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Authored by –Entwistle, G., Roberts, D., and Xu, Y.

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Measuring the Local Economic Impact of Community-Owned Energy Projects

Final Report

The James Hutton Institute working in partnership with Gilmorton Rural Development
For
Community Energy Scotland

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Garth Entwistle*, Deborah Roberts[Π] & Yan Xu[Π]

* Gilmorton Rural Development, Aberdeenshire[1]. Email:garth.entwistle@gmail.com
[Π] Social, Economic & Geographical Sciences Group, The James Hutton Institute.
Email: deb.roberts@hutton.ac.uk; yan.xu@hutton.ac.uk

[1] Significant use is made of unpublished work commissioned in 2013 by Grampian Housing Association and prepared by Gilmorton Rural Development (Entwistle, 2013).

1. Executive Summary

1.1 Gilmorton Rural Development and The James Hutton Institute were commissioned by Community Energy Scotland to prepare a framework for measuring the local economic impact of community-owned energy projects, working with alternative business models for raising finance and retailing energy which may increase local social and economic impacts.

1.2 The framework focusses on communities of "place" rather than communities of "interest". In particular, the focus is on community groups within a specific locality, involved in renewable energy projects in that locality, either working by themselves or within a Joint Venture with other parties. Community Benefit Funds and renewable developments by locally-owned businesses are not considered. The "place", the locality, is considered to be the area community residents identify with most closely and have an immediate involvement with. This will include the area in which community residents live, socialise on a day-to-day basis and conveniently shop.

1.3 In analysing economic impacts, the word 'community' is used in three distinct senses in this report:

- The community organisation which develops and owns the renewable energy project, or holds a stake in a project in the case of joint ventures with other partners. In Scotland this is typically a non-profit distributing organisation, usually with charitable status, whose primary purpose is to undertake activity for the collective benefit of a defined geographic community. A special purpose vehicle (SPV), usually a wholly owned trading subsidiary, is used to manage the project and transfer profits to the parent community organisation. Income received by the community organisation is typically used for 'common good' causes, either through the distribution of grants or direct investment by the community organisation.
- Local community investors in a project, where part of the finance required has been raised locally, either through a community share offer or bond issue.
- The totality of the local economic system within a community, which includes all economic activity within the defined geographic area.

1.4 The analysis focuses on case studies of community-owned onshore wind developments, although community hydro projects were also considered in our study. A standard case study example is developed, based on a 900kW wind turbine, using the most common form of ownership model in Scotland to date.

1.5 This assumes that the community organisation is non-profit distributing, and the finance for the capital costs of the project is raised by a 'non-recourse' commercial loan from a bank.

1.6 This shows that community income arises from five main sources:

- Pre-planning income. Generally very little income is received locally when most time is given voluntarily at little or no charge.
- Construction impacts. The involvement of local contractors in on-site civil and electrical works is estimated to bring approximately £10,000 (with a 900kw turbine) into the locality at the beginning of the project

- Impacts arising from the operation and maintenance of the project. These typically involve land rental and local management charges – estimated at £20,000 per annum with a 900kW turbine.
- Operational income from renewable energy generation and sale. This ranges from approximately £100,000 per annum (800kW turbine - Udny) with a good wind resource to around £250,000 per annum (900kW turbine - Tiree) in exceptional west coast/northern Isle cases. This approximates to £125,000 - £280,000 per MW of capacity.
- This funding, in-turn, leverages in significant additional match-funding from a wide range of public and private sources, typically 1.5 – 3.0 times the value of the operational income alone.

1.7 Alternative business models which increase the income and associated economic activity retained within a community, are considered as:

- Accessing finance through a community Share Offer, or other local finance models involving, for example; Community Bonds or Debentures, such that the cost of capital for the community generator is reduced and/or a greater proportion of the finance costs associated with the project are retained within the local community.
- Selling electricity directly to local customers at retail prices, rather than the wholesale prices that are received for sale to licensed suppliers using a Power Purchase Agreement. Currently this is only possible using 'private wire' connections but new commercial and regulatory models are emerging which may increase the scope for direct supply.

1.8 Accessing finance through the offer of shares is becoming increasingly popular as the cost of capital using a community share offer may be less than commercial finance charges, and the cost of arranging a share offer for a small scale project is typically less than the due diligence costs of bank loans offered without asset-based security. For the purposes of this report, community share offers are estimated to provide finance at a 2% discount to bank loans and provide investors an approximate 2% premium over most comparable alternative investment opportunities. Share offers emphasising community benefit may be able to achieve greater benefits to the project with significantly lower interest charges.

Where local investors take-up 25% of a £1.0m Share Offer – representing a combined investment of £250,000 – with typically, a 2% premium offered over other locally available investment opportunities, an additional £5,000pa will accrue to local investors within the community, a portion of which will be spent on local goods and services.

Of more significance is the annual reduction in finance charges faced by the project. A 2% reduction in interest charges on a £1.0m loan will save the project around £20,000pa, adding to project net revenues within the community.

1.9 The sale of electricity at a premium to conventional wholesale rates has been shown to have the potential to significantly boost the income to both a project and therefore to the community, making the whole project more economically feasible. While it may be difficult for most communities to install private wire infrastructure due to the distances between generators and consumers or the legal challenges of securing wayleaves and commercial agreements, , where opportunities can be identified, the financial performance of the project will be enhanced.

For the purposes of this report, it is assumed that electricity supplied to local customers via private wire, represents an increase of approx. 80%/MWh (+4p/kWhr) for the community generator compared to standard PPA terms, and a saving of 26%/MWh (-4p/kWhr) for customers supplied by the community generator.

Community groups have generally been unable to reduce energy costs to local residents because of constraints to the supply and distribution of electricity. However, the UK energy industry is actively exploring systems involving relatively small volumes of electricity being conveniently matched between producers and consumers, allowing community groups to more closely approach the final consumer. We are aware that Community Energy Scotland is actively exploring these opportunities in collaboration with Highlands and Islands Enterprise and Scottish community groups through CARES Infrastructure and Innovation Funding and the Local Energy Economies Programme.

1.10 A review of methods of measuring the local impact of community-owned renewable energy projects concluded that the LM3 tool was the most appropriate method for measuring local economic impact with other approaches (input-output, Keynesian local multipliers) methods more appropriate to larger areas. The LM3 tool - developed by the New Economic Foundation (NEF) traces, with the support of community surveys, the first three rounds of spending within a community. This represents, in most cases, the vast majority of economic activity related to an economic injection. In the LM3 handbook, Sacks (2002) outlined two options (paths) depending on whether the starting point is an organisation, or a group of people, though the overall process is the same.

1.11 Application of the LM3 model using the Tiree renewable energy project (900kW wind turbine) as a case study found the following:

- The local economic impact of community-owned wind turbines during the construction stage is fairly low. In this case, the local injection was estimated as £10,000 and it generated an estimated total impact of £13,330 after having allowed for multiplier effects.
- The local economic impact associated with the operation and maintenance of a development over its lifespan is larger but remains relatively small. In the Tiree case study, the annual impact was estimated as £25,691 with a NPV of £320,167 over a 20-year period.
- The local economic impact of community projects funded by operational income from the wind turbine is far greater and generates higher multiplier effects. In particular, the overall multiplier effect in Tiree associated with projects funded through operational income (including funding leveraged from other sources) was 1.41, the (total) annual impact estimated at £684,909, resulting in a NPV of £8.535m when calculated over a 20-life span of the development.
- In relation to the alternative business models, the local economic impact of finance raised at preferential rates through a Share Offer is shown to give a NPV of £166,121 when the additional income to individuals' flows into the community is considered, through an estimated 25% involvement in the share offer. The additional income available through the project due to lower finance charges is more significant with a NPV of £2.972m.
- The local economic impact of reduced energy (electricity) costs within a community, while recognised as difficult to estimate, gives an estimated NPV of £842,434. More significantly, the additional income flowing into project activity derived from selling

electricity at a premium to the wholesale price levels within most Power Purchase Agreements (PPAs) gives an estimated NPV of £3.769m.

1.12 The above results are specific to one case study area with a 900kW wind turbine. Varying returns to scale make it difficult to convert the results onto a MW basis. Moreover the returns will be highly dependent on local conditions and decisions made by communities in relation to expenditure.

1.13 Given the current difficulties of arranging local electricity sales at preferential rates, the findings suggests that the local economic benefits from community renewables would be significantly enhanced by accessing local finance to support increased levels of community activity.

1.14 The analysis illustrates how the LM3 approach can be used by communities to differentiate between the local economic impacts of different types of activity and can thus help inform community decisions on project choices. It is recognised, however, that community action will always be primarily determined by the needs of the particular locality and (when driven by volunteers) the enthusiasm's of individual activists.

1.15 The analysis highlighted several uncertainties inherent to the process of estimating the local economic benefits of a renewable energy project. Some of the issues highlighted are methodological (for example the additionality of project funding and project activities; the extent to which new activity displaces other activities either in the locality or further afield), others are practical (for example assumptions on the appropriate discount rate to calculate the Net Present Value of future income flows). Given the number of assumptions required, it is suggested that sensitivity analysis should be conducted to provide a means of assessing the robustness of the findings. Alternatively, communities should be made aware of the assumptions implicit within the calculations.

1.16 The findings complement those of previous studies which have shown that communities involved in the development of community-owned renewable energy projects are found to be more confident, resilient and have higher levels of wealth than they would otherwise with no involvement in renewables. These communities are widely recognised to be empowered to make things happen within their communities and, as part of the process of change, to improve the community's skill base.

1.17 Moving forward, Community Energy Scotland (CES) may wish to explore the systems currently under development by the UK energy industry which aims to match relatively low volumes of electricity generated with consumers to allow both parties to benefit from more favourable price levels.

1.18 It is also suggested that CES test the LM3 approach in both an ex ante and ex poste context with communities considering/operating a community-owned renewable energy facility to confirm this model's acceptability as a measure of local economic impacts of renewable energy.

2. Introduction

In April 2014, Gilmorton Rural Development and the James Hutton Institute were commissioned by Community Energy Scotland (CES) to prepare a framework for measuring the local economic impact of community-owned energy projects. Renewable Energy policies have encouraged the widespread development of renewable energy throughout the UK and the community ownership of such schemes has increased over time. However, recent changes in policy and energy markets (see Appendix 1) may alter the nature of, and potential benefits from, new community-owned energy projects. Thus the project also considers developments in community-owned business models which may mitigate in-part the impact of these changes.

Specifically, the project involved the following tasks:

(i) Specify alternative community-owned business models which aim to maximise benefit to the involved communities
(ii) Estimate current and future financial flows into communities and local economies from community-owned projects associated with these alternative business models.
(iii) Review alternative approaches to measuring the total local economic impact of these financial flows.
(iv) Construct a framework for communities to use to measure the potential local economic impacts of community-owned energy projects and illustrate using case study data.
(v) Identify the risks and uncertainties associated with the estimation of local impacts and propose methods to mitigate the effects of this risk and uncertainty

In addition, the project team were asked to review previous studies of the broader socio-economic impacts for local communities arising from their involvement in renewable energy developments based on published and un-published sources. This was supported by the observed impact of the research team. The findings of this review are given in Appendix 2.

Community energy projects have previously been defined by CES as “renewable energy developments (created) by geographically defined communities and which are wholly or partially owned by community organisations” (Gubbins, 2010). CES would differentiate these geographical communities of affected and involved parties – defined by “place” – from ”communities of interest”, sometimes including local people though often not, with interests; perhaps as developers, investors or operators, of some type in a development. This project assumes this definition of a geographically bounded community and considers only developments wholly or partially owned by a community organisation. No account is taken of Community Benefit payments by private developers.

The geographic area involved in such projects, the “place”, will best be defined by the community itself. It will be the area community members, residents, most closely identify with. It will include where they live and the locality within which they normally socialise and perhaps, though not necessarily, conveniently shop. Each community will define the boundaries of their community in their own specific way.

Alternative business models for raising finance and retailing energy and which may increase local social and economic impacts will be described. Following this, a framework will be constructed and presented which allows for the estimation of local economic impact.

While, a wide range of alternative energy technologies are available to individual communities, this report will confine itself to the use of case studies of community owned wind turbines. However, the frameworks developed will be applicable to any renewable energy technology utilised by community groups.

3. Specification of Community-owned business models

3.1 Introduction

Within Scotland, community-owned energy projects have, to date, predominantly been developed with the following characteristics:

- 100% ownership as represented by a Development Trust or other form of local development organisation
- Bank Finance used to cover the majority of capital expenditure supported, where EU State Aid rules and OFGEM's application of these rules allow, by grant aid from various bodies
- 100% of electricity exported via the National Grid with revenues determined by:
  - Power Purchase Agreements (PPA) covering the sale of electricity generated
  - Feed-in-Tariffs paid per kWh of electricity generated by OFGEM and charged to consumers as an incentive for low-carbon electricity generation.

A wide range of other legal structures and business models have, however, been applied throughout the UK. Community Energy Plus, in its review of community-owned renewable energy projects (Hoggett 2010), found most projects (outside Scotland) were "highly leveraged" using grants and share capital to provide 60-80% of total capital cost. Share capital was considered to play an important role in levering out the required debt finance.

Share offers were considered by Community Energy Plus to offer a wider range of benefits compared to other conventional financing mechanisms. These benefits included:

(i) Unlike loans, share capital is (usually) considered permanent capital, which is not redeemable at a fixed date; and the interest on it can be limited and subject to the organisation's ability to pay

(ii) (Where returns to shareholders are capped or otherwise limited, in order to maximise returns to the community), it enables (the community) organisation to concentrate on delivering benefits to the community, rather than high profits (to lenders or investors), and it can buy time to develop a long term business strategy

(iii) It can harness the collective investment power of whole communities, often using small sums to raise large amounts of capital

(iv) The share ownership model runs through the philosophy of the organisation, its management and delivery, enabling shareholders to have an active role in decision-making processes, resulting in high levels of participation and democracy

(v) Greater commitment and support to make a project succeed also occurs as the investors are also benefactors.

