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Deliverable 5.2

Public Acceptance of Technologies Enabling Bioenergy Production in Four European Countries

Insights from Bosnia and Herzegovina, Germany, Spain, and Sweden

WP5: Recommendations: conditions for creating acceptance for bioenergy production & retrofitting

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Summary

Based on an exploratory survey study including 3054 respondents from four European countries (Bosnia and Herzegovina, Germany, Spain, and Sweden) on citizens' acceptance of bioenergy production in general and how they perceive industries' motives and values of implementing technologies to increase bioenergy production, the following results have been obtained, summarised in these **highlights**:

1. Overall, the public acceptance is relatively positive but few strong, pronounced views among citizens exist; both for bioenergy production in general, and for industries' implementation of technologies to increase bioenergy production specifically. [Sections 3.1 and 3.4]

2. In general, citizens indicate to perceive consequences of bioenergy production in terms of employment, environmental and health as relatively positive, i.e. overall, many citizen perceptions vary from neutral to slightly positive. Differences between the participating four countries are small but clear: citizens from Bosnia and Herzegovina and Spain are more positive in their perceptions than citizens from Germany and Sweden. [Section 3.2]

3. There are small, but relatively consistent differences between on the one hand Germany and Spain and on the other hand Bosnia and Herzegovina and Sweden in citizens' levels of perceived greenwashing with regard to industries' implementation of bioenergy technologies, with citizens' perceptions of greenwashing being stronger in Germany and Spain. [Section 3.3]

4. The level of public acceptance for industries' implementation of bioenergy technologies, in terms of citizens' trust or its counterpart greenwashing, varies slightly between different types of industries: fossil-based industries, particularly fossil refineries, and to a lesser extent the fossil firing power industry, overall tend to score more negatively (i.e. less trust, stronger greenwashing perceptions), relative to the other types of industries: first-generation biofuels, pulp and paper, and combined heat and power (CHP) plants. [Section 3.4]

5. Relatively speaking, citizens attribute industries' activities to implement bioenergy technologies less to being driven by industry values in the social and/or moral domain (e.g. moral obligation, interest in the community), and more to being driven by more

self-interested egoistic and strategic motives (e.g. increasing profits, gaining a tax write-off). [Section 3.5]

6. The extent to which citizens believe that industries' activities to implement bioenergy technologies is values-driven (i.e. originating from industry values in the social and/or moral domain) is the strongest predictor for citizens' level of trust and greenwashing. This makes it all the more important that citizens view these activities as originating from industry's core values, to create trust in these activities and prevent these activities from being viewed as a form of greenwashing. [Section 3.5 and Appendix 1]

7. How familiar citizens are with renewable energy technologies in their own view, plays a role in the predictive ability of values-driven citizen attributions on levels of trust and greenwashing: among citizens who feel relatively knowledgeable with regard to renewable energy technologies and who experience less fear regarding these technologies (i.e. lower technophobia), values-driven attributions are even more strongly associated with levels of trust and greenwashing. [Section 3.6 and Appendix 1]

8. Citizens' sustainability perceptions generally do not affect the predictive ability of values-driven citizen attributions on levels of trust and greenwashing: the association between on the one hand values-driven attributions and on the other hand levels of trust and greenwashing, overall does not depend on the importance of sustainability in citizens' personal lives. [Section 3.7 and Appendix 1]

9. The present work revealed few NIMBY (Not-In-My-Backyard) indications regarding industries' bioenergy technology implementation. [Section 3.8]

1 Introduction

1.1 What is retrofitting?

Modern bioenergy is one of the pillars of renewable energy in Europe and takes on many forms. Relatively straightforward applications, such as the production of heat by combustion of wood are implemented alongside biogas production through anaerobic digestion and production of transport fuels. Spurred by innovation, bioenergy technologies are becoming more advanced and diverse, leading to the production of a variety of advanced transport fuels or high-efficiency, low-carbon emission production of power, heating and cooling. Besides erecting entirely new bioenergy plants, retrofitting – which means replacing a part of a factory or installation with state-of-the-art equipment – can be a very good alternative to replace fossil fuels or to upgrade outdated renewable technology. Retrofitting often means lower capital expenditure, shorter lead times, faster implementation, less production time losses and lower risks.

1.2 Overall goal of BIOFIT project and Deliverable 5.2

In the BIOFIT project bioenergy retrofitting is promoted in five exemplary industries, namely first-generation biofuels, pulp and paper, fossil refineries, fossil firing power and combined heat and power (CHP) plants. The overall objective of the BIOFIT project is to facilitate the introduction of bioenergy retrofitting in these industries, leading to an increase in the share of renewable energy in the final EU energy consumption. Although overall and specific objectives of the project are primarily devoted to industries and market actors in the field of bioenergy retrofitting, the description of the project indicates full awareness of the importance of other stakeholders (policy makers, general public) as enablers or barriers of bioenergy retrofitting. Their (lack of) involvement, engagement and support is acknowledged as vital to bioenergy retrofitting's feasibility and opportunities.

The energy performance of existing factory buildings and installations can be improved by retrofitting components of these buildings. In the specific case of bioenergy retrofitting, parts of a factory or installations are replaced with state-of-the-art biomass technologies, as part of an emerging bioeconomy. Bioenergy retrofit allows for energy from fossil fuels to be partly or fully replaced with energy from biomass, or for an upgrade in bioenergy technologies. Hence, the production of bioenergy can be increased. This provides the

potential to contribute to a reduction in CO_2 emissions, but can also provide a boost to an industry's image and improve citizens' perceptions and views of an industry that engages in bioenergy retrofitting. A greater public acceptance of such bioenergy retrofit initiatives can contribute to accelerating a transition to a bioeconomy, as this might also incentivise the industry involved to implement the retrofitting strategies and stimulate other organisations in an industry to engage in such initiatives and increase the production of renewable energy because of an increase in certain market benefits (such as being seen as a green, responsible industry or reducing CO_2 emissions for the production of energy).

This Deliverable 5.2 has citizens as its target group and aims to enlarge our insight into European citizens' perceptions about bioenergy production generally and more specifically how they perceive the implementation of bioenergy technologies by industries to increase bioenergy production. This adds a social perspective to the topic that has so far been predominantly studied from a technological point of view. Without downplaying the potential economic advantages and sustainability merits of retrofitting practices, it is also important to realise that industries do not operate in a societal vacuum. In addition to the dimensions of Profit and Planet, the Triple P is completed with People. This suggests that innovative retrofitting practices devoted to making more and better use of non-fossil sources of energy are more than a search for improving technological feasibility and economic viability. Retrofitting, then, is not only a matter of business performance and environmental impact reduction, but also of corporate social responsibility and public acceptance. In effect, as much as it is important to investigate whether and how retrofitting serves efficiency (Profit) and sustainability (Planet) goals, it is of interest to explore whether and to what extent retrofitting initiatives and investments are accepted and perhaps even appreciated by citizens.

Specifically, Deliverable 5.2 explores to what extent different types of citizen attributions of industry motives to engage in bioenergy retrofit initiatives (i.e. why do organisations in different industries engage in bioenergy retrofit initiatives in the eyes of citizens) affect the degree to which citizens perceive such industries' decisions as being authentic and responsible. Furthermore, we explore how public acceptance of the use of bioenergy in general is affected by different types of perceived consequences of bioenergy use, as public acceptance of the use of bioenergy has the potential to affect citizens' perceptions of bioenergy retrofit initiatives. If citizens tend to view bioenergy as favourable, they might also be more inclined to view companies' bioenergy retrofit initiatives as more favourable, as bioenergy retrofit initiatives enable industries to produce more bioenergy. Finally, the present deliverable explores to what extent citizens' perceptions regarding novel technologies in general and their perceptions regarding sustainability affect the relations

between on the one hand citizen attributions of industry motives to engage in bioenergy retrofit initiatives and perceived consequences of bioenergy use, and on the other hand public acceptance of bioenergy retrofit initiatives and of the use of bioenergy in general.

By adopting a "people's perspective" this study aims to contribute to catching up with studies having a planet and profit focus. This fits into growing recognition lately that public acceptance did not receive abundant attention in scholarly research so far and that it is high time to improve our understanding of this relatively understudied field. It also connects to the recent acknowledgement that citizens are part of the transition to a circular economy as well and, therefore, public interest, awareness and support are considered crucial for making progress in sustainable development.

More practical, this study's aim is to help industries to improve understanding of public acceptance of their activities and initiatives with respect to bioenergy retrofitting, and consequently to make better assessments of which actions or strategies would help or hinder public acceptance and support.

1.3 Outline

The organisation of the remainder is straightforward. The subsequent Section 2 covers materials and method. Section 3 presents the main findings guided by the highlights as listed in the Summary. Section 4 provides a couple of recommendations in line with some of the results of this survey study.

2 Materials and method

2.1 Selection of countries for citizens survey

The following four European Countries have been selected to be involved in the citizens survey: Bosnia and Herzegovina,[1] Germany, Spain, and Sweden. We have chosen these countries for a number of reasons.[2] First, the aim is to achieve a certain degree of representativeness for the different EU regions: North (Sweden), South (Spain), West (Germany) and Central-East (Bosnia and Herzegovina). Second, these countries participate in the BIOFIT EUproject – as a partner or as a case-study. Applying these criteria resulted in choosing Bosnia and Herzegovina as the country that represents Eastern Europe. For the other three regions additional criteria were needed. Third, within each region we have assessed the production capacity in the EU Member States (MS) that participate in the BIOFIT study for the five types of industries involved. Within each region the selected MS has the highest share in production capacity: Sweden for Northern Europe, Germany for Western Europe, Spain for Southern Europe and Bosnia and Herzegovina for Central and Eastern Europe. The fourth criterion concerns the attitude towards environmental issues, climate change and the role of bioenergy. Looking at those criteria we came to exactly the same MS, because by choosing the selected MS there is variety in:

- Citizen concerns about energy supply and affordability. These concerns are very high in Spain, very low in Sweden, and intermediate in Germany. These considerations can potentially play a role in citizens' perceptions on renewable energy and fossil energy and consequently also on their perceptions on retrofitting.
- The degree to which citizens perceive climate change as a problem. In absolute terms public awareness on this issue is rather high in all countries; Sweden and Germany score relatively higher on most indicators regarding climate change problem perception.
- The extent to which citizens believe that energy should be generated from biomass. Overall only small differences exist on this point, but in Germany the percentage of citizens who believe that a large or very large amount of energy should be generated from biomass is relatively low.

