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Bio-based industries,

towards a public-private partnership under Horizon 2020?

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

Research and Innovation

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Directorate-General for Research and Innovation
Directorate E – Biotechnologies, Agriculture & Food
Unit E.2 – Biotechnologies

E-mail: RTD-PUBLICATIONS@ec.europa.eu

European Commission
B-1049 Brussels

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Directorate-General for Research and Innovation
2013 Biotechnologies, Agriculture, Food – Knowledge-based Bioeconomy

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Contents

1. Introduction

Implementing Horizon 2020 in relation to bio-based industries

Bio-based industries, at the heart of the bio-economy

Europe is committed to excelling in smart, inclusive and sustainable growth. In this context, the Europe 2020 strategy highlights the building of a **bioeconomy** by 2020 as one of the deliverables under its flagship initiative 'Innovation Union'. The Commission has recently presented the communication 'Innovating for sustainable growth: A bioeconomy for Europe' (COM(2012) 60 final).

The online public consultation conducted in connection with the preparation of the bioeconomy communication found that a large majority (> 85 %) of respondents saw significant advantages in developing a European strategy on a sustainable bio-based economy as follows:

- supporting bio-based markets and the creation of economic growth and highly skilled jobs (88.3 %);
- fostering the move towards a zero waste society (90.4 %);
- securing a sufficient supply of food and biomass (88.3 %);
- integrated, sustainable agricultural, aquatic and ecosystem services (89.9 %);
- strengthening the research and innovation base (85.7 %).

The abovementioned communication also sets out a comprehensive bioeconomy action plan. The plan includes the establishment of a public–private *partnership* on research and innovation for **bio-based industries** as a means to promote the development of integrated and diversified biorefineries, including their biomass supply chains. Consequently, the aim of a public–private partnership has been proposed in Horizon 2020, the future EU framework programme for research and innovation.

Europe needs to champion the use of sustainable bio-based resources as a major source of raw material for conversion into innovative industrial products and fuels/energy. This must be achieved without creating shortages in food and feed supply and in full respect of the environment. Several studies (e.g. by the European Environment Agency ([1])) demonstrate the potential to mobilise, in a sustainable manner, large volumes of non-food biomass in the EU as feedstock to support the growth of the bio-based industries. Europe's bio-based industries need to be technologically prepared and equipped to successfully address this challenge, along with all other participants in the value chain (e.g. farmers, foresters, waste managers).

An important goal is to expand the range and the volume of innovative products manufactured by the bio-based industries (e.g. bio-based plastics, chemical building blocks, high-value

1 'Estimating the environmentally compatible bioenergy potential from agriculture', EEA Technical Report No 12/2007; 'How much bioenergy can Europe produce without harming the environment?', EEA Report No 7/2006.

ingredients for pharmaceuticals or cosmetics, advanced biofuels) from renewable biological resources (e.g. specialty crops, residues from agriculture, forestry, fisheries and the utilisation of biowaste). This will require the development of new types of biorefineries and the associated value chains as well as innovation within established bio-based industries with a long tradition of processing renewable biological resources (e.g. the pulp and paper industry, the starch and the food industry). The pulp and paper and the starch industries have the potential to play a significant role in the innovation cycle leading to the successful development of an effective integrated biorefinery infrastructure in Europe. Furthermore, the chemical industry can play an important role by expanding its use of bio-based resources. The biotechnology industry will deliver key components for innovative new processes.

The development of bio-based industries, if successful, can bring a lot of rewards that concern many stakeholders: consumers who get access to new sustainable products based on renewable biological resources, bio-based industries that take technological and sustainability leadership and thereby build long-term competitive advantages; enhanced economic growth and new jobs in rural, coastal and industrial areas; and new revenue streams for EU-27 agriculture and forestry.

Horizon 2020 aims to build technological and sustainability leadership as a lever for industrial competitiveness on a global scale. In addition to delivering excellence in research and technology development, the aim is to deliver real innovation and to promote its deployment on a large scale.

Under FP7, the EU's seventh framework programme for research, certain sectors pioneered the use of **public–private partnerships** (PPP), as a novel means to manage and implement EU research programmes. In the context of a PPP, both private and public sector contribute resources to support research and innovation activities, based on multiannual research agendas. Examples of PPPs operating under FP7 include: the European green cars initiative; 'Factories of the future'; the innovative medicines initiative; the clean sky; and fuel cells and hydrogen. The continued use of public–private partnerships is explicitly provided for under Horizon 2020.

A large group of stakeholders from the bio-based industries has shown strong interest in the creation of a new PPP in the area of bio-based industries and has expressed a commitment to contribute to its activities. The Commission is considering supporting a PPP in the area of bio-based industries, addressing specific parts of Horizon 2020: 'Sustainable and competitive bio-based industries'.

On the basis of these considerations, the 'Bio-based industries, towards a public–private partnership under Horizon 2020?' consultation was launched to collect the opinions of stakeholders active in the field and of public at large on the state of play of the European bio-based industries, focusing on the aspects related to research and innovation.

The consultation specifically aimed at seeking respondents' views about the role of the public–private partnership in implementing research and innovation activities under Horizon 2020.

The research design of the public consultation was made up of six general dimensions (as shown in the concept map, Figure 1).

- **respondents' profile**: information about respondents according to their type of participation in the consultation (individuals or on behalf of an organisation or institution), such as occupation, organisation sector, professional field, residence and workplace;
- **identification of the problems**: this section addresses the respondents' perception about: the competitiveness of the European bio-based economy; the strengths and weaknesses of the European bio-based industries; and the innovation capacity of the bio-based industries;
- **European added value**: views about the added value of European-level intervention in facing the problems of the bio-based industries, in comparison with other levels (regional, national);
- **objectives of EU-level intervention**: what are the goals that should be addressed assuming EU-level action on research and innovation in connection with bio-based industries;
- **towards a PPP?**: considerations about the implementation of research and innovation activities in the bio-based industries area under Horizon 2020 through a PPP;
- **impacts**: this section deals with the perceived potential impact of EU research and innovation actions on bio-based industries if these actions are applied under a PPP framework.

The instrument used for the public consultation was a questionnaire (designed with assistance from the 'Inter-service Steering Group (ISG) on Article 187 initiatives'). The online version of the questionnaire was prepared using the Internet-based software package IPM (Interactive Policy Making), an Internet-based software package aiming at the creation, launch and analysis of replies to online questionnaires. The questionnaire was accompanied by a specific privacy statement and a statement for the protection of personal data.

The questionnaire was composed of six sections, resembling the research dimensions shown above. Each research dimension was measured using a single question or, more often, a set of items.

The public consultation was open for contributions between 21 September and 14 December 2012.

Awareness about the opening of this consultation was raised through a number of sources, including:

- the Directorates-General (DGs) involved in the interservice group;
- the FP7 Knowledge-Based Bioeconomy (KBBE) Programme Committee;
- the FP7 KBBE Advisory Group and relevant National Contact Points in the Member States;
- the European Bioplastics Association;
- the ERMAs (European Renewable Resources and Materials Associations);

— the European Technology Platform for Sustainable Chemistry;

— the Forest-Based sector Technology Platform;

— The Plants for the Future Technology Platform;

— EuropaBio;

— CEFIC (European Chemical Industry Council);

— CEPI (Confederation of European Paper Industries);

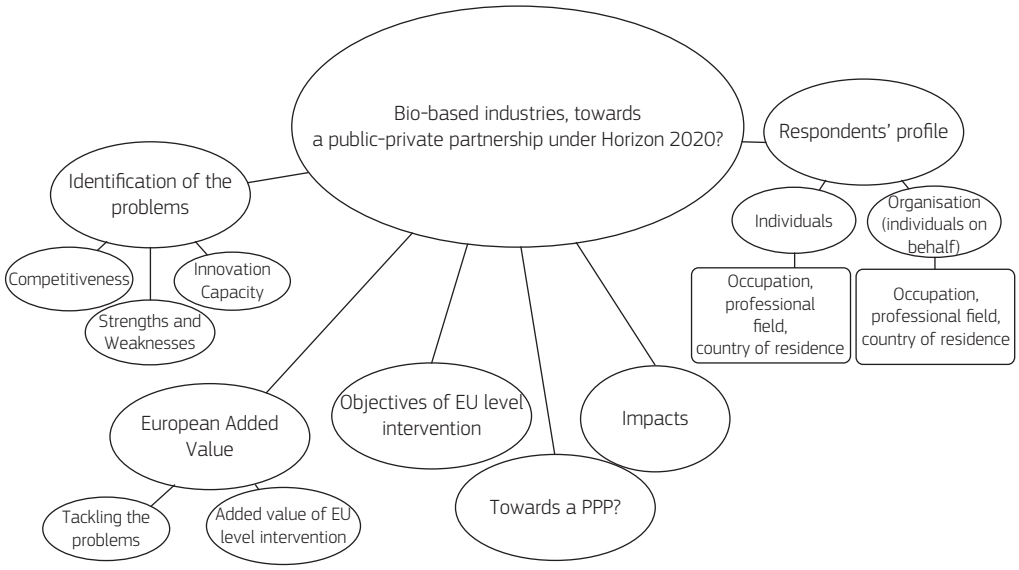
— FoodDrinkEurope;

— COPA COGECA (European Farmers and European Agricultural Cooperatives Association);

— The ESA (European Seed Association).

All contributions collected through the online questionnaire were analysed and used to generate the tables and the graphs found in this report.

Figure 1 — Concept map of public consultation



2. Results

During the consultation period from 21 September to 14 December 2012, 682 answers were collected. Data quality control and data cleaning procedures were applied to the dataset.

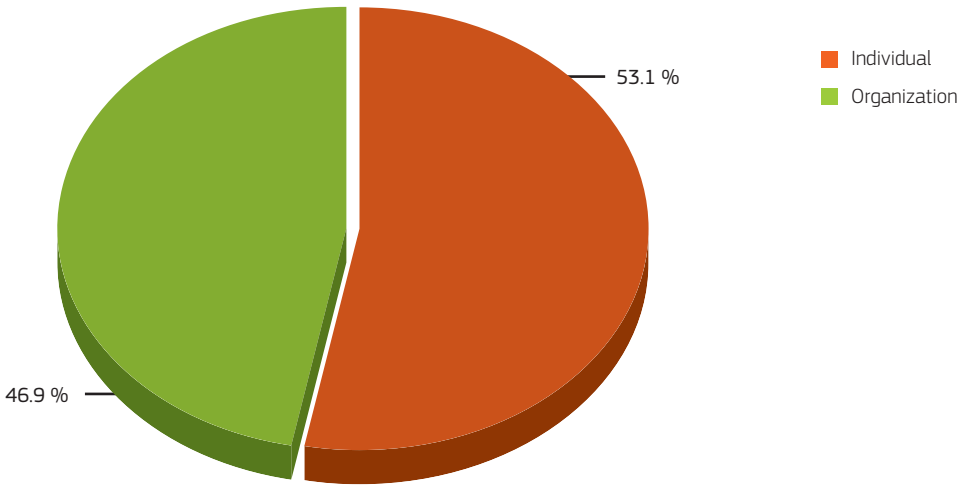
Nine participants were removed because they answered the public consultation twice (they were identified because they provided the same contact details); moreover, 35 people were removed from the final dataset because they did not agree to provide their names and contact details. During the analysis of the replies it was noted that 61 respondents from one single Member State were completely identical, apart from the contact details. These responses, representing 9.5 % of the total, were further analysed to establish whether they influenced the overall outcome of the analysis and to what extent. It was concluded that the overall outcome of the consultation was not affected by these respondents and therefore it was decided to fully include them in this report.

The final sample is therefore composed of 638 respondents.

2.1. Respondents' profile

This paragraph illustrates the profile of the participants in the public consultation. As shown in Figure 2, the number of respondents who answered as 'individuals' (53.1 %) was slightly higher than those who answered 'on behalf of an organisation or an institution' (46.9 %).

Figure 2 — Are you answering as an individual or on behalf of an organisation or an institution? (*n* = 638)



Poland was the country with the greatest number of respondents in this consultation, followed by the Netherlands, Germany, Spain, France, Belgium, Sweden, Finland, Italy and Austria.

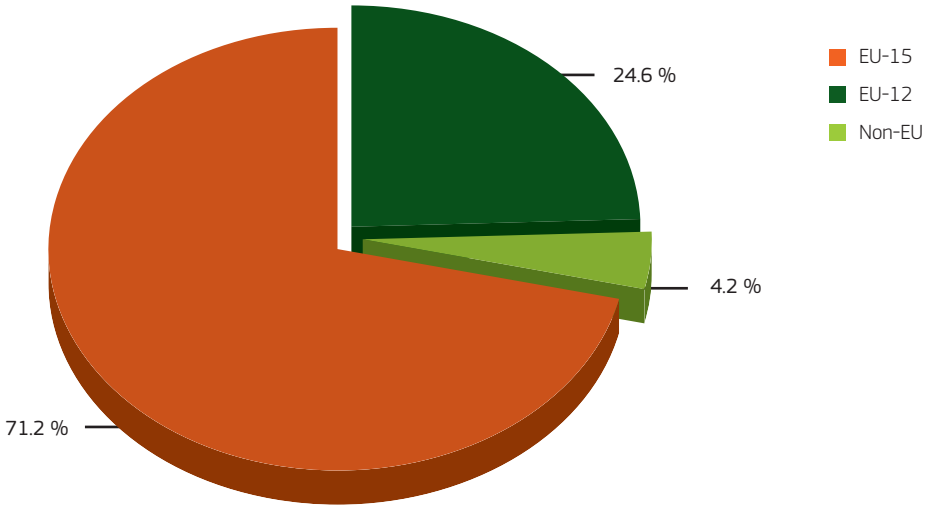
Generally speaking, a large number of EU Member States were represented; there were also some respondents from associated and non-EU countries (see Table 1).

