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The Comparative Costs of Community and Commercial Renewable Energy Projects in Scotland

Executive Summary

Key Points

- Despite being a relatively young phenomenon, Scottish 'community energy' ('CE') has experienced a rapid growth in capacity and diversity over the past decade, and is receiving increasing international attention.
- To a large extent, the Scottish CE sector has evolved independently from the commercial sector. The recent upsurge in interest and delivery of community-commercial partnership projects may suggest that this is changing.
- As a nascent sector, 'learning-by-doing'-type effects amongst practitioners and policymakers have steadily driven overall CE project costs down to the point that they are now comparable to commercial costs, although the former continue to show distinctly higher variability.
- Despite the overall cost convergence, a significant difference prevails at a crucial stage in the development pipeline: nominal costs, timelines and risk associated with progressing projects towards planning remain significantly higher for community projects. Given that projects cannot proceed without planning permission, this puts communities at a significant disadvantage vis-a-vis commercial analogues.
- Depending on how cash flows are discounted over time, and how the cost the time of volunteering in CE projects is valued, however, these early-stage handicaps facing CE projects do not necessarily translate into lower project Net Present Value (NPV) compared to commercial analogues.

1. Introduction

This report presents the findings of a study undertaken on behalf of the Scottish Government's Centre of Expertise on Climate Change (ClimateXChange). The purpose of this study is to identify any differences in the costs faced by community and commercial renewable energy projects in Scotland.

The Scottish Government has expressed a commitment to support the development of community renewable energy, including a target to establish 500 megawatts of community and locally-owned renewable energy by 2020. Given this aspiration, it is important to understand any cost barriers faced by community projects that are not faced by equivalent commercial projects. This study aims to assist policy makers in considering options to reduce any additional financial barriers faced by future community renewable energy projects in Scotland.

In this report, we compare the costs and cost factors for three different ownership types in the renewable energy sector:

(i) **Commercial** - projects owned and managed by professional private entities;

(ii) **Community** - projects owned and managed by constituted non-profit – distribution organisations established and operating across a geographically defined community.

(iii) **Commercial-community partnerships**

The study considered the costs for wind, hydro and solar PV technologies.

2. Methodology and Findings

This study applied a number of research methods to gain a better understanding of how community projects differ from commercial projects and how this in turn influences costs. This included a literature review, collection and analysis of cost data, and economic valuation modelling. Where possible, we distinguished between generic project breakpoints and periods throughout the lifecycle of energy projects including: 'inception', 'feasibility', 'pre-planning', 'planning', 'financial close', 'commissioning', 'build' and 'decommissioning'. This allowed us to identify the stages during which commercial and community projects are exposed to different cost and risk factors.

2.1 Literature Review

Based on a review of academic and grey literature, we find that the community and commercial renewable energy projects have to some degree developed as independent sectors. They are therefore subject to different external factors that influence cost, such as economies of scale, knowledge and access to markets. As with other fledgling sectors, it can be expected that the cost of services that are unique to the community sector will decrease over time as the sector expands and matures. The community renewables sector is also differentiated from the commercial sector by the influence of particular policy support mechanisms, which have significantly influenced uptake during the last decade.

The literature reveals certain challenges that are common to community projects across technologies and geographies, and have an impact on project costs:

1. **Internal process costs –** Due to their 'bottom-up' organisational structure, community projects are generally responsive to the diverse perspectives of their constituents. This can result in slower decision making, meaning community projects are less responsive to windows of opportunity and exposed to greater development times and costs.
2. **Transaction costs -** Communities commonly lack in-house skills and knowledge and therefore have to engage with the private sector for project development services. This exposes community projects to market costs, which can be exacerbated by a lack of bargaining power and market knowledge.
3. **Legitimacy costs –** As new entrants to markets in which commercial counterparts are already established, community projects can face greater challenges in accessing finance and investment.
4. **Internal diseconomies of scale –** Community organisations are typically significantly smaller than commercial renewable energy organisations. They therefore do not benefit from the same economies of scale in terms of bargaining power, finance and the ability to manage risks.

2.2 Aggregate nominal development cost analysis

In order to assess statistical evidence of differences in project costs between ownership models over time, we collected data from a range of existing databases, as well as through in-depth interviews and surveys. This process allowed us to analyse costs data from a total of 124 Scottish projects; 56 commercial, 60 community and 8 shared ownership projects.

The key findings from the aggregate development cost component of our study are that:

- **The costs of community projects are more variable than commercial projects;**
- **The total costs of community projects have decreased over time, converging with the costs of commercial projects;**
- **Community organisations experience cost advantages when they partner with a commercial developer.**

2.3 - Paired Case studies

Whilst the analysis of aggregate project costs data suggests that the costs of community renewable energy projects are more variable than commercial projects, it cannot definitively confirm whether this observation is due to ownership type or other factors.

We attempted to gain a better understanding of sector specific effects by analysing pairs of community and commercial projects of the same technology, location, size, and construction period. This process was not able to provide rigorous statistical analysis, however it does enable a more detailed analysis of which types of costs differ across ownership models during different project stages.

As shown in Figure 1, our analysis of the paired case studies reveals that:

- **Community projects typically take significantly longer to get to planning.**

- **Communities typically spend more money to get projects to planning.**

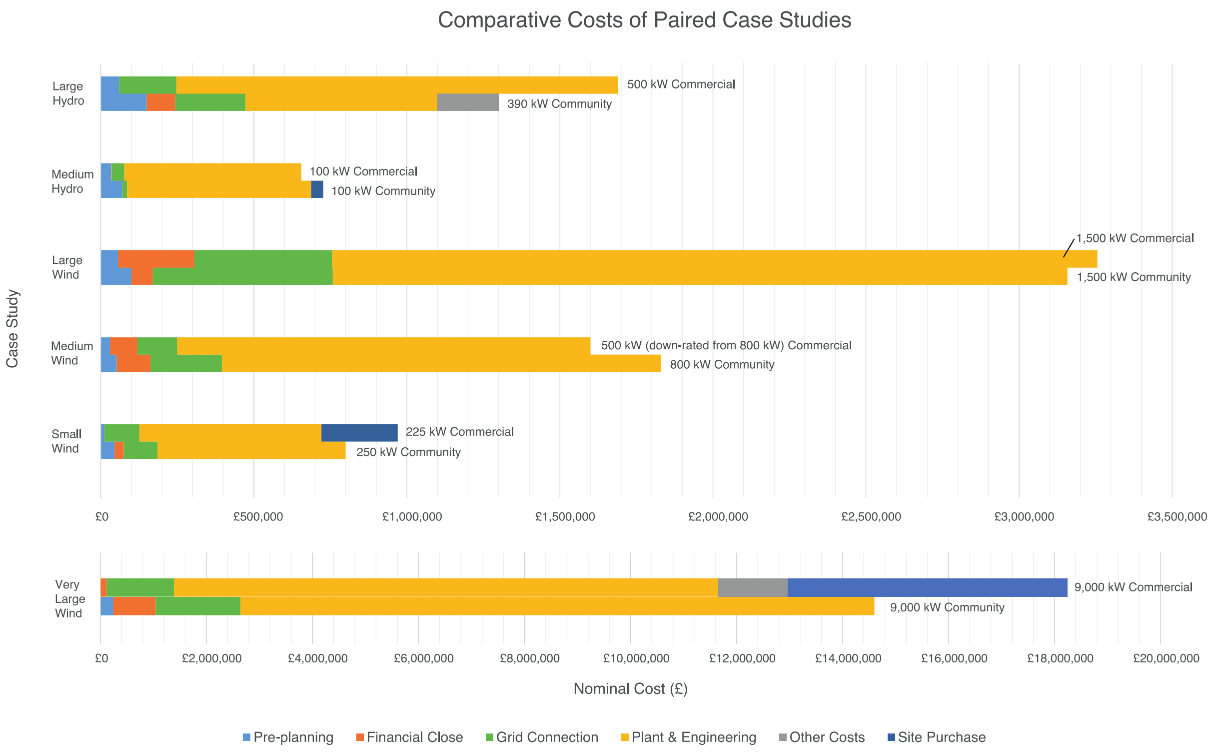

Figure 1: Nominal costs for paired case studies broken down by development stage.

2.4 Economic valuation modelling

As revealed by our literature review and analysis of paired case studies, certain stages of the development process, most clearly the pre-planning stage, tend to take longer for community-owned schemes than commercially owned schemes. This can be associated with internal processes and transaction costs, which in turn affect the likelihood of the development progressing, as well as expected costs and returns of the project.

We also noted challenges in comparing the relative economic costs beyond simple nominal financial expenditures of community developments because of differences in motivations, attitudes and forgone opportunities of participants, which can result in a valuation of resources used (time, money) that differs from market rates. The greater proportion of volunteer time dedicated to community projects, for example, poses a particular challenge in valuing a project's overall costs and returns in comparison to a commercial project.

We attempted to quantify the implications of these differences in terms of overall project returns or costs by developing an economic valuation model that allows for these aspects.

This model allowed us to:

- Value labour input used in the project feasibility and development phases (whether it is undertaken on a commercial or volunteer basis).
- Account for differences in the time taken to complete each project phase.
- Explicitly allow for differences in the risks associated with various stages of the project and how these differ between commercial and community owned projects.

As shown in Figure 2, the model we developed accounts for the probability of failure at three points in project development: (i) the project does not reach the planning stage after feasibility work is completed; (ii) the project fails to receive planning permission once an application is prepared and submitted; and (iii) the project receives planning permission but fails to reach financial close.

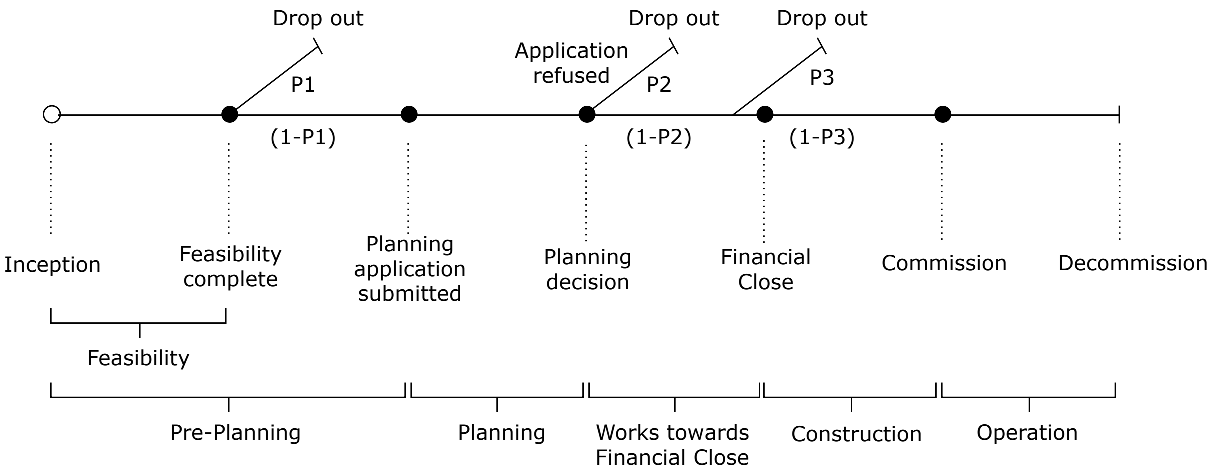

***Figure 2**: Renewable energy generation development decision tree upon which spreadsheet model is based*

The key findings from the valuation component of our study are that:

- **The main difference between community and commercial developer renewable energy costs are associated with the higher risk faced by community groups, particularly in the early stages of development;**

- **Depending on how volunteer time is valued, the overall effects on the Net Present Value (NPV) of community projects need not necessarily be detrimental, despite the fact that these projects take longer to progress through the development process.**

3. Conclusions

Community renewable energy projects are a relatively young phenomenon in Scotland, and trend data suggests that average sectoral costs (in £/MW terms) have declined over the past two decades. However, other than the community project costs being distinctly more variable, we found no statistically significant differences between average total project costs across ownership models for any one given capacity band.

Clearly, understanding the reason(s) for the observed cost decline may hold important lessons for community energy policy. While traditional economies of scale, arising from decreases in average cost-per-unit due to increases in the scale of individual projects or the organisations behind them, play a major role, the results from the literature review, paired case studies and the economic valuation model show that there are additional factors at play. These are likely to include innovations in the way that policy support is provided (through the Community And Renewable Energy Scheme, for example) as well as non-policy drivers such as the increasingly important role of intra-sectoral (that is, inter-community) learning that has occured as the number of Scottish community renewables projects has grown.

When project costs are disaggregated into different development stages, an important difference emerges that is masked in the aggregate analysis: the cost, time and risk associated with taking community projects to planning are distinctly higher than for commercial analogues. We ascribe this to a combination of higher internal process costs, asymmetric information, and higher transaction costs.

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The Comparative Costs of Community and Commercial Renewable Energy Projects in Scotland

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Key Findings

This report was prepared for the Scottish Government's Centre of Expertise on Climate Change ('ClimateXChange'), in response to a brief entitled 'Assessing the comparative costs of community- and commercial renewable energy projects in Scotland'. In the report, we compare the costs and cost factors for three different ownership models in the renewable energy sector: (i) commercial; (ii) commercial-community partnerships; and (iii) community. We define commercial projects as owned and managed by professional private entities, and community projects as owned and managed by constituted non-profit – distribution organisations established and operating across a geographically defined community. Research is based on the application of a number of methods, including a literature review, descriptive statistical analysis of cost data over a cross-section of community energy projects in the UK, and paired case studies. In addition, we develop an economic valuation model to explore how risk and timescales of project development can affect the expected net present value of a project under each form of ownership.

