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Original research article

Can co-creation support local heat decarbonisation strategies? Insights from pilot projects in Bruges and Mechelen

Christopher Manktelow^a, Thomas Hoppe^{b,*}, Karen Bickerstaff^a, Anatol Itten^b,
Michiel Fremouw^c, Madhumita Naik^b

^a University of Exeter, Geography, Amory Building, Rennes Drive, Exeter EX4 4RJ, UK

^b Delft University of Technology, Faculty of Technology, Policy and Management, Department of Multi-Actor Systems, 2628 BX Delft, The Netherlands

^c Delft University of Technology, Faculty of Architecture and the Built Environment, Department of Architectural Engineering and Technology, 2628 BL Delft, The Netherlands



ABSTRACT

Co-creation is often presented as a solution to challenges of achieving energy transitions. However, there is currently little known about how coordinating stakeholders, such as city administrations, interpret co-creation and the extent to which this influences co-creation processes. We draw on a recent project, which embedded co-creation in public decision-making about local-level, sustainable heating transitions. We specifically address the question of how co-creation has been interpreted and implemented by administrations in two major Belgian cities, Bruges and Mechelen, between 2019 and 2023. Data collection included expert interviews, participatory observation, workshops, focus groups, and reviews of action plans and policy documents. We found that a normative understanding of co-creation evolved amongst the project coordinators, who inherently valued the inclusion of citizens in sustainable heat transitions, although actual co-creation only took place at the end of the project (2022–2023). However, we observed structural impediments and contexts that impinge on co-creation: a perceived conflict between community engagement and existing policy agendas, departmental interests; the instrumental framing of projects and the role of co-creation; and the impact of wider political pressures and events (in this case the COVID-19 pandemic restrictions). Conclusions are drawn regarding the longer-term benefits of co-creation for coordinating stakeholders. We also stress the need for research to more fully attend to the structural relations that enable and constrain these actors to practice and innovate with co-creation.

1. Introduction

Global net zero emissions need to be reached by 2050 to limit global warming to 1.5 °C. Reaching this target will require the rapid decarbonisation of heating systems [1]. However, social and economic processes can make the transition to sustainable heat difficult to achieve in practice. As Cowell and Webb [2] observe, decarbonising heating and hot water systems is a major challenge in countries that are dependent on natural gas. Heat demand within buildings varies according to the local climate, building fabric, and occupancy [3]. Considerations relating to cost, health, comfort, and hospitality also affect the behaviour of occupants and produce additional variations in heat demand [4].

Furthermore, sustainable heating technologies, such as heat pumps, are often perceived to offer few consumer benefits in comparison to natural gas heating systems. For example, early adopters of these technologies face high up-front costs and a lack of information and regulations to support change [5]. This is not just problematic for residents but also for what we refer to here as coordinating stakeholders - those

responsible for the planning and implementation of local sustainable heat strategies and promoting transitions to low carbon technologies, like local municipality authorities. As such, these actors face significant challenges when initiating, governing, facilitating, and promoting sustainable heat transitions. Cowell and Webb [2] point to the critical place of ‘useful knowledge’ (p.1) – that is, knowledge with sufficient authority, potency and trust to influence change and innovation. However, as they point out, heat decarbonisation exhibits the qualities of a wicked problem that is not open to simple definitions or solutions, and for which there are many different perspectives based on differences in social and value positions. Addressing heat decarbonisation also touches on matters of energy citizenship, i.e., the role of individuals (and consumers) as citizens in enabling change - in fostering pro-environmental positions, on community engagement with low carbon transitions and on practical participation in energy decisions. Energy citizenship fundamentally raises questions about the rights and responsibilities of different actors, and particularly, the role of public bodies [6] in enabling more active modes of citizen involvement in sustainability agendas.

* Corresponding author.

E-mail addresses: t.hoppe@tudelft.nl (T. Hoppe), K.bickerstaff@exeter.ac.uk (K. Bickerstaff), a.v.itten@minezk.nl (A. Itten), m.a.fremouw@tudelft.nl (M. Fremouw).

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As a way of embracing and better accommodating these different positions, local authorities are increasingly involving citizens and other stakeholders, such as private companies, in the co-creation of sustainable heat transitions [7]. Co-creation can be broadly defined as sharing the responsibility for initiation, design, and implementation of public services with citizens and other local stakeholders [8]. Municipalities often justify the use of co-creation in planning for sustainable heat transitions on instrumental grounds. Fiorino [9] discerns different arguments coordinating stakeholders like municipalities use to define co-creation and develop expectations. First, the instrumental argument refers to citizen involvement contributing to better and more legitimate decision making, incorporating a broader range of values which will eventually deliver better results. Second, the substantive arguments hold that citizen judgement are at least as sound as those of experts alone, seeing problems and solutions that experts might miss. Third, the normative arguments holds that decision-making should live up to democratic ideals, with citizens being the “best judge of their own interests”. Over the recent past, studies have mostly acknowledged instrumentalist arguments to co-creation. For example, it is argued that co-creating heat transitions with local stakeholders and citizens may improve the social acceptability of new heating systems [10], which then makes it easier for local authorities to achieve targets for reducing carbon emissions. Co-creation is also perceived to be more effective and efficient than top-down forms of planning [11], which struggle to cope with increasing complexity of policy demands and relationships between different political actors [7]. However, this assumes that a socio-economic system applies, in which citizens are considered equal players to public and private sector actors, and in which a broader definition of energy citizenship is acknowledged and adopted in legislation to assure this [6]. These assumptions are currently not met – in part by having to use incumbent institutions on public decision-making - making it difficult for citizens and civil society groups to secure impact and public resonance. Nonetheless using less conventional and institutionalised forms like co-creation, might give these groups a fair chance to have an impact [12].

Research into use of co-creation in heat planning suggests that there are also substantive reasons for co-creating heat systems with citizens and local stakeholders. The rationale for applying co-creation to sustainable heat transitions stems from the limited ability of authorities to cope with the increasing complexity of policy demands disruptions in local heating markets, limited use of enforceable government policies, the emergence of relatively autonomous energy community movements, and the lack of progress in heat decarbonisation compared to that made in decarbonizing electricity. For example, not all households can easily (individually) adopt a heat pump, because they can either not afford it, their home does not have the thermal insulation that allows for using heat pumps efficiently, or they do not want a heat pump because it is perceived as noisy or space consuming, or they simply have other priorities. Using co-creation can deepen understanding of how heat is used in-home, and prevent fragmented or suboptimal heating systems from happening. Through exploring and exposing connected issues, knowledge, and ideas, co-creation can ultimately improve the quality of sustainable heating policy decisions. This applies especially to neighbourhoods where district heating (DH) or other heat systems requiring collective action – like thermal community energy systems - are planned or are considered for retrofit and re-use [7].

