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Financial Incentives to Promote Citizen Investment in Low-carbon and Resource-efficient Assets

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EPA RESEARCH PROGRAMME 2014–2020

Financial Incentives to Promote Citizen Investment in Low-carbon and Resource-efficient Assets

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EPA Research Report

Prepared for the Environmental Protection Agency

by

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The EPA Research Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in relation to environmental protection. These reports are intended as contributions to the necessary debate on the protection of the environment.

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Executive Summary

Many countries are incentivising the take-up of low-carbon and resource-efficient technologies such as waste-to-energy, wind, solar photovoltaic and biomass heating systems. These technologies are particularly attractive for local citizen investors because of their maturity, modularity, high reliability and the simplicity of the energy generation process. However, they face a number of barriers to widespread deployment.

Ireland has encountered considerable challenges in transitioning to a low-carbon resource-efficient economy. European Union emissions and renewables targets are not on track to being met, leaving the exchequer potentially exposed to several hundred million euros in possible fines.

Opposition to distributed energy technologies in local communities, often manifesting as objections to planning permissions for wind energy developments, has emerged as a key barrier to meeting renewable objectives. In Ireland, in contrast to countries such as Denmark and Germany, there are few examples of citizen and community renewable projects. In response, in its 2016 White Paper, the Irish Government committed to promoting "energy citizenship" and providing support for local community-led and shared ownership projects. However, designing cost-effective financial incentives that are attractive to local citizen investors is challenging.

The objective of this study is to make policy recommendations for the design and implementation of policy supports to promote community and citizen investment in these assets. We present findings from a literature review, national and international case studies, and a survey of Irish citizens.

A survey of Irish citizens conducted for this research suggests that 40% of respondents would be willing to invest and 38% of respondents may be willing to invest in distributed renewable energy technologies. However, the amounts people are willing to invest are low relative to project costs: 31% of those willing to invest indicated that they would invest up to €500, with a further 25% of respondents willing to invest between €500 and €2000, and a further 22% willing to invest between €2000 and €5000. Only 7% of those willing to invest would invest more than €10,000. Wealthier cohorts with some experience of making investment decisions were more likely to consider investing. Key barriers to financial citizen participation include insufficient savings and no access to loan finance.

These findings suggest that while smaller scale projects (circa 5 megawatt (MW)) could be fully community owned, co-development with professional project developers is necessary for citizen involvement in larger projects.

The international case studies illustrate that citizens can be mobilised as investors. This is true not only in countries with a long history of citizen investment (Germany and Denmark), but also in jurisdictions where this tradition is not evident (the UK and Ontario).

Key findings that emerge from successful examples internationally are as follows:

1. **Effectiveness of financial incentives:** Feed-in tariffs (FiTs), feed-in premiums (FiPs), quota schemes, grants and tax incentives have all been effectively deployed to mobilise greater levels of investment from local citizens. Soft loans have been less successful as a stand-alone instrument.
2. **Instrument design over instrument choice:** FiTs emerged as a crucial success factor in mobilising local citizens in many jurisdictions. However, it is not the instrument choice per se that is the key consideration, but rather the specific design characteristics of the chosen instrument. Where FiTs have been successful, they have incorporated design features to make them more attractive to citizen investors, such as differentiation according to project size, "adders", contract set-asides and mandates. Furthermore, in some cases, FiPs and quota-based schemes have also been successfully designed with citizen investors in mind.
3. **Early-stage grant supports:** Introducing incentives to overcome risks at the early (feasibility and development) stages is of crucial importance if local citizens are to be mobilised. Grants have been successfully introduced to

address early-stage barriers, for example in Denmark, where construction costs were initially part grant aided. Grant programmes require ongoing monitoring and assessment so that pitfalls in using them are avoided.

4. **Soft loans:** In combination with other incentives, the availability of soft loans (Kreditanstalt für Wiederaufbau (KfW) in Germany and the "ethical" Fælleskassen Bank in Denmark) was an important factor in promoting citizen investment. Additionally, non-recourse loans have been used effectively to address early-stage barriers to citizen investment in the UK and Ontario.

5. **Migrating to market-based incentives:** Time-bound grants can be important for pilot projects and can therefore perform an important function in immature markets. The objective should be to transition to market-based supports over time.

6. **Tax incentives:** Favourable tax treatment of income from renewable energy projects emerges as important for the business case of many community renewable energy projects. The GmbH & Co. KG structure in Germany and the guild structure in Denmark significantly increased post-tax returns to citizen investors.

7. **Agency support for technical expertise:** Incentives should be introduced as part of policy packages, with ancillary measures addressing lack of familiarity with the technology, technology immaturity or low awareness of the incentive programme itself. Informational, advisory and technical support services will be required to support citizen investors; these are best provided through an independent and trusted intermediary, e.g. CARES in Scotland.

8. **Planning and grid access:** Streamlined planning, FiT application and grid access procedures were an essential enabler of rapid deployment of citizen renewable energy, particularly in Germany. If these conditions are not present, grid access can act as a key barrier to community and citizen participation.

9. **Mandates:** Mandating a certain percentage of citizen or community ownership has been effective in mobilising community investment in Ontario and Denmark; in contrast, voluntary targets were less effective in the UK.

10. **Concerted policy attention:** Jurisdictions that do not have a tradition of citizen financial participation (such as the UK or Ontario) have particular challenges in mobilising investment from these non-traditional investors. It takes time to seed awareness and build the capacities of local actors, requiring persistent policy focus over time.

11. **Typical business models:** The design and choice of financial incentives can influence the types of business models that emerge as vehicles for community and citizen participation. In many jurisdictions, typical business models have emerged for both developer- and community-led projects, reducing transaction costs and increasing cost-effectiveness.

We proceed to making the following policy recommendations for Ireland:

1. **Target setting:** Setting a target for community ownership would underpin the commitment to local ownership outlined in the 2014 Energy White Paper and would provide regulatory stability for investors. The Scottish targets (500 MW over a 5-year period) could be used as a benchmark.

2. **Grants for community-led projects:** There is a case for the introduction of a time-bound grant programme covering feasibility, development and (a portion of) construction costs to promote fully community-owned projects. These will generally be small-scale (circa 5 MW) schemes. A pilot programme with good geographical spread would promote the emergence of exemplar projects, which would serve to illustrate what is possible across Ireland.

3. **Market-based incentives for community-led projects**: A grant-based programme might eventually be succeeded by a technology- and size-differentiated FiT programme for smaller projects, combined with non-recourse loans covering early-stage project costs.

4. **Co-operative structures:** There is a case for promoting the growth of the co-operative form for community-led projects. This can be achieved by delivering favourable tax treatment of profits, which is a key consideration for citizen investors.

5. **FiP or quota scheme for developer-let projects:** A market-based incentive programme (either a FiP

or a quota-based scheme) targeting professional developers can be designed to favour equity participation from local citizens and community groups.

6. **Mandates:** If a FiP is chosen, a mandate requiring a share offer to local citizens (as in Denmark) should be considered.
7. **Quota scheme:** In the case of a quota-type scheme, the award criteria could favour higher levels of equity participation from local communities and citizens (as in Ontario).
8. **Managing risk for citizen investors:** Given project risk at the pre-construction and construction phases, one option is for the project developer to offer a preference share to local citizen or community groups at the early stage of project development. This would allow the local community to be part of the development without putting any capital at risk. If the wind farm becomes operational, the preference shareholders will receive dividends (subject to covenants of senior lenders).
9. **Community benefit scheme:** In some cases, where there is a low appetite for local investment, an option for an enhanced community benefit scheme for neighbours or near-neighbours might be considered. This could take the form of subsidised electricity bills or a straightforward payment for local citizens.

1 Project Background and Introduction

1.1 Introduction

If the ambitious objectives of the international community, as set out in the Paris Agreement of December 2015, are to be met, rapid decarbonisation is required over the coming decades, particularly in developed countries. Many industrialised countries are incentivising the uptake of low-carbon and resource-efficient technologies such as waste-to-energy, wind, solar photovoltaic (PV), and biomass heating systems, which alone have the potential to make a very substantial contribution to global decarbonisation by 2050 (IEA, 2015).

It is notable that these technologies are particularly attractive to local citizen investors who are acting individually, as a member of a community group or as party to a project by a professional developer (Enzensberger *et al*., 2003). This is because of their maturity, modularity, high reliability, the simplicity of the energy generation process and availability of technical service providers (Yildiz, 2014).

These technologies, however, face a number of barriers when it comes to widespread deployment; this means that their full potential cannot not realised. According to the Intergovernmental Panel on Climate Change (IPCC), policy must address these barriers to enable the full theoretical potential for mitigation to be realised. As illustrated in Figure 1.1, these barriers are not just technical and economic, but also relate to socio-economic, regulatory and institutional factors (IPCC-WGIII, 2001, p. 752).

The focus of this report is on addressing two of the key barriers identified in the IPCC typology: financial barriers (and the consequent investment shortfall in low-carbon technologies (LCTs) (section 1.2)), and lack of social support among citizens for low-carbon transition (section 1.3). These barriers are discussed in turn, focusing on the potential for citizen investment to address them.

1.2 The Financial Barrier

The International Energy Agency estimated that an investment of US$44 trillion in a portfolio of LCTs will be required in the period 2015–2050 to decarbonise the energy system in line with a 2°C climate mitigation target (IEA, 2014). Access to and cost of capital is a central determinant of the pace at which relevant technologies will be adopted. Traditional investors, such as financial institutions, utilities or businesses, have been active in providing private finance for LCTs; however, for a variety of reasons, funding may not be available at the necessary scale. For example, the financial sector may not be attracted to low-carbon and resource-efficient projects because technologies have longer payback periods and higher upfront investment costs (Zhang *et al*., 2012). Investors may have biased perceptions and preconceptions that favour status quo energy production models over innovative alternatives (Masini and Menichetti, 2013); or they may perceive new technologies to be riskier and unreliable (IPCC, 2011).

The challenge of attracting finance into low-carbon and resource-efficient markets may have been exacerbated since the financial crisis by a "change in the business logic of the financial sector" including "a very significant increase in investment in financial products, an associated orientation towards short-term and speculative investments" (Jones, 2015). Traditional banks are struggling with stricter reserve requirements under Basel III reform measures; adequate finance is also not likely to come from sovereign or utility balance sheets (Simshauser, 2010; Haigh, 2011; Eleftheriadis and Anagnostopoulou, 2015). For these reasons, the adequate mobilisation of financial resources may require public investments to be greatly increased and/or a reform of the financial system (Jacobsson and Jacobsson, 2012). New sources of capital for investment in low-carbon assets are required.

Within this context, there is potentially a much greater role to be played by local citizen investors. The relevant technologies are modular, often relatively small scale (typically <50 megawatt (MW) installed capacity) compared with traditional fossil fuel and nuclear generation (typically hundreds of MW), and decentralised, making them more financially appealing to local citizen investors and somewhat less so to

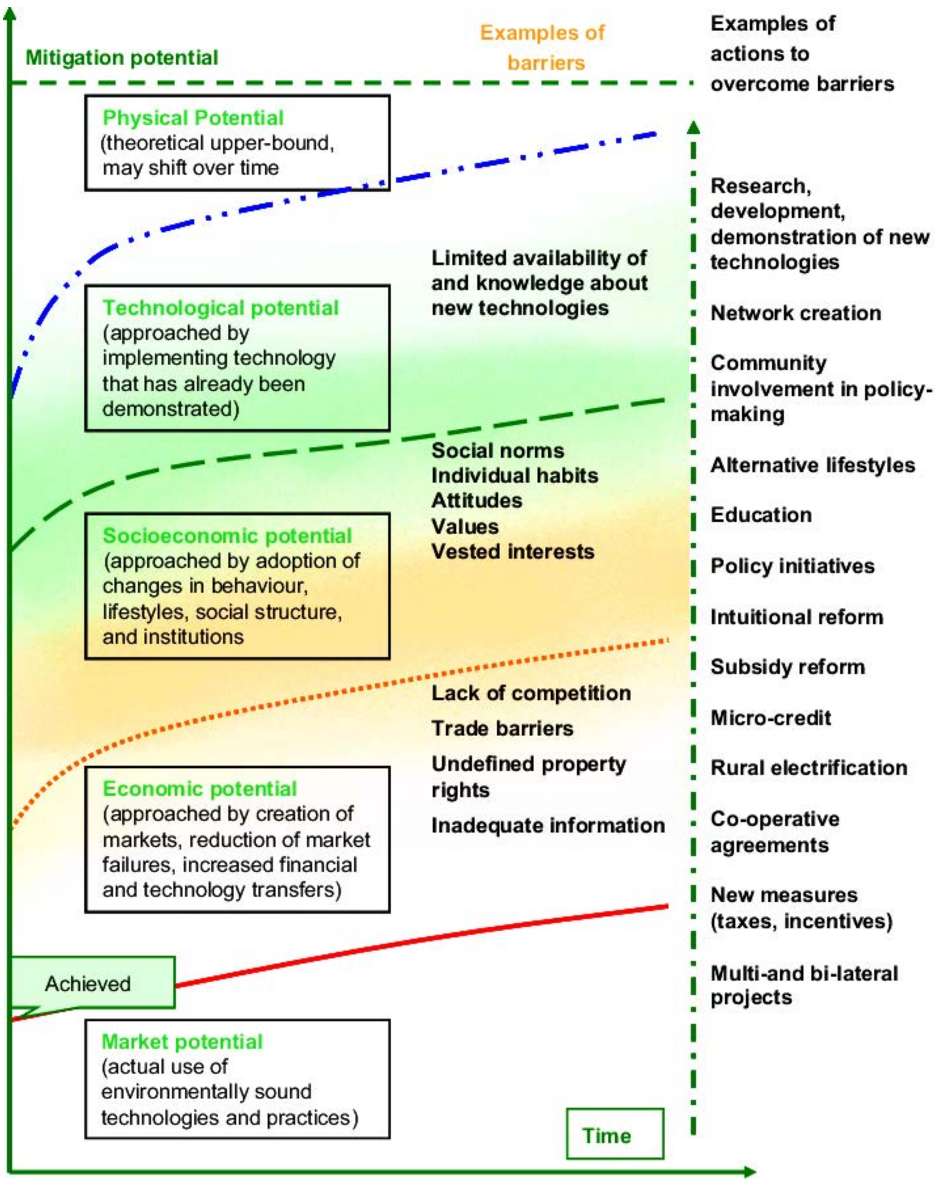

Figure 1.1. Overcoming barriers to decarbonisation. Source: IPCC-WGIII (2001).

traditional investor classes (Yildiz, 2014). Furthermore, individuals tend to control more funds than has historically been the case because of changes in pension regulation and administration (Colonial, 2013). Citizen participation schemes and local community ownership have therefore been identified as a potential source of private finance for low-carbon and resource-efficient technologies (Bergek and Berggren, 2014). For these reasons, promoting greater levels of citizen investment is seen as an approach to addressing the investment shortfall and overcoming financial barriers to investment.

1.3 Societal "Buy-in"

Individuals and communities may be slow to accept new technologies for various reasons, and addressing the issue of societal acceptability is therefore of crucial importance for low-carbon transition (Wüstenhagen *et al*., 2007). National accounts of the successes and failures of low-carbon transition identify community and societal acceptance not only as a potentially significant barrier, but also as a key enabler of success (Shackley and Green, 2007; Wolsink, 2007; Walker, 2011; Sovacool and Lakshmi Ratan, 2012; Szarka *et al*., 2012; Stokes, 2013).

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 (Heiskanen *et al*., 2010). 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 that positively interact with the wider regime in various ways (Devine-Wright, 2005; Rogers *et al*., 2008; Bergman and Eyre, 2011; Palm and Tengvard, 2011; Parag *et al*., 2013; Viardot, 2013; Devine-Wright, 2014; Bolton and Foxon, 2015; Dóci *et al*., 2015; Slee, 2015).

The experience of investing in a LCT can also positively dispose citizens to making future low-carbon investments (Dobbyn and Thomas, 2005; Keirstead, 2007; Boon and Dieperink, 2014), and greater levels of local ownership have also been found to coincide with higher rates of wind power deployment than "remote, corporate ownership" (Toke *et al*., 2008). Mobilising citizen investors has the potential to build resilience to climate change at a local level. It can also improve the cost-effectiveness of low-carbon transition by opening up optimal sites for developments that could otherwise not be accessed and by mobilising actors to devote time and effort on a voluntary basis (Rijpens *et al*., 2013; IEA-RETD, 2016; Nelson *et al*., 2016). This could have the effect of allowing more onshore development of wind power, for example, and therefore a reduction of the need for more expensive offshore wind power development.

A key means of building understanding and support for low-carbon transition is by promoting local ownership of distributed renewable energy technologies, and thereby ensuring some local benefit from technology deployment. While low social acceptability can act as a barrier to low-carbon transition, this obstacle can be addressed by ensuring benefits and opportunities arising are accessible to all cohorts in society.

1.4 Irish Policy Context

The financial barrier and social acceptability challenges have traditionally been addressed in policy with different instruments. Economic and financial incentives, measures that provide actors with monetary compensation to adopt particular technologies (Mickwitz, 2003; Bergek and Berggren, 2014), have typically been introduced to mobilise greater levels of capital investment (Painuly, 2001; IEA, 2003; De Serres *et al*., 2010). 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 (Owen, 2006; Verbruggen *et al*., 2010). What is less commonly recognised is that these two barriers are interrelated, overlapping, and to some extent, mutually reinforcing (Yildiz, 2014; Juntunen and Hyysalo, 2015).

Given the importance of investment shortfalls and social acceptability challenges, there is an increased policy focus in many countries on approaches that mobilise local citizens as investors in low-carbon and resource-efficient assets. The interest in local citizens as investors, as well as the levels of financial citizen participation, however, varies widely between countries (Curtin *et al*., 2016). In a select number of countries, such as Germany and Denmark, there is a long tradition of mobilising local citizens as investors, both as individuals or as members of community groups (Chapter 3), whereas in many other countries, including Ireland, there has been a more modest involvement from local citizens.

Over the past decade, there has been a growing interest in mobilizing citizen investment from countries that do not have a long tradition of doing so. 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 of 5% equity ownership in renewable energy projects in their area (DECC, 2015a). The Scottish Government outlined policies in 2015 in which wind farm developers have to demonstrate that at least 10% equity ownership has been offered to local individuals and community groups before applying for planning permission (Scottish Government, 2015). Ontario's Green Energy and Green Economy Act (GEGEA) of 2009 introduced a feed-in tariff (FIT) regime with strong incentives for community-owned projects (Ontario Power Authority, 2009). Furthermore, in 2016 the Québec government proposed a "new energy pact" as part of which it will promote partnerships between energy project developers and local communities (Government of Québec, 2016).

Within this context, Ireland is an interesting case. Policy, in particular the introduction of a FiT (the Renewable Energy Feed-in Tariff (REFIT) Scheme) in 2006, has been successfully attracting investment capital to the wind sector. Wind energy has expanded rapidly, reaching 24% of total energy generated in 2014 (IWEA, 2017).

However, according to the European Commission, Ireland lags behind considerably in achieving its renewable energy targets (EC, 2017). Its current trajectory of renewable energy growth suggests that the shortfall in the target of several per cent may rise by 2020 (SEAI, 2017a). In early 2016, former Minister for Energy, Alex White, told Dáil Éireann that the cost of each percentage point shortfall "may be in the range of €100 million to €150 million" annually.

In contrast to Germany and Denmark, investment in wind has been almost entirely dominated by Irish utilities and professional project developers. There is only one wind farm of 3.9 MW held in community ownership from a total installed capacity of 3000 MW (see Chapter 3). Furthermore, there are very few examples of citizen and community-owned solar, hydro, waste-to-energy or biomass plants.

While there has traditionally been a widespread acceptance of the need for distributed renewable and wind power among Irish citizens, a "sea change in social support" for wind energy and related infrastructure has been identified (NESC, 2014). Local opposition to renewables deployment has emerged as a major barrier to low-carbon development and has made deploying renewable projects increasingly challenging. One possible consequence is that Ireland may find it increasingly challenging to meet its legally binding EU commitment, which opens up the possibility of fines for non-compliance (Curtin, 2016). For these reasons, the Government's Irish Energy White Paper (2014) places a considerable emphasis on "energy citizenship". It envisages a transition from an energy system "that is almost exclusively Government and utility led, to one where citizens and communities will increasingly be participants" and includes commitments for "providing funding and supports for community-led projects in the initial stages of development, planning and construction" and "examining shared ownership opportunities for renewable energy projects in local communities" (DCENR, 2015).

1.5 Project Objectives and Methodology

The design of financial incentives that are attractive to local citizen investors is an underdeveloped theme in the academic literature (Stigka *et al*., 2014; Yildiz, 2014). A number of approaches have been employed in different contexts, with widely varied results in terms of environmental effectiveness, cost-effectiveness and distributional justice. It is therefore important for researchers and policymakers to understand the different experiences, capacities, priorities and motivations of local citizen investors when designing policy interventions such as financial incentives. Furthermore, in the literature, it is an open question whether or not the successes achieved in countries such as Denmark and Germany can be replicated in other countries. Some studies (Dewald and Truffer, 2011; Romero-Rubio and de Andrés Díaz, 2015) identify context-specific enabling factors, which suggest that experiences might not be transferable.

For these reasons, there is considerable value in exploring the experiences of countries and the different attitudes and experiences towards promoting financial citizen participation. Within this context, this project's objective were:

1. to identify international best practice in creating financial incentives for investment in low-carbon and resource-efficient technologies, focusing on "non-traditional" investors such as individuals and communities; and
2. to make recommendations for the design and implementation of financial incentives targeted at individuals or community groups in Ireland that will be socially inclusive and attract capital to these assets.

In order to achieve these objectives, the research approach employed was to progress from a general to increasingly specific analytical focus, over four discrete work packages (Figure 1.2).

1.6 Report Structure

This report presents the output from each of these work packages. Chapter 2 provides a comprehensive literature review on the use of financial incentives aimed at individuals and communities to attract capital to low-carbon and energy-efficient sectors.

Figure 1.2. Research approach.

This is followed in Chapter 3 by a presentation of four in-depth case studies exploring the use of financial incentives and the common business models that have emerged in response to these incentives. Chapter 4 assesses the use of financial incentives in Ireland to promote investment from citizens and communities in low-carbon and resource-efficient assets. Chapter 5 presents preliminary results from a survey undertaken on the attitudes of Irish citizens to investing in wind, solar, biomass and waste-to-energy projects. Chapter 6 concludes with policy recommendations and proposals for the design of socially inclusive financial incentives based on the findings from previous work packages.

2 Literature Review

2.1 Introduction

While the case for promoting citizen and community investment in low-carbon and resource-efficient assets is well developed, in the literature the question remains as to whether or not economic and financial incentives (EFIs) have been successful in mobilising local citizen investment in these sectors. While many studies have evaluated citizens' willingness to pay a premium, usually via energy bills, for renewable power (Kostakis and Sardianou, 2012; Soon and Ahmad, 2015), by contrast, the literature on citizen participation in the financing of LCTs is underdeveloped (Stigka *et al*., 2014; Yildiz, 2014) and the design and use of EFIs worldwide (e.g. for promoting the uptake of energy-efficient technologies) has not been comprehensively studied (de la Rue du Can *et al*., 2014). According to Yildiz (2014, p. 678) "the literature on citizen participation in the financing of renewable energy infrastructures is sparse considering its empirical importance."

Within this context, we undertook a systematic literature review of EFIs that are directed towards local citizen investors and aimed at mobilising investments in LCTs. The findings of this review were published in the *Journal of Sustainable and Renewable Energy Reviews* (Curtin *et al*., 2016) and are summarised in this chapter.

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.

2.2 Determining Studies of Interest

For systematic literature reviews to be robust it is important to clearly define the studies that will be included and excluded. According to the 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 (Somanathan, 2014). We therefore included 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.

"Downstream" incentives targeting individuals and communities were our primary focus. We excluded evaluations of "upstream" incentives targeting manufacturers and "midstream" incentives targeting retailers (de la Rue du Can *et al*., 2014). Energy efficiency obligation schemes and emissions trading schemes, which are targeted primarily at companies, were therefore excluded, as were evaluations of how EFIs affect investment decisions by companies. We also excluded studies focusing on institutional investors (Wüstenhagen *et al*., 2007; Mathews *et al*., 2010; Barradale, 2014; Bolton and Foxon, 2015) and general assessments of the effectiveness of EFIs (Mickwitz, 2003; Marques and Fuinhas, 2012; Bobinaite and Tarvydas, 2014; Ozcan, 2014; Somanathan, 2014; Polzin *et al*., 2015) that did not explicitly consider implications for local citizen investors.

EFIs are generally distinguished from regulatory instruments (command and control), informational and co-operative (or voluntary) policy interventions (Mickwitz, 2003), and studies covering these policy interventions are therefore also excluded. EFIs can be further subdivided into those that are technology specific or technology neutral. The former might include, for example, an incentive to purchase a low-carbon vehicle or low-carbon heating system. The latter, on the other hand, would include instruments such as carbon taxation (Bergek and Berggren, 2014; Sierzchula *et al*., 2014). We included technology-specific economic incentives in this review, but studies that address general instruments such as carbon taxation were included only insofar as they were relevant to assessing the merit of a technology-specific incentive.

In practice, this implied a focus on a specific set of EFIs. Further to analysis of the International Energy Agency's comprehensive database of economic incentives that have been implemented in the building, energy and transport sectors to promote LCTs (IEA, 2017), the IPCC's typology of sector-specific economic incentives (Somanathan *et al*., 2014, p. 1158) and reviews of several comprehensive analyses on financial incentives for renewables (Cansino *et al*., 2011; Solangi *et al*., 2011), we identified the following four categories of incentive for inclusion:

1. FiT, feed-in premium (FiP) and quota schemes[1]
2. tax incentives
3. grants and subsidies
4. "soft" loans

Several of these EFIs (in particular FiTs and quota schemes) often target large investors; therefore, only studies that explicitly considered the impacts on individuals and communities were included.

We first present in section 2.3 general findings from our review below, before evaluating the literature on each of these four categories of incentive.

2.3 General Use of Financial Incentives

There is a significant body of research that is not specific to a particular type of EFI, which identifies factors that influence the attractiveness of these incentives to local citizen investors. This work, much of it from the field of behavioural economics, suggests that, while some individual citizens may respond to EFIs in an "economically rational" manner, this will not always be the case. For example, a number of studies identified the potential importance of social comparison and the influence of peers and neighbours in the community as a factor that can have either a positive or negative impact on LCT investment decisions (Allcott, 2011; Palm and Tengvard, 2011; Costa and Kahn, 2013; Frederiks *et al*., 2015; Schultz, 2015).

Frederiks *et al*. (2015) identified several behavioural factors that need to be considered when designing EFIs, including myopia (high discounting of future benefits) and status quo biases. The prevalence of myopia in low-carbon purchasing decisions is a particularly well-developed theme (Lane and Potter, 2007; Metcalfe and Dolan, 2012), which may render individuals resistant to investing in LCTs even when EFIs are strong. Schultz (2015) found that, in addition to EFIs, strategies such as prompts, commitments, feedback and convenience can effectively promote pro-environmental behaviour – at least in some contexts and for some behaviours and individuals. Frederiks *et al*. (2015) and Rode *et al*. (2015) identified the potential for EFIs to "crowd out" intrinsic motivation, highlighting the importance of anticipating changes in an individual's motivational structures prior to "large-scale implementation" of EFIs so that negative or unintended impacts are avoided (Rode *et al*., 2015).

