Energy Policy 117 (2018) 208–217

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Densification, what does it mean for fuel poverty and energy justice? An empirical analysis

Lavinia Poruschi[a,b,*], Christopher L. Ambrey[c]

[a] CSIRO Land & Water, Ecosciences Precinct, 41 Boggo Road, Dutton Park, QLD 4102, Australia
[b] Cities Research Institute, Sir Samuel Griffith Centre (N78_3.28), Nathan Campus, Griffith University, 170 Kessels Road, Brisbane, Queensland 4111, Australia
[c] Institute for Social Science Research, Cycad Building (1018), Long Pocket Precinct, 80 Meiers Rd, Indooroopilly, Queensland 4068, Australia

ARTICLE INFO

JEL:
I32
Q41
R20
R23

Keywords:
Density
Disadvantage
Energy justice
Fuel poverty
Household, Income and Labour Dynamics in Australia (HILDA) survey
Urban Consolidation

ABSTRACT

Energy is increasingly at the forefront of the global political agenda. While there is a longstanding literature relating to fuel poverty and increasingly energy justice, there remains little evidence which explores its link with the urban form. Specifically, the purpose of this study is to explore the relationship between the urban consolidation hypothesis and the cultivation of energy justice in Australia. This study uses data from the Household, Income and Labour Dynamics in Australia (HILDA) survey (years 2007–2014), a national probability sample and indefinite life panel. The substantive findings of this study demonstrate that for low income and renting households greater urban density corresponds to a higher likelihood of experiencing fuel poverty. Further, for households with a dwelling type described as an apartment (two or three storeys) there is a separate and quite generalisable indication that this type of dwelling is associated with a lower likelihood of experiencing fuel poverty. This study connects the debate regarding urban consolidation and energy consumption to the fuel poverty and energy justice literature. Alongside this contribution, this study also provides policymakers and planners with new evidence to inform remediation policies that are directed at supporting the fuel poor.

1. Introduction

Energy is increasingly at the forefront of the global political agenda. A growing awareness of poverty, inequality, climate change and energy security have drawn attention to the energy-social justice nexus. Urban socio-technical transformations of key infrastructure, such as energy systems, need to occur at the intersection of sustainability and liveability with their performance monitored and evaluated against measures of social equity, environmental sustainability and liveability (Newton, 2012). Throughout the world millions of households suffer from "fuel poverty", generally regarded as spending 10% or more of household income on energy (Liddell, 2012a, b; Liddell et al., 2012). Having the capacity to heat or cool and maintain thermal comfort is inextricably linked to human health and wellbeing (Wilkinson et al., 2007), particularly for the very young, the handicapped and older residents. In this regard, the World Health Organization recommends that indoor air temperatures in the home should range between 18 and 24 °C to protect human health (Ormandy and Ezratty, 2012). As explained by Boardman (2012b), thermal comfort, freedom from intense anxiety about paying for energy needs, the affordability of adequate hot water and light are part of our human rights enshrined in the UN's Declaration:

> "Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care." (United Nations, 1948, article 25(1))

Nevertheless, fuel poverty is a growing concern in many countries, driven primarily by higher fuel prices that are not offset by energy efficiency improvements in the homes of the fuel poor (Boardman, 2012b). Since 2007 household energy prices have risen significantly across Australia (Azpitarte et al., 2015). This has been attributed to electricity sector liberalisation, over-investment in grid development and other factors (Chester and Morris, 2011; Graham et al., 2015; Nelson, 2015; Parkinson, 2014; Simshauser et al., 2011a, b; Smith, 2013).[1] Notably a driving factor of gas and energy prices overall is the

* Correspondence to: CSIRO Land & Water, Ecosciences Precinct, GPO Box 2583, Brisbane, Queensland 4001, Australia.
E-mail addresses: lavinia.poruschi@csiro.au (L. Poruschi), c.ambrey@uq.edu.au (C.L. Ambrey).

[1] Initially, the rise in prices was attributed to a rapid growth in peak demand for electricity, the need for greater capacity attendant cost pressures across the electricity production chain (cf. Simshauser et al., 2011a, b). However subsequent peer-reviewed and gray literature show a reduction in peak demand (Nelson, 2015; Smith, 2013). The energy market appears to show a confluence of factors leading to a reduction in total annual energy consumption, with opposing pressures on peak demand leaving a series of questions to be answered with regard to what the future of the grid and energy prices will be (Australian Energy Regulator, 2017; Graham et al., 2015).

https://doi.org/10.1016/j.enpol.2018.03.003
Received 2 September 2016; Received in revised form 24 January 2018; Accepted 3 March 2018

set-up of extensive operations which divert gas from the domestic market to export, without a legal requirement to ensure affordable supply to the local market (Australian Competitor and Consumer Commission, 2016; Queensland Government, 2010). No study has yet to consider how urban consolidation, through gains in energy efficiency and changes to household level energy consumption behaviour, may mitigate the risk of experiencing fuel poverty.

Urban consolidation or densification is often heralded as the pathway to sustainability (Glaeser, 2012; Morikawa, 2012; Neuman, 2005; Newman, 1992). It is argued that dense cities offer economies of scale in terms of public infrastructure; reduced transmission and reduced distribution losses of energy supply, compact housing with reduced heating/cooling needs all of which are thought to lead to decreased energy consumption (Burton, 2000; Capello and Camagni, 2000; Gaigné et al., 2012; Poumanyvong and Kaneko, 2010). Nonetheless, urban development focused on higher-density living intended to reduce energy consumption and enhance energy savings can lead to higher energy use behaviours (e.g. higher reliance on air-conditioning), less opportunity to save or switch to alternative sources and in turn greater entrenched disadvantage (Farbotko and Waitt, 2011; Gray and Gleeson, 2007; Newton and Newman, 2013; Poruschi and Ambrey, 2016; Steemers, 2003; Poruschi et al., 2018). To the extent that a more dense urban form contributes to lower energy consumption (cf. Holden and Norland, 2005), it is conceivable that it may also mitigate the risk of suffering from fuel poverty. In this sense, the compactness of development may be advocated as a means of redressing energy injustice.

