. Research actions for implementing the European bio-based economy

The third question in this section concerned the role of research in reinforcing the development of European bio-based economy. Respondents were asked to indicate what research actions are needed, and at what level, to enable efficient implementation of the European bio-based Economy.

According to respondents, all the research actions listed in the question (the list of 15 actions is given in Table 35) should to be strongly supported at both EU and national/regional levels.

The most chosen answers refer to actions supporting research on/into:

- Industrial applications (78.2 %);
- Fostering industrial involvement in research and innovation projects (77.2 %);
- Securing a sufficient supply of food and biomass (76.6 %);
- The reduction of greenhouse gas emissions (76.1 %);
- Fostering the move towards a zero waste society (75.6 %);
- Integrated, sustainable agricultural, aquatic and ecosystem services (72.1 %).

The research action slightly less supported by respondents is 'Building the knowledge base on impacts on developing countries and emerging economies' (48.7 %).

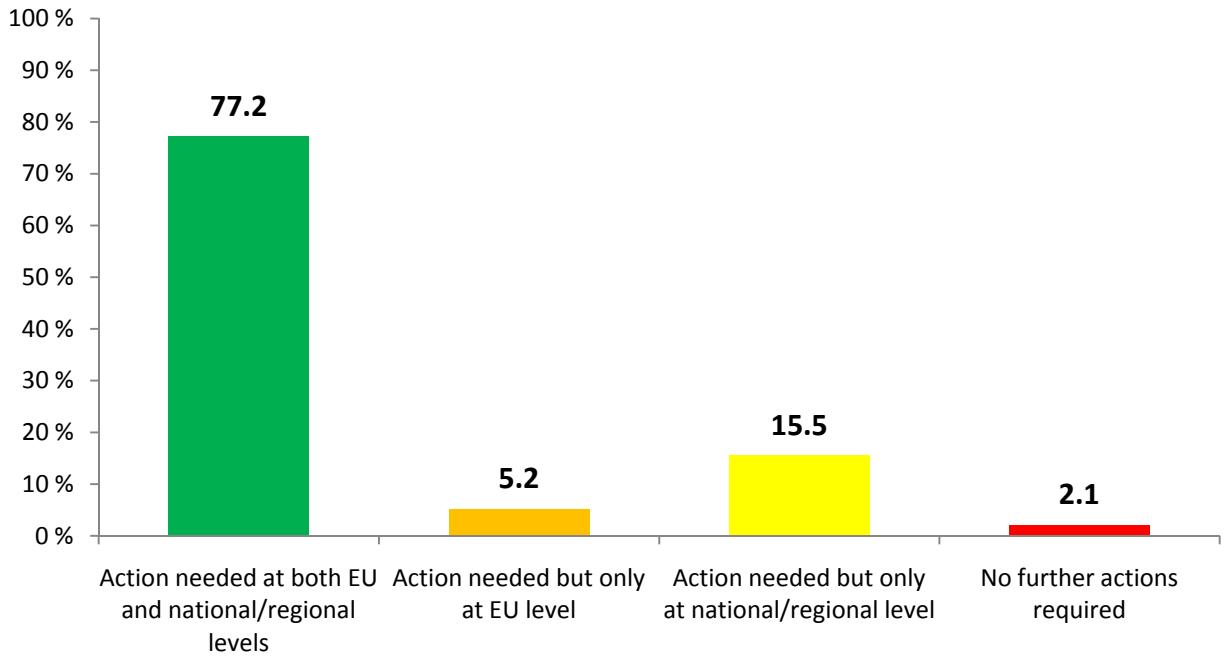
However, it is important to note that a rather high share of respondents had 'No opinion' on the necessity of some actions suggesting the existing gap in information on those issues, such as: 'Build the knowledge base on impacts on developing countries and emerging economies' (11.7 %), 'Support research on integrated, sustainable agricultural, aquatic and ecosystem services' (11.2 %), 'Support research on systems of agriculture and aquaculture coping with predicted water shortages in view of climate change' (10.7 %)(Table 35).

Table 35: Answers to question: "What research actions are necessary to implement the European bio-based economy?"

Action	Action needed at both EU and national/ regional levels (%)	Action needed but only at EU level (%)	Action needed but only at national/ regional level (%)	No further actions required (%)	No opinion (%)	Total (%)
Identify and support research on the key societal challenges in the EU	68.5	11.2	2.0	9.6	8.6	100.0
Foster international cooperation in research on global societal challenges	64.0	20.3	1.0	7.1	7.6	100.0
Support research on securing a sufficient supply of food and biomass	76.6	8.6	4.6	6.6	3.6	100.0
Support research on integrated, sustainable agricultural, aquatic and ecosystem services	72.1	8.1	5.1	3.6	11.2	100.0
Support research on fostering the move towards a zero waste society	75.6	9.1	4.1	4.6	6.6	100.0
Support research on shifting towards improving well-being through sustainable consumption	69.0	4.6	8.6	7.6	10.2	100.0
Support research on the reduction of greenhouse gas emissions (including CO_2)	76.1	6.6	4.1	8.1	5.1	100.0
Support research on systems of agriculture and aquaculture coping with predicted water shortages in view of climate change	65.0	8.1	9.1	7.1	10.7	100.0
Provide instruments and systems for knowledge transfer	67.0	11.7	6.1	7.1	8.1	100.0
Support research into industrial applications	78.2	4.6	5.6	5.1	6.6	100.0
Foster industrial involvement in research and innovation projects (including SMEs)	77.2	4.1	5.1	4.1	9.6	100.0
Build the knowledge base on socioeconomic impacts and support foresight activities	60.4	14.7	6.1	9.1	9.6	100.0
Build the knowledge base on environmental impacts	66.5	17.3	4.6	5.6	6.1	100.0
Build the knowledge base on impacts on developing countries and emerging economies	48.7	30.5	4.6	4.6	11.7	100.0
Support research into ethical and legal aspects of new and emerging technologies	60.9	17.3	2.0	9.6	10.2	100.0

Respondents' answers were further synthesised in an index measuring the necessity of research actions in general. Among all the indexes created for this analysis, this is the one showing the highest percentage in one category: in fact, the vast majority of respondents (79.3 %) call for further actions at both levels. Thus, there is wide agreement among respondents on the necessity of implementing intensely research actions to enforce the European bio-based economy (Figure 28).

Figure 28: Necessity of research action



Cross-tabulation analysis showed no differences between the views of respondents answering as individuals or on behalf of an organisation. However, there are some differences emerging if one considers the views of different sectors (Table 36, most significant results highlighted in bold): respondents working for academic organisations tend to suggest that actions are necessary at 'Both levels' value of the index, while those from the public sector call for actions more at 'Only at national/regional level' and those from NGOs, actions 'Only at national/regional level'.

