Journal of Cleaner Production 324 (2021) 129273

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

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

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ARTICLE INFO

Handling editor: M.T. Moreira

Keywords:
Bioenergy technology
Corporate social responsibility
Public acceptance
Skepticism
Trust
Greenwashing

ABSTRACT

Public acceptance of industrial activities to implement bioenergy technologies is not self-evident. Little is known about how public acceptance of such industrial activities can be increased, though public acceptance is critical to make the transition towards renewable energy. In the current study, we use a corporate social responsibility framework to examine which types of citizen attributions of industry motives to implement bioenergy technologies are associated with public acceptance (versus skepticism) of these industrial activities, in terms of trust and greenwashing perceptions. Findings from a survey conducted in four European countries (Bosnia-Herzegovina, Germany, Spain, Sweden; n = 3054) demonstrate that an important step towards public acceptance lies in citizens viewing this industrial activity as values-driven: the stronger the values-driven attributions are, the more (integrity-based) trust citizens have and the less this industrial activity is perceived as greenwashing. The strength of the relation between values-driven attributions with both trust and greenwashing is particularly pronounced among citizens who view themselves as knowledgeable on renewable energy technologies. Furthermore, citizen attributions to strictly self-benefitting causes (egoistic-driven, strategic-driven) are associated with less trust and stronger greenwashing perceptions. To conclude, the more citizens attribute industries' implementation of bioenergy technologies to core social, moral values, the greater the public acceptance of these technological advancements.

1. Introduction

Transitioning to a greater production of renewable energy forms part of a larger transition targeted by the European Union (EU) from a fossil-based economy to a circular bioeconomy (European Commission, 2018; Scarlat et al., 2015a). Currently, bioenergy is the main source of renewable energy within the EU (Scarlat et al., 2015b). When industries implement bioenergy technologies to increase the proportion of energy production that originates from biomass, this further increases the amount of renewable energy production. Few studies have investigated public opinions of bioenergy, compared to that of other renewable energy sources such as solar or wind energy (Carley et al., 2020). Despite the potential to reduce greenhouse gas emissions by implementing bioenergy technologies (Baležentis et al., 2019), the public backing of such industrial activities is not self-evident. Bioenergy ranks relatively low in terms of public approval across Europe (Schumacher et al., 2019). This can be a result of limited public awareness about potential benefits of bioenergy (for an overview, see Raza et al., 2011) and/or limited trust in decision-makers who increase bioenergy production (Fytili and Zabaniotou, 2017). There have been multiple examples of public opposition to projects aimed at increasing bioenergy production (Moula et al., 2017; Radics et al., 2015). Ultimately, a better understanding of public acceptance or rejection of bioenergy production is considered critical to fully make the transition towards renewable energy (Fytili and Zabaniotou, 2017; Rohracher et al., 2004). However, the large majority of studies have focused on technological considerations regarding bioenergy production. One exception is a study by Vainio et al. (2019) who show that (Finnish) citizens feel ambivalent towards bioenergy. Scarce public understanding in bioenergy technologies is illustrated by a review from Radics et al. (2015), which indicates that few studies focus on bioenergy technology perceptions and acceptance among citizens, thus further highlighting the limited scholarly attention for the role of public acceptance.

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https://doi.org/10.1016/j.jclepro.2021.129273
Received 20 May 2021; Received in revised form 2 September 2021; Accepted 3 October 2021
Available online 5 October 2021

1.1. Corporate social responsibility (CSR) framework

To gain a better understanding of how public acceptance is created of industrial activities to implement bioenergy technologies, we examine public views on this type of industrial activity through a corporate social responsibility (CSR) framework (Mazutis and Slawinski, 2015; Skarmeas and Leonidou, 2013). Such a CSR framework expounds different types of citizens' beliefs about underlying motives of an industry to perform an activity (Skarmeas and Leonidou, 2013). Mazutis and Slawinski (2015) describe how activities viewed by citizens as authentic prompt an industrial activity to be perceived as socially responsible in terms of CSR. To achieve this public perception of authenticity, this activity has to complement the industry's identity. Furthermore, perceived authenticity is enhanced when the activity addresses issues that exceed solely benefitting the industry; the industry has to deliver what it promises in its communication to be viewed as genuine and authentic (Gilmore and Pine, 2007). When an industrial activity such as implementing bioenergy technologies is perceived as authentic, this will give grounds for public acceptance of this endeavour.

Skarmeas and Leonidou (2013) elaborate on various types of attributions, which have the potential to lead to acceptance (or skepticism) of the industrial activity. Such an attribution is a causal inference made by citizens about why an industrial activity is conducted (Vlachos et al., 2013). Citizens can attribute an activity to either the industry adhering to its core moral, societal ideals by engaging in the activity (values--driven); to exploiting instead of supporting a cause (egoistic-driven); to achieving business goals while also supporting a cause (strategic-driven); or to the industry satisfying expectations of stakeholders (stakeholder-driven; Ellen et al., 2006; Skarmeas and Leonidou, 2013; Vlachos et al., 2009). Thus, these attributions indicate what citizens believe to be an industry's underlying motives to engage in the activity. This belief does not necessarily have to correspond with an industry's actual motives. Viewing the industrial activity of implementing bioenergy technologies in this CSR framework facilitates insight into how public acceptance, or skepticism, is driven by various motives that citizens attribute to these industrial activities. In the current study, we examine to what extent public acceptance or skepticism (in the form of trust & greenwashing) of industries' implementation of bioenergy technologies is explained by these attributions.

1.2. Connection between CSR attributions and trust & perceived greenwashing

Trust in industries is often identified as a key element of public acceptance for a renewable energy source, and the underlying renewable energy technology (Fytili and Zabaniotou, 2017; Liu et al., 2020). In the context of industrial activity to implement bioenergy technologies, trust can be characterized as industries having sufficient knowledge of and expertise in this activity (competence-based trust) and being honest and transparent about industrial activities (integrity-based trust; Liu et al., 2020; Terwel et al., 2009). Integrity-based trust has been shown to be more strongly associated with public acceptance for renewable energy projects than competence-based trust, in the context of wind energy (Liu et al., 2020). This leads to the question how trust in industries, particularly integrity-based trust, among citizens is created in the context of increasing bioenergy production. We examine this in terms of citizens' attributions, based on a CSR framework. In general, values-driven attributions are positively associated with feelings of trust, presumably because an activity that is driven by (moral, social) values is perceived by citizens as representing true feelings and dispositions of an industry which supports a certain moral cause (Vlachos et al., 2009). Even though bioenergy has a relatively low public approval rate (Schumacher et al., 2019), there does appear to be a substantial group of citizens who see potential in bioenergy contributing to the moral cause of a more sustainable energy production. This is, for instance, the case regarding the use of forest-based biomass (Ranta et al., 2020) or biofuels (Dragojlovic and Einsiedel, 2014). Given the moral connotation of industrial activities to implement bioenergy technologies being attributed by citizens as being values-driven, as well as the moral connotation of integrity-based trust, but not competence-based trust, we hypothesize that:

H1. The more citizens attribute industrial activities to implement bioenergy technologies to be values-driven, the higher the level of integrity-based trust (but not competence-based trust) of citizens in industries that perform this activity.