Table 1 — Geographical contributions

	Frequency
Poland	143
Netherlands	94
Germany	82
Spain	58
France	54
Belgium	47
Sweden	30
Finland	24
Italy	22
Austria	21
Norway	9
United Kingdom	9
Czech Republic	6
Portugal	5
Romania	5
Denmark	4
Switzerland	4
Bosnia and Herzegovina	3
Ireland	3
Hungary	2
Serbia	2
United States	2
Brazil	1
China	1
Greece	1
Israel	1
Moldova	1
Peru	1
Singapore	1
Slovakia	1
Turkey	1
Total	**638**

The previous table is summed up in the next figure that shows the distribution of the respondents according to their origin: 71.2 % of participants originated from the EU-15 (Member States of the European Union prior to 1 May 2004), 24.6 % originated from the EU-12 (those Member States joining the EU on/after 1 May 2004) and 4.2 % originated from countries outside the EU.

Figure 3 — Geographical contributions grouped according to EU aggregation (*n* = 638)



2.1.1. Respondents answering as individuals

The number of respondents who answered as 'individuals' was 339 (53.1 % of the total sample), the majority of whom worked as a researcher in a research organisation or in academia (30.1 %) or for a private company (other than an SME; 25.4 %).

A significant number of farmer/forester (19.2 %) and SME employees (13.0 %) also participated in the consultation.

Table 2 — If you are responding as an individual

	Frequency	**%**
I work as a researcher in a research organisation or in academia	102	30.1
I work for a private company (other than an SME)	86	25.4
I am a farmer/forester	65	19.2
I work for an SME	44	13.0
I am self-employed (but not as a farmer forester)	11	3.2
I work for a public authority (national level)	11	3.2
I work for a public authority (local/regional level)	8	2.4
I work for a non-governmental organisation (other than a consumer organisation)	3	0.9
I work for an international organisation (e.g. UN, OECD)	2	0.5
Other	7	2.1
Total	**339**	**100.0**

As regards professional fields, respondents were allowed to give up to two choices, which explains why the number of responses exceeded the number of respondents (Table 3).

Table 3 — Main professional field of respondents answering as individuals (*multiresponse*) (*n* = 339; responses = 432)

	Frequency	% responses
Agriculture	115	26.6
Food and feed	60	13.9
Industrial biotechnology	60	13.9
Chemicals	42	9.7
Energy and biofuels	40	9.3
Forestry	27	6.3
Environment	25	5.8
Transport	8	1.9
Health	8	1.9
Socioeconomics	5	1.2
Nanotechnology	4	0.7
Fisheries and aquaculture	0	0.0
Other	27	6.3
Other (non-pharmaceutical) biotechnologies	11	2.5
Total	**432**	**100.0**

The relative majority of respondents were engaged in the agricultural field (26.6 %). The other main professional fields represented were: food and feed (13.9 %); industrial biotechnology (13.9 %); chemicals (9.7 %); and energy and biofuels (9.3 %). There was no individual respondent from the fisheries and aquaculture field.

2.1.2. Respondents answering on behalf of an organisation or an institution

Participants who answered on behalf of an organisation or an institution mainly represented the private sector: 48.2 % represented a small or medium-sized enterprise (SME, 22.4 %), a multinational or a trans-European private company (18.1 %) or a national private company (7.7 %). Other respondents represented the academic sector (18.1 %), public authorities/public administrations (10.0 %) and industry associations or chambers of commerce (9.7 %).

Table 4 — If you are responding on behalf of organisation or an institution (*n* = 299)

	Frequency	%
I represent a small or medium enterprise (SME)	67	22.4
I represent a multinational or a trans-European private company	54	18.1
I represent an academic/research organisation or association of academic/research organisations	54	18.1
I represent a public authority/public administration	30	10.0

I represent an industry association or a chamber of commerce (national/regional/local)	29	9.7
I represent a national private company (excluding SMEs)	23	7.7
I represent an association of farmers or other primary producers (national/regional/local)	16	5.4
I represent a non-governmental organisation/ associations of NGOs (excluding consumer association)	9	3.0
Other	17	5.6
Total	**299**	**100.00**

Participants who replied on behalf of an organisation mainly represented the industrial biotechnology field (17.9 %) and fields like agriculture (14.4 %), food and feed (12.7 %), energy and biofuels (12.2 %) and chemicals (11.2 %).

Table 5 — Main professional field of respondents on behalf of an organisation or an institution (*multiresponse*) (*n* = 299; responses = 418)

	Frequency	**% responses**
Industrial biotechnology	75	17.9
Agriculture	60	14.4
Food and feed	53	12.7
Energy and biofuels	51	12.2
Chemicals	47	11.2
Forestry	28	6.7
Environment	23	5.5
Transport	6	1.4
Health	6	1.4
Fisheries and aquaculture	5	1.2
Socioeconomics	4	1.0
Nanotechnology	3	0.7
Other	47	11.2
Other (non-pharmaceutical) biotechnologies	10	2.5
Total	**418**	**100.0**

2.1.3. The whole sample

In order to synthesise the information about the type of organisation the respondents worked for, a typology was created, combining the answers to the variables shown in Tables 2 and 4.

The typology has four categories ([2]): private, public, academia and NGO (non-governmental organisation) (Table 6).

2 Respondents who chose the residual category, i.e. 'other', could add a specific comment to the text. The content analysis allowed the open answers to be reclassified into one of the four categories. The same criterion has been adopted for the recategorisation of the professional field.

The majority of respondents worked in a private organisation (64.6 %), whereas 24.6 % belonged to the academic sector. Few respondents were categorised as coming from the public sector (8.8 %) or an NGO (2.0 %). Overall, the number of responses received was considered relatively high with the exception of replies from the NGO category. The relatively low number of replies from NGOs in particular would need to be considered with regard to their representativeness.

Table 6 — Type of organisation

	Frequency	%
Private	412	64.6
Academia	157	24.6
Public	56	8.8
NGO	13	2.0
Total	**638**	**100.0**

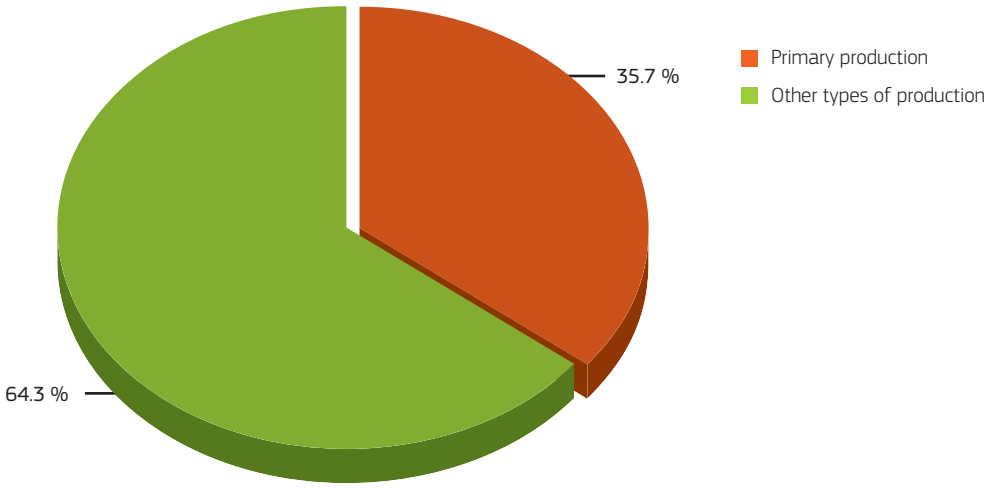
Considering the entire sample, the most represented professional field was agriculture (20.6 %), followed by industrial biotechnology (15.9 %), food and feed (13.3 %), energy and bio-fuels (10.7 %) and chemicals (10.5 %).

Table 7 — Main professional field of respondents (whole sample; *multiresponse*) (*n* = 638; responses = 850)

	Frequency	% responses
Agriculture	175	20.6
Industrial biotechnology	135	15.9
Food and feed	113	13.3
Energy and biofuels	91	10.7
Chemicals	89	10.5
Forestry	55	6.5
Environment	48	5.6
Transport	14	1.6
Health	14	1.6
Socioeconomics	9	1.1
Nanotechnology	7	0.8
Fisheries and aquaculture	5	0.6
Other	74	8.7
Other (non-pharmaceutical) biotechnologies	21	2.5
Total	**850**	**100.0**

In the following graph, professional fields were recategorised according to primary (35.7 %) and other type of production (64.3 %).

Figure 4 — Type of production (*n* = 638)



3. Identification of the problems

Section B of the questionnaire addressed the respondents' perception about the competitiveness of the European bio-based industries. Participants were asked to express their view about the state of the-art of the bio-based economy in Europe, focusing on the problems faced by European bio-based industries. This section of the questionnaire contained three sets of items, whose specific aim was to survey the opinions of the respondents about the potential strength and weakness of the bio-based industries in relation to the current state of affairs in research and innovation.

3.1. Overall views on the competitiveness of the European bio-based industries

The first question in Section B was intended to analyse what participants thought about the general level of competitiveness of the European bio-based industries. This topic was surveyed with a set of seven statements, each of which referred to the perceived competitiveness in various steps of the value chain (primary production; logistics and storage; extraction and processing of renewable resources; commercialisation; market development).

Respondents were asked to express their agreement with each item using a five-point Likert scale, ranging from 'strongly disagree' to 'strongly agree'.

According to the respondents' answers, the items were divided into three groups:

(1) sectors in which European bio-based industries were considered competitive in a global context (Figure 5):

- logistics and storage ('strongly agree' + 'agree' = 65.0 %) and
- primary production ('strongly agree' + 'agree' = 54.5 %);

(2) sectors in which uncertainty prevailed over European bio-based industries' competitiveness in a global context (Table 8):

- extraction and processing of renewable biological resources into value-added bio-based materials ('neutral' = 40.1 %) and
- extraction and processing of renewable biological resources into biofuels ('neutral' = 39.3 %);

(3) sectors in which European bio-based industries were not considered competitive in a global context (Figure 5):

- EU measures for market development, harmonisation and standardisation in the field of bio-based industries ('strongly disagree' + 'disagree' = 55.7 %) and

- commercialisation of value-added products produced from renewable biological resources ('strongly disagree' + 'disagree' = 50.5 %).

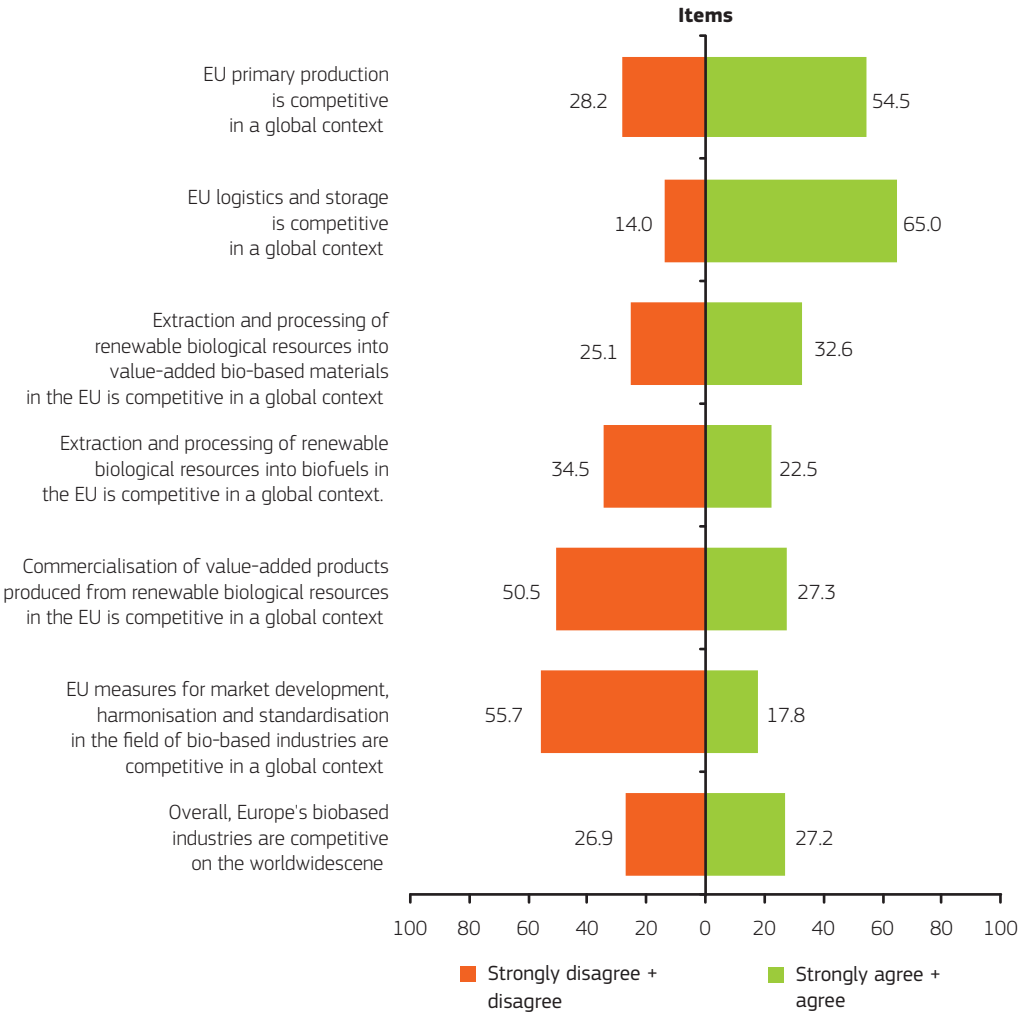
Table 8 — What are your overall views on the competitiveness of the European bio-based industries? (%)