These findings highlight the importance of considering EFIs as part of wider policy interventions (Michelsen and Madlener, 2016) and the need for complimentary, or in some cases supplementary, policy interventions in addition to EFIs (Lane and Potter, 2007) to promote investments in LCTs from local citizens. These interventions could include, inter alia, information provision or using the power of social comparison. It should be noted, however, that Momsen and Stoerk (2014) found that using social comparison as a "nudge" was ineffective in prompting individuals to choose renewable energy (Momsen and Stoerk, 2014).

A further strong conclusion from the literature is the importance of considering the target demographic when designing EFIs and the importance of avoiding "one size fits all" solutions. Several studies found that demographic characteristics such as gender, age and income are important factors in determining likelihood of investing in LCTs (Egbue and Long, 2012; Fraune, 2015; Greenberg, 2009; Kosenius and Ollikainen, 2013). Kosenius and Ollikainen (2013)

1 A FiT is an agreement to pay a guaranteed amount over a set period of time for certain types of renewable heat and electricity. A guaranteed price tariff is a FiT scheme where a set rate is paid for each unit of electricity generated and supplied to the grid. FiPs are similar to FiTs, except that in this case a fixed premium is added to the market price when exporting electricity to the grid (Couture and Gagnon, 2010). There are two broad categories of quota scheme. Quotas with tradable green certificates are certificates issued for every unit of renewable electricity. They allow generators to obtain additional revenue from the sale of electricity. Demand for certificates originates from an obligation on electricity distributors to surrender a number of certificates as a share of their annual consumption (quota). Under tendering/bidding systems, on the other hand, the government invites renewable electricity generators to compete for either a financial budget or renewable electricity generation capacity. Within each technology band, the cheapest bids are awarded contracts and receive the subsidy (del Río and Bleda, 2012)

additionally found that regional differences existed in preferences for renewable energy in Finland. It is not just demographic characteristics that are relevant, however. Coad *et al*. (2009) found that responsiveness to EFIs varies by personality type, while West *et al*. (2010) found that “worldview” would also influence responsiveness to EFIs (Coad *et al*., 2009; West *et al*., 2010).

These findings underscore the importance of market segmentation techniques to identify sections of the public that are more likely to invest in a particular LCT, such as early adopters (Lane and Potter, 2007), and to tailor incentives and measures to these markets. For example, information provision policies (such as the energy labelling for cars) may be effective in encouraging certain intrinsically motivated consumers to adopt green cars, whereas EFIs may be more persuasive for extrinsically motivated consumers (Coad *et al.*, 2009). It should be noted, however, that the potential downside of this approach is that it could mobilise opposition from excluded sections of society (West *et al*., 2010). Furthermore, where EFIs are not cost-effective, they can result in increased electricity prices or taxes, with the potential to undermine “buy-in” from wider society (see also sections 3.2 and 3.3).

A related, though somewhat less developed, theme explores differences between traditional investors and “new” local citizen investors. Bergek *et al*. (2013) and Linnerud and Holden (2015) found that investors in LCTs come from heterogeneous groups – from traditional investor classes to non-traditional small-scale investors such as farmers’ associations and individuals. Non-traditional investors may have varied levels of experience and divergent motivations for investing (Bergek *et al*., 2013; Linnerud and Holden, 2015) and may also have less business experience and financial strength than traditional investors (Bergek *et al*., 2013; Salm *et al*., 2016); non-traditional investors may have different investment preferences as a result (Salm *et al*., 2016). What therefore emerges from this subset of the literature is the need for discrete EFIs that are specifically targeted towards the needs of local citizen investors, who will have different experiences, capacities, priorities and motivations compared with professional project developers. There are opportunities to explore the specific types of incentives that might be attractive to these groups.

There are a considerable number of studies that identify the importance of the characteristics of the technology itself in the effectiveness of EFIs in motivating investments in LCTs. Some studies, such as Palm and Tengvar (2011), Stigka *et al*. (2014) and Claudy *et al*. (2010), found that socio-economic characteristics, trust, acceptance, knowledge and understanding of the LCT in question can impact willingness to pay and invest in a particular LCT. These factors may also be prevalent when it comes to purchasing electric vehicles, where a lack of consumer confidence (Steinhilber *et al*., 2013) or uncertainty associated with the reliability of battery technology (Egbue and Long, 2012) may render EFIs ineffective in mobilising LCT investments. These studies highlight the importance of technology maturity and the perceived advantages of one technology over another (Claudy *et al*., 2010; Egbue and Long, 2012) in motivating individual investment decisions, and they underscore the importance of supplementary policies aimed at promoting understanding and acceptance of emerging technologies in addition to strong EFIs. This may include education and awareness raising, establishing trusted standards and regulations, or supporting strong warranties on emerging technologies.

While some literature exists on the effectiveness of EFIs in incentivising individuals to investment in LCTs, there are comparatively few studies that assess the general effectiveness of EFIs in promoting participation in community energy schemes. Whereas Hoffman and High-Pippert (2010) found that participants in community renewable energy schemes are motivated by contributing to the community as well as by economic considerations (Hoffman and High-Pippert, 2010), Dóci and Vasileiadou (2015) found that personal gain was the primary motivating factor, although they also noted that other secondary hedonic and environmental motivations were also present. There is an opportunity, therefore, for further research to explore the relative importance and effectiveness of EFIs in motivating participation in community energy schemes (sections 3.2 and 3.3).

Finally, several studies highlight institutional and regulatory barriers, such as applying for planning permission, as important factors when considering LCT investment decisions. Palm and Tengvar (2011) found, for example, that rules by grid companies and regulations are considered a hindrance to investment in micro-LCTs, whereas other studies highlighted fragmented infrastructure (Egbue and Long, 2012) and the absence of standards and regulations (Steinhilber *et al.*, 2013) as factors that may render EFIs less effective and potentially less attractive to local citizens unless they can be addressed.

2.4 FiTs, FiPs and Quota-based Schemes

The most popular EFIs to promote the adoption of renewable electricity are guaranteed price FiT and quota systems (Dusonchet and Telaretti, 2010), although FiPs are becoming an increasingly common instrument (Ragwitz *et al.*, 2012). FiTs have also been used to promote the adoption of renewable heating systems, though less commonly so (Cansino *et al.*, 2011). For the most part, these EFIs have been used to mobilise investments from professional project developers, project developers and utilities (Cansino *et al.*, 2011), although the focus here is on their attractiveness to citizens and communities.

Some studies indicated that FiTs have advantages over quota-based schemes when it comes to promoting growth in community-owned generation (Meyer, 2003; Walker, 2008; West *et al.*, 2010). An important factor here is the actual FiT level, as some countries offer higher FiT rates than others, and these countries have generally witnessed greater renewables deployment but reduced economic effectiveness. Fouquet and Johansson (2008) found that FiTs could be more appropriate for small and medium-sized investors, whereas quota schemes could create investment risk for independent power producers and opportunities for market dominance by larger players. Several studies found that FiTs could boost social legitimacy for deployment of wind turbines (Butler and Neuhoff, 2008; del Río and Bleda, 2012; Mabee *et al.*, 2012), while others found that quota schemes tended to favour large wind farms at the expense of smaller independent producers and had resulted in a geographical concentration of development (Feurtey *et al.*, 2015).

An integral design feature of FiTs that makes them attractive to local citizen investors is the guaranteed level of support they provide over time, which results in additional investment security (Lipp, 2011; Mabee *et al.*, 2012; Saunders *et al.*, 2012; Dóci *et al.*, 2015; Lipp *et al.*, 2016). Sovacool and Lakshmi Ratan (2012) found that the certainty provided by the long-term FiTs resulted in access to lower cost finance for German individual investors, whereas Dóci and Vasileiadou (2015) concluded that governmental policies should provide long-term and calculable EFIs such as FiTs to support these groups. This may be a particularly important consideration for local citizen investors, given their relative lack of capital compared with traditional investors.

It is unclear, however, if FiTs are the best option when it comes to attracting local citizen investors. Some studies identify the importance of specific design features of an EFI over instrument choice. Mabee *et al.* (2012), for example, found that the German FiT system identified a wider range of project sizes compared with a Canadian FiT scheme, thus offering more opportunities for local benefit. Saunders *et al.* (2012) found that a quota scheme that was introduced in the UK in 2002 was unappealing to community groups because of a number of unattractive design features, including the complexity of the scheme. On the other hand, Linnerud and Holden (2015) found that the short duration and the abrupt termination of a quota and tradable green certificate scheme in Norway compared with a Swedish scheme contributed to additional risk and transaction costs, which made it less attractive to new investor classes. Feurtey *et al.* (2015) found that a specifically designed community quota, stipulating that at least 30% of profits were to be redistributed to local communities, had contributed greatly to improving the level of local acceptance in Québec. They therefore concluded that FiTs may be suitable for small projects (under 10 MW), while quotas could be more suited for medium and large projects; however, in both cases mandatory financial participation criteria may be required to ensure fair outcomes for local citizen investors.

These studies highlight the importance of designing EFIs with the needs of local citizen investors in mind (section 3.1), whatever the choice of EFI, and align with other research focusing on cost-effectiveness, which also emphasises the importance of EFI design over choice of instrument (Huber *et al.*, 2007). Few studies, however, explicitly consider the design features that are most attractive to local citizen investors and in many cases these findings are implied rather than explicitly stated. These are therefore questions that merit further research and investigation.

A weakness in this literature is the absence of studies comparing the impact of FiTs with that of FiPs on local citizen investors. There is growing policy focus on FiPs, particularly within the EU in the light of EU state aid guidelines, which anticipate the gradual replacement of FiTs with the more market-price-dependent FiPs. There is some evidence from Denmark to suggest that FiPs may be off-putting to local citizen investors compared with FiTs (Meyer, 2007; Gotchev, 2015) because these investors may be highly risk averse. It is unclear, however, whether it is the level of the financial incentive provided or the choice of instrument itself that is the more important factor as far as local citizen investors are concerned; this area merits further analytical attention.

Other studies touch on the importance of complementary measures to support the central EFI, be it a FiT, FiP or quota-based scheme. Sovacool and Lakshmi Ratan (2012), for example, identified excellent information on tariffs as an important supplementary measure to the German FiT. In many cases, complementary measures have been deployed to address access to capital, which has been identified as a key barrier to local citizen participation (Lipp, 2011), particularly at the riskier early project stages, such as feasibility assessments, pre-planning development work and planning applications. Yildiz (2014), Romero-Rubio and de Andrés Díaz (2015) and Saunders *et al*. (2012) all highlighted the availability of publicly supported soft loan programmes as an important success factor that complemented FiTs in promoting the growth of local citizen investment in LCTs in Germany. There are opportunities for further research into the most effective way of addressing early-stage project risk for local citizens, drawing on the experiences of different countries, as these have not been comprehensively studied.

Context-specific factors have also been identified in several studies and are an important consideration in successful FiT implementation. Sovacool and Lakshmi Ratan (2012), Dewald and Truffer (2011) and Romero-Rubio and de Andrés Díaz (2015) found that the support of local citizen associations focused on energy and local decision-making provided the necessary background for successful deployment of LCTs in Germany. Dewald and Truffer (2011) found that market success was not sustainable in Spain because, by contrast, these necessary pre-conditions for success were not in place. These findings are consistent with those of Romero-Rubio and de Andrés Díaz (2015), who found that the greater focus on community energy in Germany compared with Spain in response to FiTs could be explained by a number of context-specific factors including, inter alia, a relatively high sensitivity to environmental issues and a large number of people with sufficient financial resources to invest. These findings attest to the dangers associated with coming to general conclusions from the experiences of a particular country (Romero-Rubio and de Andrés Díaz, 2015).

Finally, some studies also identified a tension between mobilising local citizen investors and increasing electricity prices, which can have a countervailing impact on social legitimacy for LCTs (section 3.1). For example, del Río and Bleda (2012) and Butler and Neuhoff (2008) found that total costs of FiT schemes have significantly increased in countries such as Spain and Germany. Others, however, found that FiTs were a success in terms of promoting new investors in small-scale solar PV energy in New South Wales, but that the level of investor participation had been underestimated, resulting in cost overruns (Martin and Rice, 2013). While there is some evidence that using FiTs, quota-based schemes and other EFIs to mobilise local citizens as investors can reduce the overall costs to society or low-carbon transition by, for example, opening up optimal sites for renewables deployment (Nelson *et al*., 2016), this is not a topic that has been explored in the academic literature. These findings highlight the importance of careful *ex ante* analysis of incentive programmes to ensure that they deliver the anticipated outcomes.

2.5 Grants

Grants, generally applied as a percentage of either the total installed cost or capital cost of an investment, are a widely used instrument employed to promote individual and community investment in LCTs. In 2010, grants and rebates were available in 42 of 195 countries globally to promote low-carbon heating, cooling and electricity generation (Bobinaite and Tarvydas, 2014). Grants are the most widespread measure of support for the use of renewable energy sources for heating in the EU (Stevanović and Pucar, 2012) and are also commonly used in the USA (Mundaca and Luth Richter, 2015).

Several studies illustrate the effectiveness of grants in mobilising investment from individuals. It is clear from these studies that grants can encourage the adoption of capital-intensive LCTs by reducing high upfront costs, which is often cited as a key barrier to investment (Painuly, 2001; Saunders *et al*., 2012). For example, in an evaluation of grant incentives to promote uptake of solar water heating (SWH) internationally, it was found that grant programmes were generally successful in promoting technology adoption (Roulleau and Lloyd, 2008), while others found that a grant programme was necessary for deployment of micro-LCTs to achieve critical mass in Swedish households (Mahapatra and Gustavsson, 2008). Chang *et al*. (2011) concluded that grants were successful in promoting SWH uptake in Taiwan (Chang *et al*., 2011), while another study found that a Chinese grant (covering approximately 10% of cost) for LCT appliances was effective in targeting some segments of the population (Yang and Zhao, 2015).

Grant programmes have also been identified as important in promoting community renewable energy initiatives in some studies. Madlener (2007) found that rapid diffusion of wood-fuelled district heating schemes in Vorarlberg, Austria, many of which were promoted locally and owned by communities and agricultural co-operatives, was dependent on the provision of attractive upfront capital grants and, to a lesser extent, on soft loans (Madlener, 2007). Two studies found that many UK community energy groups were able to take advantage of EFIs, in particular, but also FiTs (Saunders *et al*., 2012; Seyfang *et al*., 2013), while another study found that a grant programme was helpful for community wind initiatives in Oregon (Yin, 2012).

Comprehensive assessments of grant programmes are, however, not common in the academic literature, nor are *ex ante* studies considering the cost-effectiveness of these programmes. While Roulleau and Lloyd (2008) found a German grant programme to be cost-effective, they found that cost-effectiveness assessments were not common in the programmes they evaluated.

On the other hand, several potential downsides of grants programmes are identified in the literature. One potential weakness is that grants can increase capital and installation costs (Cansino *et al*., 2011). Chang *et al*. (2011) found, for example, that significant unit cost increases occurred over the lifetime of the grant programme, leading to grant increases and supplementary incentives from local authorities. It has also been suggested that to avoid technology cost increases, grants based on total installed costs or use of both performance and cost criteria in grant programme design might be considered. However, the success of schemes would then depend on the extent to which industry can provide both high-performance and low-cost systems (Roulleau and Lloyd, 2008). Madlener (2007) identified techno-economic performance guidelines that greatly improved the technical efficiency and economic viability of plants as a key success factor in ensuring a cost-effective programme, and Chang *et al*. (2011) concluded that greater coherence between national and regional initiatives could improve cost-effectiveness.

A further challenge is that grants can lead to stop–start investment cycles (Cansino *et al*., 2011), arising from the sudden termination of support, rather than the creation of a sustainable market for the LCT in question. Indeed, Roulleau and Lloyd (2008) found evidence of stop–start investment cycles in several of the programmes they evaluated. Seyfang *et al*. (2013) and Saunders *et al*. (2013) found that grants were important for community energy projects, but that a stable supply of funding is important for these local organisations to operate effectively in the longer term. Seyfang *et al*. (2013) found that policy and regulatory threats and unpredicted policy changes were a real problem for many projects, while Saunders *et al*. (2013) found that constantly chasing grants was taking up too much of members' time. The long duration of the programmes, which gives confidence to consumers and suppliers, has been identified as an important design feature to counter policy and regulatory uncertainty.

There are also several studies that consider non-financial success factors in grant programmes. It has been argued that the administrative burden of applying for grants can be off-putting to potential investors (Cansino *et al*., 2011) and it is therefore unsurprising that Yin (2012) and Madlener (2007) identified the simplicity of application procedure as a key success factor. Mahapatra and Gustavsson (2008) highlighted the importance of technology reliability, trust in installers and personal contacts for information on the technology, while Yang and Zhao (2015) highlighted the importance of knowledge, awareness and attitude to products and the subsidy programme itself. These factors underscore the importance of supplementary measures to EFIs (sections 3.1 and 3.2), targeting additional barriers to investment and the need for these incentives to be considered as part of wider policy packages.

Some studies also highlight the differences in responsiveness to grant programmes in different geographical locations and different demographic cohorts. Mahapatra and Gustavsson (2008), for example, identified differences in individual preferences between Swedes and other nationalities, while Yang and Zhao (2015) concluded that moderate grants do not significantly influence the entire population, but effectively influence people from high-income households. The study concluded that the subsidy programme should target higher income groups to maximise the policy effect and that a tailored programme would be required to target low-income groups. Madlener (2007) identified the pioneering work of innovators and early adopters as a key success factor in widespread technology adoption and diffusion in society. There are, however, potential downsides to these market segmentation techniques (section 3.1).

2.6 Tax Incentives

Globally, tax incentives are the most widely used policy instrument to promote LCTs (Bobinaite and Tarvydas, 2014). The most commonly used tax incentives are deductions, exemptions or reduced corporate tax rates for businesses and income tax rates for individuals, but some countries have also introduced reduced property taxes and VAT rates to promote LCTs (Chandrasekar and Kandpal, 2005; Cansino *et al*., 2010, 2011; Solangi *et al*., 2011; Mundaca and Luth Richter, 2015).

While there has been considerable empirical focus on the cost-effectiveness of carbon tax versus other EFIs (Markandya *et al*., 2009; Lin and Li, 2011; Montag, 2015), there has been a comparatively limited focus in the academic literature on the effectiveness of tax incentives in mobilising LCT investment.

From evaluations with a focus on local citizens, it is clear that, like grants, tax incentives can be effective in mobilising investment from these actors. Roulleau and Lloyd (2008) found that a French scheme whereby a reduced VAT rate was introduced to complement an income tax rebate effectively promoted SWH deployment, as did a Greek scheme that offered an income tax rebate on the total installation cost. Another study found that a variety of state-level tax incentives, some of which were directed at individuals (including capital cost rebates, sales tax exemptions and property tax exemptions), had a significant positive impact on wind energy growth in the western states of the USA (Black *et al*., 2014). Solangi *et al*. (2011), in a review of solar policy globally, found that income tax credits for solar PV (used by both households and businesses) was the most important component in the growth in solar PV in the USA. Tax incentives have been commonly used to promote the purchase of low-carbon vehicles in particular and their impact and effectiveness has been quite widely evaluated compared with the impact of tax incentives on other LCTs. Sierzchula *et al*. (2014) found that EFIs (reductions to registration taxes and annual car tax) were positively correlated with a country's electric vehicle market share in the 30 countries examined, while two studies found that the strong tax incentives introduced in the Netherlands and Ireland were highly effective in promoting purchasing behaviour towards lower carbon dioxide (CO_2)-emitting vehicles (Rogan *et al*., 2011; Kok, 2015).

As with grants, few of the studies provided comprehensive *ex post* assessments of the strengths and weaknesses of the instrument, and assessments of cost-effectiveness were somewhat uncommon. Where cost-effectiveness is considered, results are mixed. While Black *et al*. (2014) concluded that sales and tax rebate programmes had positive revenue effects without considering the additional wider positive economic impacts in society, other studies have identified cost-effectiveness concerns. Kok (2015) and Rogan *et al*. (2011) found that a rapid fall in government revenue resulted from the introduction of tax incentives for low-carbon vehicles, although the wider societal costs and benefits were not evaluated in these studies. Roulleau and Lloyd (2008) found that French income tax rebates resulted in significant capital cost increases, which may have been attributable to the fact that the magnitude of the tax credit depended on the cost of the technology.

Considering the wide usage of tax incentives globally, the absence of comprehensive cost-effectiveness evaluations in the academic literature is notable.

Stop–start investment cycles were identified as an issue with tax incentives in the case of some schemes, highlighting the importance of long-term policy signals and programmes. For example, Roulleau and Lloyd (2008) found that policy changes resulted in market uncertainty in the case of the Greek scheme, and Solangi *et al*. (2011) found that an income tax credit for solar PV in the USA was subject to continuous political uncertainty, which undermined its effectiveness.

Other studies focused on the importance of the design characteristics of tax incentives to improve effectiveness and their attractiveness to local citizens. Kok (2015) identified the "salience" of the tax (the visibility, transparency and attention drawn to tax incentives) as an important success factor, while Yin (2012) found that neither a production tax credit nor an Oregon business energy tax had been designed with communities in mind and were not therefore conducive to community investment. These findings again highlight the importance of designing EFIs with local citizens in mind (section 3.2).

There are also a number of studies that compare tax incentives with other EFIs. Compared with grants, tax incentives have the disadvantage of not generally addressing the upfront investment costs barrier. Both Cansino *et al*. (2011) and Kok (2015) concluded that the upfront nature of tax incentives is an important design consideration, while Roulleau and Lloyd (2008) found that the *ex post* reimbursement of investors (who received compensation when tax returns were filed) may have undermined the effectiveness of the programme.

As with grants and FiTs, the importance of wider context-specific considerations was identified as an important consideration by Sierzchula *et al*. (2014), who concluded that tax incentives alone are important but not sufficient to guarantee high technology adoption rates. Finally, the overall impact of tax incentives on social acceptability of technology is not widely discussed in the literature. It should be noted, however, that tax incentives necessarily target tax payers and, in some cases, provide a higher level of relief to wealthier cohorts in society. The equity implications of a Greek tax incentive programme are questioned on this basis (Roulleau and Lloyd, 2008).

2.7 Soft Loans

A loan is "soft" when the rate of interest charged on the loan is lower than the commercial rate charged by banks and other financing institutions for commercial loans (Chandrasekar and Kandpal, 2005). Loans are a common LCT financing instrument, particularly in Germany, where their use is important. Soft loans are often provided by commercial banks supported by the government; however, governmental organisations can also act as lenders (Bobinaite and Tarvydas, 2014).

There is mixed evidence on the effectiveness of soft loans as a stand-alone EFI, based on limited evidence and few studies. Zhao *et al*. (2012) found that homeowners were attracted to financial incentives, but that they valued tax credits much more than interest-free loans when it came to investing in LCTs, in part because local citizens were debt averse (Zhao *et al*., 2012). Similarly, Chandrasekar and Kandpal (2005) found that an interest subsidy scheme provided for selected LCTs by the Indian Government was not as attractive as an income tax benefit. According to Roulleau and Lloyd (2008), New Zealand introduced an interest-free loan for SWH appliances in 1978, covering 60% of cost, although the scheme was not found to be attractive to consumers and was discontinued as a result of low take-up. Under the UK Green Deal scheme, loans were made available to homeowners to promote building retrofitting. Marchant *et al*. (2015) found that, while the concept was appealing, the cost of finance on offer (8–10%) was one of the key barriers to uptake. This finding was supported by *ex ante* studies, which predicted that uptake would be low unless much lower interest rates could be offered (Dowson *et al*., 2012; Hough and White, 2014). It should be noted, however, that it is questionable whether or not the loan could be considered "soft" in this case, and factors such as limited awareness of the programme and upfront cost barriers were also identified as problematic.

In many cases, however, a soft loan may be combined with another financial incentive to make it more attractive as an EFI (Cansino *et al*., 2010, 2011). Perhaps the most important example of soft loans is those provided by the German state-owned Kreditanstalt für Wiederaufbau (KfW) Bank. Strupeit and Palm (2016) and Yildiz (2014) found that while tax incentives and FiTs had been a central element to the German offering, the availability of low-interest loans, provided by KfW and issued through local banks, was an important success factor in the deployment of solar PV in Germany (Strupeit and Palm, 2016). Overall, there are few assessments of the effectiveness of soft loan programmes and fewer still that evaluate soft loans as a stand-alone EFI. Their attractiveness and effectiveness in mobilising local citizen investors therefore emerges as another opportunity for further research.

2.8 Conclusion and Policy Implications

Our review suggests that, while some individual citizens may respond to EFIs in an "economically rational" manner, this will not always be the case. Considering the behavioural, social, institutional and regulatory barriers to investment faced by local citizens can therefore enhance the effectiveness of policy interventions.

We found that FiTs, quotas, grants and tax incentives can be successful in mobilising greater levels of investment from local citizens, but that soft loans tend to be less effective as a stand-alone instrument. Our review also identified potential disadvantages of using these instruments, which need to be considered carefully, including cost-effectiveness and social equity concerns. However, we identified approaches to mitigating these downsides through instrument choice and design. Overall, we find that there is a need to come to a greater understanding of the costs, benefits and distributional impacts for society of mobilising local citizens as investors using EFIs and for potential downsides to be carefully monitored so that social legitimacy is enhanced and not undermined.

Our findings highlight the importance of understanding and responding to the specific needs of local citizens in EFI design. There may often be a requirement to include specific design features in FiTs, quotas, grants and tax incentives that will cater to the specific needs of this cohort. Providing regulatory stability and policy certainty emerges as an important success factor, as is understanding the characteristics of the target demographic and indeed the characteristics of the LCT in question. If these factors are not considered in policy design, an EFI may not have the desired or predicted impact. Our findings also highlight the importance of introducing EFIs as part of policy packages (Michelsen and Madlener, 2016), where complementary measures can address non-financial barriers, such as lack of familiarity with the technology, technology immaturity and low awareness of the incentive programme itself.

Many studies also highlight the importance of context-specific considerations (Dewald and Truffer, 2011; Romero-Rubio and de Andrés Díaz, 2015). We therefore concur with Delmas and Montes-Sancho (2011) that understanding the natural, social, policy and regulatory context under which economic incentives operate is necessary to measure success. Overall, EFIs targeting local citizens that are carefully designed emerge as a potentially important means of mobilising private finance in LCTs. This in turn can engender greater levels of societal support for low-carbon transition and contribute to addressing climate change.

It should be noted that, given the narrow focus on technology-specific and downstream incentives in several places, the literature is sparse. Furthermore, a key weakness we identified in the literature is that studies tend not to systematically and consistently evaluate the impact of EFIs. The vast majority of studies did not systematically assess policy success using the IPCC evaluation criteria. Other complicating factors relate to context specificity (Delmas and Montes-Sancho, 2011), the use of instruments in combination with other measures (Cansino *et al*., 2010) and co-benefits and negative spillovers from policy interventions that are difficult to consider within a single analytical framework (Somanathan *et al*., 2014).

3 Case Studies

3.1 Introduction

In this chapter, we present four international case studies exploring the experiences of Denmark, Germany, the UK and the Canadian state of Ontario.[2] In so doing we introduce an additional element into our research. In each case, we explore not only the use of financial incentives, but also the relationship between the use of financial incentives and the types of innovative business models that have emerged as vehicles for local citizen investors.