[1] Bosnia and Herzegovina is as yet not an EU Member State.

[2] BIOFIT partners have had the opportunity to participate in this selection process and the final selection made by Wageningen Economic Research has also been based on their input.

2.2 Structure of the survey

The citizens' survey has a so-called "funnel structure", in which respondents first answered relatively generic questions and subsequently answered questions that become increasingly more detailed (Appendix 2). This structure is used to help preventing that respondents' answers to earlier questions affect their answers to questions later on in the survey. Consequently, the contents of the survey runs from general to detailed as follows:

- Questions about perceptions and beliefs regarding sustainability
- Questions about energy consumption and production in general
- Questions about perceptions and beliefs regarding novel technologies, first in general and then with regard to renewable energy technologies
- Questions about bioenergy production in general
- Questions about bioenergy retrofitting for a specific industry

For the fifth part of the survey, respondents were randomly allocated to one of five industries (see subsection 1.2) and answered questions about bioenergy retrofitting for one of the following industries:

- First generation biofuels industry
- Pulp and paper industry
- Fossil refineries industry
- Fossil firing power industry
- Combined heat and power plants industry

Survey scales from studies that have been used and validated previously were used for the development of the citizens' survey to provide greater assurance that different concepts that are included in the survey are measured in a valid manner. In order to pre-test the comprehensibility of the survey's questions and structure, the survey was presented to a few relatives of members of the Dutch research team. This led to some minor adjustments.

2.3 Data collection

Three market research agencies were approached by Wageningen Economic Research and asked to send a tender for conducting the survey in the four selected countries (Bosnia and Herzegovina, Germany, Spain, and Sweden), with 800 respondents per country and for a

sample that was representative of the respective countries in terms of socio-demographic characteristics such as age and gender (see Table 1 for the sample characteristics).

The tenders were reviewed based on the proposed plan of the market research agencies to collect the data in each country, their experience in having conducted similar studies before and quotation. Based on these criteria, MSI-ACI was selected to collect the data for the survey.

Before the final data were collected, a pilot study was conducted in which the developed survey was distributed among a small sample in each of the four countries (10 respondents per country) to explore whether the contents of the survey were clear. Respondents had the opportunity to make comments. The pilot study did not reveal any unclarities regarding the survey contents. Consequently, the data collection could start, which took place in July 2020.

2.4 Background statistics study participants

Table 1. Sample characteristics overall & per country (%)

	Overall (n = 3054)	**Bosnia Herzegovina (n = 753)**	**Spain (n = 753)**	**Germany (n = 768)**	**Sweden (n = 780)**
Gender					
Male	49.4	47.9	48.7	51.7	49.1
Female	50.4	52.1	51.0	47.9	50.8
Other	0.2	0.0	0.3	0.4	0.1
Age					
18-29	21.3	30.0	20.6	17.1	17.8
30-39	20.2	24.2	20.8	17.6	18.5
40-49	19.9	23.4	20.3	17.4	18.5
50-59	19.2	15.8	20.1	23.6	17.3
60+	19.4	6.6	18.2	24.3	27.9
Place of residence					
Metropolitan area (1-5 million inhabitants)	14.4	0.7	27.6	10.7	18.7
City (100.000 – 1 million inhabitants)	27.2	32.3	30.9	22.8	23.1
Large town (20.000 – 100.000 inhabitants)	23.9	20.3	22.6	26.4	26.3
Small town	19.7	32.5	15.9	18.8	11.8
Village	8.6	12.7	0.1	13.3	8.2
Rural	5.6	1.3	2.3	7.6	11.0
Don’t know/ can’t say	0.5	1.1	0.5	0.5	0.9

2.5 Distribution of participants across industries

For the latter part of the survey, respondents were randomly allocated to one of the five industries: first generation biofuels industry, pulp and paper industry, fossil refineries industry, fossil firing power industry, and combined heat and power plants industry. In Table 2 below, the allocation of participants across the five different industries is shown, across countries (overall) as well as for each individual country.

Table 2. Allocation of study participants across industries

	Overall		**Bosnia Herzegovina**		**Spain**		**Germany**		**Sweden**	
Industry	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
First generation biofuels industry	583	19.1	141	18.7	141	18.7	152	19.8	140	17.9
Pulp and paper industry	621	20.3	161	21.4	161	21.4	157	20.4	156	20.0
Fossil refineries industry	608	19.9	145	19.3	145	19.3	154	20.1	155	19.9
Fossil firing power industry	620	20.3	151	20.1	151	20.1	152	19.8	168	21.5
Combined heat and power plants industry	622	20.4	155	20.6	155	20.6	153	19.9	161	20.6
Total	**3054**		**753**		**753**		**768**		**780**	

3 Results

The presentation of the main results of the survey will be structured along the highlights which were listed in the Summary. As this deliverable has public acceptance at its core, Section 3 opens with the results obtained with respect to public acceptance of bioenergy production in general, followed by the related result that respondents in all four countries are relatively positive about the perceived consequences of bioenergy production (Section 3.2).

To start, it is important to note that the term retrofitting has not been used literally in the survey – because citizens are expected to be unfamiliar with this notion – but it has been operationalised in terms of implementation of bioenergy technology to enable bioenergy production. In other words, although retrofit was not explicitly presented to the respondents, the terms in which questions were posed refer to what retrofitting represents. Within the context of this project deliverable it is therefore relevant to clarify that a more general framing has been used in terms of technologies enabling bioenergy production rather than the specific notion of bioenergy retrofits. What renewable energy and bioenergy entails was explained to respondents in an infographic (see Appendix 3). In this respect it is also worth mentioning that the phrasing in the survey was about several industry sectors and their implementation of novel energy technologies aimed to expand the production of bioenergy. This wording was used to refer to the fact that it concerns plants that are already there to avoid going into much detail about the idea of retrofits – i.e. instead of erecting new bioenergy production plants replacing parts of an existing factory or installation with state-of-the-art technologies supporting bioenergy utilisation.

3.1 Public acceptance of bioenergy production is relatively positive (Highlight 1)

Overall, citizens view bioenergy as relatively acceptable. This can be seen in Figure 1 below, in which the level of acceptability of bioenergy production in each of the participating countries is visualised.

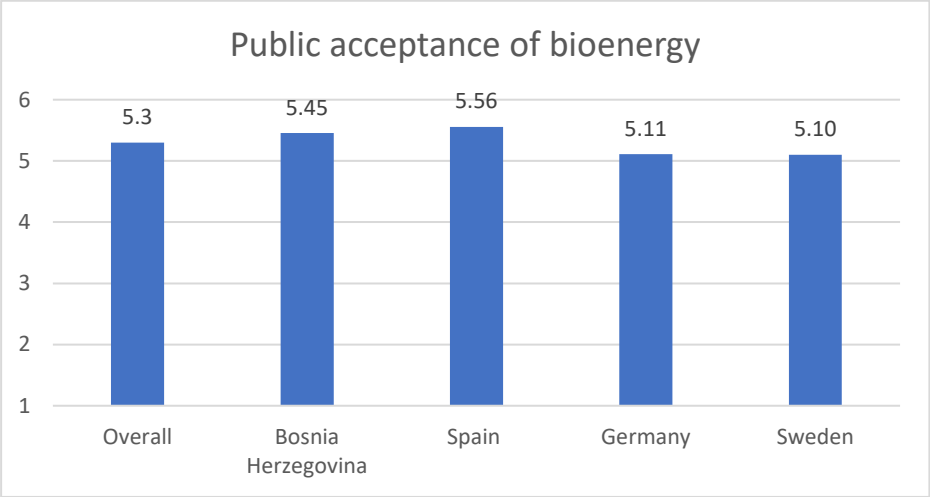

Figure 1. Means of public acceptance of bioenergy

The degree of public acceptance regarding bioenergy production is relatively high in all countries (all means significantly differ from neutral score "4" on a 1-7 survey scale), particularly in Bosnia and Herzegovina and Spain (Figure 1). Thus, public acceptance of bioenergy production is relatively positive.

- The higher the score (measured on a 1-7 scale), the more respondents believe that bioenergy production is acceptable and necessary (1 = *completely unacceptable [unnecessary]; 7 = completely acceptable [necessary*])

Table 3 shows which means differ between countries in a statistically significant manner (Post-Hoc Bonferroni test). To illustrate, the level of acceptability of bioenergy production in Spain (2) significantly differs from the level of acceptability in both Germany (3) and Sweden (4). Looking back at Figure 1, one can see that this level of acceptability of bioenergy production was higher in Spain, than in Germany and Spain.

Table 3. Country differences in public acceptance of bioenergy

Country	*Significant difference with:*
1. Bosnia Herzegovina	3; 4
2. Spain	3; 4
3. Germany	1; 2
4. Sweden	1; 2

Note. Post-hoc Bonferroni test

3.2 Citizens' perceptions of consequences of bioenergy production are moderately positive (Highlight 2)

Section 3.1 showed that public acceptance of bioenergy generally is above "5" (on a 1-7 survey scale) in all four countries. In line with these scores are citizens' perceptions of possible *consequences* of bioenergy production. Overall, citizens assessed bioenergy production's consequences, in terms of consequences for the economy, environment and health to be relatively positive too (Figure 2). Thus, public acceptance and perceived consequences point to similar outcomes, which suggests that both are related. This is further reflected in positive perceptions regarding consequences of bioenergy production of respondents from both Bosnia and Herzegovina and Spain – the two countries with the highest public acceptance scores (Section 3.1). Respondents from these two countries were most outspoken in the sense that they perceive relatively large positive consequences of bioenergy production. Beneficial environmental consequences received higher scores and adverse consequences in the form of rising energy prices and health risks received the lowest scores in Bosnia and Herzegovina and Spain, in contrast to Germany and Sweden Employment opportunities as a result of bioenergy production were perceived as most beneficial in Spain.

