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Creating possibility spaces for the development of circular bioeconomy initiatives

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ABSTRACT

To help move society towards more sustainable states, policies have been developed in various countries to create a circular bioeconomy (CBE) in biobased sectors such as forestry and agriculture. In operationalizing CBE, initiatives must be created in which feedback loops between life-cycle stages are established to enable a “stock” of resources to be recirculated in the economy. By creating such feedback loops, CBE aims to decouple economic growth from natural resource depletion and degradation. However, few CBE initiatives have been developed. This implementation gap has partly arisen because policies to promote CBE are somewhat theoretical and do not seem to be informed by the practical realities of implementing CBE initiatives on the ground. While CBE policies do not and should not set out detailed implementation plans to address these issues, they do need to better account for how favourable circumstances and contexts can be created for the development of CBE initiatives. In response, this paper critically examines how possibility spaces can be created for the development of CBE initiatives. Assemblage thinking is used in longitudinal case study research focused on a major CBE initiative situated in the south of Sweden: Foodhills. Assemblage thinking is both an approach and method widely used in geography to study *how* spaces for action such as the construction of CBE initiatives are created. As such, the paper identifies and unpacks multiple issues arising in the development of CBE initiatives on the ground including geographical relations, actor networks and power.

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Introduction

There is a growing sense of urgency to transform global production-consumption systems which are increasingly unsustainable. Two potentially transformative visions that have gained momentum are the circular economy and the bioeconomy (D’Amato and Korhonen 2021). The bioeconomy vision is based on the idea that inputs for production and consumption (e.g. energy, materials) should be based on renewable biological resources such as biomass (McCormick and Kautto 2013; European Commission 2018). The circular economy (CE) vision states that the value of products, materials and resources

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should be maintained in the economy for as long as possible (Geissdoerfer et al. 2017; D'Amato et al. 2020). In biobased sectors such as agriculture and forestry, these two visions are combined into circular bioeconomy (CBE) (Carus and Dammer 2018; Stegmann et al. 2020; Muscat et al. 2021). To operationalize CBE in practice, feedback loops between life cycle stages must be established to enable a “stock” of valuable materials to be recirculated (in the economy). In this way, ideas about CBE aims to decouple economic growth from natural resource depletion and environmental degradation (Giampietro 2019). It has been suggested that moving towards more CBE will require substantial changes to systems of production, consumption and established industrial practices (Merli et al. 2018; Gottinger et al. 2020; Näyhä 2020). Policies to promote CBE have been developed and endorsed by supranational governments covering significant territories such as the European Union, national governments such as Sweden and UK as well as a range of non-governmental organizations (European Commission 2018; European Energy Agency, 2018; WBCSD, 2020; Kardung and Drabik, 2021). However, despite explicit policy goals to create CBE, there are few examples of CBE initiative on the ground (Brandão et al. 2021; Hinderer et al. 2021; Holden et al. 2022), and the opportunities which this approach may provide to move society towards more sustainable states are being lost.

To advance CBE science and address this implementation gap, research has focused on the development and management of such initiatives in various industrial settings. For example, there are several papers that focus on the creation of circular economy initiatives in the bio-based sector, often focused on bio-refineries (cf.; D'Amato et al. 2020; Hedeler et al. 2020; Ubando et al. 2020), and the transformation of bio-based waste into energy or nutrients that closes material loops and help societies develop more circular economies (Longhurst et al. 2019; Banu et al. 2020; Mak et al. 2020; D'Amato et al., 2021). Much research on CBE developments is rooted in the somewhat positivistic epistemology of environmental and resource management which emphasize abstraction and generalizable results (Hernández et al. 2019). While such studies offer credible and valid insights on CBE developments, we identify two critical gaps in research on CBE. First, studies on governing CBE developments often focus on two sets of actors; these are governments setting policies for circular bioeconomies and, firms who respond to policy and market signals (e.g. Stegmann et al. 2020). Here a logic of neo-classical economics is often at work and human actors are presumed to make rational choices. However, the somewhat generalizable “clean” results of such studies has limited capacities for motivating practical actions to create and implement CBE initiatives on the ground. Second, research on CBE emphasizes abstract representations of CBE (e.g. D'Amato and Korhonen 2021; Muscat et al. 2021), while there is a paucity of research which considers the practical realities of implementing CBE initiatives on the ground. This matters, because CBE policy is largely based on assumed behaviours and logics of abstractions informed by resource economics and management rather than the actual and practical realities of implementing CBE initiatives.

CBE initiatives are situated in space and time, meaning problems and solutions arising in their implementation are to a significant extent contextually defined. Thus, we do not advocate changes to CBE policy based on detailed plans (i.e. blueprints) for the implementation of CBE initiatives which condone *particular* problems and solutions. Nonetheless, policy needs to pay greater attention to implementation and identify

favourable circumstances and contexts for the development of CBE initiatives. In order to address such gaps in knowledge, Hobson (2016) argues that the development of CBE initiatives proceeds in “possibility spaces” and should be studied as such. Here, the term “possibility space” is used to conceptualize how situated practices to assemble CBE initiatives actually unfold rather than follow simplistic linear logics such as “detailed requirements – design – implement” underpinned by rational choice.

