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From warming bodies to heating spaces: Using feminist energy justice and oral histories to unpack home heating transitions in Europe, 1945-present

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A B S T R A C T

Home heating transitions influence sociocultural practices and bring about structural changes in daily life. To uncover the power dynamics underpinning these transformations, this paper applies a visionary framework for feminist energy systems designed to challenge hegemonic and unsustainable energy cultures in pursuit of a more just and equitable future. Drawing on the framework's political, economic, socio-ecological, and technological dimensions, we analyse a pan-European collection of 284 oral histories, documenting individuals' memories of past heating arrangements and transitions to new heating systems, collected through the JustHeat project. The project aims to combine reflections on past experiences with visions for the future, revealing new insights into the conditions of contemporary home heating transitions.

The research, conducted across Sweden, Finland, Romania, and the UK, deepens our understanding of how heating transitions have driven sociocultural shifts, such as the shift from warming bodies to heating spaces and from embodied to concealed heating practices. While these changes may have offered greater convenience, our findings reveal that they often came at the expense of reduced enjoyment, less social interaction, and decreased care work associated with keeping warm. By applying the feminist energy systems framework to our findings, this study highlights how dominant power structures, including technomasculinity and 'green growth' ideologies, have shaped home heating transitions, de-politicised them, and overlooked relational aspects of energy systems in favour of increased productivity and efficiency. These findings support challenging hegemonic power structures to envision and realise more desirable and inclusive energy transitions, grounded in care, equity and relational sustainability.

1. Introduction

Home heating is not only one of the largest drivers of energy use in Europe and the UK, but is also deeply interwoven with the routines of everyday life and our ability (or otherwise) to enact desired and necessary social and cultural practices [1–4]. This is the premise of the JustHeat project, which employs oral histories and art methods to explore experiences of heating transitions across time and place and distil learning for the present transition to low carbon heating [5]. The significance of heating and its infrastructure for wellbeing, safety, nostalgia, social relations, and sense of place remains underestimated in policy contexts [5–7]. This gap is reflected in the limited consideration

of these aspects in debates about heating futures. The project responded to the EU's accelerating ambitions to quickly transition towards smart and decarbonised heating systems [8] to better understand the life-altering effects of heating transitions. These transitions impact the sensory experience of home and the social relationships and cultural experiences connected to that [9].

Despite research pointing out the human attachment to home heating [10], the uneven yet fundamental social and cultural impacts of previous heating transitions – from solid fuels to collective and individual heating systems to new smart heating technologies – remain under-researched. JustHeat along with its preceding pilot study [5] explores how changes in heating technology have affected social and

cultural aspects of everyday life, using oral histories as a methodology suited to capture personal experiences of homelife [11]. This paper investigates specifically how these changes have shaped and been shaped by political and economic paradigms. Drawing on archival research and ∼ 300 pan-European oral histories of past home heating transitions, this study delves into intimate narratives of heating transitions from the Second World War to the present day, spanning Romania, Finland, Sweden and the UK. By analysing these accounts, the paper aims to unpack underlying power structures to better understand the contemporary conditions of home heating.

The framework of energy justice serves as a tool to highlight, critique, and address injustices primarily concerning distributive, recognition, or procedural implications [12]. Much focus has been given to reducing inequalities and ensuring just procedures and outcomes in energy transitions [13]. However, the framework has been criticised for not properly addressing the historical processes and underlying power structures that have produced unsustainable and unjust energy systems [14]. While the distributional, recognitional and procedural tenets of energy justice adopt both normative and evaluative approaches and can identify various manifestations of injustices across decades of energy transitions, this policy driven approach cannot fully grasp the impacts of these transitions on families within the heart of the home [15]. For example, in all four countries included in the study, heating transitions from various solid fuels to newer technologies generated forms of inequality both in the "spatial distribution of energy infrastructures" [16], but also in how the processes of transition were designed. However, merely identifying where, what and how households experienced these heating transitions provides an incomplete picture of the societal transformations that emerged during these processes. Thus, while the traditional energy justice framework is useful when exploring injustices within current and hegemonic energy systems, particularly to inform policymaking contexts, it is not designed to fundamentally question and challenge these systems.

As this paper aims to explore the lived experiences of past home heating transitions and the underlying structures that have driven technological and sociocultural changes, there is a need to apply a framework that enables scrutiny of structures, changes, and developments beyond instances of injustice to capture a wider range of social and cultural implications of transitions. An appropriate framework for this purpose is proposed by Bell et al. [17] who suggest using visions for feminist energy systems as a tool to guide the design, planning, and use of future energy systems. Bell et al. argue that despite the increased integration of renewable energy, total energy use continues to rise, indicating that the alleged energy *transition* rather should be viewed as an energy *addition* [18]. They argue that this underscores the need to look beyond technology to achieve a sustainable energy transition and, focusing instead on the underlying power structures and economic imperatives that keep us "stuck in unsustainable energy cultures" [17]. In their framework, feminist theory is applied to its full potential to uncover power relations beyond gender to envision more fair and inclusive energy systems. Rather than limiting our analysis to justice and particular theories within that realm, we thus strive to analyse past heating transitions in terms of power, fairness, and inclusivity, grounded in feminist theory. This approach has been identified as a pressing need in energy research where deep and interdisciplinary applications of feminist theory have been missing [19]. Therefore, we will explore and challenge dominant and deeply embedded (in society and in energy research) sociotechnical imaginaries that are shaping current transition pathways [20]. Bell et al. outline four dimensions in their framework: the political, the economic, the socio-ecological, and the technological, which enable the exploration of a wide range of social, cultural, and power implications of transitions as revealed through the oral histories.

The aim of this paper is thus to apply and test the framework as an evaluative analytical tool to uncover often overlooked sociocultural aspects and underlying assumptions and structures that have shaped past home heating transitions. In many ways, this is an exercise in uncovering *new* memories of the past, and potentially contradicting or elaborating dominant narratives of home heating transitions. Ultimately, applying a visionary framework to the past allows us to triangulate the past, present, and future and to see the stark contrasts and subtle nuances between where we have been, where we are, and where we want to go. An important contribution of the paper is also to operationalise the theoretical framework for feminist energy systems by adding concrete examples to it. This will make it easier to understand and showcase how current and future transitions can have unintended consequences, what these could be, and how visions of feminist energy systems can be utilised to bring out underlying assumptions commonly overlooked in energy research.

1.1. The grand narrative of home heating transitions

Home heating has undergone multiple transitions across Europe since the Second World War. While transitions have come at different times and relied on different fuels and technologies across countries, some general traits are shared. Solid fuels such as wood, coal, and coke were for a long time used in point-source systems such as stoves and fireplaces in one, multiple, or all rooms [9]. These systems came to be replaced with, or complemented by, central heating, leading to radiators in all rooms and individual boilers for every house. In most contexts, boilers were first fuelled with solid fuels that came to be replaced with oil or gas. Today, gas central heating still dominates in the UK, whereas collective district heating systems have been deployed in urban areas of Sweden, Finland and Romania. Other collective heating systems, such as electricity, have also increased in Sweden and Finland particularly, where a majority of the single-family houses today are heated with heat pumps and/or wood. More details about heating transitions in the four countries can be found here [9].

Heating transitions have been driven by fuel affordability, geopolitical tensions, regulations for clean air and reduced climate impact, political investments and directions, and technological development for improved comfort and convenience [21,22]. Overall, housing standards and buildings' energy performance has improved since the Second World War, which has led to improved thermal comfort through less cold, damp, and draughty indoor environments [23]; yet, there is still a substantial pent-up need for renovation of post-war housing stocks across Europe, and standards in terms of thermal insulation varies significantly across countries [24]. As heating technology has become more efficient and automated, the labour of keeping warm has decreased, leading to more convenient heating and less interaction with heating systems in everyday life. With improved energy performance of buildings and more efficient and decarbonised heating technology, the climate footprint of home heating has been improved. However, similar as in many other sectors, the improvements in heating efficiency have not been sufficient to offset the overall increase in heating demand [25]. Primarily, this demand stems from increasing heated space per person and overall growth of building stocks, meaning that despite improvements in efficiency, the overall energy use for heating has not decreased [26].

Although sufficiency perspectives are being increasingly highlighted as necessary approaches to reach climate targets within the heating sector, energy efficiency remains the dominating strategy within policymaking [27,28]. This follows from transition policymaking being guided by techno-economic reasoning [29] and green growth assumptions of decoupling energy use and emissions from increasing energy demand [30]. This technology-centred governance often contributes to a de-politicisation of transitions [31] and a neglect of how heating transitions affect people on a personal level in favour of laying out the grand narrative of how technology has and continues to improve our lives [32]. The following section will introduce the framework that is applied to reveal more nuances to this story as well as hidden and parallel transitions that have unravelled as a consequence of technologically designed developments.