(Hoggett 2010)

At the time of Hoggett's review, the use of share offers to raise capital for community energy projects was not at all common in Scotland, due to the historic availability of public grants and the legal requirements of grant funders which prevented any form of profit distribution. Share Offers within the renwable enery community are, however becoming increasingly common, supported, where necessary, by bank borrowings or public loans (Social Investment Scotland, Renewable Energy Investment Fund).
Examples include:

(i) Green Energy Mull – Garmony Hydro (Community Benefit Society) Share Offer January 2014
(ii) Dingwall Wind Co-operative - Share Offer September 2013
(iii) Harlaw Hydro (Community Benefit Society) – April 2013
(iv) Spirit of Lanarkshire (Co-operative) – closed March 2014
(v) Islay Community Wind Project (Community Benefit Society) – closed March 2014

It should be noted that share offers issued by community benefit societies (Bencom's) cap returns to members at a set level, typically 4-6%[2], whereas the dividend paid to cooperative members has no inherent limit subject to the need to raise sufficient capital, although members may choose to voluntarily place a limit on it. Returns to cooperative members typically range from 6-8% for renewable energy projects. Additional tax benefits[3] may increase the return to investors, although this does not directly affect the cost of capital for the community energy project. For the purposes of this study a maximum return to investors of 2%p.a.over and above that generally available is assumed.

Share Offers provide the opportunity for a wide-range of investors with, commonly, preference given to "local" investors, to help finance community-owned projects. Financial returns are generally set to allow:

- Investors to earn slightly higher interest compared to what they would otherwise gain from the standard investment opportunities offered by the current market, with additional potential tax advantages
- Community energy projects to attract finance at rates slightly cheaper than bank finance

The procedures for issuing share offers are now well developed and can be prepared by a range of institutions at little more than, or similar to, the cost of arranging bank finance. Where bank finance is required to supplement share offerings, a bank can underwrite the share offering.

3.2 Alternative Business Models

The alternative business models considered here all aim to maximise the economic benefit achieved by the community supporting the project. They aim either to:

(i) Reduce Capital & Operating Costs by accessing finance from within the local community – and elsewhere - at a lower cost than conventional sources. The provision of project finance within a share offer provides, in-turn, the community the opportunity to earn a greater return from the project than they would otherwise, again using conventional methods.

(ii) Increase returns to the community project by selling the electricity generated at premium prices to local consumers – both domestic and commercial. The purchase of energy (electricity) at below market rates by community members may also, as with the provision of local capital, increase the disposable income of local residents and add to the economy of the area.

[2] CES Review of Renewable Energy Share Offers 2013

[3] HMRC's Seed Enterprise Investment Scheme (SEIS) provides a 50% tax relief on the first £150,000 of shares purchased. The Enterprise Investment Scheme (EIS) provides a 30% tax relief on all shares purchased provided they are held for at least three years. These schemes will increase investment returns to those who can take advantage of them.

All of the business models will be considered using the framework developed to measure the local economic impact of renewable energy projects within a community.

3.3 The conventional business model

Case studies of operational community-owned wind turbines (Entwistle, 2013) show 800kW machines, commissioned in 2011, operating with approximately 30% wind capacity utilisation[4] (Udny Case study) can provide an average of £100,000 per annum to their community after operational costs and finance charges are taken into account.

In comparison, West Coast and Northern Isles communities with exceptionally good wind resources can achieve an annual wind capacity utilisation averaging 45% for 900kW machines (Tiree Case study) and will provide an average of £250,000 pa. to their community, again after operational and finance charges are taken into account.

It follows that the income flowing into the surrounding community from a community-owned wind development comes in three forms:

- Planning, developing, constructing and commissioning wind turbines (i.e. construction phase)
- Operation and maintenance of turbines
- Operational income generated by the sale of electricity and public incentives for renewable electricity (FiTs, ROCs etc) which may, in turn leverage in additional project funding from other sources.

Below we detail the conventional model against which the total economic impact of all three business models can be compared.

3.3.1 Construction, Operation and Maintenance

Construction Phase

The local impact of planning, developing, constructing and commissioning community-owned renewable energy projects is estimated using current (2013/14) construction budgets[5] for a single 800kW wind turbine (Table 3.1).

Table 3.1 Typical planning & construction costs – 800kW wind turbine (2013/14)

No.	Activity	Budget (£)
1	Pre-planning feasibility studies, options appraisal, community consultations and identification of constraints	0 – 100,000
2	Planning Application & Environmental Impact Assessment (EIA)	50,000
3	Turbine – delivery, construction & commission - Including Foundations	850,000
4	Site works – civils – site dependent	30,000 – 70,000
5	Site works – electricals	30,000
6	Grid Connection – site dependent	200,000 av.
7	Legal & Professional fees	150,000 av.
8	Finance Arrangement fees	50,000
TOTAL		£1.35m - £1.5m

[4] 30% wind capacity utilisation is considered good for Scottish conditions.
[5] Unpublished construction budgets developed over 2012/13/14.

The majority of expenditures included in Table 3.1 involve specialist contractors which are most unlikely to be found within a local community (ADAS, 2003; Munday et al, 2011). Local communities may, however, be able to support professional/semi-professional inputs into pre-planning activities and civil works on-site.

Professional/semi-professional inputs into pre-planning activities
Many local communities possess the skills, if they can be mobilised, to undertake the activities required to plan and consider the opportunities their communities have to develop their own renewable energy resources. Where these skills can be mobilised and effectively deployed, considerable expenditures can be saved. Typically, community-owned projects will mobilise local skills offered voluntarily with little or no expenditures incurred. While this can motivate the community and support community-wide consultation, this is unlikely to bring new financial flows directly into the community until the project is actually developed.

Where this is not possible, communities have often utilised financial support available from the Scottish Government 'CARES' programme. Historically this included grants of up to £150,000, but due to Feed in Tariff rules this was changed to a system of unsecured loans of up to £150,000 with a write off facility in the event a project is found to be not viable.

Civil works on-site
Where local contractors are available, some site works involving the construction of access tracks and the digging of foundations may be contracted locally. Depending on the length of track required this may involve around £50,000 of expenditure with 800-900kW turbines of which around £10,000 may be retained locally as payment for labour. Of this, a portion can be assumed to be spent locally on local goods and services.

Operation and Maintenance

Annual operational and maintenance expenditures for a conventional wind turbine generally involve a land rental, annual service and maintenance charges set in agreement with the turbine supplier, insurance, business rates, professional fees (management and accountancy charges) and various charges associated with metering and the use of the grid system.

Of these, only the annual land rental and some management charges are likely to be retained locally involving a local land-owner and a local member of the community-owned operating company. For 800-900kW turbines these sums may total £15,000 – 20,000 pa. with a proportion spent locally on goods and services.

3.3.2 Operational income generated by the sale of electricity

As noted above, relatively large sums can be made available from community-owned renewable energy projects for community activities. The expenditure of these sums depends on the capacity of the community to utilise them. In some instances (Pers. comm. Entwistle 2013), large reserves are built-up for future use. Case study data (Entwistle, 2013) shows a wide variety of projects have been financed with renewable energy funds.

Income invested by the community organisation in community activities or assets can leverage significant additional funds from a wide variety of sources. The additional funds represent, on average, 60-75% of total project costs although the percentage varies by project type. Grant recipients suggest that the renewable energy funds were critical to the levering-in of these additional funds and, based on this, in the following analysis we assume leverage funding is 100%

additional (i.e. would not have flowed into the locality unless the renewable energy development had taken place).

3.4 Alternative Business Model 1 – access to local finance

As noted above, community-owned renewable energy projects in Scotland have, to date, been substantially supported by bank finance. When little or no asset-based security is available to the project developer – the community – banks will insist on fairly stringent "step-in" conditions allowing them to take-over the project should problems arise. Bank finance offered without securities has, however, become increasingly expensive as these banks have sought additional funds in the regulatory environment introduced after the 2008 banking crisis. With unsecured bank-finance currently available (spring 2014) with interest charges of around 8-9% for long-term, 15-year plus finance, the availability of equity finance in the form of shares at 5–8% interest is attractive.

As a consequence, renewable energy projects throughout the UK are increasingly looking to raise finance at lower cost by the offer of shares. Examples include:

> **Dingwall Wind Co-op (Highlands)** – Share Offer – September 2013 - £856,000 – interest projected, depending on performance, at 7.5% plus tax benefits.
>
> **Wester Derry Wind Co-op (Angus)** – Share Offer – April 2014 - £800,00 – interest, projected at 7%pa plus tax benefits , will be based on performance.
>
> **Green Energy Mull - Garmony Hydro (Mull)** – Share Offer – January 2014 - £1,100,000 – interest expected at 4-5% depending on performance plus tax benefits. Advertised as "both a social investment as well as a financial investment".
>
> **Halton Lune Hydro, Lancashire** – Share Offer – December 2013 - £976,000 – interest offered at 5% plus tax benefits.
>
> **Plymouth Energy Co-operative, SW England** – Share Offer – February 2014 - £500,00 + - interest offered at up to 6% plus tax benefits

Share offers allow for a greater flexibility with capital repayments allowing, in turn, for example, the "early year" returns to a community project to be enhanced by restricting capital repayments to Year (5) onwards – or whatever is agreed with shareholders.

Share offers are now arranged by a variety of organisations with arrangement and due diligence fees similar to those charged by banks and are intended to cover all the necessary due-diligence required by the FCA to support a Share Offer. These offers attract support from throughout the UK. While a preference is generally shown to local investors the proportion actually taken-up by local community members will depend on the size of individual communities and their support for the project. The Dingwall Wind Co-op, for example, report 75% of shareholders lie within 15 miles of the Dingwall Turbine. The Plymouth Energy Co-operative reports over 50% of investors were Plymouth residents.

3.4.1 Increased income for local investors

If 25% of a community-owned share offer is conservatively assumed to be supported by local community residents, each of which earn an estimated 2% premium to what otherwise they could earn from their available capital[6], this will bring in additional funds to the community. Of this, some will be spent on local good and services generating knock on multiplier effects. For example, a share offer of approximately £1.0m with 25% - representing £250,000 – raised from within a community will bring in an estimated additional £5,000pa into the community. Of this, perhaps 20% - representing £1,000pa – will be spent on local good and services.

3.4.2 Reduction in annual project financing charges

Share Offers providing finance to community-owned projects with an estimated 2% reduction in interest charges[7] can bring benefits to a community estimated to be more significant than those derived from the local provision of capital. A 2% reduction in interest charged on, for example, a £1.0m loan will save £20,000pa in finance charges. This saving will immediately be transferred to the Operating Surplus available to the community and can be re-directed into funding community activities.

The impact of locally supported share thus appears to have a significantly greater impact on the funds available to community projects than the increase in income derived from community members investing in the project.

3.5 Alternative Business Model 2 – local electricity sales

Conventional renewable energy projects will export electricity through the National Grid and sold to licensed suppliers at prices negotiated within a medium (3-5yrs) to long-term (5-15yrs) Power Purchase Agreement (PPA). PPA prices are set by current and forecast wholesale prices of electricity. PPA prices offered throughout the UK have softened over the 2013/14 winter due to an abundance of stored energy (gas) and a comparatively light demand for energy across Europe.

PPA's can, however, be significantly improved on by retailing electricity directly to local customers. For example, the Halton Lune Community Hydro project expects to sell[8] electricity directly to a local housing association (Lancaster Co-Housing) at a significant premium to wholesale levels. Price levels of approximately 9p/kWhr or better, as estimated from the Halton Lune Share Offer document, lies half-way between the OFGEM Export Tariff (4.77p/kWhr) and local retail levels. Without this price premium, Halton Lune Hydro income expectations falls by around 15%pa – approximately £24,000 – and the annual surplus available to the community falls by over 50% to around an estimated £28,000. This is barely enough to cover the estimated £30,000pa required to build up the capital reserves needed to eventually repay share capital.

Clearly, the sale of electricity at preferential rates can make a significant difference to the surplus generated by community-owned energy projects and can affect the feasibility of these projects. The distribution and supply of electricity via the National Grid, however, requires a license under the Electricity Act (1989) and its various updates. Licensing imposes various duties relating to safety, the environment and industry codes and practices. Distribution and supply licences are thought to add an unacceptable burden to community-owned projects and are generally felt by the renewable industry to be unobtainable by such projects. The direct supply of electricity by private wire from a generator to a consumer does not require a license, subject to certain thresholds and other conditions. A number of private generators of electricity, particularly farms and other agri-businesses will supply their own business directly from their own generator.

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[6] This estimate was based on a comparison of 2013/14 community-owned share offers and alternative, commonly used investment opportunities to local residents.

[7] CES review of community Share Offers – 2013 – shows a 2% reduction in interest charges can be achieved when share offers replace bank finance with further reductions possible if a community benefit is supported within a Bencom.

[8] Halton Lune Hydro Share Offer 2013

Where community-owned renewable energy generators can identify and connect directly with significant energy users at an economic cost, and negotiate preferential prices for electricity supplied, the additional income can:

- Increase the income available for distribution to the parent community organisation and therefore increase the annual surplus available for investment in other community projects.
- Mitigate the impact of FiT Degression on the financial returns to the business.

The direct supply of electricity, by private wire to a consumer with a demand closely matching generation capacity as demonstrated by the Halton Lune Hydro project, can bring significant benefits. Matching the location of a renewable energy scheme with a conveniently situated consumer cannot be easily replicated. Most community-owned renewable energy project will not have the opportunity to supply a local, conveniently sited, consumer at a premium to wholesale levels.

The National Trust[9] is, however, working with various parties within the UK energy market to explore various processes that allow consumers to be conveniently matched with renewable energy providers. “Sleeving” matches the energy usage of a defined customer group with the output of a specific generation source. Pricing mechanisms within sleeving systems, while recognised as administratively difficult, could provide consumers with a more direct relationship with the source of their energy, probably at reduced prices (Walton 2013).

“Virtual Aggregation” using Smart Meter Data gives the potential to merge large numbers of customers in to one single customer with access to preferential tariff rates (NT pers. comm. 2014). Virtual Aggregation, however, introduces risks associated with the balancing and settlement of electricity supply and demand. Large, perhaps multiple, generation sites need to be matched with numerous large customers if balancing and settlement risk is to be effectively managed. If this leads to a sustainable matching system, community groups should be able to add-value to their electricity by selling more directly to consumers, perhaps local consumers, both domestic and industrial.