In contrast, egoistic-driven and stakeholder-driven attributions are typically negatively associated with trust, which has to do with a sole focus on profit or avoiding retributions from stakeholders being viewed by citizens as exploiting a certain cause (Vlachos et al., 2009). The level of strategic-driven attributions is often unrelated to forms of trust (Vlachos et al., 2009), and skepticism (Skarmeas and Leonidou, 2013), but the relation can turn out negatively when citizens believe industries strategically engage in an activity because of mainly economic reasons (Vlachos et al., 2009). Regarding the industrial activity of implementing bioenergy technologies, stronger egoistic-driven, strategic-driven and/or stakeholder-driven attributions would entail that citizens believe industries engage in this activity strictly for their own benefit (i.e., increasing profits, satisfying stakeholders), and not to support the moral cause of making energy production more sustainable. Consequently, we expect that:

H2. The more citizens attribute industrial activities to implement bioenergy technologies to be egoistic-driven/strategic-driven/stakeholder-driven, the lower the level of integrity-based trust (but not competence-based trust) of citizens in industries that perform this activity.

In the CSR perspective in which we examine public acceptance of industrial activities to implement bioenergy technologies, the possibility awaits that citizens view such activities as a form of corporate greenwashing. Citizens can perceive industrial activity as corporate greenwashing when they hold the belief that an activity is deliberately framed as sustainable to manifest itself as environmentally-friendly, even though actual environmental performance is poor (de Freitas Netto et al., 2020). Such public perceptions of greenwashing can also rise when industries take measures in the energy domain (De Vries et al., 2015). Perceptions of greenwashing concern a gap between an industries' communicated motive for an activity and what citizens believe to be its actual motive. In terms of industrial activity to implement bioenergy technologies, greenwashing perceptions can occur when citizens feel industries are not transparent about their actual motives to perform this activity; that they do so merely to gain the appearance of an environmentally-friendly industry, but not necessarily for a cleaner environment (De Vries et al., 2015). If citizens perceive the activity as greenwashing this can ultimately have detrimental consequences for the industry (Pizzetti et al., 2021; Polonsky and Rosenberger, 2001).

We argue that an important component of values-driven attributions of industries' activities to implement bioenergy technologies lies in the public-serving cause of contributing to a more environmentally-friendly energy production, given the potential of bioenergy to contribute to this cause (Scarlat et al., 2015b). In contrast, the other types of attributions (egoistic-driven, strategic-driven, stakeholder-driven) are connected to more self-interested causes, as they contribute to benefitting the industry in terms of maximizing profits, achieving business goals or satisfying stakeholders. Therefore, we hypothesize that:

H3. The more citizens attribute industrial activities to implement bioenergy technologies to be values-driven, the less they perceive this activity as greenwashing.

H4. The more citizens attribute industrial activities to implement bioenergy technologies to be egoistic-driven/strategic-driven/stakeholder-driven, the more they perceive this activity as

greenwashing.

1.3. Individual differences in associations between values-driven attributions and both trust and perceived greenwashing

The concept of a circular bioeconomy is relatively unfamiliar among citizens (Lynch et al., 2017; Sijtsema et al., 2016), while at the same time a limited consumer awareness and interest in this concept is an important barrier to overcome to progress towards a circular bioeconomy (Grafström and Aasma, 2021; Kirchherr et al., 2018). Citizens generally feel uninformed about renewable energy sources and technologies, also with regard to bioenergy (Upreti and van der Horst, 2004; Fytili and Zabaniotou, 2017). A greater level of subjective knowledge regarding renewable energy technologies has been shown to be positively associated with public acceptance for implementing renewable energy technologies (Huijts et al., 2012). Also, less perceived risk of a technology is more strongly associated with more trust in the industry managing the technology, particularly among more (subjectively) knowledgeable citizens (Siegrist and Cvetkovich, 2000). In terms of CSR, greater subjective knowledge on renewable energy technologies increases the likelihood that public acceptance for industrial activity to implement bioenergy technologies is guided by values-driven attributions, as such citizens are more likely to be familiar with the moral, social cause to which this activity can contribute. Hence, we hypothesize that:

H5. Values-driven attributions of industrial activities to implement bioenergy technologies are positively associated with integrity-based trust in industries that perform this activity, particularly among citizens with a relatively high level of subjective knowledge on renewable energy technologies.

As an activity is perceived by citizens to be greenwashing when a gap is perceived between a communicated motive for this industrial activity and what citizens believe to be the actual motive, such a gap is less likely to occur when citizens feel they know more about renewable energy technologies. We expect this to be the case, since subjective knowledge about what renewable energy technologies can do for the environment is a prerequisite for actually believing that an industry implements bioenergy technologies to contribute to a cleaner environment. Therefore, we hypothesize that:

H6. Values-driven attributions of industrial activities to implement bioenergy technologies are negatively associated with greenwashing perceptions, particularly among citizens with a high level of subjective knowledge on renewable energy technologies.

Citizens for whom sustainability plays a relatively important role in their lives can potentially be more susceptible to values-driven attributions for industrial activities to increase bioenergy production, since they may more strongly value the underlying social, moral industry values of why the technology is implemented to contribute to a more sustainable energy production. Initial evidence underscores this possibility, as individuals with stronger environmental values more positively evaluate renewable energy sources (Perlaviciute and Steg, 2015; Visschers and Siegrist, 2014). Part of the underlying mechanism behind this relation can lie in the extent to which the production of renewable energy is attributed to being driven by social, moral values such as protecting the planet by 'greening' energy production. We hypothesize that:

H7. Values-driven attributions of industrial activities to implement bioenergy technologies are positively associated with integrity-based trust in industries that perform this activity, particularly among citizens with a relatively high level of environmental values.