A wide range of factors influence development project value and costs, including exchange rates, technology choice, project size, tax and support incentives, grid access and capacity, and site location (e.g. island vs. mainland projects). There are also a range of factors that can influence project value indirectly, by affecting risk, bankability and cost of capital. The report highlights which of these factors affect community and commercial projects to different extents, and explores how specific costs have changed over time.

Our analysis suggests several findings. In comparison to the commercial sector, development costs in the community sector:

(1) Are more variable. Community energy project costs are more variable, but have become less variable over time.

(2) Have higher pre-planning costs. These ranged from 25% to 275% higher than commercial analogues in the paired case studies examined.

(3) Show a downward trend over time, **converging over time with commercial cost levels.** While a formal analysis of the underlying causes of this downward trend are beyond the scope of this report, this trend is consistent with Learning-by-Doing amongst communities and policymakers.

(4) Community-commercial partnership projects show a cost advantage on a 'community £ invested / community MW' basis. Engaging in partnerships with commercial developers enables community organisations to acquire greater degrees of project ownership for every pound they invest.

(5) Projects in the community sector take longer to complete than those in other sectors, largely because they take much longer to get to planning. Getting from inception to planning submission took 50% to 1100% longer for community projects in the paired case studies we examined.

Although our study focused on nominal cost differences, an additional observation made on the basis of our empirical data and modelling is worth noting:

(6) Community projects can be strongly disadvantaged through the higher risks of project failure, particularly at the feasibility stage. Results from our valuation model of a 500 kW single wind turbine suggested that allowing for this increased risk can decrease expected net present value (the total discounted net value of the project) to levels where projects become infeasible and levelised cost of electricity (the total discounted cost per unit of electricity over the lifetime of the generating asset (in £ per kWh or MWh) is above that offered by the market. Importantly, the results from the valuation model suggested that higher community pre-planning costs, longer timescales and different labour inputs, by themselves, do not necessarily make community projects less economically attractive. However if, as is quite plausible, these higher costs and longer development times lead to higher probability of failure then their impact can be highly significant (and negative) on the overall project economics.

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Glossary

CARES	Community and Renewable Energy Scheme
Cost factor	Factors that influence cost
Commercial project	Projects owned and managed by professional private entities
CRE	Community renewable energy, defined as owned and managed by constituted non-profit – distribution organisations established and operating across a geographically defined community
ESCO	Energy Service Company
External economies of scale	The lowering of costs due to factors outside the control of the organisation
FIT	Feed-In-Tariff
IEM	Internal Energy Market
LCOE	Levelised cost of electricity, the total discounted cost per unit of electricity over the lifetime of the generating asset (in £ per kWh or MWh)
Net Present Value	The total discounted net value of the project
NFFO	Non Fossil Fuel Obligation
Nominal cost	The monetary cost of a product or service
REIF	Renewable Energy Investment Fund
ROC	Renewable Obligation Certificate
SG	Scottish Government

1. Introduction

This report investigates whether there is evidence of substantial variation in project cost between community- and commercially– owned renewable energy developments in the last decade. In particular it focusses on claims that the former have higher costs as a result of the unique challenges faced by community renewable energy (CRE) projects (Harnmeijer *et al.*, 2012; DTI, 2006; Hain *et al.,* 2005*;* IPPR, 2010; Walker, 2010). These observations suggest that any cost comparative work needs to be based on an understanding of how community projects differ from commercial projects, and how in turn this influences cost.

Understanding and quantifying costs and benefits of different project ownership and financing structures can inform Scottish Government policy making around targets and support mechanisms for both community and renewable energy. Once the trade-offs of different ownership models are understood, appropriate policies can be put in place, for instance to influence cost burdens that may be specific to community ownership by accounting for them in the design of the CARES and REIF frameworks. There is evidence that CRE projects beyond Scotland and the UK share many common challenges that are unique to community ownership (Harnmeijer *et al.,* 2012; Roberts *et al.,* 2014). The results of this report are therefore likely to be instructive for policy makers hoping to level the playing field, ensure the right conditions for investment, and increase citizen engagement in the renewable energy transition internationally.

We undertake a comparative assessment of costs and cost factors for three different ownership models in the renewable energy sector: (i) commercial projects, (ii) commercial-community partnerships, and (iii) community projects. These are defined in accordance with the Scottish Community Energy Policy Statement (SG, 2014), with the explicit proviso that arrangements between commercial developers and energy co-operatives of all kinds are included under ‘commercial-community partnerships’. Commercial projects are owned and managed by professional private entities and may be investor or utility owned. Most RE development in the UK falls in this category (Stenzel and Frenzel, 2008; Ofgem, 2014). Community projects are owned and managed by “constituted non-profit –distribution community organisations established and operating across a geographically defined community, including Community Benefit Societies (‘Bencoms’)”, representing approximately 43 MW of installed capacity in Scotland in 2013 (<1% of total installed capacity) (Energy Saving Trust, 2014). Finally, commercial-community partnerships are revenue sharing arrangements between community and commercial entities, of which there are currently only 12 projects in the UK but which represent a relatively large proportion of total community-owned capacity (Haggett *et al.,* 2014, Scene, 2012). We limit the scope of this study to project financed developments encompassing single RE generation installations, and therefore exclude community owned Energy Service Companies (ESCO’s) providing local customers with district heating and cooling services in urban settings (Hannon and Bolton, 2015). We also exclude projects that involve publicly owned companies or organisations from our analysis on the basis that outside the realm of ESCO’s, there are very few known cases in the UK (Hannon and Bolton, 2015; Bale 2012). The geographic focus rests on Scotland, but we draw on some data from English projects.

Considerable changes have occurred in the renewable energy sector over the last 10 years including changes in cost and scale of technology, as well as the availability, nature and terms of monetary and non-monetary assistance that is available. Such changes may have influenced project costs in community and commercial sectors within Scotland and the UK to variable extent, so that project costs need to be analysed and understood over time. Where possible, we distinguish between generic project breakpoints and periods: ‘inception’, ‘feasibility’, ‘pre-planning’, ‘planning’, ‘financial close’, ‘commissioning’, ‘build’ and ‘decommissioning’. This study analyses comparative costs for wind, hydro and solar PV projects. Many of our examples primarily focus on wind energy, which currently constitutes around 45% of community energy projects in Scotland (Harnmeijer *et al.*, 2012). However, the findings are likely to be broadly representative of any complex, risky and time consuming RE project requiring technical feasibility studies, upfront capital investment, legal work and planning permission.

This report was prepared for the Scottish Government's Centre of Expertise on Climate Change, in response to a brief entitled '*Assessing the comparative costs of community- and commercial renewable energy projects in Scotland*'. Work on this project commenced on Monday 24 November 2014, and was completed on the 10th of May 2015. The report is organised as follows. Section 2 provides an introduction to project cost and cost factors in community and commercial RE sectors, reviews academic and grey literature available and identifies a set of working hypotheses emerging from the evidence. While testing these hypotheses formally is beyond the scope of this report, the remainder of this document sets out to assess in as far as possible whether the empirical evidence holds up to these hypotheses. Section 3 provides a description of the Methodology, including data collection and model specification. Section 4 describes the results, first providing descriptive visual and statistical evidence of differences in project nominal cost between ownership models in terms of variability and trends over time. This is followed by results of paired case studies, which enable a more detailed analysis of which types of costs differ across ownership models at different project stages. Finally we use the results from a specifically designed economic valuation model to explore how differences in exposure to specific risks as well as in labour cost and time taken for development can affect expected project value. A preliminary sensitivity analysis shows which factors are most critical in determining overall costs and returns as well as the stage in the development process at which they occur, enabling a discussion on the implications for different ownership models on overall project value. We conclude by describing data and study design limitations, summarizing conclusions and policy implications emerging from the evidence, and we identify recommendations for future work.

2. Project costs and cost factors in commercial and community renewable energy – a review of the evidence

While our analysis focuses on the project level, it is important to understand that costs are a function of market and institutional context. Community- and commercial projects have to some degree developed as semi-independent sectors and are consequently subject to different external economies of scale. Given that the community energy sector in the UK has only recently been brought into the market, and is comprised of actors, networks and institutions that are to some extent separate from the commercial sector, it can been seen as a new ('nursing') market around the application of renewable energy technology. 'Nursing' markets in any sector are characterised by high and variable costs (or 'external diseconomies of scale') because there is a poor knowledge base, because the innovation at hand may not be recognised as a legitimate opportunity by key stakeholder groups, such that market places may not exist and potential customers may not have articulated their demand (Bergek *et al.,* 2008). As a market grows and attracts new entrants, resources are mobilised, supporting institutional frameworks are developed, and product and process standardisation takes place (Bergek *et al.,* 2008). Cost savings arise over time as a result of positive externalities and learning-by-doing when a pooled labour market develops that can provide specialised goods and services and facilitate knowledge spill-overs (Bergek *et al.,* 2008; IRENA, 2012). Following this logic, we can expect cost reductions in services that are unique to the community sector as the sector expands and matures. The policy contexts in which community and commercial projects develop also differ. This is particularly true in Scotland, where impactful and evolving support mechanisms specifically targeting the community renewables sector have greatly influenced uptake since the early 2000's. It is well recognised that government action (or inaction) strongly influences the boundaries, characteristics and aims of community-led development by opening and closing niches for potential grassroots action (Mansuri & Rao, 2012; Morris, 2013; Nolden, 2013). In our conclusions, we briefly highlight the important roles that learning-by-doing and dynamic responsiveness in the sphere of policy have played in driving down the costs of community projects.

In principle, factors that influence the cost of renewable energy projects are well understood. To set the stage for a comparative assessment, we draw selectively from a large volume of literature detailing commercial project-level costs, trends in RE technology cost, as well as the cost implications of financial, regulatory, socio-political risks and constraints facing projects. **Table 1** is an illustrative overview of capital expenditures (CAPEX) and operating costs (OPEX) typically faced by conventional (commercial) onshore wind energy projects at various stages of development. Total projects costs are often summarized as levelised costs of electricity (LCOE), the total discounted cost per unit of electricity over the lifetime of the generating asset (in £ per MWh). Costs that enter directly into project financial evaluations are affected by exchange rates, technology choice, size of the project, the cost of finance, tax and support incentives, grid access and capacity, as well as site location (e.g. island vs. mainland projects). In addition, project costs can be indirectly influenced by factors such as the general economic environment, the market and political context, the nature and risk of contracts associated with each ownership model, and the relationship with the local community. These factors affect the perceived risk, bankability and cost of capital (Wiser, 1997), but can also increase scoping and planning costs for instance through the need for planning appeals or alternative development sites (Klesman, 2013). Given the limited number of development sites that have both renewable energy potential and are low risk planning sites, land ownership and lease negotiations are increasingly a key risk, and significantly affect the probability of a successful outcome for CRE projects (Harnmeijer et al., 2012). **Table 1** illustrates key risks that exist at different stages of wind project development.

Cost components can change over time, and vary for different niches and scales of technology. Technology costs typically comprise upwards of 50% of total project cost, so market dynamics and capacity factor improvements of generation technology have had a particularly large impact on LCOE. For instance, the capital cost of wind development declined by 10% annually in Europe between 1980-2000 through learning-by-doing and the development of more advanced and larger turbines (IRENA, 2012; Lanz *et al*., 2012). This was followed by capital cost increases from 2004-2009 resulting from supply chain bottlenecks and an increase in the cost of material and labour inputs in turbine manufacturing (Lanz *et al*., 2012; IRENA, 2012). Performance improvements and falling turbine prices are expected to drive LCOE downwards in the near future at learning rates of 7% or lower (Lanz *et al*., 2012; IRENA, 2012). Both community and commercial projects will benefit from the ability to develop on less windy sites at lower cost, but larger scale installations are likely to benefit in particular (Lanz *et al*., 2012). While the average scale of CRE projects is increasing in Scotland, large scale installations have by and large been beyond the reach of community projects (see Scene, 2012).

In contrast to our understanding of cost structure and its determining factors in commercial RE, very little academic work has explicitly addressed cost differences across different ownership models within the renewable energy industry, either in Scotland, the wider UK or elsewhere. Wiser (1997) compares wind project costs of (vertically integrated) utility ownership with non-utility private ownership, and shows that the nature and terms of finance and tax incentives associated with different ownership models can have a substantial influence on project cost.

There is scant literature on community energy cost or cost determining factors. An exploratory survey of Scottish community energy projects conducted in 2011-2 demonstrated that pre-planning costs comprised a higher proportion of total costs than in commercial projects (Harnmeijer et al., 2012). This is surprising given that community projects at early stages in particular are often run by volunteers, with low or zero labour costs. A diversity of studies have looked at costs that are specific to the community sector in other industries, including community forestry (Ezzine de Blas *et al*., 2009; Teitelbaum, 2014; Vega & Keenan, 2014; Chand *et al.* 2015; Chhetri *et al*., 2012; Adhikari & Lovett, 2006; Meshack *et al*., 2006), water (Aggarwal, 2000; Carter, 2006) and urban sanitation projects (Bremer & Bhuiyan, 2014; Ibem, 2009; Hasan, 2008). The literature broadly suggests that the community sector faces certain common challenges that occur across different geographies and sectors and that influence project costs. These challenges can be categorised as 1) ‘Internal Process Costs’, 2) ‘Legitimacy Costs’, 3) ‘Transaction Costs’, and 4) ‘Internal Diseconomies of Scale’. These are discussed in turn.

