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The economic scale of community and locally owned renewable energy in Scotland and projections to 2020

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1. Key Points

- The Scottish Government asked ClimateXChange (CXC) to review the current and projected economic benefits of the expansion of community and locally owned renewables in Scotland.
- CXC examined the current level of community and locally owned renewable energy development in Scotland. We used a survey of operational community renewable energy projects in Scotland to provide technology-specific income figures. Given the limited sample size and assumptions necessary to extrapolate from this, our results should be considered as illustrative of the scale of the incomes accruing to community and locally owned renewable energy projects in Scotland.
- We estimate that the renewable energy capacity operational in January 2012 provided an illustrative annual net income of £42 million to community and locally owned organisations.
- Within that total, our analysis suggests that total net incomes to the category "Community groups" are approximately £5 million per year.
- Taking a scenario in which the Scottish Government's target of 500MW (capacity) in community and locally owned renewable energy by 2020 is met – and based on current capacity and capacity in development – over the period between 2012 and 2020 a total net income from community and locally owned renewable energy projects of £610 million could be delivered.
- Over the anticipated operational lifetime of existing and projected capacity, total net income of £1,932 million and total gross income of £3,361 million could be realised. In present (2012) value terms, this equates to between £1.3 and £2.2 billion.
- The evidence base for income from community and locally owned renewable energy projects in Scotland is small and we recommend a national database to gather more robust economic data on the levels of gross and net income earned annually for different technologies and different ownership categories.
- Additionally, such a database could usefully collect information on 1) how incomes are used by groups, 2) where expenditure is made, by region, 3) the specific funding model used for the project, and 4) whether funds from the renewables project have been successfully "leveraged" against additional funding.

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2. Introduction

The Scottish Government has a target of 500MW capacity of community and locally owned renewables by 2020.

To respond to the research question, this project examines: first, the scale, and net income of installed community and locally owned energy capacity in Scotland as of January 2012, disaggregated by technology and category of ownership; and second, projections to 2020, and over the devices' lifetime, of the gross and net incomes from community and locally owned renewable capacity.

Section 6 of this report details items not considered here, but which will have a bearing on the incomes and economic impact from community and locally owned renewable energy projects in Scotland.

3. Current scale of community and locally owned renewable energy in Scotland

3.1 Project data

This report relies heavily on the Energy Saving Trust's (EST) database of community and locally owned renewable energy projects: "Database of community and locally owned renewable energy in Scotland, as at June 2011 and Jan 2012" (Energy Saving Trust, 2012). This database provides details on all community and locally owned renewable energy projects in Scotland, including information on their operational status at two points in time. Additionally, for each project a range of data is provided, including:

- the type of organisation involved in the project
  - Local authority (including schools), Housing associations, Community groups, Other public sector and charities, Farm estates, Local businesses
- the technology type, e.g.
  - Wind, Heat Pump (Ground Source, Air Source), Hydro, Biomass (including district heating), Solar
- the installed capacity (including both the technology size (e.g. per turbine) and the number of installations per project)
- the percentage of the project in community ownership (where this is less than 100%, i.e. the community has a joint share in a larger project)
- the estimated annual energy output of the project

3.2 Total installed community and locally owned renewable energy capacity and production, by technology and organisation type

Detailed analysis of the database reveals that as of June 2012, there was a total of 205MW of operating community and locally owned energy capacity within Scotland. The capacity in January 2012 (166MW) comprised 1,498 projects.

We begin by considering capacity. Table 1 identifies the installed community and locally owned renewable energy capacity in Scotland in January 2012 and June 2012, broken down by type of organisation and showing absolute and (%) share of capacity.

Table 1: Installed community renewable energy capacity (MW), by organisation type, January and June 2012

	January 2012		June 2012[1]	
Category	Installed capacity (MW)	Share of total capacity (%)	Installed capacity (MW)	Share of total capacity (%)
Local authorities	25	14.8	26	12.7
Housing associations	16	9.7	40	19.5
Community groups	23	13.6	26	12.7
Other public sector and charities	17	10.2	18	8.8
Farm estates	66	39.7	68	33.2
Local businesses	20	12.0	27	13.2
Total	166	100.0	205	100.0

Sources: Energy Saving Trust (2012; 2013) and author's calculations. Note: Totals may not sum due to rounding.

As can be seen, the level of overall community and locally owned capacity increased by 39MW between January and June 2012. There was an absolute increase in the capacity in all categories, but much of this increase (24MW) is due to increases in capacity in "Housing associations", with smaller increases across other categories. The 7MW expansion in capacity under "Local businesses" was the second highest absolute increase over the year.

As a result, the share of all installed capacity for housing associations more than doubled to 19.5%, and for "Local businesses" increased to 13.2% by June 2012.