H8. Values-driven attributions of industrial activities to implement bioenergy technologies are negatively associated with greenwashing perceptions of industries performing this activity, particularly among citizens with a relatively high level of environmental values.

In the following sections, we expound how we tested our hypotheses across four European countries (Section 2) and examine how public acceptance (or skepticism) is driven by various citizen attributions and possible individual differences that exist in these relations (Section 3). This is followed by a discussion of potential implications of our findings (Section 4).

2. Method

2.1. Participants

An online survey was conducted for four weeks (mid-July 2020 till mid-August 2020) among 3,054 participants in four European countries: Bosnia-Herzegovina (n = 753), Germany (n = 768), Spain (n = 753), and Sweden (n = 780). Partners from these countries participated in the research project which included the current study. These countries were also selected to include public perspectives on the topic of industries' implementation of bioenergy technologies from various European countries, geographically located in diverse locations (North, West, East, South of Europe), and considering a diverse perspective on citizens' worries regarding energy supply and energy affordability, and the degree to which citizens view climate change as a problem (based on the European Social Survey, 2016). Further criteria used for the sample were age, gender and education level; the market research agency collecting the data was to draw a representative sample for the respective countries regarding these characteristics. Participants were recruited through a consumer panel of the market research agency (M_{age} = 44.0 years; 50.4% female, 49.4% male, 0.2% other/unknown). Participants collected points for their participation which they could save and exchange for products/gifts. The study was approved by an Ethical Committee of a Dutch university. To make sure our sample size was large enough to have sufficient power, we checked the minimum required sample size by performing a power analysis using G*Power 3.1.9.7 (Faul et al., 2007). Results of this analysis showed that our sample size was well above the threshold of 395 (effect size f2 = 0.02; $\alpha = 0.05$; power (1-β) = 0.8). All questions in the survey were 'forced response', so non-response was not possible; the only exceptions were questions regarding gender, age and education level.[1]

2.2. Design, procedure & measures

Participants first read that the survey is about energy production and energy technologies, and that questions will also be asked about the importance of sustainability and the role of renewable energy technologies in their lives. Participants first responded to statements that together measured their environmental values (Cronbach's α = .853; Visschers and Siegrist, 2014; see Table 1 for all items). This was followed by a short description about renewable energy technologies by means of an infographic (Appendix A),[2] and subsequently a measure of subjective knowledge on renewable energy technologies (Cronbach's α = .838; Van Rijnsoever and Farla, 2014; see Table 1 for all items). After these questions, participants read an infographic about what bioenergy entails (Appendix B). Participants were then randomly allocated reading about one of five industries (1. First generation biofuels industry, 2. Pulp and paper industry, 3. Fossil refineries industry, 4. Fossil firing power industry, 5. Combined heat and power plants industry). The remaining questions in the survey were posed regarding the industry to which participants were randomly allocated.

[1] All participants gave an answer regarding age, six participants did not indicate gender and eight participants chose not to answer the question regarding education level.

[2] The survey, including the infographics, was translated by the market research agency into the language of respondents from the four participating countries.

Table 1
Means, standard deviations and Cronbach's alpha of all constructs in the survey.

Items per construct (all 7-point Likert scales)	Mean	SD	Cronbach's α
Citizen attributions (Ellen et al., 2006; 'Organizations in the [industry] typically implement novel bioenergy technology because … '; 1 = totally disagree, 7 = totally agree)			
Values-driven attributions (5 items)	4.60	1.19	.865
they feel morally obligated to.			
they have a long-term interest in the community.			
their owners believe in this cause.			
they want to make it easier for consumers who care about the cause to support it.			
they are trying to give something back to the community.			
Egoistic-driven attributions (3 items)	5.02	1.06	.650
they are helping their own business.			
they want to get publicity.			
they want it as a tax write-off.			
Strategic-driven attributions (3 items)	5.11	1.05	.734
they aim to get more customers because of it.			
they will keep more of their (current) customers because of it.			
they hope to increase profits because of it.			
Stakeholder-driven attributions (2 items)	4.89	1.18	.740
they feel their customers expect it.			
they feel society expects it.			
Subjective knowledge renewable energy technologies[a] (Van Rijnsoever and Farla, 2014; 1 = totally disagree, 7 = totally agree; 5 items)	4.03	1.26	.838
I know a lot about various novel energy technologies.			
I do not feel very knowledgeable about various novel energy technologies.			
Among my circle of friends, I am one of the 'experts' on various novel energy technologies.			
Compared to most other people, I know more about various novel energy technologies.			
When it comes to novel energy technologies, I really do not know a lot.			
Environmental values (Visschers and Siegrist, 2014; 'How important is it for you that ….'; 1 = not at all important, 7 = very important; 4 items)	5.62	1.21	.853
environmental protection stands over economic progress?			
energy technologies are adapted to nature?			
future generations are not burdened with the consequences of our current energy resources?			
energy technologies are safe for humans and the environment?			
Trust (Liu et al., 2020; 'I believe that organizations in the [industry] that decide to implement novel bioenergy technologies typically ….'; 7-point Likert scale from −3 till +3)			
Competence-based trust (2 items)	4.75	1.24	.883
have little (−3)/much (+3) experience in developing energy projects			
have little (−3)/much (+3) knowledge in developing energy projects			
Integrity-based trust (3 items)	4.44	1.28	.893
are dishonest (−3)/honest (+3) about their activities regarding energy projects.			
are not transparent (−3)/transparent (+3) about their activities regarding energy projects.			
very little (−3)/very much (+3) take interests of citizens into account.			
Perceived corporate greenwashing (De Vries et al., 2015; 1 = totally disagree, 7 = totally agree; 3 items)	4.68	1.27	.785
I think organizations in the [industry] typically aim to improve their reputation by presenting themselves as an environmentally-friendly organization.			
I think the organizations in the [industry] typically pretend to be more environmentally-friendly than they actually are.			
I think organizations in the [industry] typically have a hidden agenda.			

[a] The items 'I do not feel very knowledgeable about various novel energy technologies' and 'When it comes to novel energy technologies, I really do not know a lot' were reverse-scored for creating the scale for the data-analysis.