There is a wide-ranging literature that deals with business model innovation relevant to the mobilisation of citizen investment, which emerged as an important theme in our research. The key insight from this literature is that new technologies will not achieve widespread adoption unless they are commercialised via business models (Chesbrough, 2010). The traditional energy utility business model has revolved around the bulk generation of electricity in centralised plants and selling output to customers on a per unit basis, often combined with horizontally integrated transmission and distribution networks (Richter, 2013). The widespread deployment of distributed generation technologies is potentially disruptive for this model (Johnson and Suskewicz, 2009; Engelken *et al*., 2016) and has prompted a focus on business model innovation within the sector (Schoettl and Lehmann-Ortega, 2011; Richter, 2013).

However, there are many barriers to innovation (Engelken *et al*., 2016), and it remains to be seen if and how the traditional utility model can evolve in response to these pressures (Richter, 2013). Within this context there are openings for new actors and for business model innovation from outside the traditional energy sector. The emergence of new and replicable business models has the potential to spur on the transformation of the energy sectors (Hellström *et al*., 2015). The link between financial incentives and the typical business models has been identified in some studies (Bolinger, 2001; Regen SW, 2015), but has received little analytical attention.

Within the context of the importance of business models, in this chapter we look at the relationship between financial incentives and business models in four jurisdictions. The following section provides a justification for our choice of cases. We proceed to present the results of each of the four cases individually, covering:

- a short historical overview of the importance of LCTs in the power generation mix, highlighting the participation of local citizen investors;
- an assessment of the use of financial incentives at early (feasibility and development) and late (construction and operation) stages (SEAI, 2016a); and
- an evaluation of "typical" business models that have emerged as vehicles for local citizens.

In the following discussion section, we "generalise patterns across cases" (Eisenhardt, 1989, p. 540), focusing on the comparative use of financial incentives and evaluating the connection between the use of these instruments and the emergence of typical models. A conclusions section follows.

3.2 The Choice of Cases

We have chosen Denmark, Germany, the UK and the Canadian state of Ontario as our cases based on a number of criteria. First, in all cases, financial incentives have successfully been introduced to promote deployment of wind and solar PV technologies. Second, these incentives have specifically targeted local citizen investors in all cases. Third, it is recommended that selected cases illustrate a difference in a particular phenomenon by comparing instances in which it occurs with instances where it does not (Odell, 2001). For this reason, we selected Denmark and Germany because mobilising local citizen investors had been a key feature of low-carbon transition in these countries for several decades. By contrast, the use of financial incentives targeting local citizens is a more recent occurrence in the UK and Ontario. The choice of cases therefore allowed us to

2 While Ontario, unlike the other cases, is a state, and therefore guided by the Federal Government in its energy policies to some extent, electricity generation is primarily governed at the provincial level (Krupa *et al*., 2015).

explore the role of financial incentives within different contexts and to compare the differences between countries, but also intertemporally within countries. Key data from each case study are summarised in Table 3.1.

3.3 Denmark

3.3.1 Investments from local citizens

Denmark is a pioneer in the development of wind energy technologies (Ratinen and Lund, 2015) and, like Germany, is also a leader in the deployment of wind energy supported by local citizens. In 2014, over half of Denmark's electricity was generated from renewables, with wind accounting for 40% of total generation (Table 3.1). Of total wind generation, 40% is from offshore turbines (Energienet, 2015).

Local citizen ownership has been a key aspect of the Danish model. Several thousand wind energy guilds existed as early as 1990. These were often small projects owned by farmers, private households or local companies (Oteman *et al*., 2014). By 2001, 150,000 households owned or held shares in wind projects (Walker, 2008). In 2015, small private wind energy operators were responsible for 50% of the total electricity market share (Vindenergi Danmark, 2015).

3.1.2 The use of financial incentives

The development of renewable energy in Denmark gained impetus following the energy crises of the 1970s. High energy taxes were introduced (supplemented by carbon taxes since 1992) to promote energy efficiency, creating an early incentive to explore alternatives to fossil fuels (Nachmany *et al*., 2014).

In 1979, a grant covering 30% of the purchase price of a wind turbine was introduced. As wind power economics improved during the 1980s, the investment subsidy was gradually reduced before being eliminated in 1989 after a total government investment of €38 million (Meyer, 2003). While early producers received a price for their electricity relative to retail rates, the grant proved attractive to local citizen investors (Oteman *et al*., 2014), who were responsible for all early investment. In this period, the income from wind farms received favourable tax treatment: interest on loans for purchase of shares in a wind turbine was tax deductible and businesses could depreciate the value of a wind turbine by up to 30% annually (Bolinger, 2001).

A fixed FiT was introduced by the Danish government in 1993 (IRENA, 2012). This was combined with a tax refund for income from wind power generation for individuals who participated in wind energy co-operatives, introduced in 1997 (IEA, 2016). Together these incentives delivered strong growth in wind capacity through the remaining part of the 1990s (Meyer, 2007). Furthermore, grants were available from the Danish Energy Agency to cover feasibility assessments (Middelgrunden Cooperative, 2000). By 2002, wind already accounted for 15% of the country's electricity generation, and 40% of installations were run by local wind energy guilds (Gotchev, 2015). Income from shares in wind farms remained tax deductible up to a certain limit. In these early years, projects were smaller and easier to finance, not least because of the presence of "ethical" banks such as

Table 3.1. Key case study data

	Proportion of electricity generation (%, 2014)				Local ownership
	Renewables	Wind	Solar PV	Other	
Denmark	53	40.5	0.2	12.3	Over half of total investment in wind technologies from local citizen investors
Germany	25.8	9	5.0	11.8	Over half of total investment in wind and solar PV technologies from local citizen investors
UK	19.1	9.5	0.6	9	Low initial level of local citizen investment, growing gradually from 2000 and more rapidly between 2009 and 2015
Ontario	28.7	4.4	<0.1	24.3	Low levels of community and citizen ownership, growing rapidly from 2009

Sources: Danish Energy Agency, 2014; DECC, 2015b; IESO, 2015a; BMWi, 2016; Energienet DK, 2016.

Fælleskassen providing loans for wind turbines at below-market rates (Bolinger, 2001).

The intention to move to a more market-orientated support scheme was flagged in the Electricity Reform Act (2001), and a FiP was eventually introduced in 2003. These developments resulted in slow-down in investment. In 2009, investment in wind energy began to recover. This has been attributed to an increase in the premium available to wind energy producers and the reforms introduced in the Promotion of Renewable Energy Sources Act (2008). This Act introduced a number of initiatives to promote local acceptance and participation, which was deemed necessary, given increased local objections to wind developments, as well as the progression towards larger and more complex wind turbines (Danish Energy Agency, 2012; Oteman *et al*., 2014). The Act required project developers to offer at least 20% of the ownership shares for sale to the local population within 4.5 km of developments. It also introduced a specific measure to mitigate early-stage project risks for citizen investors in the form of loans to local groups covering project feasibility studies, up to a maximum of approximately €70,000 (Figure 3.1). In addition to the state guarantee, local citizens tend to have access to project finance, generally from commercial banks, as projects have an established track record and are considered low risk (A. Bjerre, Danmarks Vindmølleforening, 11 April 2016, personal communication).

3.3.3 Business models for citizen investors

Danish community wind projects tend to take the form of guilds. In 2009, approximately 15% of Danish wind energy projects were owned by guilds (Danmarks Vindmølleforening, 2009). These are profit-orientated partnership structures that take decisions in a similar way to co-operatives (one member, one vote). Partners have joint and several liability, but risks are reduced for investors by bylaws precluding partnership as they cannot contract debt and require wind turbines to be adequately insured (Tranaes, 1996). Finance is raised through the issuance of shares, with one share generally corresponding to an annual production of 1000 kWh (Danmarks Vindmølleforening, 2009). There is generally a limit to the number of shares that an individual can purchase (A. Bjerre, Danmarks Vindmølleforening, 11 April 2016, personal communication) and “criteria of residence” require that members of a guild live within a certain proximity. Even though guilds are often confused with co-operatives, they are legally distinct. Co-operatives are very common in Denmark, but the great majority are active in the biomass district heating sector and are operated as not-for-profit organisations (REScoop, 2016). While a limited number of wind co-operatives exist, these are less common than the for-profit guild structure (P. Maegaard, 20 April 2016, personal communication).

The increased scale, turbine size and investment requirements of wind projects over the past decade,

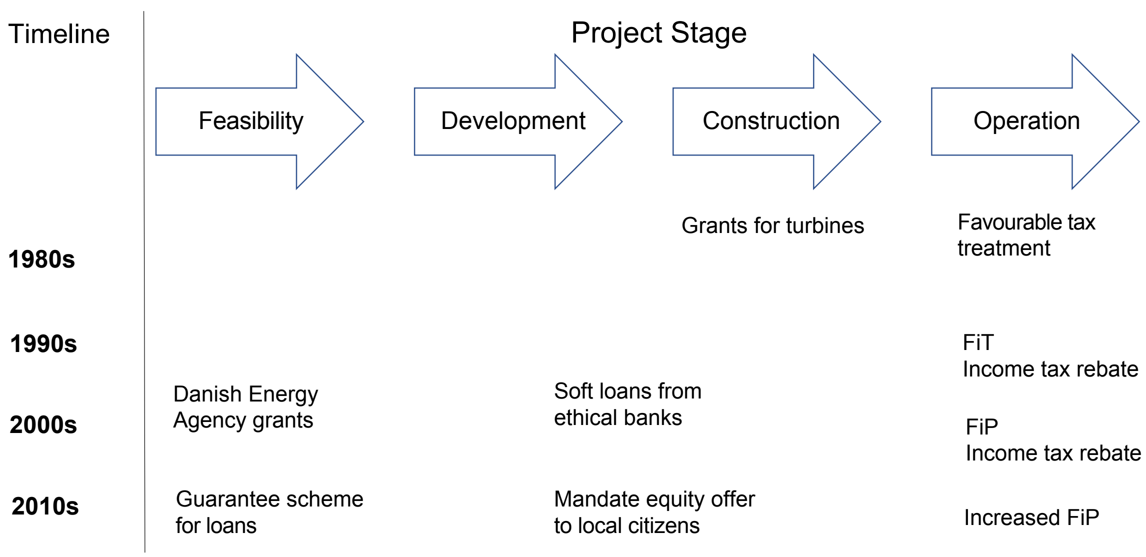

Figure 3.1. Danish incentives over time and project stage.

as well as the subsequent introduction of the co-ownership requirement in 2009, resulted in the emergence of a growing number of partnerships between community guilds and professional developers such as energy utilities (Gotchev, 2015). These projects are generally led by professional developers who take on early-stage project risk, while guilds are offered an opportunity to invest before the construction phase. These partnerships therefore help community groups overcome early-stage project risks and the difficulties associated with raising large amounts of finance (A. Bjerre, Danmarks Vindmølleforening, 11 April 2016, personal communication). The Middelgrunden Offshore Wind Farm (40 MW), for example, was developed through a partnership between the local municipality energy company and 8000 local citizen investors organised into a guild (Danmarks Vindmølleforening, 2009). In this case, the utility guaranteed the project if all shares were not sold (Middelgrunden Cooperative, 2000), but a limited partnership structure was maintained with joint and several liability for all guild members. While there are examples of project developers that promote citizen participation without guilds, the majority of new onshore projects involve partnerships between local citizen guilds and professional developers. Guilds have therefore continued to thrive in an era of increasingly industrialised wind energy development (A. Bjerre, Danmarks Vindmølleforening, 11 April 2016, personal communication).

3.4 Germany

3.4.1 Investments from local citizens

Germany is a pioneer in the deployment of distributed renewable energy technologies for electricity generation and in the involvement of local citizens as investors in low-carbon transition. In 2014, nearly 26% of Germany's electricity was generated by renewables, with wind and solar PV accounting for over 9% and 5% of this total, respectively (Table 3.1). Citizen-led energy initiatives are a cornerstone of the German energy transition. Almost 46% of all investment across wind, solar and other renewables has come from individual and community groups (Trend Research, 2013). Of total citizen investments, 54% comes from individuals, 26% from shareholdings in renewable projects and 20% from co-operatives (Trend Research, 2013). Collective citizen ownership of renewable energy technologies is particularly widespread in the area of onshore wind power and solar PV, as well as biomass technologies.

3.4.2 The use of financial incentives

Public concern around nuclear power spurred the German government to introduce research and development (R&D) policy supports to promote renewables in the late 1970s. However, by the end of the 1980s, Germany's electricity supply system was dominated by very large utilities that relied on coal and nuclear generation (IRENA, 2012). The appearance of climate change as a concern and the 1986 Chernobyl nuclear accident acted as catalysts for change.

Following a pilot programme that provided grants for wind power deployment in 1989, the first Electricity Feed-in Act (1990) introduced a FiT for renewable electricity. The Act made it obligatory for utilities to connect new independent power producers to the grid, thereby reducing the risk that FiT-approved projects would not achieve grid connection and de-risking the early-stage investments. Subsequent incentives have, to a greater extent, focused on the construction and operation phases of project development.

The introduction of the FiT is widely considered to have been a turning point for both the deployment of wind power and the role of local citizen investors in Germany's electricity market (Jacobsson and Lauber, 2006; IRENA, 2012). By offering an undifferentiated FiT, in practice, onshore wind power, which is the most cost-effective renewable energy source, was favoured. Additional supports for wind power included loans at preferential rates and significant tax advantages. For example, citizen investors in German wind partnerships could aggressively write off depreciation against all forms of income, including wage income, until the late 1990s (Bolinger, 2001). As a result of these incentives, early investors were mainly small independent power producers, including individual citizens and collectively owned projects (Bolinger, 2001; Jacobsson and Lauber, 2006).

While the first FiT was not financially attractive for solar PV investments, some utilities began to offer local supports for PV (Jacobsson and Lauber, 2006). More significantly, the "1000 Solar Roofs Initiative", a grant programme launched in 1991, provided up to 70% of the upfront costs for these installations. This grant

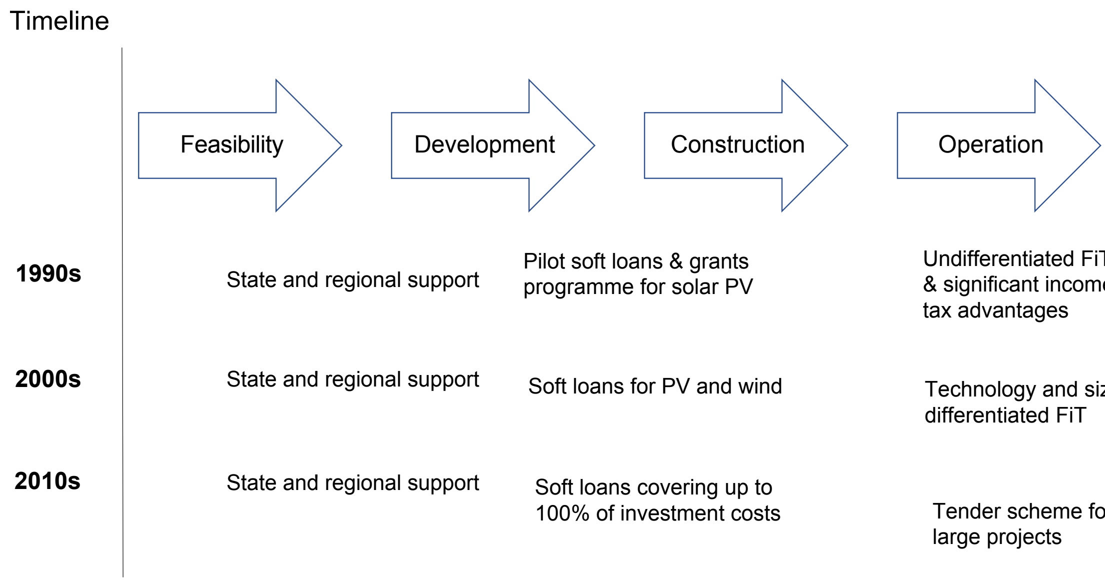

Figure 3.2. German incentives over time and project stage.

programme was followed in 1999 with the "100,000 Solar Roofs Initiative", under which the German state-owned development bank (KfW) offered loans to individuals and small companies at low interest rates (under 2%), covering the full cost of projects, with the objective of delivering 300 MW of installed capacity (Weiss and Sprau, 2002). These soft loan programmes were expanded to cover all renewable projects, with finance covering both development and construction costs (IEA-RETD, 2016).

While the number of applications for preferential loans programmes was initially low, this changed when the Renewable Energy Act (2000/305) came into being: it introduced a FiT regime that differentiated according to technology type and project size, and included a much more attractive tariff for solar PV projects (Figure 3.2). The Act has undergone four amendments (in 2004, 2009, 2012 and 2014). Several studies point to the combined impact of the FiT and the widespread availability of soft loans that cover development and construction costs as key success factors in the German case (Yildiz, 2014; IEA-RETD, 2016; Strupeit and Palm, 2016).

A number of reforms to the incentive programmes have been introduced in the past 5 years, with the objective of transitioning towards more market-based support mechanisms. These have included significant cutbacks in the FiT levels for new projects (2012 and 2014) and replacing the FiT with an optional (2012) and then mandatory (2014) FiP for new projects based on a contracts for difference[3] approach. As of 2017, the FiT will be replaced by a competitive bidding model (tenders) for larger projects. These changes have created challenges for smaller independent producers (Wassermann *et al*., 2015; Bauwens *et al*., 2016). None of the successful bids for the federal government's first solar park tender for 157 MW came from individuals or smaller independent producers, suggesting that the new scheme may have created barriers to entry for these actors (IEA-RETD, 2016).

Finally, a proliferation of regional and local-level advisory services and citizens groups provided expertise and management services, often on an unpaid basis, to community projects (Schreuer, 2015). Indeed, regional clusters of community energy projects are located in places where support services are offered (Holstenkamp and Müller, 2013).

3.4.3 Business models for citizen investors

Two typical business models have emerged in Germany as vehicles for citizen investors. The first is

3 Under this approach, generators sell energy into the market; to reduce exposure to changing electricity prices, the price is a variable top-up from the market price instead of pre-agreed. At times where the market price exceeds the strike price, the generator is required to pay back the difference.

a GmbH & Co. KG[4] structure (Bolinger, 2001; Yildiz, 2014), which is the preferred model for the majority of collectively owned wind farms. This is a developer-led model in which the developer incorporates the business as a limited liability company (GmbH). The developer is the project manager, responsible for entrepreneurial and operational decisions. For each project undertaken, a private limited partnership (KG) is created, under which large numbers (up to 15,000) of individual project partners are brought in as equity investors (Bolinger, 2001). It should be noted that investment opportunities are widely advertised and that not all investment comes from the local area (Schreuer, 2015). The limited partners are consulted only with respect to fundamental company decisions, and minimum and maximum levels for shareholdings are often set to avoid domination by large investors (Yildiz, 2014).

The second popular model is the community-led co-operative structure, which is a particularly important vehicle for collective solar PV projects. Cooperatives are often explicitly linked to political goals of democratisation and empowerment through the ‘one member, one vote’ rule, and are therefore balanced between achieving economic benefits and taking social responsibility (Schreuer, 2010; Debor, 2014). As of 2014, there were 484 solar PV co-operatives and 114 wind co-operatives. These can generally be classified as small to medium-sized organisations (the majority have under 200 members who are shareholders). The growth of co-operatives has, however, slowed since 2014, when only 29 co-operatives were established in total (Müller, 2015). While solar PV cooperatives remain dominant, the increase in wind co-operatives has been notable in recent times, perhaps resulting from changes to the FiT for solar PV (Debor, 2014; Müller, 2015), but also pointing to the fact that co-operatives were willing to consider more capital-intensive investment opportunities (Debor, 2014). Finally, four German crowdfunding platforms have emerged, which focus on raising funding for energy co-operatives. While these do not target citizens in a particular locality, they offer the opportunity to further democratise the energy transition by offering an entry point for investors with low levels of access to capital (Borchert, 2015).

3.5 The UK

3.5.1 Investments from local citizens

In contrast to Denmark and Germany, the UK has been a relatively late adopter of distributed renewable energy technologies such as solar PV and wind. In total, 19% of electricity was generated from renewables in 2014. Of this total, 9% came from wind and less than 1% from solar PV (Table 3.1). In 1990, there was virtually no locally owned renewable energy generation (Breukers and Wolsink, 2007). Since the year 2000, however, there has been an increase in local citizen investment (Bolinger, 2005; Toke *et al*., 2008). By 2013 the level of community renewable electricity capacity installed had risen to 66 MW, with another 200 MW in development, 85% of which was accounted for by wind and 14% by solar PV (Carpenter, 2014). A number of partnership projects between community groups and professional project developers were also in development or had been completed (DECC, 2015c). While the role of local citizen investors therefore remains marginal, it is growing fast.

3.5.2 The use of financial incentives

Renewable energy deployment in the UK[5] traditionally focused on large-scale, utility and private sector-driven wind power applications (Breukers and Wolsink, 2007; Walker *et al*., 2007). The early liberalisation of the UK energy sector (in 1989) was followed by the introduction of the Non-fossil Fuel Obligation, introduced in the Electricity Act of 1989, which required electricity distribution operators to purchase a specified amount of non-fossil fuel energy from suppliers. Contracts were awarded to the lowest cost projects following a competitive tendering process, thereby favouring large companies with strong financial backing. The administrative burden of participating in the scheme and the absence of tax incentives

4 The GmbH & Co. KG is a limited partnership in which, typically, the sole general partner is a limited liability company. It can thus combine the advantages of a partnership with those of the limited liability of a corporation.

5 The UK consists of the following four countries: England, Scotland, Wales and Northern Ireland. While overall energy policy is co-ordinated centrally, each country has considerable autonomy in energy policy development and in the introduction of financial incentives.

and capital investment subsidies at that time further undermined its attractiveness for local citizens (Bolinger, 2005; Breukers and Wolsink, 2007).

A Renewables Obligation (RO) (Utilities Act, 2000) scheme followed in 2002, which required electricity suppliers in England and Wales to supply an increasing portion of electricity from renewables. This scheme was equally unattractive to community groups because of the higher costs associated with the smaller scale projects that they tended to propose (Breukers and Wolsink, 2007). Other barriers to community group participation included the complexity of the application process and the perceived higher risk (Saunders *et al*., 2012). While the RO itself was phased out in 2016 and replaced with a contract for difference support schemes (DECC, 2015d), community groups have identified a number of concerns with the latest scheme, including the high administrative and upfront costs, tight timelines and penalties for contract withdrawal (DECC, 2015a).

The beginning of the new millennium is often cited as a turning point with respect to local and community engagement in renewable energy projects (Bolinger, 2005; Walker *et al*., 2007; Toke *et al*., 2008). The change in direction came in part as a response to planning and permitting difficulties experienced by larger commercial wind projects. Giving the local community a financial stake in the success of a project came to be seen as a way to bolster community support (Bolinger, 2005; Walker *et al*., 2007; Toke *et al*., 2008; DECC, 2014), but also as a way of educating the public (Walker *et al*., 2007).

During this period, a number of pilot programmes were launched, which focused on providing grant support to exemplar community energy projects along with earlier stage advice and support, including the 5-year Community Renewables Initiative, launched in 2002 (Walker, 2008). This was followed by the Low Carbon Communities Challenge in 2009, under which advice and support on project development was provided and grant support was made available to cover investment costs for 20 “test-bed” community projects across England, Wales and Northern Ireland (DECC, 2012). At local and regional level, national programmes were supplemented with grants.

Many UK community energy groups were initially able to take advantage of grants, but they found a stable supply of funding to be important to operate effectively in the longer term (Saunders *et al*., 2012; Seyfang *et al*., 2013). A major turning point in supporting local community energy projects was reached with the introduction of technology- and project size-differentiated FiTs in the Energy Act (2008/21) (DECC, 2014), which entered into effect in 2010. Payments through the mechanism replaced the RO for small-scale projects (5 MW, raised to 10 MW in 2015) (DECC, 2015a). In general, FiTs cannot be combined with grant programmes, although some exceptions have been made (DECC, 2015a).

The rates of tariffs available under the programme have been subject to considerable uncertainty, as cuts were announced on several occasions, including in the first year of the scheme (DECC, 2011) and in December 2015, along with a more stringent degression mechanism (OFGEM, 2016). These have been justified on the basis of high take-up and the declining cost of installation and hardware, especially for solar PV (DECC, 2014). However, community groups have complained that the cuts themselves have damaged confidence in the community energy sector (Quantum, 2015).

FiTs, however, were not found to overcome all hurdles faced by community energy projects (Nolden, 2013; Bauwens *et al*., 2016). Particular challenges in raising early-stage finance from the private sector were identified due to the weak balance sheets of community groups (DECC, 2014). A grant of up to approximately €26,000 was therefore made available for feasibility assessments as well as a non-recourse loan of up to €167,000 for pre-planning development work (DECC, 2014). Similar schemes have been introduced by the Scottish and Welsh administrations (DECC, 2015a).

A number of tax advantages were also available for community investors (Figure 3.3). This included schemes to provide up to 30% tax relief to investors in new companies, early-stage start-ups and social enterprises. In 2015, however, the UK Treasury announced that community energy projects benefiting from subsidies would be excluded from these schemes (CEE, 2015). According to community groups, these changes will negatively affect the business case for projects. Challenges notwithstanding, the package of incentives, and the FiT in particular, has proven itself popular among community groups and has driven the expansion of this sector (CEC, 2015).

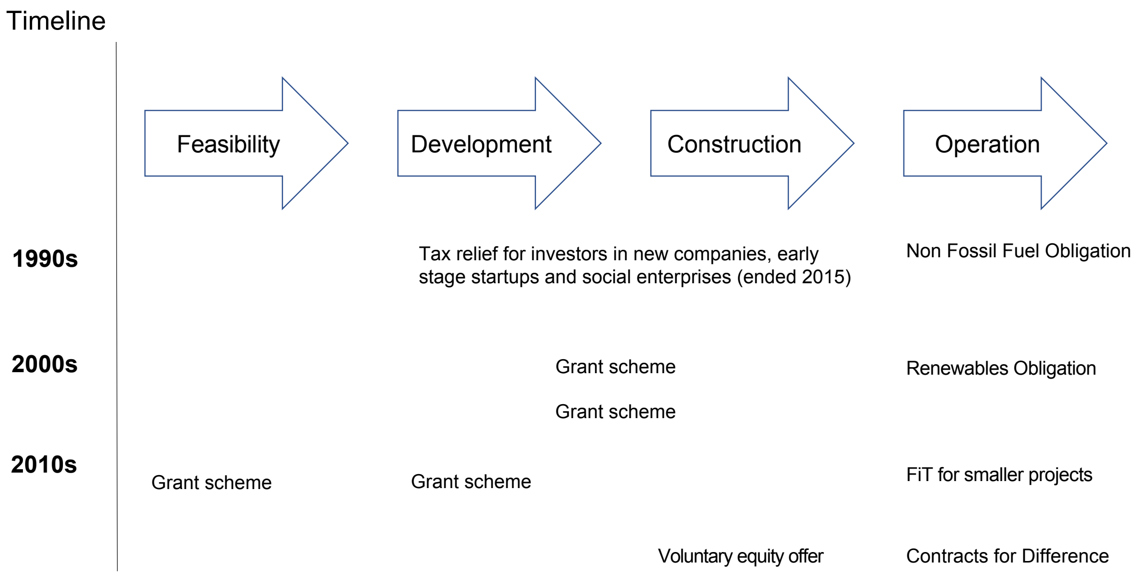

Figure 3.3. UK incentives over time and project stage.