2. Theoretical framework

In their framework, Bell et al. analyse energy along four intersecting dimensions: the political, the economic, the socio-ecological, and the technological, as can be seen in Table 1. They structure these dimensions in terms of visions and ways to plan ahead for feminist energy systems, emphasizing that the past oftentimes holds a nostalgia and memories that can appear more appealing than alternative futures as "the future has no memories to offer" [33] (p.21). Feminist theory and thinking are thus applied here, as in other contexts, as a tool to offer "memories of the future that we hope to attain" [33] (p.21) that are rooted in longings for change across and beyond the four dimensions of the framework. As we aim to apply the framework as an evaluative analytical tool to expose power imbalances, injustices, trade-offs, and underlying assumptions in past home heating transitions, we will here describe and interpret the framework through an evaluative lens and tailor it to the specific context of home heating.

2.1. Political

In the political dimension of their framework, Bell et al. highlight that renewable energy technologies alone do not guarantee sustainability, democracy, or justice. Instead, they assert that new energy technologies must be accompanied by new energy politics to truly disrupt paths and patterns of unsustainability [17]. They draw on examples of unjust outcomes from renewable energy projects that rely on old, centralised modes of development and extraction that contribute to upholding power imbalances and inequalities in the favour of dominating energy regimes [34]. Moreover, the framing of climate change as a problem rooted in the natural sciences reinforces a narrative in which solutions are expected to primarily emerge from this domain, namely through renewable energy technologies [35]. This strong reliance on technological solutions to mitigate severe effects of climate change contributes to a de-politicisation of energy transitions that Lövbrand et al. describe as a "socio-political arrangement that replaces ideological contestation and struggles by techno-managerial planning" [35]. An increasing reliance on techno-economic reasoning in decision-making has led to a rise in neoliberal policymaking and a growing trust in the increasingly privatised market to deliver desired and sustainable transitions [17]. In this context, just outcomes are, if considered at all, merely assumed to follow. Behind the trust in ecomodernist, capitalist, and authoritarian approaches to achieving sustainable transitions lies several assumptions that, to date, lack empirical evidence, such as the ability of hegemonic political strategies to be truly sustainable from both ecological and social perspectives. When presenting their framework, Bell et al. bring attention to these underlying assumptions and power structures and call for a re-politicisation of energy transitions where public and democratic ownership is applied to generate communal wealth rather than private profit [17]. Pluralist and decentralised energy systems are considered favourable for democracy as they can offer diverse solutions tailored to a wide range of contexts, thereby enabling communities to regain power, ownership, and control of their energy systems.

Another concern within the political dimension is the divide between the public and the private, or the political and the personal. It has been shown that "the depoliticization of the environment rests upon the devaluation of reproductive activities, which are relegated to the exploited, hidden spheres of "nature" and "household."" [17]. This devaluation of socially reproductive labour and care work which accompanies the devaluation of environmental externalities is seen as part of a technomasculine narrative that is rejected within feminist energy systems [36]. A technomasculine narrative refers to the dominance of masculine-coded values, practices, and power structures in the design, deployment, and governance of technology, often emphasizing control, efficiency, and technical expertise while marginalizing relational, emotional, or care-oriented perspectives [37,38]. Within the ecofeminist literature, the divide between the political/personal and public/private has been shown to not only devalue certain activities, but to actively harm certain bodies in benefit of modern extractive regimes [39].

Based on Bell et al.'s analysis of energy systems in the political dimension, we can discern certain themes and questions that emerge as relevant to highlight when evaluating previous home heating transitions through the lens of feminist energy systems/justice. The first theme is democracy and control, which encompasses, in the political sphere, to what extent heating transitions have been politicised, if and how much influence people have had, and finally, in the private sphere, how much control people have had over their heating in their own homes. This also relates to what has been possible and allowed in terms of choices and options for home heating under different political regimes and in times of scarcity, crisis, or unaffordability. These key themes and questions are summarised in Table 2.

2.2. Economic

In the economic dimension of their framework, Bell et al. centres their arguments around the fact that empirical research does not support the assumption that high GDP, and thus high energy consumption, correlates with well-being, equality, or ecological sustainability. As such, they refrain from the notion that the growth imperative, measured through GDP, should dictate energy systems, and instead promotes putting well-being over profit and growth [17]. Some of the main conflicts between well-being and growth that they highlight are the globally embedded inequalities and violence that enables growth as well as the restrictions that the growth imperative and the emphasis on wage labour puts on individuals and communities. The former refers to the fact that growth, technological development, and energy-intensive lifestyles have been enabled by an uneven distribution of labour and resources, violence on communities and ecosystems, and the underdevelopment of the Global South [17,40–42]. In here lies not only an argument against endless growth on account of well-being and justice, but also on account of the logical fallacy of extending such development worldwide "absent its unequal and violent underbelly" [17].

The second conflict between well-being and growth concerns the correlation between labour time for gainful employment and energy use, where research has shown how a shorter work week could reduce energy demand and greenhouse gas emissions [43] while at the same time improving the health and overall life satisfaction of individuals [44]. They thus envision feminist energy systems being deeply entangled with economies less dependent on gainful employment and with a higher valuation of social reproduction. By increasing the share of pink-collar jobs, i.e. jobs within care, service, teaching, community events, and environmental restoration, wage labour can be increasingly decoupled from energy demand and greenhouse gas emissions as these jobs generally are less energy-intensive than traditional blue and white-collar jobs [17]. Battistoni thus argues that "pink-collar jobs are green jobs" [45] and can as such contribute to increased value and care devoted to both the environment and human as well as non-human well-being [46]. This is inevitably strongly related to the devaluation of socially

Table 1
The feminist energy systems framework presented by Bell et al. [17].

Feminist Energy Systems	
Dimension	Vision
Political	Democratic; decolonial; decentralised; pluralist; publicly owned
Economic	Prioritises human and more-than-human well-being and biodiversity over profit; refuses the growth imperative; committed to community economies and pink-collar jobs
Socio-ecological	Relational; transparent; attuned to the violence of energy production and engaged in efforts to mitigate or compensate that violence; committed to building a culture of care
Technological	Distributed; community-directed and collaborative; heterogeneous and multiple

reproductive labour brought about by the de-politicisation of energy transitions in the light of techno-managerial approaches and technomasculine narratives.

Based on Bell et al.'s analysis of energy systems in the economic dimension, some themes and questions can be derived to analyse past home heating transitions through a feminist energy justice lens. First, relating to the growth imperative and the associated continuous increase in energy use, we can ask: How has the growth imperative affected how we heat our homes, and the total energy needed to do so? Second, relating to the devaluation of domestic labour and care work within the growth economy, we can ask: What has happened to energy use for heating, social relations, and well-being as the labour of keeping warm has decreased? How has the ratio between labour and enjoyment shifted with home heating transitions? These key themes and questions are summarised in Table 2.

2.3. Socio-ecological

In the socio-ecological dimension of their framework, Bell et al. call for increased accountability of the violent and unjust nature of energy systems across all the scales in which they operate. Particularly, this means increasing the transparency of the entire lifecycle of energy systems, from extraction of minerals needed for construction of e.g. solar PV panels to disposal at end of life, and as such increasing the public awareness about the social and ecological costs of energy sources [17]. Increased transparency has brought greater recognition of the asymmetric distribution of benefits and burdens associated with energy systems, particularly on a global scale. These burdens include communities disproportionately affected by violent resource extraction, unsafe labour conditions, and the severe impacts of climate change, environmental degradation, and waste disposal. The scales involved, ranging from individual bodies to global systems, are all central to feminist energy justice and need to be understood despite their complexity [14]. Moreover, it is not only fossil fuels that pose great risks to social and ecological communities, but the lifecycle of e.g. solar PV has been found to lack environmental and worker safety regulations in the extraction phase [47] and risk causing major problems in terms of solar e-waste, often disproportionately disposed in the Global South, once their service life comes to an end [48].

Being aware and critical of the asymmetric distribution of benefits and burdens of energy systems is in the framework viewed as a form of care work that, unlike the domestic care labour discussed in the economic dimension, operates at a larger scale beyond the sphere of the home. Considering that feminist energy justice addresses the effects of energy systems on human as well as more-than-human communities, Cunsolo and Ellis [49] argue that this care work also includes facing ecological grief on a personal level to confront "the magnitude of the ecological challenges facing our global society". This follows from how feminist energy justice values the connection between the human and more-than-human worlds to foster more sustainable energy systems.

Finally, the socio-ecological dimension not only addresses injustices occurring in the present or those that may arise in the future, but also considers those of the past. For instance, the concept of "ecological debt" reflects the "accumulated, historical, and current debt" that nations in the Global North owe to people in the Global South [50]. This debt demands recognition of how burdens have been distributed to offer compensation when needed, and/or other forms of support for affected communities. If transparency and accountability are not ensured, there is a substantial risk that "a renewable energy transition could unfold as "eco-colonialism", with intensive and unjust extraction from the Global South and Indigenous peoples" [51](p. 151).