The following part of the survey started with items that measure the various attributions with regard to industrial activity to implement bioenergy technologies. Participants had to finish the statement 'Organizations in the [industry] typically implement novel bioenergy technology because … ' with items that measured values-driven attributions (Cronbach's α = .865), egoistic-driven attributions (Cronbach's α = .650), strategic-driven attributions (Cronbach's α = .734) and stakeholder-driven attributions (Cronbach's α = .740), based on Ellen et al. (2006; see Table 1 for all items for each type of attribution). We then measured participants' level of competence-based trust (Cronbach's α = .883) and integrity-based trust (Cronbach's α = .893) in industries that decide to implement bioenergy technologies, based on Liu et al. (2020; items used are in Table 1). Finally, we measured the extent to which participants perceive such activities as a form of greenwashing (Cronbach's α = .785; De Vries et al., 2015; see Table 1 for all items). Descriptive statistics and correlations between the constructs are reported in Table 2 (descriptive statistics and correlations between the constructs for each individual country can be found in Appendix C).

3. Results

3.1. Citizen attributions & public acceptance (trust) vs. skepticism (greenwashing)

All statistical analyses were conducted using SPSS (Statistical Package for the Social Sciences) version 25.0 software. Three regression analyses were conducted to examine the extent to which the various types of citizen attributions for industries' activities to implement bioenergy technologies explain public acceptance for these activities, in the form of trust in the industry (integrity-based trust, competence-based trust), and public skepticism for these industrial activities in the form of perceived greenwashing. For these analyses either competence-based trust, integrity-based trust or perceived greenwashing was regressed on values-driven, egoistic-driven, strategic-driven and stakeholder-driven attributions of industrial activities to implement bioenergy technologies.[3]

Combined, the predictors explained 38.6% of the variance (Adjusted R^2) in integrity-based trust (Table 3). The more participants attributed industrial activities to implement bioenergy technologies to be values-driven ($\beta = .60$, $t(3049) = 33.70$, $p < .001$, 95% CI [0.61, 0.69]), the higher the level of integrity-based trust, as was hypothesized (H_1). When industrial activities to implement bioenergy technologies were attributed to being more egoistic-driven ($\beta = -12.$, $t(3049) = -6.07$, $p < .001$, 95% CI [-0.19, −0.10]) or strategic-driven ($\beta = -0.06$, $t(3049) = 2.90$, $p = .004$, 95% CI [-0.13, −0.03]), integrity-based trust was lower, in line with H_2. However, stronger stakeholder-driven attributions were positively associated with integrity-based trust ($\beta = .06$, $t(3049) = 3.14$, $p =$

[3] As described in Section 2, these questions were answered for organizations in a specific industry. The analyses reported in the present paper are for the industries pooled together, as the type of industry is not a focus for this paper; this was included because it was relevant for the research project this study was a part of. The analyses were also conducted for each individual industry (overall, results were robust across industries); these results are available from the first author upon request.

Table 2
Correlations among and descriptive statistics for study variables.

Variables	M (SD)	1	2	3	4	5	6	7	8	9
1. Values-driven attributions	4.60 (1.19)		.14	.30	.60	.08	.22	.41	.60	-.21
2. Egoistic-driven attributions	5.02 (1.06)			.69	.35	.09	.22	.11	-.06	.42
3. Strategic-driven attributions	5.11 (1.05)				.52	.08	.26	.21	.07	.34
4. Stakeholder-driven attributions	4.89 (1.18)					.09	.26	.30	.35	.03*
5. Subjective knowledge renewable energy technologies	4.03 (1.26)						.16	.16	.09	.05
6. Environmental values	5.64 (1.21)							.17	.09	.08
7. Competence-based trust	4.75 (1.24)								.56	-.13
8. Integrity-based trust	4.44 (1.28)									-.36
9. Perceived greenwashing	4.68 (1.27)									

Notes. All reported correlations are statistically significant ($p < .05$; two-tailed), except when an asterisk is shown. Reported correlations in Table 1 are for the complete sample of 3,054 participants.

Table 3
Summary of multiple regression analysis for variables predicting trust in industrial activities to implement bioenergy technologies.

	Competence-based trust						Integrity-based trust					
Types of attribution	β	t-value	Sig.	LLCI; ULCI	Cohen f2	VIF	β	t-value	Sig.	LLCI; ULCI	Cohen f2	VIF
Values-driven	.36	17.55	<.001	.32;.40	0.124	1.579	.60	33.70	<.001	.57;.64	0.348	1.579
Egoistic-driven	-.01	-.44	.661	-.05;.04	0.000	1.906	-.12	−6.07	<.001	-.16;-.08	0.011	1.906
Strategic-driven	.09	3.73	<.001	.04;.14	0.006	2.278	-.06	−2.90	.004	-.10;-.02	0.003	2.278
Stakeholder-driven	.03	1.46	.145	-.01;.08	0.001	1.952	.06	3.14	.002	.02;.10	0.003	1.952

Notes. Competence-based trust: Adj.R^2 = .175, F = 163.14 ($p < .001$). Integrity-based trust: Adj.R^2 = .386, F = 480.57 ($p < .001$); LLCI = Lower level of 95% confidence interval; ULCI = Upper level of 95% confidence interval; VIF = variance inflation factor.

.002, 95% CI [0.03, 0.11]), which was not hypothesized (H_2). Combined, the different predictors explained 17.5% of the variance (Adjusted R^2) in competence-based trust (Table 3). The more participants attributed industrial activities to implement bioenergy technologies to be values-driven (β = .36, t(3049) = 17.55, $p < .001$, 95% CI [0.34, 0.42]), the higher the level of competence-based trust, which was not hypothesized (H_1). There was no significant relation between either the strength of egoistic-driven attributions (β = −0.01, t(3049) = −0.44, p = .661, 95% CI [-0.06, 0.04]) or the level of stakeholder-driven attributions (β = .03, t(3049) = 1.46, p = .145, 95% CI [-0.01, 0.08]) with competence-based trust, as expected (H_2). There was a positive relation between strategic-driven attributions and competence-based trust (β = .09, t(3049) = 3.73, $p < .001$, 95% CI [0.05, 0.17]), which was not expected (H_2). The Variance Inflation Factors (VIF) indicate that multicollinearity was not an issue in the reported analyses (Table 3; VIF <10; Thompson et al., 2017).

Combined, the different predictors explained 27.3% of the variance (Adjusted R^2) in perceived greenwashing of industrial activities to implement bioenergy technologies (Table 4). The more participants attributed such activities to be values-driven, the less this activity was perceived as greenwashing (β = −0.32, t(3049) = 16.33, $p < .001$, 95% CI [-0.38, −0.30]), as hypothesized (H_3). Furthermore, the more participants attributed industrial activities to implement bioenergy technologies to being egoistic-driven (β = .32, t(3049) = 15.19, $p < .001$, 95% CI [0.28, 0.37]) or strategic-driven (β = .21, t(3049) = 8.99, $p < .001$, 95% CI [0.16, 0.26]), the stronger greenwashing perceptions were of these industrial activities to increase bioenergy production, in line with H_4. However, the level of stakeholder-driven attributions was not significantly associated with the level of perceived greenwashing, though this was expected (H_4). The Variance Inflation Factors (VIF) indicate that multicollinearity was not an issue in the analyses reported in Table 4 (VIF <10; Thompson et al., 2017).