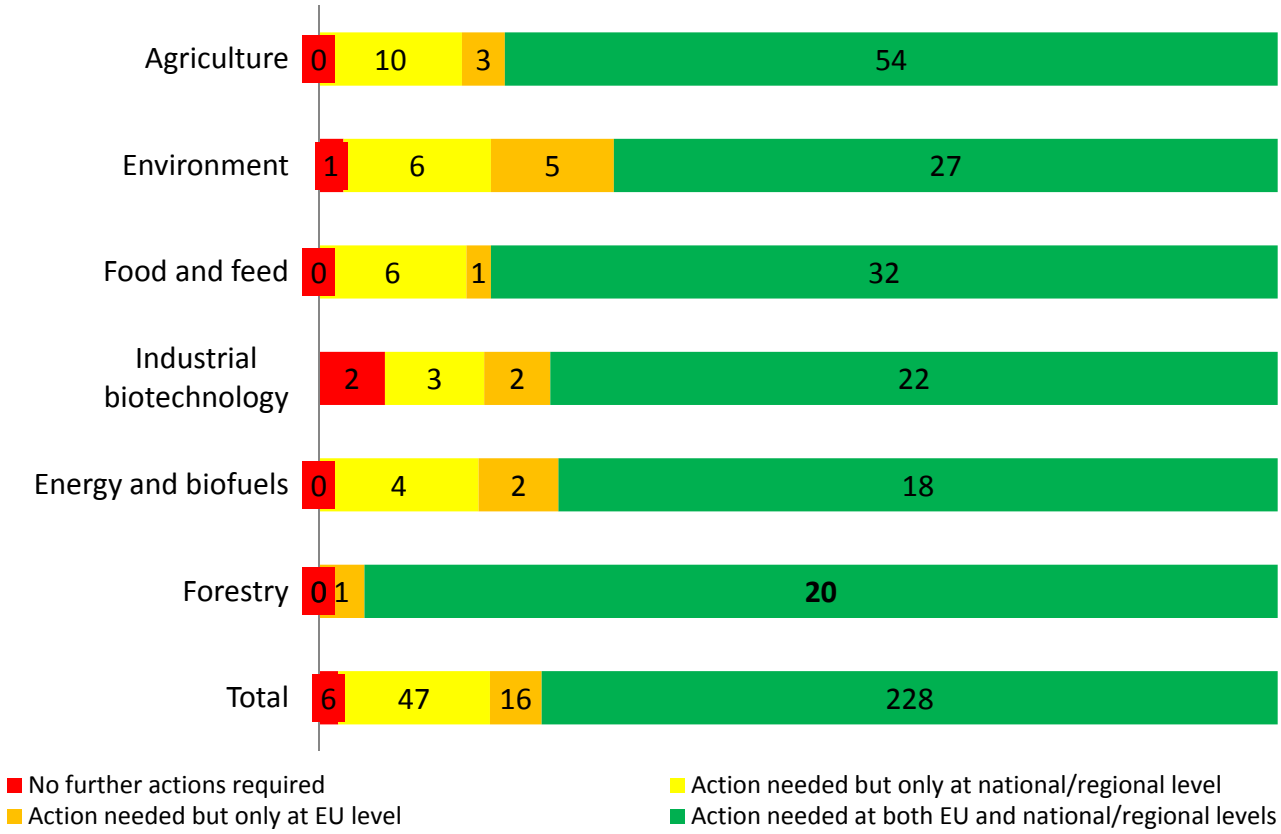
Table 36: Necessity of research action by sectors

Necessity of action	Private (%)	Public (%)	Academic (%)	NGOs (%)	Total (%)
Action needed at both EU and national/regional levels	73.8	71.4	**85.9**	71.4	77.2
Action needed but only at EU level	3.8	7.1	1.6	**19.0**	5.2
Action needed but only at national/regional level	18.8	**21.4**	10.9	9.5	15.5
No further actions required	3.8		1.6		2.1
Total	100.0	100.0	100.0	100.0	100.0

Respondents from the Food and feed field are by far those most inclined to think that research actions are required at both EU and national/regional levels (Figure 29) while those from the Environment field showed the highest quota of 'Action needed but only at EU level'.

Figure 29: Necessity of research action by professional field (multi-response)

(count; fields with more than 20 answers; 'Total' refers to whole sample responses)



Additional comments of respondents dealt with different topics as summarised in Table 37.

Table 37: Research actions for implementing the European bio-based economy

Open answer topics	Frequency
Need for innovation actions	9
Address Forestry sector issues	8
Encourage the involvement of farmers	7
Promote participatory research	7
Support cross-disciplinary research	7
Foster SME involvement	7
Foster knowledge transfer	6
Support sustainability criteria	4
Foster synergy between bio-based economy actors	4
Increase funding	3
Support breakthrough research projects	2
Improve competitiveness	2
Create jobs in rural economies	2
More research on housing	2

Encourage developing countries' involvement	2
Support paradigm shift	2
Include targeted SME programmes	2
Address food security	2
Address ecosystem impact	1
Address ethical issues in decision-making process	1
Develop GMO technology	1
Support research in ICT and robotics	1
Promote local organisation	1
Support research in marine and aquatic resources	1
Support research on socioeconomic impact	1
Total	85

Examples of the comments provided include:

- 'Need for innovation actions':
  [51] 'In order to address societal needs, research actions should always be complemented by innovation actions' (*On behalf of an organisation*, *Private, Industrial biotechnology, Chemicals*);
- 'Encourage the involvement of farmers':
  [52] 'Farmers and organic farmers in particular are important source innovations to value and support' (*On behalf of an organisation*, *Academic, Agriculture*);
- 'Need for participatory research and cross-disciplinary research':
  [53] 'Much more trans-disciplinary, participatory research is needed' (*On behalf of an organisation*, *Public*, *Agriculture*, *Forestry*);
- 'Fostering SME involvement':
  [54] 'Farmers and SMEs are a major source of innovation in the food and farming sector' (*On behalf of an organisation, NGOs, Agriculture, Food and feed*);
  [55] 'Targeted SME programmes are needed' (*On behalf of an organisation*, *Academic, Chemical, Energy and biofuels*).

3.4.4. Actions to support the development of bio-based markets, economic growth and sustainable employment

The fourth question looked into actions needed to promote bio-based industries and economic growth and employment in the bio-based economy sectors. Respondents were asked to indicate what actions are more necessary, and at what level, in order to improve the economic performance of the European bio-based economy and, specifically, of bio-based industries (12 statements were provided and are shown in Table 38).

The results mirror the trends of the previous questions having the same response scheme: the majority of respondents think that the 'Actions are needed at both EU and national/regional levels'. Here the percentage of respondents choosing this modality is always higher than 50 % for each item (Table 29).

The most rated item is, in a certain way, linked to the items previously analysed (Section 3.4.3) as it regards a Research and Innovation action: 'Improve access to finance for research and innovation' is by far the action seen as the most necessary action at both EU and national/regional levels (82.2 %). Other supported actions refer to incentives for industry: 'Propose incentives for industries trying to take innovative bio products to market' (73.1 %) and actions related to public sector: 'Further develop public procurement related to awareness-raising of bio-based products' (70.1 %).