Individual UK households consume on average 4,226kWhr of electricity per year[10] when adjusted for average winter temperatures. This consumption only becomes significant when related to small-scale micro-generation projects involving wind turbines, for example, of around 11kW. Community-owned wind turbines with an 800kW capacity will produce over 2,000MWhr/yr with a good wind resource. Household consumption only becomes significant when multiple households are connected – or sleeved - as is often possible through a housing association. Private wires to, perhaps 100+ individual households, in a local community is considered infeasible without a pre-constructed community grid. Where distances are small this may well, however, become feasible. Wind turbines and hydro schemes are, nevertheless, generally developed some distance from households due to various environmental constraints.

Individual businesses and community facilities, such as schools, will generally use significantly more electricity than individual households. Conveniently sited, significant non-domestic electricity users will be very site-dependent. The Department of Energy and Climate Change (DECC) regularly publish price statistics on industrial energy[11]. Business rates of 9-10p/kWhr are not uncommon (see Table 3.2). Large national buyers, e.g. Scottish Education Department for schools and colleges will, however, have negotiated more favourable rates.

[9] Keith Jones, National Trust – Wales
[10] DECC Energy Consumption in the UK (2013) URN:13D/158
[11] DECC March 2014 Gas & Electricity Prices in the Non-Domestic Sector

Table 3.2 – Electricity prices in the non-domestic sector – 4th Qtr. 2013

Average price	**10.16 p/kWhr**	**including Climate Change Levy (CCL)**	
Range	**Very Small** **0 – 20MW/yr**	**Medium** **2,000 – 19,999 MW/yr**	**Extra Large** **150,000 MW/yr**
Av. Price	14.45p/kWhr	9.57p/kWhr	8.81p/kWhr
Source: DECC March 2014			

Electricity sales at around 9-10p/kWhr could transform many community-owned renewable energy projects making them increasingly viable and increasingly attractive to their local community. Electricity sales at around these prices would fully compensate a standard 800kW community-owned wind turbine for Degression in the Feed-in-Tariff. Prices above 9.0p/kwhr are clearly available from some industrial users of electricity. Consumers of around 2,000MWhr/year are, however, not always conveniently available. New community-owned renewable energy projects will need to build their business model around such consumers if they are to compensate for FiT Degression or down-scale the size of their project to suit local energy consumption.

In terms of local economic benefits, this business model gives rise to two additional income injections to the local community: it brings savings in energy costs to local consumers which may then be re-spent and it brings additional surplus through electricity sales to the local community which can be spent on projects. Both, in turn, will give rise to local multiplier effects.

4. Measuring the local economic impacts of community-owned energy projects

As noted in section 3.3, community–owned energy projects may give rise to local economic benefits through three paths: through the economic activities directly associated with the development and construction of the development, through the subsequent operation of the development, and through the activities arising from the financial injections into the community associated with energy generation or savings from energy costs in the new financial models. The latter may further lever additional project funding into the community.

Previous authors have noted that renewable energy generation, particularly wind but also hydro and solar (when compared to other types of economic activities), requires relatively few physical inputs or local goods and services (labour) during the construction phase or once operational. In particular, apart from many small-medium scale bio-energy projects, renewable energy projects often have limited interactions with the local economy with the majority of goods and services brought in from elsewhere. In contrast, the financial flows into a local area associated with the generation of energy or energy saving can be significant and generate economic multiplier effects well beyond the direct impacts of the original projects. The magnitude of the multiplier effects will depend on many factors, such as the nature of the project and the characteristics of the local economy. This chapter considers the alternative approaches for estimating the total economic benefits of both the renewable project itself and the economic benefits arising from the financial inflow.

4.1 Multiplier effects

Multipliers arise from the fact that local businesses, households, and government agencies purchase goods and services from one another. The concept of a multiplier, first developed by John Maynard Keynes, is a single number that summarizes the total (direct, indirect and induced) effects of a given change in the economy relative to the size of the initial injection (Lewis et al, 1979). In this case, we are interested in those benefits which accrue to the local economy. Hence we are looking for a way of measuring local (as opposed to national or regional) multiplier effects. The definition of "local" is important because the area chosen will affect the potential magnitude of multiplier. Generally speaking, the smaller the defined area, the lower the potential multiplier as there will be more leakage of both the initial injection and subsequent re-spending from the economy. However it may also depend on geography with some very remote rural areas (including Island economies) having slightly higher multipliers as the structure of the economy adjusts to reflect the geographic isolation.

As noted in the introduction, for the purpose of this study, the focus is on communities of "place" as opposed to the much more dispersed communities of "interest" representing owners, investors and developers. This lends itself better to measurement of multiplier effects. However, little research has been conducted to quantify the local economic impacts of community-owned renewables. Against this background, we review three alternative approaches for measuring the magnitude of local multiplier effects from community-owned energy projects: regional Input-output (IO) analysis, regional Keynesian multiplier analysis, and the LM3 approach, and review their respective strengths and weaknesses.

4.2 Overview of the alternative approaches to measure multipliers

4.2.1 Regional Input-output (IO) analysis

Since their introduction (Leontief, 1941), input-output (IO) models have been applied to analyse various economic issues, at national and regional levels. IO models provide a means of estimating the economy-wide effects stimulated by an initial change in economic activity in an economy. They are based on a form of matrix (IO table) which provides a complete picture of the flows of goods and services (products) in the economy for a given year and detail the relationship between producers and consumers and the sales between industries.

The multipliers derived from an IO model capture three levels of effects: direct, indirect and induced effects. The standard model considers the impact of a change in final demand (as opposed to investment) although the model can be adjusted to analyse alternative types of (externally generated) impacts. In detail, if there is an increase in **final demand** for a particular product, there will be an increase in the output of that product in order to satisfy demand. Producers purchase more inputs from their suppliers; this is the **direct effect** of the change in final demand. However the impact does not stop there. Input producers will increase their output, increasing demand for their suppliers and so on; this is the **indirect effect**. As a result of the direct and indirect effects the level of household income throughout the economy will increase as a result of increased employment and labour income. A proportion of this increased income will be re-spent on final goods and services, giving rise to further adjustments in the economy: this is the **induced effect**.

Different types of multipliers can be calculated from an IO model. So called “Type I” multipliers sum together direct and indirect effects while “Type II” multipliers also include induced effects. In addition to standard Type I and Type II output multipliers, employment effects and employment multipliers can be generated, the former indicating the magnitude (and potentially the type) of additional employment generated for each unit of extra demand for output from a particular sector, the latter showing the total amount of employment associated with one additional job in a particular sector.

A key advantage of the IO approach is the level of detailed information it provides in terms of the sectors that are most affected by the initial change in the economy. Formally, the basic equation for IO multiplier analysis is given in equation (1). It show that if the final demand (ΔY) increases by one unit, the total output (ΔX) will increase by $(I-A)^{-1}\Delta Y$.

$$\Delta X = (I - A)^{-1}\Delta Y \qquad (1)$$

where

A is the matrix of input-output coefficients derived from the IO table, X is the column vector of gross output, and Y is the vector of final demand.

$(I\text{-}A)^{-1}$ can also be expressed as the sum of an infinite series and thus the total impact written:

$$\Delta X = (I + A + A^2 + \cdots + A^n)\Delta Y = (\Delta Y + A\Delta Y + A^2\Delta Y + \cdots + A^n\Delta Y) \qquad (2)$$

Here, *n* is the number of rounds required to produce results approximating those obtained from equation 1 when *n* approaches infinity. Normally, in the IO literature, ΔY is called the injection, $A\Delta Y$ is called first round, and $A^2\Delta Y$ is called second round, etc. Each round of effects will get progressively smaller. For most cases, *n* = 6 is high enough to capture over 97 percent of the flows; eight rounds capture over 99 percent.

Most IO models have been adopted at national level because the IO tables are available at that level. Scotland is fortunate compared to the other UK regions in that the Scottish government produces analytical IO tables at Scottish level on an annual basis[12].

[12] http://www.scotland.gov.uk/Topics/Statistics/Browse/Economy/Input-Output/Downloads

In order to apply the IO models at "local" level, local IO tables are needed. Constructing a regional or local IO table is a time-consuming and data-exhaustive process. Riddington et al (2006) looked into three approaches of building local IO tables: using Location Quotient (LQ) models to modify the national IO table to reflect the relative density of activity in each area; using gravity models to estimate trade between each local area; using surveys either as a means of modifying the national tables or as a complete solution. The latter is the most expensive option. The authors find that LQ approaches may produce misleading results; while the gravity model-based approach produces similar results to the survey-based approach.

In addition to the Scottish national IO tables, IO tables are available for the Shetland Islands for the year of 2010/11[13], the Western Isles for the year of 2005 (Roberts 2005) and Orkney for the year of 1995 (McGregor et al., 1998). Some of these tables are now dated and are thus arguably no longer good representations of the respective economies. Further, there are many *ad hoc* studies which have been carried out which have involved the construction of IO tables or similar although these are not generally publically available (see for example North East Scotland in Phimister & Roberts (2012); Moray, Badenoch and Strathspey Enterprise area in Riddington et al. (2006), East Highlands in Pouliakis et al. (2012).

There are several examples of IO type models used to assess the local economic impacts of renewable energies (Allan et al, 2011; Phimister & Roberts, 2012). The economic benefit of community ownership of wind energy projects was estimated by the Fraser of Allander Institute (Allan et al, 2011) for the Shetlands Island Council as part of their consideration of the proposed Viking Wind farm. The Viking Energy Scheme is modelled using the 2003 SAM [14]for the Shetlands developed by Newlands & Roberts (2006). Only the operational stage of the development was considered, with the construction phase ignored on the basis that any impacts generated would be transitory. Local ownership is shown to give significantly greater indirect and induced benefits to the local economy than external ownership with employment multipliers more than tripled. A key issue in relation to this study is that, in the absence of any other information, the authors assumed that the expenditure of income associated with local ownership was spent in an identical pattern as local authority expenditure.

Phimister & Roberts (2012) modelled the impact of new on-shore wind developments in the North East of Scotland on the rural economy and, specifically, to show how changes in ownership structures affect the size and distribution of these effects. They used a CGE model based on a specially constructed SAM for the North East Scotland area. As in Allan et al., only the operational stage of the energy scheme was considered. They showed, with no local ownership by landowners or communities, wind developments do have a significant effect on rural GDP but little or no wider effects with no effect on household incomes. Significant spill-over effects only occur if additional factor incomes associated with local ownership (land rentals and returns on investment) are re-invested in the local economy. Community ownership gives rise to the largest increase in rural (non-farm) household incomes and welfare. They conclude community ownership provides the greatest scope for retaining, for the community, the income generated. As in Allan et al., expenditure from local community ownership was assumed to follow the same pattern as expenditure by the local authority.

4.2.2 Regional Keynesian multiplier models

The Keynesian multiplier model is based on economic theory that assumes spending generates more spending, ultimately to the benefit of the economy as a whole. It was first developed by Richard F.

[13] http://www.shetland.gov.uk/coins/viewDoc.asp?c=e%97%9Dc%94n%82%8B

[14] A Social Account Matrix (SAM) provides a more detailed picture of the economy than an IO table explicitly accounting for the distribution of income between institutions.

Kahn in 1931, who described an employment multiplier for government expenditure during a period of high unemployment. At that early stage, the Keynesian multipliers were termed macroeconomic multipliers and only considered at national level. Starting from the pioneering contribution by Isles and Cuthbert (1956), many authors tried to apply Keynesian multipliers to the regional context (Faggian and Biagi, 2003) and more latterly at local level (Courtney et al., 2006; Courtney et al., 2005).

Regional and local Keynesian multipliers are the exact analogue, at a regional level, of national Keynesian multipliers. They are aggregate multipliers, which means that, unlike Input-output models, they do not distinguish between the sectors where the initial changes originate and indicate, only a single value. The basic formula to calculate (the aggregate) regional Keynesian multiplier is as equation (3). This allows for the leakage of spending and re-spending of initial income within the region through household saving, the importation of goods from outside of the region, and taxes paid to the government. This is then multiplied by the injection to indicate the magnitude of total impacts in an economy.

$$k = \frac{1}{1-c(1-m_a-m_r-t_i)(1-t_d)} \quad (3)$$

where:

c: marginal propensity to consume;
m_a: marginal propensity to import from abroad;
m_r: marginal propensity to import from other regions;
t_i: the rate of direct taxation;
t_d: the rate of indirect taxation;

The application of different models of regional multipliers was prolific until the end of the 1980s (see for instance, Harris et al 1987, for the analysis of oil and the Aberdeen economy; Sinclair and Sutcliffe, 1983, for tourist expenditure analysis). Since then, their popularity has waned (Faggian and Biagi, 2003). However, it does not imply that Keynesian multipliers are not useful. Especially when the specific information at a high level of spatial disaggregation is not available and the main aim of analysis is to investigate horizontal regional disparities rather than absolute values (Faggian and Biagi, 2003). For example, Kim and Kim (1998) compare income generation effects for various localities in Korea using Keynesian multipliers. The paper confirms that the smaller economies with poor economic structure necessarily suffer from high leakage and low income gains.

For the case of Scotland, Courtney et al. (2006) adopted regional Keynesian multipliers to estimate the income and employment multipliers of natural heritage on local rural development in four selected case study areas, using a combination of data from a questionnaire survey, information from secondary sources and parameters from previous studies. The four case areas are: Thurso and hinterland (the north coast of the Scotland), Skye and Kyle (West Coast of Scotland), Badenoch and Strathspey(middle of Scotland), and Castle Douglas and Dalbeatie (South of Scotland). The study area boundaries were designed to ensure a population of around 500 or more individual businesses/organizations in each case study area. They found that, in general, the multipliers are low with little variability between areas, given the relatively small size of the economies under analysis. In a small town project for the Scottish Government[15], the standard Keynesian local multiplier approach was extended into an interregional multiplier model so as to allow for the two types of economic links between small town and hinterland: flows of factor income, the most important of which will arise from households resident in one locality and working in the other, and

[15] Economic Linkages Between Small Towns And Surrounding Rural Areas In Scotland Final Report, March 2005 http://www.scotland.gov.uk/Resource/Doc/37428/0009554.pdf

flows associated with households resident in one locale purchasing goods from the other. Using the interregional Keynesian multiplier model, the overall income effect on each case study area arising from a £1000 injection into the town economy was estimated.

