



# Socio-cultural conditions for social acceptance of bioeconomy transitions: the case of Norway

Maja Farstad<sup>1</sup> · Pia Piroshka Otte<sup>1</sup> · Erika Palmer<sup>1</sup>

Received: 6 December 2019 / Accepted: 22 May 2023  
© The Author(s), under exclusive licence to Springer Nature B.V. 2023

## Abstract

Under the umbrella of sustainable development, the bioeconomy presents one vision for overcoming complex sustainability challenges, such as climate change, by replacing non-renewable resources with renewable biological resources. But how will the efforts to implement this transition be received by the general public? Among Norwegians, the acceptance of a bioeconomic transition appears to be relatively high, and this study identifies critical enabling conditions in Norway that may be necessary to foster social acceptance in other countries as well. We employed a theoretical framework of social acceptance to demonstrate the complexity of this social phenomenon as a basis for an open and qualitative methodological approach. The study finds that trust, extinguished hopes of a pure life and intrepidness are enabling conditions that make people more receptive to new developments and future cultural adaptation. As these fear averse conditions are not experienced globally, lower social acceptance of a bioeconomic transition can be expected elsewhere.

**Keywords** Bioeconomy · Sustainable development · Social acceptance · Norway · Socio-cultural conditions

## 1 Introduction

Sustainable energy strategies require new approaches that decrease dependency on fossil fuels, while increasing biological and renewable resources for future energy consumption. Under the umbrella of sustainable development, the bioeconomy presents one vision for overcoming these important challenges. The European Commission (2012) defines the bioeconomy as “the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based

---

✉ Maja Farstad  
maja.farstad@ruralis.no

Pia Piroshka Otte  
pia.otte@ruralis.no

Erika Palmer  
ekp48@cornell.edu

<sup>1</sup> Ruralis–Institute for Rural and Regional Research, University Centre Dragvoll, 7491 Trondheim, Norway

products and bioenergy” (European Commission, 2012:9). On the EU level, the transition to a bioeconomy from today’s more oil-based economy has been given political priority because of the bioeconomy’s anticipated potential to address key global issues. Through the appropriate use of renewable biological resources, the bioeconomy is expected to provide food security to a growing world population, limit the depletion of natural resources, reduce negative environmental impacts and, not least, contribute to a far more climate-friendly society (European Commission, 2012). The original European Bioeconomy strategy was renewed in 2018 with 14 key actions to accelerate the transition to the bioeconomy (European Commission, 2018). Thus, the bioeconomy contributes to a range of the Sustainable Development Goals (UN, 2019).

While technological, chemical and biological issues central to a bioeconomic transition are increasingly represented in scientific literature and many advances in the technical capacity needed for transition implementation have been realized, the social science aspects of bioeconomic transitions are to a large degree unexplored (Sanz-Hernández et al., 2019). Underpinning this issue is that the public has a poor understanding of what the bioeconomy is (Mustalahti, 2018; Takala et al., 2019). Public perceptions will play a crucial role since bioeconomic development ultimately depends on consumers’ and citizens’ interests and transitions is needed, including the identification of socio-cultural conditions that may foster social acceptance of the bioeconomy. The transition to the bioeconomy is expected to have considerable consequences for society, especially for rural areas, given the natural location of most bioresources (Lehtonen & Okkonen, 2013). As with other transitions labeled as “green” or “sustainable” (Bismarck et al., 2006), it is critical that national bioeconomic strategies address socio-cultural risk, utility assessments and ethical considerations.

Norway aspires to be a bioeconomy pioneer, reflected in its national strategy for the bioeconomy (Regjeringen, 2016). Building on analyses of the public’s acceptance of a bioeconomy in Norway (Farstad & Otte, 2021), this paper contributes to the debate by exploring socio-cultural conditions that enable the social acceptance of bioeconomy transitions in the Norwegian case. Norway is an interesting case to study because it has access to a wide range of renewable biological resources, as well as industrial capacity and competence that makes the implementation of a national bioeconomic strategy realistic. In 2016, the Norwegian government launched its own bioeconomic strategy. The Norwegian bioeconomy strategy includes the use of sustainable bioresources for food, feed, health products, energy, materials, chemicals, paper, textiles (Regjeringen, 2016). The strategy aims to contribute to three overall national goals: (1) increased value creation and employment; (2) reduction of GHG emissions; and (3) more efficient and sustainable use of resources (Regjeringen, 2016:23). The Confederation of Norwegian Enterprise (NHO 2015) points out that the transition to a bioeconomy can be expected to have a ripple effect in the form of many additional jobs in industry, service industries and public administration. Motivated by these outlooks, promoting innovation formed an important part of Norwegian bioeconomy strategy (Carrez, 2017). Yet, the bioeconomy is still a concept under development in Norway (Hansen and Bjørkhaug, 2017).

We apply a qualitative, explorative approach in order to capture people’s perceptions, understandings, preferences and concerns regarding a bioeconomic transition. The analysis is based on eight focus group interviews with 53 participants representing members of the Norwegian public. The social acceptance of related innovation in terms of alternative energy and new agrifood developments has been widely investigated in previous research (e.g., see Stigka et al., 2014; Gupta et al., 2012; Costa-Font et al., 2008). The approach of asking the general public about the bioeconomy as a broad concept has yet to

be investigated (Dieken et al., 2021). The new contribution of our study is that we examine the underlying socio-cultural conditions that enable social acceptance, within a bio-economic context. This means that we are not limited to a particular technology, but we explore people's perceptions on several bioeconomic developments/products and thus take a more holistic approach to studying social acceptance.

This paper is structured as follows. In the following section, we present relevant literature on socio-cultural elements of bioeconomic transitions, including a social acceptance theoretical framework. After presenting our data and methodology, we continue with our results regarding socio-cultural conditions for social acceptance of a bioeconomy transition in Norway, and a discussion in a more general perspective. Finally, we outline the future steps for research on the social acceptance of bioeconomic transitions.