Table 4
Summary of multiple regression analysis for variables predicting perceived greenwashing of industrial activities to implement bioenergy technologies.

	Perceived corporate greenwashing					
Types of attribution	β	t-value	Sig.	LLCI; ULCI	Cohen f2	VIF
Values-driven	-.32	−16.33	<.001	-.36;-.28	0.095	1.579
Egoistic-driven	.32	15.19	<.001	.28;.37	0.082	1.906
Strategic-driven	.21	8.99	<.001	.16;.26	0.029	2.278
Stakeholder-driven	-.01	-.14	.892	-.05;.04	0.000	1.952

Notes. Adj.R^2 = .273, F = 287.93 ($p < .001$); LLCI = Lower level of 95% confidence interval; ULCI = Upper level of 95% confidence interval; VIF = variance inflation factor.

3.2. Individual differences in the relation between values-driven attributions and public acceptance (integrity-based trust) and skepticism (greenwashing)

To test H_5, we used the SPSS PROCESS model 1 (Hayes, 2012) with integrity-based trust as the dependent variable, values-driven attributions as the independent variable and subjective knowledge on renewable energy technologies as the moderator. A similar analysis was conducted to test H_6, only now with perceived greenwashing as the dependent variable. The interaction between values-driven attributions and subjective knowledge regarding renewable energy technologies on integrity-based trust was significant: β = .04, t(3050) = 3.52, $p < .001$ (Table 5). We employed a simple slopes analysis to interpret this interaction. Among participants with a relatively high level of subjective knowledge regarding renewable energy technologies (1 standard deviation (SD) above the mean), the positive relation between values-driven attributions and integrity-based trust was relatively stronger (β = .64, t(3050) = 35.85, $p < .001$) compared to participants with a relatively low level of subjective knowledge (1 standard deviation (SD) below the mean; β = .55, t(3050) = 26.29, $p < .001$; Fig. 1), in line with H_5. The interaction between values-driven attributions and subjective knowledge regarding renewable energy technologies on perceived greenwashing was also significant (Table 5): β = −0.05, t(3050) = −3.08, $p < .001$. Simple slopes analysis showed that among participants with a relatively high level of subjective knowledge with regard to renewable energy technologies, stronger values-driven attributions of industrial activities to implement bioenergy technologies were more strongly associated with weaker greenwashing perceptions (β = −0.26, t(3050) = −11.79, $p < .001$), compared to participants with a lower level of subjective knowledge (β = −0.16, t(3050) = −6.30, $p < .001$; Fig. 2), in

Table 5
Test interaction between values-driven attributions and subjective knowledge regarding renewable energy technologies.

	Integrity-based trust				Perceived corporate greenwashing			
	β	t-value	Sig.	LLCI; ULCI	β	t-value	Sig.	LLCI; ULCI
Values-driven attributions	.59	49.46	<.001	.56;.62	-.21	−11.64	<.001	-.24;-.17
Subjective knowledge renewable energy technologies	.04	3.09	.002	.02;.07	.07	3.91	<.001	.03;.10
Values-driven attributions * Subjective knowledge	.04	3.52	<.001	.02;.07	-.05	−3.08	.002	-.08;-.02

Notes. Integrity-based trust: Adj.R^2 = .368, F = 592.76 (p < .001). Perceived greenwashing: Adj.R^2 = .053, F = 56.61 (p < .001). LLCI = Lower level of 95% confidence interval; ULCI = Upper level of 95% confidence interval.

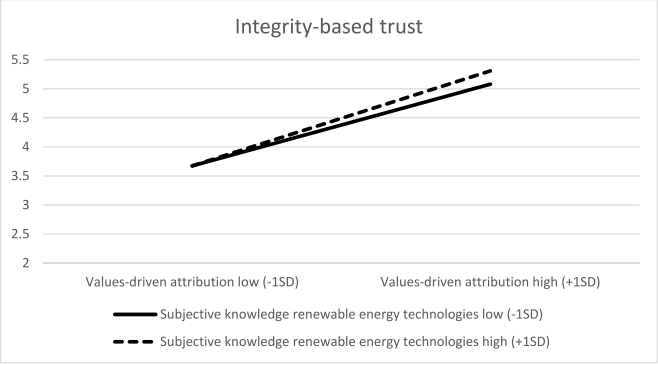


Fig. 1. Simple slopes analysis of influence of subjective knowledge regarding renewable energy technologies in the relation between values-driven attributions and integrity-based trust.

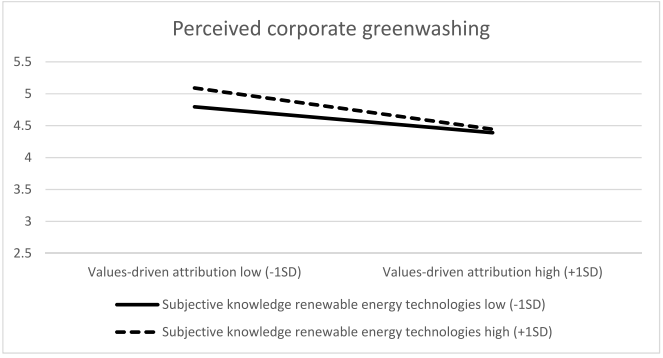


Fig. 2. Simple slopes analysis of influence of subjective knowledge regarding renewable energy technologies in the relation between values-driven attributions and perceived greenwashing.

line with H_6.

To test H_7, we again used the SPSS PROCESS model 1 (Hayes, 2012) with integrity-based trust as the dependent variable, values-driven attributions as the independent variable and environmental values as the moderator. H_8 was tested in a similar fashion, only with perceived greenwashing as the dependent variable. The interaction between values-driven attributions and environmental values on integrity-based trust was not significant, in contrast to what we hypothesized (H_7): β = .01, t(3050) = .48, p = .634 (Table 6). Similarly, there was no significant interaction between values-driven attributions and environmental values on perceived greenwashing, though this was expected (H_8): β = −0.02, t(3050) = −1.31, p = .190.

