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The governance of urban energy transitions: A comparative study of solar water heating systems in two Chinese cities

Ping Huang [a, *, 1], Vanesa Castán Broto [b], Ying Liu [c], Huizi Ma [d, **, 2]

[a] Bartlett Development Planning Unit, University College London, WC1H 9EZ, London, UK
[b] Sheffield Urban Institute, S1 4PD, Sheffield, UK
[c] Independent Scholar, 518040, Shenzhen, PR China
[d] Financial Engineering Research Institute, Shandong University of Science and Technology, 266590 Qingdao, PR China

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ABSTRACT

This paper examines how urban energy transitions are unfolding in China, in relation to the deployment of solar water heating (SWH) systems in two Chinese cities, Rizhao and Shenzhen. Cities play a significant role in the energy transition in China. Scholarly efforts have looked into the translation of top-down visions into locally actionable policy. This article contributes to this body of research with an analysis of the urban governance of urban energy transitions in China, and how low carbon technologies are deployed in particular urban contexts.

The comparative analysis of Rizhao and Shenzhen suggests that specific socio-spatial arrangements shape the evolutionary trajectories of urban energy transitions of SWH systems in both cities. In the case of Rizhao, policy approaches have been erratic. Nevertheless, governmental and civil society actors have worked to forge alignment among political visions, built environment constraints, and social practices. The proximity of an industrial cluster supporting SWH technology and the early uptake of this technology by households are two key factors that explain the rapid spread of SWH systems in Rizhao. In Shenzhen, the local government has promoted SWH systems through regulation and incentives in a top-down and coordinated manner. These programmes have been, however, abandoned, after they did not deliver the expected results.

The two contrasting cases suggest that the urban energy transition in China is the result of the coordinated actions of multiple actors, and success depends on the fit between technologies and the urban development contexts, rather than on aggressive government-sponsored actions.

1. Introduction

This paper examines how urban energy transitions are unfolding in China, in the case of the deployment of solar water heating (SWH) systems in two Chinese cities, Rizhao and Shenzhen. In the context of the 2015 Paris Agreement, China has taken a leadership role in international climate policy (Nunez, 2017). For example, China's Intended Nationally Determined Contributions (INDCs) include ambitious targets, such as: reaching peak greenhouse gas (GHG) emissions, increasing the non-fossil fuel share of total energy to 20%, and reducing carbon intensity by 60–65% below 2005 levels all by 2030. Most commentators agree that such commitments will be significantly exceeded, considering that China has previously delivered on the country's commitments. During its 12th Five Year Period (FYP) there was a shift from broad goals and statements of priority to specific instruments for emissions reductions which had a dramatic impact on the country's emissions (Song et al., 2015; Robiou Du Pont et al., 2017).

City-based action has been a crucial part of China's climate change action frameworks, both in the 12th FYP (2011–2015) and the 13th FYP (2016–2020). China's low carbon province and cities program, for example, was launched in 2010, with a further extension in 2012. Pilot carbon trading systems were established in seven cities in 2011 (NDRC, 2011). The FYPs support both actions led

* Corresponding author.
** Corresponding author.
E-mail addresses: p.huang@ucl.ac.uk, huang_ping1987@hotmail.com (P. Huang), helen_mahuizi@126.com (H. Ma).
[1] Present address: 34 Tavistock Square, WC1H 9EZ London, UK.
[2] Permanent address: 579 Qianwangang Road, Huangdao District, 266590 Qingdao, PR China.

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by the local government and policies for local industrial development. In this context, this paper examines the delivery of climate mitigation action in Chinese cities and the mechanisms that facilitate urban energy transitions in Chinese cities.

The urban energy transition is a multifaceted process that entails multiple technical, organizational, institutional, and social changes in urban areas (Frantzeskaki et al., 2017). Urban transitions require transformations in governance (Hodson and Marvin, 2010). Governance refers to the multiple mechanisms that are used to steer action and processes. Climate change governance entails processes of building authority to respond to climate change within and beyond the state, i.e., multi-level governance (Bulkeley and Betsill, 2005, 2013; Castán Broto, 2017). These fundamental transformations also require the collective involvement of a range of local actors and the penetration of low-carbon practices and technologies in urban physical, economic and social systems (Okereke et al., 2009; Grin et al., 2017). *Urban energy governance*, in particular, has been defined as "the multitude of ways in which urban actors engage with energy systems, flows and infrastructures to meet particular collective goals and needs" (Rutherford and Jaglin, 2015: p. 174).