Municipalities report benefiting from sharing knowledge with local stakeholders and gathering local expertise from citizens [13,14]. This facilitates the development of place-specific heating systems, such as a district heating networks, and makes it easier to implement similar projects in new contexts [14]. It can also encourage the exploration of different issues and ideas with local stakeholders and citizens, which then improve the quality of sustainable heating policy decisions [13]. There is evidence to suggest that co-creation can improve the quality of the planning process, as well as helping municipalities achieve their political and economic objectives [15]. These objectives mostly address

economic, social but also sustainability goals (like CO₂ reduction targets). But in practice economic goals or beliefs in aesthetic landscape quality often outweigh the social and sustainability ones when decisions have to be made [16].

Finally, there are arguments that co-creation is an intrinsically or normatively valuable process, regardless of its instrumental and substantive benefits. It is argued that co-creation empowers citizens [15], promotes social stability by creating a sense of community [17] and reconfigures unequal knowledge and power hierarchies [18]. However, it is important to recognise that local authorities tend to cite substantive and instrumental reasons for using co-creation, rather than normative ideals [11]. Nevertheless, there is evidence to suggest that co-creation can be more democratic than mere top-down approaches to planning and implementing sustainable heat transitions [15].

Whilst recent years have seen an expansion in co-creative approaches to governing sustainable heat transitions, scholars and coordinating stakeholders have expressed concerns over the capture of these processes by depoliticised problem framings [7,19]. For example, instrumental rationales for using co-creation can bypass uncertainties and dilemmas by prioritising consensus building at the expense of openly confronting political and social controversies [20]. Moreover, co-creation is often initiated and coordinated by state and market actors that exercise greater power than community and civil society actors, such as citizens or energy cooperatives [21]. The latter can therefore easily be co-opted by more powerful actors, without changing the status quo [22]. The instrumentalist uptake of co-creation therefore needs to be critically examined to ensure that community and civil society actors also benefit from the transition to sustainable heat.

Moreover, there is little consensus on what counts as co-creation and on how to define and operationalise the concept [23]. This conceptual ambiguity can make it difficult to evaluate co-creation and gather evidence that can be used to identify beneficial outcomes. For example, there is disagreement over whether co-creation only refers to the involvement of citizens [11] or whether other stakeholders, such as non-governmental organisations and private companies, should also be included [24]. Similarly, there is a lack of consensus over *when* actors need to be involved in a sustainable heat transition for it to be understood or classified as co-creation [7]. We therefore focus on understanding how the idea of co-creation functions and creates meanings in different social contexts, rather than on identifying a singular definition for what is a contested concept. Nonetheless, here we adhere to notions of energy democracy and energy citizenship that have a strong focus on communities and include practical participation in energy decisions, which indirectly call for transitioning to a new paradigm of public governance, and move away from traditional elitist monocentric forms of top-down government [25].

Furthermore, existing efforts to evaluate the use of co-creation in strategic planning for sustainable energy and heat transitions do not always acknowledge the temporality of the co-creation process. Evaluative frameworks do not often distinguish between the initiation, design, and implementation phases of the co-creation process [11,26]. In practice these phases often overlap as new stakeholders join and as the implementation of co-creation activities generates new opportunities and obstacles. One such approach to analyse how co-creation is enacted in urban contexts, and with what effects and consequences for sustainable heat policy, is the theoretical framework developed by Sillak et al. [19] that allows one to systematically evaluate co-creation in strategic planning for urban energy transitions. The framework consists of three stages (i.e., initiation, design, and implementation) and four core elements of co-creation planning processes (i.e., involvement, activities, goals, and outcomes). These core elements are further subdivided separately. For involvement this refers to a distinction in societal domains (i.e., state, market, community and third sector). For activities this pertains to expectation alignment, social learning, resource acquisition, assessment and evaluation. And for goals and outcomes this refers to effectiveness, efficiency, and acceptability.

Whilst there is an extensive literature on the use of co-creation in sustainability transitions [7,19] several literature reviews argue that efforts to evaluate the effects of co-creation in general [11,27], and more specifically of co-creation in sustainable heat transitions [19], are underdeveloped. Much of the literature relies upon qualitative evidence from single case studies, rather than seeking to compare drivers of and obstacles to co-creation across two or more case studies [11,27]. This reliance on single case studies, along with the conceptual ambiguity of co-creation [11], means that efforts to evaluate co-creation sometimes lack theoretical and methodological rigour. It is therefore important to develop and use frameworks for assessing co-creation to understand the conditions under which co-creation is useful for accelerating energy and heat transitions [19]. Comparing case studies can highlight how different governance structures, economic contexts and policy frameworks shape and constrain the co-creation process. However, it is not always helpful to use a set of predefined criteria to compare uses of co-creation against an idealised process and set of outcomes. A descriptive, explorative approach that seeks to understand how coordinating stakeholders involved in co-creation interpret the concept in different contexts could therefore yield insights that cannot be gained from evaluative approaches alone.

We address this gap through evaluating two pilot projects in front-runner cities in Belgium implementing co-creation in sustainable heating – with particular attention to the role of municipalities as coordinating actors – that share the same national context but are implemented by different local administrations and associated partnerships. We seek to analyse how local authorities as coordinating stakeholders perceive the concept of co-creation and to identify what expectations they have. We also reflect on the extent to which these definitions and expectations are reflected in the implementation of co-creation by coordinating stakeholders and in the outcomes of the co-creation process. We do this by studying two project pilots that are part of a project on sustainable heating transitions. The project aims to promote the adoption of low-carbon heating in residential and community buildings. One central aspect of this work is to explore the potential of co-creation in accelerating the transition to sustainable heat.

2. Research design and methodology

To examine and compare how co-creation is prepared and implemented two case studies are explored and compared [28] focusing on local administrations preparing and implementing sustainable heating policy, which aim to stimulate the adoption of low-carbon heat technology in residential and communal buildings. This includes co-creation approaches that are encouraged and facilitated by the municipality as a coordinating stakeholder, rather than by another type of stakeholder like a social housing organisation. Exploring and comparing two case studies allows for comparisons to be made between the varieties of co-creation in each municipality – in terms of action plan, stakeholders involved, characteristics of the built environment and heat energy infrastructure, as well as implementation.