4. General discussion

Industrial activities to implement bioenergy technologies that enable an increase in bioenergy production can potentially contribute in transitioning from fossil-based to renewable energy production, as part of a larger transition from a fossil-based economy to a circular bioeconomy (Scarlat et al., 2015a). How public acceptance of such industrial activities is created has received little scholarly attention; the current research also supplements the call to incorporate the role of citizens in transforming the energy system (Zabaniotou, 2018). Bioenergy can play a role in the transition to a circular economy, provided bioenergy is produced sustainably (e.g. expanding bioenergy production without competing with food needs, use of biomass residues to produce bioenergy), and that both economic gains, and societal and environmental benefits are taken into account (Souza et al., 2017; Zabaniotou, 2018). Using a corporate social responsibility (CSR) perspective, our findings indicate that a key factor in gaining public acceptance, instead of evoking skepticism, lies in these industrial activities to implement bioenergy technologies as being viewed by citizens as values-driven activities. The more citizens attribute these industrial activities to being values-driven (i.e. being in line with social, moral industry values),

Table 6
Test interaction between values-driven attributions and environmental values.

	Integrity-based trust				Perceived corporate greenwashing			
	β	t-value	Sig.	LLCI; ULCI	β	t-value	Sig.	LLCI; ULCI
Values-driven attributions	.60	39.66	<.001	.57;.63	-.23	−12.47	<.001	-.27;-.19
Environmental values	-.05	−3.20	.001	-.08;-.02	.11	6.18	<.001	.08;.15
Values-driven attributions * Environmental values	.01	.48	.634	-.02;.03	-.02	−1.31	.190	-.05;.01

Notes. Integrity-based trust: Adj.R^2 = .371, F = 359.51 (p < .001). Perceived greenwashing: Adj.R^2 = .067, F = 43.54 (p < .001). LLCI = Lower level of 95% confidence interval; ULCI = Upper level of 95% confidence interval.

the higher their level of acceptance in terms of (integrity-based) trust and the less perceptions of greenwashing regarding this industrial activity are evoked. These relations are particularly pronounced among citizens with a relatively high level of subjective knowledge on renewable energy technologies (i.e. citizens believing they are well-informed about this matter). The strength of the relation between values-driven attributions and both trust and greenwashing did not depend on the level of citizens' environmental values, even though we did expect this. One potential explanation may be that bioenergy production is only under certain conditions a positive contributor in mitigating climate change. To illustrate, forest bioenergy can in some instances threaten to lead to an increase in overall greenhouse gas emissions (Helin et al., 2016), while technologies to produce biogas have been associated with citizen concerns regarding naturalness (Dumont et al., 2021). Consequently, a subset of citizens who hold strong environmental values may view bioenergy as counterproductive in mitigating greenhouse gas emissions or as unnatural. This can partially explain why stronger values-driven attributions are not more strongly associated with greater public acceptance of industrial activities to implement bioenergy technologies among those citizens with stronger environmental values. Future research can explore the extent to which these concerns contribute to driving public acceptance of industrial activities to implement bioenergy technologies, in relation to citizens' environmental values. Additionally, we expected that citizens' attributions of industry motives are related to integrity-based trust, but not to competence-based trust. However, stronger values-driven citizen attributions were also positively associated with more competence-based trust, though not as much as with integrity-based trust. A belief may exist among citizens that performing activities to enable bioenergy production because this fits with core moral, social values held by the industry will ultimately only benefit society when the industry also has the capabilities and expertise (i.e. competence) to properly perform these industrial activities.

In absolute terms, our findings indicate that citizens attribute industrial activities to implement bioenergy technologies more to being egoistic-driven and strategic-driven and to a lesser extent to being values-driven (Table 1). This presents an opportunity to increase public acceptance in terms of (integrity-based) trust and lower skepticism in terms of greenwashing perception. The room for improvement in these industrial activities being attributed by citizens to being values-driven can be used to convince citizens that these activities are rooted in core moral, societal values held by the industry. For instance, communication towards the public can emphasize that the industry aims to increase bioenergy production as this matches industrial values that aim to address the moral, societal issue of lowering the environmental impact of energy production. Ultimately, the key may lie in citizens perceiving this industrial activity to increase bioenergy production as being authentic and being 'true to oneself' as an industry (Harvey et al., 2006). If this is the case, then citizens are more likely to view industrial activities as being tied to industrial values, as well as societal expectations. Industrial CSR activities are generally viewed as more authentic, when they are both distinctive, and well-embedded in what citizens expect from the industry (Mazutis and Slawinski, 2015): distinctiveness and social connectedness are key for an industrial activity to be viewed as authentic by citizens. Authenticity can be part of the underlying mechanism of why stronger values-driven attributions are associated with greater (integrity-based) trust and weaker greenwashing perceptions of industrial activities to implement bioenergy technologies in the current study, as stronger values-driven attributions can be expected to be connected to citizens viewing this activity as being more 'true' to what an industry represents.

Promoting industrial activities to implement bioenergy technologies as values-driven is particularly important to gain the (integrity-based) trust of the public, when citizens believe they are relatively knowledgeable with regard to renewable energy technologies. Citizens generally are relatively unfamiliar with renewable energy sources and technologies such as bioenergy (Fytili and Zabaniotou, 2017). However, if an industry operates in an area where citizens are more familiar with the matter, communicating to citizens that industrial activities that enable bioenergy production occur as they fit with moral, societal industrial values is particularly critical. In the process, our findings demonstrate the pertinence of citizens ultimately not (solely) viewing these industrial activities as being conducted merely for the own benefit of an industry, either from an egoistic (e.g. doing it for a tax write-off) or strategic perspective (e.g. getting more customers), as this makes it likely that perceptions of greenwashing are evoked among citizens. It should be noted that while integrity played a role in our study in terms of integrity-based trust, citizens' own predispositions regarding integrity can also matter in how industrial CSR practices are perceived. As revealed by Castro-González et al. (2019), CSR practices have the potential to lead to stronger feelings of admiration among citizens for an industry that administers CSR practices, particularly when citizens strongly value integrity in leading their own lives. Future research can explore to what extent such individual differences concerning the importance of integrity in citizens' lives moderate the relation between different citizen attributions and both (integrity-based) trust and greenwashing.