## 2 Relevant literature and theoretical framework

Although clear objectives underlie bioeconomic development, there is no unified understanding of exactly what the bioeconomy will encompass or what type of society this will entail (Hausknost et al., 2017; McCormick & Kautto, 2013). Without a unified vision of the bioeconomy, it is not yet possible to develop an implementation strategy. For example, the development of an "eco-economy" has been proposed as a preferred version of bioeconomic development (Kitchen & Marsden, 2009; Marsden, 2012), with a particular focus on safeguarding and exploiting local benefits through the establishment of short value chains and local production adapted to the local ecology based on local knowledge. The development of a bioeconomy will also depend on the technological innovations being developed, as well as the public's views on the utility, risk, and ethical implications of these innovations.

How the public views various initiatives must be considered an important part in the transition to a bioeconomy, not least because the needs and attitudes of the population are central to decision-making processes in democratic societies (Fytli and Zabaniotou, 2017). This means that the transition to a bioeconomy will depend on how the public perceives and assesses the bioeconomy and various bioeconomic solutions. Devaney et al. (2017) argue that implementing good governance principles (i.e., ensuring accountability, transparency, efficiency, participation, and fairness) in the processes toward a bioeconomic transition will build momentum, credibility and trust in the bioeconomy, at the benefit of both governments, industries and firms, and the wider society. Related to this, Wreford et al. (2019) point out how a transparent public discourse around the potential benefits and negative implications, including all sectors of society, is necessary to prevent alienation of the wider public, and hence allow for realization of the full benefits of a bioeconomy. Hagemann et al. (2016) underline that the ways in which political influence might unfold is an important factor for social acceptance of bioeconomic developments. This relates to the role of media, and the angles and perspectives they choose to emphasize. Stern et al. (2018) in their study on how Austrian citizens perceive the general political vision of a bioeconomy find that the bioeconomy is, overall, associated with positive perceptions and expectations. They do not analyze the contextual reasons for the social acceptance; however, while ecological aspects seem romanticized, technology-related aspects of the bioeconomy appear to be associated with somewhat more negative attributes (Stern et al., 2018). In the Norwegian case (from previous research), we know that citizens in general demand

high security, quality and welfare standards, as well as products that are as locally produced as possible and of high ethical standards (Ministry of Agriculture and Food, 2012).

While only a few studies have examined the social acceptance of a bioeconomic transition among the general public (Stern et al., 2018; Farstad & Otte, 2021), the present paper takes research on this topic one step further, empirically exploring socio-cultural conditions for social acceptance of a bioeconomic transition. As a previous study (Farstad & Otte, 2021) identified relatively high social acceptance of a bioeconomic transition in Norway, we argue that Norway provides a useful case for identifying important social-cultural conditions for this kind of acceptance. The findings also throw light on the chances that bioeconomic developments will be widely accepted at the global level.

## 2.1 A social acceptance theoretical framework

Due to the scarce research on the social science aspects of bioeconomic transitions, we considered a theoretical framework thoroughly explaining social acceptance to be supportive to our explorative research approach. Social acceptance is a term that is often used in the research literature on practical policy, while Wüstenhagen, Wolsink and Bürer (2007) seem to provide the most theoreticized contribution to this concept. The Wüstenhagen et al. framework focuses on this phenomenon in the context of renewable energy innovation and distinguishes three dimensions of social acceptance: socio-political acceptance, local community acceptance and market acceptance. *Socio-political acceptance* is described as social acceptance in its broadest form. Both politics and technologies are relevant to this dimension of social acceptance, and social acceptance has previously shown to be a barrier to bioeconomy transitions due to a lack of understanding of the technical aspects of the bioeconomy and how this affects plant and animal life (Zabaniotou, 2018; Wüstenhagen et al., 2007) point out how measurements in many countries indicate high socio-political acceptance of renewable energy technologies and associated policies, and how this generally positive picture has led to the conclusion that social acceptance is unproblematic. However, when the focus is shifted from global to local, as well as from general positivity to technologies and policies to execution through investment and localization decisions, social acceptance could still be problematic (Bell et al., 2005, 2013). There are barriers to the implementation of new projects that, when evaluated, are a manifestation of a lack of societal acceptance. Key socio-political stakeholders, including political actors, can affect the innovation pathways, investment, planning and decision-making as has been shown in many energy-related projects (Jones et al., 2017). Political actors affect the social acceptance of energy transitions, and the public can be swayed ideologically for or against energy transition by political actors regardless of their opinions toward environmental causes (Dermont, 2018).

*Community acceptance* is another dimension of the social acceptance of energy transitions. Local community acceptance represents the acceptance by local people and local authorities of local development projects, including localization decisions. This is related to socio-political acceptance; just as political actors can sway the public, backlash against localization decisions affects politicians in decision-making against energy transition planning and decisions. This arena is a natural place for so-called NIMBY (Not In My Back Yard)-ism, where a distinction between acceptance for the general and opposition to the specific is explained by the fact that people are positive for various development projects as long as they do not have any local impacts (Batel et al., 2013; (Batel & Devine-Wright, 2015a, 2017). Such local resistance (or possible acceptance) can be linked to perceived

fairness in terms of the distribution of benefits and costs, perceived fairness in decision-making and participatory processes and confidence in the intentions of investors and other stakeholders outside the community (Bidwell, 2016a, b; Fytli & Zabaniotou, 2017). A distinctive feature of local community acceptance is that it involves a time dimension. Wolsink (2007) finds that local community acceptance typically follows a U-curve before, during and after a project, with the highest acceptance, respectively, before and after a new project has been established and implemented. To achieve community acceptance, policy decision-makers need to aim to understand public attitudes and responses to gain real support rather than just public consent (Batel et al., 2013), while considering the U-curve of acceptance.