The values for the parameters in this study were derived from the surveys of households and businesses. Because of the size and nature of the economies being considered, all of the multiplier effects are limited in magnitude. However, the results also indicate that there are considerable differences in the extent to which each of the case study areas captures benefits from an injection of income and, importantly it suggests differences in the way in which benefits are distributed between town and hinterland areas. The study also carried out the sensitivity analysis to show how much the magnitude of spill-over effects varies when each of the parameters values is increased by 10%. The results of sensitivity analysis indicate that the multiplier effects are most sensitive to the value assumed for parameter c, the marginal propensity to consume in each case study area.

4.2.3 LM3

The calculation of multiplier effects is a complex and lengthy business, and requires economic expertise. However, the New Economics Foundation (NEF) has recognised the potential benefit of this type of calculation in evaluating the impact of spending within communities (Sacks, 2002). In response, they developed a method for the non-economist or communities themselves to measure and understand the multiplier effect of an injection of money within an area which they term LM3 (Sacks, 2002). Unlike the other approaches, LM3 was designed explicitly for use at the local level.

LM3 (standing for 'Local Multiplier 3') is so called because it traces the first three "rounds" of spending, which in most cases will include the vast majority of spending. The measuring process starts with a source of income and follows how it is spent and re-spent within a defined geographic area. By adding the money from all three rounds together and dividing by the initial income (see equation 4), the answer is the local multiplier score for three rounds or LM3 (Sacks, 2002)

LM3 = (Round one + round two + round three)/round one (4)

In the LM3, initial injection in IO (ΔY in equation 2) is called first round or round one, and round two is corresponding to the "first round" in the IO approach ($A\,\Delta Y$ in equation 2). From equation (4) and equation (2), LM3 can be seen as a short cut to IO multipliers as the former only catches the first three rounds (i.e. $I+A+A^2)Y$ while the latter catches the indefinite rounds (i.e. $I+A+A^2+\ldots+A^n)Y$.

As part of the approach, NEF developed a survey instrument that can be used to collect the necessary information. It also provides instructions on how to calculate the LM3 from the information obtained.

During the process of developing LM3, NEF has worked with 10 communities in five sectors across the UK, testing the methodology and application. These five sectors were: government procurement, food and agriculture, social enterprise, access to finance (through a local cashpoint machine), welfare benefit take-up campaigns (i.e., working families tax credit and income support). The examples are included in the report itself to illustrate the nature and process of the method.

In addition to these pilot projects, Thatcher and Sharp (2008) applied LM3 method to quantify the economic impact of the Cornwall Food Program (CFP), a localised procurement initiative and this study provides a useful practical example of the approach. The three "rounds" of spending analysed were as follows: Round One: total income of the Royal Cornwall Hospitals Trust (RCHT)'s Catering Department for the financial year 2003-2004; Round Two: total expenditure of RCHT's Catering Department that remains within Cornwall for the same financial year (= total spent on Cornwall-based suppliers and staff); Round Three: estimated amount of Round Two spending that is re-spent within Cornwall (= total spent within Cornwall by Cornwall-based suppliers and staff). Round Two calculations were made through a breakdown of actual RCHT expenditure for each local contract. For Round Three, generic survey forms were distributed to RCHT catering staff and suppliers. The surveys required respondents to make detailed estimates of the proportion of their expenditure on different goods and services.

Estimating the proportion of this expenditure based in Cornwall required assumptions to be made about which goods and services were supplied locally and which were not, in line with recommendations made in the NEF LM3 guidance document (Sacks, 2002). For example it was assumed that all spending on utilities and taxes was not "local". In this particular application, a low staff response rate to the survey meant that a valid estimate of LM3 could only be made by excluding RCHT's staff expenditure. On this basis, the LM3 was calculated at 1.81. The authors suggest that the LM3-based estimate of the CFP's absolute impact on the Cornish economy could more than double if accurate staff re-spend figures were available.

The findings confirm that the CFP has a considerable impact on the local economy. However, they also conclude that "difficulties in data collection combined with inaccuracies inherent to the LM3 process created a large margin of error in the findings" (Thatcher and Sharp, 2008). They also suggest LM2 (which only covers the first two rounds of local spending) would provide a completely reliable indicator of local economic benefits with considerably less effort, and only some loss of detail, as an LM2 score could be calculated for the CFP with 100% confidence. Using the figures provided by RCHT only, the LM2 of the CFP is calculated as 1.52, indicating that for each pound spent in the RCHT catering department, 52 pence is re-spent in Cornwall. This figure itself provides a useful indication of the programme's impact. The authors conclude "An additional qualitative analysis, to support and expand the LM2 findings, could be used to identify problem areas or further opportunities, making more efficient use of the time and resources available to the surveying organisations" (Thatcher and Sharp, 2008).

4.3 The strength and weakness of the above three approaches in relation to measuring the economic impacts of community-owned energy projects

IO multipliers have the advantage of being disaggregated by sectors and thus can highlight the impact of demand changes on particular industry sectors within a region or potentially locality, but have the disadvantage of requiring considerable resources to build an IO table. They can capture the direct, indirect and induced impacts of any development very well and can be used to contrast the multiplier effects arising from different types of community projects but mainly at national or regional level. There are few examples of using IO multipliers at local level. Further, in relation to measuring the impact of renewable electricity projects themselves, given that wind, solar and hydro projects, when compared with a manufacturing operation; for example, have limited input and labour requirements after being commissioned, they do not utilise the strengths of IO models well due to their limited backward linkages with the local economy. In terms of local economic impacts arising from the additional income injection into the community associated with electricity generation, information on how this income would be spent is very important. If the spending is mainly on service type activities, again IO type models have a less clear advantage relative to other techniques as service sectors normally have very few linkages with other sectors in local economy.

In contrast to IO multipliers, regional Keynesian multipliers are aggregate multipliers, which means they can't capture detailed impacts on different sectors within the region or be used to illustrate differences between types of projects funded by the community. However, an aggregate multiplier is a much simpler way of drawing a picture of regional macro-characteristics. The comparison of these macro-characteristics among different regions can give very interesting results and guidance for regional policies (Faggian and Biagi, 2003). Despite the apparent simplicity, the calculation of an aggregate regional multiplier is not an easy task. All the variables in equation (3) must be estimated for the context under analysis which may require primary data collection.

NEF's LM3 tool is an adapted and simplified version of the traditional multiplier, developed for the non-economist to measure and understand the multiplier effect of money within an area. It has the advantage of being simple and quick to complete and it can be adopted at local community level. As regards scale, among the three approaches discussed here the LM3 tool is only one which is suitable for analysis below local authority level. Furthermore, the process of collecting data from survey and calculating LM3 can highlight some of the "leaks" and areas for possible improvement. However, it has shortcomings as indicated by Thatcher and Sharp (2008): "surveys require detailed expenditure figures from staff and suppliers which may be time consuming to obtain, and asking for them could be deemed intrusive". The approach needs a lot of assumptions about what is "local" and tracing only three rounds may not capture all useful information.

It is worth noting that all three approaches are restricted by strong underlying assumptions. For example, the assumption of "constant returns to scale" in the IO approach implies the same quantity of inputs is needed per unit of output, regardless of the level of production. In other words, if output increases by 10%, input requirements will also increase by 10%. They also assume there are no restrictions to raw materials and assumes there is enough to produce an unlimited product. The same is true in terms of labour use and labour availability.

After considering and comparing the strengths and weakness of the three approaches in relation to measuring the local economic impacts of community-owned renewable energy projects, the LM3 approach seems most suitable as the basis for the project given its focus on the local economy, its non-technical nature and relatively low cost. In the following section, we provide the process overview of LM3 tool.

4.4 Applying the LM3 approach

The method of applying the LM3 approach is described in Sacks (2002). There are two options (paths) as described in the Figure below depending on whether the starting point is an organisation, or a group of people.

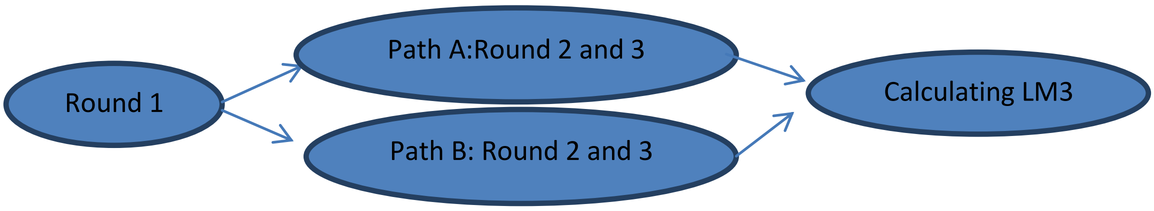

Figure 4.1: process overview of LM3 approach

The principle difference between path A and path B is whom you survey. The process is otherwise the same. If you are starting with the income of an organisation, such as a business, or charity, then path A is appropriate and the survey focusses on how the business spends its income. If you are starting with the income of a group of people, then path B is followed and the survey is targeted at how the people spend their income. In the case of each of the community renewable business models, the application of the LM3 approach requires a combination of both Paths A and B because some of the injection goes direct to local people (such as land rental during wind turbine operational phase, income from share ownership) and part to local business (such as management charges during operational phase). In this case therefore the LM3 will be a sum of total effects having allowed for multiplier effects along both paths.

Below we give an example of the Path A and Path B steps. Two flowcharts in the Appendix 3 and 4 will also describe how LM3 works for both Path A and Path B.

Overview: Path A

Round 1
The first step is to determine the initial income. Let's take management charge income during operational phase as an example. Say then initial income going to a local management company is £10,000.

Round 2
In Round 2, the amount of local as opposed to non-local expenditure of the management company needs to be determined through a business questionnaire (see Appendix 6).

The principal items organisations spend money on in the local area tend to be: staff, contractors and sub-contractors, suppliers of goods and services, investment in the company, and rent/mortgage. Assume, in this case the local management company spends £5,000 in the local area.

Round 3

In Round 3, how much the various local people and organizations who receive money from this local management company then re-spend locally needs to be calculated. The organizations will spend money on similar items as listed above. The principal items people spend money on in the local area tend to be food, clothing, entertainment, and rent/mortgage. Again the information is collected through survey instruments (See Appendices 5 and 6).

Assume, from this, the total amount spent in the local areas by people and organizations is £2,000.

Calculating the LM3 score

LM3 is calculated by adding up all three rounds and dividing by Round 1 to get a relative figure. In this case the calculation is as follows:

Round 1:	£10,000
Round 2:	£5,000
Round 3:	£2,000
Total:	£17,000
LM3:	£17,000/£10,000 = 1.70

Overview: Path B

This path is appropriate for types of income which accrue initially to people rather than businesses (for example in the case of land rental income to local community residents from wind turbine projects). In this case, Round 2, would focus on determining how much of local resident expenditure is retained locally using a personal spending survey (see Appendix 5). In contrast, in Round 3, you would determine how the various businesses that people frequent then re-spend their income.

Defining local

It is obvious from the process mentioned above that surveying is a crucial part of the LM3. Before conducting the survey, a definition of what should be classified as “Local” is required. In the ten pioneer projects applying LM3 described by Sacks (2002), different criteria were used and the local boundary for each project ranged from a few square miles to an entire county. For instance, the local government procurement projects used politically-defined boundaries (such as borough, district, parish or ward). Other projects attempted to define a tighter-knit neighbourhood or community. Another approach was taken by Cusgarne Organics, who used a 15-mile radius as the local area (Sacks, 2002). Sacks (2002) indicated that “you should determine your local boundary based on the nature of your project. A way to guide your thinking if you are not sure what the appropriate local boundaries are is to ask yourself the following questions:”

1) What area am I interested in?
2) What geographical area does the income for that area come from?
3) Where do supplies come from?
4) What area is data available for?
5) What area are the stakeholders interested in?

Once the local area boundaries are chosen, make sure they are clear to everyone. For instance, Heeley City Farm gave all business owners a map showing the boundaries of what they considered to be the local area. The business owners referred to this map when identifying which of their suppliers and staff were “Local”.

Next section, we illustrate using LM3 approach for the specific case of the Tiree community renewable energy development. In this case, as Tiree is an isolated island, the local area boundaries are defined as the whole island of Tiree.

5. Measuring the local economic impacts of community-owned energy projects: An application

In this section, based on the Tiree case study, we show that how the local economic impacts of community-owned energy project can be calculated using the LM3 approach. First, we will give a brief description of the Tiree case; then we will measure the total economic impacts of the Tiree 900kw wind turbine arising under three different financial models: 1) conventional business model - now superseded given that grant aid and FiT supports are incompatible (grant funding supported by bank loan, selling electricity to national grid); 2) access to local finance (share offering to local residents, selling electricity to national grid); 3) local electricity sales at preferential rates with project finance provided by banks at current rates (summer 2014).

Ideally, primary data would have been collected as part of this process to ascertain the extent to which expenditure by different types of local residents and businesses are locally retained. Time and budget constraints meant this was beyond the scope of this project and thus the percentage of local retentions given below are “guesstimates” based on previous applications of the LM3 method. Nevertheless the example does show how the survey information would be utilised within the approach and the nature of the calculations required. Example survey instruments are given in Appendices 5 and 6.

5.1 Brief description of Tiree case study[16]

Tiree is a small, fairly isolated island off the west coast of Scotland lying within the Inner Hebrides with a population of around 720 in 2012. Tiree faces problems similar to most islands and isolated communities, that of fragile economies, out-migration of its young people (leaving behind an ageing residential population), and the gradual withdrawal of centrally provided services. Tiree responded to this situation by the early creation of a Development Trust which, after a review of options, went on to support the development and commissioning of a community-owned wind turbine to bring in a much-needed new income stream to the community.

TREL – Tiree Renewable Energy Ltd. – commissioned a 900kW Enercon E44 wind turbine in 2010. Since then, this turbine has operated quite efficiently, despite problems with its undersea cable connection with the National Grid. It has achieved an annual average wind utilisation of over 45%, reflecting the very strong wind resource on Tiree which initially encouraged the development of the turbine. This 45% wind capacity figure compares very favourably with the 30% wind capacity expectation in good mainland Scotland locations. As a result of its strong wind resources, Tiree is able to deliver a surplus of approximately £250,000 pa. to the Community Trust for the community’s benefit. From this income, 4 staff posts have been supported within the Tiree Community Trust with a total salary of £72,000pa coming into the community. At the same time, through the ‘windfall’ grant scheme for community residents, businesses and voluntary organisations, it awarded 70 separate grants to community projects in 2011 and 2012 totalling £195,508. The grants ranged in size from £150 to Tiree Mainly Music to £22,039 to the Tiree Maritime Trust. The grants from the Trust are estimated to have contributed approximately 24% of total project costs and thus helped lever-in considerable additional funds from a very wide range of public and private sources. The grants provided by the Community Trust are considered to have been “vital” to the levering-in of these additional funds (Entwistle, 2013).

