

## Hearing, listening, and learning

### how bioeconomy triple helix clusters deal with uninvited societal input

Starke, Jan R.; Metze, Tamara A.P.; Candel, Jeroen J.L.; Termeer, Katrien J.A.M.

**DOI**

[10.1007/s11625-024-01537-y](https://doi.org/10.1007/s11625-024-01537-y)

**Publication date**

2024

**Document Version**

Final published version

**Published in**

Sustainability Science

**Citation (APA)**

Starke, J. R., Metze, T. A. P., Candel, J. J. L., & Termeer, K. J. A. M. (2024). Hearing, listening, and learning: how bioeconomy triple helix clusters deal with uninvited societal input. *Sustainability Science*, 19(5), 1661-1675. <https://doi.org/10.1007/s11625-024-01537-y>

**Important note**

To cite this publication, please use the final published version (if applicable). Please check the document version above.

**Copyright**

Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

**Takedown policy**

Please contact us and provide details if you believe this document breaches copyrights. We will remove access to the work immediately and investigate your claim.



# Hearing, listening, and learning: how bioeconomy triple helix clusters deal with uninvited societal input

Jan R. Starke<sup>1</sup>  · Tamara A. P. Metze<sup>2</sup> · Jeroen J. L. Candel<sup>1</sup> · Katrien J. A. M. Termeer<sup>1</sup>

Received: 5 October 2023 / Accepted: 27 June 2024  
© The Author(s) 2024

## Abstract

Policymakers in the European Union embrace collaborations of businesses, governments, and academia to develop a sustainable and circular bioeconomy. These so-called Triple Helix clusters aim to stimulate innovation and learning. However, Triple Helix collaborators also face conflicting perspectives on the desirability and directionality of the bioeconomy transition, either within a cluster or with societal actors affected by a cluster's innovations. While previous Triple Helix research focussed on how to broaden the cluster collaboration towards a more inclusive range of actors to handle such contestations, we study how cluster partners deal with uninvited input from societal actors that do not form part of a cluster. We conceptualize this input as societal back talk and distinguish organizational hearing, listening, and learning capabilities to explore how back talk contributes to innovation in three bioeconomy clusters in the Netherlands, Germany, and Ireland. Our qualitative case study analysis is based on interview transcripts, newspaper articles, and policy and planning documents. Results indicate that collaborating partners generally do not hear uninvited back talk that fundamentally challenges their tacit beliefs, because partners focus on informing the public about what they consider techno-economic benefits of their projects. As a consequence, collaborators become 'insiders', which hinders listening to divergent problem definitions and alternative solutions of 'outsiders'. Learning from uninvited back talk is therefore restricted to minor adjustments. To avoid innovative solutions remaining unexplored as a result of this discursive lock-in, Triple Helix collaborators must engage in hearing and listening to critical societal actors by establishing a reflective, two-directional dialogue.

**Keywords** Back talk · Circular bioeconomy · Discursive lock-in · Regional triple helix clusters · Uninvited participation · Organizational learning

---

Handled by Karel F. Mulder, Delft University of Technology, Netherlands.

---

✉ Jan R. Starke  
jan.starke@wur.nl

Tamara A. P. Metze  
t.a.p.metze@tudelft.nl

Jeroen J. L. Candel  
jeroen.candel@wur.nl

Katrien J. A. M. Termeer  
katrien.termeer@wur.nl

<sup>1</sup> Public Administration and Policy Group, Department of Social Sciences, Wageningen University, Hollandseweg 1, 6706 KN Wageningen, The Netherlands

<sup>2</sup> Technology, Policy and Management, Department of Multi-Actor Systems, TU Delft, Jaffalaan 5, 2628 BX Delft, The Netherlands

## Introduction

Policymakers in the European Union (EU) and beyond cherish the transition towards a sustainable and circular bioeconomy as a promising answer to tackle pressing sustainability challenges, such as climate change and the (geopolitical) dependency on fossil resources (Meyer 2017; Priefer et al. 2017; Dietz et al. 2018; European Commission 2018). A bioeconomy is an economy based on bio-based resources, including crops, wood, agricultural residues, or algae, for the production of both energy and materials (McCormick and Kautto 2013), for example biogas and other fuels, bioplastics, biochemicals, fertilizers, cosmetics, and pharmaceuticals. Specifically in the EU, policymakers aim to advance this bioeconomy transition by fostering industrial modernization and technological innovation (European Commission 2018, 2022; Ramcilovic-Suominen and Pülzl 2018; Ahola-Launonen and Kurki 2022).

However, despite high hopes of policymakers that this form of bioeconomy transition may contribute to tackling the dependency on fossil raw materials and mitigating climate change, bioeconomy governance scholars have pointed out that developing the envisioned bioeconomy is also subject to societal contestations (Kleinschmit et al. 2017; Starke et al. 2022; Riemann et al. 2022). Concerns include how further stimulating the large-scale production of bio-based products can have detrimental effects on biodiversity, environmental quality, and food security (Richardson 2012; Vivien et al. 2019; Pungas 2023; Giampietro 2023).

Addressing such complex and contested sustainability challenges as the bioeconomy transition entails connecting different forms of knowledge (for instance, scientific knowledge and the contextualized knowledge of practitioners) in innovation projects that aim to advance the tasked societal mission (Scholz 2020; Bogner and Dahlke 2022). One prominent instrument to address sustainability challenges by means of collaborative innovation processes is the so-called Triple Helix (TH) model (Scalia et al. 2018; Cai and Etzkowitz 2020). TH clusters are collaborations between the three helices of academia, industry, and government that produce specialized knowledge to gain competitive advantages for a particular region (Etzkowitz and Leydesdorff 1995, 2000; Shearmur 2011). These clusters aim to spark innovation by bringing together actors with fundamentally different perspectives (Scholz 2020). More precisely, by connecting actors that uphold divergent knowledge systems, TH clusters are believed to stimulate innovative ideas and practices due to mutual learning (Leydesdorff and Etzkowitz 1998; Murillo-Luna and Hernández-Trasobares 2023). This is particularly relevant for the European bioeconomy transition because of the multitude of possible combinations of raw materials, production processes, and products of industrial endeavours falling under the bioeconomy umbrella (McCormick and Kautto 2013; Vogelpohl et al. 2022). Because of the resulting multiplicity of involved perspectives, TH clusters are prone to face contestations on what a desirable bioeconomy is and how to achieve one. Due to the complexity and interconnectedness of the bioeconomy transition across governance scales (Wohlfahrt et al. 2019; Ahola-Launonen and Kurki 2022), this input might not only be localized towards the concrete projects that TH clusters aim to develop, but also concern the directionality of the bioeconomy transition more generally. On the one hand, such contestations—but also laudatory or indifferent input—can stem from societal partners that are invited to offer feedback by being included in the cluster. On the other hand, uninvolved actors of the broader public might provide *uninvited* input, adding even more divergent perspectives (Carayannis and Campbell 2009; Maciejczak 2009; Wehling 2012; Cuppen 2018). This input could stem from protests,

public debates in newspapers or on social media, or talks between citizens in various informal settings.

Research on the innovation potential of TH clusters has so far focussed on the collaboration process *within* clusters (e.g. Maciejczak 2009; Gustafsson and Jarvenpaa 2018; Murillo-Luna and Hernández-Trasobares 2023). Various scholars have therefore called for a better acknowledgement of the perspectives of societal actors that do not form part of TH collaborations (Grundel and Dahlström 2016; McAdam and Debackere 2018; Miller et al. 2018; Diepenmaat et al. 2020; Compagnucci et al. 2021; Casale Mashiah et al. 2023). Despite these scholarly calls for better regarding societal input in helix collaborations, research into *how* TH cluster organizations deal with uninvited societal input is still in its infancy.

In this paper, we address this knowledge gap by *exploring how collaborating actors within bioeconomy Triple Helix clusters deal with uninvited input stemming from societal actors that do not form part of a cluster*. Identifying how TH collaborators deal with societal input is relevant because this input scrutinizes how bioeconomy projects align with the overall societal mission of developing a bioeconomy that ‘needs to have sustainability and circularity at its heart’ (European Commission 2018, p. 4). Previous bioeconomy governance studies have pointed out the existence of conflicting perspectives on the desirability and directionality of the bioeconomy transition (Bugge et al. 2016; Kleinschmit et al. 2017; Ramcilovic-Suominen and Pülzl 2018; Vivien et al. 2019; Riemann et al. 2022; Giuntoli et al. 2023; Eversberg et al. 2023a), mapped resulting discursive conflicts between actor groups (e.g. Giurca and Metz 2018; Mijailoff and Burns 2023), and traced their development (Leipold 2021; Starke et al. 2023). Local decisionmakers working on the bioeconomy transition on the ground take over, translate, and localize these higher-level discourses in their projects, for instance in industrial bioeconomy clusters (Wilde and Hermans 2021). However, it remains nebulous how decisionmakers on the various levels of the bioeconomy transition can deal with these discursive conflicts productively (Cuppen 2018; Starke et al. 2022). With this paper, we aim to contribute to this ongoing debate in the bioeconomy governance literature by studying the political process of what societal input is taken up and how other input is left neglected by decision-makers in TH collaborations that aim to bring the bioeconomy transition forward. By doing so, we foreground the politics in the development of techno-economic innovation projects. These insights can help decisionmakers to avoid that costly solutions and biased problem definitions are locked-in, which might be rejected by societal actors as unfit to address pressing sustainability and circularity challenges (Stirling 2008; Simoens et al. 2022). What is more, dealing effectively with societal input creates opportunities for out-of-the-box thinking to identify trade-offs, but

also innovative solutions, which are currently overlooked by cluster partners. Moreover, critical observers could use these insights to identify and scrutinize blind spots and biases in local bioeconomy projects.