Lastly, *market acceptance* is a key dimension of social acceptance, which concerns the market's acceptance of an innovation (Wüstenhagen et al., 2007). This type of acceptance can be seen in the context of the phenomenon of diffusion of innovation (Rogers, 2003), where consumer acquisition of innovative products can be explained by a communication process between individual adopters and their environment. It is important to note the role of middle actors in affecting innovation diffusion as part of market acceptance processes. These actors, such as industrial actors, work from the middle out influencing the political 'top' actors upstream and the downstream community, while in addition affecting other middle agents (sideways) (Devine-Wright et al., 2017). Market acceptance will be particularly relevant for bioresource-based innovations aimed at individual consumers, such as different types of new foods, cosmetics and clothing.

Applying the Wüstenhagen et al. (2007) framework of renewable energy social acceptance in a bioeconomic transition context, we argue that there are three different dimensions to bioeconomy social acceptance:

- (1) Acceptance of the *idea* of a bioeconomic transition more generally (socio-political acceptance).
- (2) Acceptance of the consequences for oneself and one's surrounding environment (community acceptance).
- (3) Acceptance of the acquisition of various new products and services offered by the bioeconomy (market acceptance).

Importantly, and in line with what has been highlighted by Aitken (2010), public attitudes and responses to bioeconomic innovations should not be examined in order to mitigate potential future opposition, as the reasons behind the opposition may be well-founded, legitimate and worth listening to. Further, the dimensions of community acceptance and socio-political acceptance mentioned above (Wüstenhagen et al., 2007) are not necessarily as separated as they appear theoretically, as national and local communities may be relationally intertwined (Batel, 2018) and also comprised by the same kind of people (Batel and Devine-Wright, 2015b). Social acceptance is not a static set of attitudes or actors but a dynamic concept embracing broad, social relationships and organizations, which develop over time through learning processes (Wolsink, 2010, 2018, see also Küpers & Batel 2023). It involves different actors on each dimension, as well as different and changing acceptance objects (products, but also processes and institutional change as objects, i.e., energy innovation), which makes it a complex phenomenon to study. Fytli and Zabaniotou (2017), in a literature review of bioenergy acceptance, explain how societal acceptance may be contingent on various conditions. These conditions include awareness of climate change or other global challenges; knowledge of relevant technologies; perceived justice related

to decision-making; costs, risks and benefits associated with new innovations; features of the local context (often related to potential localization problems); as well as trust in policy makers and other relevant stakeholders. Underlying this and specific to designing a transition to a circular waste-based bioeconomy, Zabaniotou (2018) identifies local identity and culture as key elements in sustainably meeting such a transition, while Morone and Imbert (2020) highlight the involvement of different stakeholder groups as a key enabler in this context.

Some of these conditions form the basis for the assessment when one is either positive or negative toward an idea or concept. Perceived benefits, costs, risk (of varying probability and severity) and ethical considerations are key variables when individuals occupy a particular position for innovation. This is also reflected in scientific literature on social acceptance of new forms of energy (von Wirth et al., 2018), gene modification (Costa-Font et al., 2008) new foods (Ronteltap et al., 2007), as well as the bioeconomy (Bröring et al., 2020). In addition, elements that can have a major impact on the outcome of the assessments are important in this context, i.e., whether the object is perceived as a dis/advantage, as risky and/or whether it is considered ethically in/correct (Fytli & Zabaniotou, 2017).

Given this background, we investigate how people's perceptions and assessments of different aspects of the bioeconomy are balanced between benefits and costs (including risk perceptions and ethical considerations) and relate to the three dimensions of social acceptance. Based on empirical evidence, we identify plausible socio-cultural conditions enabling the current state of social acceptance of the bioeconomy in Norway.

### 3 Methodology and methods

This paper is based on a qualitative study of the social acceptance of a bioeconomic transition in Norway. As is demonstrated by the theoretical framework presented above, social acceptance is a multidimensional phenomenon that may be based on a range of assessments and considerations undertaken by individuals accepting or not accepting what they are presented. Additionally, as research on social science aspects of bioeconomic transition is limited, we had no prior understanding of what the general public's response to bioeconomic transition was likely to be. While quantitative methods, such as structured surveys, require an understanding of the subject under investigation, qualitative research is open to any new material that emerges (e.g., Flick et al., 2004).

The analysis is based on data from eight focus group interviews with the Norwegian public. The focus group interviews were all conducted in 2016, and the number of interviews was adjusted by the principle of saturation (Glaser & Strauss, 1967), i.e., the data collection was ended when we perceived that more data would not necessarily lead to more information. The purpose of the study was not to quantify the prevalence of different views in Norway, but to capture different known and, not least, new perspectives and applied dimensions when it comes to evaluations of a particular phenomenon, such as the bioeconomy. Like other qualitative research, our study is concerned with meaning rather than making generalized hypothesis statements (Mason, 2010). To introduce the bioeconomy to our participants and make it more concrete, we decided to present the focus groups with various, meaningful examples of innovation in the bioeconomy, both to explore people's personal boundaries in terms of ethics and risk and to provide a good foundation for meaningful discussions in the interviews. We then chose different examples that exist in the world today (e.g., changed land use, widespread use of waste, genetic technology, new

types of food and bacteria-based textile creation), and if not all examples are fully relevant in Norway yet, then those are likely to become so in the next 20 years.

To establish contact with potential participants and put together different groups of people, we decided to direct our inquiry through preschools because preschools are a type of institution that brings together different people (in the form of guardians: parents and grandparents) with different socio-economic backgrounds in the Norwegian system<sup>1</sup>. These backgrounds also cover a large age range and different genders. We also chose to conduct focus group interviews in different parts of the country, in both urban and rural areas, to capture potential variations among places and local cultures that could potentially have an impact on people's perceptions and views. Because we chose preschools, the socio-economic diversity leaves out childless persons, and this is a noted limitation of the study.