In response, this paper focuses on a longitudinal in-depth case study of a major CBE initiative (Foodhills) situated in the south of Sweden. It uses assemblage thinking to critically examine how a possibility space for this CBE initiative is being created. The Foodhills initiative is located on an industrial property in the municipality of Bjuv (in the province of Skåne in Sweden). Situated on an industrial site formerly occupied by Findus (a large food processing corporation), Foodhills was established in 2017 with the stated aim to become an “industry leader in Europe on system for circular food production that contributes to a more sustainable future” (Foodhills 2018). The paper draws on assemblage theory as both an approach and method because it is used in geography to study *how* spaces for action such as the construction of CBE initiatives are created, not in a mechanistic way but to account for a multiplicity of relevant issues such as power, geography and actor networks. As such it is a powerful approach and method to help address the CBE implementation gap. For example, within the paper assemblage thinking brings into view the situated practices of creating a possibility space for the Foodhills CBE initiative and crucially how it is contingent upon spatial relations.

The remainder of this paper is structured as follows: first it introduces the theoretical perspective and methods for analysing the CBE initiative. The theoretical perspective and methods follow constructivist perspectives in social science and build upon assemblage thinking as methodological-analytical approach. This analytical perspective identifies Foodhills as an emerging assemblage. The analytical template that informs the analysis comprises three interrelated themes; these are multiplicity, which reveals that Foodhills is made in multiple sites and situations; process, which reveals practices of assembling; and socio-material relations, which reveals its situated and contingent relations. Second, the results from longitudinal case study is presented with in-depth details on a CBE initiative in the making. Third, the findings are summarized, and conclusions drawn.

Theoretical perspective and methods

Following Hobson’s (2016) conceptual insights which advocate the fostering of possibility spaces for the development of CE practices, we explore the creation of a particular possibility space of the nascent CBE. Here our working assumption is informed by Law (2004) that existing CBE initiatives are complex, contingent and that space and power matter in their development. Thus, our study is not an exercise in “blueprint” abstraction but rather follows the constructivist perspective in social sciences and focuses on the emergent properties and capacities of socio-material assemblages that may form the basis of a CBE. This analytical approach builds on a relational ontology that emphasizes a need to recognize the spatial dynamics of innovation and sustainability transitions (cf. Grandin and Haarstad 2020). Here, assemblage thinking as a methodological-analytical approach has informed our theoretical perspective (DeLanda 2006).

Assemblage thinking

Assemblage thinking as methodological-analytical approach is based on a relational ontology that defines assemblage as “*wholes characterized by relations of exteriority*” (DeLanda 2006, p. 10). Seen this way, an assemblage consists of parts that create a whole (e.g. an implemented policy, a firm or an industrial property development), but the parts (actors and material artefacts) that constitute a whole cannot be reduced to the function within that whole. Rather, they form part of multiple assemblages and are shaped by their interactions and relations within and between assemblages. Research on assemblages therefore emphasizes the capacities, and not functions, of components to understand the dynamics of assemblages, which recognizes that an assemblage as a whole is greater (or perhaps even different) than the sum of its parts (Dittmer 2014). Seen this way, an industrial property site is more than a fixed assemblage consisting of material artefacts and people that perform (business) practices on the site.

Since assemblages are not static entities but are constant in flux with component parts adding in or dropping out, they have capacity to make various contingent futures possible. Here, assemblage thinking offers a vocabulary to capture how relations are made between actors and material artefacts as well as how power is exercised through practices of assembling (Allen and Cochrane, 2011). The analytical aim of studying assemblages is therefore to understand “*how things work and what they produce*”, rather than trying to “*explain, understand or interpret what an assemblages is*” (Cumming 2015, p. 145; 141). For instance, assemblage thinking is deployed in research on policy mobility: how policy ideas are mobilized through complex relations of actors, materials and networks – with the analytical aim of revealing, interpreting and representing the world of policy making (Baker and McGuirk 2017). Here, policy assemblages are constituted by complex relations that are situated in spatial, social and material relations. For example, Prince (2010) identifies an “*implemented policy*” as an assemblage of texts, actors, agencies, and networks (Prince 2010). However, as suggested by Albrecht (2018), research on policy mobility is needed beyond a focus on policy making to gain knowledge on places of policy materialization, which consequently shape the effects, direction, and mutation of (CBE) policy mobility’s. Here we note the work of O’Neill and Gibbs (2016) who recognize entrepreneurship as a particular mode of relational practice making connections between policy making and business practices. Thus, in this study we focus on the making of a specific CBE assemblage, namely Foodhills, which not only includes practices of policy making but also entrepreneurial practices, which are situated in temporal and spatial relations.