2.1. Case selection

Two city-based experiences of co-creation for the strategic planning of sustainable heat transitions are examined and compared. This is done in the Flanders region in Belgium, focusing on two major cities: Bruges and Mechelen. Both are in the top six of cities in the region in terms of residents, have progressive climate programs, are signatories of the Covenant of Mayors (CoM; Mechelen since 2012 and Bruges since 2014) [29]. Mechelen has even served on the CoM Board and has accordingly formulated and implemented local climate policy. Bruges was later in the process but caught up quite well. Both are considered frontrunners in the Flanders region. More importantly to this study, both municipalities have significant ambitions around heat transitions and with a commitment to delivering co-creation activities at scale. And both serve as pilots

within an EU funded project, entitled "Sustainable Heating: Implementation of Fossil-Free Technologies" (SHIFFT), focusing on sustainable heating transition, with special attention to citizen engagement, participation and co-creation, and are delivered by municipal authorities. The pilots took place over a three year period (February 2020–February 2023). The main characteristics of the two cases are presented in Table 1.

2.2. Data collection

Information was collected by the authors over the period in which the co-creation pilots were implemented with the authors being part of the (academic) "Co-creation expert team". This entailed supporting, providing guidance, expertise and monitoring the two pilots (as well as a number of pilots in other countries, not presented in the present paper) through monthly meetings with representatives from each of the pilots, occasional bilateral discussions, progress sessions at semi-annual project meetings, cross-border learning sessions, and sequential co-design webinars to prepare an evaluation methodology. The co-creation expert team monitored and evaluated the activities of the two local authorities through participant observation in these activities [30] and through interviews with (amongst other) the project coordinators to collect qualitative data on the preparation and implementation of co-creation, and through collecting quantitative data to review their progress in reaching targets for carbon reductions and number of households reached.

A three-step approach was used in both co-creation pilots. First, in February 2020 a stakeholder analysis was performed and key characteristics of situational circumstances were mapped (concerning e.g., demographics, heat infrastructure, building characteristics). Second, the co-creation expert team supported pilot leaders in drafting co-creation action plans. Pilot leaders could attend webinars in state-of-the-art co-creation, bilaterally discuss co-creation options, and get feedback on action plan drafts from the expert team. Action plans were delivered by 30 June 2020. These outlined their initial targets (including key performance indicators on carbon reductions and the number of households reached), as well as co-creation activities that each project pilot planned to do. Table 2 presents the highlights for the action plans drafted by City of Bruges and City of Mechelen. Third, the action plans were implemented between July 2020 and February 2023. This process was supported and monitored by the co-creation expert team. Monitoring pertained to periodic meetings (first bi-monthly in 2020–2021 and later on monthly basis as per 2022) organised by the co-creation expert team in which pilot leaders were asked to present information on developments and progress made. To monitor progress both pre-set key performance indicators (e.g., on households engaged, investments and CO₂ reduction) were used as well as a monitoring and evaluation

Table 1
Main characteristics of the two cases.

	Mechelen	Bruges
Heat and related technologies targeted in policy and actions	Heat pumps, solar thermal, thermal insulation	District heating, heat pumps, solar thermal, thermal insulation
Physical context	86,996 inhabitants, rather old building and housing stock	118,509 inhabitants, World Heritage Site, rather old building and housing stock
Key stakeholders	City of Mechelen, citizens, 'Klimaan cvso' (community energy collective), renovation coaches and installers, Province of Antwerp, condominium organisations, distribution system operator	City of Bruges, citizens, De 'Schakelaar' (department in charge of renovation scans and home audits), 'Buurtkracht' (NGO), schools, neighbourhood organisations

Table 2
Overview of action plan highlights for the two cases.

Bruges	Mechelen
<p><i>Projected output:</i></p> <ul style="list-style-type: none"> • CO₂ emission reduction of 276 tons/year. • 160 households invest in new sustainable heating installations (e.g. heat pumps) • 420 households reduce their energy use & CO₂ emission <p><i>Aim:</i></p> <p>To support residents in a customer journey in order to implement sustainable heating and energy renovations. The task of the municipality is to implement actions of inspiration, advice and orientation to other citizens. Ambassadors of a neighbourhood or street can join forces to set up an early adopters team (following the 'Buurtkracht' approach).</p> <p><i>Actions:</i></p> <ul style="list-style-type: none"> • Open networking moments twice a year • PVE • Living Lab • To implement online tools like EnergieID to make residents more aware of their energy consumption. • To organise an annual climate festival with presentation of the local sustainable heat policy • To make a climate point available to support municipal public service provision building • To publish magazines, newsletter, and infographics to engage local residents • The City's online energy platform is updated to inform residents about actions, tools and policies the municipality gas available to enable them • To provide free renovation scans (and thermal insulation scans) to households • To make a Refurbishment premium available under which households are supported with and made aware about sustainable heating options and thermal insulation • To hold awareness raising actions like organising neighbourhood safari's, a neighbourhood survey, energy parties, home warmings, neighbourhood plan, group purchases, increasing social cohesion • To have a supportive subsidy scheme available for residents investing in heat pumps, thermal insulation or heat exchangers • To launch co-creation actions during development of local heat plan and climate plan • To make an Inventarisatie of neighbourhoods and contact persons to form an early adopters team (part of the 'Buurtkracht' approach) 	<p><i>Projected output:</i></p> <ul style="list-style-type: none"> • CO₂ reduction 103 tons/year • 25 households investing in sustainable heating installations • 225 households reduce their energy use & CO₂ emission from heating <p><i>Aim:</i></p> <p>To achieve the above mentioned project output by improving the municipal home energy renovation service so that it better supports households in their customer journey towards a sustainable home with fossil-free heating.</p> <p><i>Actions:</i></p> <ul style="list-style-type: none"> • To make an Energy Home available to guide residents in their customer journey towards a comfortable and energy-efficient home targeting 'fossil-free' heating. • To set-up co-creation sessions with citizens • To support energy monitoring with the platform EnergieID as a supportive online tool • To participate in a construction trade fair and organise lectures and information evenings (e.g., "Warme Winteravond Groen Verwarmen") • To make a group offer available to check heat/gas boiler in combination with a grant for social target groups for the maintenance of boilers. • To run a "Do the 50-degree test" campaign to raise awareness about unsustainable heating practices • To make group offers available regarding adoption of heat pumps • To launch of a call for apartment buildings owners and residents to apply for energy renovation • To launch a learning network with syndics and condominium associations • Deliberative workshops • Story telling • To improve communication to reach residents via municipal website, newsletter, social media, and other communication channels

methodology co-designed by the expert team and project consortium members in 2021, focusing on citizen engagement and the implementation of co-creation actions.