Based on Bell et al.'s analysis of energy systems in the socio-ecological dimension, we can derive some themes particularly relevant to analyse past home heating transitions from a feminist energy justice

perspective. There are the aspect of scales and asymmetric burdens, and particularly how heating transitions have affected our ways of connecting with the uneven global implications of warming our homes, and by extension how this has affected our relationship to home heating. These themes also tie into our connection to nature and the empathy directed towards more-than-human worlds and poses the question: How have heating transitions affected how people connect with the energy source of their home heating and by extension how they connect to nature through home heating? These key themes and questions are summarised in Table 2.

2.4. Technological

In the technological dimension of their framework, Bell et al. challenge underlying and hidden assumptions about technology and provides a vision for how technology and socio-technical systems can be designed to be more aligned with feminist values. They depart from the notion that technology is not politically neutral; it is not a natural process of development, but it is a development controlled by "the highest bidders" who they argue to more often than not be "transnational corporations that emphasize profit over people" [17]. The power that these actors hold over today's centralised energy systems is by extension a power over the trajectory of our future if we agree to understanding technology as "intentional action that constitutes a gap between the world as it was … and the new world [that technology] calls into being" [52] (p.55) [17]. This echoes the need to re-politicise transitions as discussed in the political dimension of the framework and emphasises the role of feminist theory as a tool to promote more just energy systems by envisioning futures built on alternative value systems. Moreover, it brings attention to these "highest bidders" and the hegemonic systems that control energy technology. These dominating structures not only prioritises profit over people, but are also strongly intertwined with notions of masculinity, or technomasculinity as has been mentioned in other dimensions of the framework [17]. Here, feminist science study scholars put emphasis on "the mutually shaping relationship between gender and technology" where they point to the ways in which technology both form and is formed by gender relations and inequalities [53]. This is a telling example of how hegemonic technomasculinity has repercussions from the highest political scales down to the personal scale of individual households [37,38]. Bell et al. argue that "Technologies are stabilized by users, often in ordinary and even intimate social relations" and as such technologies are in close relations with individuals, affecting them at a personal level, but also meddle in the relationships between people [17]. Again, this alludes to how power imbalances at the highest political scale trickle down to intersectional power imbalances at the household level, affecting multiple layers of privilege and discrimination.

Finally, an important aspect of the framework's technological dimension is the need for plurality and decentralisation in energy systems to allow for diversity tailored to specific contexts; through a redistribution of power back to communities, this can be an effective means to ensure that the needs of communities are prioritised over the accumulation of capital [17].

Based on Bell et al.'s analysis of energy systems in the technological dimension, some key questions appear for the purpose of analysing past home heating transitions through a feminist lens. In terms of how new technology demands changes in our lives and worlds, which they explore by looking into the future, we can instead look back into the past and ask: How have home heating transitions changed our lives and our worlds? How have they affected relationships in general and relations between genders in particular? Ultimately, we can ask what has been lost and what has been gained in the intimate sphere of the home in terms of the social and cultural aspects of home heating. These key themes and questions are summarised in Table 2.

Table 2
Adapting Bell et al.'s framework for the purpose of evaluating past home heating transitions.

	Vision	Evaluative questions for past home heating transitions	Keywords for evaluating past home heating transitions
Political	Democratic; decolonial; decentralised; pluralist; publicly owned	To what extent have heating transitions been politicised? How much influence have people had in political decisions? How much control have people had over home heating in their own homes?	*Re*-politicisation, democracy, control, public/private; political/personal
Economic	Prioritises human and more-than-human well-being and biodiversity over profit; refuses the growth imperative; committed to community economies and pink-collar jobs	How has the growth imperative affected how we heat our homes, and the total energy needed to do so? What has happened to energy use for heating, social relations, and well-being as the labour of keeping warm has decreased? How has the ratio between labour and enjoyment shifted with home heating transitions?	total energy use and profit, valuation of domestic labour, care and well-being
Socio-ecological	Relational; transparent; attuned to the violence of energy production and engaged in efforts to mitigate or compensate that violence; committed to building a culture of care	How have heating transitions affected our ways of connecting with the uneven global implications of warming our homes? How has this affected our relationship to home heating? How have heating transitions affected how people connect with the energy source of their home heating and by extension how they connect to nature through home heating?	scales, transparency, asymmetries in benefits and burdens, connection to nature and more-than-human worlds
Technological	Distributed; community-directed and collaborative; heterogeneous and multiple	How have home heating transitions changed our lives and our worlds? How have they affected relationships in general and relations between genders in particular? What has been lost and what has been gained in the intimate sphere of the home in terms of the social and cultural aspects of home heating?	technological development, changes in the home, technology and gender

3. Methods

Underpinning our analysis of past heating transitions is a collection of oral histories recorded by JustHeat: Looking back to move forward: a social and cultural history of home heating. JustHeat is a CHANSE funded, international and interdisciplinary project grounded in historical research methods. The project is developing understanding of previous transitions to inform policymaking for a sustainable home heating future in local, national, and European arenas. The JustHeat team, which includes expertise in energy studies, political science, history, architecture, and artist research and practice, collected 284 oral histories in case study locations across Finland (109), Sweden (44), the UK (59), and Romania (72). This paper can by no means do justice to all the nuances of this rich empirical material; thus, we chose to strictly analyse the oral histories through the lens of the framework for feminist energy systems, leaving other facets of the material to be explored in other publications to come from the JustHeat project.

The vast majority of oral histories were conducted in national languages, but all quotes included in this paper have been translated to English; this can entail a loss of nuance and detail both in terms of semantics as well as in descriptions of local and historical technologies. The case study approach has allowed for consideration of the impact of place on experiences of home heating in each national context, as well as the opportunity for transnational connection and comparison across the four countries. Case studies were selected based upon preliminary research on past, present, and proposed transitions in each location and to provide contrast (e.g. rural v. urban). Participants were recruited through community representatives and organisations, and on an individual basis. To ensure diverse samples of participants, efforts were made in each country's second case study to compensate for any socio-demographic under-representations in the first case study. In the end, we managed to recruit participants across a wide age span (from students to people in retirement), in privileged and vulnerable financial situations, in urban as well as rural areas, and with vastly differing knowledge and experiences of home heating.

The oral history method provides access to memories of everyday life as experienced by individuals. Illuminating the seemingly mundane is one of the main virtues of the method, as well as capturing voices that are often excluded from written records; homogeneity and diversity in everyday experiences; and the social and emotional dimensions of 'keeping warm' in the domestic space [54]. The method's ability to capture the dialectical nature of personal experiences and everyday life has been argued to make oral history particularly well-suited for research with feminist inquiries [55] and allows for nuanced and paradoxical reflections on the losses as well as the gains brought about by technological change. The geographically selective oral history collection has confirmed the importance of place in shaping attitudes to heat and, through focus on individuals, disrupted the grand narratives that present transition as linear nationwide collective movements of progress. The process of remembering also involves personal reflection in the present, which allows for new interpretations of our individual and collective histories and reconnection between 'then' and 'now'. There are challenges with the nature of memory and process of remembering. Nevertheless, using oral history to look back and move forwards has precedence in energy research [5,11,32,56].

The JustHeat oral history collection was conducted alongside archival research. Analysis of official documents, newspaper sources, and other historical records produced since 1945 illuminated the grand narratives and decision-making that shaped the trajectory of home heating change to the present day. Importantly, this contextualises individual memories within the broader historical record, provides a point of methodological reflection on oral testimonies, and exposes the contribution of personal narratives to understandings of the past and present. Crucially, analysis of archival sources in tandem with oral histories has enabled deep reflection on the structural in relation to the individual, facilitating the analysis of overarching power structures' impact on everyday life that is central to this paper. In the following analysis, all oral history material has been utilised to derive overarching trends within each dimension of Bell et al.'s framework. Quotes have been selected to emphasise and exemplify specific aspects of the findings from the structural analysis, and thus represent common as well as contrasting views.

4. Operationalising the framework as an evaluative tool on the case of home heating

In this section, we will unpack the oral histories and the archival material through the four dimensions of the framework. The framework is applied to identify common developments across the four countries, but differences between the countries will also be highlighted. A

summary of the findings is presented in Table 3.

4.1. Political

By asking questions of how much past heating transitions have been politicised, to what extent they have been democratic, and how much control people have had over home heating in the political as well as in the private sphere, some particular trends emerged across the transnational archival and oral history data.