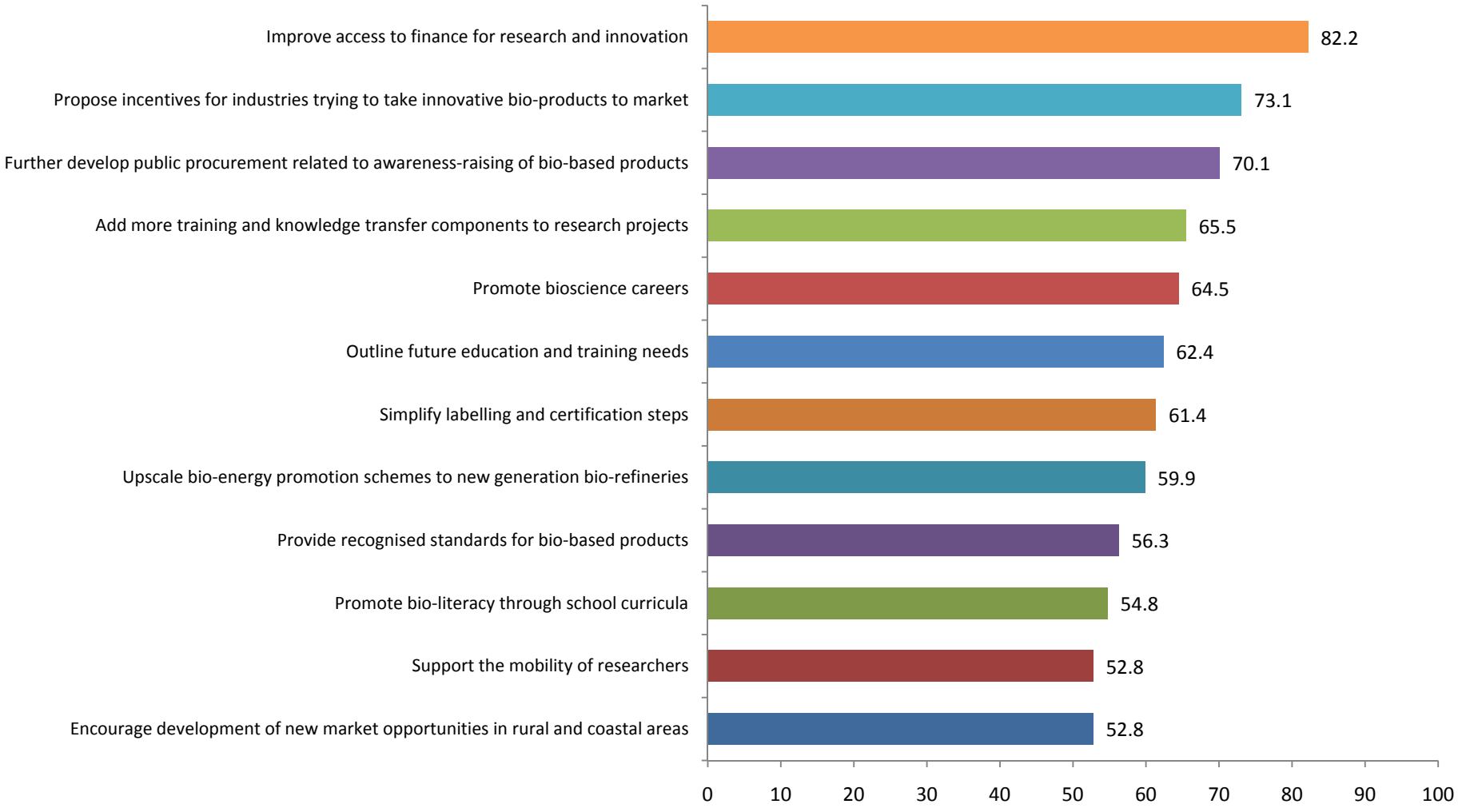
There is also a strong demand for other actions (each one receiving more than 60 %), such as: ‘Add more training and knowledge transfer components to research projects’ (65.5 %), ‘Promote bioscience careers’ (64.5 %), ‘Outline future education and training needs (62.4 %) and ‘Simplify labelling and certification steps’ (61.4 %). These results are summarised in Figure 30.

The action most demanded at EU level is to ‘Provide recognised standards for bio-based products’ (27.9 %), while ‘Promote bio-literacy through school curricula’ (24.4 %) and ‘Encourage development of new market opportunities in rural and coastal areas’ (21.3 %) are the actions most supported at national/regional level.

Table 38: Answers to question: "Which are the actions necessary to support the development of bio-based markets, economic growth and sustainable employment?"

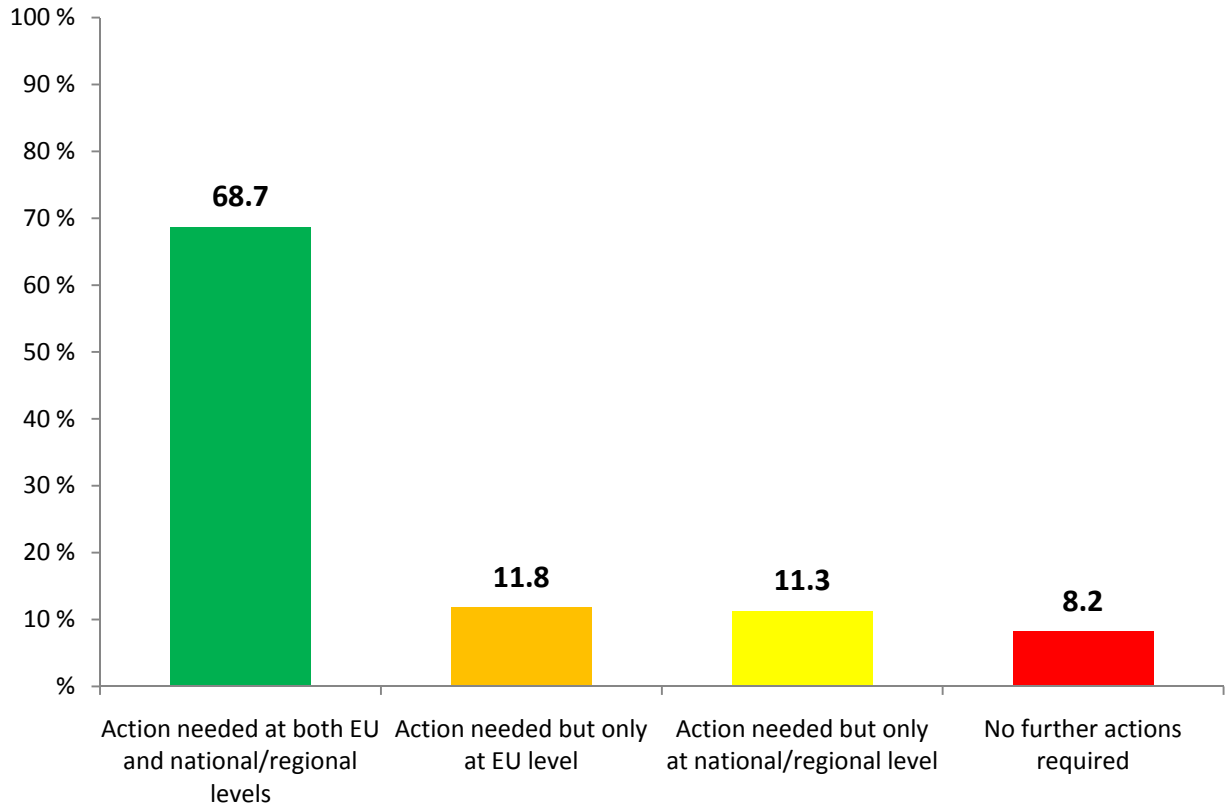
Action	Action needed at both EU and national/regional levels (%)	Action needed but only at EU level (%)	Action needed but only at national/regional level (%)	No further actions required (%)	No opinion (%)	Total (%)
Propose incentives for industries trying to take innovative bio products to market	73.1	3.0	8.1	11.2	4.6	100.0
Encourage development of new market opportunities in rural and coastal areas	52.8	4.6	21.3	12.2	9.1	100.0
Further develop public procurement related to awareness-raising of bio-based products	70.1	3.0	10.2	11.2	5.6	100.0
Provide recognised standards for bio-based products	56.3	27.9	4.1	5.1	6.6	100.0
Improve access to finance for research and innovation	82.2	3.6	3.0	5.6	5.6	100.0
Simplify labelling and certification steps	61.4	16.8	4.1	12.7	5.1	100.0
Upscale bio-energy promotion schemes to new generation bio-refineries	59.9	3.0	4.6	17.3	15.2	100.0
Add more training and knowledge transfer components to research projects	65.5	3.6	9.1	13.2	8.6	100.0
Support the mobility of researchers	52.8	18.3	4.1	13.7	11.2	100.0
Outline future education and training needs	62.4	5.6	11.7	9.1	11.2	100.0
Promote bioscience careers	64.5	4.6	10.7	13.2	7.1	100.0
Promote bio-literacy through school curricula	54.8	2.0	24.4	8.6	10.2	100.0

Figure 30: Actions to support bio-based markets, economic growth and sustainable employment needed at both EU and national/regional levels (%)



Respondents' answers were combined into one index in order to measure with a single variable the necessity of new actions in this area (Figure 31). The majority of respondents feel it is necessary to perform a wide range of economic actions at both levels (68.7 %); less than 10 % of respondents think, on the contrary, that no further actions are required. Finally, the remaining respondents were almost equally split between those who think that actions are needed only at EU level (11.8 %) and those who suggested that most actions are necessary only at national/regional level (11.3 %).
The comparison of this index with the indices in previous questions shows that actions at national/regional level receive slightly more support in this domain.