To explore how TH cluster collaborators deal with uninvited societal input, we first conceptualize processes and preconditions of organizational hearing, listening, and learning capabilities. We build upon organizational learning literature that provides generic answers on what these capabilities consist of but is less sophisticated about how TH clusters apply them. We therefore sharpen and empirically anchor the conceptualization by applying it to three major bioeconomy TH collaborations in different EU member states: *Chemport Europe* in the Northern Netherlands, *Bioeconomy e.V.*<sup>1</sup> in Saxony-Anhalt (Germany), and the *Irish Bioeconomy Foundation*, located in Tipperary (Ireland). We base our results on an interpretative analysis of interviews, contextualized by newspaper articles as well as policy and planning documents.

### Societal actors in triple helix conceptualizations

Scholars have criticized TH clusters for being too exclusive towards societal actors (Diepenmaat et al. 2020). This is because TH clusters are set up to fulfil societal missions towards sustainability and take into account interests above and beyond their own organization (Scalia et al. 2018; Geritsen et al. 2019). In TH clusters, however, these societal missions are—at best—only indirectly represented, for example in the cluster’s mission and by involved governments or universities. This results ‘in a higher risk of a narrow value creation process, with negative costs to society and natural eco-systems’ (Diepenmaat et al. 2020, p. 2).

TH scholars have conceptually addressed these exclusivity concerns by proposing new forms of collaboration: *N*-tuple helix extensions and TH twins. Advocates of *N*-tuple helix extensions call for broadening the range of actors and connected perspectives engaged in collaborations. TH clusters are embedded in society which, in turn, is inseparable from the natural environment and therefore bound to biophysical characteristics of the region as well as planetary boundaries (Carayannis et al. 2012; Van Bueren et al. 2023). To include according perspectives, Carayannis and Campbell (2009, p. 201) proposed to add ‘the perspective of the media-based and culture-based public’ as a fourth helix, thereby extending the model towards a Quadruple Helix. In another extension, Carayannis and Campbell (2010) and Carayannis et al. (2012) further developed the model towards a Quintuple Helix by adding the natural environment as a fifth helix.

In fact, the model might be extended even further, into an ‘*N*-tuple of helices’ (Leydesdorff 2012, p. 25). By adding additional helices, particularly by inviting societal actors to become part of the collaboration, innovation processes are assumed to better align with societal perspectives and facilitate transformative change (Grundel and Dahlström 2016).

Etzkowitz and colleagues proposed the concept of *TH twins* as a different way of coping with exclusivity concerns (Cai and Etzkowitz 2020). A TH twin is a university–government–public collaboration mirroring original TH clusters with a specific focus on realizing sustainability goals (Etzkowitz and Zhou 2006; Zhou and Etzkowitz 2021; Gebhardt et al. 2022). Twinning the original TH should foster innovation that is not purely justified on economic merits and therefore assumed to better align with societal demands (Zhou and Etzkowitz 2021).

These forementioned conceptual and organizational advances both aim at inviting societal actors to become part of the collaboration. However, dealing with this form of *invited* input does not suffice in addressing input from societal actors that are not part of the collaboration (Grundel and Dahlström 2016; Cuppen 2018). Scholars have therefore reflected on questions such as who should partake and have influence in TH collaborations, what to do with possible knowledge imbalances, or how to avoid the ‘incorporation and co-optation [of the participation process] by powerful political and scientific institutions or economic actors’ (Wehling 2012, p. 55). One proposition to counter knowledge imbalances is to develop a continuous learning approach, rather than organizing (a series of) singular moments of invited participation (Wehling 2012). Continuous learning takes place alongside the societal opinion formation process, in which actors change positions over time when encountered with new information and opinions (Cuppen 2018). TH clusters that aim to adhere to societal ambitions can learn from these developing opinions, interests, ideas, and values without making all actors part of the collaboration or organizing public participation processes. TH clusters can adapt and learn by listening to this *uninvited* societal input.

### ‘Dealing with’ uninvited societal input

In this paper, we conceptualize such uninvited societal input as *back talk*. The notion of back talk stems from design rationality thinking and describes a form of direct reaction towards new realities created by policy designers in action (Schön 1983; Schön and Rein 1994; Korsmeyer et al. 2022). Back talk consists of the ‘messages sent back to policy designers that surprise them by violating their taken-for-granted assumptions’ (Schön and Rein 1994, p. 123). This back talk exceeds feedback, because it fosters reflection-in-action on beliefs that underlie design decisions (Yanow

<sup>1</sup> The abbreviation e.V. stands for *eingetragener Verein*, a German legal denomination for a registered non-profit association.

**Table 1** Key processes and preconditions of organizational hearing, listening, and learning capabilities

Capability	Processes	Preconditions
Hearing	Detection of back talk	<ul style="list-style-type: none"> <li>• Network outside of cluster boundaries</li> </ul>
Listening	Interpersonal generation of meaning	<ul style="list-style-type: none"> <li>• Hearing</li> <li>• Meaningful relationships with outsiders</li> </ul>
Learning	Reflection and implementation of required adaptations	<ul style="list-style-type: none"> <li>• Listening</li> <li>• Ability to share knowledge across and beyond cluster boundaries</li> <li>• Organizational memory</li> </ul>

2009; Kuitenbrouwer 2018). TH cluster partners function as policy designers in developing business models and organizational policies. Societal actors, through media and other outlets, may bring in perspectives, knowledge, ideas, and values that critically scrutinize or even conflict with the perspectives held by the TH cluster. For example, societal actors may question the resource harvesting, production process, or product properties and uses of bio-based products developed by TH cluster collaborators. Moreover, back talk scrutinizes taken-for-granted assumptions, including the fundamental logics and value considerations underlying bio-based production (Metze et al. 2017).

To conceptualize how collaborating actors within a TH cluster deal with back talk, we draw on organizational learning literature, which has a long tradition in explaining how organizations learn. According to this literature, organizations reflectively learn by effectively hearing and listening to societal input (Jacobs and Coghlan 2005; Pahl-Wostl 2009). Organizations necessarily do so selectively, because people cognitively filter incoming information and interpret it according to underlying belief systems, so-called frames (Schön and Rein 1994). Hearing, listening, and learning are capabilities. A capability is an organization's ability to observe ill-defined and contested problems and to act accordingly (Termeer et al. 2015).

More specifically, *hearing* is an organization's capability to detect societal back talk. For an individual, hearing is 'the physiological detection of auditory stimuli' (Yip and Fisher 2022, p. 660), while for organizations, hearing is the detection of diffuse input from outside the organization's boundaries. Organizations can increase their hearing capability by expanding and diversifying their network (Lahtinen 2013; Gieske et al. 2016).

*Listening* is an organization's capability to constitute relationships with societal actors for intersubjective meaning generation (Jacobs and Coghlan 2005). While a multitude of definitions of listening in organizational contexts exist, a common denominator is that listening 'is an interpersonal communication process that involves a *listener* receiving messages from a *speaker*' as well as 'responses that signal comprehension' (Yip and Fisher 2022, p. 657, original highlighting). Whereas hearing is a precondition for listening by the detection of input, listening exceeds hearing because it

involves the generation of meaning of this input between persons (Jacobs and Coghlan 2005; Van Quaquebeke and Felps 2018). Feedbacks in this sequence are possible, as listening to societal back talk can result in identifying blind spots concerning which actors are currently not being heard and a consequent network extension. Meaningful listening reaches the depth of fundamental values and tacit belief systems (Jacobs and Coghlan 2005). Particularly valuable for organizations is listening to actors that sponsor divergent frames, which enables exchanging perspectives across the boundaries of one's own cognitive frame (Schön and Rein 1994).