We contacted the general managers of preschools in selected areas via email. An invitation and information letter addressed to the guardians was either distributed or hung on the wall in the preschools. We then offered a form of paid participation: if the preschool asked about eight parents of different ages and genders for an interview, and if the interview could be conducted on the preschool's own premises in the evening, the kindergarten would receive NOK 3000 (about 330 EUR) for use in such a way that it would benefit the preschool. In this particular context, we found it appropriate to use paid participation since the research topic does not obviously appear to be relevant to either preschools, children or the parents. In addition, we depended on the request provoking sufficient interest or goodwill on the part of two different types of actors: among the preschools who were asked to convey the request and among a sufficient number of guardians. For these reasons, we concluded that an economic incentive would be necessary.

We contacted enough preschools that we had interview agreements in both urban and rural municipalities in different parts of the country. The data were collected in one urban and one rural municipality in North Norway; one urban and two rural municipalities in Mid-Norway; one semi-urban municipality in the north-west part of the country; and one urban (Oslo) and one rural municipality in South-East Norway. The collected data consist of eight focus group interviews with a total of 53 participants of mixed genders (31 women and 22 men) with ages ranging from 20 to 70 s. We did not systematically collect information on each participant's occupation, but through the interview discussions, a wide spectrum of occupations and social backgrounds were confirmed when people accidentally shared experiences from their own lives. Some of the participants seemed to show up as if they were participating in volunteer work organized by the preschool and not because they were motivated by the theme. This is something we consider a strength, as our desire was to be able to interview general persons, rather than a group that was clearly interested in environmental issues and/or community development. We also verbally emphasized that participation was voluntary, and all interviewees actively participated in the discussions.

We did not expect the interviewees to be particularly familiar with the bioeconomy, neither as a concept nor in terms of the national commitment to a transition to a more bioeconomy-based society, which was later confirmed by the interviews. For this reason, we started the group interviews by presenting a brief, neutral description of key objectives and instruments in the bioeconomic initiative. Regarding "social acceptance", we did not use the term in the interviews and hence did not translate "social acceptance" directly to

---

<sup>1</sup> Norway heavily subsidizes preschool attendance while, although there is some variation, Norwegian housing policy in general ensures a low degree of class segregation by neighborhood; and hence, most preschools have a mix of children (and parents) from different socio-economic backgrounds.

Norwegian. We used a rather explorative approach to get an impression of how most people will respond to the bioeconomy in general, as well as various bioeconomic innovation examples more specifically. We made sure to include examples from several relevant sectors, such as healthcare, chemistry and agriculture, in line with recent research definitions of the bioeconomy (Bugge et al., 2016). We introduced five specific themes and initiated open discussions around them. First, we asked about the interviewees' views on new types of land use. These included new landscapes, such as willow trees (fast-growing tree species) and more intensified forestry related to increased biofuel production. Other thematic areas introduced were food production versus bioenergy production from both a global and a national perspective, as well as localized themes such as biogas plants. We then examined the interviewees' views on the widespread use of waste, mainly focusing on sewage sludge, but also consumable products with debatable content (such as facial treatments with bird droppings). Another theme was genetic technology, where participants were challenged on this in both food and medical care. We also examined the interviewees' views on different types of new, alternative food. This included lab-grown/cultured meat (in vitro), insects as a virtually untapped food resource in the western world, and 3D-printed food. In addition, participants were also introduced to new, bacteria-based products, such as clothing. The latter was presented mostly as a gimmick, to show the range of technology already relevant to the bioeconomy.

The interviews were recorded and transcribed verbatim before being analyzed with NVivo. This software allows for a 'cross-sectional code and retrieve' approach, where a common system of conceptual and analytical categories is applied across the data set to enable the search and retrieval of labeled data (Spencer et al., 2003). The transcribed data were initially analyzed by having a thorough read-through of each transcription document, where meaningful units of data (comments, sentences, paragraphs), providing information about relevant concepts, were identified. These units of data were consecutively labeled and categorized according to their similarities with other units of data. In addition to identifying different themes based on participant perspectives, this categorization process includes noting differences and similarities between participants and across interviews, as well as recognizing both anticipated and unanticipated linkages to other research in the field. As such, the analysis is based on meaning condensation and meaning categorization (Kvale, 1996). When all the interview transcriptions were categorized, three of the developed categories stood out as socio-cultural conditions for social acceptance of bioeconomic development. These are further presented as the main results in the next section.

## 4 Results and discussion

In general, the interviewees appeared to be positive about the idea of a bioeconomic transition. The overall objectives of the bioeconomy are easily agreed to as the participants understood that new energy sources are needed to address climate change. In addition, solutions to reduce hunger, illness and death are also easy to support, and no one was critical of the idea of a bioeconomy. Except for a few informants who questioned the realism of being able to meet future energy needs with plant material, the interviewees seemed to largely perceive this as a promising and viable solution to major, global challenges. When we look at the more concrete, potentially controversial, bioeconomic solutions, there were also positive attitudes toward the bioeconomy because of the naturalness quality of bioresources (Farstad & Otte, 2021). This is also in line with previous research on social



acceptance of various forms of food technology (Ronteltap et al., 2007; Tenbült et al., 2005; Connor & Siegrist, 2010).

However, when we looked more closely at the various concrete examples of bioeconomic solutions/examples we brought into the interviews, there was no unconditional embrace of a bioeconomic future. The interviewees had several interests and values that they were concerned about, such as preventing potential negative changes in their own local environments (basic conditions of NIMBY-ism) and ensuring maintenance of national food production (Farstad & Otte, 2021). Overall, the participants emphasized that a bioeconomic transition must be carried out in an orderly way and within the limits of reason and ethics. A participant from an urban group in the north of Norway reasoned as such:

Under certain conditions, I could support everything we talked about today. While under other certain conditions, I could also oppose everything we talked about. Thus, it depends fully on the separation of these developments.

Resulting from our analysis, we have identified three reoccurring attributes/themes across all bioeconomic examples, which appear as socio-cultural conditions for bioeconomic transitions: Trust; extinguished hopes of a pure life; and intrepidity.

#### 4.1 General trust

The first and most obvious socio-cultural condition we found is trust. The fundamental trust in the public sector was consistently reflected in the interviews. This is exemplified here by a participant in an urban group in central Norway:

Imagine how nice the welfare society we live in is; it is managed well, and we have confidence in the authorities. They do the best for people.