Items	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	No opinion	Total
EU primary production is competitive in a global context	5.2	23.0	14.6	47.0	7.5	2.7	100.0
EU logistics and storage is competitive in a global context	1.6	12.4	15.5	55.6	9.4	5.5	100.0
Extraction and processing of renewable biological resources into value-added bio-based materials in the EU is competitive in a global context	3.6	21.5	40.1	24.1	8.5	2.2	100.0
Extraction and processing of renewable biological resources into biofuels in the EU is competitive in a global context	5.8	28.7	39.3	17.2	5.3	3.7	100.0
Commercialisation of value-added products produced from renewable biological resources in the EU is competitive in a global context	29.2	21.3	19.1	19.9	7.4	3.1	100.0
EU measures for market development, harmonisation and standardisation in the field of bio-based industries are competitive in a global context	28.4	27.3	21.6	13.9	3.9	4.9	100.0
Overall, Europe's bio-based industries are competitive on the worldwide scene	3.1	23.8	42.9	21.9	5.3	3.0	100.0

NB: ■ = 'Strongly agree' plus 'agree' more than 'strongly disagree' plus 'disagree'; ■ = 'strongly disagree' plus 'disagree' more than' strongly agree' plus 'agree'; ■ = 'neutral' more than 25 %;

Figure 5 — What are your overall views on the competitiveness of the European bio-based industries? (%)

Whole sample

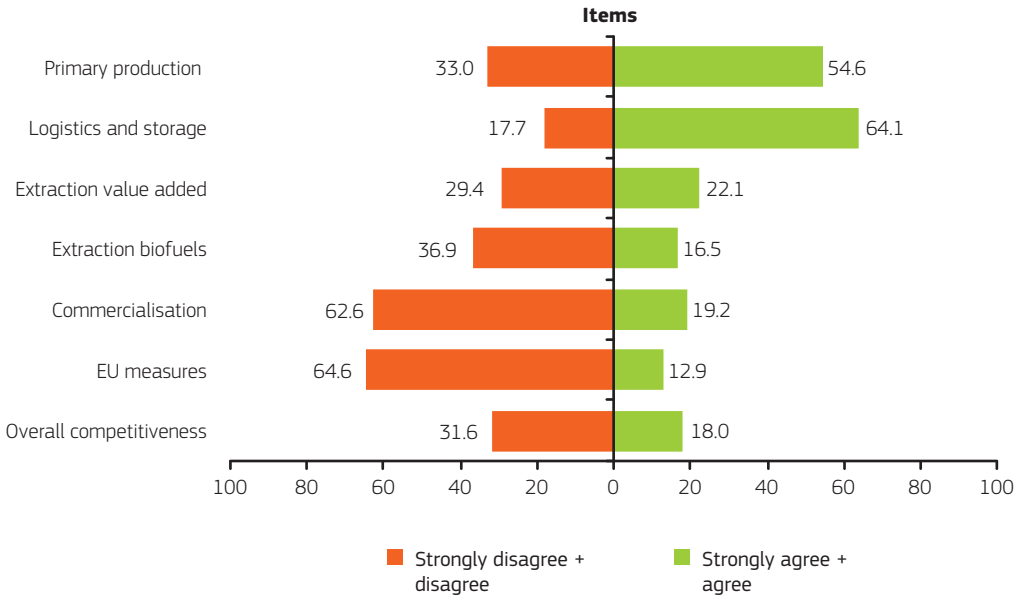


As shown in the following graphics (Figures 6 and 7), the survey revealed an overall positive opinion with regard to the competitiveness of primary production and logistics and storage in the EU. However, some differences between stakeholder groups were also recognised, as follows:

- In particular, stakeholders of the private sector did not agree that all subsequent processing steps after primary production and logistics and storage were competitive, whereas the other groups showed a less unified response pattern.
- The academic stakeholder group was identified as showing the starkest contrast to the private sector and the other stakeholder groups in so far as the majority of academic respondents indicated that European bio-based industries were competitive on all but one item surveyed.
- Also to be noted was that respondents from the NGO sector showed a unanimous disagreement regarding the competitiveness of current biofuel extraction from renewable biological resources. The majority of stakeholders from the private sector also disagreed with this statement.

Figure 6 — What are your overall views on the competitiveness of the European bio-based industries? (%)

Private sector



Academic sector

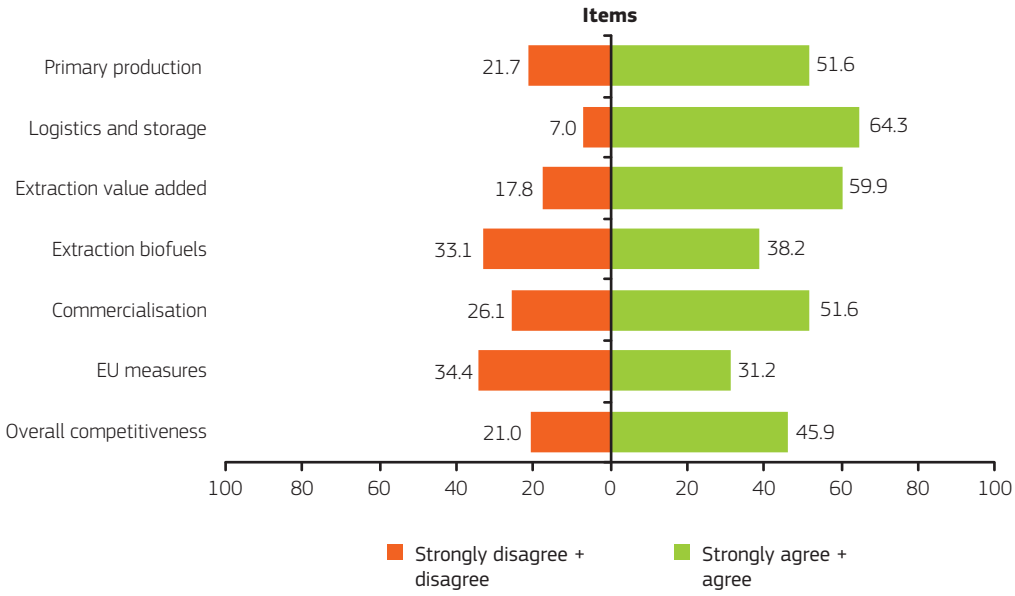
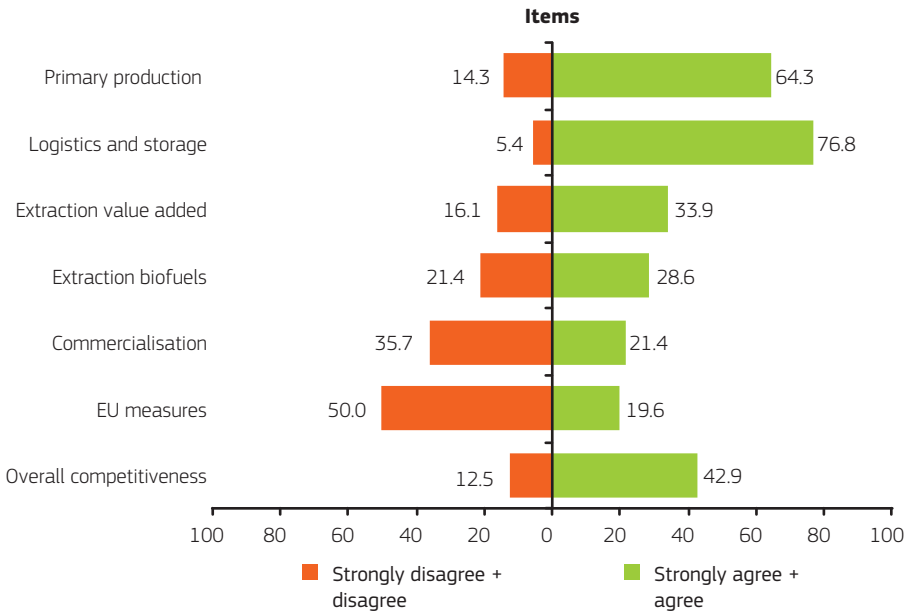
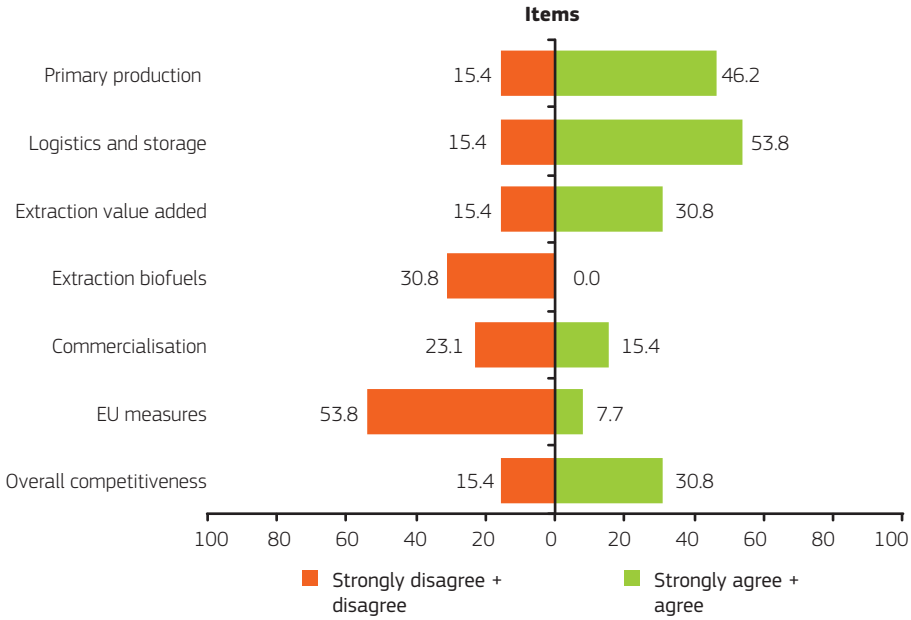


Figure 7 — What are your overall views on the competitiveness of the European bio-based industries? (%)

Public sector



NGO sector



3.2. The European bio-based industries: strengths and weaknesses

The next part of the questionnaire dealt with the perceived strengths and weaknesses of the European bio-based industries. Two subdimensions were surveyed: (1) the EU's current situation and (2) the current innovation capacity of the bio-based industries.

Regarding the evaluation of the EU's current situation, respondents were asked to rate, on a five-point scale from 'very weak' to 'very strong', the EU's current situation for 10 items, having as the benchmark what they believed was required for Europe to be successful in the development of competitive bio-based industries (Table 9).

According to the responses received, the following three items received the highest approval rates, based on summing up the results for 'very strong' and 'strong':

- strength of basic research in areas of likely future relevance, with 78.7 %;
- investment of the private sector in research and innovation related to bio-based industries, with 50.3 %;
- filing of patent application, with 42.6 %.

Other items considered 'strong' rather than 'weak' by respondents were:

- strength of applied research and technology development (41.8 %);

- SME participation in research and innovation related to bio-based industries (40.7 %).

Having analysed the responses for 'very weak' and 'weak', two items were identified as being by far the weakest points:

- access of bio-based industries to a range of state-of-the-art demonstration plants, with 70.8 %;
- involvement of primary producers (farmers, forestry or aquaculture) in innovation efforts related to the development of supply chains for biomass as feedstock for bio-based industries, with 68.5 %.

Other items considered more 'weak' than 'strong' by respondents were:

- collaboration between stakeholders along value and supply chains in terms of conducting research and innovation pertinent to bio-based industries (60.7 %);
- investment of the public sector in research and innovation related to bio-based industries (59.3 %);
- EU-wide coordination of applied research and technology development (55.9 %).

In the context of this online public consultation it was surprising to see that even the public sector itself seemed to indicate that the investment in research and innovation by the public sector was considered a weakness (Figure 9). Due to the sample size of 638 valid responses, this result could certainly not be regarded as fully representative for the public sector in the EU in general; nevertheless it was considered to underline some consensus among all stakeholder groups, calling for better and more public support for research and innovation activities in the EU.