1. Internal process costs. Communities face significant costs managing their activities to the satisfaction of all members *(‘Internal Process Costs’)* (Aggarwal, 2000; Carter, 2006). Wellens & Jegers (2014) call this challenge a ‘multiple principles’ situation in which various stakeholders may not only have different expectations of what should be done but also of how decisions should be made, resulting in higher time and labour costs in particular. Bottom-up organisations are – by definition – responsive to the diverse perspectives of their constituents and therefore face inherently higher decision-making costs than their top-down, hierarchical commercial counterparts. Internal process costs are likely to be particularly high for new organisations, or organisations that have no prior experience in managing complex projects and have not developed decision-making processes and internal conflict resolution strategies. This may make community organisations less able to respond effectively to windows of opportunity, such as time-sensitive invitations to engage in shared ownership (Bone, 2015). Higher internal process costs are likely to translate into increased project management and consultancy costs and longer development times at all stages, but at early project stages in particular. This is problematic because the costs of managing a community-led development are often borne by individual members of the initiative (Adhikari & Lovett, 2006; Meshack *et al*., 2006). Overall, this increases the risk that developments do not make it past the initial feasibility stage of the development process, due to unresolved impasses in the negotiation process.

***Table 1**: Typical risk and expenditure profile for onshore wind projects at different phases of development.*

	PROJECT STAGE				
	Capital cost (CAPEX)			Operating cost (OPEX)	
COST CATEGORY	Feasibility	Planning	(Pre)-Construction	Operation	Decommissioning
Management	Project management; Legal fees	Project management; Legal fees	Project management	Project management	Project management
Technology	Grid appraisal	Utility upgrades, transformers, protection, metering and wiring ; Design engineering	Turbine and tower acquisition and transport ; Wiring to turbine base ; Turbine erection	Insurance & Warrantee, Operation and Maintenance	Technology decommission and transport
Scoping, design and permission	Technical feasibility study;	Environmental Statement/Impact Assessment and Planning Fees	-	-	-
Other material inputs	-	Land acquisition	Construction contracts, construction of access roads and foundation; Land lease	Land lease	-
Financing	-	-	Interest, equity returns, financing fees	Interest, equity returns, financing fees	-
RISKS	Erroneous pre-feasibility assessment; lack of viable projects sites	Planning rejection; Grid connection queues and terms of Power Purchase Agreement	Landing delays; delays in commissioning	Export/generation tariff; Down time; Actual resource; Electrical losses; Wake effects	-

Transaction costs. Second, communities can face significant transaction costs when they lack in-house skills or knowledge and have to engage with the private sector (‘Transaction Costs’). When the community organisation in question does not have access to the skills or materials for project development, external contractors must be sought. Resulting transactions costs can be compounded by the issue of asymmetric information vis-à-vis commercial players, where an absence of up-to-date market knowledge brings additional search and information costs associated with identifying competent suppliers and negotiating contracts. Having to go to market also exposes community organisations to bargaining costs, in that they may not have the clout or the experience to negotiate the terms and costs of land lease, service or power purchase contracts. Finally, additional outsourcing results in additional policing and enforcement costs associated with monitoring quality of service. Often, community groups suffer significant costs from poor service delivery as a result (Vega & Keenan, 2014; Ezzine de Blas *et al*., 2009). Together, these factors likely increase project costs and the time taken for certain stages of the development process, and may generate additional costs and risks. The degree of in-house skills and self-reliance can be a key determinant of project outcome and group income (Ezzine de Blas *et al*., 2009).

Legitimacy costs. Communities face significant costs associated with a lack of legitimacy when they are only recently established or in sectors where private commercial developments are the norm ('Legitimacy Costs'). Successful groups described in the sampled literature all tended to have established themselves as legitimate actors and faced few costs associated with challenges to their position, with evidence that this translates into better access to commercial, public and private finance. For example, banks in the US were more likely to lend to well-established community development corporations (Lowe, 2008) and there is evidence that pre-existing community groups are better able to benefit from government support mechanisms (Ezzine de Blas *et al*., 2009). Legitimacy is also a core component of trust required to enable local private investment in community projects. For example, older and better established community forest management groups have been found to be more efficient and effective (Chand *et al*. 2015; Chhetri *et al*., 2012), and more likely to be perceived as a legitimate channel to collect funding from residents (Bremer & Bhuiyan 2014).

Legitimacy of the community energy sector more generally is closely associated with its size, degree of specialisation and ability to generate the positive externalities typically associated with mature markets (Bergek *et al.,* 2008). Legitimacy costs become less relevant in contexts where community-led management is perceived as the norm (Makino & Matsuda, 2005; Gautam *et al*., 2004), but the process of legitimation can take considerable time in particular when it conflicts with competing interests (Bergek *et al.,* 2008). For example, while there are generally few options for small scale project finance in the UK compared to large scale projects, local renewable energy co-operatives in Germany benefitted from long standing local ownership and control of regional state owned banks, which translated into credibility as lenders (Nolden, 2013).

Internal Economies of Scale. Commercial RE developers are typically significantly larger than community organisations, and through having larger bank balances, turnovers and larger more specialised workforces, may enjoy a range of advantages over community organisations ('internal economies of scale'). Commercial renewable developers enjoy 'purchasing economies', which are advantages gained when firms buy in bulk and achieve discounts as a result; 'administrative savings', which accrue when larger firms spread their administrative and management costs across their operations; and 'financial savings', which accrue where larger firms get to borrow more cheaply. In addition, compared to community organisations which tend to have only one development option, commercial developers have certain 'risk-bearing economies' with any one development being in effect one item in a wider portfolio of different RE development options. This is particularly true for larger commercial firms which can bear development risks more effectively than smaller ones. For example, while community projects may face a lower risk of planning rejection than a commercial project (Haggett *et al*., 2013), they may be less likely to have the means to finance itself through a planning appeal. Within the energy governance literature, there is broad consensus that large developers have historically benefitted from a lower cost base, less risk and easier access to finance and contracts than smaller-scale investors, because both the NFFO and ROC support mechanisms required financial reserves large enough to sustain long planning cycles and large uncertainty over project outcomes (Stenzel and Frenzel, 2009; Mitchell, 1995; Szarka and Bluhdorn, 2006; Munday *et al.,* 2006). Even with the arrival of FIT's, there is anecdotal evidence that CRE projects are classified as high risk by commercial lenders, and community organisations have faced unfavourable terms, conditions and cost of finance (Walker *et al.*, 2010; Pepper and Caldwell, 2010).

Some of the advantages that come with internal economies of scale are likely to apply to larger well established community organisations. Throughout the literature, older and better established community groups seem to suffer less from process and transaction costs than their younger counterparts by gaining experience and developing the necessary skill sets. Many studies have made the link between community development groups' age and their effectiveness. International reports have demonstrated empirically that older groups were more efficient (Chand *et al*., 2015) and generated more income (Chhetri *et al*., 2012). This observation was also made specifically for the Scottish community renewables sector (Haggett *et al*., 2014), although not found to significantly affect the probability of CRE project outcome (Harnmeijer, 2012).

3. Methodology

Onshore wind and run-of-river hydro RE developments are complex, risky and time-consuming undertakings, and these are thus appropriate technologies in which to look for inter-sectoral cost differences. This report focuses on onshore wind energy, but we also collected data for run-of-river hydro projects and a small number of solar PV projects. There are currently no sizable community solar projects operational in Scotland, and existing projects are newly commissioned, resulting in poor data availability. However, we anticipate that inter-sectoral cost differences in solar PV are less prominent; given that its development process is more straightforward. We exclude bioenergy projects from the analysis entirely, on the basis that there are few community-owned installations, and that individual projects are highly bespoke, giving rise to greater cost variation from installation to installation than the three technologies selected as the focus of this report.

3.1 Data collection

Development cost data for a range of renewable energy technologies was collected from a variety of sources (see **Appendix B** for an overview), and for three ownership types ('sectors'): (i) commercial; (ii) commercial-community partnerships; and (iii) community. The capacity ranges used to distinguish small-, medium- and large scale projects are shown in **Appendix B – Table B1**.

Primary data was collected from a suite of community and commercial projects by means of a survey (**Appendix A**). The survey was conducted primarily through in-depth telephone interviews, to supplement electronic surveys. The survey data was used to complement existing Scene datasets, comprising of survey based data collected in 2011-and 2012 and updated in 2014 (see Harnmeijer *et al.,* 2012). The key criteria for inclusion of CRE projects in this study follows that of much of the academic literature, in requiring the involvement of a place-based social enterprise, together with evidence for both actual participation (process) and collective benefits (outcome) (Harnmeijer *et al*., 2012; Harnmeijer *et al.,* 2013; Walker & Cass, 2007; Walker & Devine-Wright, 2008a; Walker and Devine-Wright, 2008b). Through structured interviews, fine-grained cost data was obtained on a total of 15 community renewables schemes: 9 wind, 5 hydro and 1 solar projects, supplemented with coarse-grained cost data for 45 community projects from Scene's in house database. Coarse-grained cost data on 8 onshore wind partnership projects in the UK were obtained from the Scene dataset. Interviews for commercial cost data resulted in data for 11 wind, 10 hydro and 2 solar projects. In addition to survey based project level data, a selection of average cost data was taken from range of industry publications (see Appendix B – Table 3).

This process resulted in cost data on a total of 124 projects, of which 56 were commercial, 60 were community projects and 8 projects were shared ownership arrangements. Where possible, data was disaggregated into particular development stages by identifying generic project breakpoints and periods: 'inception', 'feasibility', 'pre-planning', 'planning', 'financial close', 'commissioning', 'build' and 'decommissioning'. Costs were adjusted for inflation using the retail price index inflation measure.

3.2 Analysis

The analysis consisted of descriptive statistics and comparative case study analysis, as well as an economic valuation model.

Paired case studies were used to compare projects of the same technology, location, size, and construction period, in an attempt to isolate any sector specific effects. However, it is important to note this paired case study approach cannot account for a number of other factors known to influence the cost of renewable energy developments, including specific technology options and innovations, market conditions at the time development services are procured, grid connection cost, particular planning or other statutory requirements, particular legal requirements, the nature of rental, option and other lease arrangements, as well as 'saturation effects' where the best sites get developed first so that costs are driven up over time. Neither the scope of this study, nor the size of our dataset allows for rigorous statistical analysis of the relative roles of these and other factors. Instead, this report seeks to tease out broad trends that distinguish commercial and community renewables development costs, with a focus on those trends that we think may have policy relevance. Thus, our conclusions are largely descriptive in nature.

The data collected was used to parameterise an economic valuation model. The aim of the model was to identify the key parameters and variables that differ between community versus commercial ownership and which substantially influence the LCOE and net present value of projects. In particular, the model captures the expected returns and costs for a single hypothetical renewable development to show how these would differ if the same project was developed by a commercial owner or by a community group. Cost data collected for the 56 and 60 commercial and community projects respectively was used to calibrate the model that calculates project net value (in terms of expected NPV) and cost (in terms of LCOE), allowing for differences in a) actual project expenditure, b) the time taken for the development c) the costs of labour inputs and d) risk of project failure at different project stages in commercial and community-owned RE projects. The model captures the conception, feasibility, development, construction and operational phases of a project but excludes costs associated with decommissioning. This is because there is scant data on decommissioning costs and because we have no clear expectations of how costs at this stage would differ.

Figure 1 provides an overview of the structure of the economic valuation model. The model accounts for the probability of failure at three points in project development: (i) the project does not reach the planning stage after feasibility work is completed; (ii) the project fails to receive planning permission once an application is prepared and submitted; and (iii) the project receives planning permission but fails to reach financial close. The literature review suggested that the probability of drop out at stages i) and iii) will be higher for community groups than commercial developers, but most likely lower or equal at stage ii). By using values based on expert opinion of interviewees and conducting a sensitivity analysis around values for probabilities of development at each project stage, the consequences of ownership models for expected NPV and expected LCOE can be calculated.

To validate the modelling, we checked that key model results were comparable to those produced by the LCOE offshore wind model made available by the Crown Estate[1] and the Ricardo-AEA modelling framework constructed for the Scottish Government CARES programme[2].