Finally, there has been a growing emphasis on encouraging communities and industries to work together on schemes of mutual interest (DECC, 2015c). To this end, a voluntary approach was trialled in which developers offered between 5% and 25% of shares to local communities in cases where the project size exceeded €3.2 million (DECC, 2015c). The UK government has legislated to create reserve powers within the Infrastructure Act (2015/7), which, if exercised, would make this voluntary approach mandatory.

3.5.3 Business models for citizen investors

While in the cases of Denmark and Germany a number of typical structures can be identified, the legal forms taken by collective local energy projects in the UK are quite diverse (Rijpens *et al*., 2013). Local citizen investment can take one of several legal forms that are recognised under FiT guidance (DECC, 2015a).

While there are fewer co-operatives in the UK compared with other European countries (Bolinger, 2001), they are increasing in popularity. In 2013, the most popular options for community energy projects was either co-operatives or community benefit societies, which accounted for 90 projects (Carpenter, 2014). These legal forms were introduced under the Cooperative and Community Benefit Societies Act (2014/14) (Regen SW, 2015). Both can raise capital from the public through community shares issues and are exempt from some aspects of financial regulations. The key difference is that co-operatives are run for the benefit of members in a for-profit manner, whereas community benefit societies are projects that aim to benefit the community (Carpenter, 2014; DECC, 2014). Charities are another popular vehicle for renewable energy project developers, with some 50 projects having taken this legal form in 2013 (Carpenter, 2014). A less popular legal form than charities is the community interest company, which is limited by guarantee or shares. This form is designed for social enterprises that want to use their profits and assets for the public good; profits are therefore locked and cannot be distributed to shareholders. However, unlike charities, their directors can be paid a salary.

As with Denmark, another recent trend is towards shared ownership models led by professional developers, rather than towards fully locally owned projects. As of the end of 2015, there were five schemes in England and a further 12 schemes in Scotland with some form of community or individual investment, with the community investment taking a variety of forms, including joint ventures between community groups and project developers (DECC, 2015c; Strachan *et al*., 2015). These partnerships may have potential for “replicating and up-scaling” community ownership (Strachan *et al*., 2015, p. 103). There are also several examples of community groups applying for loans and individuals buying debentures in a project through, for example, a regulated investment platform. This type of investment vehicle can enable very low levels of investment, making schemes highly accessible to the broader community (DECC, 2015c).

3.6 Ontario, Canada

3.6.1 Investments from local citizens

The Canadian state of Ontario has been a relative latecomer to deploying wind and solar PV energy, but it has sought to mobilise local citizens as investors as a central dimension of its transition to a low-carbon economy. Whereas in 2006 virtually no wind or solar PV electricity was generated, by 2014, renewables accounted for 24% of electricity generated, with over 4% coming from wind and under 1% from solar PV (Table 3.1).

Between 2010 and 2015, 4627 MW of renewable contracts were awarded by the Independent Electricity System Operator (IESO). Community equity participation has been a central feature, with some form of community and/or Aboriginal (First Nation and Métis) participation in 22% of total contracts issued (IESO, 2015b).[6] Furthermore, an additional 20,000 micro-FiT contracts have been issued for small solar PV installations, representing 181 MW of capacity (IESO, 2015b), which included applications from many farmers, business owners and homeowners. Some community groups pursued their first projects as a result of the micro-FiT programme by aggregating a number of these contracts (Lipp *et al*., 2016).

3.6.2 The use of financial incentives

The Renewable Energy Standard Offer Program (2006) introduced a FiT for renewable energy in Canada. This programme encouraged a high concentration of larger developers because of the high cost of applications, among other factors. This was followed by the Green Energy and Green Economy Act (2009/12), which introduced a technology-differentiated FiT, offering stable prices and long-term contracts. Compared with the Renewable Energy Standard Offer Program, the price schedule for the FIT offered a considerably more attractive return for investors.

The new programme was divided into two streams: the FIT stream and the micro-FiT stream. The micro-FiT programme – for projects not exceeding 10 kW – focused on homeowners and small businesses. It also introduced a streamlined application and contract issuance procedures. Ontario's FiT policy has been compared to the German FiT scheme. It comprises a set of prices for multiple technologies, differentiated according to project size. In both cases, as the project size decreases, the tariff increases (Mabee *et al*., 2012; Stokes, 2013), although the German scheme has a greater number of options (Mabee *et al*., 2012).

A distinctive design feature of the 2009 FiT was the strong additional incentives and supports for community-owned projects. There was a particular emphasis on promoting projects owned by Aboriginal communities, which are an acutely disadvantaged minority in Ontario. Aboriginal peoples face even greater barriers in participating in renewable projects than other community groups (Krupa, 2012a, 2013), yet nearly all future electricity developments will occur within their territories (Krupa *et al*., 2015).

The key incentive mechanism was an "adder" to the FiT, an additional amount per kilowatt-hour of energy produced over standard FIT rates, related to the percentage of equity ownership by Aboriginal and other community groups (Cameron, 2011). As can be seen from Table 3.2, this adder varied by technology and was higher for Aboriginal groups than for other local community groups. In addition to the adder, Aboriginal groups in Canada are exempt from taxation for many activities (J. Krupa, University of Toronto, 14 April 2014, personal communication).

A 2011 review of the programme found that the FiT rules using a "first come, first served" approach disadvantaged community and Aboriginal participation, because these project types tended to take more time to organise and were more challenging to finance (IESO, 2012). Subsequently, under the second phase of the FiT, commercial projects with equity participation of 15% from local or Aboriginal communities received additional points on their application. Furthermore, 25 MW of the FiT was set aside for projects that had 50% equity ownership from co-operatives (this legal form was given specific recognition) and a further 25 MW was set aside for projects with 50% equity ownership from Aboriginal groups (Lipp *et al*., 2016). Further to these requirements, a significant number

6 This includes a small number of hydro and biomass projects.

Table 3.2. Maximum adder to FiT price schedule (c/kWh)

Source of power	Aboriginal groups	Other community groups
Wind	1.5	1
Solar PV	1.5	1
Hydro	0.9	0.6
Biogas	0.6	0.4
Biomass	0.6	0.4
Landfill	0.6	0.4

Source: Cameron (2011, p. 12)
c/kWh, cents per kilowatt-hour.

of FiT contracts were issued involving community participation and a majority of co-operatives active in the renewable sector were established in response to FiT 2 (People Power Planet, 2016).

In 2013, as a result of concerns around the cost to the exchequer (Krupa *et al.*, 2015), it was announced that "large" renewable projects (over 500 kW) would be removed from the FiT programme (IESO, 2013). A competitive tendering process was introduced for these projects. The degree of community engagement and ownership, including equity ownership from co-operatives, Aboriginal groups, local landowners and municipalities were included as important criteria in this tendering process. As a result, 13 of the first 16 projects (five wind, seven solar PV and four hydroelectric) contract offers included participation from one or more Aboriginal communities, including five with more than 50% Aboriginal participation. Additionally, 75% of the successful proposals received support from local municipalities and more than 60% had support from abutting landowners. None of the projects, however, involved participation from a co-operative or a non-Aboriginal community group (C. Koenig, Ontario Sustainability Services Inc., 5 April 2016, personal communication).

Under the FiT for medium-sized projects (10 kW to 500 kW), which remains in place, 968 applications were received, representing a total of 582 MW. Of these, 13% had Aboriginal community participation, 35% had municipal and public sector participation and 25% had community participation (IESO, 2016). Finally, under the micro-FiT, approximately 50 MW of solar PV is to be procured between 2013 and 2017, and the majority of this will come from individuals, small businesses and some community groups (Government of Ontario, 2016).

The FiT, however, was not the only support introduced for community projects. A number of incentives were made available to address key barriers to community participation, such as access to finance to cover establishment and early-stage project feasibility assessments and planning applications studies (The Federation of Community Power Co-ops, 2015). These programmes were streamlined into the Energy Partnership Program (Figure 3.4), which provides grant funding to cover the legal, technical, financial, due diligence and soft costs of community energy projects supported by the FiT. Charities, not-for-profit organisations and co-operatives are eligible for the fund and so are projects developed by individual Ontario residents, such as farmers. These grants have been an important factor in getting community projects off the ground (The Federation of Community Power Co-ops, 2015).

3.6.3 Business models for citizen investors

Housing co-operatives, farm co-operatives or credit unions have a long history in Ontario. A number of regulatory changes have ensured that co-operatives are a key feature of community participation in Ontarian renewable deployment. First, a specifically tailored renewable energy co-operative was established pursuant to the Green Energy and Economy Act (2009/12). This removed the obligation for co-operatives to conduct 50% of their business with members. Second, since the second stage of the FiT regime in 2012, the co-operative has been the sole legal form recognised for community energy projects (J. Lipp, TREC Renewable Energy Cooperative, 12 April 2015, personal communication).

It is estimated that 30 to 35 co-operatives are actively developing projects, and there have been annual

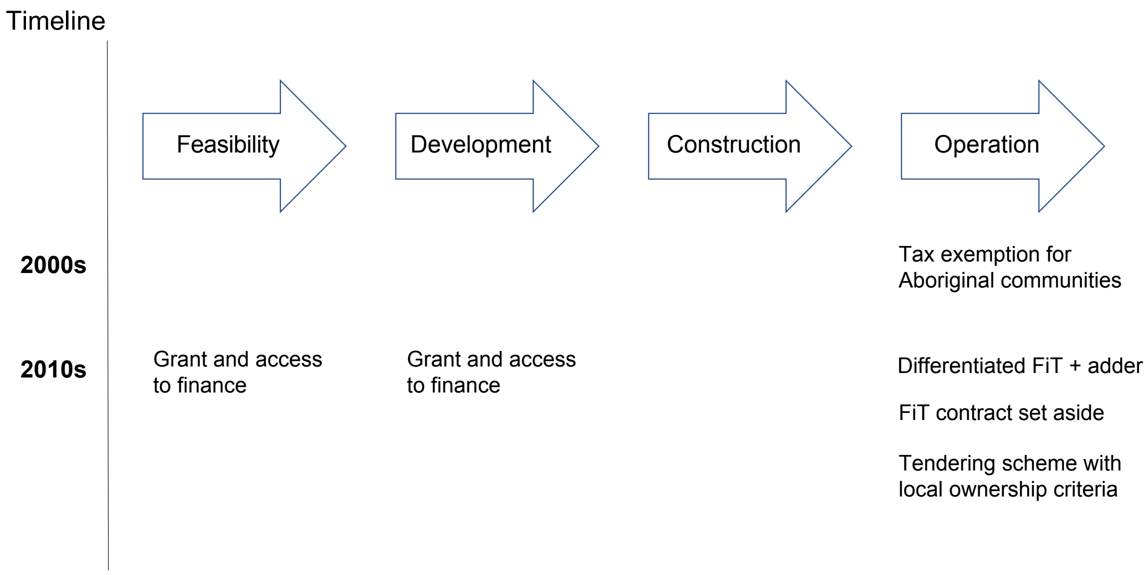

Figure 3.4. Ontarian incentives over time and project stage.

Box 3.1. Conference on mobilising Irish citizens as investors

Cork University Business School hosted a conference as part of this project on the topic "Financial incentives to promote local ownership and investment in low-carbon technologies: identify pressures, inform policy and develop solutions", held in the Spencer Hotel on 8 December 2016. The event was attended by some 80 experts and stakeholders from across government, the private sector, non-governmental organisations (NGOs) and community groups. Kevin Brady, Head of Strategic Energy Policy Division in the Department of Communications, Climate Action and Environment, opened the conference. Mr Brady outlined the critical importance of engaging citizens in Ireland's energy transition from the government's perspective, as encapsulated in the Energy White Paper (2014). He detailed the key policy initiatives on the horizon, including the design of a new support scheme for renewables in 2017, which will be designed with citizen investors in mind.

This was followed by a keynote address by Professor Dr Rolf Wüstenhagen, Good Energies Professor for Management of Renewable Energies, University of St Gallen, on the topic "Promoting citizen investment in renewable energy technologies: Swiss and German experiences". Professor Wüstenhagen, who is one of the key figures globally on the topic of promoting citizen investment on LCTs, outlined approaches to promoting citizen investment and the pitfalls to be avoided, drawing in particular on German and Swiss experiences. This was followed by a keynote address by Jennifer Ramsay, Local Energy Scotland, on the topic "Financial incentives to mobilise local citizens in Scottish wind projects". Ms Ramsey outlined the successes of the Scottish Government in terms of promoting more citizen participation in wind project developments and highlighted the importance of providing trusted advice and expertise to citizens through a trusted intermediary as a key success factor.

In the second session, Joseph Curtin and Dr Celine McInerney presented interim project findings. Joseph Curtin presented the findings of four country case studies (see Chapter 3), highlighting in particular the importance of overcoming discrete barriers to citizen investment at early (feasibility and development) stages of developing a renewable energy project. Dr McInerney presented a typology of business models for citizen participation (see Chapter 6), focusing on the importance of de-risking projects for citizens and the potential for positive forms of financial collaboration between project developers and citizens.

The final session was an expert panel discussion followed by audience interaction. Participants in the panel discussion were Ruth Buggie (Sustainable Energy Authority of Ireland), Peter Harte (Irish Wind Energy Association), Kate Ruddock (Friends of the Earth), Paul Kenny (Tipperary Energy Agency) and Anthony Rourke (Bank of Ireland). All participants were positive about the potential for citizen financial participation on renewable energy projects, but they highlighted the challenges of transitioning from a system where citizens play only a marginal role on renewable development to a system where they can play an increasingly central part.

increases in the number of co-operatives, the project volume and the membership recruitment since the inception of the FiT in 2009 (Lipp *et al*., 2016). The vast majority of co-operatives are involved in solar PV projects and the majority are raising capital through the issuance of shares or bonds and are run on a for-profit basis (The Federation of Community Power Co-ops, 2015). Non-profit organisations, such as charities and faith-based organisations, have also been active as investors in renewables in Ontario, albeit at a smaller scale under the micro-FiT programme (People Power Planet, 2016).

A key feature of renewables deployment in Ontario is participation from Aboriginal peoples. Projects tend to be joint ventures or limited liability partnerships between a professional developer and an Aboriginal group (Krupa, 2012b; Pic River, 2016). The co-operative form is not a favoured vehicle for participation among Aboriginal groups (Lipp *et al*., 2016). Typically, projects involve a corporation or holding company that is fully owned and operated by a particular group on a not-for-profit basis for the benefit of the local community. An example is the Pic River Energy Corporation, which is fully owned by the local Ojibway people. According to Krupa (2012a,b), the corporate structure is similar to that of many corporations and includes annual general meetings and Aboriginal-led boards, etc., which means that it is fully accountable to its local community members (Krupa, 2012b). The Pic River Energy Corporation began as a minority equity partner in a hydro-electric site in 1982, but is now a partner in a portfolio of projects, including two large wind projects in development, which have a combined installed capacity of 100 MW.

3.7 Discussion

3.7.1 Use of financial incentives

Our case studies reveal the importance of introducing financial incentives at both the early and later stages of these renewable projects to establish a business case for local citizen participation. They also reveal the crucial importance of incentives to overcome early risks at the feasibility and development stages: professional developers can generally offset these risks by developing a portfolio of projects, but this option is not available to local citizens. These early-stage project supports are particularly evident in the cases of Ontario and the UK, and in more recent years in Denmark as well. In these three cases, non-recourse loans and grants were introduced to cover feasibility and development costs for local citizen initiatives. In Germany, however, while soft loans were available to cover some of the development costs, examples of specific financial incentives targeting feasibility assessments are less common. This can perhaps be attributed to the approach to project approval in Germany, which aligns planning, grid access and FiT contracting application, thereby reducing early-stage project risks (IEA-RETD, 2016). It perhaps also reflected the proliferation of local and regional groups and agencies available to support local citizen groups (Dewald and Truffer, 2011; Romero-Rubio and de Andrés Díaz, 2015) and the high numbers of developer-led initiatives in the wind sector where early-stage project risks are ameliorated by the professional entity.

In all cases, incentives were introduced at the later (construction and operation) phases of project development. We found that, although in the UK, Denmark and Germany early adopters and pilot projects were encouraged to use grant-based supports, the introduction of a FiT was a crucial turning point and a critical success factor in mobilising local citizen investors at scale in all four cases. A key characteristic of FiTs is that they provide a stable long-term income stream, and therefore reduced risk, and made it easier to access bank funding, which appears particularly important for local citizen actors. In all cases, the favourable tax treatment of income from renewable energy projects emerges as an important supplementary consideration. Indeed, the removal of various tax incentives in the UK has undermined the business case for many renewable energy projects since 2015.

These findings could be interpreted as supporting claims for the attractiveness of the FiTs themselves for local citizen investors (Butler and Neuhoff, 2008; Fouquet and Johansson, 2008; Couture and Gagnon, 2010; del Río and Bleda, 2012; Saunders *et al*., 2012). This would be of concern within the context of the transition from FiTs to increasingly market-based supports, which is evident in all four cases. It is noteworthy, for example, that when Denmark transitioned from a FiT to a FiP in 2003, no new guilds were established in the period from 2003 to 2007 (Meyer, 2007; Gotchev, 2015) and several existing guilds ceased to exist (Gotchev, 2015).

However, our case studies reveal that there are more important considerations than the choice of instrument per se. For example, specific design features were an important factor in the success of FiTs. In Ontario, the UK and Germany, FiT programmes were differentiated according to project size and technology type, opening up niche opportunities for local citizen actors. In Ontario, adders, set-asides and mandates have been used to counteract the advantages of commercial organisations in bringing capital-intensive projects to fruition and in accessing finance.

Furthermore, while the case of Denmark demonstrates that the transition from a FiT to a FiP was not seamless, the 2009 reforms illustrate that the latter incentive can be designed in such a way that it is attractive to community groups. Additionally, the case of Ontario illustrates that quota-based tendering schemes can also be designed in a manner that is advantageous to local community groups. The German and UK quota/tendering schemes, however, appear not to have been designed with these actors in mind and have created barriers to entry for them. Ultimately, therefore, we would concur with the findings of the studies (Feurtey *et al*., 2015; Curtin *et al*., 2016) that emphasise the importance of specific design features and the importance of the provision of stable financial revenues (Simcock *et al*., 2016), as opposed to the choice of financial incentives per se. This could be particularly important in the context of migration to more market-based supports within the EU (Ragwitz *et al*., 2012) and elsewhere.

Our cases illustrate that the cost-effectiveness of FiT schemes has been questioned, which has resulted in abrupt changes to the levels of support available. This regulatory uncertainty has clearly undermined the confidence of local citizen investors, who appear less resilient in the face of these changes than more traditional investor classes. Governments would argue that controlling the cost of transition to a low-carbon economy is a necessary priority to deliver continued societal buy-in. On the other hand, involving local citizens, who often provide their time on a voluntary basis (IEA-RETD, 2016; Rijpens *et al*., 2013), has been found to open up access to the optimal sites (for onshore wind or, for example, south-facing roof tops), thereby reducing cost (Nelson *et al*., 2016). The net cost-effectiveness of involving local citizens as investors requires further evaluation.

3.7.2 Linking incentives with typical models

Our cases reveal that a variety of innovative business models have emerged, offering characteristics that are appealing to different types of investors. These can be divided into those that are community led and those that are developer led (Bolinger, 2001).

Community-led projects are more common in the solar sector, where several legal forms are evident, including co-operatives, limited partnerships, charities, guilds and community interest companies. Some of these, such as the Danish guild and the Ontarian and UK co-operatives, are profit-orientated, whereas others, such as the UK community interest companies, are for the benefit of the local community. These structures often tend to place restrictions on the amount invested to avoid domination by one party and they tend to link their financial activity to achieving social and political goals of democratisation and empowerment.

Developer-led co-ownership models have become increasingly important in all cases, particularly in the wind sector, perhaps as a response to its increased industrialisation and professionalisation. Wind projects increasingly tend to be instigated by a professional project developer, even in countries such as Denmark, where community-instigated projects were once the norm. Within this sector, a variety of models have emerged, with some more profit orientated than others. For example, German and Danish partnerships are fully commercial, whereas in the Ontarian joint venture, the local citizen participation is non-profit and surpluses are reinvested back into the community. The Danish approach has been successful in ensuring that guilds remain an important partner in onshore wind projects, while the German limited partnership offers local citizens a chance to invest in a project without involvement in operational decisions or strategic direction of projects.

In all cases – apart from the UK, where the landscape appears somewhat more fragmented – typical business models can be identified (Table 3.3).

With respect to developer-led models, governments have used mandates (Denmark), voluntary obligations (UK) or adders and minimum reserve requirements in FiTs and award criteria in tenders (Ontario) to encourage professional project developers to involve local communities as equity investors in projects. Specific models have been influenced by tax considerations in particular. The popularity of the GmbH & Co. KG structure in Germany can be linked to the tax treatment of depreciation: in the 1990s, individual investors in these partnerships were allowed to offset depreciation charges against all income (Bolinger, 2001). It remains a highly tax-efficient structure, even if this shelter has been phased out (Bolinger, 2001; Yildiz, 2014). Similarly, the tax status of Aboriginal communities and Danish guilds was influential in determining the vehicles chosen by local citizens to organise themselves in partnerships with professional developers.

It appears, therefore, that the design of the financial incentives that are introduced, as well as existing incentives implicit in the tax code, can be an important factor in underpinning business model innovation. Indeed, the choice and design of financial incentives have directly given rise to the emergence of typical models in several cases. These findings suggest that financial incentives can be used to promote the emergence of typical business models. Early financial advantages of a particular model over another can result in the replication of a “lighthouse” model and its emergence as a typical model. This can happen through word-of-mouth, or indeed through the active promotion of a successful model by government and voluntary organisations (Schreuer, 2015).

3.8 Conclusions

In this chapter, we evaluated the use of financial incentives introduced at different LCT project stages and their importance in mobilising local citizen investment in Germany, Denmark, the UK and the Canadian state of Ontario. We also explored the typical business models that have emerged as vehicles for these investors in these jurisdictions and the connection between the financial incentives introduced and business model innovation.

It is clear that, if governments wish to successfully mobilise citizen investment, financial incentives must be considered at both the early and later stages of a project’s lifecycle. This enables citizen investors to overcome barriers at the feasibility and development stages of projects. The requirement for early-stage incentives is a distinguishing feature of projects with citizen involvement and appears to be central to the value proposition of many business models. This perhaps reflects the greater risk aversion of this cohort of investors and their inability to balance risk between a portfolio of projects, as is the case with professional project developers. Incentives are therefore required

Table 3.3. Typical models

Jurisdiction	Community led	Developer led
Denmark	Guild	Partnership between guild and professional developer
Germany	Co-operative	GmbH & Co. KG structure
UK	None	None
Ontario	Energy co-operative	Joint venture or partnership between professional developer and Aboriginal non-profit corporation

at the feasibility and development stages to mitigate higher early-stage project risks, although other measures, such as setting out clear planning, grid access and other procedures, are also important.

With respect to incentives introduced at later construction and operation phases, we conclude that market-independent supports such as FiTs and grants have been important in mobilising local citizens as investors. However, in contrast to previous literature, an implication from this study is that market-based supports such as FiPs and quota-based schemes, which are becoming increasingly popular within the EU and globally, can also be designed in a manner that is attractive to citizen investors.

In three of the four cases, we found that typical business models have emerged as vehicles for local citizen investors in both community-led and developer-led projects. Furthermore, links between these typical models and the types of financial incentives that have been introduced are evident, and the tax treatment of profits appears to be a particularly important consideration in this respect. To the extent that tax relief against other income sources is available, it effectively underwrites the risk of the investment. Even if the project fails, investors can receive a rebate on their initial investment. It is clear, therefore, that financial incentives can be used to mobilise citizen actors, but also to promote the emergence of typical "off the shelf" investment models. These can reduce transaction, legal and professional costs, and promote the more widespread deployment of distributed renewable energy technologies controlled by local citizens.

In support of the proposition by Johnson and Suskewicz (2009), we conclude that when new technologies (wind and solar PV in this case) are combined with favourable government policy that promotes business model innovation in a particular direction, widespread system change can result. This process is particularly evident in early-adopter markets such as Denmark and Germany, and has created challenges for incumbent business models and actors.

4 Use of Financial Incentives in Ireland

4.1 Introduction

A variety of technology-specific downstream financial incentives (see Chapter 2) have been introduced to mobilise investment by local citizens in low-carbon and resource-efficient assets in Ireland. In this chapter, we present an assessment of the main incentives that have been introduced, with the objective of drawing lessons for the design of future financial incentives (Chapter 6).

In each case, we provide a brief description of the incentive and an assessment of its success in mobilising local citizen investment in low-carbon assets. Where data allow, we evaluate these incentives using the IPCC evaluation criteria for climate change policy:

1. environmental effectiveness;
2. cost-effectiveness and economic efficiency
3. institutional, political and administrative feasibility and flexibility; and
4. distributional equity and broader social impacts (Somanathan *et al*., 2014).

To present our results, we have categorised incentives according to the typology proposed in Chapter 2. The following sections therefore consider in turn grants, tax incentives and FiTs/quota schemes. No soft loan schemes have been introduced in Ireland that target citizens and communities, and this category of incentive is therefore not considered. The chapter concludes by considering lessons for future policy development.

4.2 Grants

Several grants schemes have been introduced in Ireland to reduce the upfront investment costs of low-carbon and resource-efficient technologies for citizens and communities.

4.1.1 The Home Energy Saving Scheme

The Irish government introduced the Home Energy Saving Scheme in 2009 (known as the Better Energy Homes Scheme since 2012). The scheme provides upfront grants to cover a proportion of the cost of roof and wall insulation, renewable and energy-efficient heating systems, and the cost of a building energy rating (BER) assessment. These grants typically cover between 20% and 40% of the installed cost of measures (Curtin, 2009).

According to the Sustainable Energy Authority of Ireland (SEAI), between 2009 and August 2015, approximately 160,000 households benefited from a grant for one or more measures and over 425,000 individual measures were installed (SEAI, 2015a). The number of householder grants peaked in 2011, with 88,000 household applications approved, before declining significantly in 2012, 2013 and 2014 (SEAI, 2015a). The cost to the exchequer of the programme was €178 million.

A cost–benefit analysis of the scheme found that it saved society €5 in energy, CO_2 and other pollutants for every € 1 spent (in net present value terms). Participating households were estimated to save an average of €450 per annum on energy bills and to reduce CO_2 emissions by approximately 1.5 tonnes per dwelling (Motherway and Scheer, 2011). Furthermore, billing and survey analysis found that participants in the scheme saved an average of 21% on their annual gas bill, enjoyed warmer, more comfortable houses and saw substantial improvements in their BER (Scheer *et al*., 2013).

Furthermore, applicants for a Home Energy Saving grant come from a relatively wide cross section of society and not just from better-off households, although single-adult households are somewhat underrepresented (SEAI, 2014a). The Better Energy Warmer Homes Scheme also provides retrofits for owner-occupied fuel-poor households that may not be in a position to apply for a grant, addressing to some extent the negative potential distributional implications of the scheme.

Cavity insulation, roof insulation and BER assessments, the cheaper interventions for which grants are available, accounted for the majority of overall applications (SEAI, 2015a), although external wall insulation accounted for 26% of overall grant funding. An average spend of approximately €3000 was recorded, which includes the grant payment of approximately €1000 (Curtin and Maguire, 2011; Curtin, 2013). A very significant proportion of funding has therefore been used to promote cost-effective and mature technologies with short payback periods.