Table 9 — The European bio-based industries: strengths and weaknesses — the EU's current situation (%)

Items	Very weak	Weak	Neutral	Strong	Very strong	No opinion	Total
Strength of basic research in areas of likely future relevance	0.6	7.7	11.1	64.6	14.1	1.9	100.0
Strength of applied research and technology development	0.6	40.6	15.7	32.1	9.7	1.3	100.0
EU wide coordination of applied research and technology development	26.6	29.3	23.8	13.6	4.1	2.6	100.0
Involvement of primary producers (farmers, forestry or aquaculture) in innovation efforts related to the development of supply chains for biomass as feedstock for bio-based industries	8.2	60.3	17.1	9.9	2.4	2.1	100.0
Investment of the private sector in research and innovation related to bio-based industries	4.1	23.0	20.4	45.6	4.7	2.2	100.0
SME participation in research and innovation related to bio-based industries.	6.3	23.2	24.1	35.7	5	5.7	100.0
Investment of the public sector in research and innovation related to bio-based industries	5.2	54.1	20.7	14.7	3.6	1.7	100.0
Filing of patent applications (in line with the exploitation potential of research results obtained)	1.6	14.7	27.0	40.4	2.2	14.1	100.0
Collaboration between stakeholders along value and supply chains in terms of conducting research and innovation pertinent to bio-based industries	4.9	55.8	20.5	12.1	3.1	3.6	100.0
Access of bio-based industries to a range of state of the art demonstration plants	39.0	31.8	14.7	7.4	2.8	4.3	100.0

NB: ■ = 'Very strong' plus 'strong' more than 'very weak' plus 'weak';■ = 'very weak' plus 'weak' more than 'very strong' plus 'strong'; ■ = 'neutral' more than 25 %; ■ = 'no opinion' more than 10 %.

Figure 8 — The European bio-based industries: strengths and weaknesses — the EU's current situation (%)

Whole sample

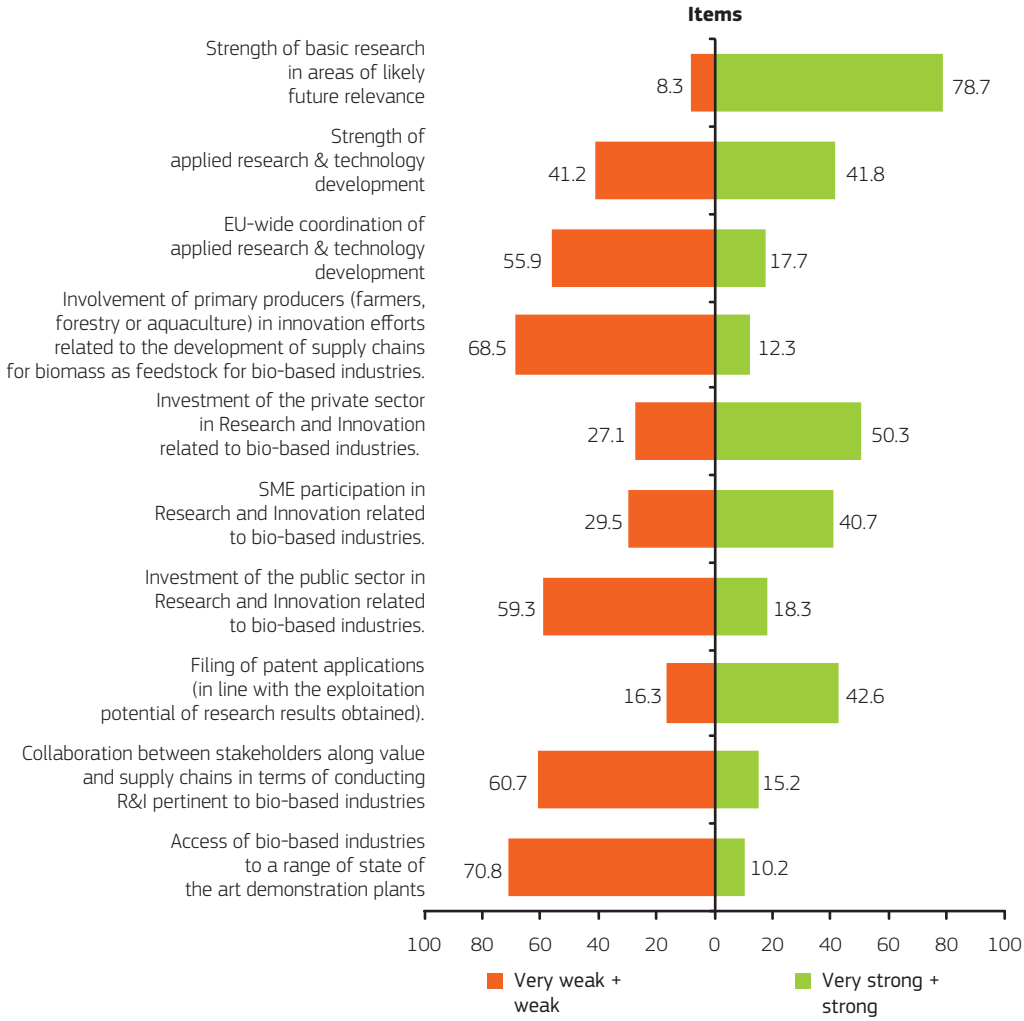
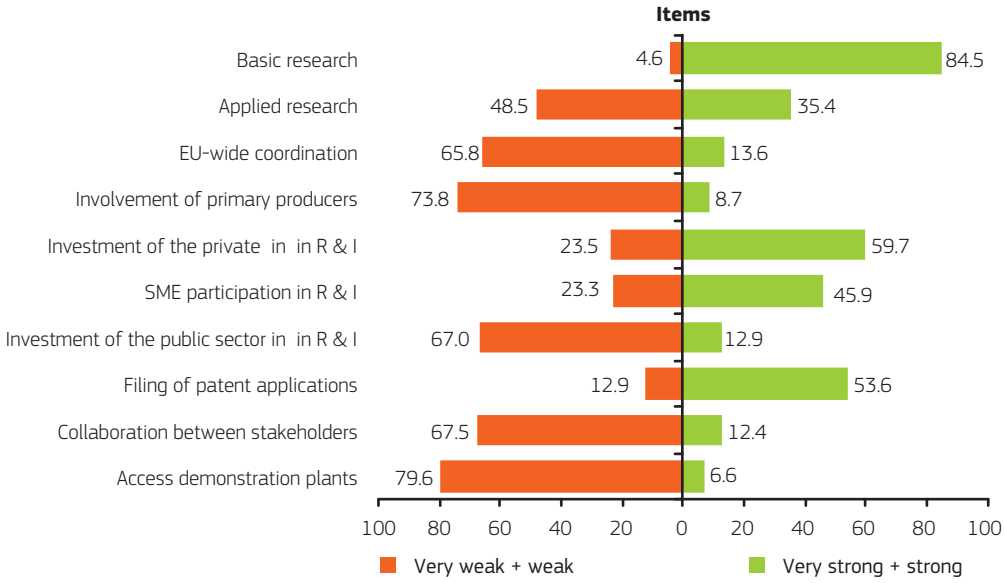


Figure 9 — The European bio-based industries: strengths and weaknesses — the EU's current situation (%)

Private sector



Academic sector

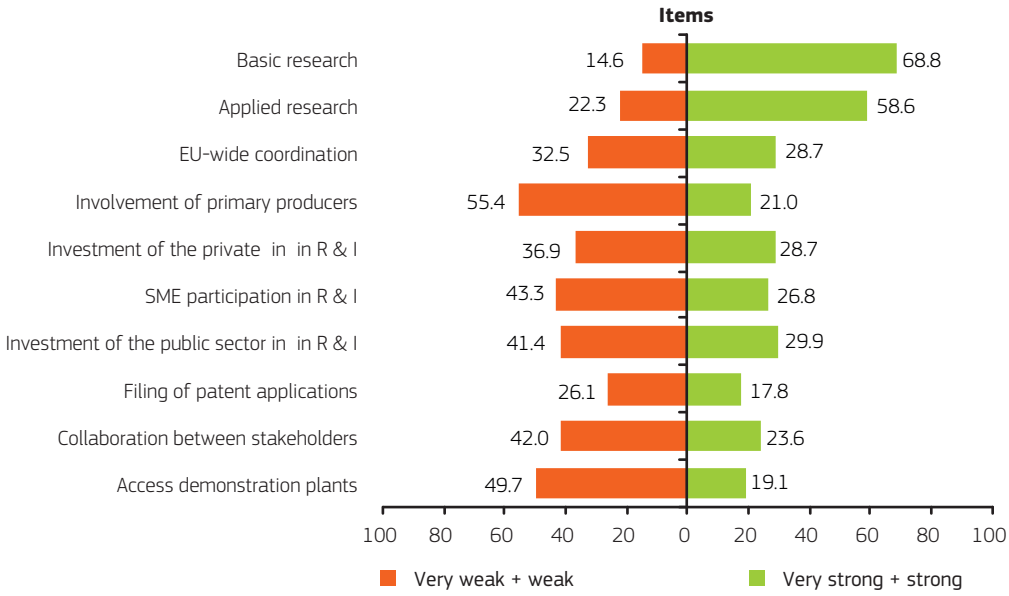
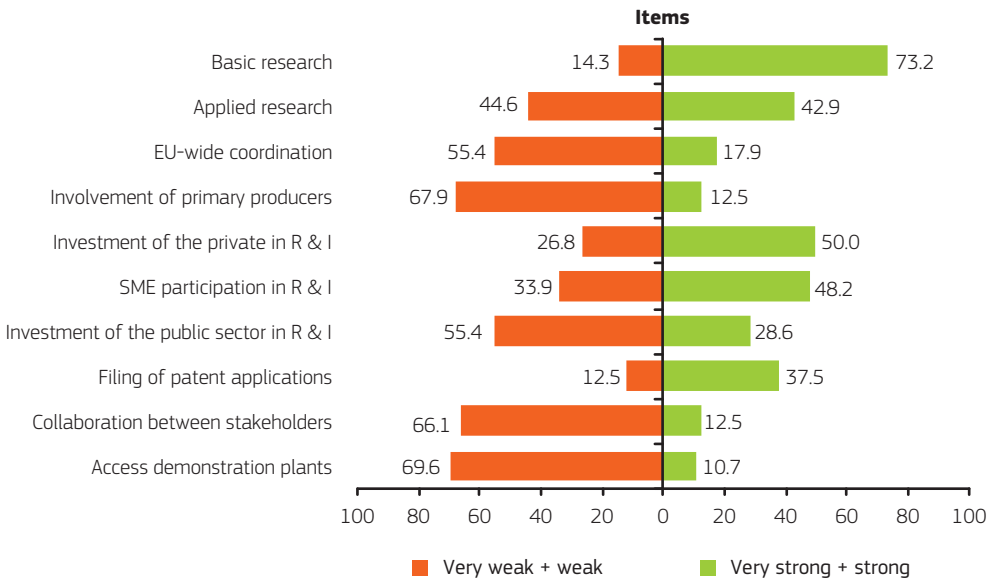
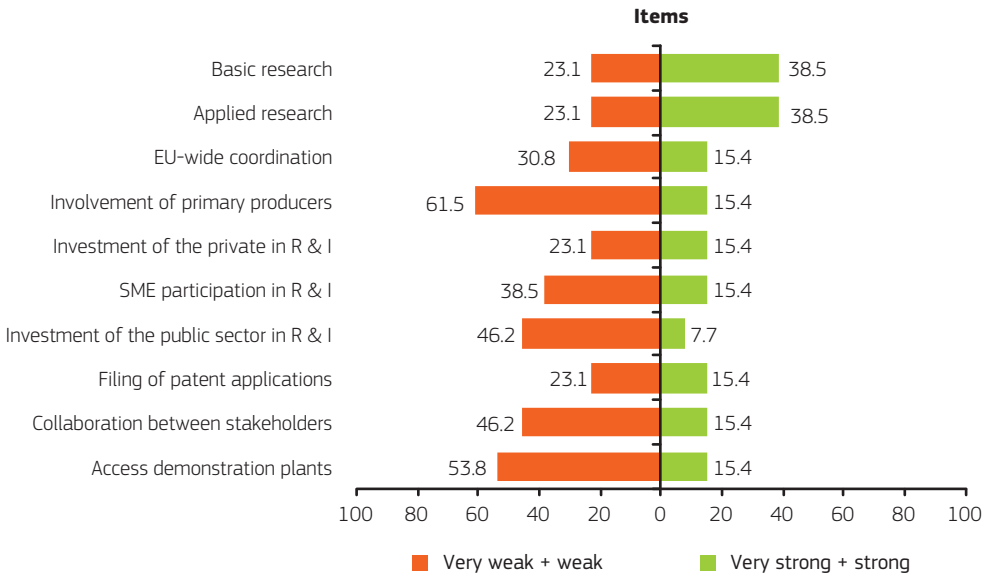


Figure 10 — The European bio-based industries: strengths and weaknesses — the EU's current situation (%)

Public sector



NGO sector



Overall, the perception of individual stakeholder groups with regard to the items surveyed was found to be very similar and in line with the overall results for all stakeholder groups together. However, some interesting indications in terms of different views between stakeholder groups were identified as follows:

- The NGO and academic sector differed from the other two sectors in that they regarded the participation of SMEs in research and innovation activities as being rather weak, whereas the private and public sectors considered this as rather a strong point in the EU.
- The private and public sectors regarded the investment of the private sector in research and innovation as a strength, whereas the NGO/academic sectors seem to have considered this rather a weakness.
- Finally, the same pattern was identified for filing patent applications, which was regarded by the private and public sectors as rather a strength, in contrast to the other two sectors, which held the opposite view.