Next we look at energy output. Table 2 shows the total energy output across the different types of organisation. For energy output we are only able to report up to the end of January 2012, as the EST database for end-June 2012 was not available. We follow the same assumptions as are made in the EST database in estimating the energy production from each technology's capacity. Details on these assumptions are provided in Energy Saving Trust (2013). Table 3 breaks the data down further by technology type.

[1] Data for June 2012 are taken from Table 3 in Energy Saving Trust (2013). Those data are a more up to date version of the database to which we had access during the preparation of this report.
[2] This is income net of costs, i.e. gross income minus operating and finance charges.

Table 2: Yearly energy output (GWh), by organisation type, January 2012

	January 2012	
Category	Yearly energy output (GWh)	Share of energy output (%)
Local authorities	64.2	15
Housing associations	33.1	8
Community groups	49.2	12
Other public sector and charities	42.9	10
Farm estates	162.2	39
Local businesses	66.5	16
Total	418.3	100

Sources: Energy Saving Trust (2012) and author's calculations. Note: Totals may not sum due to rounding.

Comparing Table 1 and Table 2, we can see that there are differences between a given category's share of total capacity and its share of total output. For example, "Housing associations" are responsible for 9.7% of total capacity, but only 8% of energy output. Similar increases are seen in the energy output for "Local businesses", with 12.0% of total capacity and 16% of energy output. "Local authorities" have a share of installed capacity (14.8%) broadly in line with than their share in energy output (15%), while "Community groups" have 13.6% of capacity and 12% of energy output). These differences are explained by technology types, shown in Table 3, as well as the scale of projects.

Table 3: Yearly energy output (MWh) by organisation type and technology, January 2012

	Wind	Biomass	Hydro	Heat pump	Solar	Total
Local authorities	1,909	45,192	-	16,172	945	64,218
Housing associations	2,143	8,075	-	21,180	1,733	33,131
Community groups	29,347	13,068	6,100	564	163	49,241
Other public sector and charities	4,562	34,570	1,946	1,556	252	42,885
Farm estates	131,801	29,728	570	111	13	162,223
Local businesses	2,756	62,741	39	601	321	66,458
Total	172,518	193,374	8,655	40,184	3,427	418,157

Sources: Energy Saving Trust (2012) and author's calculations. Note: Totals may not sum due to rounding.

4. Net income from community and locally owned renewable energy in Scotland: 2012

4.1 Income Data

A Community Energy Scotland (CES) report from 2013 provides revenue, cost and other economic data for existing community renewable energy projects in Scotland (Community Energy Scotland, 2013). The CES report estimated the gross and net income or average energy saved (kWh) from standalone electricity generating projects and renewable energy projects incorporated into facilities (where heat or electricity is supplied to building(s)).

For standalone electricity generating projects, the following technologies were covered:

- Onshore wind
- Hydroelectric

The facility projects covered included:

- Photovoltaic
- Air Source- and Ground-Source Heat Pumps (ASHP and GSHP)
- Solar PV and Thermal
- Biomass

This report uses the CES figures – sourced from individual community facilities, and disaggregated by technology – to estimate the net incomes to existing community and locally owned renewable energy capacity.

Some important caveats should therefore be borne in mind when considering the results and the analysis of these figures that follows.

- The sample size used by CES for each technology is small. For example, there were only two hydro schemes surveyed, and a total of 6MW of capacity for small scale standalone wind. Extrapolating to the total scale of community and locally owned renewable energy capacity therefore has significant limitations. In the absence of a full national dataset which collects figures on incomes for community energy projects, these assumptions, while increasing the uncertainty about the scale of the results which follow, are necessary given the survey undertaken. For these reasons, we might consider the results which follow as being principally *illustrative* of the general scale of gross and net incomes from community and locally owned energy projects in Scotland.

- The data in the CES report relate to community group owned assets, which whilst being the principal subject of interest in this report, is only one sub-category of the ownership types included within the definition of community and locally owned renewables. The scope of the CES survey did not extend to, for example, “Farm estates” or “Local businesses”. To the extent that there are differences in net incomes between different categories and between different technologies for each – perhaps due to greater efficiency, or achieving a better price for their electricity – this will not be picked up in this analysis. Where there are differences, for example, in projects which receive FITs or ROCs across different categories, or where there are differences in funding sources – e.g. grants or private finance – these will not be taken account of in our analysis.

4.2 Net Income

We can create a net income table for each technology by multiplying the elements in Table 3 (output disaggregated by technology type) by the corresponding technology net income per kWh figure. The net income figures for each technology were estimated from the annual production from each technology (kWh), as shown in Table 3 above.