4.1. Practical implications

Getting citizens to attribute industrial activities to implement bioenergy technologies to core societal, moral values held by the industry appears to be an important step towards gaining public acceptance. This leads to the question how such attribution can be achieved. Perhaps at first sight somewhat paradoxically, initial evidence reveals that communication aimed at citizens will be viewed as being in line with social, moral industry values if both economic and environmental considerations for an industrial activity are communicated (De Vries et al., 2015). The perception is thus less likely to occur that industries withhold something in their communication regarding their decisions to implement bioenergy technologies. De Vries et al. (2015) show that acknowledging economic considerations when engaging in activities to increase renewable energy production contributes to decreasing citizens' greenwashing perceptions. Consequently, communication involving a balancing act between stressing that industrial activity matches core social, moral industry values and transparently acknowledging this activity can also lead to more self-interested benefits, might be needed to strengthen values-driven attributions, and in turn create public trust and minimalize greenwashing perceptions. This can also contribute to increasing the perceived authenticity of the industrial activity in the eyes of the public, which is ultimately critical for industries to be perceived as socially responsible in terms of CSR (Mazutis and Slawinski, 2015).

Furthermore, demonstrating transparency in general as an industry contributes to citizens believing that an industry performs an activity because of a commitment to a social cause. Dunn and Harness (2018) recommend transparent communication via social media as a means to get citizens to typify certain industrial activities as values-driven. A similar recommendation can be made to strengthen citizen attributions of industrial activities to implement bioenergy technologies as values-driven.

Finally, the fit of industrial activities to implement bioenergy technologies with the norms within the industry operates in, as well as the industry's history in sustainable practices, can affect the extent to which citizens will ultimately attribute these industrial activities to core social, moral values. Citizens tend to attribute industrial activities to a greater extent to intrinsic (i.e. selfless) causes when perceiving the activity as deviating from the industry norm (Leonidou and Skarmeas, 2017), which corresponds with distinctiveness being described as critical for an industrial activity to be viewed as authentic (Mazutis and Slawinski, 2015). Furthermore, industrial activities are also attributed to intrinsic causes more, when citizens believe the industry already has a history of

sustainable practices (Leonidou and Skarmeas, 2017). This suggests that activities to enable bioenergy production will more likely be attributed to core social, moral industry values when citizens believe this matches a longer line of sustainable practices. Thus, when an industry decides to implement bioenergy technologies, a combination of a fit of this industrial activity within a history of sustainable industry practices with an element of being distinctive within an industry (i.e. not solely following an industry norm), can lead to citizens attributing this industrial activity to core social, moral industry values and in turn drive public acceptance for these industrial activities, instead of evoking skepticism.

4.2. Limitations & future research

The current study revealed a number of options for future research, and some study limitations that can be addressed in future research.

First, in the current study we did not distinguish between different types of biomass that can be used to generate bioenergy. Initial studies indicate that the level of public acceptance for industrial activities that increase bioenergy production, may differ depending on the type of biomass. For instance, while energy use of forest biomass is overall perceived as sustainable, such perceptions can change if the level of forest biomass used to generate bioenergy increases (Ranta et al., 2020). The distinction between first generation and second generation biofuels is also relevant in the public debate (Mohr and Raman, 2013): first generation biofuels are mainly produced from food crops such as sugar cane, while second generation biofuels mainly come cellulosic energy crops such as wheat straw which is residue from agricultural processes. First generation biofuels have generated relatively much public opposition, also because of the potential to threaten food security (Mohr and Raman, 2013). Future research can investigate to what extent our findings in the current study are generalizable to different types of biomass that can be used to generate bioenergy.

Second, the current study is relatively scenario-based. Study participants were not confronted with a specific industrial activity within their area which would lead to an increase in bioenergy production. Future research can examine to what extent the current study findings hold up when study participants are presented with a real-life, industrial activity that increases bioenergy production. If such a case becomes more specific, certain types of public attributions might gain even more influence in driving public acceptance (or skepticism) for such industrial activities, for instance because of citizens' Not In My Backyard (NIMBY) considerations (Giuliano et al., 2018).

Third, the methodology used in the current study (survey research) invites certain limitations that subsequently require a certain degree of caution when interpreting the results of the current study. Most notably, different types of response bias can occur, such as a tendency by respondents to agree with statements posited in a survey (acquiescence bias; Danner et al., 2015), and a tendency to ascribe traits to oneself that are socially desirable (social desirability bias; Van de Mortel, 2008). Additionally, while we used existing, validated scales for our survey, these scales were validated in previous studies, and not in the current study.

Finally, the current study did not address considerations in terms of legislation, which can play an important role in industries' decision-making to implement bioenergy technologies (Mäki et al., 2021). Future research can explore to what extent citizens consider legislation considerations when attributing industrial activities to implement bioenergy technologies to certain types of industry motives.

5. Conclusions

Public acceptance of industrial activities that enable bioenergy production has so far received little scholarly attention, but is ultimately critical to increase renewable energy production. The current study uses a Corporate Social Responsibility (CSR) perspective to examine how public acceptance of industrial activities to implement bioenergy technologies is driven by different types of citizen attributions. The findings indicate that to gain public acceptance and prevent skepticism, industries need to find ways that persuade citizens that these industrial activities ultimately are an extension of core moral, societal industry values. Corporate or industrial communication towards citizens can benefit from on the one hand stressing that these industrial activities match core social, moral industry values, while on the other hand also acknowledging this activity can lead to self-interested benefits as well, so that the communication is fully transparent and viewed as authentic by the public. This strengthens citizens' values-driven attributions, and in turn creates public trust and minimalizes greenwashing perceptions. This becomes even more important when dealing with citizens who believe they are relatively knowledgeable on the topic of renewable energy technologies.

CRediT authorship contribution statement

Danny Taufik: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. **Hans Dagevos:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing.

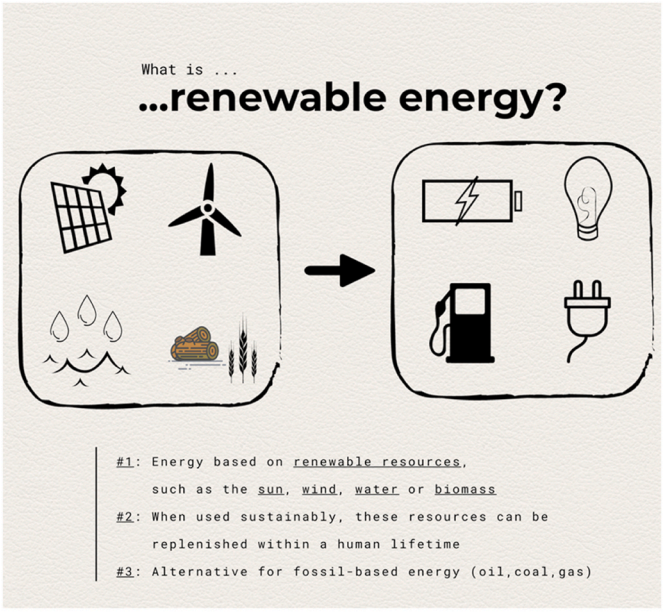
Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