The second item surveyed the opinion of stakeholders regarding the current innovation capacity of the bio-based industries in the EU. A set of 11 statements was presented in the questionnaire. These statements were considered as having a direct or indirect impact on industrial innovation capacity. Respondents were again asked to rate these statements on a five-point scale from 'strongly disagree' to 'strongly agree'.

Participants were found to generally disagree with the majority of the statements, which therefore indicated an overall limited innovation capacity of bio-based industries in the EU. Taking the responses of all stakeholder groups into account, the most disapproved of statements were as follows (see Table 10 and Figure 11):

- Consumers are well informed about benefits and risks associated with bio-based products (82.2 %).
- Bio-based industries are sufficiently consolidated and integrated (critical mass) across Europe to support the growth of the biorefinery infrastructure (69.9 %).
- Appropriate industry standards, certification systems and labels are in place to create a favorable economic environment for the development of bio-based industries (68.8 %).
- Member State public support mechanisms stimulating large-scale deployment of innovation in the bio-based industries are strong (68.0 %).

However, two statements overall received fairly positive ratings from all participants, namely:

- There is good potential to source, in an environmentally sustainable way, other types of non-food feedstocks (56.9 %).
- There is a sufficient availability of traditional feedstock, mainly food crops such as maize, wheat, sugar beet or oilseeds in Europe, to support the rapid growth of bio-based industries while assuring food and feed supply (51.1 %).

Generally speaking, under the current circumstances respondents seemed not to have much confidence in the current innovation capacity of the bio-based industries in the EU. This issue is further analysed in the following sections of this report.

Table 10 — European bio-based industries: strengths and weaknesses which may have a direct or indirect impact on the innovation capacity of the bio-based industries (%)

Items	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	No opinion	Total
Bio-based industries are sufficiently consolidated and integrated (critical mass) across Europe to support the growth of the biorefinery infrastructure	8.3	61.6	13.6	11.8	1.7	3.0	100.0
There is a sufficient availability of traditional feedstock, mainly food crops such as maize, wheat, sugar beet or oilseeds in Europe, to support the rapid growth of bio-based industries while assuring food and feed supply	8.6	21.3	13.5	21.0	30.1	5.5	100.0
There is good potential to source, in an environmentally sustainable way, other types of non-food feedstocks (e.g. residues from agriculture, forestry and biowaste, lignocellulosic crops) in Europe, supporting the future development of EU bio-based industry	2.0	6.3	33.2	36.8	20.1	1.6	100.0
Appropriate solutions to ensure an effective biomass supply chain are already in place (e.g. logistics, stable supply contracts)	11.6	31.8	39.5	13.2	1.4	2.5	100.0
Necessary cross-sectoral collaboration between stakeholders in bio-based value chains enabling smart and sustainable ways of using biomass is in place	8.5	56.7	15.5	11.9	4.9	2.5	100.0

EU-level public support mechanisms stimulating large-scale deployment of innovation in the bio-based industries are strong	37.8	29.8	18.5	9.1	1.9	3.0	100.0
Member State public support mechanisms stimulating large-scale deployment of innovation in the bio-based industries are strong	34.0	34.0	18.0	9.4	1.4	3.1	100.0
Appropriate industry standards, certification systems and labels are in place to create a favourable economic environment for the development of bio-based industries	8.9	59.9	13.8	10.3	2.4	4.7	100.0
Policy measures and initiatives promoting the use of bio-based products create a favourable environment for the development of local bio-based industries	9.1	52.7	15.2	13.0	6.9	3.1	100.0
There is a strong and effective integration of measures to protect the environment with measures aimed at the development of bio-based industries	7.7	53.0	17.1	14.7	2.8	4.7	100.0
Consumers are well informed about benefits and risks associated with bio-based products	48.7	33.5	9.4	5.6	.9	1.9	100.0

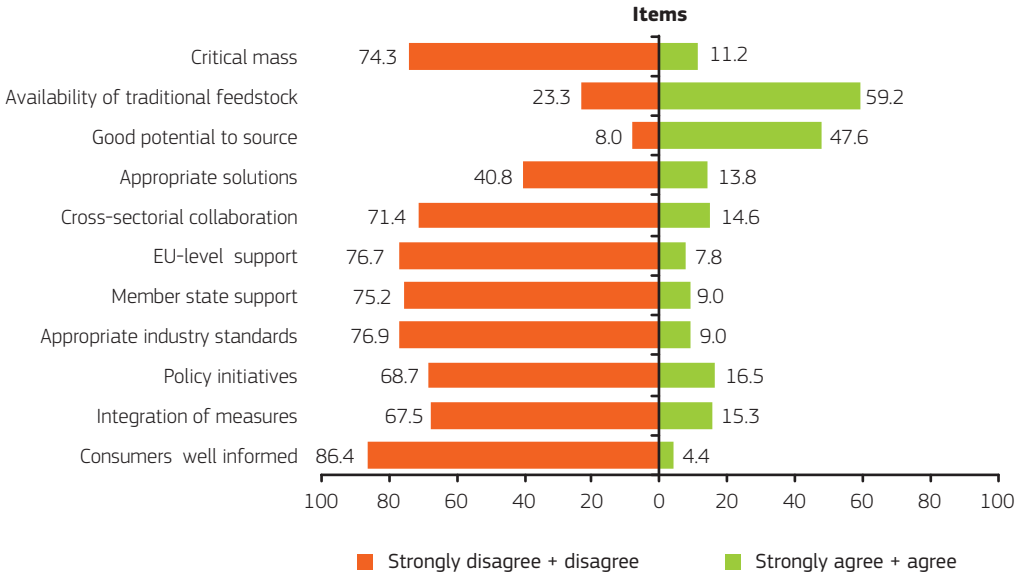
NB: ■ = 'Strongly agree' plus 'agree' more than 'strongly disagree' plus 'disagree'; ■ = 'strongly disagree' plus 'disagree' more than 'strongly agree' plus 'agree'; ■ = 'neutral' more than 25 %.

Figure 11 — Actions required for Europe to be successful in enhancing the innovation capacity of the bio-based industries (%)

Whole sample

Figure 12 — Actions required for Europe to be successful in enhancing the innovation capacity of the bio-based industries (%)

Private sector



Academic sector

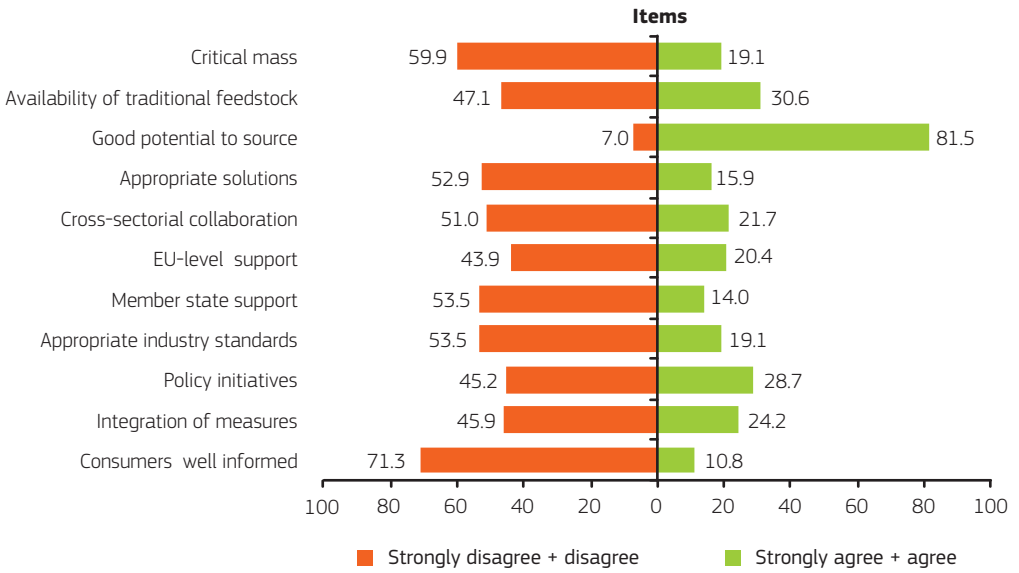
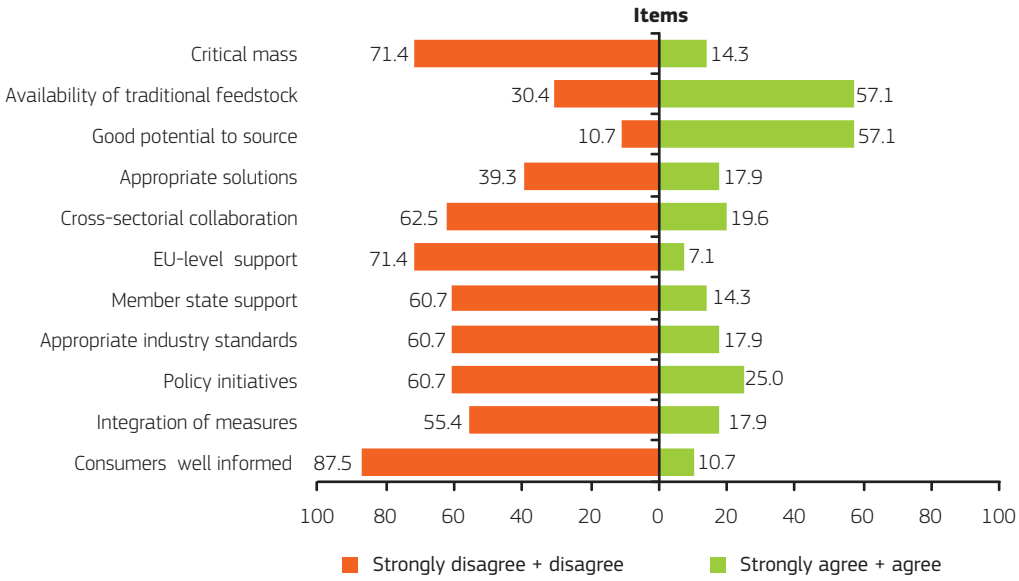
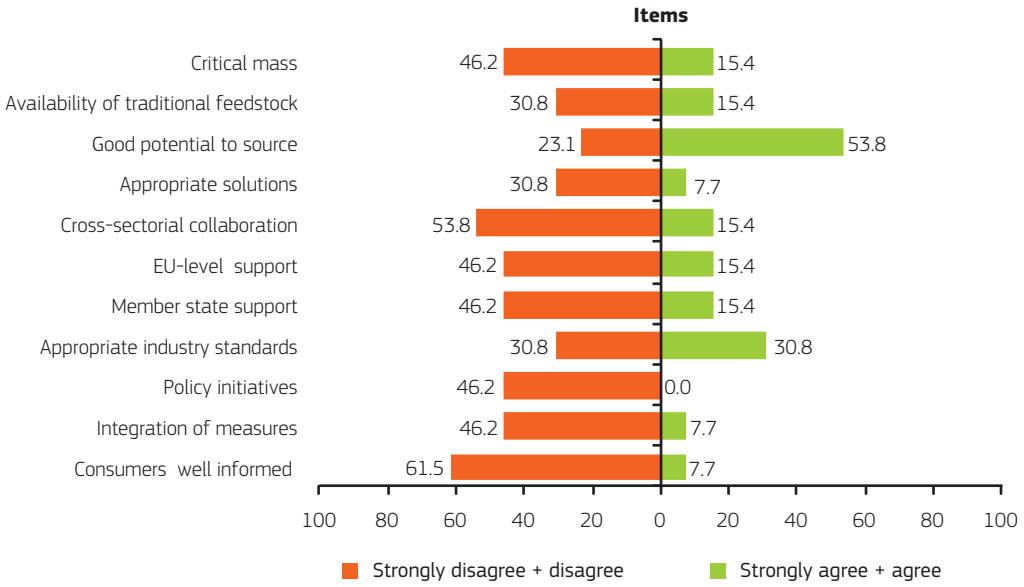


Figure 13 — Actions required for Europe to be successful in enhancing the innovation capacity of the bio-based industries (%)

Public sector



NGO sector



Figures 12 and 13 display the opinion of the individual stakeholder groups regarding the 11 statements mentioned. Apart from two issues, no major differences between the groups were identified.

The statement 'There is a sufficient availability of traditional feedstock, mainly food crops such as maize, wheat, sugar beet or oilseeds in Europe, to support the rapid growth of bio-based industries while assuring food and feed supply' was supported by the majority of respondents from the private and public sector groups, whereas the majority of the academic and NGO groups did not agree with this statement.

Another difference in views between stakeholder groups was found regarding the statement 'Appropriate industry standards, certification systems and labels are in place to create a favourable economic environment for the development of bio-based industries'. Here, opinion within the NGO group was equally split between those who agreed and those who disagreed (both 30.8 %), while respondents from the other three groups largely disapproved of this statement.

4. European added value

Section C of the questionnaire requested the view of stakeholders on the added value of EU-level action on research and innovation for the bio-based industries. Respondents were asked to provide their opinions regarding: (1) the importance of EU-level intervention in comparison with other types of interventions and (2) the added value of EU-level intervention.

4.1. The importance of EU-level intervention

Participants were asked to provide their opinion concerning the added value of EU-level intervention in comparison with no public intervention and intervention at regional and/or national levels.