Figure 31: Necessity for actions to support economic growth and employment



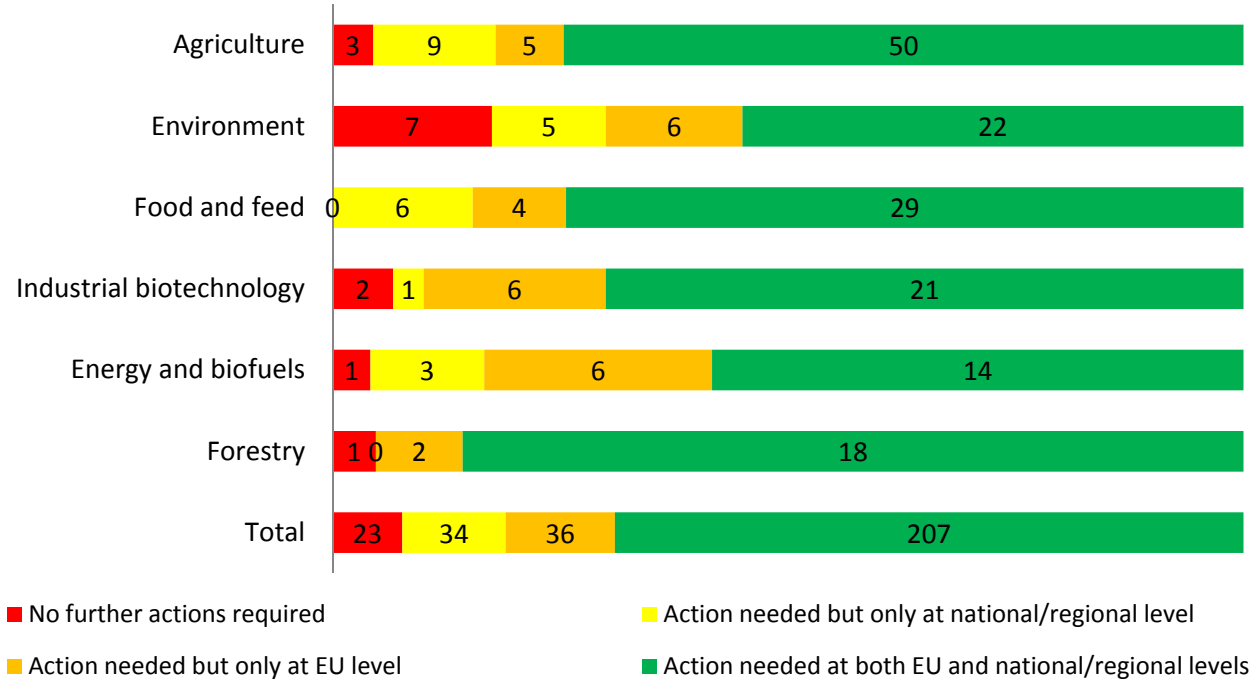
No significant differences can be found if one compares the replies of those answering individually or on behalf of organisations, while there are some relevant differences between different sectors (Table 39): respondents from, or representing, the Academic sector tend to think that actions are necessary at both levels, while respondents from NGOs are more likely to say that no further actions are required at all in relation to economic growth and employment.

Table 39: Necessity for actions to support economic growth and employment by sectors

Necessity of action	Private (%)	Public (%)	Academic (%)	NGOs (%)	Total (%)
Action needed at both EU and national/regional levels	69.1	67.9	**76.6**	45.5	68.7
Action needed but only at EU level	9.9	17.9	7.8	22.7	11.8
Action needed but only at national/regional level	12.3	7.1	12.5	9.1	11.3
No further actions required	8.6	7.1	3.1	**22.7**	8.2
Total	100.0	100.0	100.0	100.0	100.

Bivariate analysis by professional field shows more varying results: respondents from the Forestry field are more likely to suggest that actions are needed at both levels, while those from the Energy and biofuels and Industrial biotechnology fields tend to suggest the necessity of actions at EU level (Figure 32).

Figure 32: Necessity for actions to support economic growth and employment by professional field (multi-response; count; fields with more than 20 answers; 'Total' refers to whole sample responses)



Additional comments provided to this question are summarised in Table 40.

Table 40: Actions to support the development of bio-based markets, economic growth and sustainable employment

Open answer topics	Frequenc
Education for sustainable consumption	8
Closer producer-consumer relationships	8
Strengthen social innovation	5
Support the development of organic farming	5
Actions based on sustainability criteria	5
Support to industries	4
Create standards for bio-based products	3
Protect ecosystems	4
Raise consumer awareness	2
Incentives for sustainable use of resources	2
Knowledge sharing	2
Improve certification and labelling	2
Support the development of organic market	2
Upscaling of bio-energy promotion	2
Build advanced aquaculture methods	1

Building bio-clusters	1
Promote EU countries' cooperation	1
Housing	1
Impact assessment	1
Lifecycle analysis-based	1
Prevent lobbying	1
Monitor the effectiveness of bio-based-related policies	1
Non-bio products forced out of the market	1
Paradigm shift	1
Strengthening of organic food and farming	1
Tax unsustainable economic behaviour	1
Total	67

Some examples show that respondents support actions to support economic growth and employment in the following areas:

- 'Promote education for sustainable consumption':
  [56] 'Education is needed to increase public awareness of the benefits of bio-economy' (*On behalf of an organisation*, *Academic, Energy and biofuels*);
- 'Create closer producer-consumer relationships and strengthen social innovation':
  [57] 'Social innovation (e.g. green public procurement, delivering public good and social benefit) would strengthen relations between producers and consumers, supporting and improving the economic growth and fostering employment in the private and public sector' (*On behalf of an organisation, NGOs, Agriculture, Food and feed*);
- 'Support the development of organic farming':
  [58] 'Maintaining and further developing the organic food and farming concept represent a key step to developing the market' (*On behalf of an organisation, Public, Agriculture, Forestry*).

Another important consideration made by respondent was that:

- [59] 'Any action supporting the development of the bio-based economy should always be based on sustainability criteria' (*On behalf of an organisation, Private, Industrial biotechnology, Chemicals*).

3.4.5. Actions to better engage society and foster social innovation in the bio-based economy

The engagement of society and fostering social innovation in the bio-based economy are the main issues of the last set of items in the questionnaire. Respondents were asked to specify what actions are more necessary, and at what level, in order to better involve society and to improve the social impact of the European bio-based economy itself (the list of eight actions is given in Table 41).

Three actions were considered most necessary at both EU and national/regional levels (Table 29).

The first two regard issues of communication and promotion:

- 'Enhance actions related to communication and dissemination of information on the advantages and risks of the bio-based economy' (77.2 %);
- 'Improve information on bio-based products for consumers' (70.6 %).

The third deals with fostering sustainable consumption:

- 'Enhance actions to encourage healthier, sustainable consumption' (70.1 %).