*Learning* is an organization's capability for reflection and adaptation, if necessary (cf. Belle 2016; Presbitero et al. 2017). Learning can be achieved in different depths. First-loop learning describes adaptations within current logics; second-loop learning describes adaptations of underlying logics themselves (Argyris and Schön 1978). Third-loop learning means working towards adapting the context, which shapes underlying logics (Hargrove 2008; Pahl-Wostl 2009; Gerritsen 2019). Learning experiences need to be stored in an organizational memory to not be forgotten when personnel within an organization shifts (Argyris and Schön 1978). In an interorganizational context, listening is a precondition for learning because knowledge needs to be transferred beyond organizational boundaries. Learning must therefore include the ability to share knowledge across different groups (cf. Presbitero et al. 2017). Also in this sequence, a feedback is possible, since organizations can learn to improve their hearing and listening capabilities (see Table 1).

## Materials and methods

To empirically anchor the outlined conceptualization, we explored processes and preconditions of hearing, listening, and learning from societal back talk by bioeconomy TH clusters. We did so in three different cases of TH clusters (see Table 2) that all had some form of media exposure. In all clusters, actors from industry, local government, and research collaborated on the transition from fossil to bio-based industries in the EU. The selected cases concern three



**Table 2** Overview of case characteristics

Cluster organization	Involved actors	Connected bioeconomy project(s)	Operational phase
Chemport Europe ( <i>Northern Netherlands</i> )	<i>Industry:</i> enterprises in the food, materials, chemicals, waste management, and energy sectors <i>Government:</i> provincial administrations <i>Academia:</i> five connected universities and universities of applied sciences	Chemistry parks; waste management projects; R&D facilities; knowledge campus	Established, expanding
Bioeconomy e.V. ( <i>Saxony-Anhalt, Germany</i> )	<i>Industry:</i> chemistry enterprises plus suppliers <i>Government:</i> saxony-Anhalt state administration <i>Academia:</i> three connected universities and universities of applied sciences; various private research institutes	Chemistry parks	Expanding; biorefinery about to become operational
Irish Bioeconomy Foundation ( <i>Tipperary, Ireland</i> )	<i>Industry:</i> enterprises in the food, biotechnology, and renewable energy sectors <i>Government:</i> county administration <i>Academia:</i> nine connected universities, universities of applied sciences, and research institutes	Rehabilitation of a mining area by developing a renewable energy and bioeconomy hub	Conceptual, initial

TH clusters facilitating three different forms of bioeconomy projects in three different EU member states that operate in three different stages of development at the time of writing: (1) a transition towards green chemistry around multiple bio-based raw materials on Chemistry Park Delfzijl (the Netherlands) with several operating industrial installations; (2) a large-scale factory to produce bio-based chemicals (a so-called biorefinery) in a former petrochemical region in Leuna (Germany), which is planned to operate in the near future; and (3) a knowledge-based bioeconomy and renewable energy hub hosting several pilot installations for organic waste treatment and dairy by-product refining on a former mining site in Lisheen (Ireland) in the early stages of development, with no operations on industrial scale taking place. This diversity allowed us to study the content of back talk that arises for projects across a range of raw materials, process technologies, and products as well as in different development phases, and how TH clusters with different degrees of institutionalization deal with this back talk. This will help to contextualize the different processes and preconditions for hearing, listening, and learning.

We gathered three types of data (interviews, newspaper articles, and policy and planning documents) for different purposes. We conducted 23 in-depth *interviews* (Weiss 1995) to understand how the bioeconomy projects have been developed in the different regions and how cluster partners deal with back talk. Accordingly, interviews centred around the development processes of the respective cluster and connected bioeconomy projects, relationships with societal actors, as well as the content of societal input. Annex 1 contains an overview of interview partners. As the focus of this

study is on TH organizations, we focussed the interviews on the cluster organizations' management boards.

To identify the content of societal back talk, we also interviewed local actors that were not a collaborating partner in the TH cluster. In addition, we collected *newspaper articles* from the Nexis Uni data base. We used the key words "biorefinery" and "bioeconomy" in the respective languages, in combination with the specific region, the names of the cluster organizations, and involved companies.<sup>2</sup> In total, we collected 555 newspaper articles for Delfzijl, 309 for Leuna, and 74 for Lisheen. To contextualize this more localized back talk in the broader bioeconomy transition, we examined 24 *policy and planning documents*, see Annex 2 for an overview. Documents were either found online or were provided by interview partners to further substantiate claims or clarify points that they made during interviews.

For the analysis of processes and preconditions for hearing, listening, and learning as well as for identifying societal back talk in each case, we conducted an interpretative analysis (Yanow and Schwartz-Shea 2015). We coded the data thematically in Atlas.ti 22 for instances of what interview respondents experienced or newspapers reported as important events in the development of the projects. Furthermore, we coded for the content of back talk in interviews with

<sup>2</sup> For Delfzijl, the search string was ("Chemport Europe" OR "Chemiepark Delfzijl"), for Leuna: ((Bioraffinerie OR "Bio-raffinerie") AND (Leuna OR Sachsen-Anhalt OR "Sachsen Anhalt" OR UPM)), and for Lisheen: ((Tipperary OR Lisheen) AND (biorefinery OR bioeconomy OR "bio-based" OR biobased)). Articles published before April 24, 2023 were included in the analysis.

societal actors and newspaper articles. In interview transcripts, we coded statements congruent with the assigned topics of hearing, listening, and learning. We identified codes arising from the interview data and categorized them into the defined topics (Weiss 1995). During an initial round of reading, we constructed the coding scheme, which we provide in Annex 3. In a second round, we congruently coded the material based on the coding scheme.

## Results

We present the analysis results of the three cases by starting with a brief description of the respective TH cluster and the connected bioeconomy project(s). Next, we outline per case (1) the content of back talk and (2) the empirical anchoring of processes of and preconditions for hearing, listening, and learning capabilities.

### Chemport Europe (the Netherlands)

Chemport Europe has the mission to foster a bio-based chemistry in the Northern Netherlands, one of the major projects being Chemistry Park Delfzijl. The approximately 1400-hectare site traditionally hosted chemical industries valorizing proximate salt deposits. Nowadays, the site is transitioning towards bio-based chemistry. The Chemport Europe TH cluster originates from a collaboration of the provinces of Groningen and Drenthe to stimulate green chemistry investments, following on from a report of a commission around former Shell president and senator Rein Willems (John 2019; NL11\_G<sup>3</sup>). The cluster is a loosely organized network of businesses, research institutes, and the provincial administrations. The management board is seconded from the different partner organizations.

#### Back talk

Local back talk in this case has centred around accidents on site, for instance a fire of unknown cause and resulting smoke generation (e.g. Eemsbode 2022). In addition to this, a regional newspaper reported environmental nuisances in the neighbouring village of Borgsweer, such as noise and odour emissions (Johan 2013). In the same article, a local action group expressed concerns that small, surrounding villages have to bear the environmental costs, while the town of Delfzijl reaps the economic benefits. From the interviews with societal actors, we learned that recently, societal back talk also contains less local concerns. Installations on site are discussed because of their required energy demand as

well as sustainability concerns about overseas shipments of bio-resources to be used for production (NL8\_A). Hence, societal back talk in this case ranges from on-site safety issues to local environmental concerns and more regional or even global possible downsides of large-scale bio-based production.

#### Hearing

We conceptualized hearing as the process of detecting societal back talk, with the precondition of having a network that spans beyond the cluster's boundaries. In this case, we find that hearing is mostly restricted to the own cluster or to experts in the cluster's network.

When asked about hearing capabilities, interviewees referred to hearing and knowing about general public concerns due to their *processes* of reading newspapers, engaging on social media and because in rural regions people know each other (NL6\_G; NL8\_A; NL9\_I). However, interview partners pointed out that the diffuseness of the general public impedes their hearing capabilities. As one interviewee expressed: in contrast to organizations with an organigram, it is hard to pinpoint contact persons in the broader public (NL6\_G).

In relation to this, interview partners mentioned several *preconditions* for hearing: transparency as well as equipped personnel who are able to hear concerns and extend the organization's network. Regarding transparency, collaborating partners stressed that to provide input, the public first needs to be informed transparently about operations on site (NL9\_I; NL11\_G). Actors involved in the cluster claimed to achieve transparency, for instance by elaborating newsletters, informing the local press, and engaging on social media (NL9\_I). In addition to transparency, cluster partners pointed out that organizations also need sufficiently equipped personnel to hear public back talk. However, Chemport Europe is merely a bridging organization with limited resources:

*“We aren't actively engaging with citizens who are worried. [...] If that were the case, we'd be moving too far away from our core mission. It's a very flat, small organization. We already struggle to get our work done. That would then no longer be manageable for us.” (NL11\_G)*

Another precondition to hear is a network exceeding the cluster's boundaries. In this case, we find that apart from talks within the own cluster or the connected industrial ecosystem, networking outside cluster boundaries only stretches as far as expert symposia (NL4\_G) or information evenings for the direct neighbourhood (NL8\_A). Consequently, cluster partners only hear aspects restricted to technical issues and local emissions or incidents. As expressed by several interviewees, fundamental issues, such as the availability of

<sup>3</sup> These codes refer to analysed interview transcripts, see Annex 1.

bio-based raw material, are less discussed (NL2\_I; NL5\_G; NL6\_G). One way to solve this, according to interviewees, is that public concerns should be brought in by involved partners, in particular from the academic and government helices (NL6\_G; NL8\_A; NL9\_I).