According to the replies displayed in Table 11, respondents strongly believed that support for research and innovation actions at European level is essential; the statement 'An intervention at EU-level is needed to help industry address the problems' was supported by 94.3 % of all participants. No major differences between stakeholder groups were noted in this regard, although the statement received slightly more support from private and academic stakeholders and slightly less from NGOs and public stakeholders.

In this context it is also to be noted that some participants from academia (with 18.5 %), NGOs (15.4 %) and private stakeholders (10.2 %) expressed support for intervention at regional or national levels.

Table 11 — Tackling the problems (%)

Items	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	No opinion	Total
Industry alone, without government support, is able to address the relevant problems	54.5	38.7	3.4	1.7	0.8	0.9	100.0
An intervention at the level of the regions or of Member States would be sufficient to help industry address the relevant problems	10.2	59.9	16.8	9.7	2.5	0.9	100.0
An intervention at EU level is needed to help industry address the problems	0.8	1.1	2.5	31.0	63.3	1.3	100.0

NB: ■ = 'Strongly agree' plus 'agree' more than 'strongly disagree' plus 'disagree'; ■ = 'strongly disagree' plus 'disagree' more than 'strongly agree' plus 'agree'; ■ = 'neutral' more than 15 %.

Figure 14 — Tackling the problems (%)

Whole sample

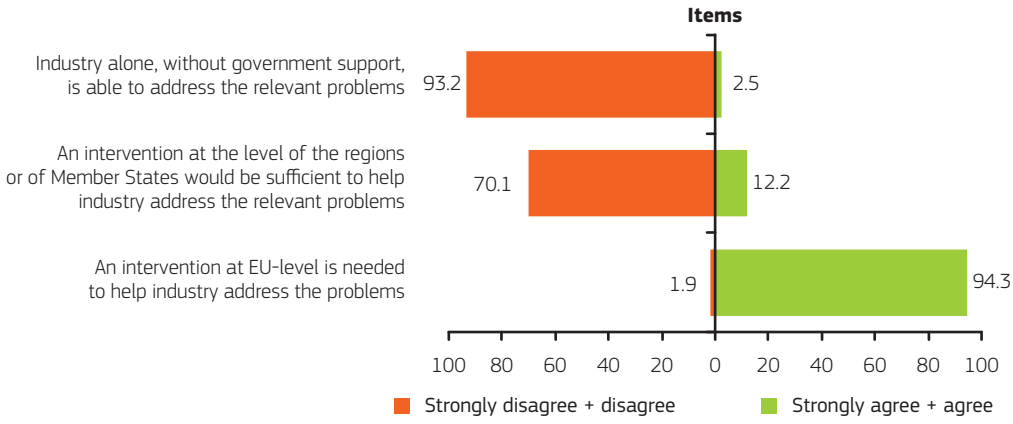
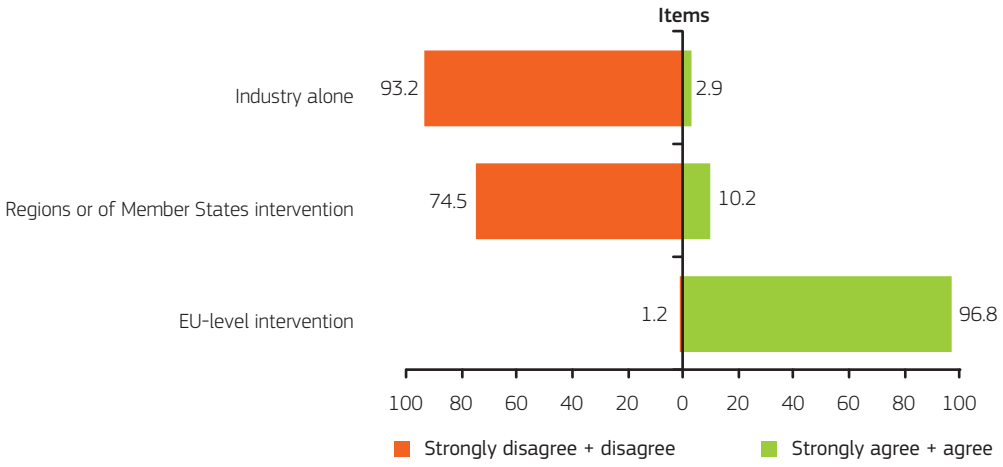


Figure 15 — Tackling the problems (%)

Private sector



Academic sector

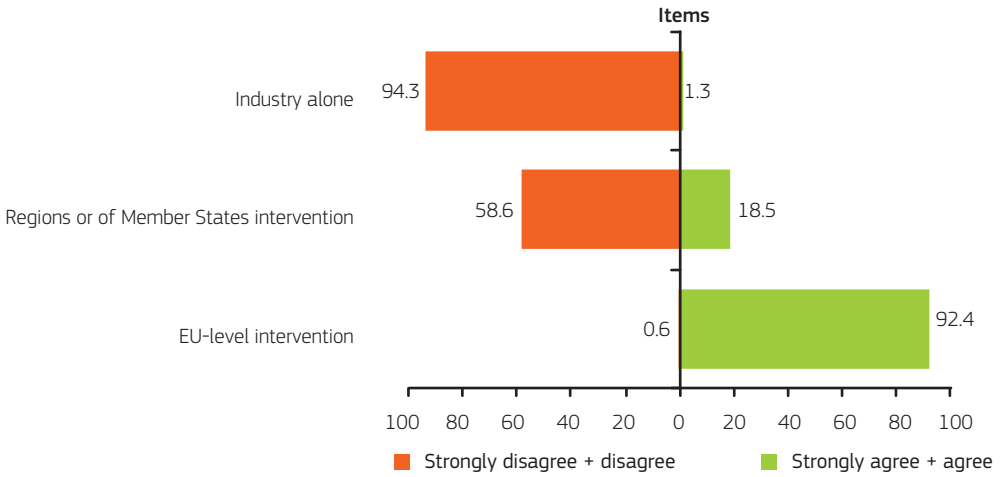
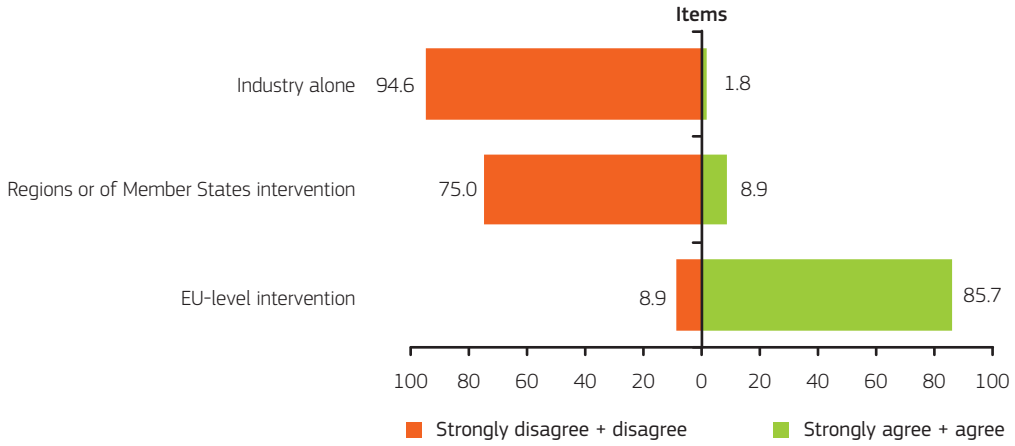
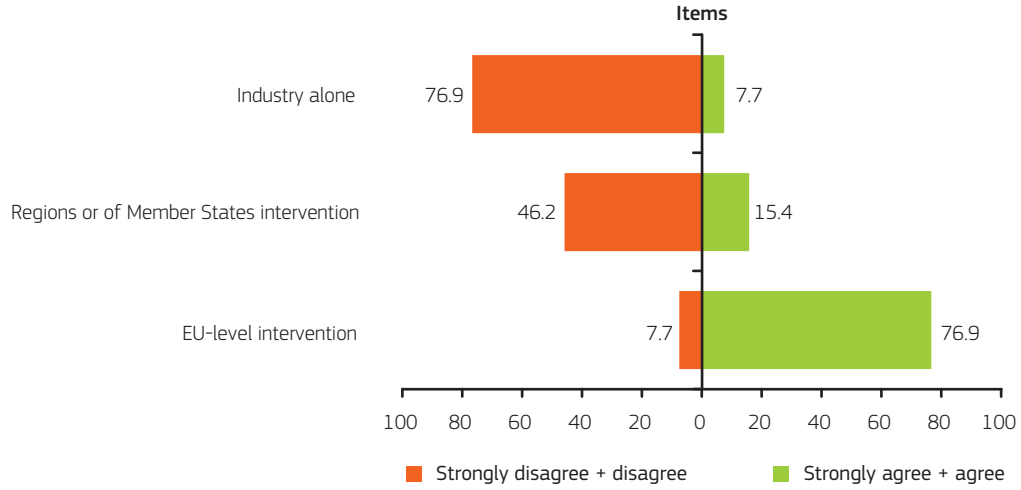


Figure 16 — Tackling the problems (%)

Public sector



NGO sector



4.2. Added value of EU-level intervention

The next section of the questionnaire aimed to gather stakeholders' views about the potential added value of public intervention at EU-level with regard to bio-based industries. The section was composed of eight statements, which respondents were asked to rate, using a series of five points ranging from 'strongly disagree' to 'strongly agree'.

Table 12 and Figure 17 respectively provide an overview of the responses received and the results achieved in terms of ranking the eight statements on the added value of a possible EU intervention. According to the results, all statements listed in the questionnaire were considered by the stakeholders to indeed provide added value, with strongest support for:

- achieving the required level of investment in research and innovation, with 93.1 %;
- ensuring EU-wide cooperation between all relevant stakeholders along the value chains, with 92.0 %;
- providing improved policy coherence, for example in terms of environmental, agricultural and industrial policies, with 91.4 %;
- promoting non-traditional partnerships (transnational, cross-sectoral) between stakeholders that may otherwise lack opportunities or incentives to collaborate, with 90.8 %.

The least appreciated statement was identified as 'greater mobilisation of research efforts in universities and research institutes', which was supported by 61.5 % of the respondents, with 34.3 % of them giving a 'neutral' answer.

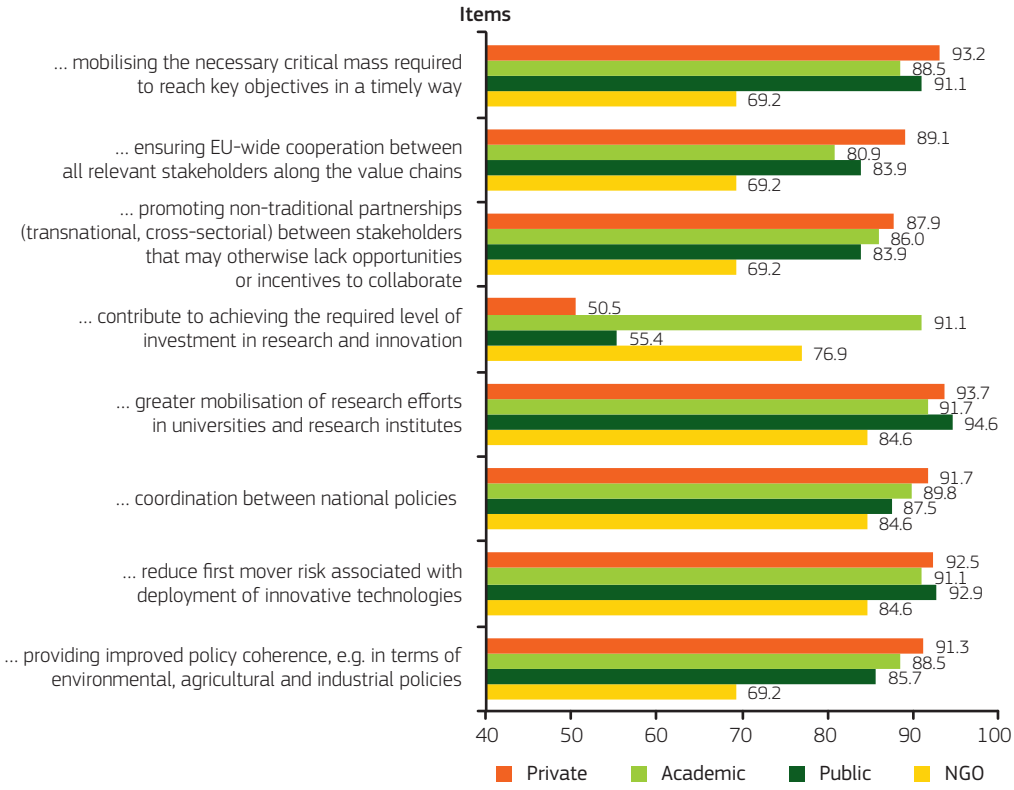
Table 12 — EU intervention will provide added value in terms of (%)

Items	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	No opinion	total
… mobilising the necessary critical mass required to reach key objectives in a timely way	0.6	1.3	7.1	38.9	50.8	1.3	100.0
… ensuring EU-wide cooperation between all relevant stakeholders along the value chains	0.2	1.6	5.3	62.2	29.8	0.9	100.0
… promoting non-traditional partnerships (transnational, cross-sectoral) between stakeholders that may otherwise lack opportunities or incentives to collaborate	0.3	1.1	6.9	32.3	58.5	0.9	100.0
… contribute to achieving the required level of investment in research and innovation	0.5	0.8	4.7	32.0	61.1	0.9	100.0
… greater mobilisation of research efforts in universities and research institutes	0.5	2.4	34.3	35.3	26.2	1.3	100.0
… coordination between national policies	0.3	1.1	9.6	60.3	26.3	2.4	100.0
…reduce first mover risk associated with deployment of innovative technologies	0.2	1.6	8.2	27.4	58.8	3.8	100.0
… providing improved policy coherence, e.g. in terms of environmental, agricultural and industrial policies	0.3	0.9	5.5	29.5	61.9	1.9	100.0

NB: ■ = ‘Strongly agree’ more than ‘agree’ ■ = ‘agree’ more than ‘strongly agree ‘; ■ = ‘neutral’ more than 20 %.