None of the interviewees appeared to be very concerned that the transition to a bioeconomy could be too little controlled, and there is confidence in public authorities and their regulation of important conditions and processes where necessary. The interviewees perceive information as important from those who manage relevant knowledge. Several mentioned the Norwegian Food Safety Authority in this context, and a participant's statement regarding product information from a rural group in central Norway exemplifies here the high confidence in the public regulation of the market:

And if it has come to the store, then it is approved, and then it gives me security.

The finding of trust as a socio-cultural condition for the social acceptance of bioeconomy transitions is in line with other research that shows that Norwegians have, over time, stood out in international comparison with a high degree of trust in public authorities (Catterberg & Moreno, 2005; Wollebæk & Seggaard, 2011). In addition, this also applies in connection with trust in public authorities with handling and preventing any crises that could arise in society (Christensen et al., 2011). A participant from an urban group in central Norway gives an example of this trust based on publicly owned industries, elaborating on their trust toward the correct handling of sewage sludge as manure:

Several important industries are owned by society, by the State, which do not place profit over anything else. For some private industries, economic surplus is more important than other conditions. I do not think a public company is cheating with numbers to hide anything, for example, if they are not able to cleanse sufficiently or

if they do not use the right detergent, to save money. In this matter, I have less trust in private companies.

This illustrates the public's basic trust toward publicly owned companies in Norway. The somewhat weaker trust toward private companies still does not affect people's general trust toward their environments. Here, this is reflected through a quote by a participant from an urban area in Western Norway:

I don't think I would be afraid to try it [genetically modified food], as in Norway we know the rules are so strict that it means everything is thoroughly tested.

Hence, the level of regulation and responsibility undertaken by public authorities and institutions ensures the general perception of a safe society to live and maneuver within.

## 4.2 Extinguished hopes of a pure life

The second of the socio-cultural conditions that we identified is that hopes of a "pure life" are gone. The idea of an uncontaminated life, free of risks and toxins, is a life that many people have already extinguished any hope of having. There is a sense that people are increasingly unable to control external impacts on their own body and environments, both at home and when abroad. This appears to make people more resigned in meeting with various new developments. This resignation seemingly relates to the continuous knowledge production on the harmful content and effects of commonplace items/processes that were previously seen as safe.

Increased mobility and experience through journeys abroad are also likely to have made people less control-oriented when it comes to what they are exposed to. A participant statement from a rural group in central Norway exemplifies how many participants felt that preventing their body from various toxins was a lost case:

I mean, the human body has been exposed to all kinds of substances since the beginning of the industrial revolution, so it has been affected so much that if we use this [gene tech] to medicate, I don't see many dilemmas related to it.

Despite a high trust in public regulation, a participant from a rural group in northern Norway exemplified the difficulties with controlling external impact on one's own body and environment:

I got recommendations for a cream, as my skin is very sensitive, so I tried it, and three days after I got terrible sores. Three weeks thereafter, a media article reported that there were carcinogenic contents in these creams – in products from the pharmacy. Then I thought "hmm".

Such an even-tempered response to carcinogens in products purchased at a pharmacy shows how resigned people feel over time to live an "impure" life. When asked about the willingness to buy genetically modified strawberries in the store, a participant from an urban group in western Norway commented:

I don't think I would be afraid to try it [...]. I would not give it to my children, but for me who is fully-grown, who is fully developed, it does not matter that much anymore.

While they would not give their children any potential risk, they had lowered their guard for their own sake.

### 4.3 Intrepidity

The third identified socio-cultural condition for social acceptance of a bioeconomic transition is intrepidity. When there is nothing that creates fear, this enables long-term habituation. We found most skepticism related to new foods, such as insect and cultured meat, though nuanced (Farstad & Otte, 2021); while some were very negative, others were more curious and thought this was something they could certainly come to accept. This is exemplified by the following exchange on cultured meat:

Interviewer: Do you think this may be the solution?

Participant 1: It may be.

Participant 2: It's hard to say. It requires some kind of mental jump in one way or the other.

Participant 1: Yes, it does. You know, it is something new.

Participant 2: It is also thinkable that in 50 years no one will think about this at all.

Many participants had a self-reflective understanding of their own immediate aversion or skepticism toward new biological solutions. For example, these participants from the urban group in western Norway concluded: "It's actually simply about training" and "Yes, it is culture." Such insight also allows for adaptation, which is illustrated by a quote from a participant in the rural group in central Norway:

Originally, I thought it [GMO] sounded a bit unpleasant, to be honest, but it may be that some more knowledge on this topic makes it less frightening.

Positive outcomes from changed consumption habits also enhanced the willingness for change; for example, one of the participants from an urban group in western Norway emphasized this while talking about insects:

The CO<sub>2</sub>-emissions when producing x tons of insects compared to the same amount of meat - that is a formidable difference. As long as the end product is good, and I won't get sick, I am not negative to this.

### 4.4 Discussion

Trust, extinguished hopes of a pure life and intrepidity are identified as enabling socio-cultural conditions, meaning they are socio-cultural conditions that lead toward social acceptance of a bioeconomic transition. We argue from the analysis that, in a bioeconomic context, a high degree of trust in public authorities allows people to disregard the risks of trying new bioeconomy products (intrepidity). In addition, a sense of resignation caused by increasingly uncontrollable external impacts on one's own body and environment, both at home and abroad, makes people more realistic about the hope of living an uncontaminated life and more accepting of new developments. Trust in public authorities makes this resignation easier to develop because people will know that the authorities will keep the products from being too harmful. Each condition—trust, extinguished hopes of a pure life and intrepidity—is fear averse, and, hence, they allow for a willingness for future cultural adaptation to the bioeconomy.

