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Community solar initiatives in the United States of America: Comparisons with – and lessons for – the UK and other European countries

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ABSTRACT

Solar energy systems that are increasingly economic with regard to their design, delivery and operating costs, hold the potential to contribute considerably to a nation's energy mix. While solar generation comes in many forms, 'shared solar', or a community-based system with an array size intermediate between a large-field and an individual residential system, offers many advantages that utility-scale projects are not able to deliver. The aim of this paper is to examine the development of shared solar initiatives in the recent history of US energy policy in order to reveal lessons that could be applied to future renewable energy generation in other developed nations including the UK and other European countries. Specifically the paper offers original appraisal of the 'solar gardens' scheme being trialled in Minnesota, drawing on findings from a survey with over 650 respondents representing a range of local renewable energy organizations and their customers. We examine the salience and influence of four key factors, namely: (i) perceived individual benefits; (ii) sources and trustworthiness of information; (iii) location; and (iv) project financing. Taken together the findings contribute understanding on the potential for community solar projects to assist in the transition towards a more sustainable and resilient energy future.

1. Introduction

One of the most common criticisms of a renewable energy future is the inability of sources such as wind and solar to replace fossil fuels as the backbone of any reasonably priced power generation system. Such a claim is under increasing challenge. The U.S. National Energy Renewable Laboratory's (NREL's) Renewable Electricity Futures Study, for instance, concluded that "*electricity supply and demand can be balanced in every hour of the year in each region with nearly 80% electricity from renewable resources, including nearly 50% from variable renewable generation*" (NREL, 2012: 3). While no doubt a challenging journey necessitating a range of demand and supply-side solutions, incorporating grid storage, more responsive loads, new transmission and new types of operations vis-à-vis power systems, the report's authors found that "*the abundance and diversity of U.S. renewable energy resources can support multiple combinations of renewable technologies that result in deep reductions in electric sector greenhouse gas emissions and water use*" (NREL, 2012: iii). Similar conclusions were reached by the over 150 authors of *America's Power Plan*, a study overseen by the Energy Foundation and which offered numerous recommendations for working through the multitude of issues involved in the transition to a more sustainable energy future (Harvey and Aggarwal, 2013).

Among the resources likely to hold the greatest potential to aid transformation of the current central station, grid based system of electricity generation and consumption are increasingly economic solar energy systems (Wiser and Dong, 2013). While much attention has been paid to utility-scale projects, one of the most significant challenges to the current system might well be community solar projects with array sizes intermediate between large-field and individual residential or commercial systems. This paper highlights the opportunities and challenges for community solar projects to assist in the transition towards a more sustainable and resilient energy future with findings from a US case study considered in the context of possible lessons for the current and future development of local-level solar electricity generation in the

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UK and other European countries. Whilst it is acknowledged that some of the lessons emerging from the US research may well have application potential in countries outside the EU (including prominent 'emerging economies' like China and India) for the sake of clarity and tightness of focus in this paper the central point of concentration is on the UK. Increasingly the potential expediency of local-level and community energy/sustainability initiatives in helping to meet legally binding climate targets has been a key feature of UK policy making over the last decade and a half, with a range of policy documents, White Papers and other government communications bearing witness to this – particularly in respect of effective community engagement (for example, DECC, 2009; The Cabinet Office, 2010; DCLG, 2011; HM Government, 2011; HM Government, 2018). This has spawned an ongoing dialogue on extant opportunities, challenges, enabling and inhibiting factors in the fields of current policy analysis and academic inquiry. The current paper contributes fresh insights to this ongoing UK-based debate with some additional evidence discussed and compared in relation to other European countries; specifically Denmark the Republic of Ireland, and Germany. These nations represent geographic and cultural diversity and have all made concerted efforts in terms of policy and practice at various points during the last two decades regarding the design and delivery of effective renewable energy strategies, including solar applications.

It is important to remember that considerable variations in solar irradiance, or insolation, occur both within and between countries. This clearly has potential implications for the applicability of community scale solar at different locations, both in relation to electricity generation capacity and also regarding implications for the efficacy of community pressure and action. So in the UK, for example, the application possibilities for solar in insolation terms are greater in South-West England than in Northern Scotland. In order to give an idea of the magnitude of variation for the five countries described in this paper, Table 1 provides solar insolation figures measured in kWh per square meter per day in a summer month (July) at five disparate locations (North, South, East, West and Central) in each country. The data has been obtained from the 2017 edition of the Solar Electricity Handbook (Boxwell, 2017). From the data shown here the USA and Denmark stand out as having the highest insolation levels at this time of year – but with substantial national variations evident in each case. The UK and Germany share similar but lower level profiles, with Ireland more consistently lower on average across the country in July.