[16] More detailed information can be referred to Entwistle, 2013.

The economic impact of windfall grants is based on a survey (April/May 2013) of 11 of the 70 grant recipients. This sample covered 56% of the total value of grant awarded. A summary of 11 sample projects is in Table 5.1. The sample projects focus on four different areas:

- Business Development - with projects supported to the value of £286,000
- Cultural Heritage - with projects supported to the value of £ 84,000
- Health and wellbeing - with projects supported to the value of £ 81,989
- Quality of Life - with projects supported to the value of £ 7,659

Table 5.1 - Tiree Summary of Windfall grant recipients

Tiree Community Trust – Sample of grants awarded 2011 & 2012					
No.	Project	Project Cost	Grant awarded	% project cost	
1	Discover Tiree - Development of new web-site and app.	£16,000	£10,000	63%	Business development
2	Tiree Rural Centre - Upgrade & refurbishment of Tiree Rural Centre	£120,000	£21,489	18%	
3	Tiree Community Business - Purchase of Tiree Business Centre	£150,000	£27,000	18%	
4	Tiree Tapestry Group - Provision of materials, equipment and running costs (insurance & rent)	£4,000	£1,200	30%	Culture heritage
5	Tiree Maritime Trust - Construction of new Boat sheds for (4) renovated traditional lug boats to support their display and use as training aids.	£80,000	£22,039	27%	
6	Curam Thiriodh (Care in the Tiree Community) - Volunteer Coordinator Post - Consultancy Input - Exercise Club Trial	£8,369 £1,050 £570	£7,096 £600 £400	85% 57% 70%	Health and wellbeing
7	Tiree Lunch Club - Retention of weekly Lunch Club those with various disabilities, respite for carers and the development of various services to enable the disables to involve themselves in community activities	£72,000	£13,530	19%	
8	Mainly Music - Provision of musical instruments & toys	£250	£150	60%	Quality of life
9	Horse & Pony Club - Provision of regular series of instruction using riding instructors from off the island	£2,000	£2,000	100%	
10	Tiree Tots - Provision of soft-play area	£2,500	£589.80	23%	
11	Tiree Youth Work Week - Provision of a range of activities in support of Tiree Youth Week	£,2,909	£2,909	100%	
Total		**£459,648**	**£109,007**	**23.7%**	

The projects supported by the Trust and financed by the renewable energy project have directly created 3 part-time project-specific posts within the community in addition to the 4 separate long-term posts to support the activities of the Trust. The creation of 7 posts within a small fragile economy like Tiree is considered a very significant achievement. As the projects develop, particularly the purchase and re-development of the Business Centre, further posts will be created.

Project activity and the work of the Trust indirectly supported the key industries of the island, particularly agriculture, tourism and recreation. This, in turn, helps maintain, develop and safeguard the wide range of services locally available to the community.

The maintenance of this level of activity over the life of the wind turbine – estimate at at-least 20 years – can be expected to make a considerable and very important contribution to the economic and social life of the community.

5.2 Measuring local economic impacts of Tiree community owned 900kW E44 wind turbine under the conventional business model

5.2.1 Local economic impacts from construction phase

As mentioned in Section 3, given the very specific nature of the work required to bring renewable energy projects to completion, local contractors are considered unlikely to contribute very much other than the fairly straight-forward civil site-works, involving the construction of access tracks and the digging of foundations. Depending on the length of track required, this may involve around £50,000 of expenditure of which we assume £10,000 is retained locally as labour inputs. Here we use LM3 (Path B) to measure the multiplier effect within the construction phase.

Round 1: initial income
From the above data, initial additional income to the Tiree community is £10,000 from the civil works on-site.

Round 2: How much the initial income is spent locally
As Tiree is a fairly isolated island, here we assume 30%[17] is spent locally on local goods and services (such as spending on food, rent, clothes, entertainment, etc.). Local spending in Round 2 is thus £10,000*30%=£3,000.

Round 3: how much the Round 2 income is re-spent locally
Here, we assume 11% of the income from round 2 is re-spent locally by local shops. 11% is taken from LM3 guide book on local spending by sector (Sacks, 2002, p115). Therefore, local spending in Round 3 is £3,000*11%=£330.

We put all of the above information together:

Round 1, initial income (local labour input into civil works on site)	£10,000
Round 2, local spending by local staff on local goods and services:	£3,000
Round 3, local spending by local providers of goods and services:	£330
Total:	£13,330

The LM3 score is thus:
LM3 =13,330/10,000 =1.333

[17] This is a guesstimate based on figures reported in Sacks (2002). Ideally it would have been derived from a survey of local staff involved in civil site-work to see how much they spend locally.

This suggests that the total economic impact from the construction phase of the turbine development, including local multiplier effects is £13,330. Here, it is worth noting that we assume very high locally re-spending rate for this specific case. For many other communities, the locally re-spending rate could be much smaller (say 5-10%) and thus the multiplier score could be smaller, too. Here we only demonstrate the methodology itself. In order to get more accurate figures, a detailed survey on the local employees and local providers of goods and services is necessary. In Appendix 5 and 6, we provide tables showing the recommended structure of personal spending surveys and business spending surveys.

5.2.2 Local annual economic impacts from Operation and Maintenance (O&M) phase

Annual operational and maintenance expenditures for a conventional wind turbine generally involve a land rental, annual service and maintenance charges set in agreement with the turbine supplier, insurance, business rates, professional fees (management and accountancy charges) and various charges associated with metering and the use of the grid system. As noted in section 3.3, of these, only the annual land rental and some management charges are likely to be retained locally. These sums may total £15,000 – 20,000 pa. We assume £15,000 going to local land owners as land rental and £5,000 going to local management company as management charges. For the former, we choose Path B to calculate LM3 and we choose Path A for the latter. And then we calculate them separately.

Local annual economic impacts from Land rental

Round 1: initial income
As we assume local land rental comes to £15,000, this represents the Round 1 initial additional income flowing into the community residents from the O&M phase.

Round 2: how much of the initial income is spent locally
Ideally we need to use a personal spending survey (see Appendix 5) to determine how much of local resident expenditure is retained locally (Path B). For this project we use the same assumption as above, i.e., 30% of the additional income to local residents is spent locally on local goods and services. Therefore, money flow in Round 2 is £4,500.

Round 3: how much of the Round 2 income is re-spent locally
Again we use the same assumption as above, i.e., 11% of the additional income for local providers of goods and services is spent locally on local goods and services. Therefore, money flow in Round 3 is £495.

The following chart clearly shows the local money flows in the Tiree community arising from land rental income under operational phase.

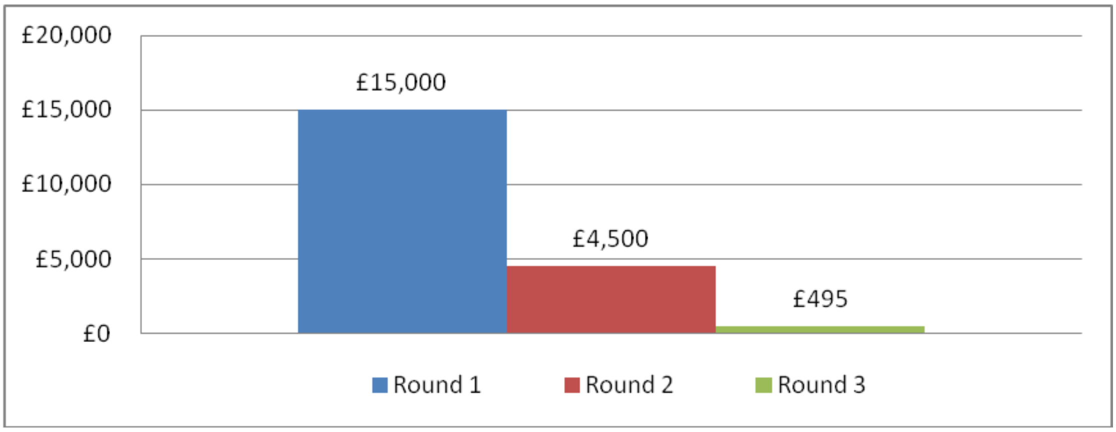

Figure 5.1 Local money flows in Tiree arising from land rental income under operational phase

We put all of the above information together:

Round 1, initial income (local land rental and local management charges)	£15,000
Round 2, local spending by local residents on local goods and services:	£4,500
Round 3, local spending by local providers of goods and services:	£495
Total:	£19,995

The LM3 score is thus:
LM3 =£19,995/£15,000 =1.333

Total annual economic impact arising from land rental income under O&M phase, if considering multiplier effects, is £19,995.

Local annual economic impacts from management charges

Round 1: initial income
As we assume local management charges come to £5,000, this represents the Round 1 initial additional income flowing into local business from the O&M phase.

Round 2: how much of the initial income is spent locally
Ideally we need to use a business spending survey (see Appendix 6) to determine how much of local business expenditure is retained locally (Path A). For this project we again assume 11% of the additional income for the local business is spent locally on local staff and local goods and services. Therefore, money flow in Round 2 is £550. Here, we assume £450 going to local staff and £100 going to local shops.

Round 3: how much of the Round 2 income is re-spent locally
Again, we assume local staff spends 30% of their income locally and local business spend 11% of their income locally. Therefore, money flow in Round 3 is £146 (£450*30%+100*11%).

The following chart clearly shows the local money flows in the Tiree community arising from management charge income under operational phase.

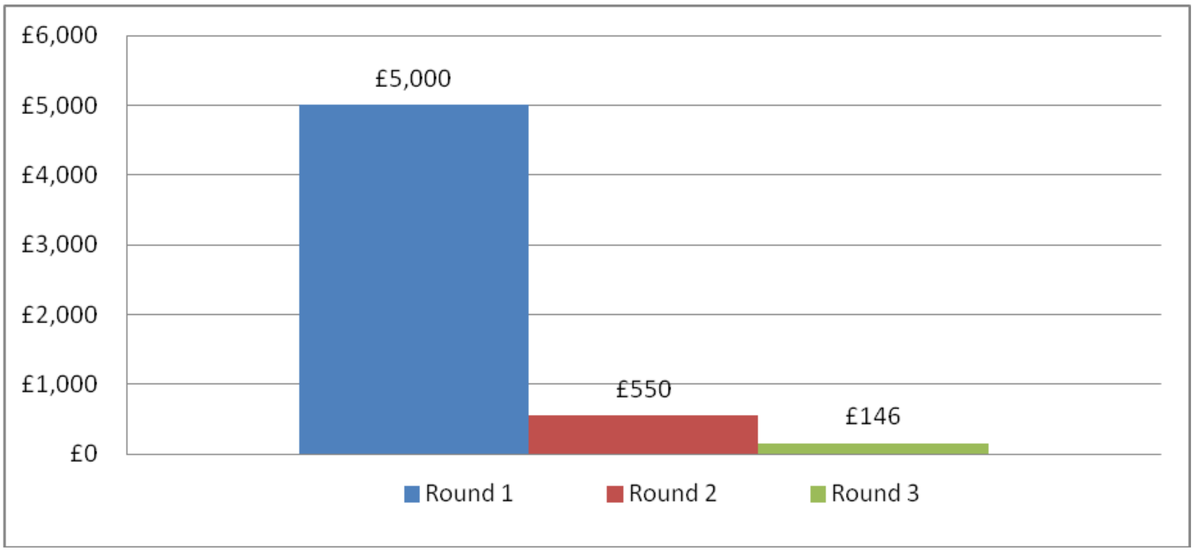

Figure 5.2 Local money flows in Tiree arising from management charge income under operational phase

We put all of the above information together:

Round 1, initial income (local management charges)		£5,000	
Round 2, local spending by local management company		£550	
Of which:	Staff		£450
	Local spending on goods and services		£100
Round 3, local spending by local staff and suppliers:		£146	
Total:		£5,696	

The LM3 score is thus:
LM3 =£5,696/£15,000 =1.139

And total annual economic impact arising from management charge income under O&M phase if considering multiplier effects is £5,696.

Local annual economic impacts from Operation and Maintenance (O&M) phase

Local annual economic impacts from O&M phase include two parts: total annual economic impact arising from land rental income (19,995) and total annual economic impact arising from management charges (£5,696). Therefore, annual economic impacts from O&M phase for the Tiree community is £**25,691**. The combined LM3 is thus:

LM3 = £25,691/£20,000 = 1.285

5.2.3 Local annual economic impacts from income surpluses

Round 1: initial income

Initial additional income flowing into the Tiree community in Round 1 includes total salary (around £72,000pa) for 4 staff employed by the Community Trust, "windfall" grants, and additional funds leveraged from other sources. Therefore, here is the combined Path A and Path B process. The windfall grants for the year of 2011 and 2012 were £195,508. As there is no additional data available, we assume a 50:50 distribution over 2011 & 2012. We calculate windfall grants in the year of 2011 as £97,754. As the average percentage of windfall grants in the total project expenditure for the 11 surveyed sample projects was 23.72% (see Table 5.1), total project expenditure (including leveraged funding) is estimated as £97,754/23.72% =£412,198.

The initial income in Round 1 is thus:
£72,000+£412,198 = £484,198

Round 2: how much the initial income is spent locally

Money flow in Round 2 includes two parts: local spending by four Trust staff, and local spending arising from 70 projects awarded by windfall grants.

First, we look at local spending by 4 Trust staff. The same assumption is used here as above, i.e., 30% is spent locally on local goods and services. Local spending of local staff in Round 2 is £72,000*30%=£21,600. Again, a detailed survey of personal spending is recommended to get an accurate local spending rate.

Next, we look at how much local spending arising from the 70 windfall awarded projects. Each of the different projects supported by grants will give rise to different types and different levels of wider economic impacts. Based on case-study information on the 11 sample projects listed in Table 5.1 (such as wages going to three local part time jobs, percentages of total operational cost going to local contracts, and so on), the local spending rate for each of these 11 projects is calculated and shown in Table 5.2.