Figure 17 — EU intervention will provide added value in terms of (%; strongly agree + agree)

Figure 18 — EU intervention will provide added value in terms of (%; 'strongly agree' + 'agree'; differences by stakeholders)



5. Objectives of EU-level intervention

Section D of the questionnaire sought stakeholders' views on a range of objectives of EU-level intervention. Respondents were asked to rate in five steps from 'not important at all' to 'very important' the significance of these 15 objectives, the results of which are summarised in Table 13.

According the replies received, the top five ranked EU-level intervention objectives were to:

- facilitate more rapid deployment of promising technologies in pilot, demonstration and 'first of its kind' industrial scale plants, with 94.2 %;
- generate knowledge required for competitiveness of EU industries in the medium and long term, with 93.4 %;
- promote effective collaboration on research and innovation between all stakeholders along the value chain for greening the industry, with 93.3 %;
- deliver innovative technologies for the use of biomass in smart and efficient no-waste processes, with 92.0 %;
- deliver innovative technologies aimed at building stable, competitive and sustainable biomass/biowaste supply chains (e.g. with regard to logistics and integration of supply networks), with 90.6 %.

The objective of 'ensuring that greater emphasis is placed on seeking protection through intellectual property rights when promising results emerge' was the least supported statement among respondents, but still received a relatively good score of 64.9 %.

With regard to differences between individual stakeholder groups, it was noted in particular that the objective of 'reinforcing and effectively utilising the research and innovation potential present in Europe's universities and research centres' showed significantly higher support from academia compared to the public and private sectors. Given the discussions on the innovation 'valley of death' in Europe, this could be interpreted as a confirmation of a gap between basic and applied research, which closer cooperation between academia and private sectors is expected to overcome.

With regard to differences between stakeholder groups, NGOs seemed to consider the following two statements as of much lower importance than the other three groups:

- 'Ensure that greater emphasis is placed on seeking protection through intellectual property rights when promising results emerge' was considered by only 23.1 % of NGOs as being an important objective of EU-level intervention.
- 'Favour high industrial participation rates in funded projects' was considered important by 46.2 % of NGO participants, but still considerably lower compared to other stakeholders.

Table 13 — Objectives of EU-level intervention: EU-level action on research and innovation in connection with bio-based industries should (%)

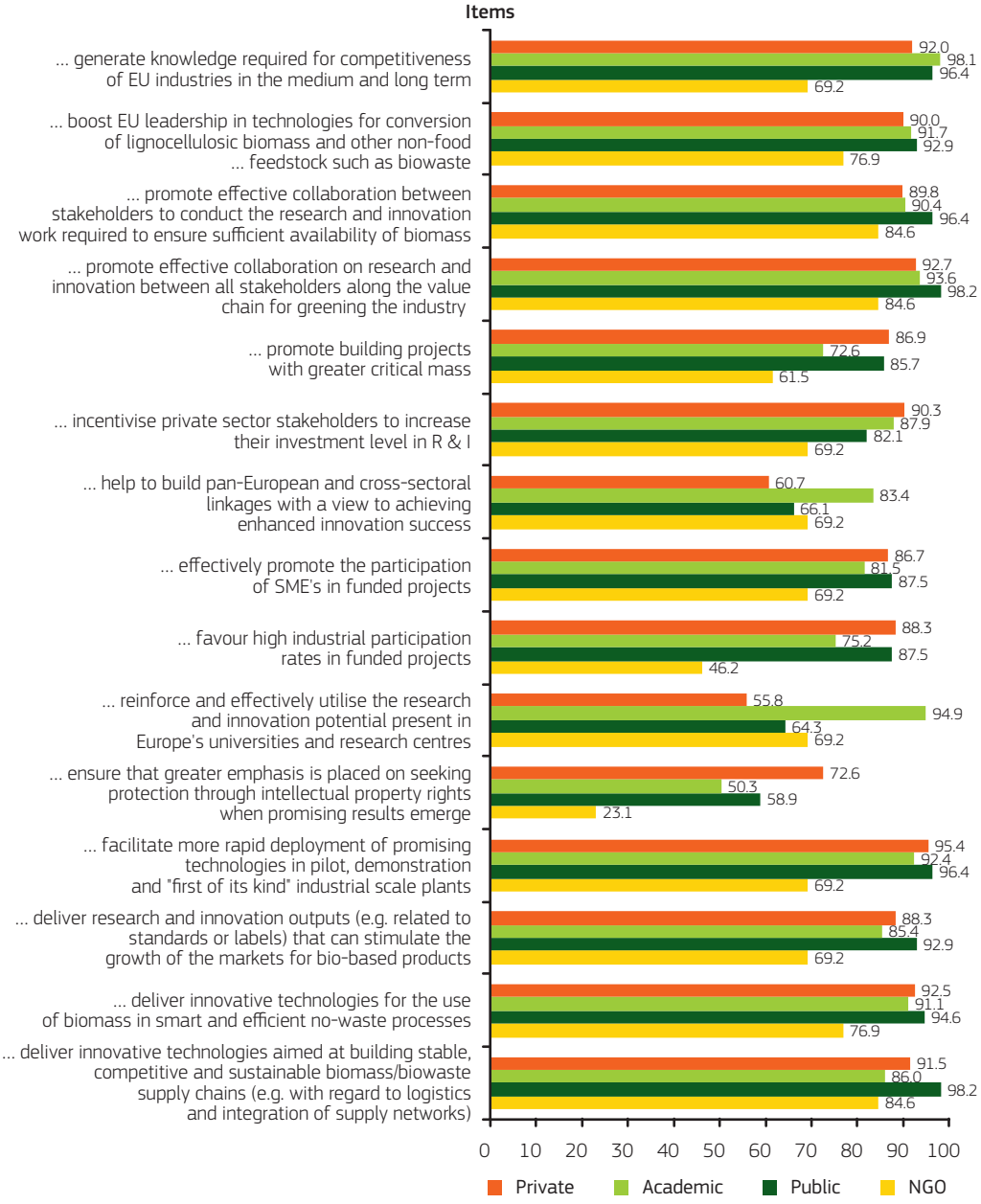
Items	Not at all important	Unimportant	Neutral	Important	Very important	No opinion	Total
... generate knowledge required for competitiveness of EU industries in the medium and long term	0.2	0.6	4.7	31.5	61.9	1.1	100.0
... boost EU leadership in technologies for conversion of lignocellulosic biomass and other non-food feedstock such as biowaste	0.0	0.5	7.4	26.2	64.3	1.6	100.0
... promote effective collaboration between stakeholders to conduct the research and innovation work required to ensure sufficient availability of biomass	0.0	0.6	7.8	33.7	56.7	1.2	100.0
... promote effective collaboration on research and innovation between all stakeholders along the value chain for greening the industry	0.0	1.3	4.9	33.4	59.9	0.5	100.0
... promote building projects with greater critical mass	0.3	2.5	12.9	29.5	53.3	1.5	100.0
... incentivise private sector stakeholders to increase their investment level in R & I	0.0	1.4	8.5	34.5	54.1	1.5	100.0
... help to build pan-European and cross-sectoral linkages with a view to achieving enhanced innovation success	0.0	1.3	29.9	37.3	29.6	1.9	100.0
... effectively promote the participation of SMEs in funded projects	0.2	1.7	11.6	53.1	32.0	1.4	100.0
... favour high industrial participation rates in funded projects	0.2	1.4	13.2	31.8	52.4	1.0	100.0

... reinforce and effectively utilise the research and innovation potential present in Europe's universities and research centres	0.0	0.3	31.8	32.6	33.9	1.4	100.0
... ensure that greater emphasis is placed on seeking protection through intellectual property rights when promising results emerge	0.6	6.4	22.9	50.5	14.4	5.2	100.0
... facilitate more rapid deployment of promising technologies in pilot, demonstration and 'first of its kind' industrial scale plants	0.0	0.8	3.6	23.8	70.4	1.4	100.0
... deliver research and innovation outputs (e.g. related to standards or labels) that can stimulate the growth of the markets for bio-based products	0.2	1.6	8.8	30.1	57.5	1.8	100.0
... deliver innovative technologies for the use of biomass in smart and efficient no-waste processes	0.0	0.6	5.6	30.6	61.4	1.8	100.0
... deliver innovative technologies aimed at building stable, competitive and sustainable biomass/ biowaste supply chains (e.g. with regard to logistics and integration of supply networks)	0.0	0.9	6.9	59.9	30.7	1.6	100.0

NB: ■ = 'Very important' more than 'important'; ■ = 'important' more than 'very important'; ■ = 'neutral' more than 20 %.

Figure 19 — EU-level action on research and innovation in connection with bio-based industries should (%; 'important' + 'very important')

Figure 20 — EU-level action on research and innovation in connection with bio-based industries should (%; 'important' + 'very important'; differences by stakeholders)

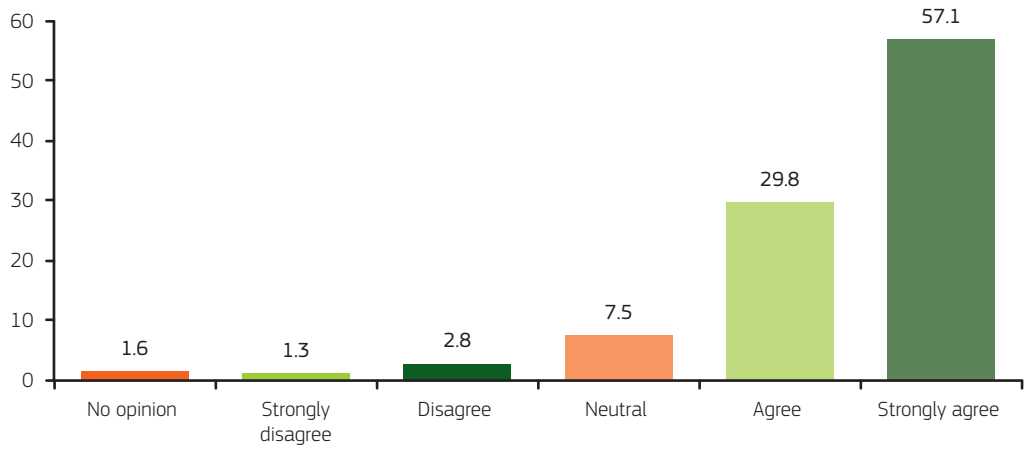


6. Towards a PPP?

Section E of the questionnaire contained a single question seeking the view of stakeholders regarding the format of a future EU research programme on bio-based industries. It was explained in the questionnaire that compared to the standard management of collaborative research by the European Commission, setting up a public–private partnership would allow for a much greater role of private sector stakeholders in establishing a jointly agreed long-term strategic research agenda with the European Commission. It was furthermore explained that compared to standard collaborative research, a PPP would allow a greater private sector financial contribution to be taken on board, thus generating additional 'leverage' at European level, and that different types of PPP structures could be considered.

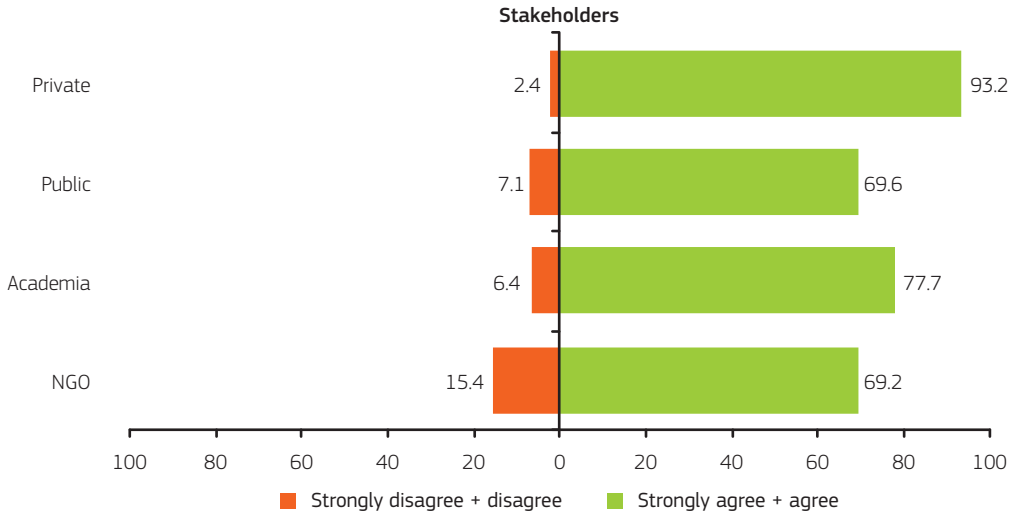
The vast majority of stakeholders, 86.9 %, agreed or strongly agreed that a PPP was the most appropriate mechanism to implement the research and innovation programme for bio-based industries under Horizon 2020 (Figure 21).