We begin by discussing the community-level context, focusing on the opportunities and constraints related to definitions of community energy and mobilization – at the local level – of people individually and collectively in sustainable energy initiatives and sustainability projects more broadly.

Table 1
Average solar insolation at locations North, South, East, West and central for each case study country in July (measured in average kWh per square meter per day). [Source: Boxwell, 2017].

Location	Germany	UK	USA	Denmark	Republic of Ireland
North	Hamburg 4.68	Aberdeen 4.31	Saint Paul Minnesota 6.05	Aalborg 6.27	An Longfort 4.21
South	Freiburg 5.48	Exeter 5.28	Houston Texas 5.94	Odense 5.41	Cork 4.61
East	Dresden 4.84	Norwich 4.86	Bangor Maine 5.40	Copenhagen 5.30	Dublin 4.21
West	Dusseldorf 4.78	Swansea 4.71	Los Angeles California 7.54	No data available	Castlebar 4.28
Central	Hanover 4.61	Nottingham 4.50	Bellevue, Nebraska 6.19	Arhus 5.52	Tullamore 4.21

2. Background and literature review

2.1. Community energy – concepts, definitions and practices

Recent work by Seyfang et al. (2013) considers the argument that, whilst community organization and mobilization has been offered as an effective delivery mechanism for local level carbon reduction strategies, there are currently inconsistent ways of assessing this approach. Also, and perhaps more importantly, inconsistencies exist in relation to supporting the development of low carbon communities through appropriate regulatory and policy frameworks. They suggest that part of the problem relates to the fact that there is no universal definition of 'community energy'; rather "they encompass a wide range of initiatives such as locally-owned renewable energy generation, community hall refurbishments, collective behaviour change programmes, are claimed to bring additional public engagement benefits to top-down policy initiatives" (Seyfang et al., 2014: 22). In a similar vein, and having observed the diverse range and extent of local-level initiatives identified as so-called 'community energy projects', Walker and Devine-Wright (2008) developed an evaluatory grid to assist in providing clarity on the characteristics of a project regarding two principal dimensions. First, dimensions relating to process – Who is the project for? Who owns, operates and manages the project? And second those relating to outcomes – Who actually benefits from the project? How do they benefit; and in what ways are those benefits shared out? The authors highlight that assessing the potential contribution of local and community responses to carbon management and the broader climate challenge requires an understanding of how the processes and outcomes of such endeavours are applied and distributed in practical terms.

The difficulties of defining what 'community' means is a subject that has been extensively deliberated in range of academic literature particularly with regard to the diversity of social organization found within and across different community 'types'; for example communities of 'place', of 'practice', of 'interest' and so on (Peters et al., 2010). In their paper, Walker and Devine-Wright (2008) discuss those difficulties in an energy project context. It is posited that projects possessing a true community nature would be characterized by a high level of involvement of local people in the planning, setting up and, potentially, the running of the project; with the core benefits arising being distributed locally (e.g. energy generation, providing jobs, contributing to local regeneration or providing an educational resource).

The ability of local action to galvanize collective community activity is, however, seldom a straightforward process; and access to sufficient start-up capital can also be restrictive. In order to investigate such community-oriented challenges in greater depth, Seyfang and her colleagues set in motion a research programme designed to build on three existing surveys – by the Low Carbon Communities Network, Energy Saving Trust, and a Friends of the Earth study of 267 community climate action groups. During the period of June to October 2011, they compiled a database of community energy projects, collated from comprehensive internet based searches and snowball sampling from the personal contacts within the research team. This included "local, regional and national organizations working in climate change, sustainability and sustainable energy issues" (Seyfang et al., 2013: 980). These organizations were subsequently contacted and asked if they would be willing to circulate a link to a web based survey to their members and other organizations that they might be in touch with.

The closed and open questions in the survey incorporated several key themes including: 'structure/organization; 'location' i.e. rural or urban; 'kinds and types of projects' i.e. renewable energy installation, behaviour, or conservation; 'activities'; 'regulation and policy' – a development which they suggest will enable a better understanding of the financial and political backing which is so essential to longer term consolidation for the