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Heating ecologies: Resituating stocking and maintenance in domestic heating☆

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ABSTRACT

This article focuses on describing the different domestic and non-domestic practices and infrastructures through which heating is organized in domestic settings. Based on recent scholarly work interested in researching the interlinks between domestic heating use and non-domestic energy practices and infrastructures, it proposes to understand domestic heating as the practical outcome of existing *heating ecologies*, which are defined as the dynamic interrelations of in-home and out-home heating infrastructures and practices. The argument empirically unfolds using material from six months of ethnographic fieldwork that focused on a heater replacement policy program in central and southern Chile. Using the data we collected from participant observation and follow-up interviews, we describe the installation phase and establishment of new less polluting heaters, as well as how the installation of those new heaters problematizes and redefines preexisting heating ecologies that constitute domestic and non-domestic practices and infrastructures linked to firewood heating. We focus on two specific aspects of this change which proved to be particularly relevant in terms of the adoption of the new heaters: first, the change in the infrastructures and practices of fuel provision and, second, the change in the infrastructures and practices of maintenance and repair. The article ends by suggesting that further understanding of *heating ecologies* — their dynamics and changes — could be a critical element for explaining the success or failure of low carbon domestic technological transitions and policy intervention.

1. Introduction

This article focuses on describing how the installation of a new heater in southern Chile redefines domestic practices, non-domestic practices, and infrastructures in which heating is organized in everyday life. We analyze this process by developing the concept of *heating ecology*, which describes domestic heating as the result of the dynamic interrelationship among in-home practices, outdoor practices, and infrastructures. By doing this, we address the current scholarly interest in researching domestic heating by considering the links between domestic practices and wider energy systems [1]. The argument empirically unfolds using material from 6 months of ethnographic fieldwork documenting a heater replacement policy program in central and southern Chile. During this time we undertook participant observation as well as in-depth interviews with beneficiaries during the replacement of the old heater and after the installation of the new one.

This paper contributes to the research on the social aspects of heating and heating transitions in two ways. First, our main focus lies in addressing the growing interest in researching the links between domestic energy use and energy socio-technical systems, thus, counterbalancing preexisting dualism in approaching the social dimensions of energy. Inspired by Social Practice Theory (STP) and with insights from Science and Technology Studies (STS), we take a relational approach where domestic heating is understood as the practical outcome of existing *heating ecologies,* which are defined as the dynamic interrelationship among in-home practices, out-of-home practices, and heating infrastructures. Understanding *heating ecologies* —their elements, relationships, and changes— might be a critical for unveiling the normative nodes as well as potential limitations and overflowing [2] in the design and application of sustainable heating policies.

In addition to developing the concept of heating ecology, by providing empirical material and describing existing heating ecologies in Chile, this article also seeks to counterbalance current Global North bias in scholarly work on the social aspects of domestic heating and energy

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transitions. As argued elsewhere [3], considering the increasing global challenge of shifting to more environmentally-friendly forms of heating, we need more empirical research that highlight the different national and local forms of organizing heating. By examining domestic heating practices and their current changes in Chile, we contribute to the literature by adding a case from less industrialized countries. Here, we argue that approaching domestic heating from a *heating ecology* viewpoint is effective for understanding heating transitions in less industrialized contexts because it brings to the forefront the relatively common coexistence and eventual competition of the multiple ways of organizing domestic heating, each of them comprised of different infrastructures and practices.

The paper is organized as follows. The last part of this section presents an overview of the existing scholarly literature about social aspects of heating and domestic heating transitions, describing their mayor contributions and limitations. Using this literature review as a starting point, the theoretical background is then presented in the next section of this article. Departing from the Social Practice Theory and Science and Technology Studies literature, which understands domestic heating as result of the entanglement of domestic practices and wider sociotechnical energy systems, we suggest describing domestic heating as a result of existing *heating ecologies*: an interrelationship of in-home practices, out-of-home practices, and infrastructures. These elements are linked by shared materials, forms of knowledge, and temporal forms of coordination. The third section describes the case, the installation phases of a heater replacement policy program in central and southern Chile, and the methods which included participant observation of the new heater installation processes in different households as well as in-depth interviews with users and professionals involved in the process. The fourth section presents empirical material in which we describe how heating replacement redefines existing *heating ecologies*. We do so by describing two specific aspects of this change. Firstly, we present the redefinition of existing infrastructures and practices of fuel provision. This involves the introduction of new standardized and commercial forms of mediation between users and fuel, which relate to new actors and practices of provision. Secondly, we present the changes in the repair and maintenance practices, where experts and closed infrastructures were introduced, problematizing and redefining existing infrastructures and repair and maintenance practices. Based on this analysis, the next section discusses the main characteristics of the two *heating ecologies* described in the empirical section. It focuses on describing how each of them involves mobilizing conflicting temporalities and forms of knowledge. The paper finishes with a discussion about how the concept of *heating ecology* could help to contribute to analyze -at the normative and practical level- the multiple forms of coexistence and tensions through which energy infrastructures and energy demands are organized in less industrialized contexts.