The Wüstenhagen et al. (2007) framework of social acceptance adapted for bioeconomic transitions is in several ways reflected in the results of this study. The first dimension of this framework is socio-political acceptance. We found that there is a high degree of trust in public authorities in Norway especially when it comes to, among others: ensuring

product safety, addressing crises that affect society, market regulation and regulation of new technology. This trust, as a key condition, fosters the overall (socio-political) acceptance of bioeconomic transitions. The socio-political acceptance seems also conditioned by people's intrepidity. When there is a lack of anxiety about future adaptation, people will be more willing to be guided by political stakeholders in transitioning to new objects of social acceptance.

The third dimension of the Wüstenhagen et al. (2007) framework—market acceptance—is reflected in all three identified socio-cultural conditions. In accepting new bioeconomic products, the public must trust that the market will be regulated by public authorities in their best interest, for example, with food and overall consumer safety. The public also realizes that there will be some risk or what is seen as “impure” in their lives in a bioeconomic society. Given this, people have an intrepidity quality that makes them fear averse, where they garner excitement about innovation and change. Whether bioeconomic developments will be the winners on the market in the end (in the competition with the various qualities and prices of other products) is another question that remains to be answered.

However, none of the identified conditions of relevance relates to community acceptance as the second dimension of the Wüstenhagen et al. (2007) framework. While high levels of trust as a socio-cultural condition clearly provide an explanation to both socio-political acceptance (i.e., acceptance of the idea of a bioeconomic transition more generally) and market acceptance (i.e., acceptance of the acquisition of various new products and services offered by the bioeconomy), it is important to highlight that none of the interview participants stated neither their trust toward authorities nor extinguished hopes of a pure life, resignation or intrepidity when it came to issues such as unpopular localization or public management of local resources. As such, this study has not identified socio-cultural conditions that promote every dimension of social acceptance of a bioeconomic transition. After all, this is also in accordance with the Wüstenhagen et al. (2007) approach, which points out how the various dimensions of social acceptance usually involve different levels of resistance.

The bioeconomy had to be presented and explained to the participants, which is a rather light touch of what the bioeconomy could potentially mean for them. This light touch of the bioeconomy means that we can only really understand the social acceptance of bioeconomy transitions on the most basic level. The study is explorative, and there may be other contextual conditions that we did not uncover. For example, the political and economic background of a country can play a significant role for social acceptance. Norway is a country with generally high levels of prosperity, and it may be easier for people to make idealistic choices when one is socio-economically situated rather than when one is struggling. Furthermore, Norway is a universal welfare state that is based on a social protection system with principles such as solidarity and equality, and where governmental trust is a prerequisite to a well-functioning system. This system may apparently differ in relevant ways to more liberal contexts that we did not consider in our study. Additionally, although we continued to arrange interviews until we perceived that nothing new could be added by another interview, it cannot be ruled out that interviews with other participants would have brought about more—and/or contrasting—results.

## 5 Conclusion and implications

Social acceptance of the bioeconomy has had limited research. While a few studies have examined social acceptance among the general public (Stern et al., 2018; Farstad & Otte, 2021), we have taken research on this topic one step further, empirically exploring socio-cultural conditions for social acceptance of a bioeconomic transition. Our findings indicate that trust, extinguished hopes for a pure living and intrepidity are important enabling conditions for an optimistic view on a future bioeconomic transition in Norway. As these socio-cultural conditions are fear averse, they create a willingness for future cultural adaptation to the bioeconomy. The socio-cultural conditions revealed are most likely transferable beyond the study's sample. Trust in public authorities is high in Norway, and this affects perceptions of product safety—a result that may be transferable to countries with the same levels of trust, yet difficult to replicate in other contexts with lower levels of trust. If systemic trust is lacking, and/or if people have their ideas about what they will expose their bodies to which collide with central bioeconomic developments, social acceptance will probably be low.

Nevertheless, at least, the overarching objectives of bioeconomy transitions are relatively easy to agree on within most contexts. As progress moves forward with bioeconomic transitions, the objects of social acceptance will become clearer to key social stakeholder domains. Future research on social acceptance of bioeconomic transitions needs to focus on these objects—i.e., objects as products, processes or institutional change. Though the vision of what the bioeconomy will be like and what its objects will be, have yet to be set in stone, basic socio-cultural conditions of social acceptance can be explored, as we have shown. We encourage further research that explores the generalizability of these conditions, operationalized in form of a quantitative (questionnaire) and/or comparative (cross country) research design. In addition, social acceptance in this area is a welcome addition to the underdeveloped social science dimension in bioeconomy literature and as part of sustainability research. Studying social acceptance early in sustainability-oriented transition processes can help to identify and address social stakeholders' concerns for implementing appropriate policies or product development that will ensure overall a wide adoption of the bioeconomy.

**Acknowledgements** This study was financed by The Research Council of Norway, through their research program on sustainable innovation in food and bio-based industries (BIONÆR, project number 244608). Our thanks are due to our former colleague Dr. Reidun Heggem, who participated in research design development and data collection. In addition, we are grateful for the useful comments from five anonymous reviewers.

**Data availability** The data that has been used is confidential. Different context information is not included in the stored transcripts due to anonymisation, and context knowledge is a prerequisite for thorough analysis of qualitative data. The interviewees were also not asked whether the transcripts could be made public.