## Listening

We conceptualized listening as the two-directional process of generating meaning between persons, provided that relationships with societal actors are in place that enable the utterance of underlying beliefs.

In Delfzijl, cluster partners claimed to achieve a dialogue of sufficient depth by the *process* of trying to properly *understand* stakeholder concerns (NL6\_G). However, in this case, cluster partners aimed at *informing* the public (NL2\_I; NL9\_I; NL11\_G). Such one-directional communication channels with the broader public does not reach the level of fundamental values and leaves little room for critical back-talk to surface. As one interviewee said: discussions centre around technical aspects (NL4\_G). This is because actors professionally involved in the cluster organization stressed that emotional concerns should be clearly separated from evidence-based discussions (NL1\_I). For instance, cluster partners experienced that citizens connect the circular materials transition with the energy transition, which would interfere a productive dialogue. One interviewee explained:

*“On the energy side, the coal-fired power plant at Eemshaven is also in play, with the idea that you will first add biomass to it and eventually switch over completely. That is a discussion that really plays in the public. [...] The discussion on the energy side is really conducted and very relevant. The materials discussion is much less of an issue, but the discussion is polluted by what is happening on the energy side.” (NL9\_I)*

Interviewed TH cluster collaborators confirmed the value of forming long-term relationships by continuous dialogue and regard this as a crucial *precondition* to properly understand stakeholders (NL4\_G; NL5\_G; NL6\_G; NL9\_I). However, it is unclear who precisely is responsible for establishing such relationships. While cluster partners pointed at other involved helices (NL11\_G; NL6\_G), provincial government officers regarded the national government as responsible for collecting stakeholder concerns and forming a clear vision (NL6\_G; NL11\_G).

## Learning

According to our conceptualization, learning consists of reflecting on what is heard and listened to as well as the implementation of necessary adaptations. Preconditions are the ability to share knowledge across and beyond cluster

boundaries and an organizational memory to not ‘forget’ what was learned. In this case, we find that learning from societal back talk does not exceed first-loop adaptations of already established business models by gradually sharpening funding criteria.

For Chemport Europe, cluster partners attributed positive effects to collaborations that include multiple perspectives, enabling a reflection *process* by looking at a problem with a different lens (NL4\_G; NL5\_G). Based on insights from these reflections, interviewees involved in the cluster noted that research calls and funding criteria have been sharpened gradually (NL3\_G; NL6\_G). For example, a stronger focus on the sustainability of raw material harvesting and transport (NL10\_I) as well as emissions, have been considered more in operations in Delfzijl:

*“We’re learning in the sense that we’re well aware that sustainability is a must [...] That you have to take steps towards emission reduction.” (NL11\_G)*

An organizational memory is a *precondition* for continuous learning from the dialogue with the cluster’s societal environment. However, in this case, insights are stored in dispersed organizational memories because the cluster is organized as an informal network. A lacking common organizational memory is indicated by an interviewee who pointed out that it is unclear whether adaptations are due to public pressure or an intrinsic motivation of involved organizations to change operations (NL9\_I). Moreover, several interview partners felt that a predominant risk-averse mentality, in particular of investors, impedes further learning (NL1\_I; NL2\_I; NL5\_G; NL7\_I). This mentality undermines the feasibility of experimentation and to develop radically new business models (NL5\_G).

In sum, we find that learning experiences in Delfzijl are spread across the various partner organizations and the connected industrial ecosystem. Particularly valuable is listening to actors sponsoring divergent frames. However, in this case, cluster partners mainly listen to experts sponsoring congruent techno-scientific frames. Instead of a two-directional dialogue, communication with the public is restricted to one-way communication, as involved actors fear a ‘pollution’ of discussions by emotional and apparently unrelated concerns. Although framed by cluster partners as being clearly separable, the bioenergy and -material transitions share fundamental similarities, for example value-based questions on the scale of consumption and the availability of raw material. Such fundamental concerns are not heard and consequently remain undiscussed. While the shift from fossil to bio-based production in general is a major adaptation of underlying production logics, linear take-use-dispose logics within bio-based production remain widely unchallenged within this cluster.



## Bioeconomy e.V. (Germany)

Saxony-Anhalt in Eastern Germany has a long industrial tradition in the chemical sector. Currently, the region strives to become one of Europe's forerunners in developing a more sustainable chemistry sector, facilitated by the Bioeconomy e.V. TH cluster. One of the region's major chemical industry ecosystems is the 1,300-hectare Leuna Chemistry Park, where the multinational wood company UPM constructs a large-scale biorefinery. The biorefinery is planned to become operational in 2024 to produce the platform chemicals biomonoethylene glycol (bio-MEG) and bio-monopropylene glycol (bio-MPG) out of local beech wood. The industrial ecosystem in Leuna is closely intertwined with the cluster organization, since directors of UPM and the chemistry park's infrastructure company are also board members of Bioeconomy e.V. The TH cluster is a formally registered association with an honorary management board consisting of seconded members from the different partner organizations. A state government representative is advisory committee member.

### Back talk

Local back talk in Leuna concerns the scale until which sustainably sourced wood is available in the region (dpa, 17 August 2023; DE3\_C; DE5\_A), which is the biorefinery's envisaged raw material. When more industrial actors start demanding regional wood resources, this could cause shortages (DE3\_C). Moreover, an interviewed politician who is not affiliated with the cluster pointed out that in the future, water availability might be limited for industrial processes due to climate change impacts (DE4\_G). Furthermore, the chemistry park's high energy demand is under scrutiny in the context of the German energy transition (Ronzheimer 2019). In addition to these national and regional concerns, more local back talk concerns fears about a further spreading of the industrial park towards agricultural areas, which might lead to land use conflicts (DE4\_G).

### Hearing

In Leuna, interviewed cluster partners noted similar processes of hearing back talk as in Delfzijl. Also here, transparency was pointed out as a precondition for gathering back talk. However, interviewed cluster partners focussed on scientific input, which restricts the range of heard actors and concerns.

In this case, cluster partners stated that they gather back talk by the *processes* of engaging on social media (DE1\_I), organizing expert conferences (DE6\_I), publishing a newsletter (DE2\_I; DE6\_I), by making sure to appear regularly in local newspapers (DE2\_I), and by organizing open days

and bus tours on site (DE2\_I). Accordingly, an interviewee underlined that the Leuna Chemistry Park has an award-winning visitor centre (DE2\_I).

Cluster partners in Leuna stressed the importance of a broad network, both within the cluster and beyond cluster boundaries as a *precondition* to hear societal concerns (DE2\_I; DE5\_A). Within the cluster, involved partners are assumed to bring in societal input (DE1\_I; DE2\_I; DE5\_A). To also gather input from beyond the cluster's boundaries, partners underlined transparency as a requirement. As one interviewee argued:

*"It's important to us [...] to be maximally transparent with regard to our activities, otherwise it is difficult to build trust. At the same time, it's important [...] to argue in a fact-based manner and to base our arguments on scientific foundations. In my experience, we can then succeed in convincing even really critical voices."* (DE1\_I)

However, this focus on the 'fact-based' discussion also establishes a bias of whose input is heard. Resultingly, cluster partners noted that input from outside the cluster organization is restricted to experts, for instance from the state government or the municipal administration (DE2\_I; DE7\_G).

### Listening

In Leuna, both cluster partners and societal actors noted a generally supportive attitude for large-scale chemical industry due to the region's long industrial tradition (DE2\_I; DE3\_C; DE4\_G; DE7\_G). According to cluster partners, this attitude forms the basis for an informed listening *process* (DE2\_I). According to one interviewee who is not affiliated with the cluster, it is precisely the long-standing chemistry tradition and the public's attitude of not having unsubstantiated concerns that would allow for a more fundamental debate:

*"We have enormous expertise in this [chemistry] sector, we have a high level of acceptance among the population for these topics [...]. There isn't an attitude of: Chemical industry? We don't want that here! [We should] use this positively as a starting point for a real [...] societal debate that weighs up also broader issues."* (DE4\_G)

Based on this supportive attitude, cluster partners underlined the careful explanation of fact-based information to the public as a *precondition* for fruitful dialogue (DE1\_I; DE5\_A). To this end, cluster partners strived to broadly invite to thematic events and open days (DE6\_I). However, societal actors experienced that these formats do not form fora to bring in critical statements about currently unresolved issues (DE4\_G). Such issues include to what scale a

bioeconomy is sustainable in the region as well as unclear impacts on land use and biodiversity (DE3\_C; DE4\_G; DE6\_I).