Even though the modal category is always the same, there are some actions collecting a significant number of ‘Actions needed but only at national/regional level’ answers. These are:

- ‘Provide incentives for consumers to buy sustainable bio-based products’ (21.8 %);
- ‘Promote social innovation in the agri-food chain such as local delivery of food, etc.’ (23.9 %);
- ‘Enhance actions to reduce food waste in households and the food service industries’ (19.8 %).

Probably, and according to many respondents, these actions have also the strongest local/regional characterisation.

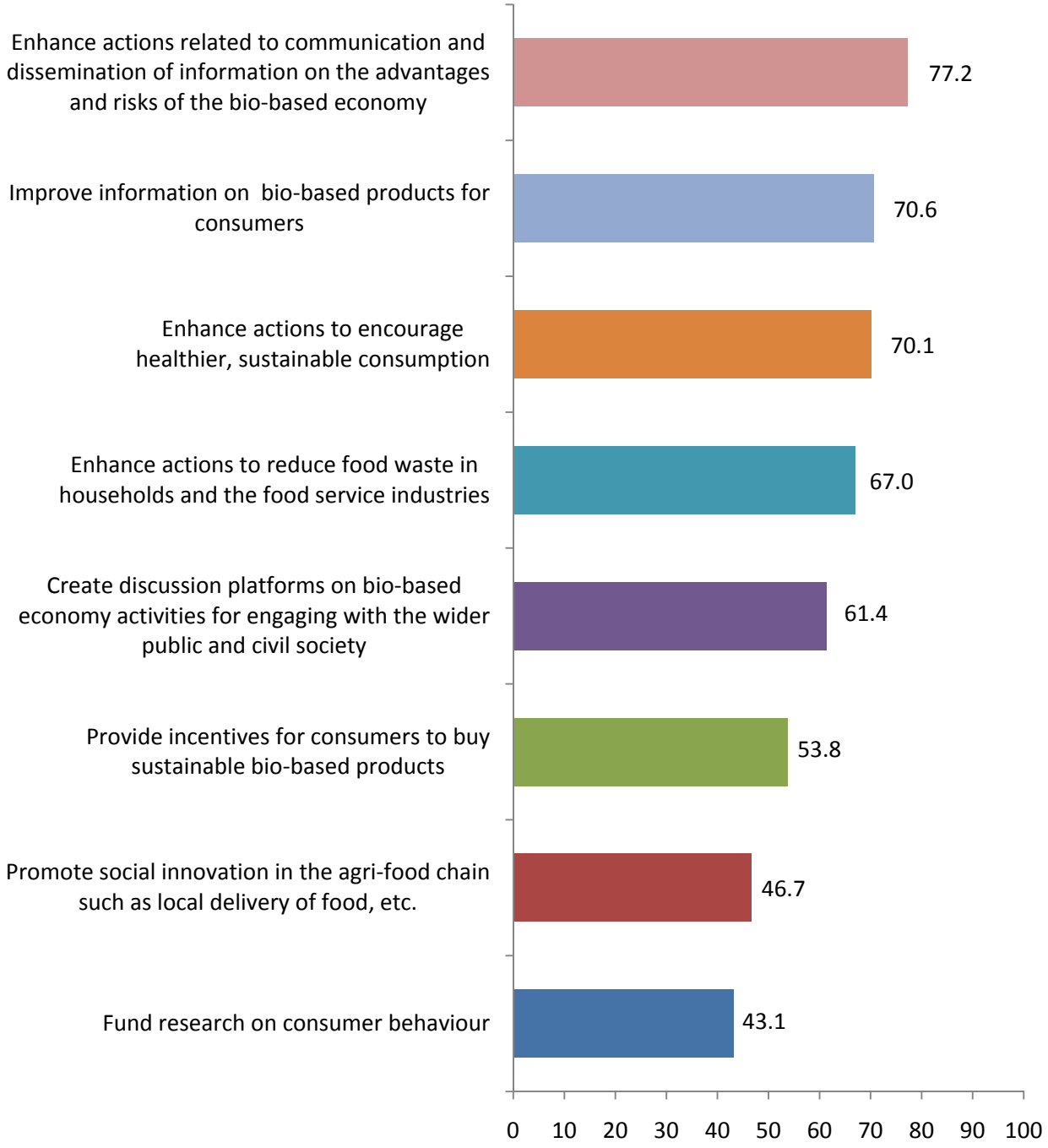
Respondents seem to have more divergent opinions on the necessity for actions to ‘Fund research on consumer behaviour’: this action received by far the highest percentage of ‘No further actions needed’ (26.9 %) and also received a consistent percentage of ‘No opinion answers’ (13.7 %).

To summarise, in line with the results from the analysis of other questions in this section, respondents are more inclined to think that actions to better engage society and foster social innovation in the bio-based economy have to be performed at both EU and national/regional levels (Figure 33).

Table 41: Answers to question: "Which are the actions necessary to better engage society and foster social innovation in the bio-based economy?"

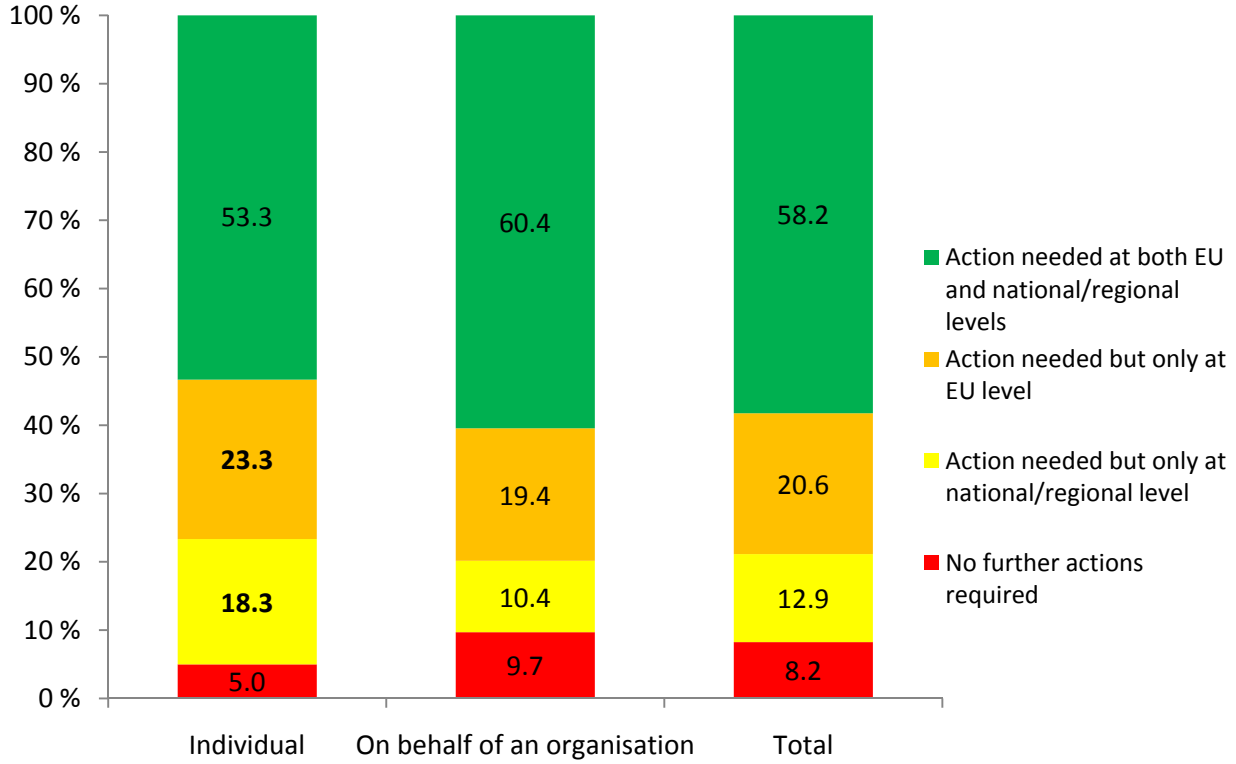
Action	Action needed at both EU and national/ regional levels (%)	Action needed but only at EU level (%)	Action needed but only at national/ regional level (%)	No further actions required (%)	No opinion (%)	Total (%)
Enhance actions related to communication and dissemination of information on the advantages and risks of the bio-based economy	**77.2**	4.1	8.6	7.1	3.0	100.0
Create discussion platforms on bio-based economy activities for engaging with the wider public and civil society	61.4	6.1	14.2	12.2	6.1	100.0
Improve information on bio-based products for consumers	**70.6**	3.6	16.8	5.1	4.1	100.0
Provide incentives for consumers to buy sustainable bio-based products	53.8	2.5	21.8	12.2	9.6	100.0
Fund research on consumer behaviour	43.1	11.2	5.1	26.9	13.7	100.0
Promote social innovation in the agri-food chain such as local delivery of food, etc.	46.7	1.5	23.9	10.7	17.3	100.0
Enhance actions to encourage healthier, sustainable consumption	**70.1**	3.0	13.7	5.6	7.6	100.0
Enhance actions to reduce food waste in households and the food service industries	**67.0**	2.0	**19.8**	4.1	7.1	100.0