## Declarations

**Conflict of interest** The authors declare that they have no conflict of interest.

## References

- Aitken, M. (2010). Why we still don't understand the social aspects of wind power: A critique of key assumptions within the literature. *Energy Policy*, *38*, 1834–1841.
- Batel, S. (2018). A critical discussion of research on the social acceptance of renewable energy generation and associated infrastructures and an agenda for the future. *Journal of Environmental Policy & Planning*, *20*, 356–369.
- Batel, S., & Devine-Wright, P. (2015a). Towards a better understanding of people's responses to renewable energy technologies: Insights from social representations theory. *Public Understanding of Science*, *24*(3), 211–325.
- Batel, S., & Devine-Wright, P. (2017). Energy colonialism and the role of the global in local responses to new energy infrastructures in the UK: A critical and exploratory empirical analysis. *Antipode*, *49*(1), 3–22.
- Batel, S., & Devine-Wright, P. (2015b). A critical and empirical analysis of the national-local 'gap' in public responses to large-scale energy infrastructures. *Journal of Environmental Planning and Management*, *58*(6), 1076–1095.
- Batel, S., Devine-Wright, P., & Tangeland, T. (2013). Social acceptance of low carbon energy and associated infrastructures: A critical discussion. *Energy Policy*, *58*, 1–5.
- Bell, D., Gray, T., & Haggett, C. (2005). The "social gap" in wind farm siting decisions: Explanations and policy responses. *Environmental Politics*, *14*(4), 460–477.
- Bell, D., Gray, T., Haggett, C., & Swaffield, J. (2013). Re-visiting the "social gap": Public opinion and relations of power in the local politics of wind energy. *Environmental Politics*, *22*(1), 115–135.
- Bidwell, D. (2016a). The effects of information on public attitudes toward renewable energy. *Environment and Behavior*, *48*(6), 743–768.
- Bidwell, D. (2016b). Thinking through participation in renewable energy decisions. *Nature Energy*, *1*, 16051.
- Bismarck, A., Baltazar-Y-Jimenez, A., & Sarikakis, K. (2006). Green composites as panacea? Socio-economic aspects of green materials. *Environment Development and Sustainability*, *8*(3), 445–463.
- Bröring, S., Baum, C. M., Butkowski, O. K., & Kircher, M. (2020). Criteria for the success of the bioeconomy. In J. Pietzsch (Ed.), *Bioeconomy for beginners* (pp. 159–176). Springer.
- Bugge, M., Hansen, T., & Klitkou, A. (2016). What is the bioeconomy? A review of the literature. *Sustainability*, *8*(7), 691.
- Carrez, D. (2017). European strategies and policies getting towards a bioeconomy. In I. Virgin & E. J. Morris (Eds.), *Creating sustainable bioeconomies, the bioscience revolution in Europe and Africa* (pp. 209–223). Routledge.
- Catterberg, G., & Moreno, A. (2005). The individual bases of political trust: Trends in new and established democracies. *International Journal of Public Opinion Research*, *18*(1), 31–48.
- Christensen, T., Fimreite, A. L., & Lægreid, P. (2011). Crisis management: The perceptions of citizens and civil servants in Norway. *Administration and Society*, *43*(5), 561–594.
- European Commission. (2018). *Bioeconomy: The European way to use our natural resources. Action plan 2018*. Directorate-General for Research and Innovation.
- European Commission. (2012). *Innovating for sustainable growth: A bioeconomy for Europe*. EU Commission.
- Connor, M., & Siegrist, M. (2010). Factors influencing people's acceptance of gene technology: The role of knowledge, health expectations, naturalness, and social trust. *Science Communication*, *32*(4), 514–538.
- Costa-Font, M., Gil, J. M., & Traill, W. B. (2008). Consumer acceptance, valuation of and attitudes towards genetically modified food: Review and implications for food policy. *Food Policy*, *33*(2), 99–111.
- Dermont, C. (2018). Citizens' support for the energy transition. The influence of policy and politics on citizens' opinions towards renewable energy promotion. Doctoral dissertation. Bern: University of Bern.
- Devaney, L., Henchion, M., & Regan, Á. (2017). Good governance in the bioeconomy. *Eurochoices*, *16*(2), 41–46.
- Devine-Wright, P., Batel, S., Aas, O., Sovacool, B., Labelle, M. C., & Ruud, A. (2017). A conceptual framework for understanding the social acceptance of energy infrastructure: Insights from energy storage. *Energy Policy*, *107*, 27–31.
- Dieken, S., Dallendörfer, M., Henseleit, M., Siekmann, F., & Venghaus, S. (2021). The multitudes of bioeconomies: A systematic review of stakeholders' bioeconomy perceptions. *Sustainable Production and Consumption*, *27*, 1703–1717.
- Farstad, M., & Otte, P. P. (2021). A full package of gains? Lay perspectives on a bioeconomic transition in Norway. *International Journal of Sustainable Society*, *13*(2), 73–89.