In Romania, Sweden, and Finland, countries that all have district heating, many oral histories allude to a desire to gain more agency and autonomy over one's home heating. While the historical and political contexts differ, there is a development of wanting to move from collective district heating to individual heating systems. In Sweden and Finland, where district heating is well established, this trend is primarily observed among households with the financial means to opt-out of district heating and replace it with individual renewable heating systems, such as heat pumps powered by their own solar PV. In Sweden, Svante described how discussions and fears for increasing district heating prices drove him to install a heat pump instead of district heating: "*And I was feeling unsure because there had been warnings or quite a lot of discussions about the district heating prices. […] it made me think about what's to come. So it further pushed my decision of choosing a different energy source for heating. And now we'll see, because I was thinking I could become completely self-sufficient on the electricity for the heat pump.*" In Finland the lack of control over warmth at home in the district heating system was reflected on by several participants, sharing how it could be difficult to get the temperature to feel right and how relying on a third party in case of the heating not working affected their feeling of being in charge of their heating at home. Maria for example shared "*It was definitely unpleasant to always call. And then not knowing when they were coming and when they [the radiators] were starting to work. It was a bit of an unpleasant thing, because you couldn't influence it yourself.*"

Often, there is also a desire to complement new sustainable technology with wood stoves; partly out of "cosiness", but also as a means to have flexibility and resilience if electricity prices rise again or in the case of a power shortage. Primarily, this appears to reflect a will to regain control and agency in the private sphere of the home to ensure comfort, stability, and sustainability; not necessarily due to distrust or disagreement with political decisions on home heating, but rather as a means to safeguard against unforeseeable events, crises, and developments that to a large extent lie outside the control of citizens and decisionmakers alike. A challenge here lies in the fact that not everyone can afford or have the possibility to opt out of district heating. The top-down political decisions that have led to the monopoly of district heating grids thus cause lock-in effects for those unable to replace or supplement district heating with other heating systems, and there is a substantial risk that people lacking such flexibility will be stuck with the increasing costs of a large collective system that loses profitability as user density decreases.

In Romania, however, the desire for increased control and agency in relation to home heating is a direct consequence of the loss of control that occurred under the Communist regime when district heating was strictly planned by the central government and the local authorities. The district heating infrastructure was constructed in almost all Romanian urban spaces as a tool to deliver some basic utilities to the rapidly industrialized cities and hence, their constantly growing population. Despite the extended heating infrastructure, not all building blocks were heated equally; the constructions situated in the proximity of the neighbourhood grid were warmer than the ones situated at the periphery, even though the costs were the same. Georgeta recalled: "*I really lived this experience. I had friends who lived very close to the district heating plant and they said, wow, how hot the radiators can be. We were staying towards the end of the grid and there were clearly temperature differences among our apartments. So the heat that reached us was clearly inferior to those who lived closer to the plant.*" However, the grim years of the 80's left many households in cold as rationalization, that included the heat,

became a state policy. The 90's were not much better, since the transition to a market economy forced many municipalities to shut down the district heating, as they were financially incapable to subsidise the energy prices and offer heating benefits to the households in need. Hence, many Romanian households had been forced to look for various coping strategies, from improvised heating devices to building stoves in the apartments or modifying the gas and electricity meters, as described by Rodica: "*…the electricity wasn't that expensive and the world was doing improvisation. I know that the husband used to dig inside some BCA bricks and put a resistance on it and plug it in so that it would heat up to give heat in the house, so that we could heat ourselves with something or radiators*". These coping strategies were used in the 90's as well. Moreover, testimonies indicate that working spaces were cold as well, with some variations depending on the industry. For a political regime that normatively valued the working class, this was the category highly impacted by poor working conditions and cold during winters. The oral histories are a testimony to these recent memories and point to how past political trauma drives the will to regain control. At the same time, there is a lack of feasible options for heating, and individual solutions or coping mechanisms people reach for, such as improvised heating devices or gas boilers, are in some cases discouraged by authorities. The oral histories include examples of people in rural areas of Romania using stolen wood or other agricultural materials when fuel access is limited. The downfall of district heating in combination with lack of feasible heating options and coping mechanisms has led to a situation where power over home heating is transferred directly to the hands of the individual, which actually inhibits adequate home heating in the private sphere of the home. Moreover, a constant search for coping mechanisms has left people with a strong desire to have agency and autonomy on heating matters. As Bogdan recalls from the communist past, this need to find solutions on his own continued in the 90's and left strong desires of agency even today "*it's not like now when you notice a problem and think about what you can do to solve it. You activate your resilience mechanisms, and you know it can't be fixed. There was no alternative. Because it cannot be solved, I knew that no one solves anything.*"

Overall, heating transitions have been driven by geopolitical events and high-level political decisions, with limited influence from citizens. In the oral histories from the UK, the closure of coal mines lives in popular and personal memory. People recall the transition away from coal as "brutal", with little regard for the social and economic consequences on mining communities. They remember how it affected the domestic space as well as the local economy and way of life. One narrator, Elaine, whose father worked for the gas industry but who lived in the (former) coal-mining town of Maltby, Rotherham throughout her life, maintained that: "*Maltby pit was the heart of Maltby… Something should have been done earlier [to support the community with the transition] … I get quite emotional because I talk to people every day. You can see, it might be years back now, but it's still deep in their heart, it still has an effect on how they are today.*" Coal-mining, and its place in home heating history is also undivorceable from class and labour politics in the UK. Elaine continues: "*all these people that have lived in the big houses that have had coal from Maltby pit, they've got to think that… They'll be using gas now, but in the time gone by, that [Maltby colliery] was feeding them, that was giving them their warmth. And I don't think there's been enough respect for that in some ways.*"

In earlier heating transitions from individual point-source heating, such as wood stoves, to collective systems, such as district heating, much has been gained in terms of e.g. air pollution, convenience, and comfort. But the oral histories point to what has been lost in terms of agency and control within one's own home; households' ability to be flexible has become restricted, and this appears to be one of the reasons for the increasing desire to return to individual heating systems. Individual systems can offer alternatives, such as using the wood stove instead of the heat pump when electricity is expensive, and enable undesired yet sometimes necessary coping mechanisms such as burning other, less expensive fuels when affordability or supply is lacking (the oral histories

include examples of burning furniture, pallets, and twigs collected out and about). These alternatives and this flexibility are restricted in collective heating systems that, while providing several benefits, fail to give individuals agency in times of crisis; either personal crises or larger societal crises that may limit individuals' affordability. In addition, the oral histories even include examples alluding to higher levels of agency and control contributing to increased thermal comfort, or a higher tolerance for discomfort. This highlights the complex relationship between the political and the personal and particularly the diverging developments that can co-occur across different scales; collective heating through e.g. district heating reflects a development at the political level that ensures an increasingly stable heating supply across society while at the same time making households subordinate to political malfunctions or neglects (Romania), unable or prohibited to adopt coping mechanisms for heating when needed, and unable to control the particulars of heating their own homes.

4.2. Economic

In the economic dimension of the framework, we ask how the growth imperative has affected how we heat our homes, how energy use for heating, social relations, and well-being has changed as the labour of keeping warm has decreased, and how the balance between labour and enjoyment has shifted with home heating transitions.

In the oral histories across all four countries, it is evident that most of the memories people recall when asked about home heating are connected to the labour of keeping warm with solid fuels in individual heating systems. The labour of collecting, chopping, and stacking wood is a vivid memory in oral histories from Romania, Finland and Sweden, and the countries have different expressions for saying "*Firewood warms time and again*"; a proverb capturing the bodily heat that is generated in multiple steps when preparing firewood before finally receiving the heat from burning it.

In the oral histories, this preparatory labour is more often than not described as being performed by men, often fathers, grandfathers, uncles, and sons with much intergenerational learning and passing down of knowledge regarding wood types, how to take down trees, how to chop, etc. This labour is heavy and extensive but also rare; it is done on an annual basis to prepare for the winter season and was usually an event when male family or friends would come to help. Similarly, in the UK fuel extraction (coal mining) and fuel deliveries (by a coal merchant, for example) was masculine labour, and the waste produced by coal-fired heating system – the ash and dust – was eventually carried away by the "dust *man*".