The scheme is challenging to administer and requires individual processing of each grant, quality assurance of contractors and technologies, auditing of interventions, ongoing assessment of impacts and take-up, and so on. Annual budgeting can also create challenges and has led to rapid and unpredictable fluctuations in market activity from year to year (e.g. between 2011 and 2012), in response to changes in the amount of government funding available and the level of grants provided. Fluctuations in market activity of this nature make the creation of a sustainable market in retrofitting challenging and creates difficulties for private contractors, businesses and investors in the sector.

4.2.2 Better Energy Communities

The Energy Communities programme, launched in 2012, supports new approaches to achieving high-quality improvements in energy efficiency within Irish communities and supports the use of renewable energy where possible. The programme is aimed at promoting the use of innovative financial approaches, such as energy performance contracting, and creating innovative partnership approaches that facilitate community access to existing local resources. Between 2012 and 2015, a total of €126 million in grants was provided (SEAI, 2016b).

Projects generally involve partnerships between local authorities or public sector organisations, small to medium-sized enterprises, voluntary organisations, private sector actors and local community residents or groups. Grants typically cover 35–50% of the project cost, depending on the actors involved, but this can be up to 80% in the "energy poor" sector (SEAI, 2016b).

While no full economic evaluation of the programme has been undertaken, each project is assessed for value in terms of money to the exchequer, considering energy and carbon savings. The scheme has successfully mobilised 261 local community actors to deliver projects. These projects delivered energy efficiency and renewable energy retrofits in over 12,000 private and public buildings, supporting several hundred jobs each year (SEAI, 2017a). The programme promotes once-off projects rather than long-term sustainable energy communities. It should be noted, however, that one-off niche projects may act as catalysts for future community-based projects by shaping and supporting local market formation processes (Kemp *et al*., 1998; Dewald and Truffer, 2011) and can promote acceptance of renewable technologies. As with the Home Energy Savings Scheme, this scheme requires considerable administrative oversight, as each application requires assessment and ranking, and considerable administrative challenges arise from annual budget allocations from the exchequer.

4.2.3 Greener Homes Scheme

The Greener Homes Scheme was established to stimulate the market for renewable heating technologies with a view to promoting the development of a long-term market for these technologies. Its objective was to decrease Ireland's reliance on fossil fuels and to reduce CO_2 emissions. Under the scheme, grants were available for renewable heating systems. Grant-aided technologies and the levels of grant available are given in Table 4.1 (SEAI, 2013).

Between 2006 and 2011, a total of 33,065 installed measures were grant aided under this scheme (Table 4.2) (SEAI, 2008), accounting for nearly €75 million in government revenue. Solar water heaters, the most cost-effective of the grant-aided technologies (Claudy, 2011), accounted for 63% of total applications, with biomass boilers and heat pumps accounting for 18%.

An economic evaluation shows that the cost of CO_2 emissions by installation of biomass and wood gasification boilers under the scheme is high (ESRI, 2011). The success of the scheme in achieving its other objectives, such as the development of a sustainable market in renewable heating technologies, has not been evaluated. It appears, however, that the technologies covered have not achieved widespread market adoption in the residential sector.

As with other grants programmes, there are administrative challenges as well as challenges associated with annual budgeting. While there are no data available on the demographic characteristics of

Table 4.1. Grants available under Greener Homes Scheme

Technology	Grant available (€)
Heat pump – vertical ground heat pump	3500
Heat pump – horizontal ground	2500
Heat pump – water to water	2500
Heat pump – air source	2000
Solar flat plate	250/m^2 (to maximum of 6 m^2)
Solar evacuated	300/m^2 (to maximum of 6 m^2)
Wood gasification boiler	2000
Biomass boiler	2500
Biomass stove	800
Biomass stove and back boiler	1400

Source: SEAI (2013)

Table 4.2. Summary assessment of Irish grants

Initiative	Type	Target	Effectiveness	Efficiency	Administration	Distributional impacts
Home Energy Savings (Better Energy Homes)	Grant	Household	Mobilised 160,000 household investments in EE and RES technologies	Assessments show overall cost-effectiveness of programme for society However, focused on technologies considered cost-effective without subsidy (attic and cavity wall insulation)	Considerable challenges in administering grants, quality assurance, auditing, etc. Short-term programme with annual budgeting creates variety of challenges, including potential for boom–bust investment cycles	Negative distributional implications limited by broad take-up across socio-economic categories Supplemented by Warmer Homes scheme for fuel poor
Better Energy Communities	Grant	Community group	Mobilised 261 pilot community investments in energy retrofits covering 12,000 buildings	Value for money assessment undertaken for each application, considers energy savings relative to exchequer cost No *ex post* assessment of projects yet undertaken	Considerable challenges in administering grants, quality assurance, auditing, etc. Short-term programme with annual budgeting creates variety of challenges	Envisaged as pilot/exemplar project promoting public acceptability and understanding of LCTs Projects target fuel poor who are eligible for higher grants
Greener Homes Scheme	Grant	Individual	Over 33,000 renewable heating measures installed in residential buildings	Economic assessment shows high carbon abatement cost per unit of expenditure No public assessment of programme undertaken in relation to its stated objectives	Considerable challenges in grant approval, quality assurance, auditing, etc. Short-term programme with annual budgeting creates variety of challenges	Pilot programme intended to drive uptake among early adaptors and building awareness and acceptance of new technologies No data available, but it is likely that programme take-up focused on wealthier cohorts given technology cost
Battery Electric Vehicle Scheme	Grant/tax	Individual	Mobilised investment in only 200 EVs per annum	No public economic evaluation undertaken	Low administrative costs	Pilot project aimed at driving uptake among early adaptors Likely that programme focused on wealthier cohorts given technology cost

EE, energy efficient; EV, electric vehicle; RES, renewable energy source.

grant applicants, it is likely that, given the high cost of supported technologies, the uptake may have been concentrated among wealthier cohorts. These cohorts, however, may be considered "early adaptors" and the programme may be justified on this basis.

4.2.4 Electric vehicles

A grant scheme, introduced in 2010, is available for battery-powered electric vehicle (EVs) and plug-in hybrids that meet specific standards. The maximum grant is €5000 for EVs over €20,000 (€1500 for hybrids and €2500 for plug-in hybrids). This incentive was combined with vehicle registration tax (VRT) exemption for EVs and lower VRT costs for hybrids.

As of 2014, there were 8607 licensed hybrid electric motor cars, 9293 licensed flexible fuel motor cars and approximately 529 EVs in Ireland. Approximately 1100 EVs were sold between 2010 and the end of 2015, compared with the government target of 10% of all cars being EVs by 2020 (approximately 200,000 vehicles). The scheme has therefore not mobilised significant citizen investment. This has been attributed to the existence of "other bottlenecks", such as, until relatively recently, the lack of infrastructure and "broader transport patterns in Ireland" (Department of Finance, 2015). International experience suggests that consumer awareness and trust of the technology and a series of other factors may also be at play (see Chapter 2) and that financial incentives, while necessary, are not sufficient to guarantee high adoption rates (Sierzchula *et al.*, 2014).

While no data are available, it is likely that programme take-up focused on wealthier cohorts, given the cost of technologies supported. On the other hand, the scheme could be seen to have targeted early adaptors and may have played a role in building awareness of this relatively new low-carbon option in society, which is necessary prior to paving the way to widespread uptake. The administrative costs are low because the grant is provided to the dealer and the benefit is passed on to the purchaser as a price reduction at the point of sale. No economic evaluation of the scheme has been undertaken.

4.3 Tax Incentives

There have been a number of tax incentives that have either directly or indirectly mobilised community and individual investments in the resource-efficient and low-carbon sectors.

4.3.1 The Employment Enterprise Investment Scheme

The Employment Enterprise Investment Scheme (2011), formerly the Business Expansion Scheme (1984), is an income tax incentive to encourage private investors to invest equity capital in small and medium-sized companies. The primary objective of the scheme is to provide an alternative source of finance to small and medium-sized and start-up enterprises and to support the creation and retention of employment in small and medium-sized enterprises across the economy. Tax relief is available to investors at the marginal rate of 41% when shares are held for a minimum of 5 years and up to 30% when shares are held for 3 years, for investments of up to €150,000 per annum in qualifying companies. Companies can raise a maximum of €2.5 million in a 12-month period (Department of Finance, 2014). Since 2011, it has been easier for companies producing energy from renewable sources to qualify for relief compared with the earlier scheme.

Between 2007 and 2014, 2198 applications were made and €485 million was raised by companies under the schemes, from over 20,000 individual investors. A total of 183 investments, accounting for €67.3 million, were in sustainable- and renewable-related companies, in particular wind energy. Hydropower, solar, wave and wind generation, biomass and forestry and anaerobic digestion also represented a significant amount of investment (Table 4.3). The scheme has therefore been a significant source of capital for mobilising citizen investment in low-carbon and resource-efficient sectors.

There has been a lack of comprehensive evaluations of the scheme, partly attributable to a lack of availability of data on the scheme's impact (Department of Finance, 2014). Among bodies that have considered the economic importance of the scheme (including the Commission on Taxation and the Innovation Task Force) there is consensus that it is effective and economically beneficial in terms of output, competitiveness and employment. This is because it addresses a key market failure affecting the availability of equity for start-ups and small and medium-sized enterprises (Department of Finance, 2014).

Table 4.3. Enterprise Investment Scheme investments in low-carbon and resource-efficient sectors

	Amount (€)	Number of fundraisings
Wind	49,256,704	110
Biomass and forestry	7,852,549	26
Energy efficiency	2,754,331	15
Wave and hydro	2,010,000	2
Anaerobic digestion	970,500	3
Other	4,393,747	27
Total	67,237,831	183

Source: based on Revenue Commissioners (2015)

Compared with grant-based approaches, these types of schemes are easier to administer. Tax schemes of this nature also tend to have the benefit of being multi-annual (the current scheme has been extended to 2020), unlike grant schemes, which tend to be constrained by annual budgeting.

On the other hand, a review of the scheme suggests that there was a high administrative burden on companies seeking to avail themselves of the tax incentive and that there is a low level of awareness of the scheme among enterprises (Department of Finance, 2014). Stakeholders have recommended that it be promoted more widely among enterprises. However, there has been little consideration of how the scheme could be made more accessible to local citizens and levels of awareness of the scheme for potential smaller-scale investors (local citizens in particular) has not been considered in evaluations.

A related drawback of the scheme is that it tends to only be accessible to wealthier segments of society, which are more likely to have access to an accountant for tax-planning purposes. An analysis of 266 investments undertaken by the Department of Finance shows that 44% of total investments were for more than €100,000 (Department of Finance, 2014), underpinning this point. In the past, the Department of Finance has expressed concern that these individuals can, by means of the cumulative use of various tax incentive reliefs, reduce their income tax liability to a very low level. To address this issue, a "high earners" restriction was introduced in 2007, which limited the amount of relief that can be claimed in any one year to €80,000. In Budget 2014, however, the initial 30% tax relief under the scheme was excluded from the high earners' restriction for a period of 3 years, to encourage a higher level of investments.

4.3.2 The Bike to Work Scheme

Since January 2009, employees have been incentivised to purchase a bicycle. The purpose of the scheme is to encourage more employees to cycle to and from work, or between work places, thereby contributing to lowering carbon emissions, reducing traffic congestion and improving health and fitness levels.

Under the scheme, the employer provides the bicycle and/or safety equipment to an employee who agrees to forego or sacrifice part of his or her salary every pay period to cover the cost of the benefit, up to €1000. Employees may avail themselves of the scheme up to once every 5 years. The employee repays the purchase price through deductions from his or her gross salary during the subsequent months.

The bicycle and safety equipment are therefore exempt from tax and the employee will not be liable to income tax (including employee pay-related social insurance (PRSI) or the universal social charge) at their marginal rate and will therefore not be taxed on the purchase price of the bike, nor is the employee liable for benefits-in-kind taxation. Another benefit for the employer is that the employer's PRSI is not payable on the cost of the bicycle and/or safety equipment. Employees can save up to 52% of the cost of the bike, while employers save 10.75% in employer's PRSI (IBBA, 2011). The scheme has therefore combined an attractive tax incentive and no-cost finance (effectively a soft loan) with a convenient repayment mechanism.

There are no official statistics on the uptake of the scheme available because there is no notification procedure for employers to indicate to the Revenue Commissioners that they are availing themselves of the scheme. According to the Irish Bike Business Association (IBBA), however, the scheme has been extremely popular and has significantly boosted bike sales (IBBA, 2011). The number commuting by bike has increased significantly since the introduction of the scheme in 2009 (Figure 4.1), although it is not possible to say if this has arisen in response to the scheme itself.

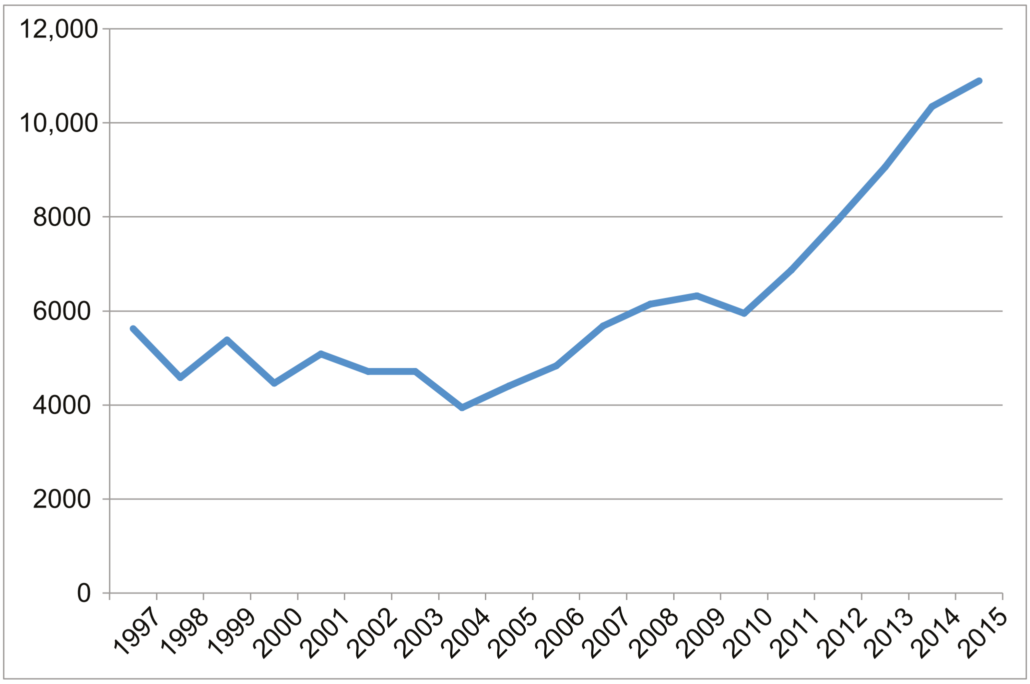

Figure 4.1. Number of people commuting by bicycle in Dublin. Source: Dublin City Council (2016).

While the IBBA has made an attempt to set out some of the costs and benefits of the scheme (IBBA, 2011), no economic evaluation has been undertaken, and the absence of reliable data on the scheme makes it challenging to evaluate. It is notable, however, that the scheme has no administrative costs for the government. The availability of a reliable repayment mechanism and the removal of the upfront cost barrier through the provision of no-cost finance are clearly attractive design features from an employee perspective. It appears to have limited barriers to entry for employers and employees given the relatively low levels of finance required and the relatively simple administrative processes.

4.3.3 Plastic bag tax

A plastic bag environmental levy of €0.15 was placed on plastic shopping bags in March 2002 and raised to €0.22 in 2007. Retailers must pass on the full amount of the levy as a charge to customers at the checkout. The charge for the plastic shopping bag is itemised on all invoices, receipts and dockets issued to customers. The charge was introduced to encourage the purchase and use of reusable bags and to help change attitudes to litter and pollution. Revenue generated from the plastic bag environmental levy goes into the Environmental Fund, which is used to support waste management, litter and other environmental initiatives. Approximately €20 million per annum was levied in the first decade of the scheme.

The introduction of the levy resulted in 90% of consumers using long-life bags within a year. Bag usage dropped from an estimated 328 bags per person per annum prior to the introduction of the levy to 14 bags per annum by the end of 2012. Plastic shopping bags accounted for only small fraction of total litter in 2014 according to the National Litter Pollution Monitoring in comparison with 5% prior to the introduction of the levy (DECLG, 2014). Revenues have also supported pro-environmental activities.

4.3.4 Vehicle registration tax and annual car tax

A new system of assessing private cars for VRT and annual motor tax came into effect in July 2008 for vehicles purchased in 2008 or later. The system moved away from assessing vehicles based on engine size to one that is based solely on the CO_2 emissions per kilometre. Seven tax bands were originally used for the VRT assessment, with the bands corresponding to the EU labelling system. The number of bands was extended to 11 in January 2013 (SEAI, 2014b). The economic rationale for the change was based on evidence that individuals did not fully consider the implications of car purchase decisions (in terms of running costs over the car's lifetime) and valued the present very highly, leading them to undervalue improvements in vehicle efficiencies (see, for example, Lane and Potter (2007) and Metcalfe and Dolan (2012)).

The recalibration of VRT and motor taxation on CO_2 efficiency has had a significant impact on car-purchasing decisions. Prior to the introduction of these bands, the average new vehicle purchased had emissions in the region of 166 g/km (this fluctuated around 165–168 g/km since 2000 until the changes introduced in July 2008) (SEAI, 2014b). In 2009, the first full year of the new scheme, the average emissions of a new vehicle entering the national fleet had reduced to around 145 g/km. By 2015 this had fallen further to 114 g/km, which is comparable with the EU average of 119.6 g/km (EEA, 2016).

No full economic evaluation of the scheme has been undertaken to assess the impact on society (Table 4.4). However, concerns have been raised about the revenue implications of the new scheme. The Department of Finance noted that revenues from VRT fell from €1121 billion in 2008 to €375 million in 2009. However, as it also notes, this is a pro-cyclical tax, and a dramatic drop in car purchases (by 63% in 2009) accounted for the majority of the difference. VRT rates recovered in 2015 following the recovery of new car sales and the recalibration of the scheme in 2013. This recalibration was intended to increase the incentive to purchase less environmentally harmful motor cars and to increase revenue.

Administratively, the scheme requires ongoing monitoring from year to year to ensure that government revenues are stable and that a continued signal to purchase efficient vehicles is delivered, in response to fast-moving technological developments. It is unclear if any such monitoring is undertaken.

4.4 FITs and Tendering/Quota Schemes

A tendering scheme was introduced in Ireland in 1998 to support the deployment of wind energy in Ireland,

Table 4.4. Summary assessment of Irish tax incentives

Initiative	Type	Target	Effectiveness	Efficiency	Administration	Distributional impacts
Employment Enterprise Investment Scheme	Tax	Individual	Mobilised €67 million investment in sustainable and renewable energy companies between 2007 and 2014	Economically beneficial in terms of output, competitiveness and employment; lack of data makes full evaluation challenging	No administrative burden for government Multiannual extensions boosted market confidence Low awareness of scheme among ordinary citizens and SMEs	Negative distributional implications with potential for use by wealthier cohorts to minimise tax burden Considerable barriers to entry and high average levels of investment
Cycle to Work Scheme	Tax (and soft loan)	Individual	Mobilised commuters to invest in bicycles; linked to increased numbers of cyclists commuting	Lack of reliable data makes economic evaluation challenging	No administrative burden; no requirement to notify revenue	Low barriers of entry and relatively low levels of investment (under €1000) makes it accessible and socially inclusive for employers and employees
Plastic bag tax	Tax	Individual	90% of consumers started using long-life bags within a year	Creation of revenue stream; reduced land fill and litter costs	Low administrative burden High level of political acceptability, possibly due to low level of charge and availability of alternatives	Possibly regressive, but builds social awareness on environmental and resource efficiency issues
VRT and annual car tax reform	Tax	Individual	Strong shift in consumer purchase decisions towards more efficient vehicles	No economic evaluation taken for society, concern of impact on government revenue overstated	Requires ongoing monitoring to ensure stability of government revenues and continued signal to purchase efficient vehicles	No clear social or distributional implications

SME, small and medium-sized enterprise.

called the Alternative Energy Requirement programme. The programme involved generators tendering to provide a fixed amount of renewable energy capacity. It was believed that a tendering scheme would be a low-cost way of incentivising renewable energy, provided that no strategic bidding took place in the auctions (Huber *et al*., 2007). Many of those who won contracts tendered bids that were too low and, consequently, a considerable number of wind farms were never built (Doherty and O'Malley, 2011).

A FiT (the REFIT Scheme) replaced the tendering scheme in 2006 with the aim of supporting 400 MW of renewable energy generation. Under the scheme, support was made available to suppliers through the provision of a floor price for the electricity they supply for 15 years. If the energy market revenue of the project falls below the floor price, the relevant supply company will be refunded the difference from the public service obligation (PSO) mechanism (paid for by electricity bill payers). In addition, a "balancing payment" was introduced to cover notional costs of "balancing", set at 15% of the indexed floor price per MWh for all technology categories, including wind.

REFIT 2, which succeeded REFIT 1, operated between March 2012 and December 2015. It provided up to 4000 MW of renewable energy generation. The same technology categories and 15-year period of support applied, with a similar balancing mechanism in place. In addition, REFIT 3 is designed to incentivise the addition of 310 MW of renewable electricity

Box 4.1. Templederry community wind farm

Ireland's REFIT has resulted in the development of only one community-owned wind farm, in Templederry, County Tipperary.

Templederry community is located on the northern edge of the Slieve Felim Mountains, between the main urban centres of Nenagh (north) and Thurles (south) in County Tipperary. It has suffered from population decline and there are limited local employment opportunities. As a result, the Community/Local Area Development Plan (1999) identified renewable energy as key to sustainable development in the area. Four individuals from the community subsequently completed a Certificate in Renewable Energy at the Tipperary Institute and sought to develop a wind energy project in the region, with the primary objective of creating economic development. These local leaders have been identified as key catalysts and protagonists for the project, without whom success would not have been achieved.

The group set up a dedicated wind development company, Templederry Wind Farm Ltd, and invited the community to become shareholders. They made clear which risks were involved, given that wind energy was a new concept to most, and looked for an initial capital investment of €1000 per person. Thirty equal shareholders came together.

Tipperary Energy Agency (TEA) was a vital partner throughout the process, assisting the group with a feasibility study, and the community group then purchased an anemometer, which was erected on the site (selected in conjunction with TEA). The group submitted a planning application and planning permission was granted in 2003. The group originally received planning permission for the erection of three 1.3 MW wind turbines in June 2003, but a moratorium on grid connections was imposed at this time. Momentum was maintained in this difficult period by enthusiasm from leaders of the project.

By the time the moratorium was lifted (nearly 4 years later), the planning permit had expired. In 2010, it was resubmitted and changed to two 2.3 MW turbines, but at this stage the financial crisis meant that their initial banking deal fell through. Enercon, the company behind Templederry's wind turbines, made an introduction to Rabobank, whose subsidiary company De Lage Landen provided project finance for the turbines. The group raised the rest of the funding from a range of sources, including shareholder equity, LEADER grant aid, an Enercon loan and the Business Expansion Scheme (Tipperary Energy Agency, 2014). It finally started selling electricity to the grid in November 2012. This is the first community-owned wind farm in operation in Ireland.

capacity to the Irish grid, composed of combined heat and power, biomass combustion and biomass co-firing. Demand for the biomass combined heat and power category has exceeded the original allocation and is significantly below the original allocations for the other two categories.

The scheme has resulted in mass deployment of wind energy in Ireland. In 2015, wind power accounted for 24% of total electricity generated (IWEA, 2017). The FiT is projected to mobilise a €12.5 billion investment in the period leading up to 2020 in Ireland (IWEA, 2011) or an annual investment of €430 million per annum by 2020.

The scheme to date has primarily been designed with larger scale developers in mind. While there are little data available on community and local citizen investment, only a very small proportion of wind power was generated by community groups (3.9 MW out of circa 2200 MW, or approximately 0.2%). In addition, there may be some farmer-owned projects, and, as noted in section 2.1.1, the EIS has mobilised some investment in wind energy, but this is relatively modest in comparison with overall investment levels.

Economic evaluations of the scheme suggest that it has been a cost-effective way of decarbonising electricity generation. An assessment by SEAI suggests that there are positive macroeconomic/gross domestic product (GDP) and employment benefits to be had from the scheme and a joint Eirgrid–SEAI report found that wind power lowered wholesale prices (SEAI–Eirgrid, 2011; SEAI, 2015b) (Table 4.5).

Given the closure of REFIT 2 in June 2015, a new support scheme is being considered for renewable energy, which, according to the Department of Finance, is likely to take the form of a FiT or a FiP, depending on the size of the installation. There are, however, variations within these high-level designs, which would include fixed tariffs, tariffs that are paid within high and low limits (termed cap and floor), contracts for difference based on a strike price or floating/indexed tariffs relative to a reference. There are also design options available that target community and individual investors. The Department of Communications, Climate Action and the Environment (DCCAE) also notes that other supports may be available, such as grants and soft loans.

4.5 Conclusions

A variety of incentives have been introduced in Ireland to promote investment in low-carbon and resource-efficient assets and technologies by citizens. In many cases, however, there is a lack of data available on these schemes. Comprehensive *ex post* evaluations are the exception rather than the rule, and even when they have been undertaken, the focus is generally on environmental effectiveness and economic efficiency. They seldom consider other factors proposed by IPCC (e.g. administrative feasibility and distributional issues). In some cases, such as the Bike to Work Scheme, it might be beneficial to require employers to notify Revenue when a scheme is being used in order to improve data availability and to enable assessment of the scheme's effectiveness.

In many ways, Ireland's experiences with these incentives mirrors international experience (see Chapters 2 and 3). Grants appear to have been effective in mobilising investment from citizen investors in new LCTs. The exception is the grant for EVs, illustrating the prevalence of multiple (network or technological) barriers in addition to high upfront investment costs. Grants can, in some cases, also be cost-effective for the exchequer and for society, but they are subject to challenges, such as annual funding allocations from the exchequer, which in turn can

Table 4.5. Summary assessment of Irish FiT

Initiative	Type	Target	Effectiveness	Efficiency	Administration	Distributional Impacts
REFIT	FiT	Corporate/ individual and some community	Mobilised substantial investment in wind, mostly from corporate and professional project developers rather than from individuals or community groups	Economic evaluations find positive effects for electricity prices, GDP and employment	Administrative burden of assessing and approving contracts	No negative distributional implications as lower electricity prices offset PSO Considerable community mobilisation against roll-out of wind energy in local communities

lead to boom–bust investment cycles and make the formation of a sustainable market challenging. When programmes (such as the Greener Homes Scheme) have been discontinued, there is little evidence that they have achieved their longer term objectives of creating sustainable markets. Grants also tend to be challenging from an administrative perspective and can favour wealthier cohorts in society, although this seems not to have been the case with the Home Energy Savings Scheme. Furthermore, schemes such as the Home Energy Saving Scheme appear to have an element of path dependency, with only incremental modifications to the original design having occurred over the following decade.

Tax incentives that have been introduced (in particular the Bike to Work Scheme, changes to motor taxes and the plastic bag levy) have been highly effective in modifying consumer behaviour. The Enterprise Investment Scheme has also been effective in mobilising investment from high net worth individuals in low-carbon and resource-efficient sectors. These tax incentive schemes have been favourable to grant schemes in two respects: they do not necessarily require annual budget allocations from the exchequer (and can be extended for pre-agreed periods of time); and they tend to be considerably easier to administer and to access than grants (where a complex application procedure is generally required). The Bike to Work Scheme was designed in a user-friendly manner and has low barriers to entry, from both an employee and an employer perspective.