Regarding implementation of the action plans the projects were severely hindered in the first nineteen months of the project by the COVID-19 pandemic, which led to lockdowns and other restrictive measures and which made it impossible to implement real-life (in person) co-creative actions. Coordinating stakeholders had to resort to

online modes of citizen engagement and co-creation. After the COVID-19 pandemic restrictions were lifted in the Spring of 2022 implementation of (adapted) action plans could be implemented in real-life (in person) settings. After the Summer of 2022 implementation processes and the number of actions implemented intensified. For both Bruges and Mechelen the expert team intended to undertake a Participatory Value Evaluation (PVE) - an online macro-public co-creative research method [31] to explore large-N residents' preferences for sustainable heating policy options.

Interviews with the project coordinators in each city were completed mid-way through the project when implementation of co-creative action was prepared (March–June 2021) (see also [32]) and a year later when actions were implemented (and COVID-19 restrictions had ended, giving more space to organising in person meetings). For each case three interviews were conducted: two in 2021 (with the co-creation pilot leader and an external stakeholder) and one in 2022 (with the co-creation pilot leader). Interviewees were asked for their informed consent and the interviews were audio-recorded and transcribed. Representatives from the local authorities of Mechelen and Bruges also shared knowledge and expertise with each other and through cross-border learning sessions and webinars. For data collection formal and informal interactions with local municipality administrators were critical (either via video conferences, in person meetings, or via email). They offered a window into how local authorities have sought to coordinate the co-creation process in different social and political contexts. These two case studies exemplify how co-creation is shaped by the sustainable heating technologies that are used and the physical environment in which these technologies are implemented.

2.3. Data analysis

Interview transcriptions were uploaded into Nvivo, a qualitative data analysis software package [33]. Each document was then coded using a series of themes. These included contextual variables that were influencing the co-creation process, such as budgetary constraints, organisational values and policies, relationships with other organisations and time and staffing constraints. Definitions and motivations for using co-creation were also identified and analysed to understand how these changed over time and varied between the two case studies. Questions and themes that had emerged from the analysis of documentation were then used to form the basis of two semi-structured interviews completed with the project coordinators in Mechelen, and Bruges in July 2022. These interviews were used to validate and elaborate on findings from the initial analysis of documentation. The two cases were explored and compared using the criteria and participatory stages from Sillak's theoretical framework for assessing co-creation in strategic planning for urban energy transitions, i.e.: Initiation, design, implementation, involvement, activities, goals, and outcomes [19].

3. Results

First, we identify changes in how co-creation is viewed, how it is implemented over time and what outcomes have been achieved. Second, we analyse the cases of Mechelen and Bruges using the framework by Sillak et al. [19].

3.1. Views to expectations of co-creation

The definition of co-creation refers to how coordinating stakeholders define what co-creation is when communicating with different audiences, such as with their colleagues in a local authority, or with the supportive co-creation expert team. In both the Bruges and Mechelen cases, in the early stages of the pilot projects, the project coordinators tended to describe co-creation mainly in instrumental terms. Project coordinators set quantitative targets for carbon reductions and households reached by co-creation actions. Co-creation was also viewed as a

way of informing citizens about the benefits of using sustainable heating, and in the case of heat pumps and solar, as a means of triggering investments in these technologies. The project coordinators in Bruges and in Mechelen were initially familiar with ‘top-down’ approaches to citizen engagement, such as presenting citizens with information on heat pump offers or on plans to install district heating networks. However, over time we observed changes in the interpretation of co-creation as each project progressed, and with input from the (academic) co-creation expert team and experiences of organising activities.

In the Bruges case the project coordinator learnt about organising brainstorm evenings with neighbourhood committees from the co-creation expert team and from a representative of a Dutch NGO called ‘Buurkracht’ (also observer partner to the project). During the brainstorm session the project coordinator decided not to give citizens information about sustainable heating beforehand to avoid influencing the discussion. This helped the project coordinator recognise the value of two-way dialogue and of giving citizens ownership of the issues that they were facing. Their experience of working with citizens therefore produced a broader definition of co-creation that focussed on the empowerment of citizens and on facilitating dialogue between state and community actors who were involved in the co-creation process. Moreover, as the project progressed, the coordinating stakeholder began to cite other reasons for using co-creation, in addition to the instrumental motivations held the start of the project:

‘I think it’s a good investment because you will collect viewpoints, different viewpoints - so making sure that you do not fall into a kind of tunnel vision. Having it from multiple viewpoints makes your work also more robust, because it takes a lot of things into consideration...’

(Project Coordinator, Mechelen, 01-07-2021)

Through organising co-creation activities with citizens, coordinating stakeholders came to value dialogue with stakeholders who had different viewpoints. Dialogue with citizens could help coordinating stakeholders learn about the needs and priorities of citizens and other local stakeholders. Experiences of organising activities with citizens not only changed how project coordinators defined co-creation but also their expectations, as project coordinators came to value substantive and normative reasons for co-creating sustainable heating solutions.

Whilst there was a shift towards more substantive and normative reasons for using co-creation in both pilots, different political contexts and strategies used by coordinating stakeholders meant that definitions of co-creation slightly varied between each city. Initially, the project coordinator in Mechelen defined co-creation as involving citizens in policymaking. This reflects much of the academic literature on co-creation, which tends to focus on co-creation with citizens and on the redistribution of power and knowledge [11]. However, after trying to form a heat coalition that would support a sustainable heat transition, the City of Mechelen changed their definition of co-creation to include a wider range of local stakeholders. They also organised these stakeholders in ‘concentric circles’ to prioritise local government stakeholders, followed by businesses and NGOs, and finally citizens.

Through organising co-creation activities and through input from the co-creation expert team, coordinating stakeholders changed how they defined what co-creation is and what they expected from the co-creation process. In both pilots, the coordinating stakeholders changed their understanding of co-creation from a top-down process of educating citizens to a dialogue where citizens and local stakeholders are given ownership of the issue. The coordinating stakeholders therefore began adopting substantive and normative rationales for using co-creation [9], as well as the instrumental rationales that they had at the beginning of the project. Whilst there was a shift towards normative and substantive rationales for co-creation, the different approaches used in each case study meant that the coordinating stakeholders had different ways of identifying which local stakeholders should be included and when they should be involved. The different strategies used for co-creating sustainable heat transitions in the two pilots therefore meant that different

definitions of co-creation developed in different social and political contexts.