4.2.1. Women's care work of keeping the family warm

The daily labour of keeping warm is however more often than not described as a woman's work in the oral histories; this either entailed keeping the coal fire burning in the UK or keeping the wood fire burning in the other countries. Participants recall memories of mothers waking up early to start a fire and keeping it burning throughout the day, and the use of wood stoves for cooking connects the labour of keeping warm to women's responsibility of preparing meals for the household. As such, the daily labour of keeping warm was indeed predominately women's responsibility, and it was connected to the greater context of care and women's lives being dedicated to the enabling of comfort of the family, often as a double burden alongside paid employment. For some, recognition of the significance of mother's work was reflected in their own emotional response to remembering. One participant, Trevor, became especially tearful, explaining: "*I regret that when I was a teenager, I regret hearing my mother come home and I'm still in bed and she makes the fire, and then I get up when its warm and I regretted that.*" This highlights the heavy burden of heating labour and the convenience brought about by heating transitions, entailing a significant shift that may be difficult to convey to younger generations. Reflecting on the transition from coal-fired heating to gas central heating, Liz expressed: "*You know, it's just, it's*

just incredible. From it being hard work, hard labour, hard slog to just flicking that switch, pressing that button. And my kids just don't believe it. They do not believe how it was back in the day. And it would have been harder for the generation before me…" In Sweden, many people recalled the relief experienced by mothers when moving from an old apartment into a modern one during the mid-20th century. Majvor described that "*it was heaven because there was central heating and hot water*", and Sofie strongly recalled: "*My mother, she cried when she turned on the hot water in the tub. It was very new for us coming from this* [old apartments]. *The mothers who had all this work of fetching water and managing fires and stuff like that.*"

The labour of keeping warm also encompassed many different practices beyond managing a heating system, such as the mother tucking in kids in bed; the mother changing from thinner summer duvets to thicker winter duvets; knitting warm socks and clothing; putting warm water bottles or other heat sources in kids' bed; putting a tray of candles at the nightstand. As Viorica in Romania described: "*Usually women were knitting wool socks and sweaters and other clothes. We were making our duvets out of wool, just to keep us warm. They weren't very soft as they are today, but they were practical.*" This care work of keeping warm appear to be where warmth, love, and safety intersect. The labour put into this care work contributes to keeping family members warm without necessarily contributing to energy use for heating. Specifically, the oral histories point to a particular focus on warming bodies rather than heating spaces, which has been shown to provide thermal comfort at a lower energy use even when powered personal heating devices are used [57]. This care work thus potentially contributed to decreased energy use for heating in a (globally) harmful way. On a larger scale, the development towards more space heating implies a loss of care work and social practices to keep warm in favour of technological heating and increased energy use. The decrease of care work in favour of gaining more heating from energy use could be a reflection of the general development within hegemonic growth economies where care work, reproductive labour, and pink-collar jobs are devalued in favour of increased hours on wage labour, economic growth, and energy use.

4.2.2. Less labour – and enjoyment – of keeping warm

As is the case for domestic labour in general, heating labour has been made more efficient or even automated to free up more time for other things, such as wage labour. But with this loss of labour of keeping warm, the oral histories testify of other losses as well; particularly a loss of enjoyment connected to heating. Although it was often described as a tiresome chore, many also emphasise a joy in having a fire, as has been shown in previous research [58]. Also, the making of firewood was seen as a possible source of enjoyment and connecting with nature. Fire management provided routine, teamwork, learning, and fulfilment, and the cosiness of a fire was prominent both in recollections from the past and in motives for currently having some sort of fireplace. People enjoyed the heating that had been enabled through the efforts of the household. This relates to the relationship between labour and enjoyment which is emphasised in the economic dimension of Bell et al.'s framework, where they argue that feminist energy systems should strive to reduce the share of wage labour and increase the share of enjoyment. What we see in the oral histories is that as the labour of keeping warm has decreased, so has the enjoyment of home heating. Much of this enjoyment came from the simplicity of social connection with family, as well as the thermal comfort of a warmed body within a colder space. As space heating replaced the solid-fuelled single heat source where households traditionally gravitated, the family and the enjoyment that came from working together to be together also lapsed. Simultaneously, the decrease in domestic labour has enabled increased hours spent on wage labour. Siv, an older woman, reflected on the paradox that despite how time-consuming it used to be to keep warm with solid fuels in mid-1900's Sweden, there does not appear to be more time for leisure today: "*But back then people had more time in a different way than they do today. Today, there is so much else that needs to be done. With all sorts of things. […] It's quite strange, actually. You feel as if you had more time back then, or*

that you have less time today. Despite all the technology we have to make life easier. It's strange." This suggests that with the transition away from solid fuels, the labour of keeping warm has come to be replaced with other forms of labour, either domestic or wage labour. There are e.g. those who argue that new technologies not only increased standards in the home and relieved women from the labour of e.g. maintaining a fire, but that expectations on a comfortable home, and thus women, also increased [59]. In this context, views of fire maintenance as being simultaneously work and leisure raises the question of how distributions between labour and enjoyment have shifted with heating transitions, as the labour *and* enjoyment of a fire might have been replaced with labour lacking such enjoyment. Thus, while we on a large scale can observe a trend of decreased care work and enjoyment in relation to home heating in favour of technological solutions – presumably driven by the devaluation of care within technomasculine growth economies – the potential benefits of reduced domestic labour have likely not been savoured by women due to increased expectations in other areas of the homelife.

Yet, the enjoyment of heating with solid fuels was never, and still is not, equally shared. While many people appreciate or prefer the warmth from a fire over radiators, the enjoyment of maintaining a fire appears to increase when being perceived as a choice and when not being a daily chore competing with the burden of a full-time job. Participants reflected on the negative aspects in cases where they had to rely on wood more than they would like to due to high overall energy prices. In Finland, Tuomas shares: *"Yes, it creates a lot of work. Now, it was a complete disaster when the electricity price rose like that, and the electricity bills jumped so much that you could easily spend over a thousand euros a month, even if it wasn't very warm. The prices were like that.",* he then goes on to add that instead of being an additional source of warmth providing a cosy atmosphere it has turned into a time and labour consuming endeavour out of necessity. Similarly, some oral history participants from Romania indicated that the heavy labour of chopping wood becomes a significant challenge for the elderly households; here, new technologies may reduce the burden of the households, especially if the daily chores also involve taking care of farm animals. Still, oral histories from several of the countries hold examples of people enjoying heating with solid fuels as complements to a more autonomous heating system, such as district heating or gas central heating, or when vacationing in a summer house or a cabin, when time is not restricted by wage labour. There is a difference in meeting heating needs in daily life and engaging in heating practices in pursuit of thermal joy. Helena, who warms her summer house with a wood stove, reflected on the differences between maintaining a fire in daily life and during time off from work: "*Well, it's quite, sort of, peaceful somehow. The fact that when you go there [to the summer house], it takes some time. When you're not working. It's different if you have to do it in the morning before lots of children need breakfast and you're heading to work. But if you do it… It's different if you do it in a summer house because there it becomes part of the recreation and relaxation somehow. So, there's a huge difference depending on if it's a must in daily life or if it's just something you do there.*" Nonetheless, this highlights how the labour of keeping warm can fulfil a meaningful purpose for well-being for people with no or limited hours spent on wage labour, and in societies moving towards shorter workweeks.

4.3. Socio-ecological

In the socio-ecological dimension of the framework, we ask questions regarding how home heating transitions have affected the scales across which we understand the implications of energy use for heating, the distribution and perception of benefits and burdens, and how transitions have affected our connection to nature and more-than-human worlds.

Oral history participants in rural and semi-rural areas that use wood for heating expressed a connection to nature and a care for the wood, trees, and forests that sustained them with their heating fuel. They described a sense of meaning and belonging when dealing with firewood and an appreciation of the trees they take down, making sure to be careful in not taking down too many or too young trees. One middle-aged man described preparing firewood as being a moment of serenity and reflection whereas a man in retirement found that it brought meaning and routine to his day by knowing what to do when he wakes up. Several people expressed an appreciation of putting some work in to get a warm home, implying that the thermal comfort was improved merely due to the effort in a similar way as cooking one's own meal can elevate the taste. Aino reflected that *"Yes, maybe you appreciate the warmth from the fireplace more when you've first carried all the wood to the cellar, stacked it, and then brought it here, one basket at a time."* In more rural areas, there was a strong connection between the strive to be self-sufficient on wood for heating and self-sufficiency in terms of growing one's own food, highlighting how wood can embody the strive to live a simpler and more locally sourced life. Caring for the local nature often seemed to extend into caring for the planet and wanting to limit global harm from energy use and food chains.

There was also a concern regarding environmental regulations among people relying on wood for heating as they were aware of the problems with air pollution. Harald, living in a rural area in Sweden, was uncertain about the future and how he would be able to meet potential requirements: "*What's interesting about firewood is, for example, 'how long can I rely on wood for heating before it is forbidden?' Because they've started to forbit it in several places. […] when it comes to wood firing, there could be new regulations such as 'now you must have an approved wood stove'. Which I don't have.*" Environmental implications of wood firing were also recognised in the UK, where Rita reflected on the trend of log-burners and the wellbeing benefits of the fireside while recognising that there is an environmental impact: "*Staring, watching the flames moving, it's just a bit like meditation, really, I think. And you've got the comfort of the warmth. Yeah, it's nice, but we can't do it, can we? We can't. We just can't be doing now - greenhouse gases - and it's not on. Yeah, we've got to find another way haven't we.*"

In Romania, especially in rural areas closer to the forests, there was a communal system of exploiting the wood. Basically, within compossessorates, individuals were putting together their belongings (in this case, forests) for a better communal exploitation. Wood chopping was strictly organised and only specific trees were cut down, following some principles of sustainability. While the activity of cutting wood has been strictly regulated across various political regimes, there are numerous anecdotal stories with people relying on irregular markets for buying the necessary wood for winter. However, wood heating, a practice encountered in almost half of the Romanian households, is not directly perceived as an environmental problem, mainly because the general rhetoric places wood in the category of renewable resources. Similarly, Kjell in Sweden has his own land and uses an ethic of care when taking down trees: "*I'm incredibly humble when it comes to trees, you have to wait 50-100 years before there is a similar tree there again. So, I'm pretty picky about what I… I want to think through which trees it's time to take down this year.*"

In the oral histories, the general public appears to have more knowledge and care more for the local air pollution caused by wood heating than the social and environmental impacts from mineral mines used for the production of e.g. solar PV, which is increasingly used in Sweden and Finland as a means for households to produce their own electricity for their heat pumps. This highlights a biased concern for local rather than global implications of energy use which both is a consequence of and helps to uphold hegemonic extractive practices in energy transitions, that maintain asymmetric distributions of benefits and burdens. Again, this also relates to the vastly different scales that home heating spans across, ranging from the intimate scale of one's body to the global scale of extraction, production, and emissions of energy systems.