The downsides of tax schemes are that predicting the impact *ex ante* can be challenging and they can, to some extent, become victims of their own successes. For example, the VRT/motor tax changes that were introduced led to a rapid change in car-purchasing behaviour and had some impact on government revenues; however, the negative impacts arose mostly from exogenous factors. It appears, furthermore, that, compared with grant schemes, there have been fewer (public) evaluations of tax incentive schemes undertaken, perhaps because funding is not perceived as coming directly from exchequer sources per se.

Finally, the design of the FiT illustrates that, if citizens and community investors are not specifically considered in instrument design, the incentive will favour professional project developers. The latter have the skills, expertise, experience and balance sheets to get projects over the line and can balance (early-stage) risks over a portfolio of projects in a way that is not possible for community and citizen investors. In fact, these early-stage project risks are best considered a discrete barrier affecting community investors (Chapter 3), and the Irish experience suggests that the central (FiT) incentive needs to be supported by early-stage project supports such as grants or provision of information and advice (Chapter 3) if galvanising citizen and community investors is a policy priority.

5 A Survey of Irish Citizen Investors

5.1 Introduction

Governments, both internationally and in Ireland, have trialled a number of approaches to mobilise local citizens as investors, covering, among other things:

- grants for specific projects;
- tax incentives and tax breaks for investment;
- FiT, FiPs and quota-based schemes with mandatory financial participation criteria for local citizens; and
- soft loans for investors (Chapters 2 and 3).

In addition to these financial incentives, a number of new approaches such as crowdfunding and the purchasing of debentures through a regulated investment platform are opening up new investment options for local citizens.

These approaches to promoting citizen financial participation have advantages and disadvantages, and vary in their effectiveness depending on the local context, the technology, the type of investor and the maturity of the market for local citizen investment (Curtin *et al.*, 2016). Furthermore, it is an open question in the literature if the successes achieved in countries such as Denmark and Germany can be replicated in other countries. As discussed in Chapter 1, some studies (Dewald and Truffer, 2011; Romero-Rubio and de Andrés Díaz, 2015) identify context-specific enabling factors in countries such as Germany, which suggests that their experiences might not be transferable to other contexts.

Within this context, Ireland is an interesting case. Wind energy has expanded rapidly, but, in contrast to Germany and Denmark, investment has been driven by utilities and professional project developers. Furthermore, there are no examples of citizen investment in biomass, waste or solar technologies. This may have affected societal buy-in and has resulted in a greater emphasis on mobilising citizen and community investment in the 2014 Energy White Paper (Chapter 1).

Given the lack of experience of Irish citizens as investors in these technologies, however, there is an absence of data to support the proposition that local citizens are interested in becoming investors in LCTs. Some professional project developers have argued that Irish citizens are different from their European counterparts in this respect.[7] It is unclear if there would be an appetite for investment in low-carbon and resource-efficient technologies, and if so what financial factors and investment attributes would be important for potential citizen investors. Furthermore, it is unclear what key barriers to investment exist. To fill these research gaps, we undertook a survey of citizen investment in low-carbon and resource-efficient technologies.

In this chapter, we present preliminary findings from this survey. Full findings will be published in an academic journal article in due course. We first explain the methodology for the survey. We next present an overview of key findings and an assessment of barriers to investment. We then present preliminary data on the results of our choice experiment, which provides insights into what investment attributes and levels are important for Irish citizen investors (see section 5.3). Finally, in the conclusions section we assess implications for the design of government interventions.

5.2 Survey Design

To explore citizen investors' preferences for investing in renewable energy projects, we undertook a survey of Irish citizens using adaptive choice-based conjoint analysis (ACBC). This involves offering respondents (who indicated a willingness to consider investing) realistic, though hypothetical, choices between investments with different attributes in a real-time environment, with the objective of deriving their utility function.

Because conjoint approaches are often used to investigate preferences for product attributes in immature markets, they are ideal for our purposes.

7 Personal communications with a representative sample of professional developers on a confidential basis.

Unlike Germany or Denmark, citizen investment in renewables is an immature market in Ireland with very limited awareness or opportunities to invest. Moreover, conjoint analysis has been applied to a variety of research fields, including the general investment decision literature and the renewable investment literature (Salm *et al.*, 2016).

To inform survey design, we undertook a literature review and six semi-structured stakeholder interviews with key experts between September 2016 and December 2016. The objective of the interviews was to identify relevant technologies and key potential investment attributes in the Irish market and possible levels of these attributes. Interviewees included professional project developers, financial sector professionals, advisors to community energy projects, energy utilities and government officials.

We identified six investment attributes in total. In the case of five of these, three levels of these attributes were identified (Table 5.1), based on the typical current characteristics of future potential characteristics of investment opportunities in the Irish market. In the case of return on investment, this was treated as a continuous pricing attribute, so that a large number of unique prices were shown to respondents between 2% and 9%.

The survey was structured as follows: all respondents were asked if they were interested in investing in renewables "if their ideal investment criteria were met". If respondents indicated that they were not willing to consider investing ("no" to the first question), they were forwarded immediately to the end of the survey where they were asked to identify key barriers to investment and to provide socio-demographic data.

If they answered "yes" or "maybe", they were asked how much they would be willing to invest and were then directed to the choice experiment. The choice experiment itself was made up of a number of parts. First, participants were required to "build your own" (BYO) preferred investment by choosing from one of the attribute levels in each attribute (this section excluded return on investment and risk, as respondents were expected to prefer high returns and low risk). Second, the survey continued with a screening task section. In this part of the survey, respondents evaluated four investment options at the same time, with different attributes, and were required to indicate if they were suitable or not (Figure 5.1).

Respondents were offered 24 choices in total (six windows) in which the options were presented, which revolved around the BYO with one or two variations each time. Respondents' choices were used to determine if non-compensatory rules were being applied to make investment choices, e.g. where an attribute level is unacceptable and cannot be compensated by an increase in another desirable attribute level. Finally, in the last part of the survey,

Table 5.1. Attributes and levels

Attribute	Level
Return on investment	Between 2% and 9%
Technology	Onshore wind
	Solar electricity
	Biomass (heat and renewable gas generated from wood, manure and other organic materials)
Partner	A community group (such as a co-operative)
	A private sector company
	A public sector company
Minimum holding period	2 years
	5 years
	10 years
Risk of losing investment capital	No risk (0% risk)
	Low risk (less than 10% risk)
	Moderate risk (between 10% and 25% risk)
Location	In your local area
	In your county
	Anywhere in Ireland

Return on Investment	2%	4%	7%	8%
Renewable technology	Solar electricity	Solar electricity	Solar electricity	Biomass(wood)
Project Partner	Community group	Public sector company	Private sector project developer	Private sector project developer
Location	My local area	Anywhere in Ireland	My county	Anywhere in Ireland
Minimum holding period	5 years	2 years	5 years	2 years
Risk of losing some of your investment	Moderate risk	No risk	No risk	Low risk
	A possibility Won't work for me	A possibility Won't work for me	A possibility Won't work for me	A possibility Won't work for me

Figure 5.1. Example of choice task.

the "choice tournament", respondents were asked to choose between one of three competing investment options (defined according to specific attribute levels). This part of the survey was focused on exploring the remaining differences in the investment opportunities that had been identified. This allowed a better estimation of zero-centred utilities for the attribute levels of lower tier important attributes. Following this choice tournament, respondents were directed to a section on barriers, before finally providing socio-demographic data.

In addition to data on what types of investments might be of interest to citizen investors, the survey design allowed us to gather information on what key barriers to investment existed for cohorts that were willing to consider investing and those who were not.

5.3 High-level Findings

A total of 1680 survey respondents were recruited from an Irish-based data access panel, and the survey was administered in January 2017. Of the total, 400 did not complete the full survey and these respondents' answers were therefore not considered in the analysis.

As described, respondents were first asked if they would be willing to invest in a renewable energy project given an attractive investment opportunity where their "ideal investment criteria are met". Only those who answered "yes" or "maybe" proceeded to the choice experiment part of the survey. We asked our data panel provider to provide us with 1000 complete choice experiment respondents who were representative of the Irish population by age and gender. Survey participants were incrementally invited until 1000 respondents completed the choice experiment. Over this period, 280 respondents answered "no" to this first question and they completed the barriers question and provided socio-demographic data (Table 5.2). As can be seen in Table 5.2, there was a very high level of interest among citizens in investing in a renewable energy project, given its attractive investment profile.

Geographical location and proximity to renewables developments did not impact on "willingness to invest", nor were there marked differences in terms of age and gender (although the "willing to invest" cohort included more males and was slightly older). However, those who were willing to invest and those who were not willing to invest differed in some respects. We found that household income was higher in the "willing to invest" cohort. This suggests that access to investment capital is a determinant of interest in investing in renewables. This finding is reinforced by responses to the barriers question. In this section, respondents were asked to rank the importance of key barriers that would prevent them from investing in renewable energy projects. For both cohorts, financial factors ("insufficient savings" and "access to loan finance") were identified as key barriers. "Not enough savings" is particularly important for the "not willing to invest"

Table 5.2. Willingness to invest

Response	Number	Percentage	Status
Yes	515	40	Full survey including choice experiment
Maybe	485	38	Full survey including choice experiment
No	280	22	Screened out after providing socio-demographic information and answering the question on barriers
Total	1280	100	

cohort, and "opposition to renewable energy in your community" is conversely less important, perhaps suggesting the primacy of economic and financial considerations. Another difference is that the "willing to invest" cohort were significantly more likely to have some investment experience (nearly half having some or a lot of investment experience). By comparison, the vast majority of the "not willing to invest" cohort had no investment experience.

While smaller investment amounts (under €500) were very popular, nearly half of respondents said that they would be willing to invest over €2000, while only 23% of the willing to invest cohort were willing to consider investment amounts of up to €10,000, or above, as shown in Figure 5.2.

To put this in context, according to SEAI, typical wind farms costs are in the region of €1.6–€2 million per MW. Hence, the cost of a 10 MW wind farm (which is small by Irish standards) is approximately €16 million. Debt finance of 75% of total cost is generally available at financial close from a bank and the equity requirement is therefore in the region of €4 million. With 200 community investors, that amounts to €20,000 each. Pre-financial close development costs average 8.6% of the total, or €1.38 million (€6880 each with 200 people), all of which is at risk before one knows if the project is viable.

These numbers suggest that, for smaller projects, full community ownership could be an option. For the vast majority of wind projects in Ireland (which are generally greater than 10 MW), financial participation from professional project developers is necessary.

5.4 Importance of Investment Attributes and Levels

We then measured the importance of the different characteristics of the investment options on citizen investors' choices. Importance scores are calculated by examining how much difference each characteristic of the investment options contributes to the overall utility of an investment option. Importance scores are standardised to sum to 100% across all attributes. We found that financial characteristics such as return on investment, risk and the holding period are very important considerations for investors, compared with

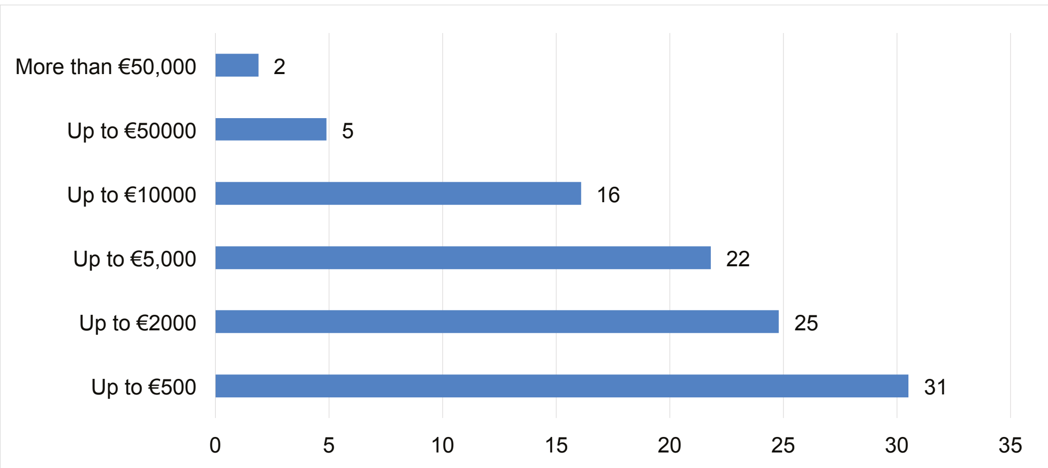

Figure 5.2. Investment amount (percentage willing to invest cohort).

the type of renewable technology, project partner and location of the investment.

This finding is also reflected in part-worth utilities. These reflect the relative desirability of an attribute level compared with other levels within the same attribute. The higher a utility, the more positively the specific attribute level influences decision-makers to opt for a certain investment. Again, the financial characteristics of an investment emerged as very important. High (8.75%) return on investment was very strongly favoured compared with low (1.25%) returns. “No risk” projects were very highly favoured compared with “moderate risk” projects and short (2-year) minimum holding periods were also strongly favoured compared with long (10-year) periods. To a lesser degree, citizen investors preferred solar to biomass (with wind in the middle) and they preferred projects closer to their home. They also had a slight preference for community-led projects in their area, compared with projects led by energy utilities and professional project developers.

5.5 Conclusions

It is clear from a preliminary analysis of our survey results that there is a willingness on behalf of many private citizens to consider investing in renewable energy projects. This is particularly the case among wealthier cohorts in society with some experience of making investment decisions. While over 30% of those willing to consider investing would invest no more than €500, nearly half would be willing to invest a substantial sum of over €2000. The key barriers for all cohorts are financial: not enough savings and no access to loan finance, but this is particularly the case for those who are not willing to invest.

The importance of financial considerations also emerges from the choice-based experiment, in which financial characteristics of investments (especially return on investment, but also risk and holding period) emerge as the key factors. While citizens tend to prefer solar projects led by community groups in their locality, these investment attributes have less importance for citizen investors compared with financial considerations.

6 Conclusions and Recommendations

6.1 Introduction

In previous chapters, we presented the findings from the work packages of the projects. These covered, in turn, a literature review, case studies, analysis of the use of financial incentives in Ireland and a survey of Irish citizens' investment preferences. These chapters form the basis for evidence-based recommendations for the design of financial incentives in Ireland, with the objective of mobilising citizen investment. In the final chapter, we synthesise key overall policy conclusions and make recommendations for the design of financial incentives.

6.2 Conclusions on Designing Financial Incentives

Drawing definitive conclusions on the choice and design of incentives is made challenging by the absence of comprehensive evaluations of programmes and schemes that have been introduced. The literature review, case studies and our evaluation of Irish incentives programmes illustrate that *ex post* evaluations are not common. In some cases, no data on take-up of schemes are available. Even when evaluations have been undertaken they tend not to be systematic or consistent. In particular, distributional implications and institutional, administrative and governance factors tend not to be considered. Overall, there is a need to come to a greater understanding of the implications of using particular financial incentives. Potential downsides of using these incentives require careful monitoring so that social legitimacy is enhanced and not undermined.

Notwithstanding this caveat, it is clear that mobilising citizens as investors would have clear advantages: it would tap new sources of private capital, while also engendering greater levels of societal support for transition to a low-carbon economy. This would address two of the most prevalent barriers to such transition in Ireland and globally. Furthermore, it is clear that Irish citizens are interested in investing in low-carbon and resource-efficient assets. We conclude from the results of our survey of Irish citizens that financial participation could be achieved if investment options offering reasonable rates of return and low levels of risk were available. This is particularly the case among wealthier cohorts in society with some experience of making investment decisions. The key barriers for all cohorts are financial: not enough savings and no access to loan finance.

Within this context, setting a target for locally owned renewable energy sources would act to provide regulatory stability and underpin government intentions to promote energy citizenship, as outlined in the Energy White Paper (2014). Equivalent Scottish targets could be used as an example to guide policy development. In 2010, a target was set to deliver 500 MW of community energy by 2020, which was delivered 5 years early. In the most recent Scottish Energy Strategy (2017), a new target has been set to achieve 1 gigawatt (GW) of community and locally owned energy by 2020 and 2 GW by 2030 (Scottish Government, 2015).

Carefully designed financial incentives emerge as a potentially important means of mobilising citizen investment. The benefits of using incentives, however, need to be balanced against the cost to the taxpayer of using these instruments. On the one hand, incentives necessarily require exchequer revenue, and governments would argue that controlling the cost of low-carbon transition is important for delivering continued societal buy-in and value for money to taxpayers. On the other hand, local citizens often provide their time on a voluntary basis (Rijpens *et al*., 2013; IEA-RETD, 2016) and their involvement has been found to open up access to the optimal sites (for onshore wind or, for example, south-facing roof tops), thereby reducing cost (Nelson *et al*., 2016). Access to optimal locations for renewable projects is a particularly prevalent concern in Ireland, where many sites cannot be accessed because of local opposition. Should local opposition to onshore wind, biomass, waste-to-energy or solar plans prevent further project development, this would necessitate greater levels of offshore wind development if Irish decarbonisation objectives are to be met. This, in turn, would increase the overall cost of meeting climate objectives. While we would therefore conclude that there is a strong economic case for mobilising citizen investment in Ireland, answering this question definitively was not the intended objective of this research project. Assessing the net costs and benefits of mobilising citizen investment is an area that merits further analytical attention.

One consideration that needs to be examined by Irish policymakers is how community-owned or partly community-owned projects could be financed in the new Integrated Single Electricity Market (ISEM). The new market arrangements are designed to lead to greater price integration with other European electricity markets and lower prices. However, the market is moving away from a fixed FiT and towards six daily auctions, which will result in significant variation in the prices that generators receive for power. This market restructuring will present potential market barriers to community and citizen groups, as significant market knowledge and the capacity to trade electricity generated into the market will be required.

Costs to the exchequer can be controlled through careful choice and design of financial incentives. Within this context, we proceed to drawing specific conclusions and recommendations for the choice and design of financial incentives.

1. **Effectiveness of financial incentives:** FiTs, FiPs, quota schemes, grants and tax incentives can be effective in mobilising greater levels of investment from local citizens, while soft loans tend to be less effective as a stand-alone instrument.
2. **Instrument choice over design:** While there is a debate in the literature concerning which financial incentives are optimal when it comes to mobilising local citizen investors, we conclude that it is not instrument choice per se that is the key consideration, but rather the design characteristics of the chosen instrument. In many cases, financial incentives are not designed with local citizen investors in mind, and while the intention may not be to exclude these actors, this can be the ultimate effect. This is because citizen investors, unlike professional project developers and developers, do not have the skills, expertise, experience or balance sheets to successfully take projects to fruition. It is necessary, therefore, to include specific design features into FiTs, FiPs, quotas, grants and tax incentives to counteract these disadvantages and to make sure that incentives are accessible to non-traditional investors classes.
3. **FiTs compared with market-based schemes:** The introduction of a FiT is a crucial turning point and critical success factor in mobilising local citizen investors in many jurisdictions. A key characteristic of FiTs is that they provide a stable long-term income stream, and they therefore reduce risk and make it easier to access bank funding, which appears particularly important for local citizen actors (abrupt changes to FiT schemes have undermined regulatory stability and market confidence, which is particularly important for citizen investors). We would emphasise, however, that introducing a FiT is not a sufficient condition for success. In many countries, not least Ireland, FiTs have not resulted in investment from non-professional project developers. What has emerged, therefore, is the importance of specific design features. FiTs differentiated according to project size and technology type open up niche opportunities for local citizens, and adders, contract set-asides and mandates have been used to modify FiTs and make them more attractive to citizen investors.
4. **FiPs and quota-based schemes:** While market-based FiPs and quota-based schemes have sometimes been deemed inherently unattractive to citizen investors (because of the greater levels of uncertainty in terms of support they provide), we would again highlight the importance of instrument design. FiPs have been deployed successfully in Denmark (combined with a mandatory share offer for local citizens) and quota-based schemes have also been designed in a manner that is advantageous to local community groups in Ontario and elsewhere. We conclude, therefore, that market-based supports can be designed with citizen investors in mind, and note that this could be a particularly important finding within the context of the migration to this category of incentive within the EU (Ragwitz *et al*., 2012) and Ireland.
5. **Early-stage supports:** Our case studies reveal the importance of introducing financial incentives at both the early and the later stages of projects to establish a business case for local citizen participation. In particular, these cases reveal the

crucial importance of introducing incentives to overcome risks at the feasibility and development stages of projects. Professional developers can generally offset these risks by developing a portfolio of projects, but this option is not available to local citizens. The requirement for early-stage incentives is a distinguishing feature of projects with citizen involvement, and it appears central to the value proposition of many business models. Non-recourse loans, soft loans and grants have all been introduced to address barriers to local citizens at feasibility and development stages. It should be noted that setting out clear planning and grid access guidelines, the provision of advice, expertise and other types of support may also be crucial in this respect.

6. **Grants:** While grants, in particular, may be effective (and indeed cost-effective for the exchequer in some cases) at overcoming early-stage project costs and barriers, they also tend to be challenging and costly to administer and can favour wealthier cohorts in society. They are dependent on annual funding allocations from the exchequer, and changes in levels of support can lead to boom–bust investment cycles, which in turn can make the formation of a sustainable market challenging. In some cases, programmes can suffer from an element of path dependency. While grants no doubt therefore have an important role, their downsides need to be carefully considered and monitored.

7. **Preference shares:** Another option for dealing with early-stage project risk is for the project developer to grant preference shares to local citizen or community groups at the very early stages of project development. This would allow the local community to be part of the development without putting any capital at risk and, if the project does not proceed, the local citizen is not financially exposed. Once the project is operational, the preference shareholders will receive dividends (subject to covenants of senior lenders).

8. **Migrating to market-based incentives:** In all of the case studies, grants were initially used to promote citizen and community involvement. For example, in the UK, two grants programmes were introduced between 2000 (when promoting citizen investment first became a policy priority) and 2009. The objective was to promote pilot demonstration projects that serve a number of purposes. In these cases, grants may cover more than early-stage (feasibility and development) costs and may also cover or part-cover construction costs. They provide policy learning when they are monitored and assessed, promote awareness of opportunities across communities and provide best practice exemplars that can be replicated. These pilots paved the way for the introduction of a FiT with a community focus in 2009. Similarly, in Denmark and Germany, grants were initially used (in the 1970s and 1980s) to promote exemplar projects with citizen involvement. In all cases, grants have given way to increasingly market-based supports over time.

9. **Tax incentives:** While citizen investors may be motivated by a wide range of factors, in the majority of cases it is necessary to offer a strong business case for investing. While a high-level financial incentive (such as a FiT or FiP) is important for the provision of long-term financial support over time, the favourable tax treatment of income from renewable energy projects emerges as an important supplementary consideration. Indeed, the removal of various UK tax incentives in 2015 undermined the business case for many renewable energy projects with community participation. Another benefit of tax incentives is that they do not necessarily require annual budget allocations from the exchequer and they can be extended for pre-agreed periods of time; they also tend to be considerably easier to administer and to access than grants (for which a complex application procedure is generally required). The downside of tax schemes is that predicting the impact *ex ante* can be challenging.

10. **Ancillary considerations:** We find that incentives should generally be introduced as part of policy packages, with ancillary measures addressing lack of familiarity with the technology, technology immaturity or low awareness of the incentive programme itself. Furthermore, understanding the characteristics of the target demographic, and indeed the characteristics of the LCT in question, is also crucial. If these factors are not considered in policy design, an incentive programme may not have the desired or predicted impact and

the cost-effectiveness and/or environmental effectiveness may suffer.

11. **Concerted policy attention:** Countries that do not have a tradition of mobilising citizen investors (such as Ireland) will have particular challenges in mobilising investments from these actors. It takes time to raise awareness of the opportunities among community groups. This requires a combination of new policy support in the form of financial incentives, combined with up-skilling of communities and dissemination of awareness of new opportunities. The case of Ontario, for example, illustrates that, even when a very attractive set of specifically tailored financial incentive are introduced (a grant covering early-stage project costs, combined with a FiT and community adder), citizen investment may not automatically result. It was only in the second stage of the FiT in 2011 (when a mandatory set-aside was introduced for community projects) that community projects began to get over the line. This highlights the importance of providing persistent policy focus and having an ability to assess the effectiveness of programmes in real time, identify problems as they arise and having the flexibility to trial and pilot new approaches on an ongoing basis. Based on the experiences of other countries, in particular the UK and Ontario, it is probable that mobilising significant levels of community investment will take persistent policy focus over at least the next decade.

6.3 Conclusions on Business Models

Typical business models have emerged in many countries as vehicles for local citizen participation, in both developer- and community-led projects, and these have been strongly influenced by the design and choice of financial incentives. Governments have used mandates (Denmark), voluntary obligations (UK) or adders and minimum reserve requirements in FiTs and award criteria in tenders (Ontario) to encourage professional project developers to involve local communities as equity investors in projects. Specific models have been influenced by favourable tax treatment of profits in Germany, Denmark and Ontario. This suggests that financial incentives can be designed to promote the emergence of typical models, which in turn can reduce transaction, legal and professional costs, and promote the more widespread deployment distribution of cost-effective renewable energy technologies controlled by local citizens.

We present a typology of models for citizen financial participation in Table 6.1 based on the findings from our work packages. These include fully community-owned projects, projects led by a professional developer, and projects that do not involve investment/ownership. From the financial characteristics of these models, it is clear that each comes with attendant advantages and disadvantages from a developer and a community/citizen perspective.

While we do not make specific recommendations in terms of choice of model, we note that for community-owned projects, co-operatives tend to predominate in most countries. For developer-led models, while a number of options are common internationally, we note that shared revenue models offer a substantially de-risked opportunity for community investors and might therefore be particularly attractive within the context of our survey results, which indicate a high level of risk aversion on behalf of community investors. This model perhaps makes the least demands of community groups and allows them to substantially piggyback the skillset of professional developers, which could perhaps be an important consideration given the low levels of knowledge, awareness and financial expertise many communities have.

The joint venture model could also have applicability in Ireland. We note that a joint venture model could be combined with a Danish-type “option to purchase” scheme, which emerged as a popular model in research and a stakeholder consultation into community ownership previously undertaken (Tipperary Energy Agency, 2016). The basis of this option is that an obligation is placed on developers to offer investment shares to citizens within a pre-determined radius of the project. The authors suggest that shares of low value (e.g. €250) could be offered to citizens and held in a trust until financial close. Our citizen survey (see Chapter 5) illustrates that many (over 30%) of those willing to invest in a renewables project would only consider amounts less than €500; popularising models that can facilitate small investment amounts could therefore be of importance. While the amounts might be small from a funding prospective, enabling citizen investors to invest could play an important role in building societal support for

Table 6.1. Typology of models for citizen participation

Structure	Form of return	Timing of return	Risks	Security	Developer considerations	Community considerations
Models involving citizen investment/ownership						
Fully community-owned (e.g. co-operative)	Dividend if available	Annual dividend if available, but may be years before capital is repaid	Project risk Potential cash calls	Ranks behind bank debt and preference equity		Taxation of income Skills and expertise: is team bankable?
Joint venture	Variable	Variable, but usually senior debt would impose restrictive covenants on disbursement	Exposed to development risk pre-financial close Party to loan agreement	Usually have title over asset	Challenges of dealing with minority investor	Avail of developer expertise Drag and tag along and pre-emption provisions Risk of cash call
Split ownership	Variable	Variable, but usually senior debt would impose restrictive covenants on disbursement	Pools revenue from all turbines so reduces turbine-specific risk	Only have title to part of asset owned	Title to substation for grid connection? Important for EIIS relief If developer wants to sell or refinance could pose challenges	Avail of developer expertise Risk of cost inflation Does not qualify for tax relief
Shared revenue	Community group provide percentage of project cost in return for share of profits	Variable – annual disbursements Capital returned at end of project Senior debt imposes restrictive covenants on disbursement	Project risk, but eliminates development risk	Community do not own a physical asset	Challenges of dealing with minority investor	Avail of developer expertise
Crowdfunding/ debt-based funding	Can be fixed coupon on debt	Variable – usually fixed and usually clear exit	Project risk	Usually ranks ahead of equity but after senior debt	Retain control	Small minimum investment – can be as low as €5 Liquid secondary market
Models not involving citizen investment/ownership						
Lease agreement	Fixed circa 2% of revenue	Annual	None	Ranks ahead of bank debt for repayment	Retains full ownership and control	No ownership Only landowners can benefit
Community benefit	€/MW pa guaranteed	Annual	None	Do not need any	Retains full ownership and control	No ownership Fixed return Specific benefits for near neighbours can be provided

LCTs and opening up investment opportunities to all socio-economic cohorts.