Analytical framework

Assemblage thinking is rooted in the following epistemological commitments listed below (Anderson and McFarlane 2011; Baker and McGuirk 2017). These commitments have informed our analytical approach to examine the contingent nature of an emerging CBE initiative.

- multiplicity – assemblages consists of heterogeneous elements that produces multiple outcomes, which replaces analytical claims of singular determination in any given situation;

- processuality – assemblages are situated and contingent upon relational and spatial process;
- labours of assembling are practices of producing and maintaining (CBE) assemblages and
- uncertainty expressed through an auto-critical disposition to research.

Following assemblage thinking, our paper is based on three research practices to investigate an emergent CBE initiative, these are: (i) adopting an ethnographic sensibility; (ii) tracing sites and situations; (iii) revealing practices of assembling. Methods for data collection and analysis are presented next.

Methods

A longitudinal case study was conducted (2017–2020) of the Foodhills Initiative in Bjuv (Skåne, Sweden). This case study was selected for several reasons. First, the research team enjoyed the benefits of excellent access to the Foodhills initiative which enable in depth research to be conducted over time. Second, Foodhills is one of the largest CBE initiatives in Europe and thus of significance at multiple scales from local to potentially even international and allowed this emerged web of spatial relations to be investigated. Third, Foodhills is situated in a facility formerly occupied by Findus and within a local as well as regional institutional arrangement known as “Food Valley of Sweden” which allowed sites and situations to be effectively traced in the course of research.

Aligning with the commitment to uncertainty associated with assemblage thinking, this approach encourages and rewards a “*methodological openness and flexibility*” (McCann and Ward 2015, p. 47). As such, the research focuses on the sites and situations implicated in the construction of a CBE initiative as a means to escape the methodological-analytical constraints of the bounded research field and explore the active and unpredictable composition and mobilities of CBE concepts, visions and practices. Following this approach our research inductively and iteratively traces people, discourses and policy ideas to particular sites that are located in topographical contexts and examines their embedding in topological contexts, which refers to wider social and spatial situations. As such, topographical sites include the offices of a ministry, or the administrative territory of a city, while topological situations might relate to prevailing notions of best practice or a hegemonic political-ideological project that exists beyond, but is nonetheless constituted, by particular sites.

The fine grain of practice was integrated to avoid over-estimating the salience of influential actors and political projects and underestimating the contingencies, failures, course corrections, and re-directions that animate the making and implementation of CBE assemblages. Whether exposing the fragile renewal of dominant agendas and political projects, or identifying and publicizing latent alternatives, assemblage methodologies offer a promising way to enlarge the analytical-political capacities of critical scholarship on CBE.

Data were collected from a series of interrelated sites and situations whose interrelations were iteratively traced over the course of the research project. The case study is therefore not defined by the organization known as Foodhills. Rather, Foodhills is defined as an emerging CBE assemblage that is contingent upon multiple relations and spaces.

Data were collected from multiple sources using multiple methods. Specifically, 12 semi-structured interviews were conducted with key informants including the Foodhills CEO, collaborating partners, consultants, representatives of the local community and the Skåne regional government. Details of the interviews are presented in Appendix 1. Interview transcripts were sent to interviewees for validation and clarification. Data were also collected using participant observations methods such as site visits at Foodhills as well as attending meetings about the Foodhills development at the Ministry of Trade and Industry, the Municipality of Bjuv, University settings (e.g. the University of Agricultural Science), Media platforms as well as at events organized at the Foodhills site. A total of seven meetings and events were attended by the researchers of this paper as detailed in Appendix 1. Access to these meetings were granted by invitation (e.g. the meeting at the Ministry) while others were public events where access was granted via registration.

Data were also collected from documentary sources such as web pages providing details of the Foodhills development, including government reports, regional council reports as well as media. All data were collected and managed in accordance with the ethical guidelines and compliant with GDPR regulations at the Swedish University of Agricultural Sciences. Qualitative data were analysed using coding and clustering techniques. An overview on how the theoretical perspective is linked to methods for data collection and codes for analysis is detailed in Table 1.

Given the exploratory nature of the research, a “flexible” analytical template was developed to assist analysis (Miles and Huberman 1994). This means that research and analysis led to refined questions and analytical themes informed by literature and in relation to data collected. As such, data were collected and reviewed in light of the literature in an iterative process that called for continual re-interpretation and reflection. For instance, at the beginning of our study, our research was informed by the innovation journey concept by Van de Ven et al. (1999), which cast innovation as a non-linear process that develops in slices of time from the initiation period, the developmental period, and the implementation or termination period. While this “innovation journey” framework usefully guides research and innovators to investigate or develop innovations, it does not account for the contingent and situated nature of innovation spaces. This framework was

Table 1. How method is linked to theoretical perspective to inform analysis.