4.3.1. Care for more-than-human worlds

This biased concern for local implications of energy use for heating does not only concern effects on nature and human health, but also

animals. In several of the oral histories, people talk about pets in their memories of home heating; this includes how pets would find a spot in front of the fire, or how people would care for their pet by creating a warm spot for them with one example of a family in the UK clearing a shelf near the coal fire for their cat. Yet, despite this heating-related care for animals expressed in the sphere of the home, care for more-than-human worlds is often limited to a very local, or even visible, scale. This highlights why participants heating with wood, and particularly those who have their own land to collect wood from, in general talk more about caring for nature in their oral histories, as they interact with a larger part of the lifecycle of their energy source. They inevitably get transparency into their energy system for heating which Bell et al. emphasise as crucial in order to achieve more just energy systems from a socio-ecological point of view.

However, there were other examples of care stretching into future generations. Bojan in Sweden described how he had made several improvements to his house's thermal insulation and heating system to improve energy efficiency. He reflected: "*You must do as good as you can. Because there will be others coming after you. So, you cannot leave the planet in this way. That's what I'm thinking about. A little more circular.*" In Bojan's case, he can extend his care to future generations in a rather tangible way through his house, which he knows will stay there for a long time. As such, the house itself becomes a form of window offering transparency into future generations, similar to how owning or being close to land that provides firewood can offer transparency into environmental implications of heating. Together, these findings suggest that ownership, influence, agency or control (i.e., being an active agent) over some part of the heating system's value chain – be it natural resources, a house, or a heating technology – can enable care that extends beyond the individual or the household. This raises questions on how the development of heating technologies becoming more centralised, hidden, and automatic affects practices and ethics of care for future generations and more-than-human worlds. The human/nature dualism described in eco-feminist theory, where nature and more-than-human worlds are considered inferior to and separated from humanity [60], is likely to be strengthened as we are increasingly physically separated from natural resources and the systems that utilise them.

4.4. Technological

In the technological dimension of the framework, we ask how heating transitions have affected our everyday lives and social relationships within the home. The technological development that has taken us from point-source heating to radiators and underfloor heating have numerous implications for everyday life apart from the decrease in labour, as has already been discussed. One aspect that is described in many of the oral histories is how the shift from point-source heating changed the social life in the home. With point-source heating, such as a coal or wood fire, families would seek out warmth by gathering around the fire. Although a home could have several sources of heating, such as multiple tiled stoves, all of them would usually not be used at the same time. Sue in the UK remembered how the coal fire used to be the centre of their family life at home: "*There's just something about a fire isn't it. It's, it was the centre of our family life and, it just was, just been all that closeness together. The food, the smell. You know, the laughter. We even had a piano. We had a piano at Church Street. We had a piano at Lawford Avenue, you know, a high… […] And my dad used to play and sing. We all had a little tinkle on it now and again. So. Yeah, it's just us. It's that family memory, and it's just. It's just wonderful. And I'm sure when you speak to Ray next door, he'll tell you the same time. You know, life was hard, but at the same time it was wonderful.*"

Gathering was also a strategy for particularly cold times, where participants e.g. describe the whole family sleeping in one room to keep warm; as such, gathering the family was both a consequence of how heating was provided and a means to stay warm. However, gathering the family ceased to be necessary once heating went from point-sources to radiators in every room. With warmth in every corner of the home, participants, particularly in the UK, recall families scattering, implying a noticeable change in the social homelife. As technology has strived to provide even heating throughout buildings, a sociocultural impact has thus been that it has enabled household members to keep greater distances to one another.

4.4.1. From warming bodies to heating spaces

Development of heating technology also entails changes in terms of the total energy use for heating; in many ways, the shift from point-source heating with solid fuels, such as fireplaces, to central heating means a shift from warming bodies to heating spaces. With point-source heating, it was more common to only heat the rooms and spaces in which people were currently spending time, or vice versa, to spend time in the room(s) that was currently heated. As such, there was a focus on keeping bodies warm embedded in the technology, and even in the structures of the home as e.g. furniture such as armchairs and sofas would often be placed in front of the fire, facing the fire, perhaps even with a small footstool in front to warm one's feet. The fact that not all rooms were heated also put more focus on warming bodies rather than spaces through other practices of keeping warm such as using clothing and blankets, with support from various actions of care such as knitting warm socks for family members. Today, as heating tends to be omnipresent, there is less need for other means of keeping one's body warm, although clothing and blankets still play a central role in keeping warm at home.

Another way in which the oral histories reveal a shift from warming bodies to heating spaces was in how the bodily experience of heating has changed with the progression of new heating technologies. People described how preferences of heating source can be based on the feeling of different kinds of heat, where the bodily experience of heat from a fire can be reason enough to choose wood firing over another option such as radiators or underfloor heating. Mårten specifically explained how he prefers to warm his body in front of a fire rather than warming his house: "*But I think it's, like, I want this sensation from heating much more than I want the house to be warm.*" In Finland, one participant described how she missed the fire when she no longer had easy access to it while living elsewhere during her studies: "*When I was studying, I was living somewhere else, and whenever I came back, well, the warmth of the fire, how it felt, how different it is from electric heating … You realise, how wonderful it is, how different it is. I don't know what it is, but it's just so much nicer than electric heat. There's just something about it.*" People also described the heat from a fire as an enjoyment and pleasure not comparable to central heating systems, which Heschong identified as "thermal delight" [61]. Thus, in addition to the lost enjoyment of building and managing a fire for heating, many people also experience a loss of enjoyment in terms of the bodily experience and sensation of heat.

Another aspect of the shift from warming bodies to heating spaces is that current heating systems strive to achieve even temperatures throughout spaces as this is what is commonly associated with a higher thermal comfort. However, this does not take into account different bodies' varying needs and desires in terms of indoor temperatures. Kjell reflected on the natural temperature gradient rooms with point-source heating would have, where people could decide how close they wanted to sit to the fire based on their personal preferences for thermal comfort. He contrasted this with today's praxis where the aim is to achieve an even temperature in a room, without a gradient, assuming one universal temperature preference for everybody. Apart from individual variations in preferences, there is also research suggesting that individuals prefer to be exposed to various thermal comfort conditions. We can thus see how heating transitions have shifted home heating towards "thermal monotony" [61] with a focus on spaces, while less emphasis is put on warming bodies in general, and a diversity of bodies in particular.

It is evident from the historical material that the increased focus on *space heating* rather than warming bodies have changed how dwellings

are being heated, as central heating allowed simultaneous heating of all rooms and as such enabled new ways to utilise dwellings and improved overall thermal comfort. Inevitably, this increase in dwellings' overall heating demand has increased the energy use for home heating [56], and it is likely that the focus on spaces rather than bodies is driving excessive energy use through e.g. heating unused rooms. In line with growth economics, heating demand – although heating systems and buildings are becoming more energy efficient – increases with norms of increased living space per person. This development has spurred a debate on sufficiency approaches that mainly address per capita living space and means to limit it [26,62,63], but by learning from the oral histories, we can complement this debate by highlighting past practices of limiting per capita *heated* space. Ultimately, the findings of this study feed into a growing foundation of historical material and research providing evidence that despite improvements in energy efficiency, heating buildings, spaces, and rooms – i.e., technical structures – is a less "efficient" and "targeted" approach than heating bodies [25,57].

What we see is how the shift from coal fires, wood stoves, and fireplaces to central heating systems has entailed a shift from warming bodies to heating spaces in several ways. First, it is embedded in the very technology that heating is no longer to be provided only where people are, but everywhere and all at once. Second, it is evident in the sociocultural practices connected to keeping warm, where gathering with family members, arranging furniture around fires, and providing care through various forms of heating labour and services to keep bodies warm are decreasingly common. Third, this shift is also present in how heat is individually perceived, where people experience less bodily sensations and delight from even space heating than from a fire. The objective of minimising thermal variations in spaces also overlooks the desire for diverse thermal environments between, as well as within, individual bodies. Through the framework, we can view these developments in light of the technomasculine dominance that de-value care work, social interdependence, and emphasise technology and technological development over individual bodies [37,38]. This devaluation of the human body within science and technology is a long-standing critique within feminist theory [64], and the parallel devaluation of marginalised bodies and nature has continued to be a central concern among eco-feminist scholars [65,66].