The following perceived consequences of bioenergy production were measured in the survey:

- Economic consequences in the form of a change in employment opportunities.
- Economic consequences in the form of a change in energy prices.[3]
- Environmental consequences in the form of a change in CO_2 emissions, global warming, and environmental quality in terms of sustainability.
- Health consequences in the form of a change in odours, unpleasant noise and public health risks as a result of bioenergy production.

In Figure 2 below, the level of these different types of perceived consequences of bioenergy production in each of the participating countries is visualised.

[3] The two types of perceived economic consequences combined formed an unreliable scale (i.e. a low Cronbach's alpha); hence they were kept separately for the analyses.

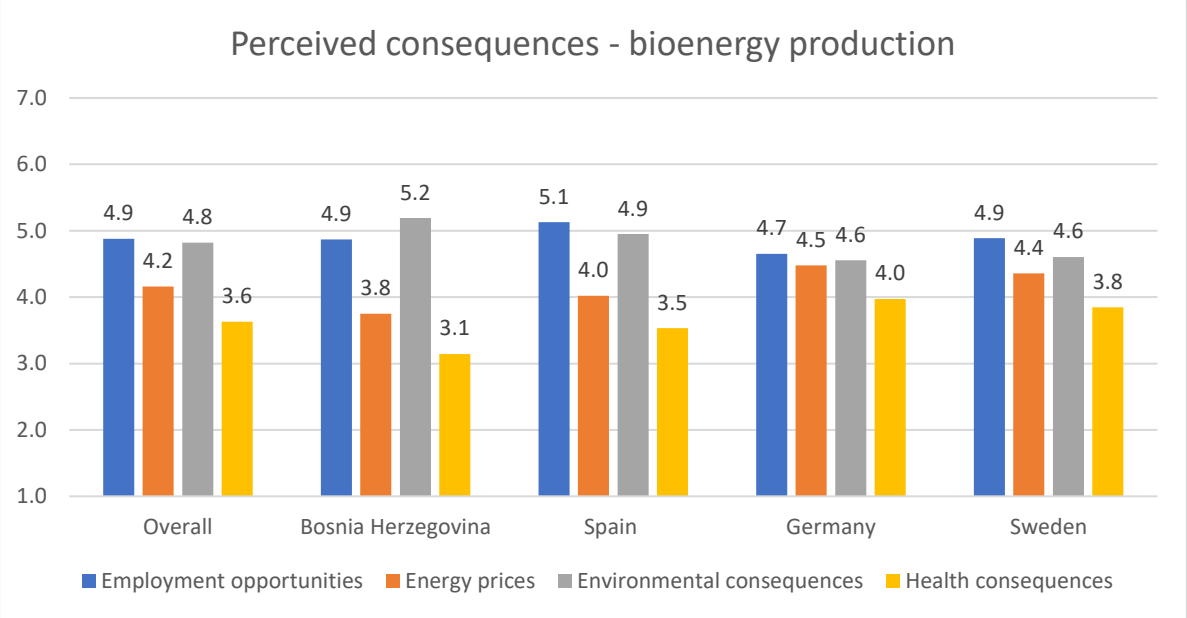

Figure 2. Means of perceived consequences of bioenergy production

Employment opportunities

- The higher the score, the more respondents believe **that employment opportunities will increase** as a result of bioenergy production (*1 = decrease in employment opportunities; 7 = increase in employment opportunities*).
- This belief that employment opportunities will increase is held relatively strongly in Spain, and the least in Germany; but even in Germany the belief is held that employment opportunities will increase rather than decrease (significant difference from neutral score "4"; $t(767) = 15.27$, $p < .001$), see Figure 2.

Energy prices

- The higher the score, the more respondents believe that energy **prices will increase** as a result of bioenergy production (*1 = decrease in energy prices; 7 = increase in energy prices*).
- Respondents expect energy prices to somewhat increase in Germany ($t(767) = 10.30$, $p < .001$) and Sweden ($t(779) = 7.56$, $p < .001$; significant difference from neutral score "4"), while in Bosnia and Herzegovina there is a minor expectation that energy prices will somewhat decrease ($t(752) = -4.42$, $p < .001$; significant difference from neutral score "4"), see Figure 2.

Environmental consequences (CO_2 emissions, global warming, environmental quality)

- The higher the score, the more respondents believe that bioenergy production will have **positive environmental consequences**; less CO_2 emissions, a decrease in global warming, improvement in environmental quality in terms of sustainability.
- In all countries, respondents believe that bioenergy use and production will have (mainly) positive environmental consequences (all means significantly differ from neutral score "4"), see Figure 2.
- This belief that bioenergy production will have mainly positive environmental consequences is strongest in Bosnia and Herzegovina, and to a somewhat lesser extent in Spain, followed by both Germany and Sweden.

Health consequences (odours, noise, public health risks)

- The higher the score, the more respondents believe that bioenergy use and production will **increase health risks**; more unpleasant odours, more unpleasant noise and greater public health risks (1 = decrease; 7 = increase).
- Respondents expect health risks to (somewhat) decrease as a result of bioenergy, particularly in Bosnia and Herzegovina ($t(752) = -16.70$, $p < .001$), and to a somewhat lesser extent in Spain ($t(752) = -9.08$, $p < .001$), see Figure 2.

Table 4 below indicates in which instances there is a statistically significant difference in the respective perceived consequences of bioenergy production between countries. For instance, the level of perceived environmental consequences among respondents from Bosnia and Herzegovina significantly differs from the level of perceived environmental consequences among Spanish, German and Swedish respondents. Looking back at Figure 2, one can see that this level of perceived environmental consequences was higher in Bosnia and Herzegovina.

Table 4. Country differences in perceived consequences of bioenergy production

	Employment opportunities	**Energy prices**	**Environmental consequences**	**Health consequences**
Country	*Significant difference with:*	*Significant difference with:*	*Significant difference with:*	*Significant difference with:*
1. Bosnia Herzegovina	2	2; 3; 4	2; 3; 4	2; 3; 4
2. Spain	1; 3; 4	1; 3; 4	1; 3; 4	1; 3; 4
3. Germany	1; 2; 4	1; 2	1; 2	1; 2
4. Sweden	2; 3	1; 2	1; 2	1; 2

Note. Post-hoc Bonferroni test

3.3 Public acceptance of industries' implementation of bioenergy technologies is relatively positive with minor differences between countries (Highlight 3)

This Section 3.3 shows that though mostly positive, overall, citizens hardly have strong, pronounced views on industries' implementation of bioenergy technologies. Whereas public acceptance of bioenergy generally is above "5" in all four countries (Section 3.1), when it comes to specifically bioenergy technologies respondents' scores vary from neutral to slightly positive (between "4" and "5" on average, on a 1-7 survey scale). Such moderately positive scores indicate that respondents are currently not against further developments in bioenergy production but neither suggest that contemporary citizens are convinced and articulate supporters as yet. The latter finds some empirical ground in the scores on perceived greenwashing. The results show that trust and greenwashing scores are not zero-sum-related (trust up/down – greenwashing down/up) but relatively independent and end up with almost similar scores.

Despite some differences between countries with respect to greenwashing on the one hand and acceptance and trust on the other, overall only minor differences between countries were found. This accords with Section 3.2 but in this case consistency in (small) differences between countries was found between other pairs of countries than in the previous section. Germany and Spain showed relatively high levels of perceived greenwashing in comparison to the respondents from Bosnia and Herzegovina and Sweden who are a little less outspoken in their assessment of industries' implementation of bioenergy technologies (Figure 3).

The extent to which respondents view industries' activities to implement bioenergy technologies to increase bioenergy production was operationalised and measured in two ways:

- **Trust**, the extent to which respondents trust industries that implement bioenergy technologies. Two different types of trust were measured, **competence-based trust** and **integrity-based trust**, with the expectation that particularly integrity-based trust is important regarding implementation of bioenergy technologies being perceived as authentic. Competence-based trust is about the extent to which respondents trust that industries have sufficient expertise and knowledge to adequately execute efforts to implement bioenergy technologies. Integrity-based trust is about the extent to which respondents trust industries to be honest and transparent.

- **Perceived corporate greenwashing**, the extent to which respondents view activities of industries that implement bioenergy technologies as a form of greenwashing, i.e. conducting activities to merely look green/sustainable to the outside world.

In Figure 3 below, the level of trust and perceived greenwashing regarding implementation of bioenergy technologies in each of the participating countries is visualised.