Assemblage approach	How it was adopted in this study	Analytical outcomes
Ethnographic sensibility	Exploratory longitudinal case study using qualitative research methods, notably semi-structured interviews, participant observations and document analysis	Qualitative data on sites and situations implicated in the making of the CBE assemblage (Foodhills)
Multiplicity	The CBE initiative is made in relation to multiple sites and situations.	The analysis reveals what sites and situations are implicated in the making of the CBE initiative such as the industrial property, local municipal, national policy.
Process	Practices of assembling as in what social actors do in the making of the CBE initiative	The analysis reveals entrepreneurial practices such as envisioning and promoting the CBE initiative as well as framing strategic priorities in the making of Foodhills
Socio material relations	The CBE initiative is situated and co-constructed in socio material relations that are multi-scalar	The analysis reveals topographical relations such as the industrial site located in Bjuv as well as topological relations such as regional actor coalitions and (inter)national policy making

therefore discounted in the course of the research. Thus, following a funnel approach (Hammersley and Atkinson 1995) the analytical approach based on assemblage thinking was adopted to inform further data collection and analysis in this longitudinal study. The analytical framework presented in Table 1 emerged in an iterative fashion from the interplay of data analysis and literature on CBE as well as critical social science perspectives on innovation. The results from longitudinal case study on Foodhills is presented next.

Exploring a circular bioeconomy initiative in the making

The analysis of the case study site is founded upon three interrelated narratives that are based on assemblage thinking. First, we explicate sites and situations in relation to the Foodhills CBE initiative. This initial narrative is structured in temporal order and offers an overarching account on the re-development of the industrial property in Bjuv in relation to actor coalitions and CBE policy developments. The second narrative focus on practices of assembling a CBE initiative to explicate how relations are made in this space, notably between the Foodhills development and ideas about CBE as well as participating actors and financial supporters. The third narrative identifies the situatedness of this CBE initiative in terms of social and spatial relations.

Tracing sites and situations

This section presents an overarching narrative of sites and situations associated with the Foodhills CBE initiative. We begin with the industrial site in Bjuv established by the Findus Corporation in 1903. Findus became an internationally recognized food processing business specializing in frozen foods (e.g. peas and fish) with Nomad Foods as formal owner since 2015. Nomad Foods terminated their food processing operations in Bjuv in 2016 but kept the Findus brand which still exists in various markets. The vacant industrial property site was acquired by Foodhills in January 2018 with the stated aim to become “an internationally recognised leader in Europe on systems for circular food production that contribute to a more sustainable future” (Foodhills 2018). At this time, Foodhills consisted of a coalition of actors led by the CEO of Foodhills and involved financial relations with Backahill (a real estate firm) and Lantmännen (a food industry company).

The vacant industrial property was identified as a promising site for developing a CBE initiative as noted by the CEO of Foodhills: “The industrial property includes 110000 square metres of buildings, with 2 500 offices, 47 hectare of factory floor, 15 hectare land that is spatially planned for food production, but not yet built on; and 35 hectare of agricultural land, a water treatment plant and a pool or storage for surface water”. The properties and capacities of these material facilities are articulated by the CEO in relation to Foodhills stated vision. Here, circular food production is described by the CEO as “an eco-system that works in industrial symbiosis” (CEO of Foodhills) which enables the recirculation of resource flows between production functions where waste streams from one production function become resource inputs for another. Circulating material and energy flows between production practices are sought that may extend to local (Bjuv) and regional communities (Skåne) via relationships with production practices undertaken outside the Foodhills site.

Since material resource symbiosis is sought, socio-material practices situated on this development cannot be constructed by lone actors working in isolation but must be built through symbiotic relations within evolving economic, social and political circumstances. Thus, Foodhills seeks to provide a possibility space for circular bio economy initiatives to develop; in which firms can collaborate in order to create circular resource flows of biobased materials that may hold significant potential to reduce environmental impacts associated with food production and processing. Here the former Findus site and its extant facilities are seen as suitable for such practices. However, beyond the topographical location, the making of Foodhills is a relational endeavour and situated in webs of relations at multiple scales. Foodhills formed relationships with Food Valley of Bjuv and Skåne Regional Council as a key public partners in the making of this CBE initiative. This coalition of actors gained financial support from the Swedish Agency of Regional and Economic Growth and was also recognized by the national Swedish food policy as a strategic initiative to promote more sustainable food production.