6.4 Proposal for Design of Irish Financial Incentives

Finally, we consider options for the introduction of financial incentives in Ireland. Our recommendations for the design of a specific financial incentive acknowledge, as a starting point, the lack of experience and understanding in Irish communities and among Irish citizens of the opportunities to develop collective projects in these areas. They also acknowledge the need to promote greater knowledge and awareness of the opportunities that exist (Chapters 1 and 5), particularly in collective wind, biomass, waste-to-energy and solar projects. In order to mobilise Irish citizen investment in renewable projects, we conclude that incentives will need to address specific barriers at different project stages (Table 6.2).

Our research indicates that, initially, there may be a need to promote the emergence of exemplar pilot community-led projects, and this will generally require grant funding. When the intention is to pilot new approaches, grants may cover feasibility and development costs but also a proportion of construction costs (see Chapter 3). Therefore, there may initially be a case for the introduction of a time-bound grant programme. It should be emphasised that this applies only to projects that are community led. To ensure regulatory stability it is crucial that all grant-based pilot projects are subject to close monitoring and evaluation so that these projects can inform future policy development.

The intention should be to migrate to a more market-driven approach over time and away from grants for community-led projects. In the medium term, grants covering some or all of construction costs can be replaced with a project- and technology-differentiated FiT (with a maximum project threshold in the region of 5–10 MW), combined with non-recourse loans or grants covering early-stage (feasibility and development) costs, as in Scotland and England. As discussed in section 6.2, it is not the choice between these instruments that is most important, but rather the design components that ensure equal access to community groups and citizens, within the context of their skills, experiences and financial circumstances.

For developer-led projects, there may be a need for the market-based incentive programme (FiP or quota-based scheme) to be designed to favour equity participation from community groups. In the case of a FiP, this could come in the form of a mandate requiring a share offer to local citizens (as in Denmark), or in the case of a quota scheme, the award criteria could favour higher levels of equity participation from local communities and citizens (Ontario).

In the case of both developer- and community-led projects, the business case for citizen participation can be aided by favourable tax treatment of profits from these projects.

It should be noted that in this report we consider only the use of financial incentives. Comprehensive policy packages may include ancillary measures addressing lack of familiarity with the technology, technology immaturity, low awareness of the incentive programme itself or ensureing grid access. Local citizens will generally require access to technical expertise if they are successful in bringing the project to fruition. Informational, advisory and support services are best provided through an independent and trusted intermediary that has linkages with local communities, such as the Sustainable Development Authority of Ireland, local community development committees and credit unions, among other actors.

Finally, in this study we only considered options for mobilising community and local citizen investment. However, our survey results indicate that not all citizens have funds available or are interested in investing. It is likely, therefore, that enhanced community benefit schemes for neighbours or near-neighbours may also be required in some cases. This could take the form of subsidised electricity bills or a straightforward payment per MW for local citizen and community groups. For example, the NTR Ora More Wind Farm Local Electricity Discount Scheme might be used as a template.

Table 6.2. Financial incentives to promote citizen investment in low-carbon projects

Incentive	Community-led projects	Developer-led projects
Phase 1	Time-bound grant programme covering early-stage and some construction costs	FiP with mandate for community participation or quota-based scheme with favourable award criteria for projects with community equity participation
Phase 2	Differentiated FiT with grants or non-recourse loans for early-stage project costs	

References

Allcott, H., 2011. Social norms and energy conservation. *Journal of Public Economics* 95: 1082–1095.

Barradale, M.J., 2014. Investment under uncertain climate policy: a practitioners perspective on carbon risk. *Energy Policy* 69: 520–535.

Bauwens, T., Gotchev, B. and Holstenkamp, L., 2016. What drives the development of community energy in Europe? The case of wind power cooperatives. *Energy Research & Social Science* 13: 136–147.

Bergek, A. and Berggren, C., 2014. The impact of environmental policy instruments on innovation: a review of energy and automotive industry studies. *New Climate Economics* 106: 112–123.

Bergek, A., Mignon, I. and Sundberg, G., 2013. Who invests in renewable electricity production? Empirical evidence and suggestions for further research. *Energy Policy* 56: 568–581.

Bergman, N. and Eyre, N., 2011. What role for microgeneration in a shift to a low carbon domestic energy sector in the UK? *Energy Efficiency* 4(3): 335–353.

Black, G., Holley, D., Solan, D. and Bergloff, M., 2014. Fiscal and economic impacts of state incentives for wind energy development in the Western United States. *Renewable and Sustainable Energy Reviews* 34: 136–144.

BMWi (German Federal Ministry for Economic Affairs and Energy), 2016. Zeitreihen zur Entwicklung der erneuerbaren Energien in Deutschland. BMWi, Dessau-Roßlau.

Bobinaite, V. and Tarvydas, D., 2014. Financing instruments and channels for the increasing production and consumption of renewable energy: Lithuanian case. *Renewable and Sustainable Energy Reviews* 38: 259–276.

Bolinger, M., 2001. Community wind power ownership schemes in Europe and their relevance to the United States. Lawrence Berkeley National Laboratory, Berkley, CA.

Bolinger, M., 2005. Making European-style community wind power development work in the US. *Renewable and Sustainable Energy Reviews* 9(6): 556–575.

Bolton, R. and Foxon, T.J., 2015. A socio-technical perspective on low carbon investment challenges – insights for UK energy policy. *Environmental Innovation and Societal Transitions* 14: 165–181.

Boon, F.P. and Dieperink, C., 2014. Local civil society based renewable energy organisations in the Netherlands: exploring the factors that stimulate their emergence and development. *Energy Policy* 69: 297–307.

Borchert, L., 2015. *Citizens' Participation in the Energiewende*. Clean Energy Wire, Berlin.

Breukers, S. and Wolsink, M., 2007. Wind power implementation in changing institutional landscapes: an international comparison. *Energy Policy* 35: 2737–2750.

Butler, L. and Neuhoff, K., 2008. Comparison of feed-in tariff, quota and auction mechanisms to support wind power development. *Renewable Energy* 33(8): 1854–1867.

Cameron, L., 2011. *Feed-in Tariffs: Accelerating Renewable Energy Projects Development in Ontario*. MaRS Discovery District, Toronto, ON.

Cansino, J.M., del P. Pablo-Romero, M., Román, R. and Yñiguez, R., 2010. Tax incentives to promote green electricity: an overview of EU-27 countries. *Energy Policy* 38: 6000–6008.

Cansino, J.M., del P. Pablo-Romero, M., Román, R. and Yñiguez, R., 2011. Promoting renewable energy sources for heating and cooling in EU-27 countries. *Energy Policy* 39: 3803–3812.

Carpenter, P., 2014. Community Renewable Energy: Potential Sector Growth to 2020. Department of Energy and Climate Change, London.

CEC (Communiy Energy Coalition), 2015. The community energy revolution pushes on in face of storm clouds. Available online: http://www.ukcec.org/community-energy-revolution-pushes-face-storm-clouds (accessed 22 April 2016).

CEE (Community Energy England), 2015. Removal of tax reliefs from community energy. Available online: http://communityenergyengland.org/policy/investment/ (accessed 23 April 2016).

Chandrasekar, B. and Kandpal, T.C., 2005. Effect of financial and fiscal incentives on the effective capital cost of solar energy technologies to the user. ISES Solar World Congress 2003. *Solar Energy* 78: 147–156.

Chang, K.-C., Lin, W.-M., Lee, T.-S. and Chung, K.-M., 2011. Subsidy programs on diffusion of solar water heaters: Taiwan's experience. *Energy Policy* 39: 563–567.

Chesbrough, H., 2010. Business model innovation: opportunities and barriers. *Long Range Planning* 43: 354–363.

Claudy, M.C., Michelsen, C., O'Driscoll, A. and Mullen, M.R., 2010. Consumer awareness in the adoption of microgeneration technologies: an empirical investigation in the Republic of Ireland. *Renewable and Sustainable Energy Reviews* 14: 2154–2160.

Coad, A., de Haan, P. and Woersdorfer, J.S., 2009. Consumer support for environmental policies: an application to purchases of green cars. *Ecological Economics* 68: 2078–2086.

Colonial, F., 2013. What investors want: F&C Management Limited. Paper presented at the British Institute of Energy Economics (BIEE) Conference, Financing the Energy Transition, BIS Conference Centre, London.

Costa, D.L., and Kahn, M.E., 2013. Energy conservation "nudges" and environmentalist ideology: evidence from a randomized residential electricity field experiment. *Journal of the European Economic Association* 11: 680–702.

Couture, T. and Gagnon, Y., 2010. An analysis of feed-in tariff remuneration models: implications for renewable energy investment. *Energy Policy* 38: 955–965.

Curtin, J., 2009. Jobs, Growth and Reduced Energy Costs: Greenprint for a National Energy Efficiency Retrofit Programme. Institute of International and European Affairs, Dublin.

Curtin, J., 2013. From Grants to Finance: How to Unlock Home Retrofit Investment. Public Policy, Dublin.

Curtin, J., 2016. How much of Ireland's "fiscal space" will climate inaction consume? Available online: http://www.iiea.com/blogosphere/how-much-of-irelands-fiscal-space-will-climate-inaction-consume (accessed 15 March 2016).

Curtin, J. and Maguire, J., 2011. Thinking Deeper: Financing Options for Home Retrofit. Institute of International and European Affairs, Dublin.

Curtin, J., McInerney, C. and Ó Gallachóir, B., 2016. Financial incentives to mobilise local citizens as investors in low-carbon technologies: a systematic literature review. *Renewable and Sustainable Energy Reviews* 75: 534–547.

Danish Energy Agency, 2012. *Danish Energy Policy Report*. Danish Energy Agency, Copenhagen.

Danish Energy Agency, 2014. *Energy in Denmark 2014*. Danish Energy Agency, Copenhagen.

Danmarks Vindmølleforening, 2009. *Cooperatives – A Local and Democratic Ownership to Wind Turbines*. Danmarks Vindmølleforening, Aarhus.

DCENR (Department of Communications, Energy and Natural Resources), 2015. *Ireland's Transition to a Low Carbon Energy Future 2015–2030*. DCENR, Dublin.

de la Rue du Can, S., Leventis, G., Phadke, A. and Gopal, A., 2014. Design of incentive programs for accelerating penetration of energy-efficient appliances. *Energy Policy* 72: 56–66.

De Serres, A., Murtin, F. and Nicoletti, G., 2010. *A Framework for Assessing Green Growth Policies (1815–1973)*. Organisation for Economic Co-operation and Development, Paris.

Debor, S., 2014. *The Socio-Economic Power of Renewable Energy Production Cooperatives in Germany*. Wuppertal Institute, Wuppertal.

DECC (Department of Energy and Climate Change), 2011. New Feed-in Tariff levels for large-scale solar and anaerobic digestion announcecedd today. Gov.uk, 9 June 2011. Available online: https://www.gov.uk/government/news/new-feed-in-tariff-levels-for-large-scale-solar-and-anaerobic-digestion-announcecd-today (accessed 22 April 2016).

DECC (Department of Energy and Climate Change), 2012. *Low Carbon Communities Challenge Evaluation Report*. DECC, London.

DECC (Department of Energy and Climate Change), 2014. *Community Energy Strategy: Full Report*. DECC, London.

DECC (Department of Energy and Climate Change), 2015a. *Government Response to the Consultation on Support for Community Energy Projects under the Feed-in-Tariffs Scheme*. DECC, London.

DECC (Department of Energy and Climate Change), 2015b. *Digest of United Kingdom Energy Statistics 2015*. DECC, London.

DECC (Department of Energy and Climate Change), 2015c. *Government Response to the Shared Ownerhip Taskforce*. DECC, London.

DECC (Department of Energy and Climate Change), 2015d. Electricity Market Reform: Contracts for Difference. DECC, London. Available online: https://www.gov.uk/government/collections/electricity-market-reform-contracts-for-difference (accessed 15 May 2016).

DECLG (Department of the Environment, Community and Local Government), 2014. Litter Monitoring Body System Results 2014. DECLG, Dublin. Available online: http://www.litter.ie/Reports/System%20Results%20Report%202014.pdf (accessed 12 March 2017).

del Río, P. and Bleda, M., 2012. Comparing the innovation effects of support schemes for renewable electricity technologies: a function of innovation approach. *Energy Policy* 50: 272–282.

Delmas, M.A. and Montes-Sancho, M.J., 2011. U.S. state policies for renewable energy: context and effectiveness. *Energy Policy* 39: 2273–2288.

Department of Finance, 2014. *Review of the Employment and Investment Incentive and Seed Capital Schem*e. Available online: http://www.finance.gov.ie/sites/default/files/EII_Report_finalrev.pdf (accessed 12 March 2017).

Department of Finance, 2015. *Tax Strategy Group Report*. Available online: http://www.finance.gov.ie/sites/default/files/TSG%2015%2006%20Energy%20and%20Environmental%20Taxes%20and%20Vehicle%20Registration%20Tax.pdf (accessed 12 March 2017).

Devine-Wright, P., 2005. Beyond NIMBYism: towards an integrated framework for understanding public perceptions of wind energy. *Wind Energy* 8(2): 125–139.

Devine-Wright, P., 2014. Renewable Energy and the Public: From NIMBY to Participation. Routledge, London.

Dewald, U. and Truffer, B., 2011. Market formation in technological innovation systems – diffusion of photovoltaic applications in Germany. *Industry and Innovation* 18(3): 285–300.

Dobbyn, J. and Thomas, G., 2005. *Seeing the Light: The Impact of Microgeneration on the Way We Use Energy*. Sustainable Development Commission, London.

Dóci, G. Vasileiadou, E. and Petersen, A.C., 2015. Exploring the transition potential of renewable energy communities. *Futures* 66: 85–95.

Doherty, R. and O'Malley, M., 2011. The efficiency of Ireland's Renewable Energy Feed-In Tariff (REFIT) for wind generation. *Energy Policy* 39: 4911–4919.

Dowson, M., Poole, A., Harrison, D. and Susman, G., 2012. Domestic UK retrofit challenge: barriers, incentives and current performance leading into the Green Deal. *Energy Policy* 50: 294–305.

Dublin City Council, 2016. Data Portal. Available: http://www.dublincity.ie/main-menu-services-roads-and-traffic-traffic-dublin/traffic-cordon-count (accessed 12 July 2017).

Dusonchet, L. and Telaretti, E., 2010. Economic analysis of different supporting policies for the production of electrical energy by solar photovoltaics in western European Union countries. *Energy Policy* 38: 3297–3308.

EC (European Commission), 2017. Renewable Energy Progress Report. COM(2017) 57 final. Available online: https://ec.europa.eu/transparency/regdoc/rep/1/2017/EN/COM-2017-57-F1-EN-MAIN-PART-1.PDF (accessed 20 June 2017).

EEA (European Environment Agency), 2016. Reported CO2 emissions from new cars continue to fall. EEA. Copenhagen. Available online: http://www.eea.europa.eu/highlights/reported-co2-emissions-from-new (accessed 12 March 2017).

Egbue, O. and Long, S., 2012. Barriers to widespread adoption of electric vehicles: an analysis of consumer attitudes and perceptions. *Energy Policy* 48: 717–729.

Eisenhardt, K.M., 1989. Building theories from case study research. *Academy of Management Review* 14(4): 532–550.

Eleftheriadis, I.M. and Anagnostopoulou, E.G., 2015. Identifying barriers in the diffusion of renewable energy sources. *Energy Policy* 80: 153–164.

Energienet, 2015. Electricity Generation in 2014. Available online: http://www.energinet.dk/EN/KLIMA-OG-MILJOE/Miljoerapportering/Elproduktion-i-Danmark/Sider/Elproduktion-i-Danmark.aspx (accessed 22 April 2016).

Energienet DK, 2016. *Electricity Generation*. Danish Ministry of Climate and Energy, Copenhagen.

Engelken, M., Römer, B., Drescher, M., Welpe, I.M. and Picot, A., 2016. Comparing drivers, barriers, and opportunities of business models for renewable energies: a review. *Renewable and Sustainable Energy Reviews* 60: 795–809.

Enzensberger, N., Fichtner, W. and Rentz, O., 2003. Evolution of local citizen participation schemes in the German wind market. *International Journal of Global Energy Issue* 20(2): 191–207.

ESRI, 2011. *Greener Homes: An Ex-Post Estimate of the Cost of Carbon Dioxide Emission Reduction using Administrative Micro-Data from the Republic of Ireland*. Available online: https://www.esri.ie/publications/greener-homes-an-ex-post-estimate-of-the-cost-of-carbon-dioxide-emission-reduction-using-administrative-micro-data-from-the-republic-of-ireland/ (accessed 12 March 2017).

Feurtey, E., Ilinca, A., Sakout, A. and Saucier, C., 2015. Lessons learned in France and Québec regarding financial and legal mechanisms to develop renewable energy: a hybrid model as an acceptable solution for onshore wind?*, Renewable and Sustainable Energy Reviews* 47: 34–45.

Fouquet, D. and Johansson, T.B., 2008. European renewable energy policy at crossroads – focus on electricity support mechanisms. *Energy Policy* 36(11): 4079–4092.

Fraune, C., 2015. Gender matters: women, renewable energy, and citizen participation in Germany. *Energy Research & Social Science* 7: 55–65.

Frederiks, E.R., Stenner, K. and Hobman, E.V., 2015. Household energy use: applying behavioural economics to understand consumer decision-making and behaviour. *Renewable and Sustainable Energy Reviews* 41: 1385–1394.

Gotchev, B., 2015. Market Integration and the Development of Win Power Cooperatives in Denmark: Lessons for Germany. Institute for Advanced Sustainability Studies, Potsdam.

Government of Ontario, 2016. Letter from the Minister of Energy. Available online: https://ieso-public.sharepoint.com/Documents/Ministerial-Directives/FIT-4-Minister-Direction-June-24-2015.pdf

Government of Québec, 2016. *Energy in Quebec*. Available online: https://politiqueenergetique.gouv.qc.ca/wp-content/uploads/Energy-Policy-2030.pdf (accessed 20 July 2016)

Greenberg, M., 2009. Energy sources, public policy, and public preferences: analysis of US national and site-specific data. *Energy Policy* 37: 3242–3249.

Haigh, M., 2011. Climate policy and financial institutions. *Climate policy* 11: 1367–1385.

Heiskanen, E., Johnson, M., Robinson, S., Vadovics, E. and Saastamoinen, M., 2010. Low-carbon communities as a context for individual behavioural change. Special Section: Carbon Reduction at Community Scale. *Energy Policy* 38: 7586–7595.

Hellström, M., Tsvetkova, A., Gustafsson, M. and Wikström, K., 2015. Collaboration mechanisms for business models in distributed energy ecosystems. *Journal of Cleaner Production* 102: 226–236.

Hoffman, S.M. and High-Pippert, A., 2010. From private lives to collective action: recruitment and participation incentives for a community energy program. Special Section: Carbon Reduction at Community Scale. *Energy Policy* 38: 7567–7574.

Holstenkamp, L. and Müller, J.R., 2013. Zum Stand von Energiegenossenschaften in Deutschland: ein statischer Überblick zu 31.12.2012. Working Paper Series in Business and Law 14. Leuphana University of Lüneburg, Lüneberg.

Hough, D. and White, E., 2014. The Green Deal. House of Commons Library Standard Note SN/SC/5763. House of Lords, London.

Huber, C., Ryan, L., Ó Gallachóir, B., Resch, G., Polaski, K. and Bazilian, M., 2007. Economic modelling of price support mechanisms for renewable energy: case study on Ireland. *Energy Policy* 35: 1172–1185.

IBBA (Irish Bicycle Business Association), 2011. *Report on the cycle to work scheme tax incentive*. Available online: http://www.ibba.ie/IBBA_Report.pdf (accessed 12 March 2017).

IEA (International Energy Agency), 2003. *Creating Markets for Energy Technologies*. IEA, Paris.

IEA (International Energy Agency), 2014. *World Energy Outlook*. IEA, Paris.

IEA (International Energy Agency), 2015. *Energy Technology Perspectices: Mobilising Innovation to Accelerate Climate Action*. IEA, Paris.

IEA (International Energy Agency), 2016. IEA/IRENA joint policies and measures database: wind energy co-operative tax incentive. Available online: http://www.iea.org/policiesandmeasures/pams/denmark/name-21034-en.php?s=dHlwZT1yZSZzdGF0dXM9T2s,&return=PG5hdiBpZD0iYnJlYWRjcnVtYiI-PGEgaHJlZj0iLyI-SG9tZTwvYT4gJnJhcXVvOyA8YSBocmVmPSIvcG9saWNpZXNhbmRtZWFzdXJlcy8iPlBvbGljaWVzIGFuZCBNZWFzdXJlczwvYT4gJnJhcXVvOyA8YSBocmVmPSIvcG9saWNpZXNhbmRtZWFzdXJlcy9yZW5ld2FibGVlbmVyZ3kvIj5SZW5ld2FibGUgRW5lcmd5PC9hPjwvbmF2Pg (accessed 13 December 2016).

IEA (International Energy Agency), 2017. Policies and Measures Database. Available online: https://www.iea.org/policiesandmeasures/climatechange/ (accessed 12 March 2017).

IEA-RETD (Implementing Agreement for Renewable Energy Technology Deployment), 2016. *Cost and Financing Aspects of Community Renewable Energy Projects. Volume II: German Case Study*. IEA-RETD, Utrecht.

IESO (Independent Electricity System Operator), 2012. *Ontario's Feed-in Tariff Program: Two-Year Review Report*. IESO, Toronto, ON.

IESO (Independent Electricity System Operator), 2013. *Development of a New Large Renewable Procurement Process: Initial Engagement Feedback and Interim Recommendations*. IESO, Toronto, ON.

IESO (Independent Electricity System Operator), 2015a. *2014 Electricity Production, Consumption, Price and Dispatch Data*. IESO, Toronto, ON.

IESO (Independent Electricity System Operator), 2015b. *Progress Report on Contracted Electricity Supply*. IESO, Toronto, ON.

IESO (Independent Electricity System Operator), 2016. *Feed-in Tariff Program: Application Summary*. Available online: http://fit.powerauthority.on.ca/what-feed-tariff-program (accessed 22 April 2016).

IPCC (Intergovernmental Panel on Climate Change), 2011. IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation. IPCC, Bonn.

IPCC-WGIII (Intergovernmental Panel on Climate Change Working Group III), 2001. *Climate Change 2001. Mitigation*. Cambridge University Press, Cambridge.

IRENA (International Renewable Energy Agency), 2012. 30 Years of Policies for Wind Energy in Germany. IRENA, Masdar City.

IWEA (Irish Wind Energy Association), 2011. Jobs and Investment in Irish Wind Energy. Available online: http://www.iwea.com/contentFiles/Documents%20for%20Download/Publications/IWEA%20Policy%20Documents/2009_06_Jobs_and_Investment_in_Irish_Wind_Energy.pdf (accessed 12 March 2017).

IWEA (Irish Wind Energy Association), 2017. Wind Statistics. Available online: http://www.iwea.com/windstatistics (accessed 12 March 2017).

Jacobsson, R. and Jacobsson, S., 2012. The emerging funding gap for the European Energy Sector – will the financial sector deliver? *Environmental Innovation and Societal Transitions* 5: 49–59.

Jacobsson, S. and Lauber, V., 2006. The politics and policy of energy system transformation – explaining the German diffusion of renewable energy technology. *Energy Policy* 34(3): 256–276.

Johnson, M.W. and Suskewicz, J., 2009. How to jump-start the clean tech economy. *Harvard Business Review* 87(11): 52–60.

Jones, A.W., 2015. Perceived barriers and policy solutions in clean energy infrastructure investment. *Journal of Cleaner Production* 104(0): 297–304.

Juntunen, J.K. and Hyysalo, S., 2015. Renewable micro-generation of heat and electricity – review on common and missing socio-technical configurations. *Renewable and Sustainable Energy Reviews* 49: 857–870.

Keirstead, J., 2007. Behavioural responses to photovoltaic systems in the UK domestic sector. *Energy Policy* 35: 4128–4141.

Kemp, R., Schot, J. and Hoogma, R., 1998. Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management. *Technology Analysis & Strategic Management* 10(2): 175–198.

Kok, R., 2015. Six years of CO_2-based tax incentives for new passenger cars in the Netherlands: impacts on purchasing behavior trends and CO_2 effectiveness. *Transportation Research Part A: Policy and Practice* 77: 137–153.

Kosenius, A.-K. and Ollikainen, M., 2013. Valuation of environmental and societal trade-offs of renewable energy sources. *Energy Policy* 62: 1148–1156.

Kostakis, I. and Sardianou, E., 2012. Which factors affect the willingness of tourists to pay for renewable energy. *Renewable Energy* 38: 169–172.

Krupa, J., 2012a. Identifying barriers to aboriginal renewable energy deployment in Canada. *Energy Policy* 42: 710–714.

Krupa, J., 2012b. Blazing a new path forward: a case study on the renewable energy initiatives of the Pic River First Nation. *Sustainable Futures: Multi-disciplinary Perspectives on Multi-level Transitions* 3: 109–122.

Krupa, J., 2013. Realizing truly sustainable development: a proposal to expand Aboriginal "price adders" beyond Ontario electricity generation projects. *Utilities Policy* 26: 85–87.

Krupa, J., Galbraith, L., and Burch, S., 2015. Participatory and multi-level governance: applications to Aboriginal renewable energy projects. *Local Environment* 20: 81–101.

Lane, B. and Potter, S., 2007. The adoption of cleaner vehicles in the UK: exploring the consumer attitude–action gap. *Journal of Cleaner Production* 15: 1085–1092.

Lin, B. and Li, X., 2011. The effect of carbon tax on per capita CO_2 emissions. *Energy Policy* 39: 5137–5146.

Linnerud, K. and Holden, E., 2015. Investment barriers under a renewable-electricity support scheme: differences across investor types. *Energy* 87: 699–709.

Lipp, J., 2011. Highs and lows for Canada solar co-op. *Renewable Energy Focus* 12(5): 56–59.

Lipp, J.D., Tarhan, M.D. and Dixon, A., 2016. *Accelerating Renewable Energy Co-operatives in Canada*. TREC, Toronto, ON.

Mabee, W.E., Mannion, J. and Carpenter, T., 2012. Comparing the feed-in tariff incentives for renewable electricity in Ontario and Germany. *Energy Policy* 40: 480–489.

Madlener, R., 2007. Innovation diffusion, public policy, and local initiative: the case of wood-fuelled district heating systems in Austria. *Energy Policy* 35: 1992–2008.