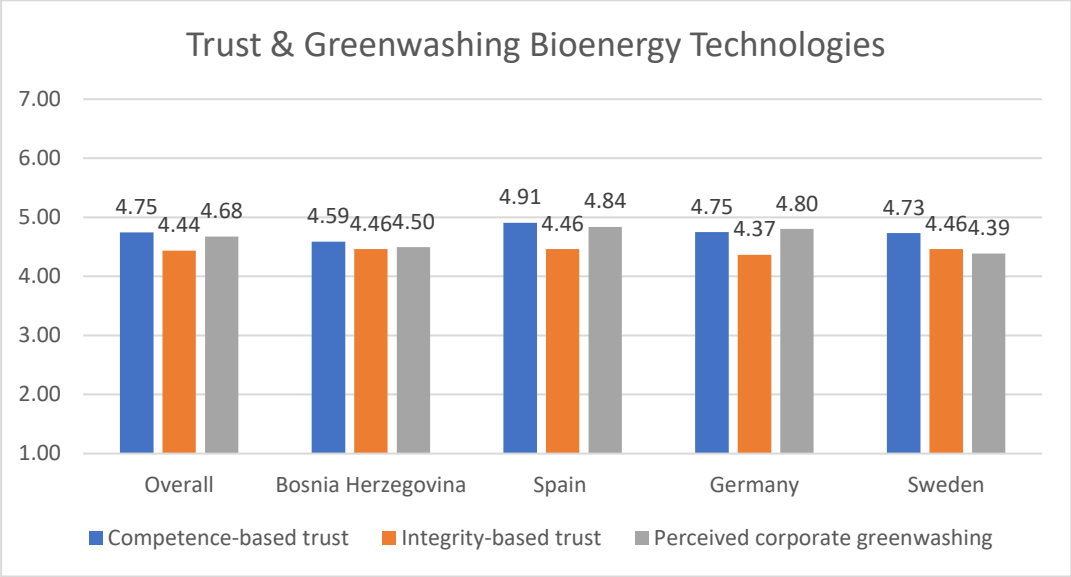

Figure 3. Means of trust and greenwashing

- The higher the score on trust, the more respondents have trust in industries that implement bioenergy technologies.
- The higher the score on perceived corporate greenwashing, the more respondents view industries that implement bioenergy technologies as a form of greenwashing.

The following conclusions can be drawn:

- The degree to which citizens trust industries that implement bioenergy technologies is moderately positive (all means significantly differ from neutral score “4”; Figure 3)
- However, the same can be said regarding to the extent to which citizens view industries’ implementation of bioenergy technologies as a form of greenwashing, these scores were also moderately positive (again, all means significantly differ from neutral score “4”), see Figure 3.
- So on the one hand, the overall level of trust is relatively positive regarding activities focused on implementing bioenergy technologies to increase bioenergy production, but simultaneously on average citizens are also a bit sceptical, which is reflected in these activities being perceived as greenwashing, more so than not.

Table 5 below indicates in which instances there is a statistically significant difference in trust and/or greenwashing between countries. For instance, the level of perceived greenwashing among respondents from Bosnia and Herzegovina significantly differs from the level of perceived greenwashing among Spanish and German respondents. Looking back at Figure 3, one can see that this level of of perceived greenwashing was higher in Spain and Germany.

Table 5. Country differences in trust and greenwashing

	Competence-based trust	***Integrity-based trust***	***Greenwashing***
Country	*Significant difference with country:*	*Significant difference with country:*	*Significant difference with country:*
1. Bosnia Herzegovina	2	-	2; 3
2. Spain	1; 4	-	1; 4
3. Germany	-	-	1; 4
4. Sweden	2	-	2; 3

Note. Post-hoc Bonferroni test

3.4 Public acceptance of industries' implementation of bioenergy technologies is relatively positive with less trust in fossil-based industries (Highlight 4)

The next highlight that guides our reporting of the main results of the survey observes the public acceptance for industries' implementation of bioenergy technologies from another perspective than Section 3.3 by changing the focus from differences between countries to differences between the five types of industries. It appears that, in terms of trust (Figure 4, 5) or its counterpart greenwashing (Figure 6), fossil-based industries (fossil refineries, and to a lesser extent the fossil firing power industry) tend to score more negatively (i.e. less trust, stronger greenwashing perceptions), relative to other types of industries, those being first generation biofuels, pulp and paper and the combined heat and power industry. Particularly with respect to integrity-based trust and perceived greenwashing this is a relatively consistent finding in all four countries.

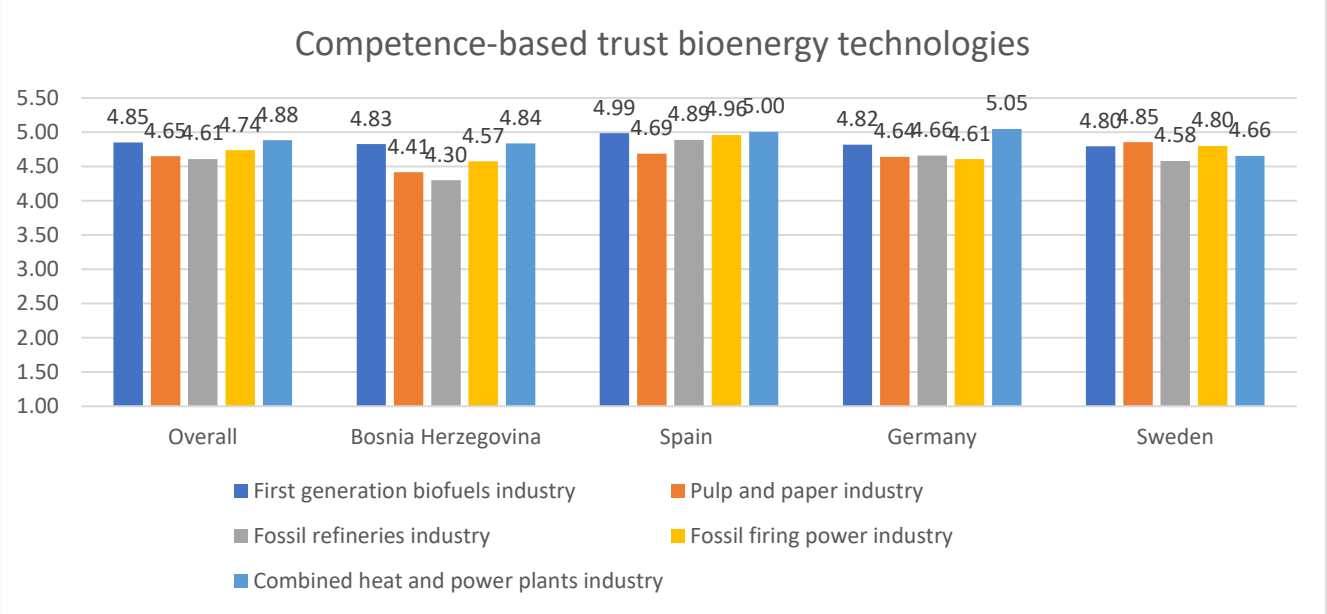

Figure 4. Means of competence-based trust

Table 6. Industry differences in competence-based trust

Industry	*Significant difference with:*
1. First generation biofuels industry	2; 3
2. Pulp and paper industry	1; 5
3. Fossil refineries industry	1; 5
4. Fossil firing power industry	-
5. Combined heat and power plants industry	2; 3

Note. Post-hoc Bonferroni test

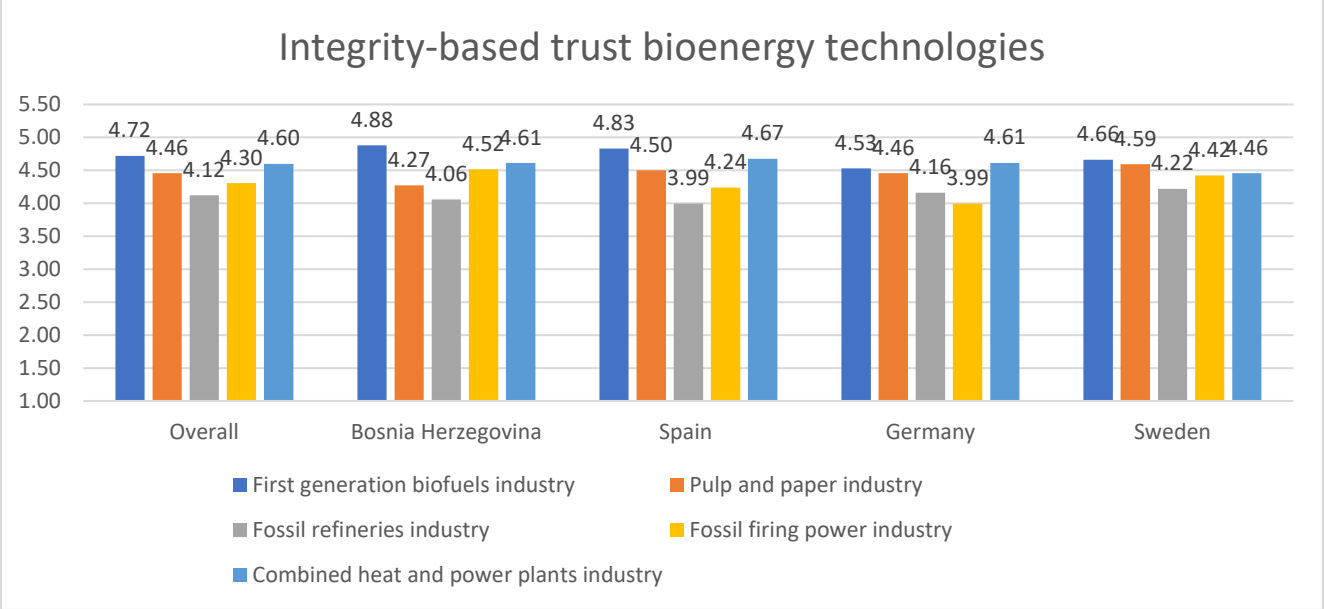

Figure 5. Means of integrity-based trust

Table 7. Industry differences in integrity-based trust

Industry	*Significant difference with:*
1. First generation biofuels industry	2; 3; 4
2. Pulp and paper industry	1; 3
3. Fossil refineries industry	1; 2; 5
4. Fossil firing power industry	1; 5
5. Combined heat and power plants industry	3; 4