The governance of urban energy transitions also requires understanding the specific material processes through which such transformations are accomplished (Bulkeley, 2015; Moss et al., 2016). Rutherford (2011) suggests that socio-technical materialities help to explain the inherent tensions and contradictions between transition aspirations and the multiple forms of materiality, the array of concrete objects and their interactions with people, that shape such transitions. This is akin to explaining who can respond to this challenge and how. Accomplishing an urban energy transition involves non-trivial processes of material adjustment through which new governance arrangements are fitted to the actual landscape of intervention (Castán Broto, 2015).

For example, the success of climate change policies in China has been interpreted as an adequate match between top-down objectives and appropriate approaches to policy action (Li et al., 2016a). These studies have also reflected the diversity of processes that shape urban energy transitions in China. Research on China has revealed the multiple interactions between different policy actors in the transition process and how they shape transition trajectories (Francesch-Huidobro and Mai, 2012; Mai and Francesch-Huidobro, 2014; Wu et al., 2016). Two common themes already explored are: 1) the gap between national policy guidance and local policy implementation and; 2) how conflicting interests between urban departments hinder municipal intervention (de Jong et al., 2016; Li et al., 2016b).

There has also been an interest in the transfer of technologies through the implementation of government's future visions, taking into consideration non-state actors' responses to the implementation of such visions (Mol, 2009; Li et al., 2016, 2016c). For instance, Li et al. (2016) analyze the public-private interactions for electric vehicles (EV) deployment in Shenzhen (China). Their study conclude that the integration of business innovations and government regulations facilitates transition processes. Citizens, they argue, play a prominent role in adaptive strategies for governing urban energy transitions.

There is, however, a strong emphasis on how the different branches of the state apparatus govern the transition, without questioning the translation of top-down visions into actual material changes in the fabric of the city. The dominant view reproduces assumptions of 'command and control' paradigms in environmental policy (Cox, 2016). Within this paradigm, local governments in China emerge as "controllers" of the urban energy transition with an assumed capacity to govern directly transitions process (Li et al., 2016).

In this paper, we seek to extend this body of literature by examining how urban energy transitions unfold in context, without assuming that local governments play a controlling role, and questioning the translation of policy into actual material transformations. The paper focuses on a technology particularly successful in Chinese cities: solar water heating (SWH) systems. In SWH systems solar collectors are installed to absorb the incoming solar radiation and convert it to heat energy. Such heat is conveyed through a working fluid (air, water, refrigerant) and can be used to heat water for washing and other domestic uses (for a thorough review see: Buker and Riffat, 2015). SWH systems may help to reduce emissions, but they need to be fitted to both the requirements of the built environment and the practices of water use. Understanding these processes requires examining broader governance changes at the urban level related to that technological change and its impact in everyday life. The study of SWH systems thus constitutes an opportunity to examine the factors that shape the urban energy transitions in China and question dominant understandings of transitions governance.

The empirical analysis focuses on the case study of two contrasting cities, Rizhao and Shenzhen. Both have had policies to promote SWH technology. In Rizhao the adoption of SWH systems has been dramatic, heralding a broader shift in the constitution of energy services in the built environment. In Shenzhen, in contrast, such visible change has not happened. Examining the detail of the case studies, and how changes occurred, the paper shows that urban energy transitions depend not just on top-down visions and efficient regulatory instruments but also on the way flexible policies are embedded within the local contexts. Urban energy transitions herald a multi-dimensional change in governance in which institutions, actors, and spatial patterns change. Rather than playing a role in controlling the transition, local governments are essential mediators that orchestrate that process.

The findings of this paper challenge the most common explanation of China's success in reducing carbon emissions: that energy transitions depend on top-down regulatory action and strong governance capacity of local governments. Instead, the case studies suggest that multiple non-state actors play a vital role in low carbon transitions in urban China.

2. Research methodology and data

2.1. Mediating material transformations in the urban energy transition

Urban energy governance refers to the actors and modes of intervention that seek to steer the means to provide and use energy in the city. In the context of the global imperative for emission reductions, urban energy governance is central to bring about a low carbon transition (Hodson and Marvin, 2010; Rutherford and Coutard, 2014; Rutherford and Jaglin, 2015). Rutherford and Jaglin (2015) note that urban energy governance can take place both through policy strategies and instruments: policy strategies primarily aim at long-term objectives and plans, while policy instruments are more concerned with specific action plans and regulations.

Urban energy transitions are multi-dimensional processes, fundamentally political, in which different actors advance competing visions of the future by building governance networks within and beyond the city (Castán Broto, 2017; Grin et al., 2017). The governance of transitions is an experimental process (Frantzeskaki et al., 2017). Intermediation is required for the coordination of different future visions and the establishment of actor constellations (Hodson and Marvin, 2009; Hodson et al., 2013). However, urban energy transitions also require a process of