## Learning

In Leuna, several adaptations have been implemented, although it is not always clear if this is a consequence of learning from societal back talk or rather a matching of public concerns with business adaptations that would have been implemented anyway.

According to an interviewee, adaptation *processes* included the introduction of a sourcing radius for utilized wood of 250 kms around the biorefinery (DE1\_I). Although this measure could function to address broader societal concerns that biorefinery wood demand could cause tropical deforestation, a critical interviewee noted that the motivation to implement this measure could also be to prevent even stricter regulation (DE4\_G). As another adaptation, the installation runs on beech wood residues from production forestry management (DE2\_I; DE5\_A; DE6\_I), matching overarching political strategies in Saxony-Anhalt (Saxony-Anhalt State Government, 2021a,b). As an interviewee explained:

*“[The biorefinery] uses beech wood that comes from forestry management. [...] Beech wood is unsuitable as construction wood because it swells too much. So up to now, two-thirds of it ends up in the fireplace. [...] It’s precisely the demand for this beech wood that promotes forest conversion and makes forests more resilient to drought and pest infestation. In this respect, there is no fear that forests will be cut down. Rather, the forest will be strengthened.” (DE2\_I)*

However, another interviewee highlighted that this adaptation only partly addresses fundamental concerns, because reflections on future use conflicts lack:

*“UPM itself says that they aim to use wood that is currently rarely used [...]: thinning wood, crown wood, which isn’t really interesting for the construction industry... This is in principle good and correct and can also help to overcome scepticism. [...] The question is whether the quantities that UPM needs can actually be obtained sustainably from the region. [...] This will become more acute when UPM is not the only actor that focuses on a bioeconomy.” (DE4\_G)*

Sharing knowledge beyond cluster boundaries as a *pre-condition* for learning is restricted in this way. Since fora for fundamental discussions lack, societal actors cannot channel back their perspectives on how established adaptations fail to fully address fundamental concerns (DE4\_G). As a result, divergent views between cluster partners and societal

actors remain conflicting on whether implemented adaptations form learning successes.

In sum, also in this case, actors involved in the TH cluster focus on informing the public instead of seeking back talk. Cluster partners stress that dialogue needs to be fact-based, meaning a focus on their own techno-scientific framing. While this fact-based information might help to create a common language for mutual understanding, it also has exclusion effects, which limit the range of heard societal actors. Consequently, broader public concerns regarding the scale of production and possible future conflicting uses of limited wood resources are left unaddressed.

## Irish Bioeconomy Foundation (Ireland)

To rehabilitate the site of a former zinc and lead mine, the Irish Bioeconomy Foundation aims to facilitate the establishment of a bioeconomy and renewable energy campus in Lisheen, a remote site in Northern Tipperary. Mining operations ceased in 2015 and a task force initiated a closure plan. The approximately 455-hectare site currently hosts renewable energy projects and bio-chemistry pilot installations. In the near future, cluster partners hope to attract further projects. Envisaged raw materials include dairy by-products, residual organic waste, and agricultural waste. Planned products entail energy, biogas, biochemicals, and nutritional goods. The cluster organization has a salaried management team. Member organizations are corporate partners, universities, and Tipperary County Council, the regional administration. As such, Tipperary County Council has fragmented roles as cluster partner on the one hand and permit and planning authority on the other hand. Different departments take on the separate roles.

## Back talk

In Lisheen, local back talk is scarce at the current stage. An official submission to a current planning process on site contained questions about expected traffic volumes and what forms of waste will be used (Tipperary County Council, 2022). Arguably due to the site’s remote location, neighbourhood concerns about local environmental nuisances have not surfaced so far. Nationally, in particular the dilution of bio-methane with fossil gas in the national gas grid is discussed. In this vein, an environmental organization pointed out that this practice could lock-in grid infrastructure and perpetuate fossil gas use (An Taisce, 2020). Similarly, an interviewee feared that valorising dairy by-products could contribute to unsustainable scales of cattle farming (IE4\_C). More generally, the interviewee stressed that just because a product is bio-based, it does not mean that it is more circular or sustainable: Single-use packing remains wasteful, even if it is bio-based (IE4\_C). While local back talk is scarce in

this case, the bioeconomy in general is discussed controversially on national level.

### Hearing

In this case, hearing societal back talk is restricted to formal planning procedures, with limited public attention and participation. Cluster partners in this case claimed to hear societal concerns in a similar fashion as in the other cases, namely by *processes* of being attentive of local newspaper reports, social media, and participating in expert consortia (IE3\_I). In the other two cases, responsibilities for societal dialogue were unclear. In this case, this task was clearly concentrated in the cluster management.

In the other two cases, cluster partners underlined the value of transparency as a *precondition* for hearing back talk. In Lisheen, TH developers rather stuck to fulfilling minimum notification requirements for permitting processes. This is because current plans to hear public back talk centred around invited public participation: Neighbours may participate in formal planning procedures, for instance by means of formal objection procedures (IE1\_G; IE2\_G). However, participation in these procedures remained limited. An interviewee attributed this to the lacking tangibility of developments on site:

*“It’s very hard for the public to engage, where they can’t find something tangible, what this means to them on the ground. [...] Trying to roll out these very high-level policies that mean nothing to an ordinary Joe Soap until there’s something happening on the ground in proximity to him is very, very difficult” (IE1\_G)*

### Listening

In this case, local actors voiced high hopes for the *process* of establishing a spatial master plan for the site:

*“We have [...] an objective to prepare a master plan for the campus. [...] There are multiple landowners, multiple stakeholders... [...] It needs to have engagement and it needs to have buy-in. That hasn’t been done to date. And it’s actually one of the key issues [...] that we don’t have a very coherent master plan.” (IE1\_G)*

However, as the project concerns a national flagship project, interviewees not affiliated with the TH cluster stressed that discussions would also require reflections on where the Irish bioeconomy should head to more fundamentally (IE1\_G; IE4\_C). If the planned approach remained restricted to spatial aspects, this would be insufficient to discuss underlying, fundamental concerns. To achieve a more meaningful

dialogue, several interviewees regarded a clear national bioeconomy vision as a *precondition* (IE1\_G; IE3\_I).

### Learning

At the current, early stage of development, reflection and resulting adaptations have remained limited in Lisheen. So far, reflection *processes* have not involved an exchange of conflicting visions between cluster management, the county administration, and the general public on the future of the site:

*“Where there was a lack of discussion: While it was discussed at a higher level, the finer detail of a discussion around the master plan should have taken place and that should have been driven by the former mining operator. [...] Further discussion around that would have possibly accelerated the process more.” (IE3\_I)*

To address this, cluster partners aimed to achieve tangible results as a *precondition* to stimulate dialogue with the general public. However, and perhaps paradoxically, partners felt that lengthy objection procedures during the planning process could impede the development of tangible results (IE3\_I).

In sum, we find that conflict smoulders in mismatching, but undiscussed perspectives regarding the site’s future. On the one hand, project developers aim at producing fast, tangible results and therefore have an incentive to be less restrictive on what initiatives settle on site. On the other hand, the county administration has the ambition to develop a national forerunner project. For this end, the county administration targets initiatives that develop activities higher on the ladder of circularity, requiring to be more selective on what initiatives operate on site.

## Discussion and concluding remarks

This paper started with the aim of exploring how bioeconomy TH clusters deal with societal back talk. Table 3 summarizes our results for the individual cases. Across the analysed cases, we find that cluster partners actively create a public of ‘outsiders’ by centring the debate around technical issues and disregarding emotional and fundamental concerns as unscientific or unrelated. As a consequence, cluster partners become ‘insiders’, who do not hear uninvited back talk that scrutinizes and challenges their tacit belief systems. Rather, ‘insiders’ focus on informing ‘outsiders’ about what they perceive as benefits of their projects. By this one-directional approach, listening is limited to issues that are already known within the cluster and can be answered by informing about technical adaptations. Fundamental issues, such as interlinkages with the energy transition (Delfzijl),

future use conflicts about woody raw materials (Leuna), or what initiatives should settle on site (Lisheen) remain largely unaddressed. Learning from uninvited input is therefore restricted to single-loop adjustments. In shifting the resource base from fossil to bio-based, fundamental logics, such as linear extract–use–dispose production and unsustainable demand scales, are left undiscussed.

Our empirical findings help in sharpening the conceptualization of organizational hearing, listening, and learning capabilities, which we have developed by building on organizational learning literature (e.g. Argyris and Schön 1978; Jacobs and Coghlan 2005; Pahl-Wostl 2009). Regarding *hearing* in TH organizations, cluster partners in Delfzijl and Leuna pointed out that transparency and sufficiently equipped personnel are additional preconditions for the conceptualized precondition of networking beyond cluster boundaries. In Lisheen, however, cluster partners are hesitant to exceed minimum transparency requirements because they fear that formal objections could further delay planning processes.