Table 5.2 The local spending rate for windfall funded projects for 2011 and 2012

Project	wages to local staff	local contracts	total local spending	total project cost	local spending rate	Project focus
Discover Tiree				£16,000	0	Business development
Tiree Rural Centre	£7,000	£96,000	£103,000	£120,000	85.83%	
Tiree Community Business				£150,000	0	
Tiree Tapestry Group				£4,000	0	Culture heritage
Tiree Maritime Trust		£20,000	£20,000	£80,000	25.00%	
Care in the Tiree Community	£8,369		£8,369	£9,989	83.78%	Health and wellbeing
Tiree Lunch Club	£15,000	£25,000	£40,000	£72,000	55.56%	
Mainly Music				£250	0	Quality of life
Horse & Pony Club		£400	£400	£2,000	20.00%	
Tiree Tots				£2,500	0	
Tiree Youth Work Week		£582	£582	£2,909	20.00%	
Total	£30,369 (6.61%)	£141,982 (30.89%)	£172,351	£459,648	(37.50%)	

It is very clear the local spending rate for each project varies significantly, even for projects within the same area. For example, under the same "business development" category, project 2 has very high local spending rate (85.83%), while the others (project 1 and 3) have almost zero local spending rate. A key point arising from the Table is that, if the project creates some local jobs, the local spending rate tends to be much higher.

Based on the average local spending rate (37.50%) of 11 sample projects, the local spending arising from the estimated round 1 total project expenditure (£412,198) was £412,198*37.50%=£154,559. Among this, wages to local staff from those 70 projects was £412,198 *6.61% =£27,234; payments to local goods and services was £412,198 *30.89% =£127,325.

Therefore, total local spending for the Round 2 = £21,600+£154,559=£176,159.

Round 3:

Here we assume part time jobs created by 70 windfall awarded projects spent 30% of their wages locally and we assume local contractors and local suppliers spend 11% of their income locally.

Local spending from local staff = £27,234*30% = £8,170; Local spending from local providers of goods and services =£21,600*11%+£127,325*11%= £16,382. Therefore total local spending for the Round 3 = £27,234*30% + (£21,600*11%+£127,325*11%) =£24,552

The flowing chart shows the local money flows in the Tiree community arising from income surplus the wind turbine.

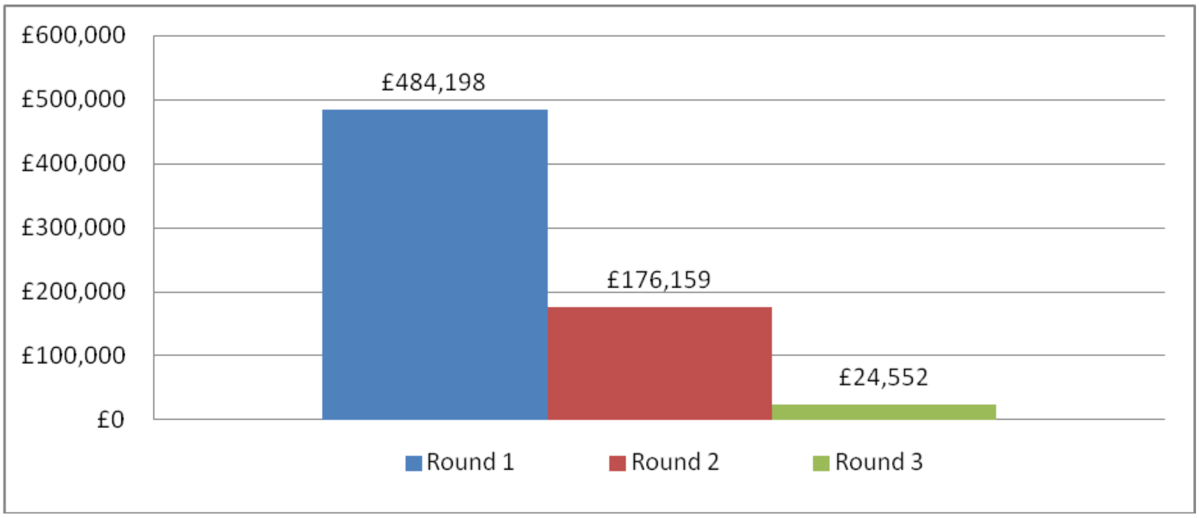

Figure 5.3 Local money flows in the Tiree community from income surplus

Aggregating all of the above:

Round 1, initial income:			£484,198	
	Of which:	Staff		£72,000
		70 windfall awarded projects		£412,198
Round 2, local spending of Round 1 income:			£176,159	
	Of which:	Staff		£27,234
		Local spending on goods and services		£148,925
Round 3, local spending by staff and suppliers:			£24,552	
Total:			**£684,909**	

The LM3 score is thus:
LM3 =£684,909/£484,198 = 1.41

It means that for every £10 the Tiree Community Trust receives as income from the income surplus of the community–owned 900kW wind turbine and spends on community projects, it generates £14.10 for the Tiree economy. The total annual local economic impact from annual income surplus is £684,909, taking account of multiplier effect, and also including additional level-in funding.

5.2.4 The whole economic impacts including constructional phase, O&M phase and income surplus

Based on the above, we can calculate the economic impacts over the whole life span of the wind turbine assuming a discount rate of 5%, and the life of the wind turbine is 20 years using the following equation:

Total economic impacts = Local economic impacts from constructional phase + net present value(NPV) of local economic impacts from O&M phase over the life of the wind turbine + net present value of local economic impacts from income surplus over the life of the wind turbine

NPV of local economic impacts from O&M phase over 20 years =
$£25,691/ (1+5\%) +£25,691/ (1+5\%)^{2}+…+£25,691/ (1+5\%)^{20}$
=£320,167

NPV of local economic impacts from income surplus over 20 years =
$£684,909 / (1+5\%) +£684,909 / (1+5\%)^{2}+…+£684,909 / (1+5\%)^{20}$
=£8,535,484

Total economic impacts over 20 years =£13,330 +£320,167+£8,535,484 =£8,868,981

5.2.5 Employment effects arising from the conventional funding model

In addition to the direct employment associated with the construction of the turbine, its operation and maintenance, and project activities, the multiplier effects identified above will give rise to additional employment in the Tiree economy. However, the effects will be spread across sectors in the local economy and it is difficult to convert them onto a FTE basis without making some arbitrary assumptions about average costs of employment.

5.3 Measuring the local economic impacts of Tiree community owned 900kW E44 wind turbine for access to local finance model

As noted in Section 3, community renewable energy projects throughout the UK are increasingly looking to raise finance at lower cost by the offer of shares. This will bring about additional local economic benefits for two reasons: First, it will bring in additional financial flows into the community in the form of returns to local investors. Secondly, share offers providing finance to community-owned projects with an estimated 2% reduction in interest charges. This will increase the operating surplus available to the community. Again, using the Tiree case study, we show below the estimated increase in local economic benefits from this business model using the LM3 approach.

5.3.1 Additional income for local share-holders

For the purposes of the analysis, we assume 25% of the community-owned share offer is assumed to be supported by local community residents. It is also assumed (based on the experience of other projects), that each local investor earns an estimated 2% premium to what otherwise they could earn from their available capital, bringing in additional funds to the community. Thus, a share offer of approximately £2.0m with 25% raised from within a community will bring in an estimated additional £10,000pa into the community. Again, we assume 30% of this additional income will be spent locally on local goods and services, and local providers of goods and services spend 11% of their income on local staff and local goods. Therefore, as for the 20-year operational phase of the development, the annual local economic impact from the additional £10,000 income to community residents incurred by share offering will equal to £10,000*1.333 =£13,330.

NPV of local economic impacts over 20 years from the additional income to community residents
= £13,330/ (1+5%) +£13,330/ (1+5%) ^{2}+…+£13,330/ (1+5%) ^{20}
=£166,121

5.3.2 Additional operational surplus from reduced finance costs

A 2% reduction in interest charged on, for example, a £2.0m loan will save £40,000pa in financial charges. This saving will immediately be transferred to the surplus available to the community and can be re-directed in to project activity. Here, we assume this additional income surplus will also be transferred to the Tiree Community Trust as a gift.

To estimate the overall local economic impact, we also need to make other assumptions. In particular we assume that this additional income will be fully spent, it will lever-in additional funding to the community in the same proportion as observed under the current financial model, and that the type of projects supported will be spent in the same way as observed under the current conventional model. If this is the case, the same LM3 score (1.41) applies for as found in section 5.2.

It follows that annual local economic impacts from the cost reduction from the new financial model will equal to £40,000/23.72%*1.41= £238,537.

NPV of local economic impacts over 20 years from the additional income surplus to community trust
= £238,537/ (1+5%) +£238,537/ (1+5%) ^{2}+…+£238,537/ (1+5%) ^{20}
=£2,972,693

The impact of locally supported share offers thus has a significantly greater impact on the funds available to community projects than the increase in income derived from community members investing in the project.

Total additional local economic impacts over 20 years under new financial model compared to the conventional business model
=£166,121+ £2,972,693 = £ 3,138,815

5.4 Measuring local economic impacts of Tiree community owned 900kW E44 wind turbine for the local electricity sales model

Clearly, the sale of electricity at preferential rates can bring saving in energy cost for the community residents. It will also make a significant difference to the surplus generated by community-owned energy projects. Here, we use the Tiree case study to estimate the additional local economic impacts from both energy saving and increased income surplus associated with this business model.

5.4.1 Reduced electricity costs for local residents

For the saving in energy cost for community residents, we assume there are 300 households in Tiree (the population in 2012 was 720) and assume 4p/kwhr saving in electricity cost. Individual UK households consume on average 4,226kWhr of electricity per year[18] when adjusted for average winter temperatures.

[18] DECC Energy Consumption in the UK (2013) URN:13D/158

Saving in electricity cost per household =4,226*0.04 = £169.04

Total saving in electricity cost = 4,226*0.04*300 = £50,712

We use the same assumption as in section 5.2. Therefore, annual local economic impacts when taking account multiplier effects from energy saving will equal to £50,712 *1.333 = £67,599

NPV of local economic impacts over 20 years from energy saving of community residents
= £67,599/ (1+5%) +£67,599/ (1+5%)^{2}+…+£67,599/ (1+5%)^{20}
=£842,434

5.4.2 Additional operational surplus from higher earnings

For the additional income surplus, we also assume a 4p electricity difference between conventional exporting at the national grid wholesale price and the preferential price under local electrical sales model. Therefore, additional income surplus will be the same as the above energy cost saving for the community residents (£50,712) with additional electricity generated exported as per normal, through the National Grid. Again, we assume any additional operational surplus will be given to the community trust as the gift and will be fully spent by the same pattern under the current conventional model. Therefore we can use the same LM3 score (1.41) as calculated under section 5.2. We also assume the same leverage rate. Therefore, annual local economic impacts from additional income surplus under the new local electricity sales model will equal to £50,712/23.72%*1.41= £302,417

NPV of local economic impacts over 20 years from the additional income surplus to community trust
= £302,417/ (1+5%) +£302,417/ (1+5%)^{2}+…+£302,417/ (1+5%)^{20}
=£3,768,781

Additional local economic impacts over 20 years under local electricity sales model compared to the conventional business model
=£842,434+ £3,768,781= £4,611,215

A summary comparison of the findings from all three alternative models is given in section 7. There is the fourth option of business model: combined local finance access with local electricity sales. The additional benefits to the community for this combined business model is just to add up the total additional local economic impacts from local finance business model with local electricity sales model.

6. Risks and uncertainties associated with the estimation of local economic impacts

This section concentrates on the risks and uncertainties associated with measuring the magnitude of local economic benefits arising from renewable energy developments (as opposed to the risks associated with the development itself). Some of the issue discussed are methodological (for example additionality), others practical (for example assumptions on the appropriate discount rate to calculate the Net Present Value of future income flows).

6.1 Additionality

This issue is critical in relation to the estimation of economic benefits arising from the projects supported by a community renewable development. The most straightforward assumption, and that utilised above, is based on the understanding that all of the project activity funded through renewable energy funds is additional to that which would have occurred otherwise. Similarly it is assumed above that all of the extra funding attracted from other sources to support new community projects is additional and would not have accrued to the community were it not for the funding from the renewable development. If this is not the case, the magnitude of local economic benefits will be overestimated.

Entwistle (2013) found evidence to suggest that renewable project funding was critical in attracting additional funding and, in this sense the assumption above may be valid. However it is always difficult, if not impossible, to be sure of what would have happened otherwise and in this sense, recognising that 100% additionality has been assumed is important.

6.2 Community Capacity for Project expenditure

The analysis in section 5 highlighted how relatively large sums can be made available from community-owned renewable energy developments for community activities. The expenditure of these sums depends very much on the capacity of the community to utilise them. In the analysis, it was assumed that all of the additional surplus funds generated under the two alternative business models was spent on new project activities. In reality however, reserves of unused cash may be built-up for future use under the conventional model as well as the alternative business models. This will clearly have a major impact on the magnitude of local economic benefits for the local community as it is only when money is spent (activity occurs) that the local economy benefits. In some cases, in the case of ex ante analyses, it may be appropriate to assume that only a portion of surplus income is spent on project activity thereby avoiding overestimating the total benefits to the local economy.

6.3 Displacement effects

Regional economists are often concerned that policies which promote economic activity in a particular locality may simply be displacing them from another similar economy in which case the overall net gain is zero. In this case, the focus is on understanding the extent to which monetary injections into a community from a community renewable energy project are locally retained and thus lead to multiplier effects. It is expected that communities will aim to try and encourage the retention of local income on the basis that this maximises overall benefits. Thus displacement effects are not considered a problem although they might be relevant to policy makers and planners operating at a wider geographical scale.

6.4 Long run effects

In the Tiree case study, several of the projects were classified as business development activities. These included the establishment of new tourism website to attract additional visitor to the island,

and establishing a new business centre. Over time these projects will bring into the locality additional business activity which will in turn generate multiplier effects for the local economy. In the analysis however only the injections associated with the projects themselves, not the longer run impacts were considered. Unlike additionality and capacity assumptions, this is likely to have led to an underestimation of the long-run impacts of the community renewable development. Where information on predicted economic impacts is available these could be utilised to improve the analysis.