4.4.2. From embodied to hidden heating

The shift from solid fuels to more invisible and abstract systems for heating has entailed a shift from heating being embodied to it being hidden in everyday life. Many people describe heating as something that is "just there", or as something they barely think about in daily life. Sue compares her current heating situation to how it used to be: *"Now, you know, you don't even think about it. You just get up and it's there. You know, it's warm. It's just so easy compared to what we used to have to do. I mean, really, the old days. It took over your life. If you just. If you didn't, you didn't get up. If you didn't get that fire, then you wouldn't be warm."*

Yet, as people's interactions with heating are decreasing, some feel as if something is lost in their roles as active agents in their own existence and life experience. Mårten described this as a loss of something meaningful: *"Now, two generations later I'm sitting here and don't have to… I don't have to do anything other than paying my electricity bill to get heating. And I don't think it's that good for us. […] We as humans need this connection, we need to, I think, add firewood to a fire and feel that we, sort of, exist."* While dealing with solid fuels was often described as laboursome and dirty, there were benefits beyond the enjoyment described by many. One significant benefit described in the oral histories was how the embodiment of heating through solid fuels enabled heating access to be handed from one person to another, to be exchanged, given, and borrowed in a way that is no longer possible through many central and collective heating systems. The oral histories include examples such as people borrowing kerosene from neighbours, buying excess concessionary coal for a cheap price within mining communities, and getting wood and coal from family-members. However, in repressive regimes, as

Romania had, there were participants describing how the social fibre of collaboration had been altered and neighbours were turning each other in to the police for illicit activities of bringing more wood home during winter. These practices happened mainly on the last decade of the communist regime when quota on fuels and other commodities were very reduced. Eminelia described: *"If you were caught, you had to pay a fine at the police or worse. Sometimes, the neighbours were mean and they turned you in. But the wood quota was not enough, and people had to find ways to warm their houses."*

If fuel for heating was not accessible through social security networks, a benefit of solid fuels was that it could sometimes be found in the forest or out on the streets. The oral histories reveal how children could be sent out to look for twigs and branches, and in times of crises, people could burn things that were not actually fuels, such as furniture, which could divert a crisis of not having any heating at all. Linda (UK) described how her childhood desk disappeared one day, only for her to realise later that it had been burned; Alfred (Sweden) recalled his father telling him about how his grandmother one harsh winter had burned the drawers in her dresser, leaving only the drawer fronts so no one would notice; Tony (UK) explained that during his employment in social services he attended the house of a family that had burned all the internal doors of their home for immediate warmth, although the subsequent lack of doors would only exacerbate experiences of cold in the longer term.

While development away from embodied heating has brought numerous benefits, not least the relief from the labour of keeping warm, the oral histories show how it also has deprived people of something existential in their human experience; how it has obstructed heating access to be passed from hand to hand; and how heating access has become more black and white as the grey-zone that burning alternative fuels provided has disappeared. The loss of security systems in the form of social networks and alternative fuels is likely to have had negative implications for vulnerable households and their ability and options to deal with energy poverty. Ultimately, and well in line with the observed development across all dimensions, financial compensation for wage labour has come to replace and be the only viable option to the social and relational components that could previously provide fuel for heating, making hierarchies within capitalist and technomasculine economies even stronger determinants of who has access to heating and who does not.

4.4.3. Knowledge and power

The oral histories also bring attention to how technological changes and developments have affected power relations within households, particularly in relation to knowledge. With solid fuels, there were often shared yet differentiated responsibilities, as the example of men being responsible for collecting/preparing fuel whereas women were responsible for maintaining a warm home on a daily basis. However, the extensive labour of these tasks demanded that other family members could be able to step in and there was thus on-going learning between spouses and from parents to children; for example, many participants recall being asked to add fuel to the fire when coming home from school as children. The embodiment of heating through solid fuels and extensive labour made it a shared experience in the sense that most family members had some knowledge and understanding of how the heating system worked, and much knowledge was transferred between generations. As technological development has made home heating more hidden, less embodied, and a smaller part of everyday life, the oral histories reveal how knowledge of how the heating system works has decreased in general, and has become centralised to one family member in particular. More often than not, participants describe men as the one's having knowledge and responsibility of, and thus power over, individual heating systems such as gas boilers or heat pumps. In Finland, a participant reflects how, after transitioning to geothermal heating, their heating system has become much more complex to manage without deeper technical understanding: *So, the technology is quite complex. For example, I'm an engineer, so I understand the technology, but my wife is completely unaware."* This echoes what is mentioned in Bell et al.'s

framework regarding technology being designed by and for men, and how this risks leading to a centralisation of knowledge and power over home heating to men in households. Yet, there are multiple examples of women being in charge of home heating systems, so even though there is a gendered aspect to the knowledge and power over heating technologies, the most notable change however lies in the shift from knowledge and responsibilities being relational and shared to them being individual and centralised.

4.5. Summary of the findings in the four dimensions of the feminist energy systems framework

Table 3
Summary of findings regarding how dominating power structures in the four dimensions of Bell et al.'s framework have altered the conditions of home heating through past transitions.

	Keywords for evaluating past home heating transitions	Identified socio-cultural implications and power shifts from home heating transitions
Political	*Re*-politicisation, democracy, control, public/private; political/personal	Reduced agency and control with district heating; household finances determine heating-related flexibility and security; lack of influence in political decisions that have driven drastic transitions into heating systems that now only can be left through significant investments
Economic	Total energy use and profit, valuation of domestic labour, care and well-being	Labour of keeping warm, often a woman's work, has decreased; care work of keeping warm has partly been replaced by technological solutions and increased energy use for heating; enjoyment of heating practices has decreased
Socio-ecological	Scales, transparency, asymmetries in benefits and burdens, connection to nature and more-than-human worlds	Wood heating forges a connection to nature, particularly in rural areas where firewood is collected from surrounding forests; a biased concern for local over global implications of heating on more-than-human worlds; lacking recognition of rural, locally-sourced lifestyles as part of sustainable heating futures in favour of extractive practices and new technologies (e.g. solar PV); being an active agent in regards to home heating can foster an ethics of care
Technological	Technological development, changes in the home, technology and gender	By removing the need to gather around a fire for warmth, central heating has enabled a decentralisation of the social home life; a shift from warming bodies to heating spaces, leading to increased energy use for heating and reduced thermal delight; from embodied to hidden heating, where solid fuels could be shared – gas, electricity, and district heating cannot; new technologies have brought a centralisation/ individualisation of previously shared/relational knowledge, responsibility and power over home heating

5. Discussion

In and of themselves, the oral histories gathered in this project constitute a rich material that significantly contributes to our understanding of sociocultural impacts of heating transitions in daily life. Many of the findings confirm what has been found in previous studies in terms of the social, cultural, and emotional significance of a fire [10,58,67], the care practices associated with energy use [3,68], the personal and cultural preferences of heat supply [4], and the impact of heating practices on everyday life [2,69]. From a transition perspective, the oral histories provide diverse stories of intimate and personal experiences of heating transitions in different national and international contexts and adds to the literature that contrasts streamlined, dominating transition narratives [5,11,32].

However, it is first through the dimensions of the feminist framework that we are able to recognise these experienced changes as systematic and as symptoms of underlying power structures embedded in energy systems and economies at large. This enables us to identify common strands of developments across the four countries despite heating transitions and systems being different in terms of fuel sources and technologies. As such, the framework elevates the sociocultural impacts of home heating transitions to not only serve as descriptions of the impact of certain technologies, but to also make them testaments to larger societal changes that say something more about our contemporary world and its embedded structures of unsustainability.

5.1. Past, present, and future viewed through the framework

There is no doubt that heating transitions have improved environmental sustainability of home heating and brought increased convenience to everyday life; this is after all the dominating narrative that is equal parts well-known and well researched. Yet the analysis of the historical material brings out striking examples of what the effects of these parallel sociocultural developments have been and raises questions about the greater implications of those developments across the framework's four dimensions:

- In the political dimension, Bell et al. call for democratic, decentralised, pluralist, and publicly owned energy systems. This is in contrast to heating systems such as district heating and gas central heating that in general are large, collective systems dominating entire heating markets. These systems have come about through transitions where the oral histories reveal how people in general do not feel as if they have been invited to participate. In many cases, the lack of influence over heating transitions has ultimately led to a situation where many people experience a lack of agency and control over heating in their own homes. Now, the increased desire for agency and control over home heating are leading households to invest in individual heating systems as complements, or even replacements, to collective ones. What will happen to large, collective heating systems – and households still relying on them – if more and more people opt out? And how can participation and agency be weaved into future sustainable heating options?
- In the economic dimension, Bell et al. challenge the growth imperative and call for carbon-intense wage labour to be replaced with less energy-intense activities that promote reproductive labour, well-being, enjoyment, and care for communities and family-members. In the oral histories and archival material, we see how ideas of green growth and ecomodernism have steered the development towards more efficient heating, but also towards increased heating demand. We see how gains in terms of convenience through reduced labour of keeping warm have come at the cost of less enjoyment and care involved in home heating in favour of technology and energy use, limiting connections to other people, nature, and people's own existence through heating. At a larger scale, what are the social and societal implications of human care being replaced with

technological solutions and thus increased energy demand? Looking ahead, how can enjoyment, care, and socialisation be re-integrated into home heating to promote more socially and environmentally sustainable heating?