Food Valley is a regional configuration that can be traced back to 2008 and is founded on collaborations between the municipality and industrial actors, e.g. the energy company E.ON and Findus. It aimed to be a food “Silicon valley” which would achieve certain economic policy objectives such as to maintain and develop local labour markets. From the outset, industrial symbiosis was a key theme in this CBE initiative and considerable emphasis was placed on the recirculation of industrial waste streams between firms such as producing biogas from biomass. In 2012, Food Valley of Bjuv formed a relationship with the Swedish Surplus Energy Collaboration (SSEC), which is a research programme established and led by the Swedish University of Agricultural Science. SSEC aimed at facilitating development and uptake of initiatives on industrial symbiosis and sustainable food production in Sweden. It is organized as a trans-local knowledge network: public (e.g. municipalities) and private (e.g. food, energy and consultancy) organizations pay an annual fee to join, and in return, gain access to knowledge on practices of industrial symbiosis and sustainable food production through network members.

In 2012 the actor coalition of Food Valley, SSEC and Findus identified the industrial property in Bjuv as an ideal location for food produced through industrial symbiosis. *“Findus was in a situation where they had a lot of spare capacity and resources to utilize in collaboration with others. We saw that as an opportunity to strengthening economic development in the municipality”* (Industrial coordinator Bjuv, Municipal). However, this actor coalition was unable to proceed with such plans on the industrial property because Nomad Foods terminated their operations in 2016: *“Findus was planning to re-direct their business model in Bjuv to open up their large facilities when the decision for closing down came as a flash from the sky”* (Industrial coordinator, Bjuv Municipal). Nevertheless, the idea to use the industrial property for producing food through industrial symbiosis continued as it was translated and reworked as part of the Foodhills vision. A diagram of this overarching narrative on multiple sites and situations in relation to this CBE initiative is presented in [Figure 1](#).

The diagram ([Figure 1](#)) identifies three analytical scales that are presented in a vertical fashion in relation to a timeline on the horizontal axis. The first analytical scale includes the industrial property that was vacated by Findus and acquired by Foodhills with the stated aim to (re)develop the site into a CBE initiative. The second analytical scale

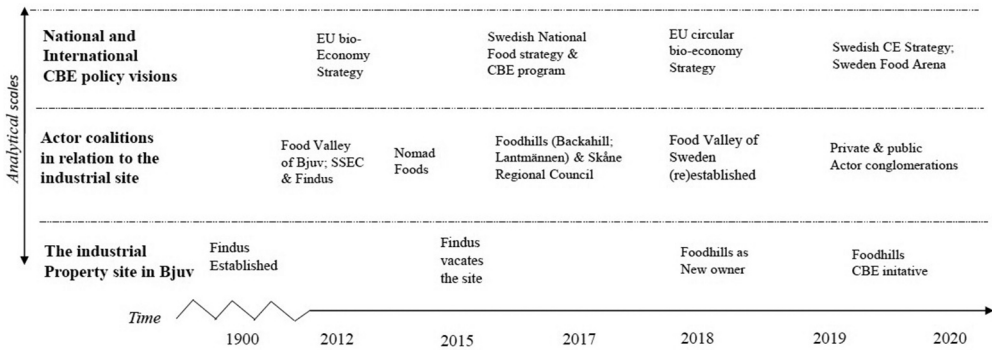


Figure 1. Developments of the Foodhills initiative over time in relation to multiple sites and situations.

identifies actor coalitions (e.g. the Food Valley of Bjuv) that were formed, but also changed over time, in relation to this industrial site. The idea of producing bio food through industrial symbiosis on this site was formulated, translated, and mobilized within and between these actor coalitions. The third analytical scale refers to significant national and international policy visions and ambitions associated with broader CBE developments. In this overarching narrative we identify Foodhills as an assemblage of socio-material relations between the Foodhills site, actor coalitions as well as national policy visions and ambitions for CBE. How these relations were (re)made in the making of this CBE initiative is examined next.

Practices of assembling a CBE initiative

The overarching narrative shows that the industrial property in Bjuv is important in the Foodhills assemblage and not a passive backdrop in the making of this CBE initiative. It is a key material component with properties and capacities articulated by social actors in (re) making this space. Notably, there is a strong and consistent Foodhills narrative, which was developed by the CEO and promulgated by him at various events including university seminars, national and international events organized by food industry association, media platforms as well as Swedish Ministry of Enterprise and Innovation. Here, the Foodhills initiative is promoted as a mixed possibility space that includes food production and processing facilities; test-bed facilities for testing and developing innovative food products and production practices; demonstration facilities to “show case” novelties; and conferencing facilities for knowledge and capacity building events, such as meetings, seminars, and conferences. While the industrial site is situated in Bjuv, this vision of Foodhills has been presented to audiences including politicians, business people, academics and government officials working at national, sectoral, regional and local scales. In this way, Foodhills not only responds to CBE policies and intentions but also recursively shapes these. In other words, it is not a passive recipient and respondent of policy intentions but an agent in the production of these. Thus, actors at multiple scales reach into Foodhills which, in turn, also reaches out to actors at multiple scales and inflects dialogues and developments of CBE.