Figure 33: Actions to better engage society and foster social innovation needed at both EU and national/regional levels (%)



Slight differences were found between the views of respondents answering as individuals and those on behalf of an organisation (Figure 34): the former seem more inclined to perceive social engagement actions to be mostly needed at 'Only national/regional level' (23.3 %) or 'Only EU level' (18.3 %).

Figure 34: Social engagement actions necessity by respondents' profile (% column)



Cross-tabulation analysis shows that respondents from the public sector share a vision of these actions at both levels, while those from NGOs are more inclined to see social engagement actions performed at EU level.

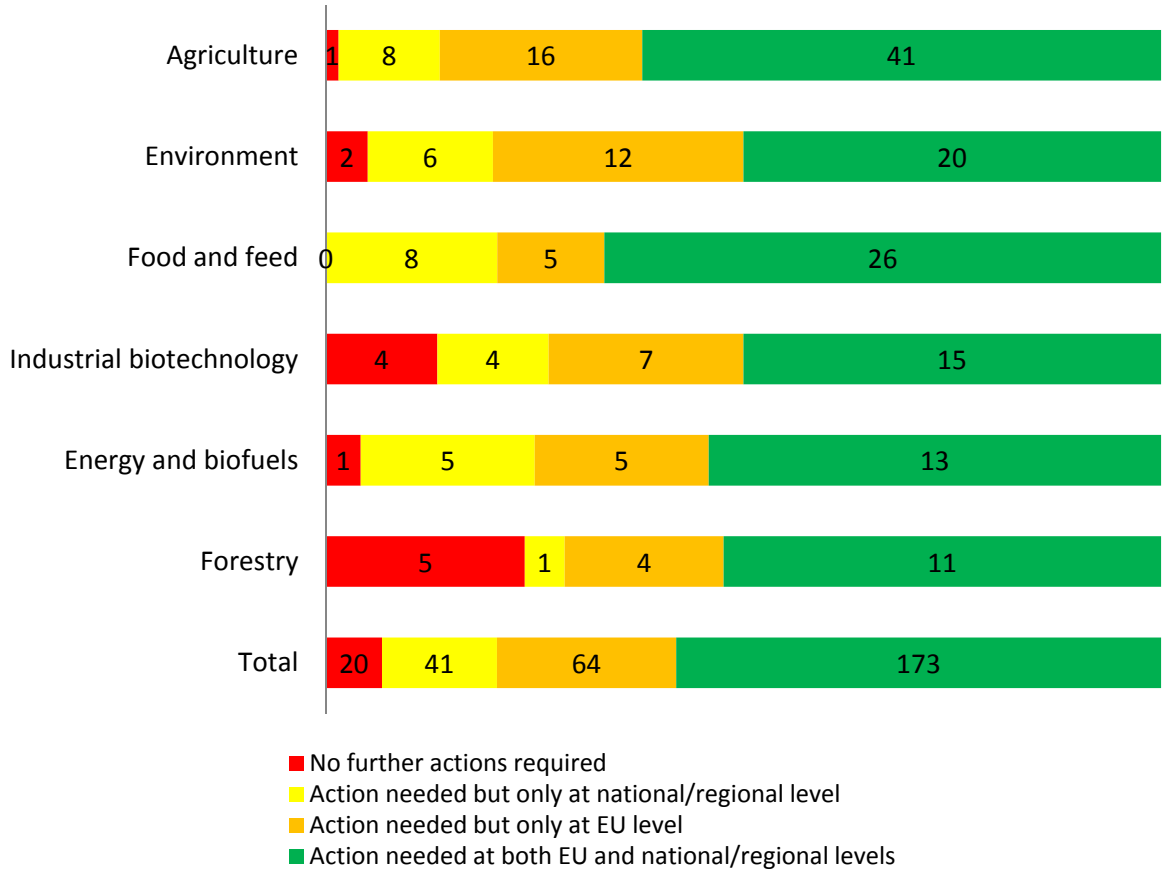
Table 42: Social engagement actions necessity by sectors

Necessity of action	Private (%)	Public (%)	Academic (%)	NGOs (%)	Total (%)
Action needed at both EU and national/regional levels	55.6	**64.3**	61.9	50.0	58.2
Action needed but only at EU level	16.0	17.9	20.6	**40.9**	20.6
Action needed but only at national/regional	16.0	14.3	9.5	9.1	12.9
No further actions required	12.3	3.6	7.9		8.2
Total	100.0	100.0	100.0	100.0	100.

Finally, respondents from the Food and feed field are more likely to perceive social engagement actions necessary at both levels, while those from Forestry show the highest rate of 'No further actions required' at all. Besides, respondents from the Environment and Industrial biotechnology fields tend to suggest that actions are necessary at EU level only, while those from the Energy and biofuels sector more suggest actions at 'Only at national/regional' level (Figure 35).

Figure 35: Social Engagement Actions Necessity by professional field (multi-response)

(count; fields with more than 20 answers; 'Total' refers to whole sample responses)



Additional comments to this question covered a wide range of topics regarding the actions necessary to better engage society and foster social innovation in the bio-based economy: these comments are summarised in Table 43.

Table 43: Actions to better engage society and foster social innovation in the bio-based economy

Open answer topics	Frequency
Promote consumers' involvement in research	11
Foster environmental protection	9
Address issues of community basic needs	9
Promote alternative economic practice	8
Link between bio-based economy actors — networking	6
Promote the innovative non-food, non-energy use of biomass	6
Promote TP involvement	4
Promote sustainability criteria	3
Address issues in the Forestry sector	3
Increase incentives and funding	3
Safeguard consumer health	2
Move to implementation	2
Support economic growth	2
Strengthen closer producer-consumer relationships	1
Clarify definition of a bio-based economy	1
Developing of organic food and farming system	1

Tackling food waste	1
More independent research	1
Need for clear labelling	1
Promoting women in science and research	1
Rural development policies	1
Support for local production	1
Support research on new GMOs	1
Supporting local food systems	1
Total	79

According to respondents, the most important action needed is the involvement of consumers in research:

- [60] 'Create opportunities for involvement in defining research topics and priorities' (*Individual, Academic, Food and feed, Health*);
- [61] 'CSOs must be involved in defining research topics and priorities (e.g. by participating strongly in the European Technology Platforms (ETPs)) to develop a joint model of social innovation production' (*On behalf of an organisation, Private, Agriculture, Food and feed*).