3.2. Implementing co-creation and co-creation outcomes

Whilst peer-to-peer learning, input from the expert team and experience of dialogue with citizens helped coordinating stakeholders broaden their definition of what co-creation is, implementing these definitions of co-creation proved to be difficult. One reason for this gap between the expectations held by coordinating stakeholders and the ‘doing’ of co-creation were budgetary and staffing constraints, which often placed limits on what could be achieved. The impact of the COVID-19 pandemic and the rise in energy prices meant that local authorities in Bruges did not have sufficient financial resources available to hire additional staff who could organise co-creation activities. This limited the scope of activities that could be planned, since it made it more difficult to organise time-intensive activities, such as workshops or PVE surveys [34]. It also meant that staff could not make the time to dialogue with citizens and other local stakeholders, which would have made it easier to learn from people with local knowledge and different values to those held by coordinating stakeholders. Furthermore, coordinating stakeholders reported not always having the political support for co-creation from local politicians within their municipality:

‘There are no frictions, but it’s a fact that the alderman, for example, initially hesitated about the co-creation process of ‘Buurkracht’ in Bruges. What do you want to do with some neighbourhoods? Some neighbourhood committees? This will not change the actions or this will not change the rising pace of renovation. For example, the scale is too small and just the neighbourhood - we have to do it faster, so we have to take measures for the whole city and just for a couple of people, just 15 people, for example and a brainstorm evening.’ (Project Coordinator, Bruges, 18-07-2022)

In the City of Bruges, the perception that co-creation is time-consuming and too ‘small-scale’ meant that local politicians were not initially supportive. The coordinating stakeholder in Mechelen reported encountering the perception that co-creation was time-consuming in their municipality. Moreover, in Bruges, a lack of support from local politicians meant that they were unable to complete a PVE survey with their citizens [32]. PVE is a method that is used to gather opinions from citizens about preferred policy options and strategies to implementation, which has been shown to be effective in other city-wide efforts to promote sustainable heating transitions [35]. However, concerns from local politicians about citizen preferences conflicting with existing policies meant that the PVE was first postponed several times and then dropped as a co-creation activity in the domain of sustainable heating [32].

Another issue emerging pertained to coordinating stakeholders holding that the lack of young people, women and ethnic minorities participating in co-creation activities was a consequence of these demographics having less free time available. Moreover, they also reported that citizens tended to view local authorities merely as a provider of public services. This made it difficult to involve citizens in co-creation activities based around dialogue or collective action. In addition, in both cases project coordinators found that citizens were primarily concerned with wanting to install heat pumps or other sustainable heating technologies within their own home. They were not always interested in working together with other citizens to develop co-creative solutions, which may simply reflect the time-intensive nature of co-creating community energy initiatives, since it takes more time to work together with other people to secure, for example, a group heat pump offer, than it does to focus on one’s own home. However, it may also reflect a perception that local government is primarily a provider of public services, and that political engagement is an activity that is limited to local and general elections. This suggests that approaches that encourage collective action amongst citizens, might be more effective in encouraging active participation from citizens than other approaches to

co-creation.

Despite these critical influences on co-creation the case studies also showed that municipalities learned throughout the project, and became more eager to adopt progressive practices from abroad – like ‘Buurkracht’, a neighbourhood approach using so-called energy ambassadors initiating from the Netherlands, whilst being adopted in Belgium by the City of Bruges – and implementing them locally, which allowed them to become more open to embrace and facilitate local bottom-up initiatives by local residents. Energy ambassadors are residents who volunteer to encourage other residents in their residential area of the benefits of sustainable energy and support them when they want to make their homes more sustainable. They do this by providing tailored advice, or using a team approach that also features feedback on home energy consumption performance and by offering ‘energy box’ kits to households. Another activity involving energy ambassadors pertains to mobilizing local residents to collaborate in teams and co-create plans, which is part of the ‘Buurkracht’ approach to make neighbourhoods “natural gas-free” [36]. In the Netherlands the use of energy ambassadors is considered to be effective, as it is practiced a lot and is valued by different stakeholders [37].

Use of ‘Buur(t)kracht’ and its energy ambassadors is illustrated by an event in the City of Bruges. In the Assebroek district, five enthusiastic residents living in a neighbourhood with 300 homes (in the north-western part of the city) contacted the municipal authority in 2022, with the question of how to make homes in their neighbourhood fossil free. At that moment there were natural gas fired gas boilers in their homes (installed in 2006) that were at the end of their economic life-cycles, and the residents were wondering how to replace them, and if a sustainable alternative would be possible. The municipality embraced this request by the residents, and organised five follow-up meetings to discuss sustainable heating but also other topics - particularly climate mitigation or adaptation - that were urgent for the residents. During these meetings the municipality participated with civil servants from different departments. To demonstrate the importance of the collaboration with residents the politically responsible official in the municipality, the Alderman, attended site visits to the neighbourhood, and met and discussed with the residents. During the five meetings problem-orientation and potential solutions were discussed and co-created between the municipal representatives and the residents. The results of these meetings led to developing a plan to study the sustainable energy potential for the neighbourhood and to make more publicity for using public budget from the ‘citizen budget scheme’ (‘burgerbudget’ in Dutch; translation by the authors): an amount of €25,000 euro per project, related to climate mitigation or adaptation, organised by two or more citizens. Residents could use this budget for example in the future for having a collective heat pump installed. Reflecting on this case the five enthusiastic residents started to serve as energy ambassadors in their neighbourhood and embraced an important intermediary role in between the neighbourhoods’ residents on the one hand, and the municipality on the other [38], illustrating how the ‘Buurkracht’ approach works in practice, and actually succeeds in mobilizing citizens and the municipality in co-creating and co-producing sustainable heating actions locally. Observing the implementation and learning from its successful approach in Bruges, a Dutch local authority participating in the project - the City of Middelburg - decided to adopt the ‘Buur(t)kracht’ approach. This observation mirrors policy diffusion from best practices or ‘policy-lesson drawing’ (from policies working well abroad; [39]), or scaling of innovative (social energy) action or practices by having the aim to replicate them in other contexts [40].

At the same time a learning process had occurred with coordinating stakeholder in the City of Mechelen, which led to undertaking more progressive forms of co-creation. In 2022–2023 co-creation was implemented in three different ways and at three different levels of aggregation: (i) Co-creation with condominium associations at the building level; (ii) Co-creation with community energy organisation ‘Klimaan cvso’ with focus groups at the city district level; and (iii) by holding a

Transition Arena experiment (or ‘Urban Transition Lab’) at the (over-arching) local government level. Co-creation with condominium associations’ members concerned organising a series of co-creative workshops and a one-stop-shop with the aim to co-design a retrofit masterplan in the ‘Mechelse Vesten’ city district for two buildings and with regard to investment decision-making in another building (2022). Next to sustainable heating goals co-benefits were also to be achieved in making the area more resilient to climate change induced extreme weather events.