*Listening* involves deepening established communication channels towards value-based discussions. Achieving this depth requires commitment towards longer-term relationships. Moreover, instead of listening only to actors with uncritical or coherent perspectives, we have specified that TH collaborators need to actively seek actors sponsoring divergent frames and not avoid conflict. Innovative potential lies precisely in appreciating multiple, plural, and diverse perspectives. Our results indicate that a one-way sending approach does not suffice to expose bioeconomy projects to such critical perspectives.

To achieve *learning* effects, TH organizations need not only to task personnel and commit to long-term relationships, but also to institutionalize processes for structural and continuous reflection and improvement. Our results underline that the value of this learning process lies in the reciprocity with the public. For instance, being transparent as cluster partners enables uninvolved societal actors to utter back talk that is targeted to the specific operation. By listening to the cluster organization's reaction, societal actors learn what relevant issues are not yet discussed in relation to the specific project. Hence, learning is bidirectional: Cluster partners and societal actors continuously learn by listening to each other. Cluster organizations point towards involved helices as being responsible for and capable of organizing learning processes. However, not gathering learning experiences in the organizational memory of the cluster organization itself holds the risk that learning experiences remain dispersed across the various partner organizations.

This study contributes to the sustainability science literature by offering a novel perspective on the governance instrument of collaborative innovation clusters. For these collaborations, we point out the value of not only

considering invited participation, but also uninvited societal input. This is required because also collaborations organized as a TH (without a helix representing the public) inevitably have to operate within a societal environment. Dealing with back talk from this societal environment in collaborative innovation projects is not a mechanistic process, but inherently political. In our cases, cluster partners—intentionally or not—work towards closing down the debate towards a biased perspective of what arguments are regarded as valid. This is done by dismissing concerns based on emotions or values as unscientific and not evidence based. By steering the discussion towards techno-economic aspects and imposing according standards, project developers exercise power over ideas (see Carstensen and Schmidt 2016). Closing down discussions about how publicly fostered innovation processes align with societal sustainability missions towards technical issues and techno-economic knowledge misrepresent messy and ambiguous political process as value-neutral, objective, and analytical (Dorren and Wolf 2023). This makes projects seem less controversial because fundamental concerns are not discussed (Stirling 2008). As a consequence, cluster ‘insiders’ create supportive publics of ‘outsiders’, which hinders surfacing fundamentally different, value-based concerns (Chakraborty and Pandey 2023). This impedes learning in a self-enforcing dynamic. A closed-down discussion leads to limited learning, which further diminishes opportunities to open up the discussion again. In this vein, decisionmakers in TH clusters should not avoid societal back talk, but regard it as an opportunity to surface undiscussed, fundamental issues.

Regarding the scholarship on the governance of the European bioeconomy transition, our findings further substantiate how the identified discursive lock-in towards techno-economic modernization pathways in broader discussions (Simoens et al. 2022; Starke et al. 2023) institutionalizes also in concrete projects. This is because cluster partners deal with societal input selectively, with a bias towards less critical, easily ‘repairable’ input. Arguably, closing down public debates towards technical issues favours adjustments that remain near to linear status quo practices. Instead of debating fundamental issues, such as how to reduce demand for energy and material or the distribution of the limited pool of available bio-based resources, the debate centres around technological optimization (see also Bogner and Dahlke 2022). Innovation projects might therefore remain near to status quo ways of thinking and doing with less potential for more transformative solutions. These findings contribute to illuminating why the bioeconomy transition might fall short on its transformative potential regarding its sustainability and circularity promises (Ramcilovic-Suominen 2022; Ahola-Launonen and Kurki 2022; Eversberg et al. 2023b; Lühmann and Vogelpohl 2023). In this sense, our analysis

**Table 3** Hearing, listening, and learning capabilities in analysed cases

	Delfzijl	Leuna	Lisheen
Content of back talk	On-site safety issues; local concerns about environmental nuisances; regional and global possible downsides of large-scale biorefining	Local concerns about land use conflicts; regional and national concerns about the sustainability and volume of required wood resources, water availability, and energy demand	Local questions about expected traffic volumes and waste treatment; broader concerns about locking-in fossil gas infrastructure and unsustainable scales of cattle farming
Hearing	<i>Processes:</i> (social) media engagement <i>Preconditions:</i> heard network is restricted to the direct neighbourhood and expert circles Cluster partners add transparency and equipped personnel as further preconditions	<i>Processes:</i> (social) media engagement; expert conferences <i>Preconditions:</i> focus on techno-scientific aspects limits the range of heard actors Cluster partners highlight transparency as paramount to build trust	<i>Processes:</i> (social) media engagement; expert consortia <i>Preconditions:</i> limited to formal objection procedures in spatial planning processes; impeded by low tangibility of on-site developments
Listening	<i>Processes:</i> one-directional public information around technical aspects does not reach the level of underlying concerns <i>Preconditions:</i> unclear responsibilities for establishing 'listening relationships'	<i>Processes:</i> supportive public attitude is regarded as beneficial for conducting an informed dialogue <i>Preconditions:</i> cluster partners view the careful explanation of fact-based information as base to form relationships However, societal actors point out that fora lack to discuss fundamental issues	<i>Processes:</i> high hopes in master plan to stimulate dialogue, but concern that this plan is restricted to spatial aspects and cannot reach the level of underlying issues <i>Preconditions:</i> cluster partners point at national government to deliver a clear bioeconomy vision
Learning	<i>Processes:</i> single-loop learning by sharpening funding criteria <i>Preconditions:</i> organizational memory is scattered across organizations Cluster partners add that the risk-averse mentality of investors impedes further learning	<i>Processes:</i> several adaptations: sourcing radius; beech wood as raw material to stimulate forest diversification <i>Preconditions:</i> limited knowledge sharing beyond cluster boundaries, resulting in a restricted reflection on societal concerns	<i>Processes:</i> lacking reflection on conflicting visions about who settles on site <i>Preconditions:</i> cluster partners regard tangible results as necessary to stimulate dialogue



constitutes a further step in acknowledging the innovative power of controversies for a more transformative bioeconomy transition. These insights are not only of societal interest, but also prudent for bioeconomy innovators to consider: When fundamental issues are left unaddressed in early stages of innovation projects, controversies might surface at later stages, where negative effects are more tangible and public attention is higher. However, as the development process of bioeconomy projects continues, costly solutions are locked-in and adaptations towards alternative pathways are less feasible.

In addition to these contributions, our analysis also has limitations. The starting point of our interviews were cluster partners, in particular the management boards of analysed TH clusters. To assess the content of back talk, we referred to newspaper articles, policy documents, and a limited range of interviewed unaffiliated actors. This approach does not allow conclusions about the extent of societal back talk in analysed cases. Future studies could study the back talk of a broader range of uninvolved societal actors. Due to a challenging identifiability of these actors, broader research designs would need to be applied, for instance surveys or social media studies. Moreover, we demarcated our analysis to bioeconomy TH clusters, which are particularly interesting due to the complexity of the bioeconomy transition and the range of back talk that includes localized concerns, but also broader input regarding the desirability and directionality of the bioeconomy transition. However, also other forms of collaborative innovation projects are relevant for exploring how societal back talk contributes to innovation. Beyond the bioeconomy transition, identified patterns might be relevant for adjacent sustainability transitions as well, for instance in the energy, mobility, food, or water management sectors. Further (comparative) analyses could contextualize our findings for other forms of collaborative innovation endeavours and in other sustainability transitions.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s11625-024-01537-y>.

**Acknowledgements** We thank the editor and two anonymous reviewers for valuable comments and suggestions. An earlier version of this study was presented at the 6th International Conference on Public Policy in June 2023. We thank participants for helpful questions and comments. Moreover, we thank Marlies Groeneveld for her input regarding the Triple Helix literature and Robbert Solleveld for his contributions to the Delfzijl case study. We thank Violet Ross for English language editing.

**Funding** This project received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 860477, 'AgRefine'. The funding source has no involvement in the study design, collection, analysis, and interpretation of data or in the writing and publication of the report.

**Data availability** The anonymized data that support the findings of this study are available from the corresponding author, J.R. Starke, upon reasonable request.

## Declarations

**Conflict of interest** The authors have no competing interests to declare that are relevant to the content of this article. Interviewees provided informed consent for their participation.

**Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

## References

- Ahola-Launonen J, Kurki S (2022) Dynamics of expectations in the bioeconomy—hopes, disillusionments, and conflicting futures. *Science and Public Policy* 49:819–829. <https://doi.org/10.1093/scipol/scac030>
- Argyris C, Schön DA (1978) *Organizational learning: a theory of action perspective*. Addison-Wesley, Boston
- Belle S (2016) Organizational learning? Look again. *Learn Organ* 23:332–341. <https://doi.org/10.1108/TLO-01-2016-0007>
- Bogner K, Dahlke J (2022) Born to transform? German bioeconomy policy and research projects for transformations towards sustainability. *Ecol Econ* 195:107366. <https://doi.org/10.1016/j.ecolecon.2022.107366>
- Bugge MM, Hansen T, Klitkou A (2016) What is the bioeconomy? A review of the literature. *Sustainability* 8:691. <https://doi.org/10.3390/su8070691>
- Cai Y, Etkowitz H (2020) Theorizing the triple helix model: past, present, and future. *Triple Helix* 7:189–226. <https://doi.org/10.1163/21971927-bja10003>
- Carayannis EG, Campbell DFJ (2009) “Mode 3” and “quadruple helix”: toward a 21st century fractal innovation ecosystem. *Int J Technol Manage* 46:201–234. <https://doi.org/10.1504/IJTM.2009.023374>
- Carayannis EG, Campbell DFJ (2010) Triple helix, quadruple helix and quintuple helix and how do knowledge, innovation and the environment relate to each other? *Int J Soc Ecol Sustain Dev* 1:41–69. <https://doi.org/10.4018/jesd.2010010105>
- Carayannis EG, Barth TD, Campbell DF (2012) The Quintuple Helix innovation model: global warming as a challenge and driver for innovation. *J Innov Entrep* 1:1–12. <https://doi.org/10.1186/2192-5372-1-2>
- Carstensen MB, Schmidt VA (2016) Power through, over and in ideas: conceptualizing ideational power in discursive institutionalism. *J Eur Publ Policy* 23:318–337. <https://doi.org/10.1080/13501763.2015.1115534>
- Casale Mashiah D, Beerli I, Vigoda-Gadot E, Hartman A (2023) Responsible research and innovation in Europe: empirical evidence from regional planning initiatives in Austria, Norway, and

- Spain. *Eur Plan Stud* 31:1949–1974. <https://doi.org/10.1080/09654313.2023.2170215>
- Chakraborty A, Pandey P (2023) Constructing ‘responsive’ publics: the politics of public engagement under india’s ‘decade of innovation’ framework. *Asian Stud Rev*. <https://doi.org/10.1080/10357823.2023.2226818>
- European Commission (2018) A sustainable Bioeconomy for Europe: strengthening the connection between economy, society and the environment—Updated Bioeconomy Strategy. Brussels.
- European Commission (2022) EU Bioeconomy Strategy Progress Report—European Bioeconomy policy: stocktaking and future developments.
- Compagnucci L, Spigarelli F, Coelho J, Duarte C (2021) Living Labs and user engagement for innovation and sustainability. *J Clean Prod* 289:125721. <https://doi.org/10.1016/j.jclepro.2020.125721>
- Cuppen E (2018) The value of social conflicts. Critiquing invited participation in energy projects. *Energy Res Soc Sci* 38:28–32. <https://doi.org/10.1016/j.erss.2018.01.016>
- Diepenmaat H, Kemp R, Velter M (2020) Why sustainable development requires societal innovation and cannot be achieved without this. *Sustainability* 12:1270. <https://doi.org/10.3390/su12031270>
- Dietz T, Börner J, Förster JJ, von Braun J (2018) Governance of the bioeconomy: a global comparative study of national bioeconomy strategies. *Sustainability* 10:3190. <https://doi.org/10.3390/su10093190>
- Dorren L, Wolf E (2023) How evidence-based policymaking helps and hinders policy conflict. *Policy Polit* 51:486–507. <https://doi.org/10.1332/030557321X16836237135216>
- DPA (2023) Fleecejacke aus Holz - Vom Plan der erdölfreien Funktionskleidung, 17 August 2023.
- Eemsbode (2022) Veel rook bij Aramid. *Eemsbode*, 7 December 2022.
- Etzkowitz H, Leydesdorff L (1995) The triple helix—University-Industry-Government Relations: a laboratory for knowledge based economic development. *EASST Rev* 14:14–19
- Etzkowitz H, Leydesdorff L (2000) The dynamics of innovation: from National Systems and “Mode 2” to a Triple Helix of university–industry–government relations. *Res Policy* 29:109–123. [https://doi.org/10.1016/S0048-7333\(99\)00055-4](https://doi.org/10.1016/S0048-7333(99)00055-4)
- Etzkowitz H, Zhou C (2006) Triple helix twins: innovation and sustainability. *Science and Public Policy* 33:77–83. <https://doi.org/10.3152/147154306781779154>
- Eversberg D, Holz J, Pungas L (2023a) The bioeconomy and its untenable growth promises: reality checks from research. *Sustain Sci* 18:569–582. <https://doi.org/10.1007/s11625-022-01237-5>
- Eversberg D, Koch P, Lehmann R et al (2023b) The more things change, the more they stay the same: promises of bioeconomy and the economy of promises. *Sustain Sci* 18:557–568. <https://doi.org/10.1007/s11625-023-01321-4>
- Gebhardt C, Almeida M, Etzkowitz H (2022) Triple helix twins: operationalizing the sustainability agenda in the Northern Black Forest National Park in Germany. *Triple Helix* 9:184–215. <https://doi.org/10.1163/21971927-bja10031>
- Gerritsen AL, Lagendijk A, Kranendonk RP, Cofino M (2019) Beyond the blind spot of knowledge-based territorial development: the mission of metropolitan food clusters. *Eur Plan Stud* 27:1–20. <https://doi.org/10.1080/09654313.2018.1538325>
- Gerritsen AL (2019) Territorial Knowledge Governance: Pursuing sustainability in agriculture and food clusters. Dissertation, Wageningen.
- Giampietro M (2023) Reflections on the popularity of the circular bioeconomy concept: the ontological crisis of sustainability science. *Sustain Sci* 18:749–754. <https://doi.org/10.1007/s11625-022-01267-z>
- Gieske H, van Buuren A, Bekkers V (2016) Conceptualizing public innovative capacity: a framework for assessment. *Innov J* 21:1–25
- Giuntoli J, Oliver T, Kallis G, et al (2023) Exploring new visions for a sustainable bioeconomy. Joint Research Centre, Luxembourg.
- Giurca A, Metz T (2018) A social network analysis of Germany’s wood-based bioeconomy: Social capital and shared beliefs. *Environ Innov Soc Trans* 26:1–14. <https://doi.org/10.1016/j.eist.2017.09.001>
- Grundel I, Dahlström M (2016) A quadruple and quintuple helix approach to regional innovation systems in the transformation to a forestry-based bioeconomy. *J Knowl Econ* 7:963–983. <https://doi.org/10.1007/S13132-016-0411-7>
- Gustafsson R, Jarvenpaa S (2018) Extending community management to industry-university-government organizations: Community management of industry-university-government organizations. *R&D Manag* 48:121–135. <https://doi.org/10.1111/radm.12255>
- Hargrove R (2008) Masterful coaching, 3rd edn. John Wiley & Sons, San Francisco
- Jacobs C, Coghlan D (2005) Sound from silence: on listening in organizational learning. *Human Relations* 58:115–138. <https://doi.org/10.1177/0018726705050938>
- Johan de V (2013) Borgsweer bereikt kookpunt. *Dagblad van het Noorden*, 14 Jun 2013
- John G (2019) Commentaar: Opmars groene chemie. *Dagblad van het Noorden*, 31 May 2019. <https://dvh.nl/meningen/Commentaar/Commentaar-Opmars-groene-chemie-24506551.html>
- Kleinschmit D, Arts B, Giurca A et al (2017) Environmental concerns in political bioeconomy discourses. *Int for Rev* 19:41–55. <https://doi.org/10.1505/146554817822407420>
- Korsmeyer H, Light A, Grocott L (2022) Understanding feminist anticipation through ‘back-talk’: 3 narratives of willful, deviant, and care-full co-design practices. *Futures* 136:102874. <https://doi.org/10.1016/j.futures.2021.102874>
- Kuitenbrouwer M (2018) Getting unstuck: the reconstruction clinic as pragmatic intervention in controversial policy disputes. In: action research in policy analysis, 1st edn. Routledge, London
- Lahtinen J (2013) Local social knowledge management: a case study of social learning and knowledge sharing across organizational boundaries. *J Inf Sci* 39:661–675. <https://doi.org/10.1177/0165551513481431>
- Leipold S (2021) Transforming ecological modernization ‘from within’ or perpetuating it? The circular economy as EU environmental policy narrative. *Environ Politics* 30:1045–1067. <https://doi.org/10.1080/09644016.2020.1868863>
- Leydesdorff L (2012) The triple helix, quadruple helix, ..., and an N-tuple of helices: explanatory models for analyzing the knowledge-based economy? *J Knowl Econ* 3:25–35. <https://doi.org/10.1007/S13132-011-0049-4/FIGURES/2>
- Leydesdorff L, Etzkowitz H (1998) The Triple Helix as a model for innovation studies. *Science and Public Policy* 25:195–203
- Lühmann M, Vogelpohl T (2023) The bioeconomy in Germany: a failing political project? *Ecol Econ* 207:107783. <https://doi.org/10.1016/j.ecolecon.2023.107783>
- Maciejczak M (2009) Implementation of triple helix model for development of the agriculture-based bioeconomy on the example of GMO applications. *Acta Oeconom Et Inf*. 1:19–22. <https://doi.org/10.22004/AG.ECON.268256>
- McAdam M, Debackere K (2018) Beyond ‘triple helix’ toward ‘quadruple helix’ models in regional innovation systems: implications for theory and practice. *R&D Management* 48:3–6. <https://doi.org/10.1111/radm.12309>
- McCormick K, Kautto N (2013) The bioeconomy in Europe: an overview. *Sustainability* 5:2589–2608. <https://doi.org/10.3390/su5062589>
- Metze T, Schuitmaker TJ, Bitsch L, Broerse J (2017) Breaking barriers for a bio-based economy: interactive reflection on monitoring water quality. *Environ Sci Policy* 74:1–7. <https://doi.org/10.1016/j.envsci.2017.04.015>

