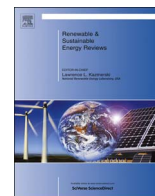




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Financial incentives to mobilise local citizens as investors in low-carbon technologies: A systematic literature review

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ABSTRACT

Mobilising greater levels of private finance through local citizen investment in low-carbon technologies can help bridge the capital shortfall to meeting climate objectives, while also building societal support for the low-carbon transition. Within this context we undertake a systematic review of literature assessing the impact of technology-specific economic and financial incentives promoting greater levels of investment in low carbon technologies from local citizen investors, both individuals and community groups. We focus in particular on the impact of feed in tariffs compared to quota schemes, grants, tax incentives and soft loans. The analysis suggests that local citizen investors do not necessarily act in an economically rational manner in response to these incentives. It underscores the importance of understanding the preferences of target demographics, the local context, as well as the characteristics of the technologies in question, and suggests interventions should be considered as part of wider policy packages. While identifying challenges to be overcome through instrument design, we find that feed-in tariffs, grants and tax incentives can be successful in mobilising greater levels of investment from local citizen investors, but that soft loans tend to be less effective as a stand-alone instrument. The review identifies areas meriting further exploration in this emerging field of research.

1. Introduction

If the ambitious objectives of the international community, agreed in the Paris Agreement of December 2015, are to be met, rapid emissions reductions must be achieved over the coming decades. Two of the key policy challenges faced by Governments in meeting this challenge are investment shortfalls in low carbon technologies (and the consequent need to mobilise greater levels of private finance) and lack of citizen “buy-in” for low-carbon transition.

The International Energy Agency has estimated that investment of \$44 trillion in a portfolio of low carbon technologies (LCTs) is required in the period 2015–2050 in order to decarbonise the energy system in line with a 2 °C climate mitigation target [53]. There is widespread agreement that given the state of sovereign and utility balance sheets, and with traditional banks struggling with stricter reserve requirements under Basel III, new sources of capital for investment in low-carbon assets are required [104,128,36,47].

While traditional investors, such as financial institutions, utilities or businesses, have been active in providing private finance for LCTs,¹ there is potentially a much greater role to be played by local citizen investors. These actors can be engaged in three distinct ways: as private individual investors in LCTs; as investors in a community-owned project; or as investors in a local project led by a professional developer [37].

LCTs are modular, often relatively small scale (typically <50 MW installed capacity) compared to traditional fossil fuel and nuclear generation (typically hundreds of MW), and decentralized, making them more financially appealing to local citizen investors and somewhat less so to traditional investor classes [128]. Furthermore, individuals tend to control more funds than has historically been the case because of changes in pension regulation and administration [40]. Citizen participation schemes and local community ownership have therefore been identified as a potential source of private finance for LCTs [118,128,5].

Abbreviations: EFI, Economic and Financial Incentive; EV, Electric Vehicle; FiT, Feed in Tariff; FiP, Feed in Premium; LCT, Low-Carbon Technology; PV, Photovoltaic; SWH, Solar Water Heater

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¹ For the purposes of this paper, the definition of LCTs is limited to technologies for individual usage (for example electric vehicles, photovoltaic panels, solar thermal systems, etc.) and larger renewable energy supply technologies (for example wind farms, biogas technologies, and solar PV farms). Nuclear energy is therefore excluded.

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With respect to citizen “buy in”, national accounts of the successes and failures of LCT deployment identify community and societal acceptance as a potentially significant barrier, but also a key enabler of success [102,109,113,115,119,121,123,126].

The ability to share local value is one of the key means of building social support for low carbon transition. Engaging local citizens as investors can help to promote behaviour changes such as conserving energy and reducing emissions [49]. Community group and individual citizen investment in LCTs can generate local income, result in more locally appropriate developments that are more likely to secure planning permission, contribute to understanding of climate and energy security issues, and create niches which positively interact with the wider regime in various ways [6,9,27,28,32,61,87,88,94,105,118,119,126,128,129]. The experience of investing in a LCT can also positively dispose citizens to making future low-carbon investments [10,30,56], and greater levels of local ownership have also been found to coincide with higher rates of wind power deployment than “remote, corporate ownership” [116].