1.1. Relinking heating infrastructures and domestic energy use

As part of a recent call for more "human-centered research methods, interdisciplinary collaborations, and comparative analysis in energy research" [4] there has been an increase in scholarly interest in social and cultural aspects of energy. These efforts extend to the analysis of the social aspects of heating and heating transition [3,5,6].

Social science research on domestic heating has often centered on a division between a bottom-up focus on heating use and acceptance and a top-down concern for institutional and wider sociotechnical aspects of energy systems and policies. Within the first approach, several researchers utilize users' perspectives to explore different aspects of organizing heating practices and technological acceptance. Here we can find two main perspectives. One perspective is characterized by a policy-oriented and quantitative view that utilize users' perceptions and acceptance of new heating technologies, and how different ranges of users choose, accept, and adopt heating technologies [7–11]. The other uses a qualitative perspective that focuses on highlighting how domestic heating relates to the social organization of everyday practices and cultural conventions [12,5,13,14]. For instance, scholars have researched coziness and comfort as key cultural elements that mediate older adults' engagement with heating technologies [14] or how domestic heat management practices rely on different cultural norms of adaptation [3].

When using the top down approach, scholars have focused on wider energy sociotechnical systems by exploring the different institutional and societal factors affecting heating practices and policies [15,16]. Research from this tradition has centered on identifying barriers and mechanisms that hinder or facilitate heating transitions. For instance, researchers have focus on describing different institutional and sociotechnical mechanisms that explain either the adoption or resistance of new heating technologies (AUTHOR, Geels, 2014). These views have identified the institutional steps and mechanisms that explain the successful incorporation of low carbon district heating [16] as well as describe institutional lock-in mechanisms, such as high institutional density and power asymmetries or coordination that made the adoption of more sustainable heating technologies more difficult [47].

Despite this diversity and amplitude, two important common flaws can be noted in the previously described literature. First, at a theoretical level, existing research demonstrates a dialectic between the focus on larger energy systems and in-home users and practices, which has been a longstanding issue in the analysis of energy use and energy systems [6,13,17]. As a result of this dualism, research on domestic heating often neglects the empirical links between in-home domestic energy practices and technologies and out-home practices and infrastructures. By proposing the *heating ecologies* viewpoint and the study of domestic heating replacement in two localities in southern Chile, this paper seeks to address both these flaws.

Second, at an empirical level, there is an overrepresentation of the Global North in researching involving how domestic heating is organized and practiced (However, see [46,18]). Therefore, to strengthen the research agenda of energy studies, a wider regional diversity in domestic heating empirical research should include at least two critical elements: i) different cultural and geographical aspects shaping domestic practices, temporalities, and cultures of heating, as argued by Hitching et al. [3], and ii) the link between domestic heating and the different existing local and national heating infrastructures and energy systems. This challenge involves the development of research in localities and national realities including precarious ones and the acknowledgement of multiple forms of organizing energy supply where universal and stable infrastructure networks are not the norm [19]. It is important to point out that social science scholars have focus on researching the social aspects of energy provision and consumption in less industrialized contexts [20]. For example, Rinkinen et al have explored the links between food systems of provisions, freezing, and energy demand by looking at the nexus of practices that organize food consumption in Bangkok. In addition, in Chile authors have researched the links between existing firewood provision systems and domestic heating [18,45,46]. A key point that arises from the literature on energy use and domestic heating in nonwestern contexts is attending to the coexistence of multiple and often heterogeneous heating supply infrastructures, in the context of weak sustainable heating policies as well as energy vulnerable populations [46,45]. Therefore, a more detailed analysis of how domestic heating is organized is needed, while also accounting for these elements, which can help develop a better understanding of heating and low carbon heating transitions in similar contexts.

2. Theoretical framework

Recently, an increasing number of scholars have begun to approach domestic heating -and energy use, more generally- with more explicit attention given the links between in-home heating practices and technologies and non-domestic energy infrastructures and actors [21,22].

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