An example of relational processes between policy intervention and the emergence of this CBE assemblage is how Foodhills gained national financial support for its CBE initiative. The Swedish Agency for Economic and Regional Growth established a working group in 2017 coordinated by the Skåne Regional Council to support regeneration of the local economy in Bjuv following the closure of the Findus operations (Swedish Agency for Economic and Regional Growth 2019). This working group collaborated with the Foodhills company to complete a feasibility study to redevelop the ex-Findus site. It was sent to The Swedish Agency for Economic and Regional Growth which granted national funding (40 million SEK) for site redevelopment into a centre for innovative food production (Swedish Agency for Economic and Regional Growth 2019). In this way, the initiative was explicitly linked to the Swedish Food strategy: *“The Ministry of Enterprise and Innovation have given the task to Innovation Skåne to develop a proposal on a vision for circular food production and what organisations should be included to deliver on that vision”* (Innovation manager, Skåne Regional Office). The Foodhills site became recognized as a possibility space for local and regional development projects as well as an exemplar initiative related to the Swedish National Food strategy as it gained financial support from national agencies.

While the Foodhills initiative is led by a private firm with commercial ambitions it is also simultaneously dependent upon collaborations with public sector actors working at regional and national scale. The relations between Foodhills and National policy objectives are coined here by the Innovation manager at Skåne Regional Office *“This initiative (Foodhills) is of national interest and is related to the national food strategy and the minister responsible for the national policy strategy is keen to see Foodhills as a strategic node for its implementation”* (Innovation Manager, Skåne Regional Office). The Food Valley of Bjuv, a regional configuration, was identified by Skåne Regional Office as an important public nodal link to financial support between the Swedish agencies (e.g. Ministry of Enterprise and Innovation and the Swedish Agency for Economic and Regional Growth) and Foodhills. Food Valley of Bjuv that was initiated and led by the municipality was renamed to Food Valley of Sweden to recognize its national and international ambition, and that of Foodhills (Skåne Regional Council 2018).

Foodhills has geographical ambitions and the Foodhills CEO was instrumental in changing the name from Food Valley of Bjuv to the Food Valley of Sweden. *“So we changed the name to Food Valley of Sweden. There is also a Food Valley of the Netherlands, and we want to work nationally and internationally. So if we use the name Food Valley of Bjuv, the national side will think it is local and not national and we miss the national perspective to make it work”* (CEO of Foodhills). Thus, Foodhills has developed through networks of actors which are simultaneously local, regional, national, and international. Through such social relations, the Foodhills assemblage is far from passive but exhibits power in the form of reach that reassembles “local” and “regional” initiatives to make them more consistent with its ambitions. It recognizes that a transition lab for CBE must include both private and public actors so that knowledge about CBE can be mobilized across networks of actors and reach multiple scales (such as markets, policy, and university).

While Foodhills is part of an actor constellation including significant public sector actors it is nonetheless a private sector led initiative. It requires rental income from tenants to develop and sustain it where Foodhills is the landlord. Foodhills has recruited

a number of firms that rent spaces on site to accommodate their business operations, including firms specialized in food processing, logistics and distribution. For example, Sydgrönt is a firm specialized in handling and distributing fruit and vegetables. The firm has established cold storage and beetroot processing facilities on the Foodhills site. Other firms include Glimåkra Åkeri AB, which is specialized in food transport and logistics and Hello Fresh, which is a meal kit delivery service company. Foodhills also conducts its own business operations on the site such as processing frozen peas.

Recruiting firms to the site requires decisions to be made about what firms are needed to achieve sufficient rental income and to develop circular flows and a CBE initiative. The vision for Foodhills development and its associated business strategy are thus used to frame, filter and ultimately recruit tenants and practically link food production activities which may form the basis of a viable CBE initiative. *“We are looking at resource flows, the water treatment plant, to measure contents in wastewater flows, to see how we can plan and steer wastewater flows to the greenhouse or to the biogas-plant. We are looking into implementing sensors in the production system at each production locale. It is a puzzle, very complicated, and it requires our tenants to actually produce what they plan to produce”* (CEO of Foodhills). Such practices of assembling include visioning and framing business strategy as well as filtering and recruiting tenants to practically link food production and related activities on the site. How such processes of assembling are situated in webs of relations is considered in the next section.

The situatedness of a CBE initiative in social and spatial webs

The Foodhills assemblage is situated in webs of both social and material relations. Extant physical facilities on site include factory buildings with necessary infrastructure such as test-kitchen, laboratories, access to cold storage as well as office and meeting space and a water treatment plant with significant capacity for food processing. These extant facilities are being reassembled to align with food production practices necessary to develop a CBE initiative. Further, looking beyond the site to local and regional relations linked to the former Findus operation, there are relations such as a pool of labour, primary food production and established markets. For insistence, proximity to Helsingborg is viewed as particularly useful in this regard, as it is a hub for the vegetable and fruit markets in Sweden. These extant facilities associated with the ex-Findus site enables business and property development on the Foodhills site to develop. A summary of the longitudinal case study on Foodhills assemblage is presented in [Table 2](#) and identifies how practices of assembling a CBE initiative is situated in multiple socio-material relations.