Note. Post-hoc Bonferroni test

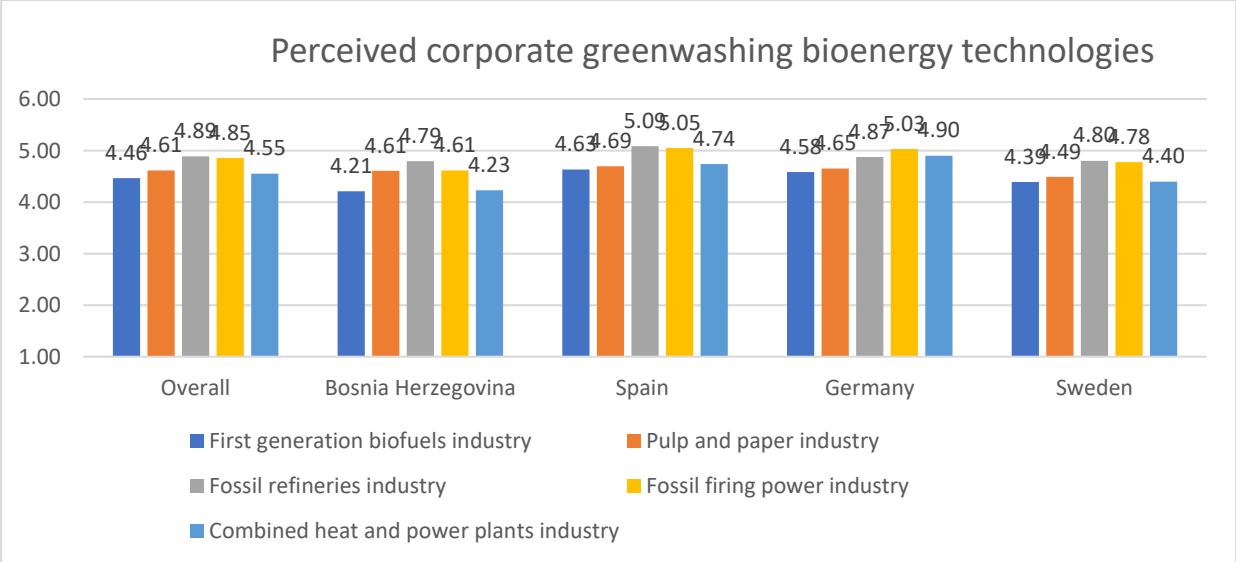

Figure 6. Means of perceived corporate greenwashing

Table 8. Industry differences in perceived corporate greenwashing

Industry	*Significant difference with:*
1. First generation biofuels industry	3; 4
2. Pulp and paper industry	3; 4
3. Fossil refineries industry	1; 2; 5
4. Fossil firing power industry	1; 2; 5
5. Combined heat and power plants industry	3; 4

Note. Post-hoc Bonferroni test

3.5 Values-driven industry motives for gaining citizens' trust and preventing greenwashing perceptions is important (Highlights 5 and 6)

Previous Highlights 1-4 concentrated on public perceptions of bioenergy, bioenergy technologies and the perceived consequences of bioenergy production in general among citizens. The subsequent Highlight 5 changes the point of view from plain scores to underlying motives. In other words, what lies behind respondents' perceptions and qualifications? What do respondents believe to be underlying motives for specific industries to engage in activities to implement bioenergy technologies to increase the production of bioenergy?

These citizen attributions about underlying industry motives to engage in activities to implement bioenergy technologies can be either:

Values-driven: Respondents attribute industries' implementation of bioenergy technologies to being driven by certain social and/or moral values held by organisations in an industry (moral obligation, long-term interest in the community, giving back to the community, believing in a cause).

Egoistic-driven: Respondents attribute industries' implementation of bioenergy technologies to being driven by egoistic motives (helping own business, getting publicity, getting a tax write-off).

Strategic-driven: Respondents attribute industries' implementation of bioenergy technologies to being driven by strategic motives (getting more customers, keeping current customers, increasing profits).

Stakeholder-driven: Respondents attribute industries' implementation of bioenergy technologies to being driven by stakeholder motives (expectations from customers, expectations from society).

Regulatory-driven: Respondents attribute industries' implementation of bioenergy technologies to being driven by regulatory considerations (European Union regulations, political pressures, national regulations).

Regarding the five types of citizen attributions about industry motives, a distinction can be made between values-driven attributions which are "other-interested" in the sense of the industry motive that lies in giving back to others in some way (i.e., values-driven), versus the four other types of citizen attributions about industry motives which are all in a way "self-interested" in the sense that the industry motive lies in providing certain benefits for the own organisation/industry.

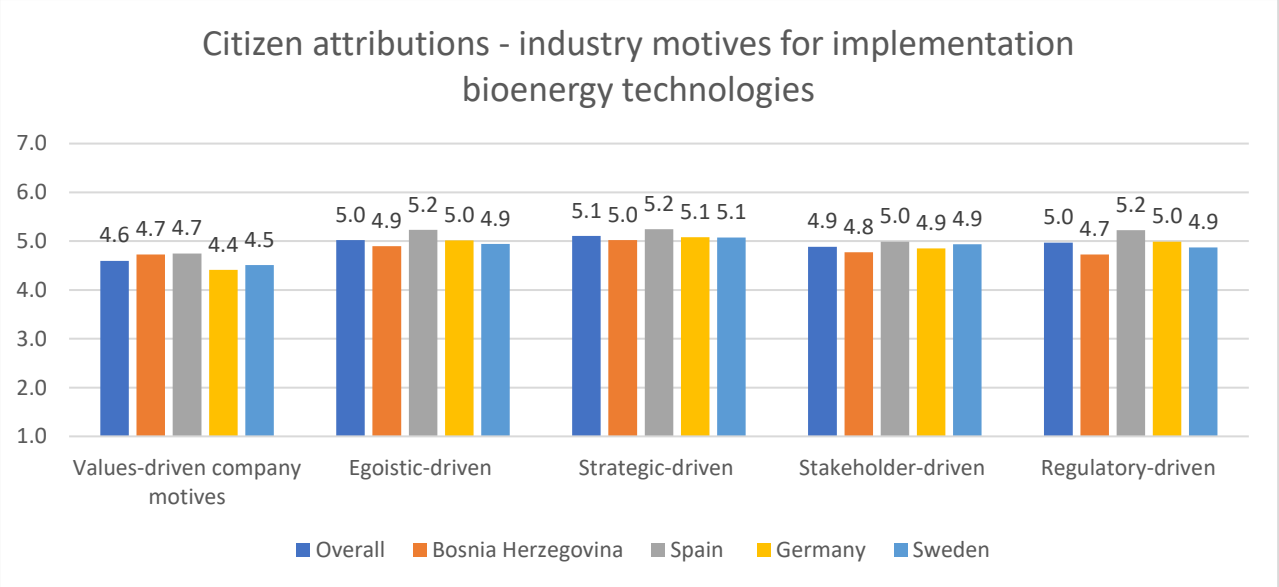

Figure 7. Means of citizen attributions of industries' activities to implement bioenergy technologies

Figure 7 above depicts clearly the fifth Highlight of this study: citizens attribute industries' activities to implement bioenergy technologies relatively less to being driven by social, moral industry values, and more to being driven by more self-interested motives (the other 4 types).

Table 9 below indicates in which instances there is a statistically significant difference in the different types of citizen attributions between countries. For instance, the level of egoistic-driven attributions among respondents from Spain significantly differs from the level of values-driven attributions respondents from the other three countries. Looking back at Figure 7, one can see that this level of egoistic-driven attributions was higher in Spain, relative to the other countries.

Table 9. Country differences in different types of citizen attributions

	Values-driven	**Egoistic-driven**	**Strategic-driven**	**Stakeholder-driven**	**Regulatory-driven**
Country	*Significant difference with:*	*Significant difference with:*	*Significant difference with:*	*Significant difference with:*	*Significant difference with:*
1. Bosnia Herzegovina	3; 4	2	2	2; 4	2; 3
2. Spain	3; 4	1; 3; 4	1; 3; 4	1	1; 3; 4
3. Germany	1; 2	2	2	-	1; 2
4. Sweden	1; 2	2	2	1	2

Note. Post-hoc Bonferroni test

- The higher the score, the more respondents attribute organisations' activities to implement bioenergy technologies to being driven by a certain type of motive: values, egoistic, strategic, stakeholder, regulatory (*1 = totally disagree; 7 = totally agree*).

One can conclude:

- In Spain and Bosnia and Herzegovina, industries' implementation of bioenergy technologies is attributed to a greater extent to be **values-driven**, relative to both Germany and Sweden (Figure 7, Table 9).
- In Spain and Sweden, industries' implementation of bioenergy technologies is attributed to a greater extent to be **driven by stakeholder motives**, compared to Bosnia and Herzegovina.
- In Spain, respondents score relatively high on all types of citizen attributions, which is also reflected in industries' implementation of bioenergy technologies is attributed to a greater extent to be **driven by egoistic, strategic and regulatory motives**, compared to the other three nations.

Likewise, as in Section 3.4 it is possible to change the focus from potential differences between countries to the five industries distinguished. In this case we restrict ourselves to present only the results obtained with respect to the extent to which respondents attribute industries' activities to implement bioenergy technologies to being values-driven (see Figure

8 below). First, because the other types of citizen attributions regarding industry motives did not bring much (significant) differences between the types of industries. Second, because of the importance of citizen attributions to values-driven industry motives in the process of gaining public acceptance. Further analysis revealed that respondents' attribution of industries' activities to implement bioenergy technologies as values-driven is the strongest predictor for their level of trust and greenwashing perception. This finding is labelled Highlight 6, and is further elaborated on in a separate study (see Appendix 1). It is pointed out how important it is for public acceptance that citizens view industries' activities as originating from their core values in the social, moral domain (e.g. moral obligation, giving back to the community). The more industries' implementation of bioenergy technologies is attributed by citizens to be values-driven (i.e., being in line with social, moral values held in the industry), the better the conditions are that these industrial activities will be trusted by the public rather than being viewed as a form of greenwashing.