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[1] http://www.thecrownestate.co.uk/energy-and-infrastructure/offshore-wind-energy/working-with-us/strategic-workstreams/cost-reduction-study/

[2] Ricardo AEA's CARES Investment Ready Tools can be found at: www.localenergyscotland.org/investmentready

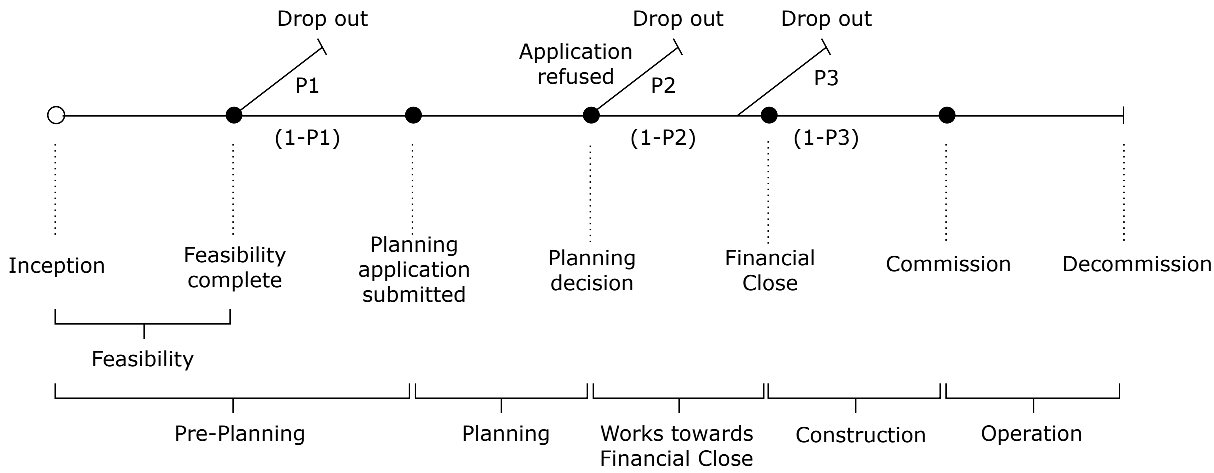

***Figure 1**: Renewable energy generation development decision tree upon which spreadsheet model is based.*

4. Results

This section first presents a descriptive summary of commercial and community cost data collected, and then proceeds to results from paired case studies and the valuation model, before summarising overall results.

4.1 Overview of costs across ownership models and summary statistics

Key Messages

- Community projects follow commercial cost trends, but show much greater variability.
- Trend data suggest a downward trend in cost of community projects over the period of 2004-2016, and a convergence over time with commercial cost levels.
- We find no statistically significant differences between average costs across ownership models for any one given capacity band or time period.
- Community organisations experience cost advantages when they partner with a commercial developer.

For onshore wind technology specifically, our dataset provides information on a range of projects of different scale commissioned between 2009 and 2016 (projects not yet commissioned at the time of writing are shown as 2016). The commercial cost data obtained through interviews (**Figure 3**) correspond closely to average cost data reported in industry publications (**Figure 2**). Clear economies of scale are present, with smaller projects (in raw kW rated capacity terms) distinctly more costly on a £/kW basis. Average cost data from industry reports suggest that commercial costs have come down since 2009, rising around 2012 for all three capacity bands (**Figure 2**). The latter trend is likely to represent counteracting effects to benefits from learning and technology innovation arising from the best wind sites being developed first. Community wind projects broadly follow these cost trends, but show much greater variation in costs. For average cost data (**Figure 2**), this variability may stem from small sample sizes for some capacity bands and years. However, the cost dispersion shown (**Figure 3)** suggests variability in cost for community projects is not just a function of data limitations.

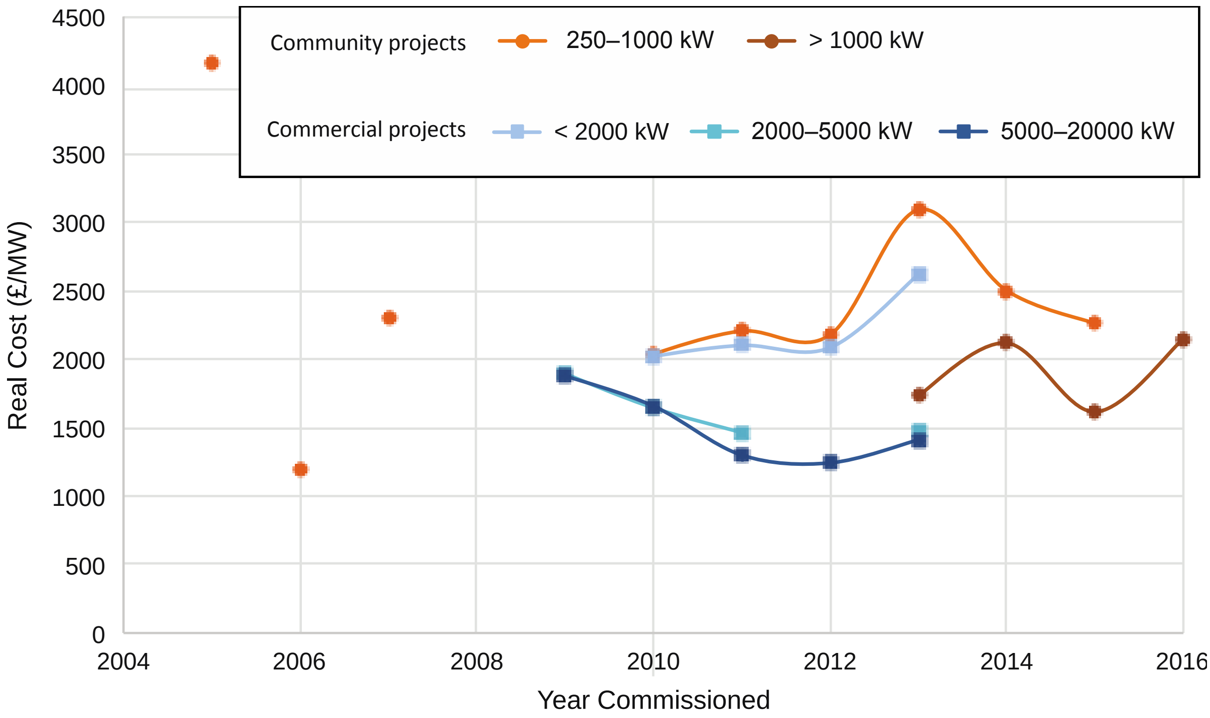

***Figure 2**: **Averaged real cost trends over time for community wind compared with commercial wind for different capacity bands** (Sources: Community wind data collected for this study and from the Scene database. Commercial data was taken from industry publications, see **Appendix B**). Data points with no trend line relate to single projects, rather than costs averaged over several projects. Costs are rebased to 2015.*

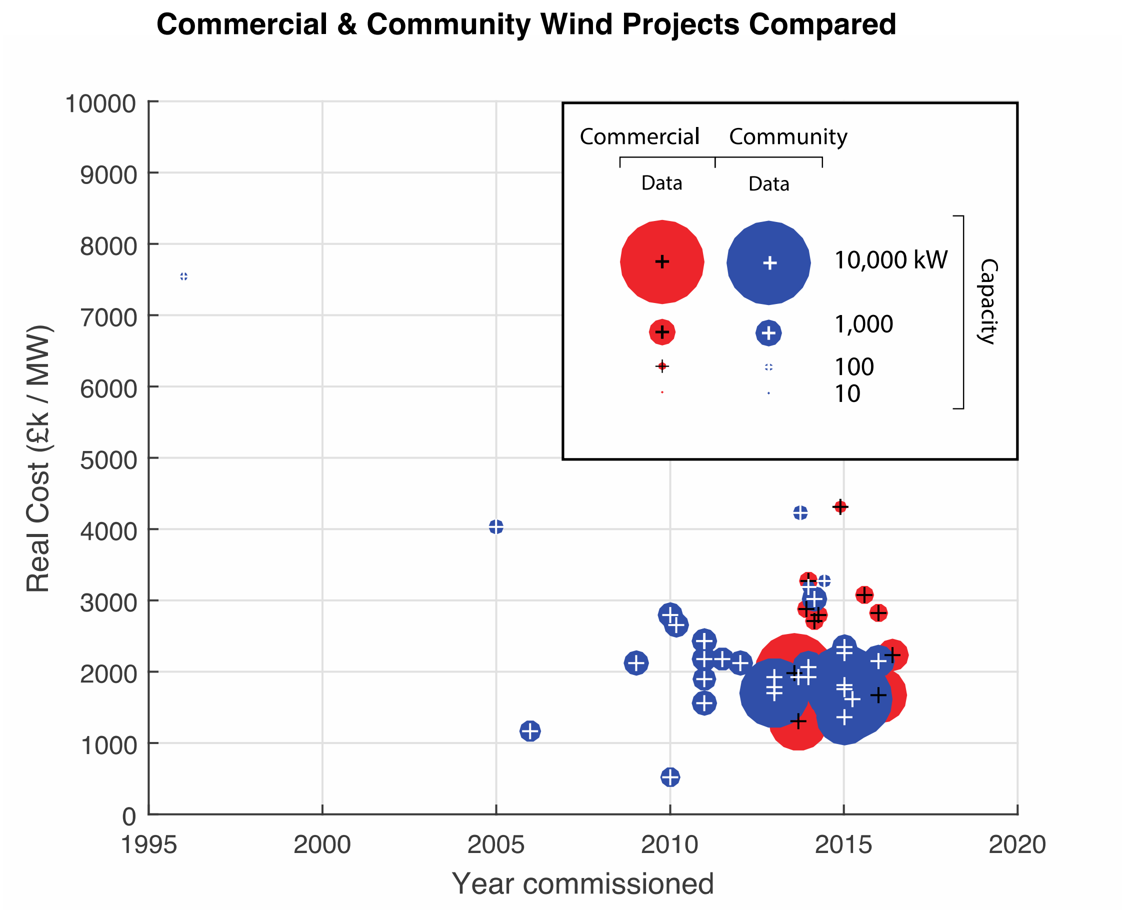

***Figure 3**: Real costs for commercial- and community onshore wind compared. The data shown was obtained through structured interviews, supplemented with data from the Scene database. Costs are rebased to 2015.*

Cost trends for the > 250 kW and < 1MW capacity band in **Figure 2** suggest that the costs of community wind development (in real £/MW terms) has fallen somewhat over the past two decades, but by no means in a smooth continuous fashion. Comparing trends across capacity bands suggests that cost decreases in community projects over the last five years are the result of an increase of scale in community energy projects. In addition, given the similarity in cost trends between commercial and community projects, we see that the community sector is not immune to capital cost increases influencing the commercial sector.

A statistical comparison of aggregate community and commercial wind projects by capacity band or by time period commissioned reveals no statistically significant differences between average costs across ownership models for any one given capacity band or time period (at $p=0.05$) (see Appendix D). After costs are adjusted for inflation, community and commercial costs are comparable, with average costs for commercial projects even slightly higher than community projects for <1000 kW and >1000 kW categories. Community projects commissioned before 2012 were more costly than commercial projects commissioned before 2012, but not significantly higher at 95% confidence levels (see Appendix D). The observed total cost trends are a function of a large range of cost factors, and paired case study results enable a more in depth analysis of cost factors over and above commissioning year and project scale.

Cost data on partnership projects was available for onshore wind projects only. Of these, seven are classed as ‘very large’, and one is classed as ‘medium’ for the purposes of this study. These projects were commissioned between 2007 and 2014. Partnership project cost is compared to cost data from wholly community-owned projects in

Figure 4. As is the case for fully commercial projects, clear economies of scale are present. The large variation in project size across this small sample of partnership projects makes it hard to draw conclusions about the presence of any trends in development cost (on a £/MW basis) over time. However, wholly community-owned projects (averaging £2,433k/MW) were significantly more expensive on a '£/community MW' than partnership projects (averaging £1320/MW, p=0.01, df=37). Community organisations therefore benefit from the cost advantages arising from partnering with a commercial developer.

Comparing trends across technologies

Run-of-river hydro schemes (**Figure 5**) provide a useful benchmark with which to compare observations drawn from onshore wind data. As is the case for wind, the costs (in real £/MW terms) are more variable for community projects, and there are strong economies of scale facing both commercial and community developers. However, the highly bespoke nature of hydro developments makes it difficult to tease out coarse systematic differences in the costs incurred by commercial versus community parties.