Mahapatra, K. and Gustavsson, L., 2008. An adopter-centric approach to analyze the diffusion patterns of innovative residential heating systems in Sweden. *Energy Policy* 36: 577–590.

Markandya, A., Ortiz, R.A., Mudgal, S. and Tinetti, B., 2009. Analysis of tax incentives for energy-efficient durables in the EU. *Energy Policy* 37: 5662–5674.

Marques, A.C. and Fuinhas, J.A., 2012. Are public policies towards renewables successful? Evidence from European countries. *Renewable Energy* 44: 109–118.

Martin, N. and Rice, J., 2013. The solar photovoltaic feed-in tariff scheme in New South Wales, Australia. *Energy Policy* 61: 697–706.

Masini, A. and Menichetti, E., 2013. Investment decisions in the renewable energy sector: an analysis of non-financial drivers. *Technological Forecasting and Social Change* 80: 510–524.

Mathews, J.A., Kidney, S., Mallon, K. and Hughes, M., 2010. Mobilizing private finance to drive an energy industrial revolution. *Energy Policy* 38: 3263–3265.

Metcalfe, R. and Dolan, P., 2012. Behavioural economics and its implications for transport. *Journal of Transport Geography* 24: 503–511.

Meyer, N., 2003. European schemes for promoting renewables in liberalised markets. *Energy Policy* 31: 665–676.

Meyer, N., 2007. Learning from wind energy policy in the EU: lessons from Denmark, Sweden and Spain. *European Environment* 17(5): 347–362.

Michelsen, C.C. and Madlener, R., 2016. Switching from fossil fuel to renewables in residential heating systems: an empirical study of homeowners' decisions in Germany. *Energy Policy* 89: 95–105.

Mickwitz, P., 2003. A framework for evaluating environmental policy instruments context and key concepts. *Evaluation* 9: 415–436.

Middelgrunden Cooperative, 2000. Feasibility studies: offshore wind farm at Middelgrunden. Middelgrunden Cooperative, Copenhagen.

Momsen, K. and Stoerk, T., 2014. From intention to action: can nudges help consumers to choose renewable energy? *Energy Policy* 74: 376–382.

Montag, J., 2015. The simple economics of motor vehicle pollution: a case for fuel tax. *Energy Policy* 85: 138–149.

Motherway, B. and Scheer, J., 2011. Economic Analysis of Residential and Small-Business Energy Efficiency Improvements. Available online: http://www.seai.ie/Publications/Your_Home_Publications_/Energy_Efficiency/Economic_Analysis_of_Residential_and_Small-Business_Energy_Efficiency_Improvements.45851.shortcut.pdf (accessed 20 June 2017).

Müller, J.R. and Holstenkamp, L., 2015. Zum Stand von Energiegenossenschaften in Deutschland: aktualisierter Überblick über Zahlen und Entwicklungen zum 31.12.2014. Leuphana University of Lüneburg, Lüneburg.

Mundaca, L. and Luth Richter, J., 2015. Assessing "green energy economy" stimulus packages: evidence from the U.S. programs targeting renewable energy. *Renewable and Sustainable Energy Reviews* 42: 1174–1186.

Nachmany, M., Fankhauser, S., Townshend, T., Collins, M., Landesman, T., Matthews, A., Pavese, C., Rietig, K., Schleifer, P. and Setzer, J., 2014. *The GLOBE Climate Legislation Study: A Review of Climate Change Legislation in 66 Countries*. 4th edition. GLOBE International and the Grantham Research Institute, London School of Economics, London.

Nelson, D., Huxham, M., Muench, S. and O'Connell, B., 2016. Policy and investment in German renewable energy. Policy. Climate Policy Initiative, Berlin.

NESC (National Economic and Social Council), 2014. *Wind Energy in Ireland: Building Community Engagement and Social Support*. NESC, Dublin.

Nolden, C., 2013. Governing community energy – feed-in tariffs and the development of community wind energy schemes in the United Kingdom and Germany. *Energy Policy* 63: 543–552.

Odell, J.S., 2001. Case study methods in international political economy. *International Studies Perspectives* 2: 161–176.

OFGEM, 2016. Guidance on Pausing the FITs Scheme. Green Energy and Green Economy Act, 2009. Available online: https://www.ofgem.gov.uk/publications-and-updates/guidance-pausing-fits-scheme (accessed 22 April 2016).

Oteman, M., Wiering, M. and Helderman, J.-K., 2014. The institutional space of community initiatives for renewable energy: a comparative case study of the Netherlands, Germany and Denmark. *Energy, Sustainability and Society* 4: 1–17.

Owen, A.D., 2006. Renewable energy: externality costs as market barriers. *Energy Policy* 34: 632–642.

Ozcan, M., 2014. Assessment of renewable energy incentive system from investors' perspective. *Renewable Energy* 71: 425–432.

Painuly, J.P., 2001. Barriers to renewable energy penetration; a framework for analysis. *Renewable Energy* 24: 73–89.

Palm, J. and Tengvard, M., 2011. Motives for and barriers to household adoption of small-scale production of electricity: examples from Sweden. *Sustainability: Science, Practice, & Policy* 7(1): 6–15.

Parag, Y., Hamilton, J., White, V. and Hogan, B., 2013. Network approach for local and community governance of energy: the case of Oxfordshire. *Energy Policy* 62: 1064–1077.

People Power Planet, 2016. Description of the model. Available online: http://peoplepowerplanet.ca/community-energy-models/co-operatives/ (accessed 22 April 2016).

Pic River, 2016. Pic River Energy: existing project. Available online: http://www.picriverenergy.com/projects.php (accessed 18 May 2016).

Polzin, F., Migendt, M., Täube, F.A. and von Flotow, P., 2015. Public policy influence on renewable energy investments – a panel data study across OECD countries. *Energy Policy* 80: 98–111.

Quantum, 2015. *Community Energy: Generating More Than Renewable Energy*. Community Energy England, Lancaster.

Ragwitz, M., Winkler, J., Klessmann, C., Gephart, M. and Resch, G., 2012. Recent developments of feed-in systems in the EU – a research paper for the International Feed-In Cooperation. Nature Conservation and Nuclear Safety (BMU). Ministry for the Environment, Bonn.

Ratinen, M. and Lund, P., 2015. Policy inclusiveness and niche development: Examples from wind energy and photovoltaics in Denmark, Germany, Finland, and Spain. *Energy Research & Social Science* 6: 136–145.

Regen SW, 2015. Financially Sustainable Business Models for Community Led Sustainable Energy. Regen SW, Exeter.

REScoop, 2016. Facts and figures. Available online: https://rescoop.eu/facts-figures-0 (accessed 22 April 2016).

Revenue Commissioner, 2015. Data on EIS participation. Revenue Commissioner, Dublin.

Richter, M., 2013. Business model innovation for sustainable energy: German utilities and renewable energy. *Energy Policy* 62: 1226–1237.

Rijpens, J., Riutort, S. and Huybrechts, B., 2013. *Report on REScoop Business Models*. REScoop.eu, Brussels.

Rode, J., Gómez-Baggethun, E. and Krause, T., 2015. Motivation crowding by economic incentives in conservation policy: a review of the empirical evidence. *New Climate Economics* 117: 270–282.

Rogan, F., Dennehy, E., Daly, H., Howley, M. and Ó Gallachóir, B.P., 2011. Impacts of an emission based private car taxation policy – first year ex-post analysis. *Transportation Research Part A: Policy and Practice,* 45(7): 583–597.

Rogers, J.C., Simmons, E.A., Convery, I. and Weatherall, A., 2008. Public perceptions of opportunities for community-based renewable energy projects. *Energy Policy* 36: 4217–4226.

Romero-Rubio, C. and de Andrés Díaz, J.R., 2015. Sustainable energy communities: a study contrasting Spain and Germany. *Energy Policy* 85: 397–409.

Roulleau, T. and Lloyd, C.R., 2008. International policy issues regarding solar water heating, with a focus on New Zealand. *Energy Policy* 36: 1843–1857.

Salm, S., Hille, S.L. and Wüstenhagen, R., 2016. What are retail investors' risk-return preferences towards renewable energy projects? A choice experiment in Germany. *Energy Policy* 97: 310–320.

Saunders, R.W., Gross, R.J.K. and Wade, J., 2012. Can premium tariffs for micro-generation and small scale renewable heat help the fuel poor, and if so, how? Case studies of innovative finance for community energy schemes in the UK. *Energy Policy* 42: 78–88.

Scheer, J., Clancy, M. and Hógáin, S.N., 2013. Quantification of energy savings from Ireland's Home Energy Saving scheme: an ex post billing analysis. *Energy Efficiency* 6: 35–48.

Schoettl, J.-M. and Lehmann-Ortega, L., 2011. Photovoltaic business models: threat or opportunity for utilities. In Wüstenhagen, R. and Wuebker, R. (eds), *Handbook of Research on Energy Entrepreneurship.* Edward Elgar, Cheltenham, pp. 145–171.

Schreuer, A., 2010. Energy Cooperatives and Local Ownership in the Field of Renewable Energy Technologies: A Literature Review. Vienna University of Economics and Business, Vienna.

Schreuer, A., 2015. Dealing with the diffusion challenges of grassroots innovations: the case of citize. PhD Dissertation. Alpen-Adria-Universität Klagenfurt, Graz.

Schultz, P.W., 2015. Strategies for promoting proenvironmental behavior. *European Psychologist* 19(2): 107–117.

Scottish Government, 2015. Scottish Government Good Practice Principles for Shared Ownership of Onshore Renewable Energy Developments. Scottish Government, Edinburgh.

SEAI, 2008. Greener Homes Scheme Statistics. SEAI, Dublin (accessed 12 March 2017).

SEAI, 2013. Greener Homes Scheme. Available online: http://www.seai.ie/Grants/GreenerHomes/Homeowners/How_to_Apply/Greener_Homes_Application_Guide.pdf (accessed 12 March 2017).

SEAI, 2014a. *Bringing Energy Home*. SEAI, Dublin.

SEAI, 2014b. Energy in Transport. Available online: https://www.seai.ie/Publications/Statistics_Publications/Energy_in_Transport/Energy-in-Transport-2014-report.pdf (accessed 12 March 2017).

SEAI, 2015a. About Better Energy Homes. Available online: http://www.seai.ie/Grants/Better_energy_homes/About_the_Scheme/

SEAI, 2015b. A Macroeconomic Analysis of Onshore Wind Deployment to 2020. Available online: https://www.seai.ie/Publications/Statistics_Publications/Energy_Modelling_Group_Publications/A-Macroeconom ic-Analysis-of-Onshore-Wind-Deployment-to-2020.pdf (accessed 12 March 2017).

SEAI, 2016a. Guidelines for Wind Farm Development. Available online: http://www.seai.ie/Renewables/Wind_Energy/Wind_Farms/Wind_Farm_Development/Guidelines_for_wind_farm_development/ (accessed 19 December 2016).

SEAI, 2016b. Better Energy Communities. Available online: http://www.seai.ie/Grants/Better_Energy_Communities/BEC-2016-SEAI-Launch-Presentation.pdf (accessed 14 March 2016).

SEAI, 2017a. BEC Grants. Available online: http://www.seai.ie/Grants/Better_Energy_Communities/-sthash.IKylixSa.dpuf (accessed 14 March 2017).

SEAI, 2017b. Energy Forecasts. Presentation by Emer Dennehy. 13 April 2017.

SEAI–Eirgrid, 2011. Wind generation not increasing wholesale electricity prices. Available online: http://www.seai.ie/News_Events/Press_Releases/2011/Wind_generation_not_increasing_wholesale_electricity_prices.html (accessed 12 March 2017).

Seyfang, G., Park, J.J. and Smith, A., 2013. A thousand flowers blooming? An examination of community energy in the UK. *Energy Policy* 61: 977–989.

Shackley, S. and Green, K., 2007. A conceptual framework for exploring transitions to decarbonised energy systems in the United Kingdom. *Energy* 32: 221–236.

Sierzchula, W., Bakker, S., Maat, K. and van Wee, B., 2014. The influence of financial incentives and other socio-economic factors on electric vehicle adoption. *Energy Policy* 68: 183–194.

Simcock, N., Willis, R. and Capener, P., 2016. *Cultures of Community Energy: International Case Studies*. T.B. Academy, London.

Simshauser, P., 2010. Resource adequacy, capital adequacy and investment uncertainty in the Australian power market. *The Electricity Journal 23*: 67–84.

Slee, B., 2015. Is there a case for community-based equity participation in Scottish on-shore wind energy production? Gaps in evidence and research needs. *Renewable and Sustainable Energy Reviews* 41: 540–549.

Solangi, K.H., Islam, M.R., Saidur, R., Rahim, N.A. and Fayaz, H., 2011. A review on global solar energy policy. *Renewable and Sustainable Energy Reviews* 15: 2149–2163.

Somanathan, E., Sterner. T., Chimanikire, D., Dubash, N.K., Essandoh-Yeddu, J., Fifita, S., Goulder, L., Jaffe, A., Labandeira, X., Managi, S., Mitchell, C., Montero, J.P., Teng, F. and Zylicz, T., 2014. National and Sub-national Policies and Institutions. In Edenhofer, O., Pichs-Madruga, R., Sokona, E., Farahani, E., Kadner, S., Seboth, K., Adler, A., Baum, I., Brunner, S., Eickemeier, P., Kriemann, B., Savolainen, J., Schlömer, S., von Stechow, C., Zwickel, T. and Minx, J.C. (eds), *Climate Change 2014: Mitigation of Climate Change.* Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge.

Soon, J.-J. and Ahmad, S.-A., 2015. Willingly or grudgingly? A meta-analysis on the willingness-to-pay for renewable energy use. *Renewable and Sustainable Energy Reviews* 44: 877–887.

Sovacool, B.K. and Lakshmi Ratan, P., 2012. Conceptualizing the acceptance of wind and solar electricity. *Renewable and Sustainable Energy Reviews* 16: 5268–5279.

Steinhilber, S., Wells, P. and Thankappan, S., 2013. Socio-technical inertia: understanding the barriers to electric vehicles. *Energy Policy* 60: 531–539.

Stevanović, S. and Pucar, M., 2012. Financial measures Serbia should offer for solar water heating systems. *Energy and Buildings* 54: 519–526.

Stigka, E.K., Paravantis, J.A. and Mihalakakou, G.K., 2014. Social acceptance of renewable energy sources: a review of contingent valuation applications. *Renewable and Sustainable Energy Reviews* 32: 100–106.

Stokes, L.C., 2013. The politics of renewable energy policies: the case of feed-in tariffs in Ontario, Canada. *Energy Policy* 56: 490–500.

Strachan, P.A., Cowell, R., Ellis, G., Sherry-Brennan, F. and Toke, D., 2015. Promoting community renewable energy in a corporate energy world. *Sustainable Development* 23: 96–109.

Strupeit, L. and Palm, A., 2016. Overcoming barriers to renewable energy diffusion: business models for customer-sited solar photovoltaics in Japan, Germany and the United States. *Journal of Cleaner Production* 123: 124–136.

Szarka, J., Cowell, R., Ellis, G., Strachan, P.A. and Warren, C., 2012. *Learning from Wind Power: Governance, Societal and Policy Perspectives on Sustainable Energy*. Palgrave Macmillan, Basingstoke.

The Federation of Community Power Co-ops, 2015. *Ontario Renewable Energy Co-operative Sector Survey 2014–2015*. The Federation of Community Power Co-ops, Toronto, ON.

Tipperary Energy Agency, 2014. Community wind energy development: Templederry case study. Available online: http://www.aceforenergy.eu/wp-content/uploads/2013/04/CASE-STUDY-Templederry-Wind.pdf

Tipperary Energy Agency, 2016. Legislative Mechanisms for Local Community Ownership and Investment in Renewable Energy Infrastructure. Tipperary Energy Agency, Tipperary.

Toke, D., Breukers, S. and Wolsink, M., 2008. Wind power deployment outcomes: how can we account for the differences? *Renewable and Sustainable Energy Reviews* 12: 1129–1147.

Tranaes, F., 1996. *Danish Wind Energy*. Danish Wind Turbine Owners' Association, Aarhus.

Trend Research, 2013. Definition und Marktanalyse von Bürgerenergie in Deutschland. Trend Research, Lüneburg.

Verbruggen, A., Fischedick, M., Moomaw, W., Weir, T., Nadaï, A., Nilsson, L.J., Nyboer, J. and Sathaye, J., 2010. Renewable energy costs, potentials, barriers: conceptual issues. *Energy Policy* 38: 850–861.

Viardot, E., 2013. The role of cooperatives in overcoming the barriers to adoption of renewable energy. *Energy Policy* 63: 756–764.

Vindenergi Danmark, 2015. *Årsrapport 2014*. Vindenergi Danmark, Copenhagen.

Walker, G., 2008. What are the barriers and incentives for community-owned means of energy production and use? *Energy Policy* 36: 4401–4405.

Walker, G., 2011. The role for "community" in carbon governance. *Wiley Interdisciplinary Reviews: Climate Change 2*: 777–782.

Walker, G., Hunter, S., Devine-Wright, P., Evans, B. and Fay, H., 2007. Harnessing community energies: explaining and evaluating community-based localism in renewable energy policy in the UK. *Global Environmental Politics* 7(2): 64–82.

Wassermann, S., Reeg, M. and Nienhaus, K., 2015. Current challenges of Germany's energy transition project and competing strategies of challengers and incumbents: the case of direct marketing of electricity from renewable energy sources. *Energy Policy* 76: 66–75.

Weiss, I. and Sprau, P., 2002. 100,000 roofs and 99 Pfennig: Germany's PV financing schemes and the market. *Renewable Energy World* 5: 64–75.

West, J., Bailey, I. and Winter, M., 2010. Renewable energy policy and public perceptions of renewable energy: a cultural theory approach. *Energy Policy* 38: 5739–5748.

Wolsink, M., 2007. Wind power implementation: the nature of public attitudes: equity and fairness instead of "backyard motives". *Renewable and Sustainable Energy Reviews* 11: 1188–1207.

Wüstenhagen, R., Wolsink, M. and Bürer, M.J., 2007. Social acceptance of renewable energy innovation: an introduction to the concept. *Energy Policy* 35: 2683–2691.

Yang, S. and Zhao, D., 2015. Do subsidies work better in low-income than in high-income families? Survey on domestic energy-efficient and renewable energy equipment purchase in China. *Journal of Cleaner Production* 108(A): 841–851.

Yildiz, Ö., 2014. Financing renewable energy infrastructures via financial citizen participation – the case of Germany. *Renewable Energy* 68: 677–685.

Yin, Y., 2012. A socio-political analysis of policies and incentives applicable to community wind in Oregon. *Energy Policy* 42: 442–449.

Zhang, X., Shen, L. and Chan, S.Y., 2012. The diffusion of solar energy use in HK: what are the barriers? *Energy Policy* 41: 241–249.

Zhao, T., Bell, L., Horner, M.W., Sulik, J. and Zhang, J., 2012. Consumer responses towards home energy financial incentives: a survey-based study. *Energy Policy* 47: 291–297.

Abbreviations

BER	Building energy rating
BYO	Build your own
CO_2	Carbon dioxide
EFI	Economic and financial incentive
EV	Electric vehicle
FiP	Feed-in premium
FiT	Feed-in tariff
GDP	Gross domestic product
GW	Gigawatt
IBBA	Irish Bike Business Association
IPCC	Intergovernmental Panel on Climate Change
KfW	Kreditanstalt für Wiederaufbau
LCT	Low-carbon technology
MW	Megawatt
PRSI	Pay-related social insurance
PSO	Public service obligation
PV	Photovoltaic
R&D	Research and development
REFIT	Renewable Energy Feed-in Tariff
RO	Renewables Obligation
SEAI	Sustainable Energy Authority of Ireland
SWH	Solar water heating
VRT	Vehicle registration tax

AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOIL
Tá an Ghníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaol a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

Rialú: *Déanaimid córais éifeachtacha rialaithe agus comhlíonta comhshaoil a chur i bhfeidhm chun torthaí maithe comhshaoil a sholáthar agus chun díriú orthu siúd nach gcloíonn leis na córais sin.*

Eolas: *Soláthraímid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírithe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.*

Tacaíocht: *Bímid ag saothrú i gcomhar le grúpaí eile chun tacú le comhshaol atá glan, táirgiúil agus cosanta go maith, agus le hiompar a chuirfidh le comhshaol inbhuanaithe.*

Ár bhFreagrachtaí

Ceadúnú
Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaol:
- saoráidí dramhaíola *(m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistrithe dramhaíola)*;
- gníomhaíochtaí tionsclaíocha ar scála mór *(m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta)*;
- an diantalmhaíocht *(m.sh. muca, éanlaith)*;
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe *(OGM)*;
- foinsí radaíochta ianúcháin *(m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíocha)*;
- áiseanna móra stórála peitril;
- scardadh dramhuisce;
- gníomhaíochtaí dumpála ar farraige.

Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil
- Clár náisiúnta iniúchtaí agus cigireachtaí a dhéanamh gach bliain ar shaoráidí a bhfuil ceadúnas ón nGníomhaireacht acu.
- Maoirseacht a dhéanamh ar fhreagrachtaí cosanta comhshaoil na n-údarás áitiúil.
- Caighdeán an uisce óil, arna sholáthar ag soláthraithe uisce phoiblí, a mhaoirsiú.
- Obair le húdaráis áitiúla agus le gníomhaireachtaí eile chun dul i ngleic le coireanna comhshaoil trí chomhordú a dhéanamh ar líonra forfheidhmiúcháin náisiúnta, trí dhíriú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúchán.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialachán um rialú ar shubstaintí a ídíonn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

Bainistíocht Uisce
- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uiscí idirchriosacha agus cósta na hÉireann, agus screamhuiscí; leibhéil uisce agus sruthanna aibhneacha a thomhas.
- Comhordú náisiúnta agus maoirsiú a dhéanamh ar an gCreat-Treoir Uisce.
- Monatóireacht agus tuairisciú a dhéanamh ar Cháilíocht an Uisce Snámha.

Monatóireacht, Anailís agus Tuairisciú ar an gComhshaol
- Monatóireacht a dhéanamh ar cháilíocht an aeir agus Treoir an AE maidir le hAer Glan don Eoraip (CAFÉ) a chur chun feidhme.
- Tuairisciú neamhspleách le cabhrú le cinnteoireacht an rialtais náisiúnta agus na n-údarás áitiúil *(m.sh. tuairisciú tréimhsiúil ar staid Chomhshaol na hÉireann agus Tuarascálacha ar Tháscairí)*.

Rialú Astaíochtaí na nGás Ceaptha Teasa in Éirinn
- Fardail agus réamh-mheastacháin na hÉireann maidir le gáis cheaptha teasa a ullmhú.
- An Treoir maidir le Trádáil Astaíochtaí a chur chun feidhme i gcomhair breis agus 100 de na táirgeoirí dé-ocsaíde carbóin is mó in Éirinn.

Taighde agus Forbairt Comhshaoil
- Taighde comhshaoil a chistiú chun brúnna a shainaithint, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeráide, an uisce agus na hinbhuanaitheachta.

Measúnacht Straitéiseach Timpeallachta
- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaol in Éirinn *(m.sh. mórphleananna forbartha)*.

Cosaint Raideolaíoch
- Monatóireacht a dhéanamh ar leibhéil radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha.
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta.
- Sainseirbhísí cosanta ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

Treoir, Faisnéis Inrochtana agus Oideachas
- Comhairle agus treoir a chur ar fáil d'earnáil na tionsclaíochta agus don phobal maidir le hábhair a bhaineann le caomhnú an chomhshaoil agus leis an gcosaint raideolaíoch.
- Faisnéis thráthúil ar an gcomhshaol ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaol *(m.sh. Timpeall an Tí, léarscáileanna radóin)*.
- Comhairle a chur ar fáil don Rialtas maidir le hábhair a bhaineann leis an tsábháilteacht raideolaíoch agus le cúrsaí práinnfhreagartha.
- Plean Náisiúnta Bainistíochta Dramhaíola Guaisí a fhorbairt chun dramhaíl ghuaiseach a chosc agus a bhainistiú.

Múscailt Feasachta agus Athrú Iompraíochta
- Feasacht chomhshaoil níos fearr a ghiniúint agus dul i bhfeidhm ar athrú iompraíochta dearfach trí thacú le gnóthais, le pobail agus le teaghlaigh a bheith níos éifeachtúla ar acmhainní.
- Tástáil le haghaidh radóin a chur chun cinn i dtithe agus in ionaid oibre, agus gníomhartha leasúcháin a spreagadh nuair is gá.

Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil
Tá an ghníomhaíocht á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:
- An Oifig um Inmharthanacht Comhshaoil
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Fianaise is Measúnú
- Oifig um Chosaint Radaíochta agus Monatóireachta Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag comhaltaí air agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.

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Financial Incentives to Promote Citizen Investment in Low-carbon and Resource-efficient Assets

epaResearch
Climate - Water - Sustainability
Identifying pressures • Informing policy • Developing solutions

Authors: Celine McInerney and Joseph Curtin

Ireland has considerable challenges in transitioning to a low-carbon resource-efficient economy. EU emissions and renewables targets are not on track to being met, leaving the exchequer exposed to several hundred million in possible fines. If Ireland is to meet its ambitious climate change and renewable energy objectives, rapid decarbonisation is required over the coming decades. This report presents findings from a literature review, national and international case studies, and a survey of Irish citizens.

Identifying pressures

In Ireland, in contrast to countries such as Denmark and Germany, there are few examples of citizen and community renewable projects. Opposition to renewable technologies in rural communities has emerged as a key barrier to meeting decarbonisation objectives, leading to a key policy focus on promoting "energy citizenship".

A survey conducted for this research suggests that 78% of a representative sample of Irish citizens were interested in investing in distributed renewable energy technologies. However, investment amounts were found to be low relative to project costs, and the majority of citizens were found to be highly risk-averse. Wealthier cohorts with some experience of making investment decisions were more likely to consider investing, and key barriers to financial citizen participation included insufficient savings and no access to loan finance.

Informing policy

The research finds that financial incentives designed with citizen investors in mind, including feed in tariffs, feed in premiums, quota schemes, grants and taxes, have been successfully deployed within a variety of contexts. Soft loans, however, have been less effective as a stand-alone instrument . The International case studies illustrate that citizens can be mobilised as investors, both in countries with a long history of citizen investment (Germany and Denmark), but also in jurisdictions where this tradition is not evident (the UK and the Canadian state of Ontario). Financial supports introduced at the early stage of project development, when risk is highest, emerge as a key success factor. Agency support for citizen groups, along with clear and consistent planning policies that are streamlined with incentive application and grid access procedures, were also found to be of high importance.

Developing solutions

The findings suggest that larger projects will generally require a professional developer acting in concert with local actors, and in these cases a market-based incentive programme, such as a quota scheme, can be designed to favour equity participation from local citizens and community groups. A mandate requiring a share offer to local citizens (as in Denmark) could also be considered. Setting a target for community ownership, following the Scottish approach, would underpin Government commitment to local ownership outlined in the Energy White Paper (2015). Furthermore, community groups will need significant agency support if they are to acquire the necessary technical, financial, legal and other skills.

Many industrialised countries are incentivising the up-take of distributed renewable energy technologies such as wind, solar and biomass, which can make a very substantial contribution to global decarbonisation. These technologies can be particularly attractive for local citizen investors because they are decentralised, small in scale, modular and reliable. Mobilising citizen investment has the potential to unlock a new source of capital, but also to promote greater levels of understanding and acceptance of these technologies in local communities.

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