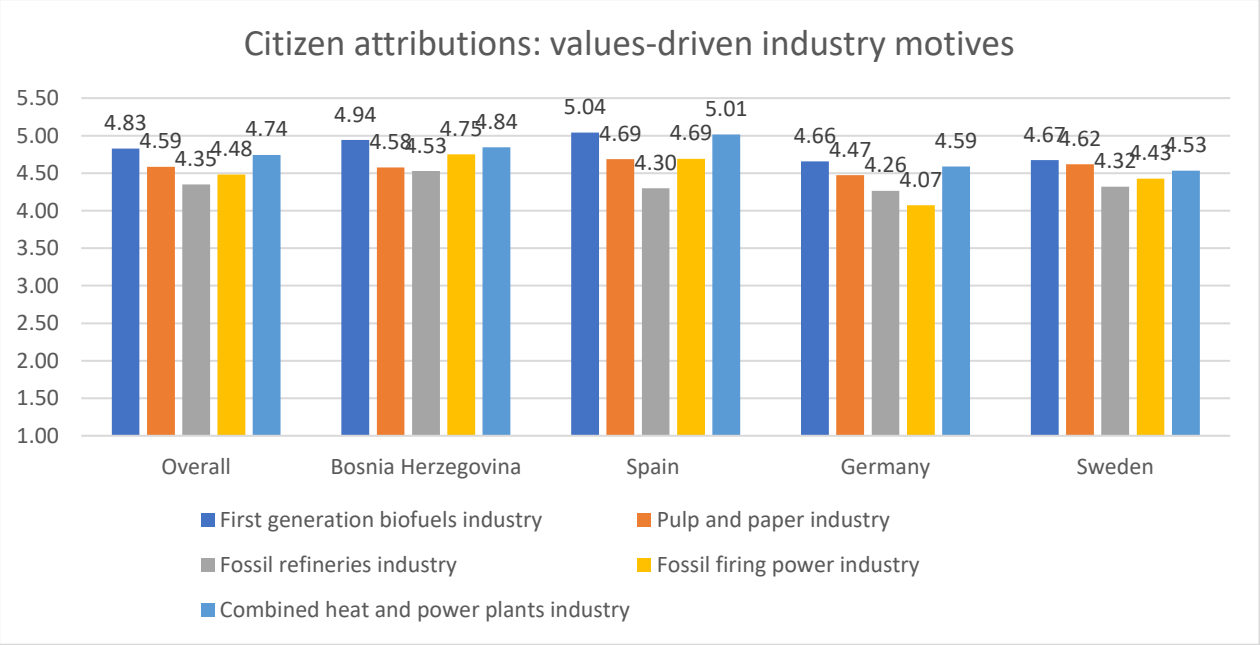

Figure 8. Means of values-driven citizen attributions for individual countries

Figure 8 above shows the level of values-driven attributes for the respective industries.

Table 10 below indicates in which instances there is a statistically significant difference in the different types of citizen attributions between industries. For instance, the level of values-driven attributions regarding the pulp and paper industry significantly differs from the level of values-driven attributions regarding the first generation biofuels industry and fossil refineries industries, according to respondents.

Table 10. Industry differences in values-driven citizen attributions

Industry	*Significant difference with:*
1. First generation biofuels industry	2; 3; 4
2. Pulp and paper industry	1; 3
3. Fossil refineries industry	1; 2; 5
4. Fossil firing power industry	1; 5
5. Combined heat and power plants industry	3; 4

Note. Post-hoc Bonferroni test

- The higher the score, the more respondents attribute industries' activities to implement bioenergy technologies to being driven by values held by organisations in the industry (*1 = totally disagree; 7 = totally agree*).

Respondents attributed industries' activities to implement bioenergy technologies to being driven by values particularly for industries from the First generation biofuels industry and Combined heat and power plants industry. With respect to the Fossil refineries industry and Fossil firing power industry the implementation of bioenergy production technologies was attributed less to being driven by industries' core values.

3.6 Citizens familiarity with renewable energy technologies plays a role in the predictive ability of values-driven citizen attributions of levels of trust and greenwashing (Highlight 7)

Highlights 1-6 are the most general outcomes of our survey study on public acceptance of technologies enabling bioenergy production. In addition, several other findings have been obtained. Highlights 7 and 8 are also covered in Appendix 1 but will be briefly reviewed too in this Section. Both highlights are concerned with moderation effects of the relation between values-driven citizen attribution of industries' initiatives to increase bioenergy production on the one hand (by means of implementing bioenergy technologies) and levels of trust or greenwashing perception regarding these activities on the other. By exploring such moderation effects, insight can be gained whether the strength of the relation between values-driven citizen attributions and trust/greenwashing varies between different types of citizens, based on a certain individual characteristic of citizens.

Highlight 7 concentrates on respondents' self-reported affinity with renewable energy technologies. It turned out that among respondents who indicated to have a relatively high level of subjective knowledge on renewable energy technologies (i.e. the extent to which

they believe to know much regarding these technologies), stronger values-driven attributions are even more likely to lead to more trust and weaker greenwashing perceptions of industries' implementation of bioenergy technologies.

Such interactions were less clear with respect to respondents who viewed themselves interested in technological innovation in general and a fear of/ resistance to renewable energy technologies in particular (i.e. technophobia with respect to renewable energy technologies). Results were somewhat mixed, showing that among citizens who report to not be afraid of novel renewable energy technologies and have therefore relatively low levels of technophobia (high levels of technophilia), stronger values-driven attributions are particularly likely to lead to weaker greenwashing perceptions of industries' implementation of bioenergy technologies.

However, among respondents with a relatively high level of technophobia, there was no significant relation between the extent to which they attributed bioenergy production technologies to be values-driven and their perception of bioenergy retrofitting to be greenwashing. A significant interaction between values-driven attributions and neophobia on (integrity-based) trust in industries that engage in bioenergy production also was not found.[4]

All in all, it is observed that citizens' self-reported familiarity with renewable energy technologies plays a role in the predictive ability of values-driven citizen attributions of levels of trust and greenwashing: among citizens who feel relatively knowledgeable with regard to renewable energy technologies and who experience less fear regarding these technologies (low technophobia), values-driven attributions are even stronger associated with levels of trust and greenwashing.

[4] It can be added that when examining the direct relation between citizens' level of technophobia concerning renewable energy technologies and greenwashing, the following is observed: the higher citizens' technophobia is, the higher level of perceived corporate greenwashing. This relation is quite robust, as it is present across the four participating countries, as well as the five different industry sectors.

3.7 The (un)importance of citizens' personal interest into sustainability does not affect corporate trust and greenwashing (Highlight 8)

The implementation of technologies to increase bioenergy production is part of larger processes of sustainable development and the transitioning towards a circular bio-based economy. From this perspective we have also included in the survey how sustainable respondents view themselves and whether or not this affects their acceptance of bioenergy production technologies and their trust in industry's motives to engage in bioenergy production. With respect to the first this appeared to be the case: the more citizens identified themselves as being sustainable (i.e. stronger environmental values, beliefs and norms), the greater the degree of acceptance of bioenergy production in general.

By the same token, it was not consistently found that citizens who view themselves as sustainable are more inclined to attribute industry's motives to engage in bioenergy production initiatives as values-driven and consequently view such initiatives as more trustworthy. Instead, particularly citizens having weaker environmental values appeared to put greater (integrity-based) trust in industry's initiatives concerning bioenergy production technologies. Another finding that blurs the picture concerns the higher likeliness of perceiving industries' efforts in bioenergy production as a form of corporate greenwashing by citizens having a high awareness of environmental problems as a result of energy consumption.

Taken together, the importance of sustainability in citizens' personal lives generally do not affect the predictive ability of values-driven citizen attributions of levels of trust and greenwashing, at least not in a consistent, robust fashion.

3.8 Relatively few NIMBY indications (Highlight 9)

At the end of the survey, respondents were asked what an acceptable distance would be for a (nearest) plant that would implement bioenergy technologies to increase bioenergy production: 1km, 2.5km, 5km, 10km, or 20km from one's residence, or not accepting such a plant within 20km from one's residence. This provides an initial exploration of a possible NIMBY (Not-In-My-Backyard) effect, regarding existing plants implementing bioenergy technologies. Table 11provides the findings regarding this question posed, from which no clear NIMBY effect emerges (i.e. almost half of the respondents would accept a plant within 5 kilometres of one's residence):

Table 11. Accepted distance (in km) to nearest bioenergy plant in individual countries

	Overall		**Bosnia Herzegovina**		**Spain**		**Germany**		**Sweden**	
Accepted distance from residence	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
1km	370	12.1	86	11.4	51	6.8	131	17.1	102	13.1
2.5km	376	12.3	78	10.4	65	8.6	144	18.8	89	11.4
5km	720	23.6	169	22.4	141	18.7	208	27.1	202	25.9
10km	518	17.0	138	18.3	135	17.9	111	14.5	134	17.2
20km	408	13.4	106	14.1	130	17.3	67	8.7	105	13.5
Not accepted within 20km	662	21.7	176	23.4	231	30.7	107	13.9	148	19.0

Furthermore, there are little indications that certain types of perceived consequences of bioenergy production are more strongly related to citizens' acceptance of bioenergy in general, among citizens who currently live more nearby a bioenergy plant themselves:

- The more individuals believe that energy prices will increase (decrease) as a result of bioenergy production, the lower (higher) their acceptance of bioenergy production is, which is particularly the case among individuals who live nearby a bioenergy production plant.
- But, other types of perceived consequences (employment, environmental, health) predicted citizens' level of acceptance of bioenergy production, irrespective of one's current distance to a bioenergy production plant from one's residence.