As illustrated in [Table 2](#), Foodhills is a mixed space developing in relation to multiple sites and situations in which possibilities are articulated, including the need for regional development to secure local and regional economy and employment; food policy ambitions to steer food production and consumption into more environmentally benign pathways; and entrepreneurial business development motives. Actors working at multiple scales (national and regional policy as well as food industry actors) reach into this space via activities, including food processing operations, test-bed operations for research and development projects as well as meeting and conferencing activities. Here, practices of envisioning CBE, framing business strategy, filtering and recruiting actors (e.g. firms) are used to create circular resource flows of biobased materials that may hold significant

Table 2. The situatedness of a circular bioeconomy initiative.

Analytical theme	Meaning	Empirical abstractions
Multiplicity	CBE initiative is made in multiple sites and situations	Economic development policy to secure local and regional industry and employment; National policy visions and ambitions on CBE developments; Property development rationales to re-develop vacant industrial property; entrepreneurial business rationales
Process	Practices of assembling a possibility space for CBE	Envisioning and promoting the Foodhills site as a node for CBE developments in the agro food sector; Framing strategic priorities to attract financial support and recruit participants; Filtering in and out potential participants; and making circular connections by practically linking food production and related practices on the site
Socio material relations	The CBE initiative is situated and co-constructed in socio material relations that are multi-scalar	Topographical relations include extant facilities, e.g. the site; and topological relations include actors at local, regional, national and international scales

potential to reduce environmental impacts of the economy. These practices are performed by actors that work at multiple scales, not only local but sectoral, regional and national. Thus, the Foodhills development is an assemblage which cannot be reduced to an initiative developing as a result of state power emanating from “above” or local power acting below. Rather, this possibility space is topologically defined by relations where actors reach in and out of Foodhills. As such the development is simultaneously local, regional, sectoral, and national and has ambitions to reach across these profoundly topologically defined networks.

Summary and conclusions

Although CBE initiatives hold significant potential to promote resource productivity, avoid environmental degradation and thus assist society in moving towards more sustainable states, there are few examples of CBE initiatives on the ground and an implementation gap has emerged (Brandão et al. 2021; Hinderer et al. 2021; Holden et al. 2022). This implementation gap has emerged at least in part because the policies to promote CBE initiatives are somewhat theoretical and do not sufficiently take into account what may constitute favourable circumstances for CBE initiatives and indeed the practical realities of developing CBE initiatives on the ground.

In response, inspired by the work of Hobson (2016), this paper aimed to critically examine how possibility spaces for the development of CBE initiatives can be created. To meet this aim, it drew on in depth longitudinal case study research focused on a major CBE initiative in southern Sweden: Foodhills. The research was founded in assemblage thinking. This approach and method are widely used in geography to study *how* spaces for action such as the construction of CBE initiatives are created, not in a mechanistic way but to account for a multiplicity of relevant issues such as power, geography and actor networks. As such, this paper provides several insights relevant for the development of CBE science and policies.

The Foodhills case clearly shows possibility spaces for CBE initiatives do not lie out there waiting to be discovered but are actively created. Seen this way, opportunity spaces

for CBE initiatives are not simply arenas in which blueprints or best practices are applied, rather they are based on extant relations which may in various ways be more or less amenable to the ideas and concepts of CBE. In this instance, Foodhills was not created in a random serendipitous fashion, but rather the vacant industrial property and extant relations relating to employment, material resource flows and policy provided a “window of opportunity” for a CBE initiative. This was identified by a consortium of actors who then actively created a possibility space for the Foodhills CBE initiative.

Drawing on assemblage theory this paper reveals how a possibility space for Foodhills was actively created by developing a narrative to enable the initiative to cohere at various scales. In the first instance, on site in Bjuv the narrative framed and filtered the recruitment of firms to the initiative. In this way, the narrative showed how Foodhills is more than an industrial site looking for tenants which may simply value its facilities. Instead, the narrative aimed to attract firms to Foodhills which are able and willing to actively participate in the CBE initiative: to network and facilitate knowledge exchange within the initiative and develop circular biobased resource flows. In the second instance, the Foodhills assemblage provided the basis for narratives that resonated and met the priorities of governance actors operating at various scales, each with slightly different interests and aspirations. Locally, Foodhills used extant industrial facilities and provided employment and thus met key local policy priorities. Regionally Foodhills assisted in the development of the food sector and regional sustainability. Nationally, it coheres to a triple bottom line logic, which is also in line with EU policies.