We use the term net income here and in the remainder of this report. Net income is equivalent to the economic benefit to the community or locally owned project from energy producing technologies, and might either represent incomes received or costs avoided.

For revenue-generating technologies (typically where electricity is sold to the grid), the calculations were straightforward, multiplying the (surveyed) average figure for net income[2] (e.g. p/kWh) by the (known) energy output for that technology.

For energy producing technologies (where the energy is used locally), the process is associated more with a saving than an income. Here we use biomass facilities as an example:

> Value of average energy saving (i.e. net income, in p/kWh) = average energy saving in pence (1,036,200p) *divided by* average annual energy production (152,632 kWh) = 6.79p/kWh

Similar calculations for ASHP and GSHP projects produce net income figures for those technologies of 3.17p/kWh and 3.91p/kWh respectively.

Multiplying the net income figures for each technology, by the estimated energy production data for operational community facilities as of January 2012, we obtain net income figures for the existing renewable facilities. The disaggregated sum of net income figures is shown in Table 4, broken down by technology and organisation type.

Table 4: Annual net income (£m) by organisation type and technology, for facilities operational as of January 2012

	Wind	Biomass	Hydro	Heat pump	Solar	Total
Local authorities	0.13	3.07	-	0.57	0.29	4.06
Housing associations	0.15	0.55	-	0.74	0.53	1.98
Community groups	2.07	2.35	0.54	0.05	0.05	5.06
Other public sector and charities	0.32	2.02	0.17	0.00	0.08	2.59
Farm estates	9.29	4.26	0.05	0.02	0.00	13.63
Local businesses	0.19	13.13	0.00	1.41	0.10	14.84
Total	12.16	25.37	0.76	2.81	1.05	42.15

Sources: Energy Saving Trust (2012), Community Energy Scotland (2013) and author's calculations. Note: Totals may not sum due to rounding[3].

[2] This is income net of costs, i.e. gross income minus operating and finance charges.

Table 4 indicates that a total of approximately £42.2 million is received annually by community and locally owned renewable energy projects in Scotland operational at the start of 2012[4].

The final column of this table shows that 35% of net income is received by "Local businesses" with an additional 32% by "Farm estates". Our analysis suggests that total net incomes to "Community groups" are of the order of approximately £5 million per year. The final row in Table 4 shows that – as expected – biomass and wind projects contribute almost 90% of the net income with a total of £37.5 million.

Individual cells in Table 4 show the illustrative breakdown of total revenue across organisation types and technology[5]. The largest single entry is the £13.1 million figure for biomass projects owned by "Local businesses". This entry equals 31% of all net income, while the second and third largest net income figures are wind projects for "Farm estates" and biomass projects for "Farm estates". These amount to £9.39 million and £4.3 million respectively. These three entries combined comprise over 63% of total net income.

5. Projections of economic benefits

5.1 Projections to 2020

Our analysis is based around a future scenario, where we assume that the Scottish Government target of 500MW installed community and locally owned renewable energy capacity by 2020 is met[6].

We disaggregate capacity by technology. For each technology, we begin with the end-January 2012 level. Future changes in capacity are then projected for each technology based on its starting level and the capacity in development for that technology (Energy Saving Trust, 2013). For instance, as of June 2012, 80% of capacity under development was for wind technology, with 8% and 7% of capacity in biomass and heat pump technologies respectively. We therefore assume that each technology's contribution to the additional capacity required to meet the 500MW target is in proportion to that technology's share in (capacity) projects in development. Thus, 80% of the growth in capacity is taken to be in wind projects, for example.

To get the annual developments in community and locally owned renewable energy capacity between 2012 and 2020 by technology in this scenario it is assumed that each technology grows by a constant annual proportionate rate such that the overall community and locally owned target is reached in 2020. The assumed capacity trajectories are shown by technology in Figure 1.

[3] It is assumed that all relevant support mechanisms, e.g. FITs, ROCs, RHIs, which each technology is qualified to receive are included within the (surveyed) figure for each technology used in Table 4. We return to the limitations of the dataset in Section 6 (page 10).

[4] As described earlier, figures are based on a small sample survey of different technologies owned by community groups. Actual realised net income could differ across organisation types and for the same technology, and so these figures should be considered illustrative.