4 Recommendations

1. **Handle public communication and information about industrial activities to implement bioenergy technologies with care and transparency**
   The relatively positive levels of public acceptance obtained in the present survey study (Highlights 1, 3 and 4) suggest that respondents have a certain level of confidence in technologies enabling bioenergy production. This gives reason to believe that on average citizens are at least initially open to industrial activities that increase bioenergy production. On the other hand, however, the outcomes leave considerable room for improvement. The results also indicate that citizens are far from outspoken as yet. This suggests that the balance between public acceptance and public scepticism is a shaky one. This assumption is supported by a certain degree of ambivalence among citizens, as at the same time activities to implement bioenergy technologies are generally also perceived as a form of greenwashing to some extent. Thus, the initial positive citizen perspective can be considered fragile and can turn more negative relatively fast. This leads to a recommendation about not to betray the shaky confidence by unthoughtful or untransparent communication and information about industry activities to increase bioenergy production.

2. **Improve citizens' knowledge of renewable energy technologies**
   Although citizens are understandably little familiar with "obscure" bioenergy production technologies, the importance of information and knowledge on renewable energy technologies have come to light nevertheless (Highlight 7). The outcome that citizens with a relatively high level of subjective knowledge regarding renewable energy technologies attributed bioenergy production more as values-driven industrial activity and perceive bioenergy initiatives less as greenwashing, leads to a recommendation about improving citizens' knowledge about both industries' activities and intentions regarding technologies supportive to bioenergy production.

3. **Concentrate on consequences of bioenergy production**
   It has been found (Highlight 2) that in general the more positive the perceived positive consequences of bioenergy production are, the greater the degree of public acceptance of bioenergy production. Particularly with respect to economic and environmental consequences the results suggest that when the implementation of bioenergy production technologies indeed bring employment opportunities and/or have positive environmental impact in citizens' perception, this will be beneficial for the level of citizen acceptance of bioenergy production technologies. At present the relation between

perceived health consequences and perceived changes in energy prices and their impact on the level of public acceptance is much less firm and clear. It is recommended that when bioenergy production technologies have positive effects – potentially and/or actually – it is important to communicate about these consequences – also when these are disappointing or even negative – because of their impact to citizens' acceptance for bioenergy production in general.

4. **Realise that credibility is crucial in gaining and maintaining public acceptance and citizens' trust**
   This study showed convincingly (Highlight 6) that the more citizens attribute bioenergy production initiatives to being values-driven, the more trust (particularly integrity-based trust, but also competence-based trust) they have in industries that engage in bioenergy technologies and the less they perceive bioenergy efforts to be a form of corporate greenwashing. In brief, to be perceived by citizens as a values-driven activity is a key factor in gaining public acceptance. This observation leads to a recommendation regarding the importance of the credibility of industries to be perceived by citizens as authentic: bioenergy activities are rooted in core societal and moral values held by an industry and serve a societal interest (next to self-interest of the company). Paying attention to this credibility is crucial to gain and maintain public acceptance and citizens' trust.

5. **Be aware of possible interference of perceptions of other (fossil-based) industries on public acceptance of bioenergy**
   The type of industry in which bioenergy technologies are implemented matters in how citizens view such activities given that implementation of bioenergy technologies in fossil-based industries, particularly fossil refineries, overall are perceived relatively negative among citizens (i.e. less trust, stronger greenwashing perceptions) compared to other types of industries. This outcome (Highlight 4) leads to the recommendation that in fossil-based industries greater efforts are needed to contribute to public acceptance for activities to increase bioenergy production. Moreover, not solely for public acceptance of its own activities and intentions but also with respect to citizens' trust in bioenergy retrofitting applied in other industries. This leads to the recommendation to pay attention to the public image of "old" fossil-based industries in the context of "greening" their production processes – not only for the sake of these industries but also because public acceptance of bioenergy technologies in other types of industries is easily positively or negatively affected by how citizens perceive bioenergy production technologies in fossil-based industries.

Appendix 1 – abstract of paper to be submitted to *Journal of Cleaner Production*

Driving public acceptance (instead of skepticism) of technologies enabling bioenergy production: A corporate social responsibility perspective

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Abstract

Industries' implementation of technologies that enable bioenergy production can contribute to alleviating the environmental impact of energy production. However, public acceptance of such activities is not self-evident, though this is ultimately critical to fully make the transition towards renewable energy. In the current study, we use a corporate social responsibility (CSR) framework to examine which types of citizen attributions of industry motives to implement bioenergy technologies are associated with public acceptance (versus skepticism) of these industry activities, in terms of trust and greenwashing perceptions. Through a survey conducted in four European countries (Bosnia-Herzegovina, Germany, Spain, Sweden; n = 3054), we found that an important step towards public acceptance lies in this industry activity being viewed by citizens as a values-driven activity: the more citizens attribute industrial activity to implement bioenergy technologies to being driven by core (social, moral) industry values, the more (integrity-based) trust they have and the less they perceive this industry activity as greenwashing. The strength of the relation between values-based attributions with both trust and greenwashing is particularly pronounced among citizens who view themselves as knowledgeable on renewable energy technologies. Individual differences in the strength of citizens' environmental values did not moderate these respective relations. Furthermore, citizen attributions to strictly self-benefitting causes (egoistic or strategic-driven) are associated with less trust and stronger greenwashing perceptions. To conclude, in order to increase public acceptance of industries' implementation of bioenergy technologies, it is important that citizens attribute these technological advancements to core social, moral values an industry represents.

Keywords: bioenergy, bioenergy technology, public acceptance, skepticism, trust, greenwashing

Appendix 2 – Excerpts from survey

Environmental self-identity

To what extent do you agree with the following statements?	Totally disagree						Totally agree
	1	2	3	4	5	6	7
1. Acting environmentally-friendly is an important part of who I am.	☐	☐	☐	☐	☐	☐	☐
2. I am the type of person who acts environmentally-friendly.	☐	☐	☐	☐	☐	☐	☐
3. I see myself as an environmentally-friendly person.	☐	☐	☐	☐	☐	☐	☐

Environmental values

How important is it for you that ….	Not at all important						Very important
	1	2	3	4	5	6	7
1. ... environmental protection stands over economic progress?	☐	☐	☐	☐	☐	☐	☐
2. ... energy technologies are adapted to nature?	☐	☐	☐	☐	☐	☐	☐
3. ... future generations are not burdened with the consequences of our current energy resources?	☐	☐	☐	☐	☐	☐	☐
4. ... energy technologies are safe for humans and the environment?	☐	☐	☐	☐	☐	☐	☐

Environmental problem awareness regarding energy consumption

Please indicate the extent to which you agree or disagree with the following statements.	Totally disagree						Totally agree
	1	2	3	4	5	6	7
1. I worry about CO_2-emissions caused by energy consumption.	☐	☐	☐	☐	☐	☐	☐
2. Energy consumption causes serious environmental problems.	☐	☐	☐	☐	☐	☐	☐
3. Energy consumption is an important cause of climate change.	☐	☐	☐	☐	☐	☐	☐

Consumer innovativeness (regarding novel technologies)

Please indicate the extent to which you agree or disagree with the following statements.	Totally disagree						Totally agree
	1	2	3	4	5	6	7
1. In general, I am among the first to buy novel technological products when they appear on the market.	☐	☐	☐	☐	☐	☐	☐
2. I am usually among the first to try novel technologies.	☐	☐	☐	☐	☐	☐	☐
3. I enjoy taking chances in buying novel technological products.	☐	☐	☐	☐	☐	☐	☐
4. I know of novel technological products, before other people do.	☐	☐	☐	☐	☐	☐	☐

5.	Compared to my friends, I own a lot of novel technological products.	☐	☐	☐	☐	☐	☐	☐

Renewable energy technologies – subjective knowledge

Please indicate the extent to which you agree or disagree with the following statements.		Totally disagree						Totally agree
		1	2	3	4	5	6	7
1.	I know a lot about various novel energy technologies.	☐	☐	☐	☐	☐	☐	☐
2.	I do not feel very knowledgeable about various novel energy technologies.	☐	☐	☐	☐	☐	☐	☐
3.	Among my circle of friends, I am one of the 'experts' on various novel energy technologies.	☐	☐	☐	☐	☐	☐	☐
4.	Compared to most other people, I know more about various novel energy technologies.	☐	☐	☐	☐	☐	☐	☐
5.	When it comes to novel energy technologies, I really do not know a lot.	☐	☐	☐	☐	☐	☐	☐

Novel energy technologies neophobia

To what extent do you agree with the following statements?		Totally disagree						Totally agree
		1	2	3	4	5	6	7
1.	The benefits of novel energy technologies are often grossly overstated.	☐	☐	☐	☐	☐	☐	☐
2.	Novel energy technologies are likely to have long-term negative health effects.	☐	☐	☐	☐	☐	☐	☐
3.	Novel energy technologies may have long-term negative environmental effects.	☐	☐	☐	☐	☐	☐	☐
4.	It can be risky to switch to novel energy technologies too quickly.	☐	☐	☐	☐	☐	☐	☐
5.	Renewable sources of energy are better than fossil-based sources of energy.	☐	☐	☐	☐	☐	☐	☐
6.	Society should depend heavily on novel technologies to solve its energy problems.	☐	☐	☐	☐	☐	☐	☐
7.	There is no sense trying out energy from renewable sources, because the ones I use are good enough.	☐	☐	☐	☐	☐	☐	☐
8.	There are plenty of good energy solutions around, so we do not need novel energy technologies to produce better energy solutions.	☐	☐	☐	☐	☐	☐	☐
9.	Renewable energy sources decrease the quality of energy supply.	☐	☐	☐	☐	☐	☐	☐

Perceived consequences of bioenergy use

Below a number of **possible consequences** are listed which **can occur as a result of the production of bioenergy**. Please indicate for each listed consequence how likely it is according to you that it will actually occur. You can do this by choosing the number that corresponds most closely to your opinion.