6.5 Estimation of net present values

In the process of measuring the NPVs of local economic impacts, we assume a standard 5% discount rate to calculate the current value of future returns. We also assume a certain lifespan of the development. Both of these assumptions will influence the overall estimates and ideally sensitivity analysis should be conducted to check on the robustness of the findings.

Critically, by calculating a NPV of expenditure on project activities, we are assuming the same level of expenditure takes place and that similar projects are financed each year by the community. This assumption could be challenged on the basis that the Community may reach saturation point and experience project fatigue. However, from a methodological perspective, could be argued to counter balance the underestimation of effects from ignoring the longevity of projects (see section 6.4 above).

6.6 Additional assumptions related to the access to the alternative business models

Under the access to local finance model, two additional assumptions were made in addition to the basic assumption noted above that any additional income surplus to the community from this business model will be fully utilised:

- The additional income surplus will lever-in additional funding to the community in the same pattern as under conventional business model; and
- The total additional funding will be spent in the same pattern as under the current conventional business model.

This application has also made an assumption on the proportion of local investors. However, in most cases, this will be unknown.

Under the local electricity sales model, in addition to the price differences for local consumers, the following assumptions are made during the estimation process:

- That local consumption of electricity is similar to the national average and, more critically, there are no changes in behaviour in relation to electricity use (i.e. rebound effects).
- That any costs savings are entirely re-spent and in such a way as to give results in the same proportion of local expenditure as observed in the conventional business model.

To mitigate the uncertainty in the measurement process, it would be useful for this model to have greater information on personal spending behaviour in the context of electricity price reductions.

More generally, given the number of assumptions involved in the estimation process, it would be useful to undertake at least some focussed sensitivity analysis so as to provide a means of assessing the robustness of the findings. This should be focussed on changing the assumptions in relation to project spend as this is where the largest economic impact is estimated to occur. Alternatively, communities should be made aware of the assumptions implicit within the calculations.

7.0 Summary and Conclusions

7.1 This project has considered how to measure the local economic impacts of community-owned energy projects arising from "alternative" business models for raising finance and retailing energy. The implicit objective of the project is to understand better how to maximise the returns to the community from community-owned renewable energy.

7.2 Conventional community-owned renewable energy projects in Scotland, in particular, have relied on, for the most part, grant aid and/or bank loans to finance their development. In addition to this model, two alternative business models are considered:

- Reducing capital expenditure and operating costs by accessing finance through Share Offers with local investors potentially increasing the income within the community.
- Increasing returns to the community by the sale of electricity at preferential rates.

7.3 Alternative Business Model – access to local finance

Community energy share offers pay interest on investors' funds of, typically, around 5-8% pa. depending on performance and thus appear attractive when compared with bank finance, with little or no asset-based security, of 8-9%.

Share Offers taken up by local community members can provide investors with at least a 2% interest rate premium over what otherwise is available to these investors. This, in-turn, can increase income flows through a community. If 25% of a £1.0m share offer is supported by local community members offering a 2% premium over existing financial earnings, this will bring in an estimated additional £5,000pa into a community.

Of more significance, however, is the reduction in annual financial charges faced by renewable energy projects when share offers are fully subscribed. A 2% reduction in interest charges on, for example, a £1.0m loan, will save around £20,000pa in interest charges. These savings will then support increased levels of community expenditure.

7.4 Alternative Business Model – local electricity sales

Conventional projects export electricity generated through the National Grid at wholesale prices fixed within Power Purchase Agreements. Where contracts can be negotiated with significant and conveniently-located domestic and/or industrial consumers of electricity, financial returns to a community-owned project and to the community itself can be significantly improved. For example, the Halton Lune community-owned hydro scheme is estimated to expect a 4p/kWhr premium from its direct sales to a local housing association conveniently placed close to the hydro project. However, not all community-owned renewable energy project will have significant consumers of electricity in close proximity to their renewable energy generator and may not be able to improve on the wholesale prices offered within normal PPA agreements.

Various processes for the management of relatively low volumes of electricity sales are being actively explored by the UK energy industry. If this leads to a sustainable system this could allow community groups to add-value to their electricity by selling more directly to consumers, perhaps local consumers, at premium prices.

7.5 There is a fourth option of business model: combined local finance access with local electricity sales. The additional benefits to the community for this combined business model is just to add up the total additional local economic impacts from local finance business model with local electricity sales model.

7.6 Income flowing into a community from established community-owned wind farms under the conventional model is shown to arise from:

- Construction impacts
  - Civil works on-site

    Typically £10,000 retained locally within a single turbine 900kW project.
- Operation and Maintenance
  - Land rental & local management costs

    Typically £20,000pa retained locally within a single turbine 900kW project.
- Project Funding
  - Community funding (based on the experience of 800kW-900kW on-shore wind turbines) of approximately £125,000pa/MW with a "good" wind resource increasing to £280,000pa/MW with an "exceptional" wind resource. This funding, in-turn, leveraging in from a wide range of other sources, an additional 1.5 – 3.0 times the value of the renewable energy fund.

All of these sources have the potential to generate knock-on multiplier effects for the local economy.

7.7 Measuring the local economic impact of community-owned renewable energy projects

Following a review of alternative approaches, NEF's LM3 tool was identified as the approach most suited for estimating the local economic impact of a renewable energy project. The approach was specifically developed to understand multiplier effects within a geographically bounded community area. It is relatively easy to calculate and requires less extensive survey data than alternative methods of measuring local economic impact. It traces the first three "rounds" of spending within a community which, in most cases, accounts for the vast majority of economic activity arising from an initial economic action. It requires, however, several assumptions re: what is local, to be made. Further, the survey information on individual spending patterns can be difficult to obtain.

7.8 A summary of the findings from the application of the LM3 approach, using Tiree Case Study data, to each of the three business models is provided in the below table and also in the chart:

Activity	NPV – 20 yrs	LM3 Multiplier
Construction Phase		
- Civil Works on site	£13,330	1.33
- Planning, preparation, consultation	zero	-
Operation and Maintenance		
- Land rental & local management	£320,167	1.28
Income for Community Activities		
- renewable energy grants only with additional funds levered-in	£8,535,484	1.41
Additional local economic benefits associated with the alternative Business Models		
Access to local finance		
- Additional income to local residents	£166,121	1.33
- Additional income for community activities	£2,972,693	1.41
Local electricity sales at preferential rates		
- Savings in household energy costs	£842,434	1.33
- Additional income for community activities	£3,768,781	1.41

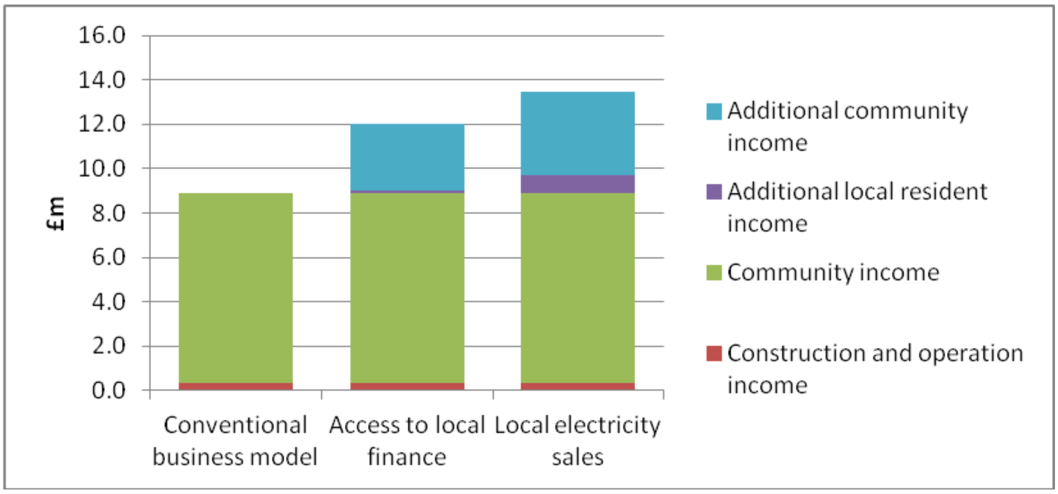

Figure 7.1: Lifetime NPV of income to local community under three alternative business models: The Tiree Case study (900kW wind turbine) (£m)[19]

[19] Explanation of legend:

Construction and operation income: NPV of income to local community from the construction, operation and maintenance of the turbine

Community income: NPV of income arising from community projects funded through the operational income from electricity generation plus associated leveraged-in funding.

Additional local resident income: NPV of income generated from increased spend of local residents arising from increased income for local investors (Access to local finance model) or reduced electricity costs (Local electricity sales model).

Additional community income: NPV of income from projects funded through additional operational income from electricity generation (plus associated leveraged-in funding) due to either lower interest charges on the funds raised or higher income from the sale of electricity at preferential rates.

The local economic impact of wind turbines during the construction stage

Local inputs into the planning, preparation and consultation stage of the project, given that they are assumed to be given at no charge by local volunteers, have no initial impact on the local economy though are likely to reduce Capital Expenditures. Civil works on site during the construction using an estimated local multiplier (LM3) of 1.33 only produce a temporary injection of £13,300 reflecting the relatively small sums involved over a limited period only.

The local economic impact during the operational life of the turbine are larger but remain fairly small, limited to land rental payments and local management charges, with a LM3 of 1.28 giving an annual impact of around £25,691 and an NPV impact of £320,167 over a 20-year period.

The local economic impact of project activity funded by renewable energy funds is significant and has a higher local multiplier effect (LM3 of 1.41). This gives rise to an annual impact of £684,909 and an NPV of impact, calculated over a 20-year period, of £8,535,484.

Compared against the conventional business model, **the local economic impact of accessing local finance** is shown to give an additional NPV of £166,121 when the additional income flowing into local residents is considered and a NPV of £2,972,693 as a result of the additional project surplus and associated project expenditure.

Thus the NPV of access to local finance is relatively modest when savings in household expenditures are considered but significant when the additional income to community projects is considered.

Again in comparison to the conventional business model, **the local economic impact of local electricity sales** is shown to give a NPV of £842,434 when savings in household energy costs are considered and a NPV of £3,768,781 assuming the additional income flowing into the community is spent on new projects.

The NPV of additional income to the community from local electricity sales or sales at preferential rates (+4p/kWhr) thus has a significant NPV derived from both local saving in household energy bills and from the increases in funds available for local community projects.

7.9 The above results are specific to one case study area with a 900kW wind turbine. Varying returns to scale make it difficult to convert the results onto a MW basis. Moreover the returns will be highly dependent on local conditions and decisions made by communities in relation to expenditure.

7.10 Given the difficulties of currently arranging local electricity sales at preferential rates, communities are shown by this model, to best consider accessing local finance to support increased levels of community project activity. Given the economic benefit arising out of local electricity sales at preferential prices, attention, however, needs to be given to the development of systems that allow this.

7.11 The analysis illustrates how the LM3 approach can be used to estimate the local economic impacts of community-owned renewables. The LM3 Model can differentiate between various types of activity and can, perhaps, focus community attention on certain types of activity. Community action will, however, always be determined when driven by volunteers by the preferences of individual activists.

7.12 CES may wish to explore the systems, currently under development by the UK energy industry, which aim to match relatively low volumes of electricity generated with consumers to allow both parties to benefit from more favourable price levels. It is also suggested that the proposed LM3 approach is used with a community operating a community-owned renewable energy facility to confirm this model's acceptability as a measure of local economic impacts of renewable energy.

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Appendix 1

Degression Policy:

UK Department of Energy & Climate Change (DECC) policies are reducing FiT rates paid to new renewable energy projects within a Degression Policy.

OFGEM e-serve describes the Feed-in-Tariff Scheme (FiT) as a government programme designed to promote the uptake of a range of small-scale renewable & low-carbon electricity generation technologies. Tariffs can be changed as often as every 3-months but once registered remain stable, adjusted annually by the Retail Price Index (RPI).

FiT payment rates are determined in accordance with the Feed-in-Tariffs (Specified Maximum Capacity) Order 2012. Rates are regularly published by OFGEM – www.ofgem.gov.uk/ofgem-publications/87074/rpiadjustedtariffsnon-pvapril2014. These show, for example, the Degression in FiTs for wind projects of 500kW – 1.5MW of:

	Period in which Tariff Date Falls	**FiT Tariff p/kWhr**
Wind Projects 500kW – 1.5MW		
	1st April 2010 – 30 Nov 2012	11.01
	1st Dec 2012 – 31st March 2014	10.05
	1st April 2014 – 31st March 2015	8.04
A further 10% degression is expected by the industry on 1st October 2014 with a further 20% degression on 1st April 2015.		

Electricity Market Reform (EMR) is replacing the Renewable Obligation Certification (ROC's) system with payments based on Contracts for Difference (CfDs). The impact of EMR on smaller community-owned projects is currently unclear. Degression is, however, significantly reducing the attraction of many community-owned renewable energy projects under consideration.

The economic impact of Degression may well be countered by projects selling electricity generated at higher prices directly to local consumers. This is normal practice for farm-based renewables where the electricity generated on the farm is used to service the farms own requirement for electricity. Consideration needs to be given to the opportunities this presents to community-owned projects.

Appendix 2

Review of previous studies of the local socio-economic impacts from community renewables

A review of literature was conducted to highlight the main types of socio-economic benefits that have been associated with community ownership of renewable energy schemes. This showed clearly that these extend beyond the local economic impacts that form the focus of this study. For example, Community Energy Scotland (Gubbins 2010), Respublica (2012) and the Joseph Rowntree Foundation (Cowell et al 2012) emphasise the impact of community ownership on community resilience, the re-energisation of communities, community confidence and social justice. This has formed a basis for encouraging governments to develop community-support programmes which, in-turn, encourage communities to develop their own community energy projects.

Specifically in relation to Scotland, SCENE conducted an extensive review of Scottish community renewables which included a survey of over 300 community organisations and collected information on 97 individual projects (SCENE Connect, 2012). For the purposes of their analysis, community energy projects were defined as "place-based" social enterprises where there was local participation in the project and collective benefits.