- Flick, U., von Kardorff, E., & Steinke, I. (2004). What is qualitative research? An introduction to the field. In U. Flick, E. von Kardorff, & I. Steinke (Eds.), *A companion to qualitative research* (pp. 3–12). Sage.
- Fytli, D., & Zabaniotou, A. (2017). Social acceptance of bioenergy in the context of climate change and sustainability – a review. *Current Opinion in Green and Sustainable Chemistry*, 8, 5–9.
- Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Aldine Publishing Company.
- Gupta, N., Fischer, A. R. H., & Frewer, L. J. (2012). Socio-psychological determinants of public acceptance of technologies: A review. *Public Understanding of Science*, 21(7), 782–795.
- Hagemann, N., Gawel, E., Purkus, A., Pannicke, N., & Hauck, J. (2016). Possible futures towards a wood-based bioeconomy: A scenario analysis for Germany. *Sustainability*, 8, 98.
- Hansen, L., & Bjørkhaug, H. (2017). Visions and expectations for the Norwegian bioeconomy. *Sustainability*, 9(3), 341. <https://doi.org/10.3390/su9030341>.
- Hausknost, D., Schriefel, E., Lauk, C., & Kalt, G. (2017). A transition to which bioeconomy? An exploration of diverging techno-political choices. *Sustainability*, 9(4), 669.
- Jones, C. R., Olfe-Kräutlein, B., Naims, H., & Armstrong, K. (2017). The social acceptance of carbon dioxide utilisation: A review and research agenda. *Frontiers in Energy Research*, 5, 11.
- Kitchen, L., & Marsden, T. (2009). Creating sustainable rural development through stimulating the eco-economy: Beyond the eco-economic paradox? *Sociologia Ruralis*, 49(3), 273–294.
- Küpers, S., & Batel, S. (2023). Time, history and meaning-making in research on people's relations with renewable energy technologies (RETs)—A conceptual proposal. *Energy Policy*, 173, 113358.
- Kvale, S. (1996). *InterViews: An introduction to qualitative research interviewing*. Sage.
- Lehtonen, O., & Okkonen, L. (2013). Regional socio-economic impacts of decentralised bioeconomy: A case of Suutela wooden village, Finland. *Environment Development and Sustainability*, 15(1), 245–256.
- Marsden, T. K. (2012). Towards a real sustainable agri-food security and food policy: Beyond the ecological fallacies? *The Political Quarterly*, 83(1), 139–145.
- Mason, M. (2010). Sample size and saturation in PhD studies using qualitative interviews. *Forum: Forum Qualitative Sozialforschung/ Forum: Qualitative Social Research*, 11(3), art. 8.
- McCormick, K., & Kautto, N. (2013). The bioeconomy in Europe: An overview. *Sustainability*, 5(6), 2589–2608.
- Ministry of Agriculture and Food (2012). Landbruks- og matpolitikken. Velkommen til bords (Meld. St. 9 (2011–2012)). Ministry of Agriculture and Food. Accessed 9 May 2019 from <https://www.regjeringen.no/no/dokumenter/meld-st-9-20112012/id664980/>
- Morone, P., & Imbert, E. (2020). Food waste and social acceptance of a circular bioeconomy: The role of stakeholders. *Current Opinion in Green and Sustainable Chemistry*, 23, 55–60.
- Mustalahti, I. (2018). The responsive bioeconomy: The need for inclusion of citizens and environmental capability in the forest based bioeconomy. *Journal of Cleaner Production*, 172, 3781–3790.
- NHO (2015). Mot bioøkonomien - NHOs innspill til et nytt internasjonalt og konkurransedyktig næringsliv. Næringslivets Hovedorganisasjon. Accessed 15 May 2019 from <https://www.nho.no/siteassets/nhos-filer-og-bilder/filer-og-dokumenter/forskning-og-innovasjon/mot-bioekonomi.pdf>
- Regjeringen (2016). Kjente ressurser – uante muligheter. Regjeringens bioøkonomistrategi. Regjeringen. Accessed 04 May 2019 from [https://www.regjeringen.no/contentassets/32160cf211df4d3c8f3ab794f885d5be/nfd\\_bioekonomi\\_strategi\\_uu.pdf](https://www.regjeringen.no/contentassets/32160cf211df4d3c8f3ab794f885d5be/nfd_bioekonomi_strategi_uu.pdf)
- Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.
- Ronteltap, A., van Trijp, J. C. M., Renes, R. J., & Frewer, L. J. (2007). Consumer acceptance of technology-based food innovations: Lessons for the future of nutrigenomics. *Appetite*, 49(1), 1–17.
- Sanz-Hernández, A., Esteban, E., & Garrido, P. (2019). Transition to a bioeconomy: Perspectives from social sciences. *Journal of Cleaner Production*, 224, 107–119.
- Spencer, L., Ritchie, J., & O'Conner, W. (2003). Analysis: Practices, principles and processes. In J. Ritchie, & J. Lewis (Eds.), *Qualitative research practice: A guide for social science students and researchers* (pp. 199–218). London: SAGE.
- Stern, T., Ploll, U., Spies, R., Schwartzbauer, P., Hesser, F., & Ranacher, L. (2018). Understanding perceptions of the bioeconomy in Austria—an explorative case study. *Sustainability*, 10(11), 4142. <https://doi.org/10.3390/su10114142>.
- Stigka, E. K., Paravantis, J. A., & Mihalakakou, G. K. (2014). Social acceptance of renewable energy sources: A review of contingent valuation applications. *Renewable and Sustainable Energy Reviews*, 32, 100–106.
- Takala, T., Tikkanen, J., Haapala, A., Pitkänen, S., Torssonen, P., Valkeavirta, R., & Pöykkö, T. (2019). Shaping the concept of bioeconomy in participatory projects—an example from the post-graduate education in Finland. *Journal of Cleaner Production*, 221, 176–188.

- Tenbült, P., de Vries, N. K., Dreezens, E., & Martijn, C. (2005). Perceived naturalness and acceptance of genetically modified food. *Appetite*, *45*(1), 47–50.
- United Nations (UN) (2019). Sustainable Development Goals Knowledge Platform. Accessed 4 Dec 2019 from <https://sustainabledevelopment.un.org/sdgs>
- von Wirth, T., Gislason, L., & Seidl, R. (2018). Distributed energy systems on a neighborhood scale: Reviewing drivers of and barriers to social acceptance. *Renewable and Sustainable Energy Reviews*, *82*, 2618–2628.
- Wollebæk, D., & Seggaard, S. B. (Eds.). (2011). *Sosial kapital i Norge*. Cappelen Damm Akademisk.
- Wolsink, M. (2007). Planning of renewables schemes. Deliberative and fair decision-making on landscape issues instead of reproachful accusations of non-cooperation. *Energy Policy*, *35*(5), 2692–2704.
- Wolsink, M. (2010). Contested environmental policy infrastructure: Socio-political acceptance of renewable energy, water, and waste facilities. *Environmental Impact Assessment Review*, *30*(5), 302–311.
- Wolsink, M. (2018). Social acceptance revisited: Gaps, questionable trends, and an auspicious perspective. *Energy Research & Social Science*, *46*, 287–295.
- Wreford, A., Bayne, K., Edwards, P., & Renwick, A. (2019). Enabling a transformation to a bioeconomy in New Zealand. *Environmental Innovation and Societal Transitions*, *31*, 184–199.
- Wüstenhagen, R., Wolsink, M., & Bürer, M. J. (2007). Social acceptance of renewable energy innovation: An introduction to the concept. *Energy Policy*, *35*(5), 2683–2691.
- Zabaniotou, A. (2018). Redesigning a bioenergy sector in EU in the transition to circular waste-based Bioeconomy-A multidisciplinary review. *Journal of Cleaner Production*, *177*, 197–206.

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.