1. I believe that the production of bioenergy will ..... employment opportunities.

Strongly	-3	-2	-1	0	1	2	3	*Strongly*
decrease	☐	☐	☐	☐	☐	☐	☐	*increase*

2. I believe that the production of bioenergy will make energy consumption in general .....

Much cheaper	-3	-2	-1	0	1	2	3	*Much more*
	☐	☐	☐	☐	☐	☐	☐	*expensive*

3. I believe that by producing bioenergy, CO_2 emissions will .....

Strongly	-3	-2	-1	0	1	2	3	*Strongly*
decrease	☐	☐	☐	☐	☐	☐	☐	*increase*

4. I believe that by producing bioenergy, environmental problems like global warming will .....

Strongly	-3	-2	-1	0	1	2	3	*Strongly*
decrease	☐	☐	☐	☐	☐	☐	☐	*increase*

5. I believe that by producing bioenergy, the quality of the environment in terms of sustainability will .....

Strongly	-3	-2	-1	0	1	2	3	*Strongly*
deteriorate	☐	☐	☐	☐	☐	☐	☐	*improve*

6. I believe that the production of bioenergy will make the air .....

Much more	-3	-2	-1	0	1	2	3	*Much more*
polluted	☐	☐	☐	☐	☐	☐	☐	*cleaner*

7. I believe that the production of bioenergy will ..... the amount of unpleasant odours.

Strongly	-3	-2	-1	0	1	2	3	*Strongly*
decrease	☐	☐	☐	☐	☐	☐	☐	*increase*

8. I believe that the production of bioenergy will ..... the amount unpleasant noise.

Strongly	-3	-2	-1	0	1	2	3	*Strongly*
decrease	☐	☐	☐	☐	☐	☐	☐	*increase*

9. I believe that the production of bioenergy will ..... the amount of (public) health risks.

Strongly	-3	-2	-1	0	1	2	3	*Strongly*
decrease	☐	☐	☐	☐	☐	☐	☐	*increase*

Consumer acceptability & necessity of energy from renewable sources

Please indicate below to what extent you believe that the production of bioenergy is acceptable and necessary, as an alternative for fossil-based energy.

I believe the production of bioenergy is .....:

Completely	1	2	3	4	5	6	7	Completely

unacceptable	☐	☐	☐	☐	☐	☐	☐	acceptable
Completely	1	2	3	4	5	6	7	Completely
unnecessary	☐	☐	☐	☐	☐	☐	☐	necessary

Consumer attributions about industry motives

Values-driven attributions

To what extent do you agree with the following statements? **Organizations in the [sector] typically implement novel bioenergy technology because ...**	Totally disagree						Totally agree
	1	2	3	4	5	6	7
1. ...they feel morally obligated to.	☐	☐	☐	☐	☐	☐	☐
2. ...they have a long-term interest in the community.	☐	☐	☐	☐	☐	☐	☐
3. ...their owners believe in this cause.	☐	☐	☐	☐	☐	☐	☐
4. ...they want to make it easier for consumers who care about the cause to support it.	☐	☐	☐	☐	☐	☐	☐
5. ... they are trying to give something back to the community.	☐	☐	☐	☐	☐	☐	☐

Egoistic-driven attributions

To what extent do you agree with the following statements? **Organizations in the [sector] typically implement novel bioenergy technology because ...**	Totally disagree						Totally agree
	1	2	3	4	5	6	7
6. ...they are helping their own business.	☐	☐	☐	☐	☐	☐	☐
7. ...they want to get publicity.	☐	☐	☐	☐	☐	☐	☐
8. ...they want it as a tax write-off.	☐	☐	☐	☐	☐	☐	☐

Strategic-driven attributions

To what extent do you agree with the following statements? **Organizations in the [sector] typically implement novel bioenergy technology because ...**	Totally disagree						Totally agree
	1	2	3	4	5	6	7
9. ...they aim to get more customers because of it.	☐	☐	☐	☐	☐	☐	☐
10. ...they will keep more of their (current) customers because of it.	☐	☐	☐	☐	☐	☐	☐
11. ...they hope to increase profits because of it.	☐	☐	☐	☐	☐	☐	☐

Stakeholder-driven attributions

To what extent do you agree with the following statements? **Organizations in the [sector] typically implement novel bioenergy technology because ...**	Totally disagree						Totally agree
	1	2	3	4	5	6	7
12. ...they feel their customers expect it.	☐	☐	☐	☐	☐	☐	☐
13. ...they feel society expects it.	☐	☐	☐	☐	☐	☐	☐

Perceived competence-based trust in industry sector

I believe that organizations in the [sector] that decide to implement novel bioenergy technologies typically ....:

	-3	-2	-1	0	1	2	3	
Have **little experience** in developing energy projects	☐	☐	☐	☐	☐	☐	☐	Have **much experience** in developing energy projects
Have **little knowledge** in developing energy projects	☐	☐	☐	☐	☐	☐	☐	Have **much knowledge** in developing energy projects

Perceived integrity-based trust in industry sector (Liu et al., 2020)

I believe that organizations in the [sector] that decide to implement novel bioenergy technologies typically ....:

	-3	-2	-1	0	1	2	3	
Are **dishonest** about their activities regarding energy projects	☐	☐	☐	☐	☐	☐	☐	Are **honest** about their activities regarding energy projects
Are **not transparant** about their activities regarding energy projects	☐	☐	☐	☐	☐	☐	☐	Are **transparant** about their activities regarding energy projects
Very little take **interests of citizens** into account	☐	☐	☐	☐	☐	☐	☐	**Very much** take **interests of citizens** into account

Perceived corporate greenwashing

Below you find a couple of statements that are made about the [sector].

Please respond to the statements, while keeping in mind **decisions to implement novel bioenergy technologies** of organizations in the [sector].

To what extent do you agree with the following statements? ITEMS RANDOM	Totally disagree						Totally agree
	1	2	3	4	5	6	7
1. I think organizations in the [sector] typically aim to improve their reputation by presenting themselves as an environmentally-friendly organization.	☐	☐	☐	☐	☐	☐	☐
2. I think the organizations in the [sector] typically pretend to be more environmentally-friendly than they actually are.	☐	☐	☐	☐	☐	☐	☐

3.	I think organizations in the [sector] typically have a hidden agenda.	☐	☐	☐	☐	☐	☐	☐

Acceptable distance of consumer to nearest plant of the [sector]
Please imagine that a plant from the [sector] in your area will implement novel bioenergy technology and start with producing bioenergy. What should the **minimum distance** between your place of residence and this plant be for you to accept that this plant will start with producing bioenergy?

I would accept such a plant with a minimal distance of ...:

☐ ... 1000 metres from my residence

☐ ... 2500 metres from my residence

☐ ... 5000 metres from my residence

☐ ... 10000 metres from my residence

☐ ... 20000 metres from my residence

☐ I would not accept this within 20000 metres from my residence

Current actual distance of consumer to nearest plant of the [sector]
Do you currently have a plant of the [sector] in the area of your residence?

I currently have a plant of the [sector] that produces bioenergy in my area within ....:

☐ ... 1000 metres from my residence

☐ ... 2500 metres from my residence

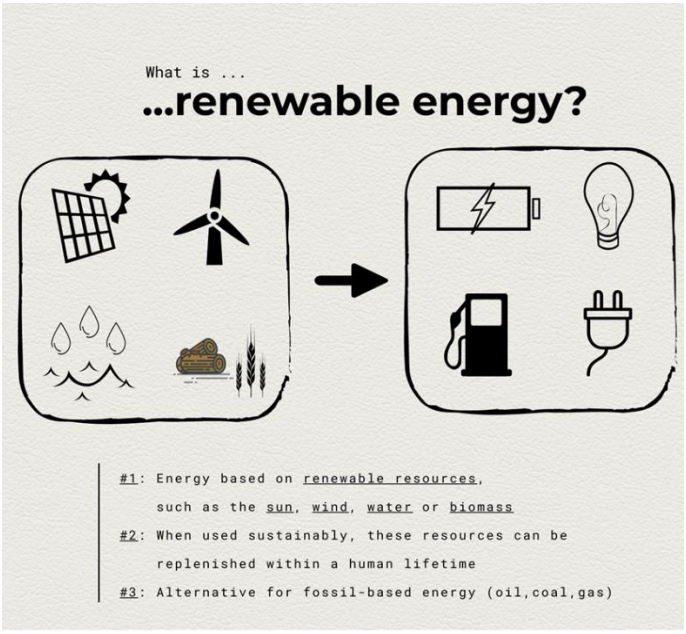
☐ ... 5000 metres from my residence

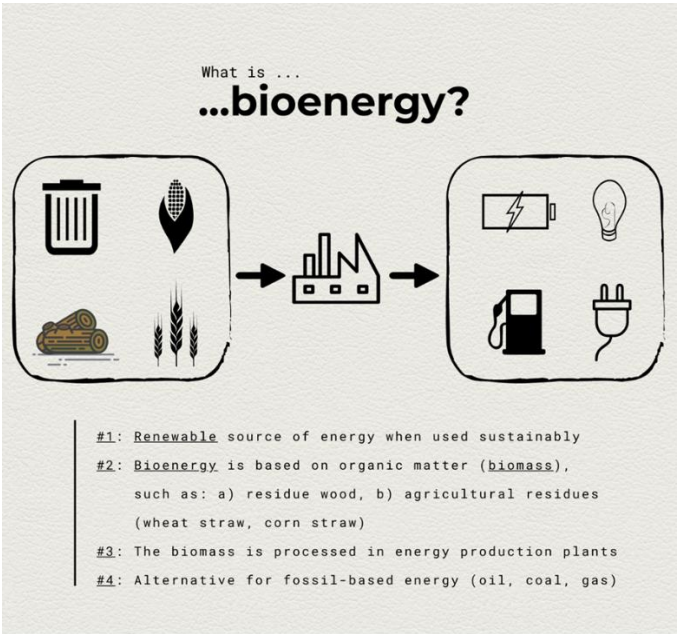
☐ ... 10000 metres from my residence

☐ ... 20000 metres from my residence

☐ As far as I know, I do not have a plant of the [sector] that produced bioenergy in my area within 20000 metres from my residence

Appendix 3 – Infographics





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