- Meyer R (2017) Bioeconomy strategies: contexts, visions, guiding implementation principles and resulting debates. *Sustainability* 9:1031–1062. <https://doi.org/10.3390/su9061031>
- Mijailoff JD, Burns SL (2023) Fixing the meaning of floating signifier: discourses and network analysis in the bioeconomy policy processes in Argentina and Uruguay. *Forest Policy Econ*. <https://doi.org/10.1016/j.forpol.2023.103039>
- Miller K, McAdam R, McAdam M (2018) A systematic literature review of university technology transfer from a quadruple helix perspective: toward a research agenda. *R&D Manag* 48:7–24. <https://doi.org/10.1111/radm.12228>
- Murillo-Luna JL, Hernández-Trasobares A (2023) Cooperation with the triple helix and corporate environmental innovation. *J Clean Prod* 384:135479. <https://doi.org/10.1016/j.jclepro.2022.135479>
- Pahl-Wostl C (2009) A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Glob Environ Chang* 19:354–365. <https://doi.org/10.1016/j.gloenvcha.2009.06.001>
- Presbitero A, Roxas B, Chadee D (2017) Effects of intra- and inter-team dynamics on organisational learning: role of knowledge-sharing capability. *Knowl Manag Res Pract* 15:146–154. <https://doi.org/10.1057/kmrp.2015.15>
- Priefer C, Jörissen J, Frör O (2017) Pathways to shape the bioeconomy. *Resources* 6:1–23. <https://doi.org/10.3390/resources6010010>
- Pungas L (2023) Invisible (bio)economies: a framework to assess the ‘blind spots’ of dominant bioeconomy models. *Sustain Sci* 18:689–706. <https://doi.org/10.1007/s11625-023-01292-6>
- Ramcilovic-Suominen S (2022) Envisioning just transformations in and beyond the EU bioeconomy: inspirations from decolonial environmental justice and degrowth. *Sustain Sci*. <https://doi.org/10.1007/s11625-022-01091-5>
- Ramcilovic-Suominen S, Püzl H (2018) Sustainable development—a “selling point” of the emerging EU bioeconomy policy framework? *J Clean Prod* 172:4170–4180. <https://doi.org/10.1016/j.jclepro.2016.12.157>
- Richardson B (2012) From a fossil-fuel to a biobased economy: the politics of industrial biotechnology. *Eviron Plann C Gov Policy* 30:282–296. <https://doi.org/10.1068/c10209>
- Riemann L, Giurca A, Kleinschmit D (2022) Contesting the framing of bioeconomy policy in Germany: the NGO perspective. *J Environ Planning Policy Manage* 24:822–838. <https://doi.org/10.1080/1523908X.2022.2071689>
- Ronzheimer M (2019) Nebenwirkungen der Bioökonomie: Ökologisch fragwürdig. *taz*, 12 January 2019. <https://taz.de/Nebenwirkungen-der-Bioökonomie/15564526/>
- Scalia M, Barile S, Saviano M, Farioli F (2018) Governance for sustainability: a triple-helix model. *Sustain Sci* 13:1235–1244. <https://doi.org/10.1007/s11625-018-0567-0>
- Scholz RW (2020) Transdisciplinarity: science for and with society in light of the university’s roles and functions. *Sustain Sci* 15:1033–1049. <https://doi.org/10.1007/s11625-020-00794-x>
- Schön DA (1983) *The reflective practitioner: how professionals think in action*. Ashgate, Farnham
- Schön DA, Rein M (1994) *Frame reflection: toward the resolution of intractable policy controversies*. Basic Books, New York
- Shearmur R (2011) Innovation, regions and proximity: from neo-regionalism to spatial analysis. *Reg Stud* 45:1225–1243. <https://doi.org/10.1080/00343404.2010.484416>
- Simoens MC, Leipold S, Fuenfschilling L (2022) Locked in unsustainability: understanding lock-ins and their interactions using the case of food packaging. *Environ Innov Soc Trans* 45:14–29. <https://doi.org/10.1016/j.eist.2022.08.005>
- Starke JR, Metze TAP, Candel JJJ, Termeer CJAM (2022) Conceptualizing controversies in the EU circular bioeconomy transition. *Ambio* 51:2079–2090. <https://doi.org/10.1007/s13280-022-01730-2>
- Starke JR, Metze TAP, Candel JJJ et al (2023) ‘Green future’ versus ‘planetary boundaries’? Evolving online discourse coalitions in European bioeconomy conflicts. *J Clean Prod* 425:139058. <https://doi.org/10.1016/j.jclepro.2023.139058>
- Stirling A (2008) “Opening up” and “closing down”: power, participation, and pluralism in the social appraisal of technology. *Sci Technol Human Values* 33:262–294. <https://doi.org/10.1177/0162243907311265>
- Termeer CJAM, Dewulf A, Breeman G, Stiller SJ (2015) Governance capabilities for dealing wisely with wicked problems. *Administration and Society* 47:680–710. <https://doi.org/10.1177/0095399712469195>
- Van Quaquebeke N, Felps W (2018) respectful inquiry: a motivational account of leading through asking questions and listening. *AMR* 43:5–27. <https://doi.org/10.5465/amr.2014.0537>
- Van Bueren BJA, Argus K, Iyer-Raniga U, Leenders MAAM (2023) The circular economy operating and stakeholder model “eco-5HM” to avoid circular fallacies that prevent sustainability. *J Clean Prod* 391:136096. <https://doi.org/10.1016/j.jclepro.2023.136096>
- Vivien F-D, Nieddu M, Befort N et al (2019) The Hijacking of the bioeconomy. *Ecol Econ* 159:189–197. <https://doi.org/10.1016/j.ecolecon.2019.01.027>
- Vogelpohl T, Beer K, Ewert B et al (2022) Patterns of European bioeconomy policy. Insights from a cross-case study of three policy areas. *Environmental Politics* 31:386–406. <https://doi.org/10.1080/09644016.2021.1917827>
- Wehling P (2012) From invited to uninvited participation (and back?): Rethinking civil society engagement in technology assessment and development. *Poiesis und Praxis* 9:43–60. <https://doi.org/10.1007/s10202-012-0125-2>
- Weiss RS (1995) *Learning from strangers: the art and method of qualitative interview studies*. First Free Press, paperback. Free Press, New York
- Wilde K, Hermans F (2021) Deconstructing the attractiveness of bio-cluster imaginaries. *J Environ Planning Policy Manage* 23:227–242. <https://doi.org/10.1080/1523908X.2021.1891872>
- Wohlfahrt J, Ferchaud F, Gabrielle B et al (2019) Characteristics of bioeconomy systems and sustainability issues at the territorial scale A Review. *J Clean Prod* 232:898–909. <https://doi.org/10.1016/j.jclepro.2019.05.385>
- Yanow D (2009) Ways of knowing: passionate humility and reflective practice in research and management. *Am Rev Public Adm* 39:579–601. <https://doi.org/10.1177/0275074009340049>
- Yanow D, Schwartz-Shea P (eds) (2015) *Interpretation and method: empirical research methods and the interpretive turn*, 2nd edn. M.E. Sharp Inc, Armonk
- Yip J, Fisher CM (2022) Listening in organizations: a synthesis and future agenda. *Acad Manag Ann* 16:657–679. <https://doi.org/10.5465/annals.2020.0367>
- Zhou C, Etzkowitz H (2021) Triple helix twins: a framework for achieving innovation and un sustainable development goals. *Sustainability* 13:6535. <https://doi.org/10.3390/su13126535>

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