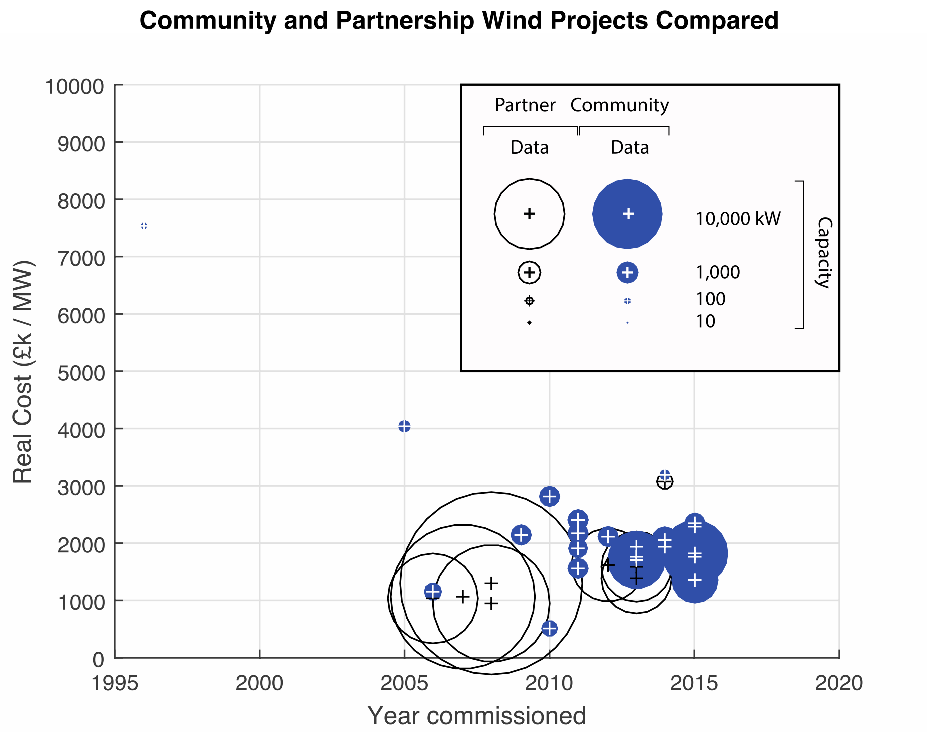

Figure 4*: Real costs for (i) partnership (empty black circles) and (ii) wholly community-owned (filled blue circles) projects in relation to project size and year commissioned. The data shown was obtained through structured interviews, supplemented with data from the Scene database. Costs are rebased to 2015, and are expressed relative to the equivalent capacity owned by the community ('£ / community MW').*

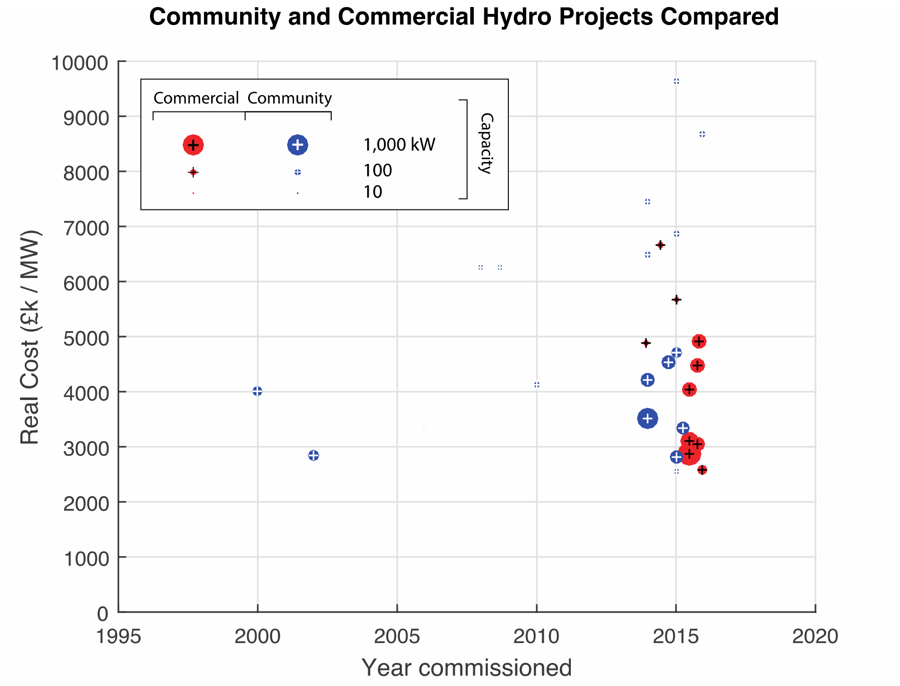

***Figure 5**: Real costs for run-of-river hydro compared. The data shown was obtained through structured interviews, supplemented with data from industry publications and the Scene database. Costs are rebased to 2015.*

4.2 Paired case studies

Key Messages

- Community projects typically take significantly longer to get to planning.
- Communities typically spend more money to get projects to planning.

The aggregate analysis above suggests that the costs of community RE projects are more variable than commercial schemes, but cannot definitively confirm whether these observations are due to ownership type or due to other factors. The analysis also suggests that the costs associated with both forms of ownership fell in the period 2000–2012, with evidence that they have increased slightly since 2012. Finally, there is evidence that partnership ownership costs are less variable and lower than wholly community-owned developments. In order to explain which costs are responsible for the cost trends observed, we turn to more detailed cost data of paired commercial and community projects. A total of seven paired case studies were identified on the basis of shared criteria (see Methodology Section) and analysed. These were:

- Small Wind – single turbine (225 – 250 kW)
- Medium Wind – single turbine (500 kW)
- Large Wind – single turbine (1,500 kW)
- Very Large Wind – multiple turbines (9,000 kW)
- Medium Hydro (100 kW)
- Large Hydro 1 (450 – 500 kW)
- Large Hydro 2 (390 – 500 kW)

In each case, due to the limited number of partnership cases, the comparison was made between commercial owned schemes and community owned schemes. **Appendix C** provides detailed overview of data, while **Figure 6** summarises the key findings from 6 of the paired case studies.

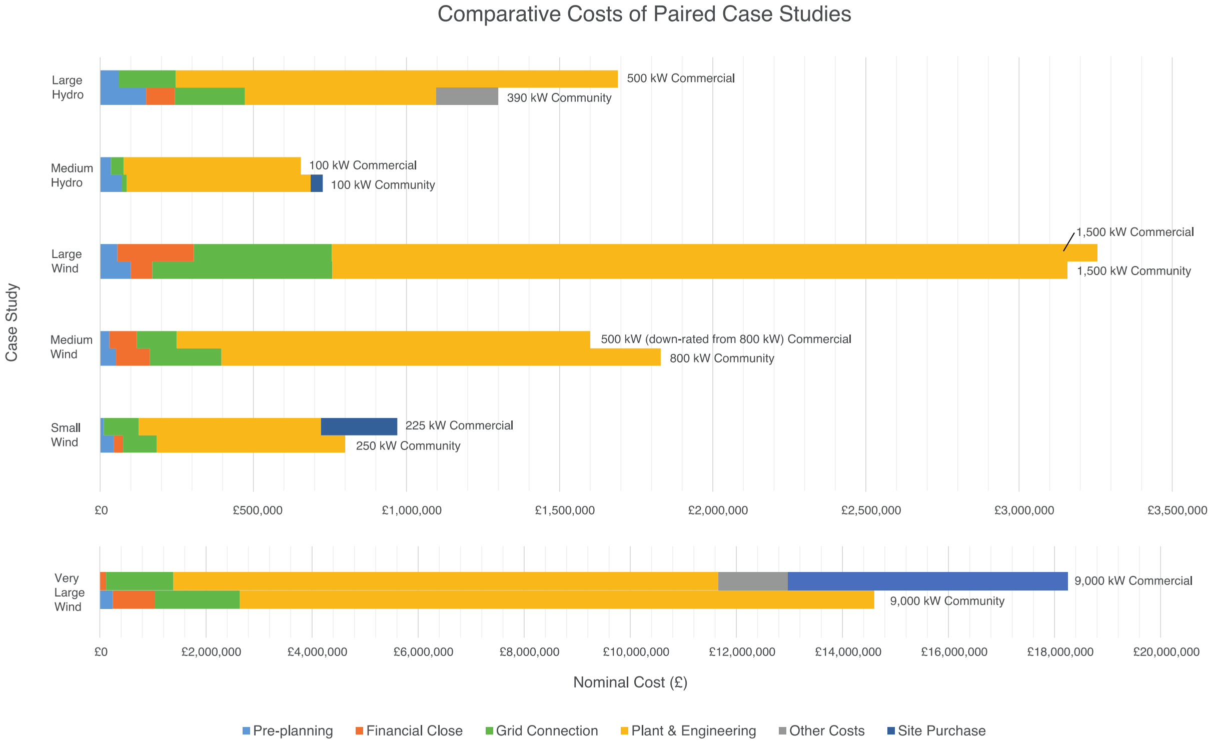

***Figure 6**: Nominal costs for paired case studies broken down by development stage.*

Results from the paired case studies suggest the following:

1) *Community projects typically take significantly longer to get to planning*.
Across technologies and scales, community organisations undergo substantially longer project development timescales, and ~70 to 1100% longer timescales to progress from inception to planning submission in particular.

2) Communities typically spend more money to get projects to planning.
Community organisations spend from 25% to 275% more at pre-planning stages, despite significant contribution of volunteer days. Pre-planning costs typically account for a minor proportion of total project costs, which is why we would not expect to see this inter-sectoral cost difference reflected in the aggregate cost data above. Nevertheless, policy support for pre-planning is crucial, as most projects require planning permission to proceed, and debt- and equity- finance are typically unavailable for this risky development stage.

4.3 Economic valuation modelling - Key factors that influence project value across ownership models

Key Messages

- Communities face substantially lower NPV and higher LCOE than commercial projects, attributed largely to differences in expected costs and returns incurred at early stages of the project.
- The largest negative differences in NPV for community projects are due to lower probabilities of project progress, higher pre-planning planning costs and labour time, even where labour day rates for community projects are set at ¼ of commercial day rates.
- The largest positive differences in LCOE for community projects are due to lower probabilities of project progress and higher pre-planning costs.
- Values for NPV and LCOE that do not take into account conception and development phases are comparable for community and commercial projects.

A key finding emerging from the survey data was that certain stages of the development process, most clearly the pre-planning stage, tends to take longer for community-owned schemes than commercially owned schemes. Based on the literature review, we attribute this to more complex internal processes and higher transactions costs of community groups. The following analysis attempts to quantify the implications of this difference in terms of overall project returns or costs. Further, the literature review (Section 2) suggested that another key difference between the two ownership modes is that they face different degrees of risk exposure at the different stages of the development process. This in turn will affect the likelihood of the development progressing and expected costs and returns of the project.

This section extends the analysis by developing an economic valuation model that allows for these aspects. In particular, the model:

- Values labour input used in the project feasibility and development phases (whether it is undertaken on a commercial or volunteer basis).
- Accounts for differences in the time taken to complete each project phase.
- Explicitly allows for differences in the risks associated with various stages of the project and how these differ between commercial and community owned projects.

Comparing the relative economic costs beyond simple nominal financial expenditures of community developments is challenging because differences in motivations, attitudes and forgone opportunities of participants can result in a valuation of resources used (time, money) that differs from market rates. For example, how should volunteer time be valued relative to market labour costs? Should the cost of capital for community investors be discounted, because their alternative investment opportunities are more limited? Should a premium be applied, to reflect the increased risk of failure associated with community projects? By developing a simple valuation model for a generic wind turbine project, and setting out some baseline assumptions we can compare costs and revenues in a way that allows for the time value of money and risk consistent with standard approaches in corporate finance and decision analysis (e.g. Newendorp and Schuyler, 2000; Berk and DeMarzo, 2007). Here we value the project costs and revenues from a standard market and commercial perspective. Differences in the structure of community costs, time input, cost of capital, and risk can then be evaluated by considering their impact on the overall economic returns and project cost. Note that other positive or negative externalities that may be present and could affect costs or revenues (such as local reinvestment) are excluded from the following analysis.

The model is calibrated using information collected from interviews and surveys along with estimates from other external sources. The model compares Expected pre-tax NPV, Expected Levelised Cost of Energy ('LCOE'), and costs for a hypothetical 500 kW project in commercial or community ownership. Expected LCOE is the total discounted cost per unit electricity over the lifetime of the generating asset (in £/MWh), and can be interpreted as the break-even value required by a producer for the project to be viable. A 500 kW wind project was selected because surveys provided detailed breakdown of costs and time estimates for this project specification.

Table 2 below summarises the assumptions used in the Commercial base case and the values used for the Community comparison. Some of the assumptions are drawn from external sources: the community labour day rates is consistent with information on median wages for personal and professional workers reported in the ONS Household Satellite Accounts which value voluntary activity in the UK (ONS, 2013). The cost of finance or 'hurdle rate' used in the analysis (8%) reflects the return an investor would expect from an investment in a comparably risky financial asset, where the higher the risk the higher the required return. This is a standard approach to the valuation of energy projects (PwC, 2012) and the values used here are consistent with those used by DECC in their LCOE calculations (2013) for onshore wind. For the reported NPV calculations the assumed FIT rate used is consistent with a commissioning date of 1 April 2014. Other base assumptions are made on the basis of the results of surveys carried out for this study, as well as expert opinion. We emphasise that the present study focused on empirical evidence for differences in nominal costs, and that no rigorous calibration of risk or time parameters was carried out on the basis of empirical data. Most of the values in **Table 2** are representative values observed in the sample (and are very similar to the values shown in the small wind turbine paired case study – see **Appendix C**).

***Table 2**: Base Assumptions.*

1. Expenditure (£)	***Commercial***	***Community***
Feasibility	10,000	10,000
Pre-Planning and Planning	**37,000**	**48,100**
Financial Close	50,000	50,000
Grid costs	150,000	150,000
Plant	785,000	785,000
Engineering	272,000	272,000
2a. Time Taken (months)		
Conception to submission of planning application	**14**	**24**
Conception and Feasibility	**3**	**6**
Pre-planning to Planning Submission	**11**	**18**
Planning	11	11
Planning permission to commissioning	**20**	**33**
Planning Decision to Financial Close	**8**	**21**
Construction Time	12	12
2b. Labour Input (person days)		

Feasibility	**15**	**150**
Pre-Planning and Planning	**30**	**60**
Financial Close	**40**	**120**
2c. Labour Cost per day (£)	**400**	**100**
3. Project progress probabilities		
Moving Feasibility to Full Planning Application (1-P1)	**1.00**	**0.50**
Planning Application Successful (1-P2)	0.70	0.70
Financial Close Achieved (1-P3)	**0.90**	**0.80**

Differences between the two ownership models are shown in bold. While labour inputs are far higher for community projects, the costs per day are valued less so the net effect is difficult to discern. The project progress probabilities (reflecting risk) were based on expert opinion. There is interdependence between the time a development takes to get through various stages of the development process and the likelihood of it being successful and this is reflected in the selected probabilities. They suggest that the chance that community projects will succeed to get beyond feasibility stage (P1) is assumed half that of a commercial owner. In contrast the chances of planning being successful (P2) are assumed identical at 0.7. There is a risk associated with neither form of owner getting past financial close (P3 in **Figure 5**) and here the community is assumed to have a higher chance of drop out at this stage (0.8 compared to 0.9 for commercial developers).