Energy community organisation ‘Klimaan cvso’ was involved in multiple co-creation actions. First, it was in multiple ways involved in policy making processes with the municipality, with co-creation contributing on the one hand to capacity and knowledge building on the theme of sustainable heat and on the other hand to establishing citizen involvement in the heat policy making process of the municipality. In addition, ‘Klimaan cvso’ was involved in the sounding board group (with a group of experts and policymakers) that supervised a local ‘heat zoning and heat potential’ study. Furthermore, it was involved in a co-creation process at district level. In the social residential area of Otterbeek, the City of Mechelen, Woonpunt Mechelen and ‘Klimaan cvso’ jointly set up a pilot on “energy sharing”, with the aim of setting up a local energy community amongst the social tenants. Another result of the collaboration between Klimaan cvso and the municipality was the EU project ‘TANDEM’, in which the two form a tandem to develop a regional support framework to support citizen-led energy communities.

Co-creation regarding establishing and running a Transition Arena concerned developing transition pathways in a series of three workshops, which applied concepts from the Multilevel Perspective [41] and Transition Management [42,43] (i.e. Transition arena with multiple stakeholders, multilevel system analysis, X-curve transition pathway development showing fossil heating system destabilization and sustainable heating system niche breakthrough into the fossil regime) applied to the sustainable heat transition in the Mechelen city context in which twenty experts and stakeholders – including ‘Klimaan cvso’ - from multiple sectors were involved (e.g., community energy, spatial planning, DH systems, fuel poverty). The methodology used was inspired by Drift Urban Transition Labs/“Cities of Tomorrow” [44]. The Transition Arena resulted into the formation of a heat coalition in which the participants of the Transition Arena act as ambassadors and involve their own network in order to expand the group and create better leverage. In addition, the results were used to provide an impetus to developing a municipal strategic vision, policy framework and action plan. In hindsight, civil servants (4) and one alderman participating on behalf of the municipality were open to the Transition Arena as an experiment. If successful for the theme of heat, replication to other policy areas would be considered. However, initially the municipal public officials worried about the concrete results of the experiment and their relationship to other policy domains (i.e., fearing that each domain would desire to have its own Transition Arena, which would lead to a lot of complexity).

In summary, the Bruges and Mechelen cases showed that after a slow start to the project co-creation eventually took hold and resulted in positive outcomes: i.e., in developing a sustainable energy potential plan and raising public publicity to a subsidy scheme (Bruges); developing a building level master plan; developing a local heat zoning potential study; developing a pilot on ‘energy sharing’; developing funded follow-up projects; developing a local Heat Coalition, and providing an impetus to developing a municipal strategic vision, policy framework and action plan (Mechelen).

3.3. Case comparison

The Bruges and Mechelen cases were compared using the Sillak et al. framework [19] for assessing co-creation in strategic urban planning in energy transitions. The results are presented in Table 3.

Reflecting on the action plan (2020) and actions eventually implemented (2023) in the Bruges case the following points stand out. Out of

Table 3
Results from comparing implementation of co-creation in the two cases.

Co-creation framework element	Bruges case	Mechelen case
Initiation	<ul style="list-style-type: none"> • Municipality, via EU-funded SHIFFT project • Via Citizen collective initiatives (bottom-up; i.e. Assebroek district) 	<ul style="list-style-type: none"> • Municipality, via EU-funded SHIFFT project
Design	<ul style="list-style-type: none"> • Action plan developed, via EU-funded SHIFFT project, with support from the expert team 	<ul style="list-style-type: none"> • Action plan developed, via EU-funded SHIFFT project, with support from the expert team
Implementation (co-creation action and supportive policies and actions):	<ul style="list-style-type: none"> • Co-creation of a local heat strategy with key stakeholders • Energy ambassadors and ‘transition families’ to mobilise other residents and adjacent city districts (using the ‘Buurtkracht’ approach, also to encourage co-creation) • Information sessions (‘energy parties’ and teaching at schools) • Webinars • Brainstorming events • Networking events (on good practice) • Residents’ survey, competition for residents’ initiatives • Initiating a DH system alliance, • Supportive policies: subsidy scheme for home energy renovation, ‘burgerbudget’ subsidy scheme, ‘gas free’ renovation scans of over 1000 homes in support of co-creative activities 	<ul style="list-style-type: none"> • Co-design of renovation scheme and master plan with condominium association members ‘Mechelse Vesten’ • Co-creation of a community energy empowerment plan at the Otterbeek city district • Having an Transition Arena experiment with 20 stakeholders including community energy collective ‘Klimaan cvso’ • Information sessions, workshops on local heat planning and policy • Organising collective actions, in line with community needs, like group purchases on a city scale, neighbourhood organisation (i.e., ‘Klimaan’ cvso) targeting the phase-out of fossil heating (e.g., by replacing gas boilers by heat pumps) • Supportive policies: campaign on sustainable heating, information sessions, free boiler check with group purchase offer, “Do the 50-degree test”, campaign on sustainable heating, publishing narratives of household experiences using sustainable heat options, customer journey, group offers for joint purchase of heat pumps • Making an ‘Energy Home’ available to inform residents and provide tailored advice
Involvement	<ul style="list-style-type: none"> • State: Mostly local government, and to some extent regional government • Market: Distributed System Operator, consultants • Community: Residents, neighbourhood collectives 	<ul style="list-style-type: none"> • State: Mostly local government, and to some extent regional government • Market: Distributed System Operator, consultants, construction engineers, social housing organisations • Community: Residents, energy cooperative (‘Klimaan cvso’), condominium organisations
Activities	<ul style="list-style-type: none"> • Expectation alignment: Move from strictly instrumental to also 	<ul style="list-style-type: none"> • Expectation alignment: Move from strictly instrumental to also

Table 3 (continued)