Equally, creating opportunity spaces for the development of CBE initiatives is not only a process of responding to the policy priorities of various actor constituencies. Rather, it also involves shaping policy priorities which manifest at various scales. Here we might observe that Foodhills is a multi-scalar initiative which seeks to affect local, regional, national and international policies and governance networks. However, such scalar imaginaries are difficult to conceptualize in topographical form and can create the impression that, for example, national policy priorities are in some way more powerful than a local initiative such as Foodhills. Further, given its policy reach and potential for large scale resource flows, it is difficult to determine whether Foodhills is a local, regional, national or international CBE initiative. Instead, this paper recommends that such topographical thinking should be supplemented by topological spatial imaginaries. This means initiatives such as Foodhills should not be classified as, for example, local *or* national, but rather are better understood to cohere transversally with forms of power expressed in terms of reach rather than a function of scalar hierarchies.

While Foodhills is undoubtedly a significant CBE initiative, far smaller CBE initiatives may equally be founded in, respond to, and reshape policy, governance networks and resource flows at multiple scales. We therefore recognize a need to build on the insights generated in this paper by further using topological spatial imaginaries, and thus transversally, to reveal the various relations and forms of power which effect the creation of CBE possibility spaces. In effect, the insights of this paper, and subsequent work undertaken in similar vein, do not simply provide insights for CBE policies at the national scale but at multiple scales such as local and regional scales. As such, it draws attention to the need for integrated or “joined up” CBE policy which is not simply the concern of a singular governance institution working at a particular scale, but the concern of multiple governance institutions working at multiple scales, not only with environmental priorities but

social and economic ones too. Foodhills and other situated CBE initiatives are often based in significant facilities and thus are real estate projects, which meet employment and social needs as well as attend to environmental priorities. Seen in this way, CBE initiatives bring the triple bottom line with its emphasis on economic, social and environmental aspects of sustainability into sharp relief.

In conclusion, by using assemblage thinking (a social constructionist approach and method) this paper provides insights which “look beyond” the realist perspectives of resource management and economics upon which CBE policy and management are based. Insights generated by this paper that are relevant for the development of CBE science and policies, to help address the CBE implementation gap in particular, are as follows:

First, opportunity spaces to create CBE initiatives do not lie out there simply waiting to be discovered. Windows of opportunity to create such spaces, perhaps arising from vacant industrial premises and economic restructuring as is the case here, can be identified but the possibility space for a CBE initiative has to be actively created.

Second, while resource flows should be measured and prices matter, the finances and economic case for CBE initiatives may be insufficient to create an opportunity space. CBE initiatives are based on material resource flows and founded in multiscale governance networks with varying priorities. Thus, CBE initiatives develop through the creation of narratives, which are based on text and numbers to create compelling arguments for their development which resonate and are aligned with governance networks promoting CBE initiatives at various scales.

Third, while CBE initiatives have clear environmental benefits, they have social and economic benefits too. For example, in time Foodhills will provide significant employment and contribute to economic development. Along with other CBE initiatives, it has significant industrial property elements which in turn effect real estate markets. Thus policies to promote CBE initiatives may have to attend to labour market effects and inputs – reskilling labour forces to work in CBE, real estate market developments – the provision of subsidized industrial units to accommodate CBE initiatives as well as helping CBE initiatives to develop the circular flows of material resources underpinning a CBE. Thus, CBE policy needs to be better integrated across governance networks working at various scales such as national, regional and local as well as across different policy areas such as for environmental protection and economic development.

Fourth, policy for CBEs rightly does not prescribe the precise form of a CBE initiative but rather uses abstract representations of circular flows to inspire and effect their development. This paper argues that this “fluid” aspect of CBE policy should continue, although possibility spaces to create CBE initiatives are unlikely to exhibit endless difference, they are likely to be highly variegated. Thus, blueprints and best practice management which condone particular problems and solutions should be avoided. Rather, greater support for the development of CBE opportunity may be needed as part of, for example, initiatives to respond to economic restructuring, industry closures and new industrial developments such as through inward investment.

Finally, this paper highlights further research to investigate CBE initiatives and overcome the implementation gap. Resource economics and management may provide useful insights, although price mechanisms alone are not the only factor which determine the development of CBE initiatives, they do play a role in their construction. Nonetheless

this paper demonstrates the utility of research on CBE initiatives undertaken from an alternate constructionist perspective to reveal how such initiatives actually unfold on the ground. Specifically, further research is needed to examine the narratives which make such initiatives actionable and cohere at various spatial scales. Innovative research founded in topological spatial imaginaries which emphasize power in the form of “reach” may be particularly interesting to reveal how CBE initiatives are constructed in complex spatial relations which defy topographical classification.

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Data Availability statement

The datasets presented in this article are subject to informed consent agreements between the authors and the individual respondents. The original data sets are not made readily available here because these can reveal individual respondents. Requests to access reduced datasets that do not reveal individual respondents should be directed to per-anders.langendahl@slu.se.

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