Table 3 below reports the results from the model. The results are presented at each of the four project development stages, namely, (i) at project inception; (ii) at development start (post-feasibility, pre-planning); (iii) at planning determination; and (iv) at financial close. Both the expected NPV and expected LCOE are reported for costs and returns incurred from that point in project development onward. Values for inception represent all costs and returns accrued from the start of the project onwards. Values for the development start are those immediately following the successful completion of the feasibility stage and represent the value of costs and returns from that point onwards. Values for planning determination represent costs and returns that apply only after the planning application is accepted. Finally, values reported at financial close assume not only that planning is approved but that finance is available. These values are therefore comparable to values for LCOE and pre-tax returns that do not account for conception and development phases widely reported in economic analyses elsewhere. From this point onward, there are no further differences between the two ownership forms and thus both the estimated NPV and LCOE values will be identical.

The first panel in **Table 3** reports the Pre-Tax NPV and LCOE results for the base commercially developed project, i.e. using the values in the first column of Table 2. These are replicated in **Figure 7** below. The remaining panels show the impact of allowing for the differences between commercial- and community owned projects in a stepwise manner. Panel II shows the results when pre-planning and planning costs are set to the community values (as specified in **Table 2)**. Table 2 shows new levels of expected NPV and LCOE, as well as the percentage difference between the value and the base commercial case (Δ%). Panels III and IV present results when, in addition to higher pre-planning and planning costs, we take into account the additional time taken for community projects (Panel III) and the labour input and associated labour costs are set to the community values (Panel IV). Finally, Panel V reports results when pre-planning and planning cost, time taken, labour input and cost assumptions plus project progress probabilities are taken into account. It thus best captures the overall impact on expected returns and costs associated with community ownership. Incorporating the extra differences in this stepwise manner provides an indication of the sensitivity of the results to each factor.

Table 3: *Expected Pre–Tax NPV and LCOE Results. % difference over base case shown in brackets. Values in **red** (**blue**) show a cost **disadvantage** (**benefit**) over the commercial base case.*

	Inception	**Development Start (Post-feasibility, pre-planning)**	**Planning Determination**	**Financial Close**
Panel I: Base Case				
ENPV (£)	43,671	60,734	178,032	283,700
LCOE (£ / kWh)	0.177	0.174	0.167	0.161
Panel II: Extra Preplanning and Planning Cost				
ENPV (£)	33,124	49,981	178,032	283,700
Δ%	(-24.2)	(-17.7)	(0.0)	(0.0)
LCOE (£ / kWh)	0.179	0.176	0.167	0.161
Δ%	(+1.0)	(+1.0)	(0.0)	(0.0)
Panel III: Preplanning and Planning Cost, Development time needed				
ENPV (£)	33,906	51,616	186,686	283,700
Δ%	(-22.4)	(-15.0)	(+4.9)	(0.0)
LCOE (£ / kWh)	0.178	0.175	0.165	0.161
Δ%	(+0.4)	(+0.2)	(-1.4)	(0.0)
Panel IV: Preplanning and Planning Cost, Development time needed, Labour input & day rate				
ENPV (£)	31,751	58,583	188,893	283,700
Δ%	(-27.3)	(-3.5)	(6.1)	(0.0)
LCOE (£ / kWh)	0.178	0.174	0.164	0.161
Δ%	(+0.6)	(-0.5)	(-1.6)	(0.0)
Panel V: Preplanning and Planning Cost, Development time needed, Labour input & day rate, Development probabilities				
ENPV (£)	-3,359	44,170	164,104	283,700
Δ%	(-107.7)	(-27.3)	(-7.8)	(0.0)
LCOE (£ / kWh)	0.185	0.175	0.165	0.161
Δ%	(+4.7)	(+0.4)	(-1.3)	(0.0)

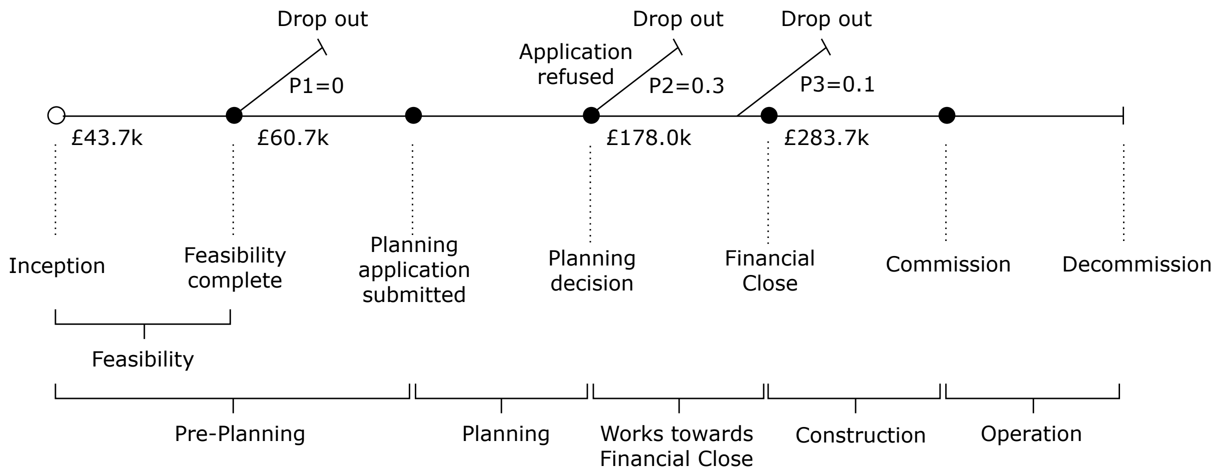

Figure 7*: Diagrammatic representation of the base case results: commercial ownership.*

Consider first the results in Panel II. As we would expect, an increase in the pre-planning and planning costs decreases the expected NPV of the project and increase the LCOE of electricity at both project inception and start of development. While the change in LCOE is small (+1%), the reductions in Expected NPV are significant and as high as 24% when conceded at inception phase, while somewhat less but still large just after the feasibility stage (-17.7%). Note that the values reported at planning determination and financial close remain unchanged in Panel II because these only consider expected costs and benefits incurred after these points in time.

In Panel III, we see that the differences in time requirements for project development have a small marginal effect on expected NPV or LCOE and in fact increase NPV and decrease LCOE somewhat compared to the results in Panel II. This is due to a combination of different effects. While the increase in the time before the project is operational and producing revenues decreases NPV, increasing the time of these phases reduces the discounted costs at each project stage. Further, the increase in time taken to conceive and explore project feasibility pushes pre-planning and financial costs into the future, which further reduces overall costs when valued from project inception.

Panel IV shows that the changes in labour input and cost of labour have a very marginal impact on overall project NPV and LCOE values. Valued from the project inception, this marginally decreases overall project NPV and increase LCOE. However, valued from the planning determination stages the project NPVs actually increase. This is due to two opposing effects, namely, a relative increase in the labour input required at each stage and a decrease in the day rate used (reflecting the lower valuation of volunteer time). The combined effect of changing the relative labour costs is that the net present value of labour costs of conception and feasibility increase, but the expected NPV of labour costs associated with pre-planning and from the planning decision to financial close decrease.

Finally, Panel V reports the impact of differences in the probabilities of project progress across ownership models. The results are shown diagrammatically in **Figures 8 and 9**. Allowing for higher risks of community ownership has a significant effect on the overall expected value of the project. Under the assumptions used in this analysis, a community project with the level of costs, time and project progress probabilities shown in **Table 2** would not be economically viable. In particular, the results suggest that when valued from inception, expected NPV declines by over 100% resulting in a negative expected NPV. The required LCOE to make the project viable increases to £0.185/kWh, which is above the net price used in the revenue calculations (i.e. the FIT). The difference between these two provides a broad indication of the increase in FIT that would be required by community projects to put them on the same cost basis as a commercial developer for this type of project. As expected, the relative negative difference in NPV and increase in LCOE when assessed at latter stages of the development process declines but is still large, with expected NPV almost 8% lower than that of the commercial scheme even after having secured planning approval.

The results from the model provide a clear indication that the main difference between community and commercial developer RE costs are associated with the higher risk faced by community groups. These can arise from the more complex internal processes of community groups, a lack of legitimacy, and a lack of skills and experience of those taking the project forward meaning that they have to rely on external agents to help them progress. The results described here are dependent on the underlying assumptions of the model. Different pre-planning costs, and more closely aligned probabilities would result in smaller differences in the overall costs and returns of the two types of owners. There are indications that community groups have a higher probability of gaining planning approval and allowing for this would again reduce the overall difference in expected returns/and LCOE of community groups relative to a commercially owned project. Further sensitivity analysis however suggested that the results are qualitatively robust, in that the implications of the higher riskiness associated with community projects gives rise to the most significant differences in relative project value. In contrast, allowing for the additional time taken for community projects to progress through the development process and valuing the cost of volunteer time did not have a substantial impact on community costs and even resulted in two situations where expected community NPV was estimated as higher than that of a commercially-owned project when assessed at later stages of the development process.

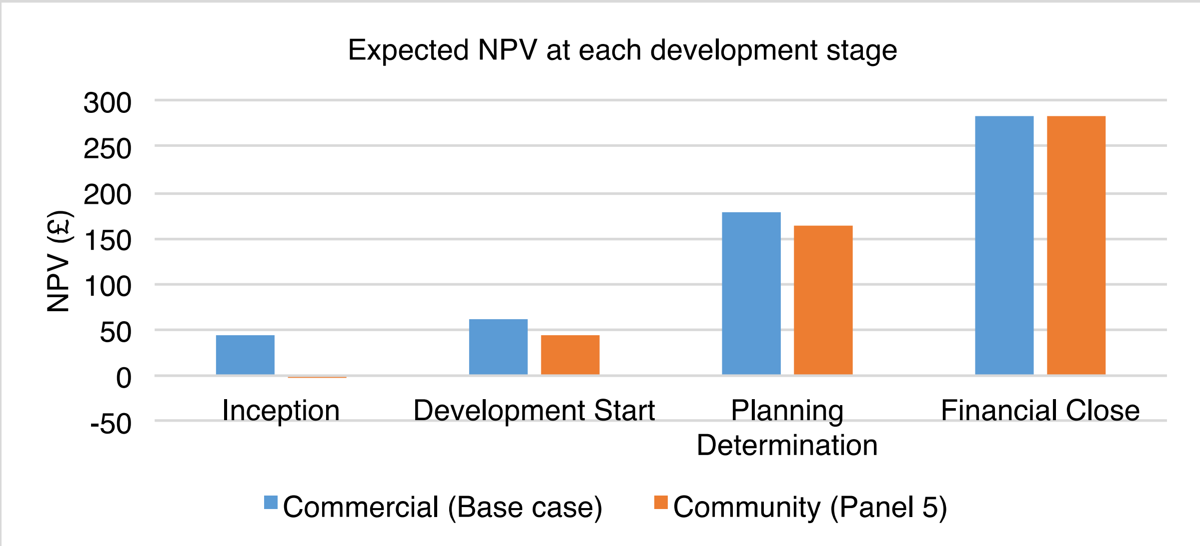

Figure 8*: Comparison of expected NPV from commercially-owned and community owned development at each project stage (£).*

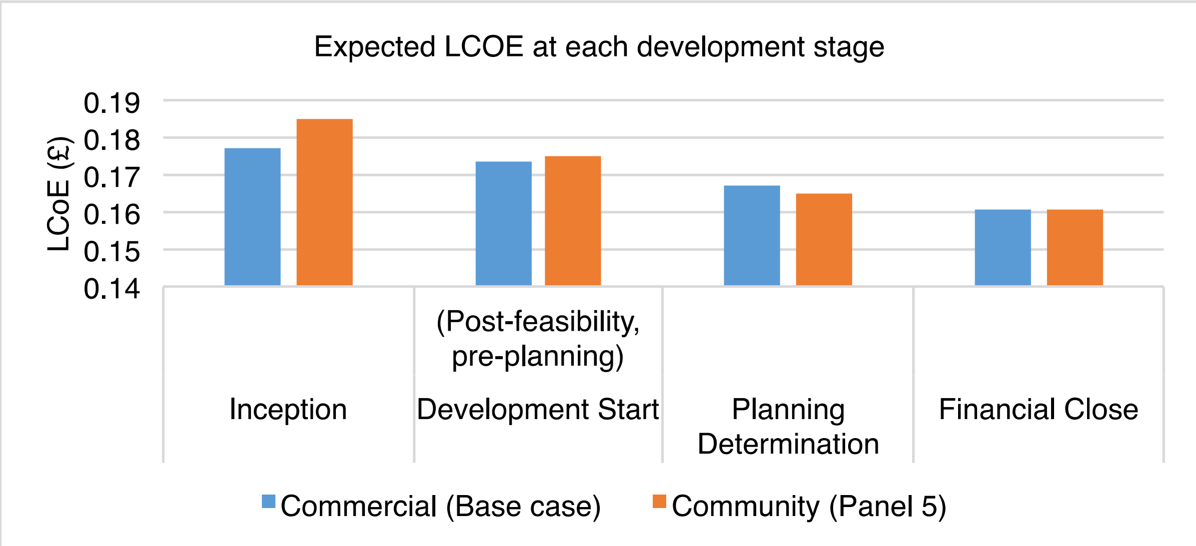

***Figure 9**: Comparison of LCOE from commercially-owned and community owned development at each project stage (£).*

5. Discussion & Conclusions

Inter-sectoral differences in nominal cost

Wholly community-owned projects

In order to control for the fact that a plethora of factors affect project cost, we employed a 'paired case study' approach to examine where in the development process inter-sectoral cost and time differences arose. The results are unambiguous: other things being equal, community projects cost more to get to planning, and take longer to do so. We ascribe this to a combination of higher internal process costs, asymmetric information, and higher transaction costs compared to commercial analogues. These differences are not visible in total project cost data, probably because pre-planning costs typically make up a minor proportion of total development costs, with up to 50% of capital costs incurred through technology acquisition.