Other important actions concern:

- 'Fostering environmental protection':
  [62] 'Before the EU moves to enhance biosciences and their application to industry, we must be sure that all methods are safe for consumers' health and the environment through research conducted by independent bodies' (*On behalf of an organisation, NGOs, Socioeconomics*);
- 'Addressing issues for community basic needs and promoting alternative economic practice':
  [63] 'Civil society organisation (CSO) engagement should be seen as a bottom-up process. Creation of social innovation should start from the community's basic needs, environmental protection and alternative economic practice' (*On behalf of an organisation, NGOs, Agriculture, Food and feed*);
- 'Creating links between bio-based economy actors':
  [64] 'Social innovation (e.g. public goods and social benefits) would strengthen relations between producers and consumer, supporting and improving the economic growth in private and public sector' (*On behalf of an organisation, Private, Agriculture, Food and feed*);
- 'Fostering sustainable activities':
  [65] 'Promote the sustainable consumption of innovative non-food products and their reuse (second-hand market)' (*On behalf of an organisation, Private, Forestry*).

4. A typology of attitudes towards the European bio-based economy

This section briefly presents the results of the multivariate analysis (a multiple correspondence analysis followed by a cluster analysis) performed in order to group respondents according to their different views on the European bio-based economy. All the 11 indexes, calculated for each question in the questionnaire and presented in the previous sections of this report were used as active variables, while respondents' profile variables were used as supplementary variables ([11]). Note that in order to increase the significance of statistical analysis and to simplify the interpretation of the results, response categories 'Action needed but only at national/regional level' and 'Action needed but only at EU level' (if present) have been joined in 'Action needed at one level'.

According to the multiple correspondence analysis results, three factors best synthesised our variables: they were subsequently used as cluster analysis criteria to group together the respondents. Cluster analysis shows that the research sample could be divided into three groups of respondents. Note that, to simplify cluster interpretation, readers may refer only to positive test values, as it could be said that those categories with the highest test value best represents a cluster.

The first cluster presented in Table 44 is the largest and contains 135 respondents (68.5 %).Respondents belonging to this group believe that actions in favour of the European bio-based economy have to be implemented at both EU and local levels; they recognise there are significant barriers to the development but they have a strong and optimistic attitude and they have a broad view of the importance of policy areas. For these reasons, this cluster was named the *Trustfuls*.

Table 44: First cluster

Variable	Characteristic modality	Test value
Necessity for actions to support economic growth and employment	Action needed at both levels	11.45
Necessity for research action	Action needed at both levels	9.40
Society involvement	Action needed at both levels	8.64
Need for actions to create a coherent policy framework	Action needed at both levels	7.44
Barriers perception significance	Significant at both levels	5.19
View of importance of policy areas	Broad	5.05
Agreement towards the European strategy on a sustainable bio-based economy	Strong	4.63
Attitude towards potential benefits	Optimistic	2.79
Effectiveness of Research and Innovation actions	Effective at both levels	2.36
Central zone		
Barriers perception significance	Significant at one level	– 2.49
Effectiveness of Research and Innovation actions	Effective at one level	– 2.72
Society involvement	No further actions required	– 3.26
Necessity for research action	No further actions required	– 3.31
Barriers perception significance	Not significant	– 4.04
Need for actions to create a coherent policy framework	No further actions required	– 4.11

([11]) The first step multiple correspondence analysis is the distinction of variables between *active* and *supplementary*: the former group of variables has a distinctive role in setting up the factors, while the latter does not, although it may contribute to their interpretation.

View of importance of policy areas	Focused	– 5.05
Agreement towards the European strategy on a sustainable bio-based economy	Weak	– 5.17
Need for action on policy framework	Action needed at one level	– 5.62
Necessity for actions to support economic growth and employment	No further actions required	– 5.67
Society involvement	Action needed at one level	– 6.30
Necessity for actions to support economic growth and employment	Action needed at one level	– 7.82
Necessity for research action	Action needed at one level	– 8.12

The second cluster is presented in Table 45 and includes 46 respondents (23.4 %). Respondents in this group generally perceive all the actions related to the European bio-based economy to be implemented at one level only. They have a confident attitude and a focused view of the importance of policy areas in building a sustainable bio-based economy. But, they seem to be more reserved in relation to the advantages of the new European strategy and action plan. For all these reasons, this cluster has been labelled as the *Cautious*.

Table 45: Second cluster

Variable	Characteristic modality	Test value
Necessity for actions to support economic growth and employment	Action needed at one level	9.78
Necessity for research action	Action needed at one level	7.49
Society involvement	Action needed at one level	7.23
Need for actions to create a coherent policy framework	Action needed at one level	4.27
Attitude towards potential benefits	Confident	3.36
Effectiveness of Research and Innovation actions	Effective at one level	3.25
View of importance of policy areas	Focused	3.18
Agreement towards the European strategy on a sustainable bio-based economy	Weak	2.60
Potential risks perception	Medium	2.49
Barriers perception significance	Significant at one level	2.37
Central zone		
Attitude towards potential benefits	Optimistic	– 2.42
Barriers perception significance	Significant at both levels	– 2.66
View of importance of policy areas	Broad	– 3.18
Agreement towards the European strategy on a sustainable bio-based economy	Strong	– 3.33
Need for actions to create a coherent policy framework	Action needed at both levels	– 3.57
Potential risks perception	High	– 3.67
Necessity for research action	Action needed at both levels	– 6.18
Society involvement	Action needed at both levels	– 7.58
Necessity for actions to support economic growth and employment	Action needed at both levels	– 8.69

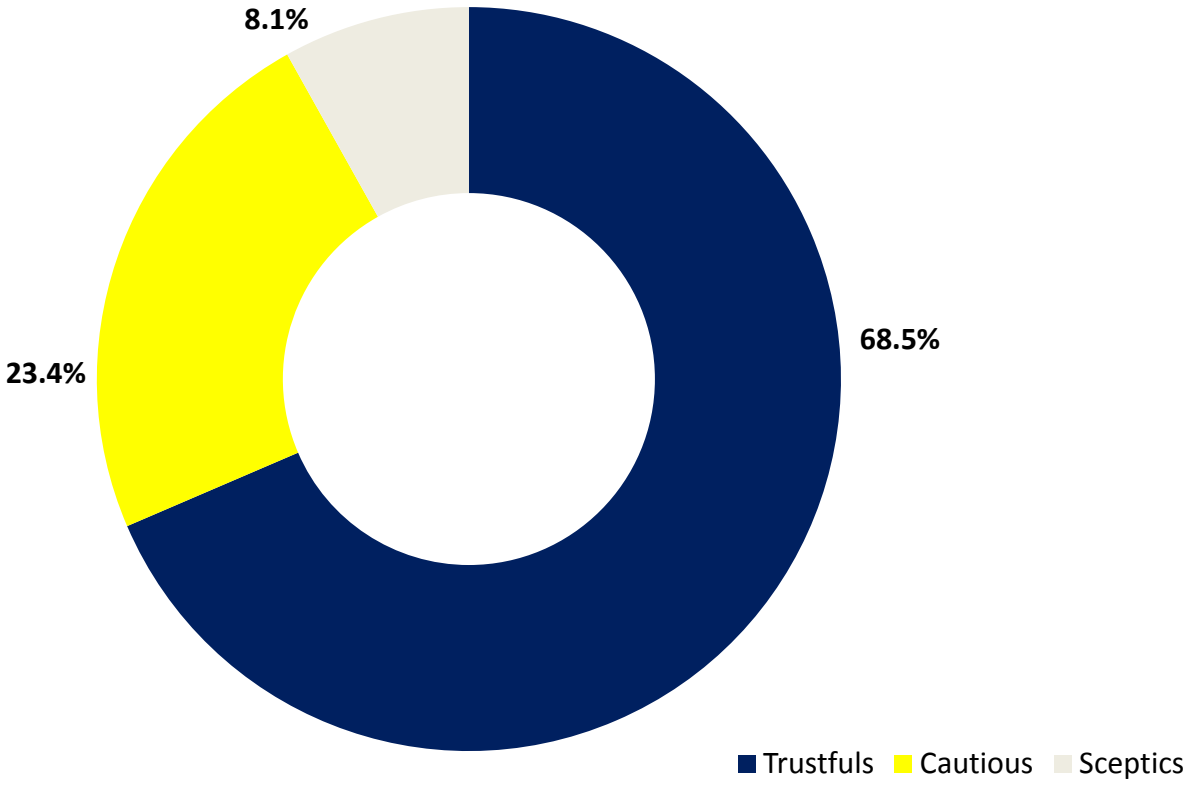
The third cluster is presented in Table 46 and is the smallest (8.1 %) and it has been named the *Sceptics* as respondents had more sceptical attitudes towards the benefits of the bio-based economy and less support for the new European strategy in general. Furthermore, they don't generally think that further actions are needed to develop the European bio-based economy.