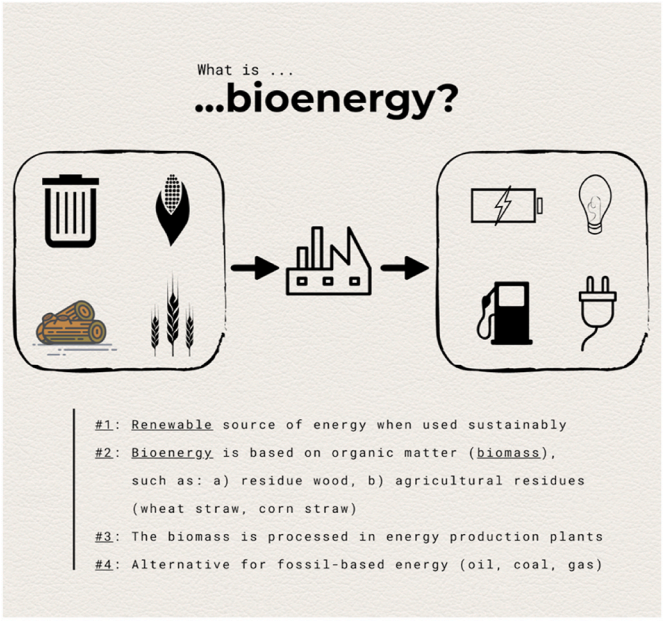
Acknowledgements

This research was funded from the European Union's Horizon 2020 research and innovation programme under grant agreement 817999 (Bioenergy Retrofits for Europe's Industry—BIOFIT). The authors would like to thank Machiel Reinders, Marieke Meeusen, Siet Sijtsema (Wageningen University & Research) and Hanna Pihkola (VTT Technical Research Centre of Finland) for their insightful comments and suggestions on an earlier draft of this paper.

Appendix A. infographic explanation of renewable energy in survey



Appendix Binfographic explanation of bioenergy in survey



Appendix C. descriptive statistics and correlations between the constructs per country

Table C.1
Correlations among and Descriptive Statistics for Study Variables (Bosnia-Herzegovina).

Variables	M (SD)	1	2	3	4	5	6	7	8	9
1. Values-driven attributions	4.73 (1.14)		.20	.45	.72	.09	.20	.39	.52	-.17
2. Egoistic-driven attributions	4.90 (1.20)			.68	.31	.07	.09	.05*	-.13	.47
3. Strategic-driven attributions	5.02 (1.14)				.53	.09	.18	.18	.05*	.32
4. Stakeholder-driven attributions	4.77 (1.24)					.10	.21	.28	.37	-.01*
5. Subjective knowledge renewable energy technologies	4.13 (1.15)						.10	.15	.07	.02*
6. Environmental values	5.51 (1.24)							.11	.09	-.03*
7. Competence-based trust	4.59 (1.30)								.50	-.20
8. Integrity-based trust	4.46 (1.26)									-.39
9. Perceived greenwashing	4.50 (1.38)									

Notes. All reported correlations are statistically significant ($p < .05$; two-tailed), except when an asterisk is shown.

Table C.2
Correlations among and Descriptive Statistics for Study Variables (Germany).

Variables	M (SD)	1	2	3	4	5	6	7	8	9
1. Values-driven attributions	4.41 (1.21)		.16	.19	.45	.01	.19	.46	.66	-.26
2. Egoistic-driven attributions	5.01 (.98)			.68	.47	.09	.30	.16	.04*	.34
3. Strategic-driven attributions	5.08 (1.02)				.57	.07	.31	.20	.02*	.35
4. Stakeholder-driven attributions	4.85 (1.14)					.07*	.29	.27	.27	.13
5. Subjective knowledge renewable energy technologies	4.19 (1.32)						.24	.12	.06*	.12
6. Environmental values	5.59 (1.19)							.24	.14	.16
7. Competence-based trust	4.75 (1.20)								.60	-.12
8. Integrity-based trust	4.37 (1.30)									-.32
9. Perceived greenwashing	4.80 (1.17)									

Notes. All reported correlations are statistically significant ($p < .05$; two-tailed), except when an asterisk is shown.

Table C.3
Correlations among and Descriptive Statistics for Study Variables (Spain).

Variables	M (SD)	1	2	3	4	5	6	7	8	9
1. Values-driven attributions	4.74 (1.27)		.02	.23	.68	.12	.25	.41	.68	-.25
2. Egoistic-driven attributions	5.23 (1.03)			.72	.21	.07*	.26	.13	-.12	.47
3. Strategic-driven attributions	5.25 (1.00)				.40	.10	.28	.25	.10	.34
4. Stakeholder-driven attributions	4.99 (1.22)					.13	.30	.38	.47	-.09
5. Subjective knowledge renewable energy technologies	4.17 (1.16)						.15	.22	.13	.04*
6. Environmental values	6.06 (.98)							.16	.06*	.10
7. Competence-based trust	4.90 (1.25)								.54	-.04*
8. Integrity-based trust	4.46 (1.39)									-.37
9. Perceived greenwashing	4.84 (1.19)									

Notes. All reported correlations are statistically significant ($p < .05$; two-tailed), except when an asterisk is shown.

Table C.4
Correlations among and Descriptive Statistics for Study Variables (Sweden).

Variables	M (SD)	1	2	3	4	5	6	7	8	9
1. Values-driven attributions	4.51 (1.09)		.16	.33	.56	.08	.23	.40	.54	-.18
2. Egoistic-driven attributions	4.94 (1.00)			.66	.41	.11	.19	.09	-.01*	.38
3. Strategic-driven attributions	5.08 (1.00)				.58	.06*	.27	.20	.10	.33
4. Stakeholder-driven attributions	4.93 (1.09)					.08	.26	.22	.27	.08
5. Subjective knowledge renewable energy technologies	3.66 (1.33)						.09	.17	.12	.01*
6. Environmental values	5.42 (1.29)							.13	.09	.04*
7. Competence-based trust	4.73 (1.18)								.60	-.19
8. Integrity-based trust	4.46 (1.18)									-.38
9. Perceived greenwashing	4.57 (1.27)									

Notes. All reported correlations are statistically significant ($p < .05$; two-tailed), except when an asterisk is shown.

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