Figure 21 — A public–private partnership is the most appropriate mechanism to implement the research and innovation programme for bio-based industries under Horizon 2020 (%)



The idea that a PPP could be the best solution to foster the implementation of a research and innovation programme was strongly supported by the private sector with 93.2 %, followed by academia with 77.7 %, the public sector with 69.6 % and NGOs with 69.2 % (Figure 22).

Figure 22 — Agreement concerning PPP among different stakeholder groups (%)



7. Impacts

Section F explored the potential impact of EU research and innovation actions — applied in the context of a PPP — on bio-based industries. Specifically, respondents were asked to rate on a five-point scale, from 'strongly disagree' to 'strongly agree', their agreement with 12 medium or longer-term socioeconomic impacts that one can expect to achieve as a result of an optimal development of the bio-based industries in Europe under the PPP frame.

Considering together 'strongly agree' or 'agree', all the items received a score higher than 80 %. This significant result means that interviewees were very favourable towards a European research and innovation strategy on the basis of a PPP and they seemed to believe that implementing this could produce many favourable outcomes in terms of socioeconomic impact (Table 14).

Participants mostly appreciated the following statements, when they were asked whether research and innovation work done in the context of a PPP:

- will enable a greater use of renewable biomaterials in a wide range of products (92.3 %);
- will help to increase overall investments in research and innovation activities in the EU in the sectors concerned (91.4 %);
- will help ensure that bio-based industries develop in line with EU objectives on sustainability (90.6 %);
- will contribute to the competitiveness of bio-based industries in the EU at a global level (89.5 %);
- will contribute to developing technologies that allow the conversion/upgrading of existing plants to use new types of biomass input and/or to manufacture new products (88.7 %);
- will help in achieving EU ambitions with regard to bio-based products from biomass in a way that is environmentally sustainable and compatible with food/feed security (88.2 %);
- will increase the chances of setting up 'first of its kind' industrial scale biorefineries in the EU based on innovative processes (87.7 %);
- will contribute to the creation of new jobs in rural and/or coastal areas (85.3 %).

The least supported items were:

- will contribute to the creation of new and attractive income streams for farmers, foresters and aquaculture (81.5 %);
- will help ensure development of bio-based industries in a way that is compatible with food security objectives (82.7 %).

Results clearly indicate that the private sector is more confident about the socioeconomic effects of a PPP than the academic and the public sectors: the percentage of 'strongly

agree' + 'agree' expressed by respondents from the private sector is by far the highest in all the items but one; 'will enable a greater use of renewable biomaterials in a wide range of products' received slightly more support from the academic sector (94.3 vs 93.9 %).

Table 14 — Achievement of socioeconomic impacts: research and innovation work done in the context of a PPP on bio-based industries (%):

Items	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	No opinion	Total
... will help ensure development of bio-based industries in a way that is compatible with food security objectives	0.6	2.5	11.4	29.3	53.4	2.8	100.0
... will help ensure that bio-based industries develop in line with EU objectives on sustainability	0.5	2.0	5.6	36.4	54.2	1.3	100.0
... will contribute to developing technologies that allow the conversion/ upgrading of existing plants to use new types of biomass input and / or to manufacture new products	0.5	1.6	7.1	33.4	55.3	2.1	100.0
... will increase the chances of setting up 'first of its kind' industrial scale biorefineries in the EU based on innovative processes	0.5	1.3	8.2	31.3	56.4	2.3	100.0
... will contribute to the competitiveness of bio-based industries in the EU at a global level	0.3	2.2	6.7	29.5	60.0	1.3	100.0
... will contribute to the development of more effective biomass supply chains in the EU	0.5	2.5	11.0	35.0	49.4	1.6	100.0
... will contribute to the creation of new and attractive income streams for farmers, foresters and aquaculture	0.2	2.7	13.0	29.8	51.7	2.6	100.0

... will contribute to the creation of new jobs in rural and/or coastal areas	0.3	3.0	8.6	28.1	57.2	2.8	100.0
... will contribute to achieving EU greenhouse gas emission reduction objectives	0.3	3.6	10.5	28.2	55.2	2.2	100.0
... will enable a greater use of renewable biomaterials in a wide range of products	0.2	0.8	5.0	26.8	65.5	1.7	100.0
... will help in achieving EU ambitions with regard to bio-based products from biomass in a way that is environmentally sustainable and compatible with food/ feed security	0.6	1.7	6.7	29.9	58.3	2.8	100.0
... will help to increase overall investments in research and innovation activities in the EU in the sectors concerned	0.2	1.6	5.6	29.0	62.4	1.4	100.0

NB: ■ = 'Strongly agree' more than 50 %; ■ = 'neutral' more than 10 %.

Figure 23 — Achievement of socioeconomic impacts: research and innovation work done in the context of a PPP on bio-based industries (%; 'strongly agree' + 'agree')

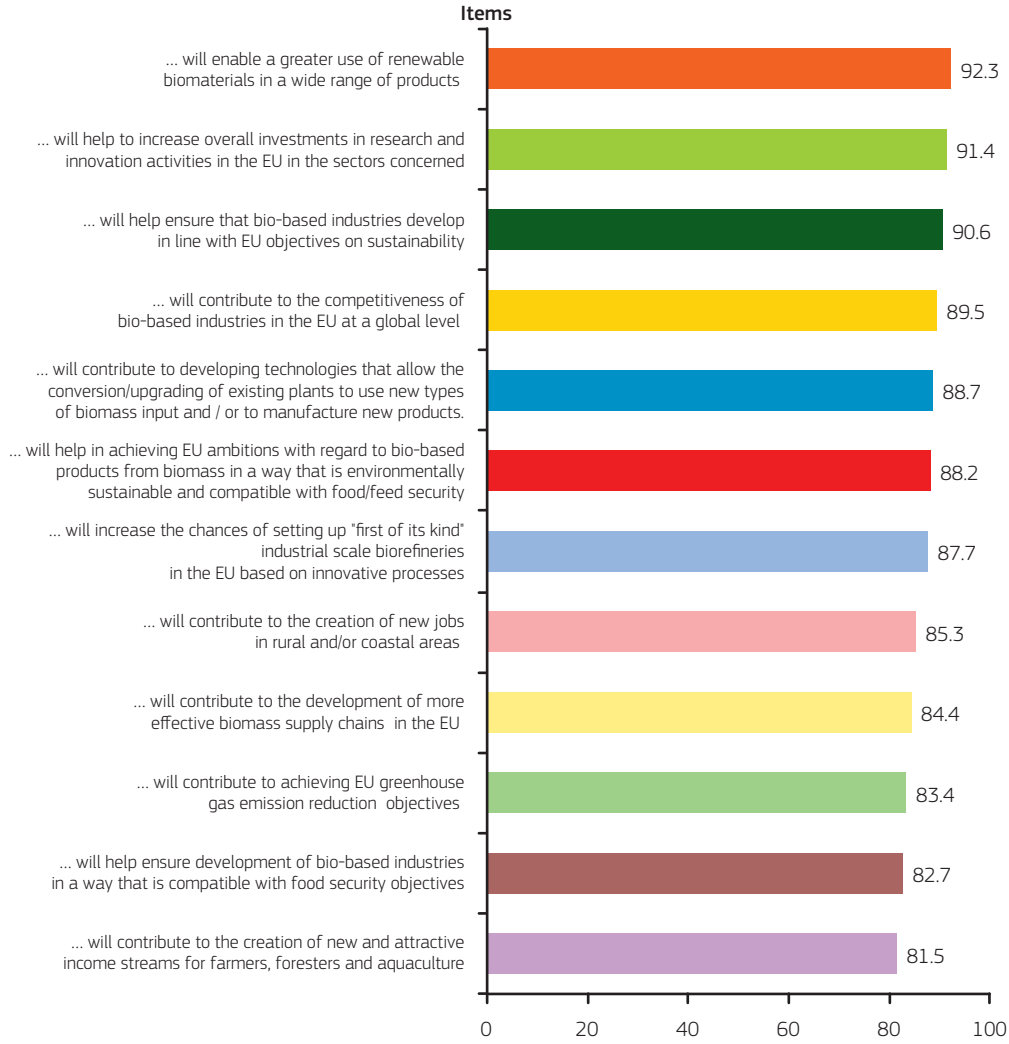
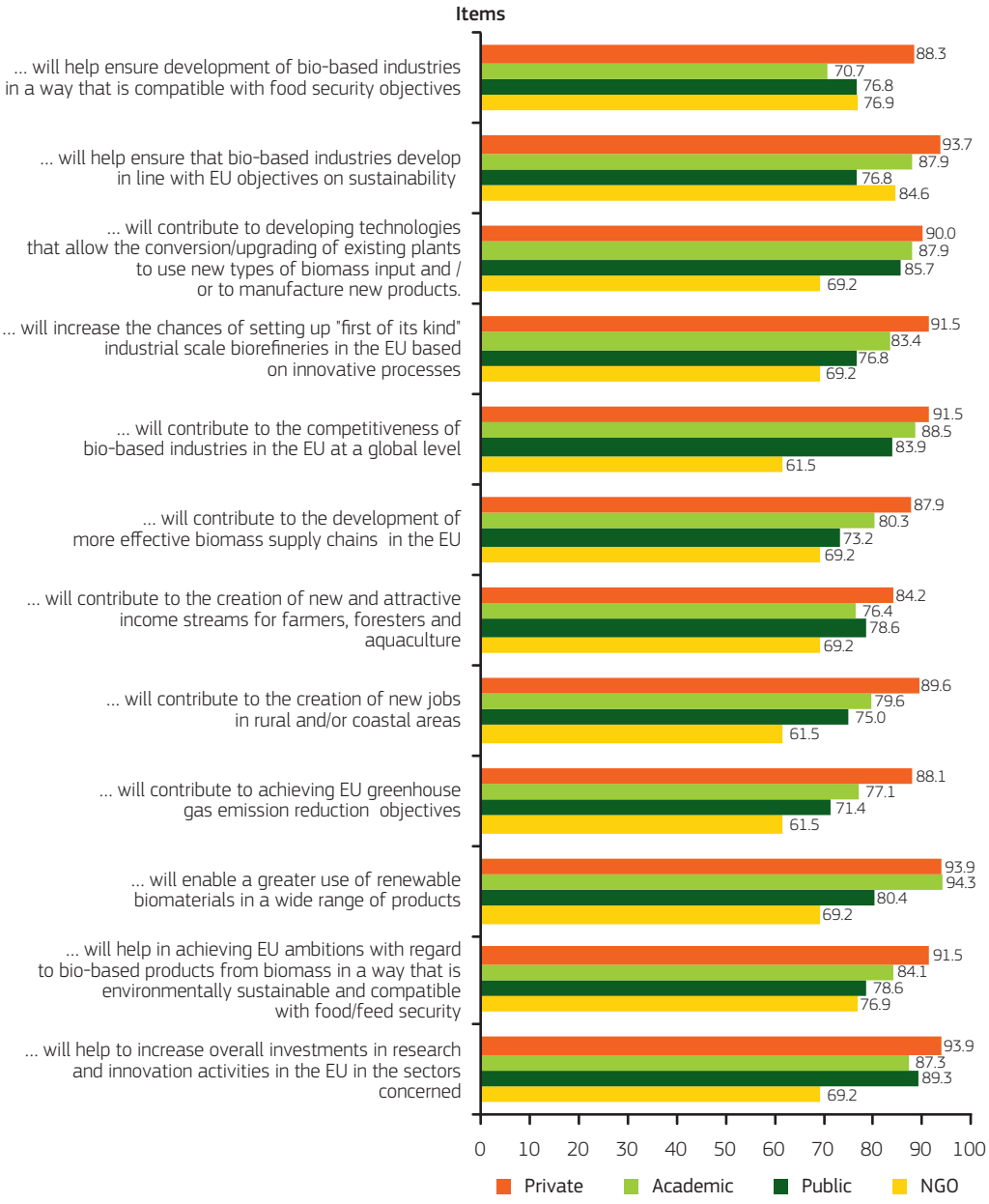


Figure 24 — Achievement of socioeconomic impacts: research and innovation work done in the context of a PPP on bio-based industries (%; 'strongly agree' + 'agree'; differences by stakeholders)



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The Europe 2020 strategy highlights the building of a bioeconomy by 2020 as a deliverable of its flagship initiative «Innovation Union». Accordingly, the Commission has recently presented the communication «Innovating for sustainable growth : A bioeconomy for Europe» (COM (2012) 60 final). Together with Horizon 2020, the upcoming next Union's Framework programme for Research and Innovation, these EU policies promote technological and sustainability leadership as a lever for industrial competitiveness on a global scale. Based on previous experience, public-private partnerships could contribute to facilitating and speeding-up innovation in the EU while reducing time-to-markets of new products and services. This publication reports upon the results of an online public consultation, conducted by the European Commission in the second part of 2012, regarding the question «Bio-based industries, towards a public-private partnership under Horizon 2020?".

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