Communities were seen to benefit from their involvement in renewable energy in (5) main areas:

(i) Access to resilient energy supplies
(ii) Economic, environmental and social opportunities presented by the project
(iii) Promotion of energy efficiency measures and an awareness of energy use
(iv) Local support arising out of local ownership helping overcome local opposition
(v) Market access and sectoral synergy – with communities investing in the project and revenues being re-cycled back into the renewable sector.

Renewable energy systems were dominated by wind (45% of projects) and hydro (18% of projects). Other technologies deployed by communities involved bio-mass, solar thermal and solar photovoltaic, CHP, anaerobic digestion, ground & air sources heat pumps and biofuels. Activity was widely dispersed throughout Scotland but with a strong concentration of activity within the Highlands & Islands – perhaps because of the remoteness of these areas and the clear need for communities in this area to strengthen their own fragile economies. The legacy of the Highlands & Islands Community Energy Company (CES) and the actions of its successor body Community Energy Scotland was also felt to have encouraged a disproportionate amount of activity in the Highlands & Islands. The involvement of communities elsewhere in Scotland is, however, increasing and with the proper encouragement could at-least equal Highlands and Islands activity. The most common primary motivations for Scottish community projects were found to be the generation of local income and the strengthening of local communities. These community-led projects appeared to be driven by primarily economic factors (63%) with environmental (17%) and social (7%) factors clearly of lesser importance (Bhopal 2012).

The findings are consistent with CES's own 2012 review of Impact (CES 2012) which argued that renewable energy schemes gave communities increases in Confidence, Resilience and Wealth:

(i) **Confidence** – Increased confidence leading to further community development

(ii) **Resilience** – More resilient and confident communities strengthen bonds in an area, reducing population migration and imbue a greater sense of pride and community spirit. Environmental resilience contributes to the Scottish Government's climate change targets with a reduced dependence on fossil fuels and, in turn, a contribution to a reduction in fuel poverty.

(iii) **Wealth** within the community. Revenue generating projects – as opposed to Facility Projects – were seen to:

   a. Lever in investment from outwith CES delivered programmes
   b. Provide projected incomes to the community ranging from £5,000 - £400,000 pa.
   c. Employ local businesses in their projects

A separate 2012 review of social benefits delivered by community-scale renewables (Walton 2013) throughout the UK, using Welsh case studies, concluded:

"Community renewable schemes can deliver a range of social and economic benefits to local communities "

These benefits are similar to those described and included:

- Increased levels of **autonomy** with long term income and control over fiancés in areas where there are often few options for generating sustainable wealth.
- Community **empowerment** by the involvement of local people in a range of activities which increase skills and confidence.
- Increased levels of community **resilience** by the use of income raised to increase the energy efficiency of local houses and community building, protecting against the impact of fluctuating fuel prices.

Other benefits identified by Walton included the increased provision of educational opportunities, a strengthened sense of placement and an increase in visitors to the area.

Finally, Callaghan & Williams (2013) considered the economic impact of community ownership of renewable energy in their 2012 review of Scottish community-owned renewable energy projects. They found, like SCENE, renewable schemes were most welcome where community ownership increased the likelihood of keeping benefits local. Communities owning their own renewable project were reported to earn around £100,000 net profit/MW pa (Callaghan et al 2012 (a), Cowell et al 2012). The economic impact of individual projects is not, however, reported because of the difficulty of deriving data from these projects (Pers. comm. 2013). Ownership and size of project was found to allow more strategic long-term thinking and planning and "opened up a range of social and economic initiatives for the local community to prioritise, including the creation of youth scholarships and investments in energy efficiency measures". A wide range of activities was found to be supported by these projects. These activities included the provision of affordable housing, the creation and encouragement – and perhaps safeguarding - of local business activity such as tourism and forestry activities.

Social impacts were seen to include the nurturing of new networks and the improvement in community confidence. They concluded their review had demonstrated community-owned renewables had the potential to improve local economic activity and make contributions to climate change.

Appendix 3

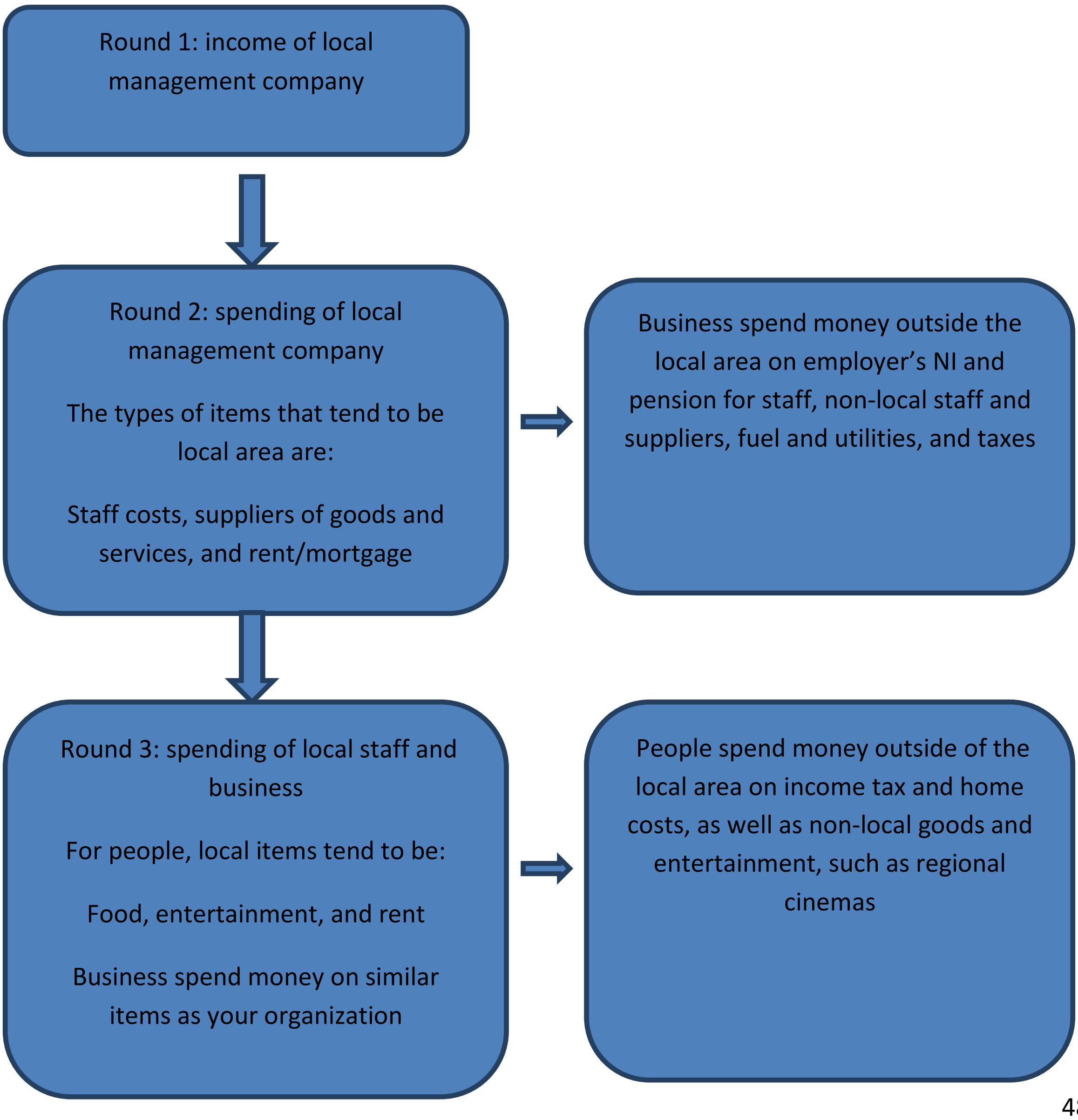
Path A:

This path starts with an injection of income to an organisation/business. It is appropriate for the following community renewable development–related flows:

- Income to local construction companies
- Income to local management companies (operation and maintenance)
- Project income

Example: Money flowing to a local management company in the operational stage of the wind turbine project

Money staying in the local area | **Money leaking out of the local area**



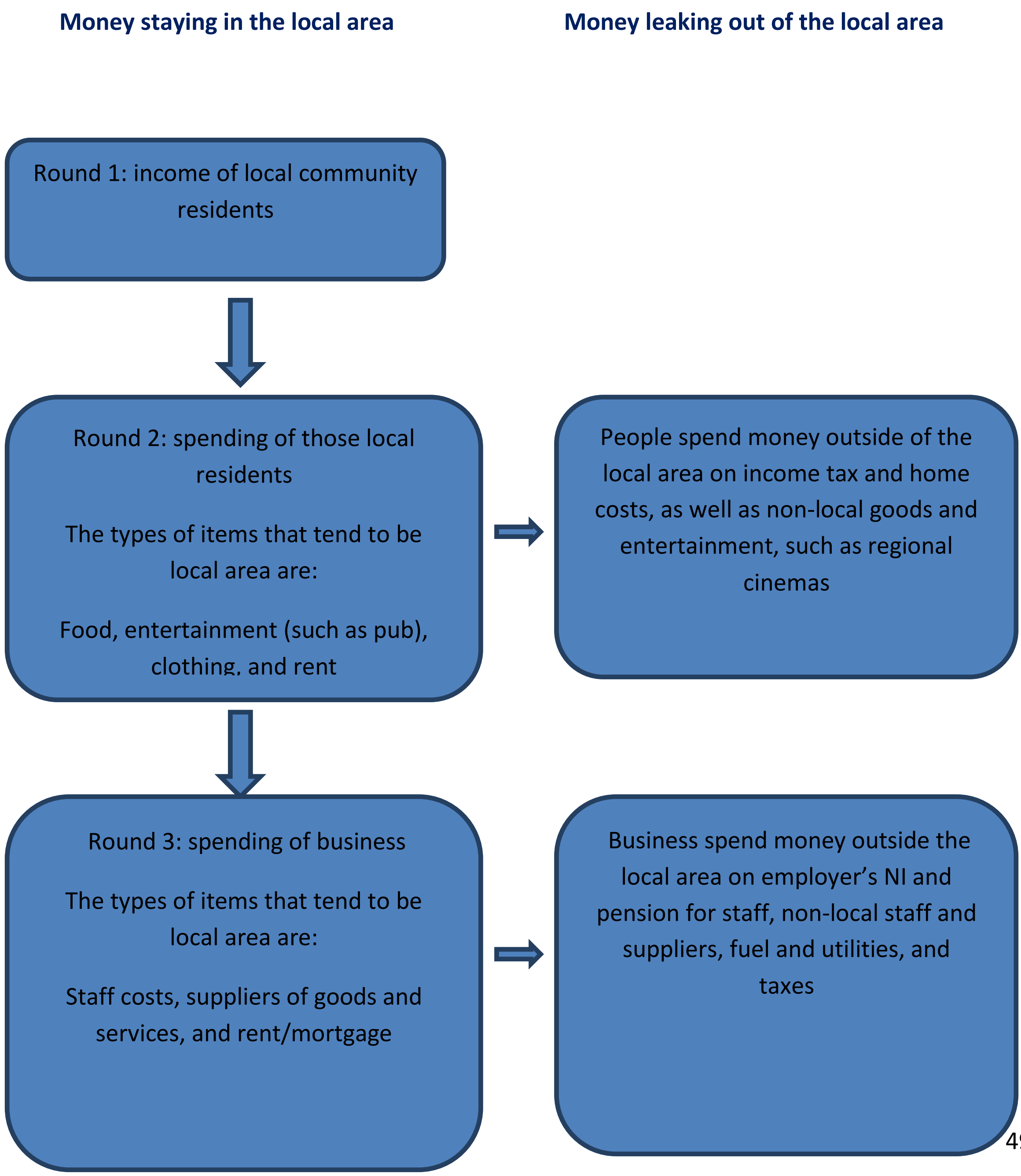
Appendix 4

Path B:

This path starts with an injection of income to an individual or group of people. It is appropriate for the following community renewable development–related flows:

- Land rental income
- Salary payments to direct employees
- Share holder income
- Additional income from reduced electricity costs

Example: Money flowing to a local residents receiving land rental income arising from wind turbine project.



Appendix 5

Personal spending survey

Thank you for taking the time to complete this form!
Please note your results will be kept in strictest confidence.

Employer Company ____

Where do you live? (Please circle)
Local Non-local (please state where)

How do you spend your income?
You may use monthly or annual figures, but please be consistent for all items below.
For each row (e.g., 'Food'), the 'Total £' should be the total of '£ Local' and '£ Non-local'

Item	Total £ (Local + Non)	£ Local	£ Non-local	Please name the main local business/es you use for each category
Example - using £ figures	*£1,400*	*£560*	*£840*	*John's Shoes*
Income tax				
Food (excl. restaurants/take-away)				
Entertainment (e.g. restaurants, video rental, betting, sport, pub)				
Clothes				
DIY/Garden/Household appliances and items				
Transportation (e.g. taxis, car tax, bus fares, petrol)				
Services (e.g. babysitting, window cleaners)				
Rent/Mortgage				
Council Tax				
Home costs (fuel and water, phone, TV tax, etc.)				
Loan Repayments				
Savings				
Other (please specify)				

Total Spending =£____________

If you have any questions regarding this survey please do not hesitate to contact
____________________ at ____________________

Appendix 6

Business Spending Survey

Thank you for taking the time to complete this form!
Please note your results will be kept in strictest confidence.

Company Name____

Address____

Contact Name and Position____

Where do you live? (Please circle)
Local Non-local (please state where)

How is the organisation's turnover spent?

You may use monthly or annual figures, but please be consistent for all items below.
For each row (e.g., 'Staff costs'), the 'Total £' should be the total of '£ Local' and '£ Non-local'

Item	Total £ (Local + Non)	£ Local	£ Non-local	Please name the main local business/es you use for each category
Example - using £ figures	*£1,400*	*£560*	*£840*	*John's Shoes*
Staff costs (excl. NI and pension)				
NI, pensions, and training				
Drawings (if sole owner)				
Director's fees and bonuses (if partnership)				
Supplies				
Subcontractors				
Rent/Mortgage				
Fuel & Utilities				
Repairs & Maintenance				
New Investment				
Insurance				
Taxes (VAT, Corporation Tax and business rates)				
Loan repayments				
Other (please specify)				

Total Spending =£____________

If you have any questions regarding this survey please do not hesitate to contact
_____________________ at _____________________