Table 46: Third cluster

Variable	Characteristic modality	Test value
Necessity for actions to support economic growth and employment	No further actions required	8.75
Need for actions to create a coherent policy framework	No further actions required	5.86
Necessity for research action	No further actions required	5.86
Attitude towards potential benefits	Sceptic	4.57
Barriers perception significance	Not significant	4.30
Society involvement	No further actions required	4.21
Agreement towards the European strategy on a sustainable bio-based economy	Weak	3.87
View of importance of policy areas	Focused	3.29
Central zone		
Attitude towards potential benefits	Confident	– 2.39
Agreement towards the European strategy on a sustainable bio-based economy	Strong	– 2.47
Society involvement	Action needed at both levels	– 2.72
View of importance of policy areas	Broad	– 3.29
Barriers perception significance	Significant at both levels	– 4.06
Necessity for research action	Action needed at both levels	– 5.03
Necessity for actions to support economic growth and employment	Action needed at both levels	– 5.37
Need for actions to create a coherent policy framework	Action needed at both levels	– 6.21

Figure 36 summarises the results of the cluster analysis.

Figure 36: A typology of attitudes towards European bio-based economy



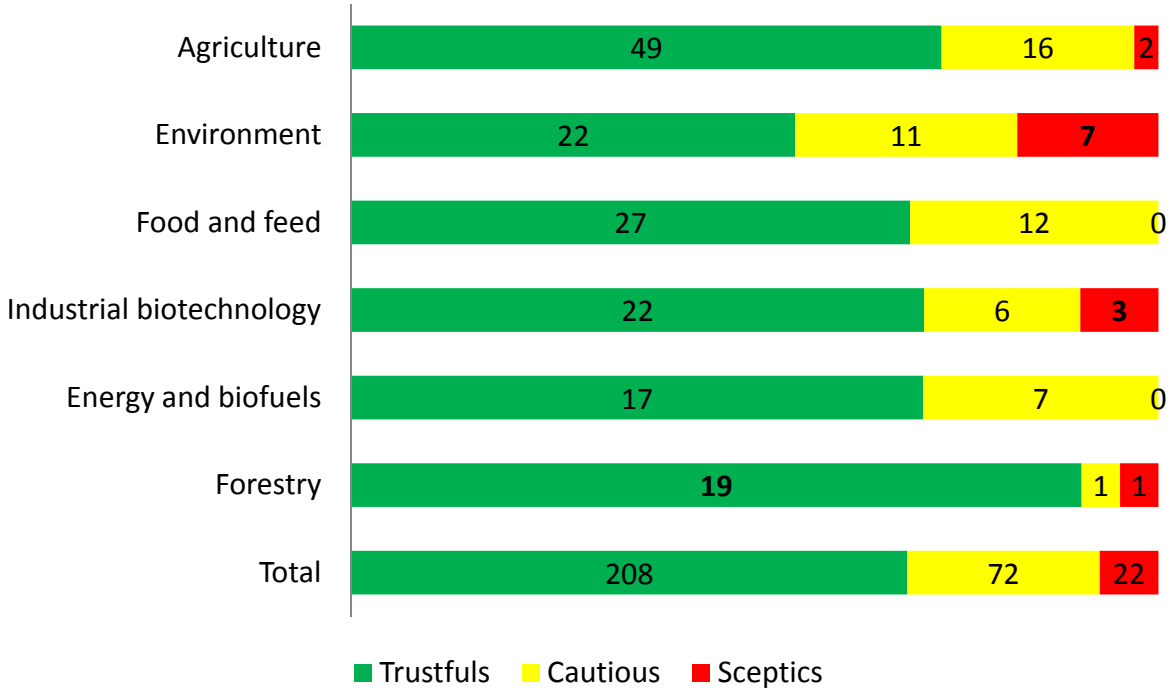
There were no significant associations between the typology and the respondents' profile. Cross-tabulation analysis shows that *Trustfuls* are more likely to come from the Academic sector (75.4 %), while *Sceptics* are more likely to come from the NGO sector (18.2 %).

Table 47: Attitudes towards the European bio-based economy by sector

Attitude	Private (%)	Public (%)	Academic (%)	NGOs (%)	Total (%)
Trustfuls	67.1	67.9	**75.4**	54.5	68.5
Cautious	24.4	25.0	20.0	27.3	23.4
Sceptics	8.5	7.1	4.6	**18.2**	8.1
Total	100.0	100.0	100.0	100.0	100.0

Respondents from the Forestry field are more inclined to be in the *Trustfuls* cluster, while those from the Environment field are more likely to be *Sceptics* (Figure 37).

Figure 37: Attitudes towards European bio-based economy by professional field (multi-response) (count; fields with more than 20 answers; 'Total' refers to whole sample responses)



European Commission

Bio-based economy for Europe: state of play and future potential - Part1 - Report on the European Commission's Public on-line consultation

Luxembourg: Publications Office of the European Union

2011 — 88 pp. — 17,6 x 25,0 cm

ISBN 978-92-79-20652-8
doi 10.2777/67383

How to obtain EU publications

Free publications:

- via EU Bookshop (http://bookshop.europa.eu);
- at the European Union's representations or delegations. You can obtain their contact details on the Internet (http://ec.europa.eu) or by sending a fax to +352 2929-42758.

Priced publications:

- via EU Bookshop (http://bookshop.europa.eu);

Priced subscriptions (e.g. annual series of the Official Journal of the European Union and reports of cases before the Court of Justice of the European Union):

- via one of the sales agents of the Publications Office of the European Union (http://publications.europa.eu/others/agents/index_en.htm).

KI-31-11-214-EN-N

This report presents the statistical analysis and the content analysis of data collected with the help of the questionnaire published in relation to the public consultation "Bio-based economy for Europe: state of play and future potential" (Open 17 February – 2 May 2011 available at: http://ec.europa.eu/research/consultations/bioeconomy/consultation_en.htm). It provides a summary of views received from individuals, organizations and public authorities that could assist the Commission in shaping strategy and action plan necessary to develop and promote sustainable European Bio-based Economy.

Publications Office

ISBN 978-92-79-20652-8

9 789279 206528