There is a long traditional in countries such as Denmark and Germany of mobilising local citizens as investors in low carbon assets, both as individuals or members of community groups. There is, however, a growing interest among policy makers in other countries in approaches to incentivising and mobilising investments from these actors. For example, the UK Energy Infrastructure Act (2015) sets out a framework pursuant to which the Secretary of State may introduce regulations under which local residents and communities would have the right to a buy a minimum 5% equity ownership in renewable energy projects in their area [24]; the Scottish government outlined policies in 2015 where wind farm developers have to demonstrate that at least 10% equity ownership has been offered to local individual and community groups before applying for planning permission [100]; the Irish Energy White Paper (2015) places a considerable emphasis on individuals and community groups as potential investors in low carbon technologies [21]; and Ontario’s Green Energy and Green Economy Act (GEGEA) of 2009 introduced a FiT regime with strong incentives for community owned projects [45].

These two key barriers to low-carbon transition, the investment shortfall and societal “buy-in”, have traditionally been addressed in policy with different instruments. Economic and financial incentives (EFIs), measures that provide actors with monetary compensation to adopt LCTs, in the form of taxes, grants, soft loans and other forms of subsidy [4,78], have typically been introduced to mobilise greater levels of capital investment ([23,86]). On the other hand, education, information, labelling, community involvement in policymaking, community engagement and awareness raising campaigns are recommended to address citizen and community acceptance issues [84,117]. What is less commonly recognised is that these barriers are interrelated, overlapping, and to some extent, mutually reinforcing [54,128].

EFIs are often critical to the success of community energy projects [88], yet designing incentives appropriate for and/or specific to individual citizens and community groups is challenging. LCT investors have traditionally been characterized as rational, rent-seeking agents, but economic motivations and “rational” economic behaviour may not adequately explain LCT investment decisions ([72,124,97]), and this may particularly be the case at individual and community level.

While the case for promoting citizen and community investment in LCT projects is well developed, it is an open question in the literature as to which EFIs have been successful in mobilising local citizen investment in LCTs. While there have been many studies evaluating citizens willingness to pay a premium, usually via energy bills, for renewable power (Soon and Ahmad [108]), by contrast, the literature

on citizen participation in the financing of in LCTs is under-developed [112,128], and the design and use of EFIs worldwide (for example, for promoting uptake of energy efficiency technologies) has not been comprehensively studied [22]. According to [128, p. 678] “*the literature on citizen participation in the financing of renewable energy infrastructures is sparse considering its empirical importance*”.

Within this context we undertake a systematic literature review of EFIs directed towards local citizen investors, which are aimed at mobilising investments in LCTs. This paper makes a number of important contributions addressing gaps in the literature: first, it provides a comprehensive analysis of the literature on EFIs aimed at promoting investment by local citizens, a subset of the overall literature on EFIs; second, it assesses the critical factors in their success or failure; and finally, it sets out policy lessons for the design of these incentives.

We proceed as follows: The following section presents a methodology for the systematic literature review; this is followed by an analysis of the findings of relevant studies identified, highlighting strengths, weaknesses and opportunities for further research; and we conclude with key policy insights.

2. Methodology

Systematic literature reviews offer an established methodological approach for presenting summaries of empirical evidence from across a range of disciplines, and generally incorporate the findings from both quantitative and qualitative studies [55]. They are commonly used to consider whether a particular intervention has been successful in relation to a given societal problem [48,55,89].

In order to ensure the scientific validity of a systematic literature review it is important to precisely define the research question and to determine the type of primary studies the review is trying to locate. This is achieved by developing clear inclusion and exclusion criteria. These criteria are used to screen research results and to identify relevant studies, the findings of which are critically appraised [55,89].

2.1. Determining studies of interest

We proceed to defining a clear search strategy and identifying explicit inclusion and exclusion criteria. According to the Intergovernmental Panel on Climate Change (IPCC), qualitative analyses and case studies complement statistical analyses by capturing the effects of policies and institutions on other aspects of the system, and the effect of institutional, social and political factors on policy success [107]. We therefore consider both quantitative and qualitative *ex post* assessments covering the impact of policy interventions, including reviews of empirical evidence, and interviews with and surveys of individual citizens and community groups. We exclude *ex ante* forecasts using economic models, as well as consultants’ reports and evaluations by Governments of incentive programmes.

“Downstream” incentives targeting individuals and communities are our primary focus. We exclude evaluations of “upstream” incentives targeting manufacturers and “midstream” incentives targeting retailers [22]. Energy efficiency obligation schemes and emissions trading schemes, which are targeted primarily at companies, are therefore excluded, as are evaluations of how EFIs affect investment decisions by companies. We also exclude studies focusing on institutional investors [125,3,73,9] and general assessments of the effectiveness of EFIs [1,8,70,78,83,85,90,107] that do not explicitly consider implications for local citizen investors.

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