- In the socio-ecological dimension, Bell et al. highlight the need to recognise the uneven global implications of energy use for people, nature, and animals alike. The oral histories show how decreased embodiment of heating and fuel, through e.g. wood heating, there is less connection to and care for nature and more-than-human worlds through home heating. As heating is becoming increasingly hidden in the physical structure of our homes and disentangled from daily routines and practices, how does that affect our way of thinking about environmental and social implications from home heating, and from other areas of life? Moving forwards, how can we work to diversify the idea of sustainable heating from urban and technologically centred to recognising and including more rural, self-sufficient, and nature-embedded lifestyles?

- In the technological dimension, Bell et al. call for technology to be developed close to communities and for people's well-being rather than for profit. The historical material shows how heating transitions have contributed to more convenient and efficient heating, but also to a shift towards heating spaces rather than warming bodies, causing even empty and unused spaces to be evenly heated while individual variations in thermal comfort and delight are neglected. This development that centres technology over many other social and relational values can be understood through the technomasculine influences that dominate the energy sector. How has this impacted our comfort and well-being, and the total energy use needed per person for heating? Looking ahead, are there ways to shift back towards warming bodies rather than heating spaces as a means to reduce energy use for heating?

While presented here in a compact and condensed format, the analysis shows significant overlaps across the framework's four dimensions. This reflects both the structure of the framework and the complex reality of how the world operates. Neatly compartmentalising observed developments and implications would result in an overly simplistic and inaccurate representation of societies where politics influence the economy, which in turn influences technology, and so on.

5.2. Sufficiency policy to promote warming bodies over heating spaces

Indeed, the findings of this study add to the vast literature on the need to ensure procedural, distributive, and recognition justice in transitions, for example seen in the perceived lack of influence in the political dimension of the framework and in the perceived exclusion of rural households from transition narratives in the socio-ecological dimension. However, with the aim to go beyond these analytical tools designed to evaluate accurate instances of injustice, the contribution of this study lies in the unpacking of underlying power structures and highlight, in broad strokes, how they have appeared in home heating transitions and affected people in their daily lives. While there are many policy recommendations that could be derived from these findings, e.g. relating to vulnerable households and more equal access to sufficient heating, we will here highlight the potential benefits that could come from complementing hegemonic energy efficiency strategies with approaches supporting a shift from heating spaces to warming bodies. In broad terms, the analysis has showed how such approaches could counteract technomasculine structures that de-value bodies, care, and inter-personal relationships in favour of increased growth and productivity.

More specifically, one approach to shift towards warming bodies is to encourage a diversity of heating solutions, even within individual homes, to enable central heating to be kept at a lower temperature while point-sources of heating can be used where people spend most of their time. Increased focus on bodily heat through technologies, such as wood

stoves or heated chairs [57], as well as non-energy demanding solutions, like clothing, could – if used correctly – contribute to reduced energy use for heating while maintaining thermal comfort and possibly improving thermal delight. Most importantly, having multiple heating options enables people to adjust the heating in line with their personal preferences for thermal comfort, even allowing members of the same household to find individual comfort zones, and provides the opportunity to experience thermal variation. An important first step in this sufficiency-oriented direction could be to work with approaches relating to information and knowledge, as shaping and changing norms can have significant impact on households' perceptions of ambient temperatures, as seen during the energy crisis in 2022/2023 [69].

In addition, supporting local energy communities is another way in which agency as well as the relational potential of heating systems can be harnessed [70] while also promoting a strong anchoring in, and thus care and connection to, the local environment [71]. Local and community-oriented energy systems, supported by technological plurality, are all keywords in Bell et al.'s framework [17], explaining why many policy recommendations from this study fall into that realm. This study has showed how these elements can have positive implications on people's lives in the context of home heating. Ultimately, there are values in these proposed policy measures that not only have the possibility to be transformative in terms of environmental and social sustainability, but that also hold an element of desirability that might be vital for people's will to participate in, and as such for the overall success of, a sustainable transition.

5.3. Past, present, and future of keeping warm

Through the use of this framework, we can see more clearly how political, economic, and technological developments have caused sociocultural changes in home heating that ultimately have altered the premises of life at home, and how unsustainable structures remain weaved into current heating systems and practices. By exploring the oral histories through this visionary framework, we get a unique triangulation of memories of the past and visions for the future that lets us see our heating present more clearly in light of what it has ceased to be and what it has yet to become. What we see in the oral histories is that there are personal and relational components to past home heating technologies that people are missing today, which invites us to consider how such components can be re-integrated into current and future heating systems. There are also components of past heating technologies supporting more social, care-oriented, and de-centralised heating systems that promote a stronger connection to nature and favour enjoyment and leisure over wage labour, productivity, and extractive practices. In line with the visions presented in Bell et al.'s framework, systems that challenge unsustainable structures that de-value the relational aspects of energy systems are key for achieving a more socially and environmentally sustainable energy future. By uncovering how these structures have influenced home heating transitions, this paper has shown how sustainable traits of old heating systems and practices can be re-integrated into home heating, and how home heating as such could be part of more sustainable lifestyles that promote well-being within the Earth's limits.

Through this empirical application, we have also showcased how the framework can be interpreted and adapted to specific energy sectors as a means to evaluate, understand, and propose directions for the future. There thus lies a significant contribution in operationalising the framework to facilitate for increased integration of feminist theory – in its full power – into energy research.

6. Conclusion

By using feminist visions for energy systems to unpack oral histories of previous home heating transitions, this paper has set out to explore how embedded economic and political structures have affected sociocultural aspects of home heating in everyday life. The aim was to apply a

visionary framework as a contrast to reveal aspects of the past and present that we want to keep and that we wish to let go of. The applied framework enabled us to explore the pan-European material of 284 oral histories and extensive archival documentation through political, economic, socio-ecological, and technological dimensions. It was found that home heating transitions have had significant implications on the configuration of social life and relationships in the home. Some of the main changes concerned the shift from embodied to hidden heating; the shift from warming bodies to heating spaces; and the decrease of control and agency over heating one's home. With these changes came increased convenience and more even heating, but at the cost of decreased enjoyment and fulfilment, social gathering, intra- and inter-generational knowledge exchange, care work of keeping warm, and care for nature and more-than-human worlds. Through the framework, it was possible to see how these changes in the sociocultural aspects of home heating had been brought about by dominating power structures in energy transitions, such as technomasculinity and green growth, that contribute to a de-politicisation of transitions and de-value relational aspects of energy systems, such as care, in favour of increased productivity.

This paper makes two core contributions. First, it offers an improved understanding of our heating present by triangulating it with stories from the past and visions for the future, as such revealing underlying power structures and assumptions of contemporary home heating. Second, by operationalising the visionary framework for feminist energy systems, this paper showcases how the framework can be utilised as an evaluative tool and provides tangible examples of how the frameworks' different dimensions can be interpreted and considered through the case of home heating. These findings speak to the wider contribution of JustHeat, which improves understanding of how previous home heating transitions have affected sociocultural aspects of people's everyday lives, diversifying the narrative of past energy transitions and providing valuable input for transitions to come.

Through this work, it is evident that home heating plays a significant role for social relations and in people's everyday lives, and that sociocultural effects of heating transitions have been palpable. The effect of heating transitions on everyday life are not only important to consider for achieving just transitions and energy systems, but also to ensure that heating transitions sustain desirable lifestyles that can be transformative for environmental and social sustainability in the long term; potentially by questioning hegemonic power structures such as green growth and technomasculine values. Looking ahead, this study has raised a number of important questions, such as: How can people's wish to gain more agency and control over their home heating be considered and accommodated for? Are there ways to shift back towards more focus on warming bodies rather than heating spaces as a means to reduce energy use for heating, and enhance the bodily experience of heat? Can enjoyment, care, and socialisation be re-integrated into home heating to promote more socially and environmentally sustainable heating? This final question invites us to fundamentally re-imagine the role of home heating in modern everyday life and consider how prioritising well-being could lead to more just, and desirable, energy systems.

CRediT authorship contribution statement

Jenny von Platten: Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Kathy Davies:** Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Sarah Kilpeläinen:** Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Andreea Vornicu:** Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Aimee Ambrose:** Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Validation, Writing – review & editing. **Jenny Palm:** Conceptualization, Formal analysis, Funding acquisition, Investigation, Project administration, Supervision, Validation, Writing – review & editing.

Declaration of competing interest

The authors have no conflicts of interest to declare.

Data availability

The authors do not have permission to share data.

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