Partnership projects

It has been argued that commercial-community partnership projects may present a vehicle that offers 'higher community MW per community £ invested'. Our findings corroborate this; and we attribute this to lower transaction costs and benefits from economies of scale enjoyed by community partners in these partnership projects.

Insights from an economic valuation model: the roles of risk and time

Our economic valuation model allowed us to take account of the role of risk (where different ownership types entail different project progress probabilities at different project stages) and time (where different ownership types entail different project development time periods). The key message from the analysis is that the higher risk involved in community projects at early stages of project development gives rise to the most significant differences in net project value vis-à-vis commercial projects.

Temporal trends in development costs

Community renewable energy projects are a relatively young phenomenon in Scotland, and trend data suggests that average sectoral costs (in £/MW terms) have declined over the past two decades. However, we found no statistically significant differences between average costs across ownership models for any one given capacity band or time period.

Clearly, understanding the reason(s) for the observed cost decline may hold important lessons for community energy policy. While traditional economies of scale, arising from decreases in average cost-per-unit due to increases in the scale of individual projects or the organisations behind them, play a major role, the results from the literature review, paired case studies and the economic valuation model show that there are additional factors at play. Although average project sizes have increased over time, the costs of delivering community projects within particular capacity bands have also decreased.

In the 1930s and 40s, Joseph Schumpeter famously argued that new methods of production emerged through a process of invention, innovation and diffusion, leading to a gradual reduction in costs per unit output (Jamasb, 2007; Jamasb & Köhler, 2007; Neij, 2008; Winskel et al., 2008). A relevant question that arises out of the more recent literature is where the source of the cost reductions lies: are decreasing costs just a natural consequence of people getting better at doing the same thing ('Learning by Doing'), or are they a result of active and directed technological innovation ('Learning by Research')? Different answers to this question entail different policy responses (Table 5).

Table 5: *Policy approaches to 'Learning by Doing' versus 'Learning by Research'*

	'Learning by Doing'	*'Learning by Research'*
Policy	Market development	Technology development
Slogan	"Grow the sector (to bring costs down)"	"Bring costs down (to grow the sector)"
Action	Stabilise and grow the market	Actively support innovation

The possible tension between these two approaches is real, as exemplified in scenarios developed for The Crown Estate's (2012) report on Offshore Wind Cost Reduction. In their 'Technology Acceleration' scenario, technological innovation brings costs down but the supply chain must continuously adapt to new technologies. In their 'Supply Chain Efficiency' scenario, on the other hand, market consolidation allows the supply chain to achieve economies of scale but innovation is limited. The best of both worlds would entail bringing stability to the supply chain while incorporating technological breakthroughs – a delicate balancing act requiring carefully targeted policy.

On the basis of field experience, we would point to several dominant policy and non-policy drivers that we think have exerted a downward pressure on the average cost of Scottish community renewables, through both 'Learning by Doing' and 'Learning by Research' effects. On the policy side, the delivery of support mechanisms for community renewables (e.g., SCHRI and CARES) has evolved dynamically in response to challenges facing the sector, driving costs down over time. Examples of policy innovations include improved due-diligence processes implemented during the assessment of CARES loan applications; the introduction of a £10k CARES 'Start-up Grant' scheme; and the introduction of a project management procurement framework. Non-policy drivers include the increasingly important role of intra-sectoral (that is, inter-community) learning as the number of Scottish community renewables projects has grown.

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Appendix A: 'Comparative Costs of Renewable Energy Survey'

This survey has been prepared for a Scottish Government research project, conducted by the ClimateXChange Secretariat, The James Hutton Institute and Scene Consulting. This survey forms part of a research project aimed at assessing the comparative costs of community and commercially owned renewable energy projects. The research is aimed at assisting Scottish policy makers in considering options for future renewable energy strategies. The survey requires information relating to project specifications and costs. Please complete the questions as accurately as possible.

Section 1 – Basic Information

Please fill out the boxes below with your contact details and information about your organisation.

CONTACT DETAILS

CONTACT NAME	
PHONE NUMBER	
EMAIL ADDRESS	

ORGANISATION DETAILS

ORGANISATION NAME	
ORGANISATION LEGAL STRUCTURE (E.G. PRIVATE LIMITED COMPANY, DEVELOPMENT TRUST)	
NUMBER OF EMPLOYEES OR MEMBERS (INCLUDE DETAILS - I.E. FTE)	
NUMBER OF RENEWABLE PROJECTS INVOLVED IN	
TOTAL OPERATIONAL CAPACITY DEVELOPED (NOTE WHETHER AS CONSULTANT OR DEVELOPER)	
TOTAL OPERATIONAL CAPACITY CURRENTLY OWNED	

Section 2 – Project Specifics

Please fill out the boxes below regarding the renewable energy project specified in previous communications with the research team.

TECHNOLOGY

PROJECT NAME	

TYPE OF TECHNOLOGY	Onshore Wind / Hydro / Solar
TECHNOLOGY DETAIL (E.G. LOW-HEAD HYDRO, SOLAR PV ETC., X TURBINES ETC.)	
TOTAL RATED CAPACITY (KW)	
TECHNOLOGY MAKE & MODEL	
LAND OWNERSHIP (E.G. OWNED, LEASED, ETC.)	

LOCATION

LOCAL AUTHORITY AREA	
DISTANCE FROM A MAJOR POPULATION CENTRE (I.E. DISTANCE TO NEAREST TOWN)	
MAINLAND OR ISLAND BASED	Mainland / Island

TIMESCALE

TOTAL TIME TAKEN FOR DEVELOPMENT FROM FEASIBILITY TO COMMISSIONING (E.G. 2 YEARS 1 MONTH)	
TIME TAKEN FROM START OF FEASIBILITY WORK TO SUBMISSION OF PLANNING APPLICATION	
TIME TAKEN FROM GRANTING OF PLANNING PERMISSION TO COMMISSIONING	
YEAR AND MONTH OF COMMISSIONING	

Section 3 – Project Finances

This section is aimed at understanding the finances and costs of your renewable project. Please fill out the boxes as accurately as possible, there is space below for further financial or cost information.

FINANCES	
PROJECT LEGAL STRUCTURE (E.G. COMPANY LIMITED BY GUARANTEE, INDUSTRIAL AND PROVIDENT SOCIETY ETC.)	
SUPPORT MECHANISMS USED (E.G. FEED-IN-TARIFF, ROC)	

SOURCE(S) AND DETAILS OF DEVELOPMENT FUNDING (E.G. CARES, OWN FUNDS, ETC.) **PLEASE STATE VALUE OF FUNDING WHERE KNOWN.**	
SOURCE(S) AND DETAILS OF CAPITAL FUNDING (E.G. SHARE OFFER, BANK LOAN, OWN FUNDS ETC.) **PLEASE STATE VALUE OF FUNDING WHERE KNOWN.**	

OVERALL COSTS

TOTAL PROJECT COSTS (UP TO FIRST GENERATION)	
TOTAL ANNUAL OPERATIONAL COSTS	
ANTICIPATED/ACTUAL ANNUAL PROJECT RETURNS (I.E. ANNUAL OPERATIONAL PROFIT/YIELD)	
	%

COST BREAKDOWN

	Monetary Expenditure	Expenditure in-kind (Please estimate the staff time invested into this project, and thereby the estimated in-house cost expended)	Total Expenditure
FEASIBILITY (INCL. ALL WORKS TOWARDS ASSESSING PROJECT FEASIBILITY, I.E. NOT SUPPORTING INFORMATION FOR LICENSING APPLICATIONS)		Estimated staff time/cost spent on project: ___________ days	
PRE-PLANNING AND PLANNING (INCL. ALL WORKS FOR PLANNING AND LICENSING, PLANNING FEE)		Estimated staff time/cost spent on project: ___________ days	
PRE-PLANNING FINANCE (INCL. RATE, TERM AND ANY IMPORTANT CONDITIONS)	%: Term:		

	Notes:		
FINANCIAL CLOSE (INCL. ALL LEGAL, FINANCIAL AND TECHNICAL WORK)		Estimated staff time/cost spent on project: ___________ days	
GRID COSTS (INCL. CONNECTION FEES AND INFRASTRUCTURE)		Estimated staff time/cost spent on project: ___________ days	
PLANT (INCL. GENERATION INFRASTRUCTURE, DELIVERY AND INSTALLATION)		Estimated staff time/cost spent on project: ___________ days	
ENGINEERING (INCL. DESIGN, ELECTRICAL, CIVIL, STRUCTURAL)		Estimated staff time/cost spent on project: ___________ days	
POST-PLANNING FINANCE (INCL. RATE, TERM AND ANY IMPORTANT CONDITIONS)	%: Term: Notes:		

FURTHER INFORMATION ON SPECIFIC COST ITEMS (INCLUDED IN ELEMENTS ABOVE)

LANDSCAPE AND VISUAL IMPACT ASSESSMENT	
TRANSPORT ASSESSMENT	
OPTION/LEASE AGREEMENT LEGAL FEES	
FINANCIAL MODELLING PRE-FINANCIAL CLOSE	

ADDITIONAL PROJECT COST INFORMATION:

Section 4 – Further Comments

Please use this section to add any further comments, thoughts or questions relating to this survey or the research project more generally.

FURTHER COMMENTS:

Thank you for your assistance.

For further information, to provide comments or to get in touch, please contact either the ClimateXChange Secretariat or Scene Consulting Ltd.

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Appendix B: Summary overview of data collected and data specifications

Table B1: *Overview of capacity bands used for different generation technologies.*

Technology	***Capacity band (kW)***			
	'Small'	*'Medium'*	*'Large'*	*'Very Large'*
Wind (onshore)	< 250	250 – 1,000	1,000 – 2,000	> 2,000
Hydro (run-of-river)	< 50	50 – 150	150 – 500	500 – 2,000
Solar PV (rooftop and ground-mounted)	< 50	50 – 100	150 – 500	500 – 2,000

Tables B2, B3 and B4 below summarise the data collected and used for this study.

Table B2: *Overview of data obtained through interviews conducted for this study.*

Sector	***Technology***	***Capacity band***				
		Small	*Medium*	*Large*	*Very Large*	*TOTAL (for specific technology)*
Commercial (n = 23)	Wind (onshore)	1	6	3	1	*11*
	Hydro (run-of-river)	0	3	1	6	*10*
	Solar PV (groundmount or rooftop)	0	2	0	0	*2*
Community (n = 15)	Wind (onshore)	2	4	2	1	*9*
	Hydro (run-of-river)	0	3	2	0	*5*
	Solar PV (ground-mount or rooftop)	1	0	0	0	*1*
TOTAL (both sectors)		**4**	**18**	**8**	**8**	***38***

Capacity bands: 'Small' = <250 kW for wind, <50 kW for others; 'Medium' = 250 – 1,000 kW for wind, 50 – 150 kW for others; 'Large' = 1000 – 2,000 kW for wind, 150 – 500 kW for others; 'Very Large' = >2,000 kW for wind, 500 – 2,000 kW for others.

Table B3: *Overview of commercial cost data used from 'grey literature'.*

Sector	*Technology*	*Capacity band*				
		Small	*Medium*	*Large*	*Very Large*	*TOTAL (for specific technology)*
Commercial	*Wind (onshore)*	0	3	5	7	*15*
	Hydro (run-of-river)	0	10	2	3	*15*
	Solar PV (groundmount or rooftop)	1	2	0	0	*3*
TOTAL		**1**	**15**	**7**	**10**	***33***

Capacity bands: 'Small' = <250 kW for wind, <50 kW for others; 'Medium' = 250 – 1,000 kW for wind, 50 – 150 kW for others; 'Large' = 1000 – 2,000 kW for wind, 150 – 500 kW for others; 'Very Large' = >2,000 kW for wind, 500 – 2,000 kW for others.

Sources: BVG Associates (2014) 'Future Renewable Energy Costs: Onshore Wind'; Renewable UK (2014), 'Wind Energy in the UK: State of the Industry Report 2014'; Garrad Hassan (2010), 'UK Onshore Wind - the true cost now & in the future'; Department of Energy & Climate Change (2011), 'Review of the generation costs and deployment potential of renewable electricity technologies in the UK'; British Hydropower Association (2012), 'Industry evidence for 2012 FiTs & ROCs'; Department of Energy & Climate Change (2013), 'Small Scale Solar PV Cost Data' (2013); and references cited in the foregoing.