Co-creation framework element	Bruges case	Mechelen case
	<p>substantive and normative rationales of co-creation; Risk avoiding attitude, resulting in decision not to perform a PVE in the sustainable heating domain</p> <ul style="list-style-type: none"> • Social learning: Between city departments, via residents’ information sessions, and via the energy ambassador’s approach (‘Buurtkracht’; as “policy transplantation” adopted from good practice in the Netherlands). Learning via support and feedback by project co-creation (academic) expert team. Adoption of good practice via knowledge diffusion in project network (i.e., ‘Buurtkracht’ approach) • Resource acquisition: Via local authority, via EU-funded, national and local subsidy schemes • Assessment and evaluation: monitoring (tool) and evaluation co-designed within the EU-funded SHIFFT project, supported and performed by the expert team 	<p>substantive and normative rationales of co-creation; Risk avoiding attitude, resulting in decision not to perform a PVE in the sustainable heating domain</p> <ul style="list-style-type: none"> • Social learning: Between city administration, other decentralised governments, local stakeholders, and engineering companies to form alliances. Fruitful collaboration emerged with local energy community (‘Klimaan cvso’) which was involved in policy making and implementation (to mobilise residents for climate actions). Learning via support and feedback by project co-creation (academic) expert team • Resource acquisition: Via local authority, collaboration with other local and regional government organisations, via EU-funded, national and local subsidy schemes • Assessment and evaluation: monitoring (tool) and evaluation co-designed within the EU-funded SHIFFT project, supported and performed by the expert team
Goals	<ul style="list-style-type: none"> • Engage with and persuade 580 households to invest in sustainable heating options • 276 tons/year CO₂ reduction 	<ul style="list-style-type: none"> • Engage with and persuade 250 households to invest in sustainable heating options or lower energy consumption. • 103 tons/year CO₂ reduction.
Outcomes	<ul style="list-style-type: none"> • Achieved an estimated 3240 households to invest in sustainable heating options • Achieved an estimated 4090 tons/year CO₂ reduction • Network formation: Co-creation activities in Bruges have captured questions from neighbourhood residents and investigated what the municipality could mean for them and how they can help them • Information evenings informed many citizens on how to contact the municipality and request a thermal insulation scan for free, and request a subsidy for installation of sustainable heating options like heat pumps • Follow-up co-creative approach in city districts 	<ul style="list-style-type: none"> • Estimated 21,555 households engaged and persuaded to invest in sustainable heating options or lower energy consumption • An estimated 327 tons/year CO₂ reduction achieved. • Through increased collaboration with stakeholders and having set up an energy counter, the local authority was able to better address the sudden increase in demand of heat pumps in Autumn 2022 • ‘Klimaan cvso’ gaining knowledge and building capacity • Network formation: a learning network was set-up with local SMEs and engineering companies. A collaborative network was developed with other local and regional

(continued on next page)

Table 3 (continued)

Co-creation framework element	Bruges case	Mechelen case
	where district heating will be installed	governments <ul style="list-style-type: none"> • As a follow-up to the co-design of a scheme with condominium associations an EU funded project (i.e., LIFE ‘CondoReno’) was secured on energy renovations with condominium associations (with the afore mentioned collaboration network partners). For co-creation with ‘Klimaan cvso’ the ‘TANDEM’ project was set-up to establish a regulatory framework to empower energy communities regionally • A Master plan for condominium owned buildings was developed

fourteen actions in the action plan only three actually concerned co-creation (i.e., in co-creating plans, approaches or policies with residents or other local stakeholders). These pertained to: a PVE survey, a Living Lab, and the ‘Buurkracht’ neighbourhood approach. The other eleven actions primarily pertained to communicative tools and the goal of raising awareness amongst residents, or important incentives, like a subsidy scheme. When comparing realisation against the action plan out of three co-creation actions only one (‘Buurkracht’ approach) was realised. Most of the other actions like thermal scans were implemented in full.

When reflecting on the action plan (2020) and actions eventually implemented (2023) in the Mechelen the following points stand out. Out of twelve actions mentioned in the 2020 action plan only two concerned actual co-creation (i.e., setting-up co-creation with citizens and having deliberative workshops). Arguably a third one, the PVE survey, can be added, although this was only considered and put on the agenda after the initial action plan had already been established. Out of these three, two were eventually realised (i.e., with the exception of PVE). Remarkably, additional co-creative actions were implemented and realised that were absent in the 2020 action plan. This applies, for example, to having the Transition Arena experiment, co-creating the retrofit Master plan with condominium association members, and neighbourhood actions in close collaboration with ‘Klimaan cvso’.

The evaluation shows that quantitative goals in terms of CO₂ emission reduction were met in both cities according to the project evaluation. Yet, it is not clear how far this can be attributed to co-creation because impact calculations were based on a wide range of policy instruments used including subsidies. Arguably, one can recognise the claim by the City of Bruges’ pilot leader who argued that co-creative output was critical and a key influence on residents requesting the subsidy, which ultimately contributed to installation of thermal insulation and sustainable heating options at their homes.

4. Discussion

Our analysis highlights the importance of studying how interpretations and expectations of co-creation change over time, and how this is reflected in its practical implementation. The results show that coordinating stakeholders initially had a largely top-down, and instrumental interpretation of co-creation but that some - but not all - of them transformed over time, adopted innovative approaches, became more open to embrace and facilitate bottom-up initiatives, and co-create

actions through them.

Nonetheless, the study also reveals the presence of substantial barriers to co-creation. These include constraints around political support and financial resources which meant that coordinating stakeholders did not have the staff and time available, nor were they permitted to implement state-of-the-art digital tools (i.e., PVE), to facilitate dialogue with a diverse range of citizens and local stakeholders. Until the Summer of 2022 co-creation activities therefore often tended to be mere generic modes of consultation, rather than spaces where citizens and local stakeholders could actually be included in decision-making and the co-creation of sustainable heat policies and action plans. The instrumental rationales for using co-creation outlined at the beginning of the project may have also locked in ways of engaging with citizens and stakeholders that aimed to achieve narrowly defined goals, whilst using policy instruments targeting awareness raising and citizen persuasion. This stands in contrast to ideals of co-creation aimed at dialogue and subverting unequal power and knowledge hierarchies, and using instruments that better allow for collective action. We therefore contribute to existing efforts to evaluate co-creation by analysing how interpretations of the concept play out in citizen-municipality encounters and in citizen involvement [45] (p. 712).

We used the framework by Sillak et al. on co-creation in strategic planning for urban energy transitions in the analysis of our study [19]. Although the analysis showed that the framework was useful we consider that there is room for elaboration. We present this classified per element of the framework: involvement, activities and outcomes. With regard to involvement our work stressed the importance of mechanisms that support the expansion of community energy agency in these collaborative activities. This was illustrated by the involvement of ‘Klimaan cvso’ in multiple co-creation arenas in Mechelen. The study also showed the importance of research institutes (and their expert teams) as agent of change supporting pilot leaders of coordinating actors. The study also revealed that co-creation is situated in a local governance landscape with wider societal issues at hand, and municipal departments vying for budget and attention. In addition, there is a multi-level dimension to co-creation. On the one hand referring to different vertical levels; i.e., building, district, city at large, as showcased in the Mechelen case. On the other hand multiple levels of government (i.e., local, provincial, national, EU) that can support and empower further co-creative experimentation. The City of Mechelen engaged provincial and EU level government bodies to co-develop projects and secure funds for running additional co-creation pilots. In terms of outcomes, this research showed that next to effectiveness, efficiency and acceptability, co-creation can also have impact in terms of network formation, resource acquisition and developing follow-up projects. This also holds for knowledge generation and capacity building, and applies to both the coordinating actor, residents and local stakeholders, who learn from co-creative experiences, and develop new skills or improve current skills. In the City of Bruges, for example, officials learned that cross-departmental alignment and collaboration was essential for setting up new rounds of co-creation.