The purpose of this study is to investigate empirically the role of a denser urban form, as it has unfolded in Australia, in mitigating the risk of fuel poverty. Density induced household level energy consumption behaviour is reasoned to underlie this empirical link. To the extent of the knowledge of the authors, this is the first study to explicitly test this link. In doing so, this study makes a distinct contribution to the fuel poverty and energy justice literature. Alongside this contribution, this study also provides policymakers and planners with new evidence to inform remediation policies directed at supporting the fuel poor.

Other work has analysed consumer behaviour related to switching energy providers and what factors influence how quickly the switch is made (e.g. Kleit et al., 2012; McDaniel and Groothuis, 2012), preferences for sources to access renewable energy and willingness to pay for this access (e.g. Yang et al., 2016), controlling consumption behaviour through technology (e.g. Diaz-Mendez et al., 2018). With the goal of informing the urban planning community and energy policymakers, this study departs from studying modification in consumer behaviour and focuses on whether there is an association between changes in the density of the urban form and changes in the risk of fuel poverty.

In this study, it is maintained that fuel poverty can be understood as an expression of energy injustice. It involves the diminished capacity to access energy services and thereby to secure a healthy living environment (Walker and Day, 2012). Situated within the emerging broader energy justice literature fuel poverty may be conceived of as a manifestation of the different dimensions of energy justice; energy production (e.g. different forms of technology), consumption; and related to environmental justice research, the issues of distributive and procedural justice (Fuller and McCauley, 2016).

In detail, the aim of this study is to investigate a number of specific research questions.

(1) What is the extent to which low income households and households in denser areas are more likely to experience fuel poverty, other things held constant? This question is important to establish the presence of; magnitude and the generalisability, on average, of any such link between: low income and fuel poverty; and density and fuel poverty. Low income is defined as 50% of the median income, a *de facto* poverty line (Australian Council of Social Service, 2014, 2016; Headey, 2006). This measure differs from the poverty rate measure used by (Kleit et al., 2012) which refers to the proportion of people in a customer's zip code below the poverty line.

It should be acknowledged that encapsulated within the broader low income grouping used in this study is a diverse range of households. It is possible that the group-specific (e.g. low income seniors) experiences' diverge in some way from the average experience of a low income household.

(2) What is the degree to which any link between density and fuel poverty depends on the having a low income, other things held constant? This research question moves beyond revealing an average link to examine the potential heterogeneity in the link between density and fuel poverty. In particular, the degree to which it may depend on financial disadvantage. This is integral to identify whether or not (and to what degree) for disadvantaged households greater density corresponds to a greater likelihood of experiencing fuel poverty.

(3) What is the magnitude to which any link between a household's dwelling type and fuel poverty depends on low income, other things held constant? This research question goes further still, substituting density with a household's dwelling type, which it is reasonable to expect are positively correlated and possibly indistinguishable from one another. Therefore, it is important to show, at least naively, whether or not (and to what magnitude) for low income households dwelling types correspond to a greater likelihood of experiencing fuel poverty.

(4) To what extent are these differences distinguishable? This research question dispenses with the naïve characterisation of the potential heterogeneity in the link between density and fuel poverty. It aims to uncover whether or not (and by how much) for low income households there is a link between a household's dwelling types and fuel poverty; and density and fuel poverty can be distinguished from one another. This is crucial for the identification of the link between, for low income households, a denser urban form and fuel poverty.

(5) Do other vulnerable groups, in denser areas, face a potentially heightened risk of fuel poverty, other things held constant? This research question examines whether or not (and by what amount) other vulnerable groups may also be at disproportionate risk of fuel poverty.

In all, it is envisaged that the insights gleaned by addressing these research questions will prove valuable to decision makers seeking to assist the fuel poor. In what follows, the remainder of Section 1 reports on the broader relevant evidence. Section 2 discusses the data and method, while Section 3 reports the results of the analysis. Finally, Section 4 discusses the findings and concludes offering insights for future research.

1.1. Urban consolidation as a means to cultivate energy justice?

Fuel poverty can be understood as an expression of energy injustice (Walker and Day, 2012). Relatedly, fuel poverty may be framed as a climate injustice, whereby households suffer disproportionately from climate change (or even adaptation and mitigation measures, such as Pigouvian taxation mechanisms) which risk further ingraining inequalities and the vulnerability of groups who already possess a limited capacity to adapt to anthropocentric climate change (Byrne et al., 2016; Callan et al., 2009; Poruschi and Ambrey, 2016; Roberts, 2008).

Fuel poverty specifically though, depends to an extent on fuel prices and incomes, but more fundamentally it depends on the energy inefficiency of the home and capital equipment. These contributors to fuel poverty highlight the importance of capital expenditure, which the fuel poor, by definition, do not have the means to undertake. Exacerbating the plight of those experiencing fuel poverty is the absence of legal rights and responsibilities for enhancing the energy efficiency of the building in which they reside (Boardman, 2012b). Renters represent a case in point. The confluence of; (1) landlords' incentives to maximise (minimise) the present value of investment profits (losses); and (2) renters' limited capacity to control the fixtures and to some extent the appliances used; means that renters potentially face being burdened by higher energy costs (compared to home owners) for the purposes of heating and cooling (Davis, 2012; Rehdanz, 2007). This is one example of where policies to address fuel poverty do not necessarily need to be