Table B4: *Overview of partnership and community cost data used from the Scene database* (see Harnmeijer *et al.*, 2012 for methods and description).

Sector	*Technology*	*Capacity band*				
		Small	*Medium*	*Large*	*Very Large*	*TOTAL (for specific technology)*
Partnership	Wind (onshore)	0	1	0	7	*8*
Community	Wind (onshore)	3	15	2	3	*23*
	Hydro (run-of-river)	1	9	3	2	*15*
	Solar PV (ground-mount or rooftop)	2	1	0	4	*7*
TOTAL (capacity band)		**6**	**26**	**5**	**16**	***53***

Capacity bands: 'Small' = <250 kW for wind, <50 kW for others; 'Medium' = 250 – 1,000 kW for wind, 50 – 150 kW for others; 'Large' = 1000 – 2,000 kW for wind, 150 – 500 kW for others; 'Very Large' = >2,000 kW for wind, 500 – 2,000 kW for others.

Data Specifications

- The raw data on which this report is based is both sensitive and technical. While every effort has been made to ensure that our data is of the highest quality, the majority was obtained through structured interviews rather than through direct access to audited financial records. Thus, the data may be prone to some degree of human error.
- Where installations are down-rated, the actual operational (that is, down-rated) capacity is used for the purposes of unit costs (£/MW) calculations. In consequence, down-rated projects can be expected to exhibit an upward bias in reported unit cost.

- Nominal costs are recalculated in terms of 2015 pounds using RPI time-series (Office of National Statistics, 2015). Where applicable, exchange rates prevailing at the time of transaction were used. All costs are presented exclusive of VAT.
- Timescales and expenditure profiles vary from project to project, making it difficult to account for inflation in the absence of accurately dated cash-flow data. To simplify calculations and limit the length of surveys, all project costs are treated as if they were incurred in the year of commissioning. This will exert a downward bias on costs reported for projects with longer development histories.
- To simplify the analysis and ensure compatibility between our empirical and theoretical workstreams, cost and timing data around connecting to the grid, appealing local planning decisions, and debt finance were not considered in detail.
- Nominal cost data pertains to completed projects: hence there is a sample selection bias, as community projects disproportionately don't make it to the point that there is an overall nominal project cost to be measured.

Appendix C: Paired Case Study Data

(1) 'Small Wind – Single Turbine' (Table C1):

Sector and Capacity	225 kW Commercial Project	250 kW Community Project
Project Overview		
Project Stage	Operational	Operational
Local Authority	Aberdeenshire	Highland
Land Ownership Status	Leased	Leased
Mainland / Island	Mainland	Mainland
Project Specifics		
Project Development Timescale	42 months	30 months
Inception – Planning Submission Timescale	6 months	6 months*
Planning Granted – Commissioning Timescale	24 months	18 months
Commissioning Date	December 2014	June 2014
Support Mechanism	FiT	FiT
Source of Development Funds	Own Funds	Developer Funds
Source of Capital Funding	Own Funds	Share Offer
Total Project Costs	£970,000	£800,000
Annual Operational Costs	£35,000	£14,000
Annual Pre-Tax Project Returns £ (%)	£85,000 (8.8%)	£84,000 (9.8%)
Development Component Costs		
Pre-Planning	£12,000	£45,000 (+ 275%)
Financial Close	N/A	£30,000
Grid Connection	£114,000	£110,000
Mechanical Plant	£360,000	£615,000
Engineering	£235,000	
Site Purchase	£249,000	*
Cost of Capital Finance	N/A	N/A

* Project brought through planning by landowner and developed through an energy co-operative.

This paired case study illustrates a common feature in our data (pertinent row shaded blue in this and subsequent tables): ***communities typically spend more cash in getting projects to planning***.

(2) 'Medium Wind – Single Turbine' (Table C2):

Sector and Capacity	500 kW Commercial Project*	800 kW Community Project
Project Overview		
Project Stage	Operational	Operational
Local Authority	Highland	Aberdeenshire
Land Ownership Status	Leased	Leased
Mainland / Island	Mainland	Mainland
Project Specifics		
Project Development Timescale	34 months	60 months
Inception – Planning Submission Timescale	14 months	24 months (+ 71%)
Planning Granted – Commissioning Timescale	14 months	19 months
Commissioning Date	January 2014	July 2011
Support Mechanism	FiT	FiT
Source of Development Funds	Own Funds	Big Lottery, LEADER, SCHRI/ CARES, Aberdeen Council, Community Council
Source of Capital Funding	Private Equity	100% Commercial Bank
Total Project Costs	£1,600,000	£1,829,000
Annual Operational Costs	£85,000	£65,900
Annual Pre-Tax Project Returns £ (%)	£320,000 (20%)	£469,500 (25.6%)
Development Component Costs		
Pre-Planning	£30,000	£52,100 (+ 25%) + 210 volunteer days
Financial Close	£90,000	£110,200 + 120 volunteer days
Grid Connection	£130,000	£233,550
Mechanical Plant	£800,000	£1,106,000
Engineering	£550,000	£328,250 + 22 volunteer days
Site Purchase	-	-
Cost of Capital Finance	N/A	unknown

* This project uses a down-rated 800/900 kW turbine and is therefore directly comparable.

This paired case study illustrates another common feature in our data (pertinent row shaded gray in this and subsequent tables): ***community projects typically take significantly longer to get to planning***.

(3) 'Large Wind – Single Turbine' (Table C3):

Sector and Capacity	1.5MW Commercial Project	1.5MW Community Project
Project Overview		
Project Stage	Planning Submitted	Planning Submitted
Local Authority	Fife	Highland
Land Ownership Status	Leased	Leased
Mainland / Island	Mainland	Mainland
Project Specifics		
Project Development Timescale	84 months	25 months
Inception – Planning Submission Timescale	24 months	22 months
Planning Granted – Commissioning Timescale	18 months (expected)	-
Commissioning Date	June 2016	-
Support Mechanism	FiT	FiT
Source of Development Funds	Lottery Grant	Energyshare, Own funds, Resilient Scotland, CARES, Private funding
Source of Capital Funding	Own Funds, Turbine Manufacturer	N/A
Total Project Costs	£3,256,000	£3,158,000
Annual Operational Costs	£70,000	£101,500
Annual Pre-Tax Project Returns £ (%)	£410,000 (12.4%)	£406,000 (12.9%)
Development Component Costs		
Pre-Planning	£56,000 + 72 days	£100,000 (+ 79%) + 50 days
Financial Close	£250,000	£70,000
Grid Connection	£450,000	£588,000
Mechanical Plant	£2,450,000	£1,900,000
Engineering	£50,000 + 20 days	£500,000
Site Purchase	-	-
Cost of Capital Finance	10 years @ 6%	N/A

* Includes periods of inactivity

(4) 'Very Large Wind – Multiple Turbines' (Table C4):

Sector and Capacity	9 MW Commercial Project	9 MW Community Project
Project Overview		
Project Stage	Operational	In Construction
Local Authority	North Lanarkshire	Comhairle nan Eilean Siar
Land Ownership Status	Leased	Leased
Mainland / Island	Mainland	Island
Project Specifics		
Project Development Timescale	50 months	96 months
Inception – Planning Submission Timescale	14 months	38 months (+ 171%)
Planning Granted – Commissioning Timescale	30 months	36 months
Commissioning Date	August 2013	April 2015
Support Mechanism	ROC	ROC
Source of Development Funds	Own Funds	CARES
Source of Capital Funding	Senior Debt (£12m), Equity (£7m)	Santander, REIF, SIS, Big Lottery
Total Project Costs	£18,315,000	£14,600,000
Annual Operational Costs	£625,500	£650,000
Annual Pre-Tax Project Returns £ (%)	£1,952,400 (10.7%)	£1,984,800 (13.6%)
Development Component Costs		
Pre-Planning	N/A (site purchased post-consent)	£240,000
Financial Close	£188,800	£800,000
Grid Connection	£1,265,800	£1,600,000
Mechanical Plant	£8,226,800	£9,400,000
Engineering	£2,046,000	£2,560,000
Site Purchase	£5,273,600	-
Other Costs (inc. contingencies)	£1,314,000*	-
Cost of Capital Finance	7 years @ 6.35%	7 years @ 6% Commercial; 10 years @ 8% Public

* Project management, insurance & legal fees(£829k); NATS (£63k); Contingency (£422k)

(5) 'Medium Hydro' (Table C5):

Sector and Capacity	100 kW Commercial Project	100 kW Community Project
	Project Overview	
Project Stage	Operational	In Construction
Local Authority	Perth & Kinross	Highland
Land Ownership Status	Owned	Leased from Community Council
Mainland / Island	Mainland	Mainland
	Project Specifics	
Project Development Timescale	25 months	56 months
Inception – Planning Submission Timescale	6 months	16 months
Planning Granted – Commissioning Timescale	21 months	36 months
Commissioning Date	May 2014	October 2015 (expected)
Support Mechanism	FiT	FiT
Source of Development Funds	Own Funds	CARES, SSE
Source of Capital Funding	Own Funds + Bank Loan	Share Offer, REIF
Total Project Costs	£655,000	£727,000
Annual Operational Costs	£20,480	£12,500
Annual Pre-Tax Project Returns £ (%)	£115,700 (17.7%)	£107,000 (14.7%)
	Development Component Costs	
Pre-Planning	£33,800	£70,000 (+ 107%)
Financial Close	£2,050	-
Grid Connection	£41,000	£16,000
Mechanical Plant	£128,000	£105,000
Engineering	£450,150	£496,000
Site Purchase	-	£40,000
Cost of Capital Finance	N/A	6.75%

(6) 'Large Hydro 1' (Table C6):

Sector and Capacity	500 kW Commercial Project	450 kW Community Project
Project Overview		
Project Stage	In Construction	Operational
Local Authority	Highland	Stirling
Land Ownership Status	Leased	Leased
Mainland / Island	Mainland	Mainland
Project Specifics		
Project Development Timescale	28 months	72 months
Inception – Planning Submission Timescale	3 months	36 months (+ 1100%)
Planning Granted – Commissioning Timescale	21 months	28 months
Commissioning Date	September 2015 (expected)	September 2014
Support Mechanism	FiT	FiT
Source of Development Funds	Own Funds	CARES
Source of Capital Funding	Own Funds + Commercial Bank	REIF + Commercial Bank
Total Project Costs	£2,200,000	£2,040,000
Annual Operational Costs	£26,500	£25,000
Annual Pre-Tax Project Returns £ (%)	£379,000 (17.2%)	£280,000 (13.7%)
Development Component Costs		
Pre-Planning	£37,000 + 46 days	Cost breakdown unavailable
Financial Close	£35,000 + 40 days	
Grid Connection	£197,000 + 20 days	
Mechanical Plant	£472,000	
Engineering	£1,300,000	
Site Purchase	-	
Other Costs (inc. contingencies)	£159,000	
Cost of Capital Finance	15 years @ 7%	~6% Commercial; ~8% Public

(7) 'Large Hydro 2 ' (Table C7):

Sector and Capacity	500 kW Commercial Project	390 kW Community Project
Project Overview		
Project Stage	In Construction	In Construction
Local Authority	Stirling	Comhairle nan Eilean Siar
Land Ownership Status	Owned	Leased
Mainland / Island	Mainland	Island
Project Specifics		
Project Development Timescale	30 months	60 months
Inception – Planning Submission Timescale	16 months	24 months (+ 50%)
Planning Granted – Commissioning Timescale	18 months	24 months
Commissioning Date	September 2015 (expected)	April 2015 (expected)
Support Mechanism	FiT	FiT
Source of Development Funds	Own Funds	CARES
Source of Capital Funding	Own Funds + Private Equity	Share Offer + REIF + Commercial Bank
Total Project Costs	£1,700,000	£1,300,000
Annual Operational Costs	£45,000	£18,000
Annual Pre-Tax Project Returns £ (%)	£355,000 (20.9%)	£235,000 (18.1%)
Development Component Costs		
Pre-Planning	£60,000	£150,000 (+ 150%)
Financial Close	-	£93,000 + 230 days
Grid Connection	£187,000	£230,000 + 12 days
Mechanical Plant	£503,000	£140,000 + 5 days
Engineering	£940,000	£485,000
Site Purchase	-	-
Other Costs (inc. contingencies)		£202,000
Cost of Capital Finance	N/A	12 years @ 6% Commercial; 10 years @ 7.5% Public

Appendix D: Statistical Analysis

Results of one tailed T-tests comparing community and commercial wind costs at different capacity bands and periods of commissioning. µ = Average value, se= standard error, T= T-value, p= P- value , df= degrees of freedom.

Sample subset	Community mean	Commercial mean	One tailed T- test
< 1000 kW	µ= 2623.4 se= 279.30	µ= 3141.95 se= 223.40	T= -0.97 p= 0.83 df= 29
> 1000 kW	µ= 1780.26 se= 106.60	µ= 2017.32 se= 120.39	T= -1.43 p= 0.91 df= 14
Commissioned before 2012	µ= 2623.55 se= 450.70	µ= 2057.96 se= 72.33	T= 0.66 p= 0.261 df= 16
Commissioned at or after 2012	µ= 2276.10 se= 186.82	µ= 2659.81 se= 229.79	T= -1.30 p= 0.90 df= 27