Finally, the study revealed new insights into co-creation activities. First, good practice methods of co-creation were adopted by coordinating actors following research institutes using their agency as intermediaries. In the Bruges case this led the local authority to adopt the ‘Buurkracht’ approach (which was eventually renamed to ‘Buurkracht’) focusing on local social structures (via ‘energy ambassadors’) to mobilise citizens and co-create a scheme. In the Mechelen case the ‘Transition Arena’ method was adopted from the Dutch research institute Drift. Both approaches can be seen as methods to support co-creation processes. Our study also revealed the importance of supportive policy instruments to expectation management and alignment in co-creation, as well as pathways to impact. In the Bruges case a co-created plan was developed that depended on the availability of thermal scans and a subsidy scheme. Finally, the study revealed a set of external factors influencing co-creative action: i.e., the COVID-19 pandemic restrictions

in 2020–2022 (negative) and skyrocketing gas prices in 2022–2023 (positive). This also holds for political and administrative factors (negative). Acknowledging the importance of these structural contexts might contribute to elaboration of current models or frameworks that analyse co-creation as across discrete performance metrics but which discount the impacts of external events or ‘shocks’ play.

Our evaluation of the two cases highlights the benefits of describing the instrumental, substantive, and normative rationales that coordinating stakeholders use to define co-creation and develop expectations [9]. Using the same criteria to evaluate and compare case studies, such as the involvement of actors (see [11,19]), can overlook the different political, social, and economic contexts in which co-creation takes place. For example, the technical nature of discussions or budgetary constraints might make it difficult or inappropriate for a local authority to involve citizens in the initiation or design phases of the co-creation process [26]. A descriptive approach, which seeks to understand how coordinating stakeholders interpret co-creation and analyses how these interpretations are implemented, therefore offers a more nuanced way of evaluating co-creation in context. Finally, we recognise the importance to address and conceptualise notions of expertise mobilised in co-creation processes. In prevailing neoliberal governance structures, expertise is typically attributed to specialists, managers, engineers, energy companies, and decision-makers rather than to citizens. Co-creation, however, is claimed to give citizens a venue to voice their values, experience, and place-based knowledges. This was showcased in the Bruges and Mechelen cases, with residents initiating and co-designing retrofit plans as well as a supportive subsidy scheme.

5. Conclusions

This paper started with the following research question: When comparing pilots in two cities, how is co-creation interpreted and implemented by local administrations? Two cases – the City of Bruges and the City of Mechelen - were analysed over a three-year span (2020–2023). Results show that coordinating actors (i.e., municipality officers) initially had fairly traditional and instrumental views in their implementation of co-creation. This was illustrated by policy makers initially using a top-down perspective on selecting policy instruments to persuade local residents to invest in sustainable heat technology without consulting or involving citizens (or their representative bodies) in decision-making. Moreover, the approach excluded multi-lateral instruments and focused on encouraging unilateral behavioural action, deploying policy instruments that qualify as symbolic, learning and incentive tools [46]. As time went by, the perspective of coordinating actors changed as they learned to appreciate and adopt more far-reaching and inclusive perspectives, which eventually led to implementation of actual co-creation action in both cities; i.e., a neighbourhood sustainable home improvement scheme in Bruges, and co-creative decision-making at three levels (condominium association owned buildings, neighbourhood, and developing visions and pathways at the City level) in Mechelen. The latter even went as far as adopting a Transition Arena approach [22,47] to developing a local heat strategy, which was to be considered for adoption by the local administration.

The study also revealed substantial barriers to co-creation. These include constraints around political support and financial resources which meant that coordinating stakeholders did not have the staff and time available, nor were permitted to implement state-of-the-art digital tools (i.e., PVE [34]), to facilitate dialogue with a diverse range of citizens and local stakeholders. Over the first two years of the pilots the co-creation activities therefore often tended to be mere generic modes of consultation, rather than spaces where citizens and local stakeholders could actually be included in decision-making and the co-creation of sustainable heat policies and action plans.

Like most research this work has several limitations. First, a large part of the project (from March 2020 until February 2022) was completed during the COVID-19 pandemic. It was a difficult,

unbalanced period with poor conditions to implementing co-creative action. Second, data was mostly provided by the coordinating actors, providing a partial perspective on co-creative action. Third, local administrations were not able to support macro public co-creation using PVE surveys, leaving the research with pre-dominantly micro public forms of citizen engagement and co-creation in public decision-making, which may well lead to overrepresentation of wealthier and more ecologically motivated residents. Fourth, the Cities of Bruges and particularly Mechelen are frontrunners in local climate policy which may limit external validity.

Future researchers are advised to replicate this study's research design (again using a longitudinal approach), and build in more diversity in city-based engagement with climate policy, city size and different structures (and powers) of urban governance. Future researchers are also recommended to analyse the power relations between coordinating stakeholders, other stakeholders, and citizens to identify ways of making co-creation more effective and inclusive. Such research would need to take into account the wider socio-political and socio-technical environment in which co-creation is positioned. This in particular pertains to the neoliberal influences on dominant energy system regimes (including regulations, policies and infrastructures), and the ways in which the role of citizens in energy supply chains is framed, often with limited scope to achieve a more mature interpretation of the concept of energy citizenship [25,48]. As coordinating stakeholders needed to advocate for co-creation within their own municipal organisation, we suggest developing methodologies for evaluating co-creation that analyse interactions between citizens, coordinating stakeholders and other local stakeholders. These methodologies could draw upon theoretical frameworks that conceptualise shifting power relations between actors, such as multi-actor perspectives [49], urban transition labs [44], co-creation in strategic planning [19], or the politics of niche development [50]. Perspectives that emphasise the materiality of sustainability transitions, such as Actor-Network Theory [51–53], could also add further insight into how networks of human and non-human actors co-create sustainability transitions.

Declaration of competing interest

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

Data availability

The authors do not have permission to share data.

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