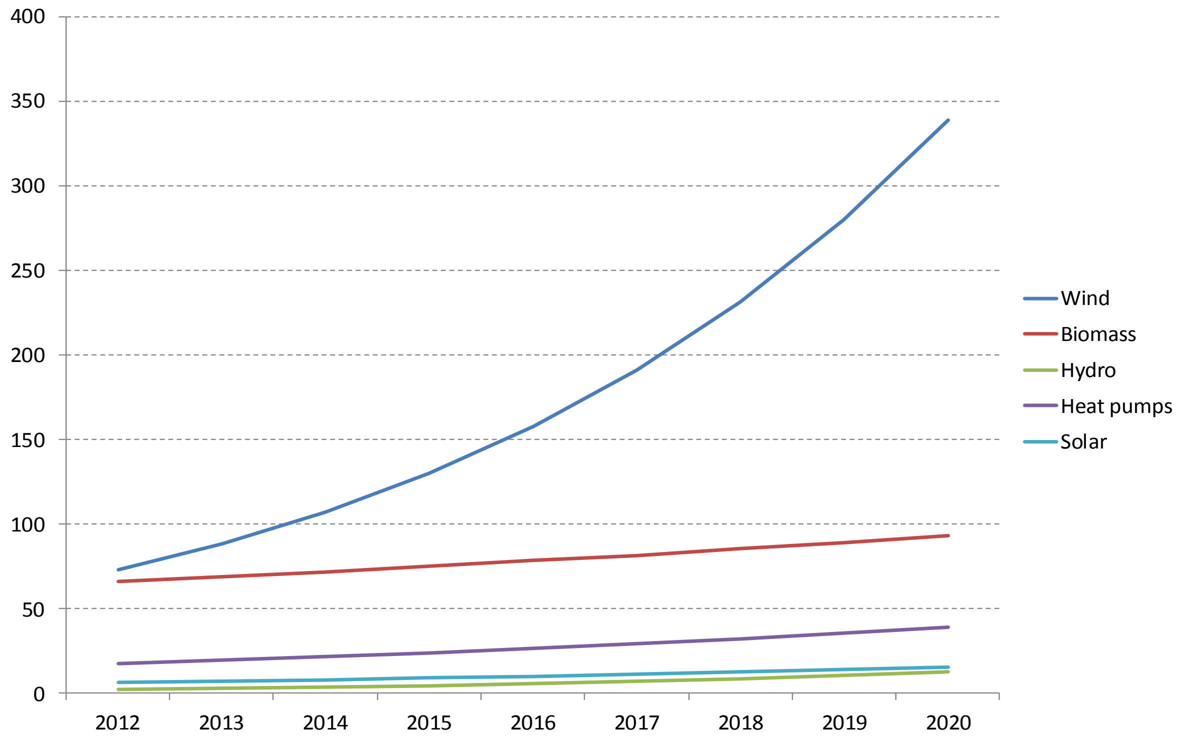
[5] See caveats on page 5

[6] Empirical findings suggest that this scenario might understate the current growth rate of renewable energy projects in Scotland during 2012. For example, Energy Saving Trust (2013) reported growth of 39MW in the first six months of 2012. It is likely that our scenario understates the net incomes in the years post 2012. However, given the uncertainty about future growth of community renewables, it seems safer to assume that the 500MW target is not met until 2020.

Firstly, note that this analysis assumes that the net incomes per MW for each technology are constant in the period to 2020. Second, only one scenario has been considered here. Of course, there are multiple other scenarios which could be considered, and each one would give rise to a different profile and headline figure for net incomes over the period to 2020[7].

From Figure 1 we see that under this scenario, of the total of 500MW, almost 350MW comes from wind projects. The other technologies are biomass, heat pumps and solar and hydro respectively. The assumed annual growth rates for each technology between 2012 and 2012 are 21%, 4.4%, 19.7%, 11.5% and 22.9%[8] respectively.

Figure 1: Assumed technology capacity trajectories, 2012 to 2020



Using the technology capacity trajectories and the net income figures for each technology in 2012, we estimate the annual net income between 2012 and 2020. The results of this analysis are shown in Table 5.

[7] It is possible that wind developments could slow as prime sites have been developed, while with policy support – for example through the RHI - the development of biomass for heat could expand beyond that currently in development.

[8] The high proportionate growth for hydro is partly explained by that technology starting from a small base (1.5% of total capacity as of January 2012), while accounting for 3% of all projects in development (slightly more than solar technology, for example).

Table 5: Annual and total net income, by technology, 2012 to 2020, £million

	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Wind	12	15	18	22	26	32	38	47	56	265.50
Biomass	25	26	28	29	30	31	33	34	36	272.44
Hydro	1	1	1	1	2	2	3	3	4	17.89
Heat pump	3	3	3	4	4	5	5	6	6	39.09
Solar	1	1	1	1	2	2	2	2	3	15.20
Total	42.1	46.4	51.4	57.1	63.8	71.7	80.9	91.9	104.8	610.13

Sources: Energy Saving Trust (2012), Community Energy Scotland (2013) and author's calculations. Note: Totals may not sum due to rounding.

For the scenario considered here, and with the same net income figures for each technology assumed in Section 3, a total of £610 million of net income could be delivered from community and locally owned renewable energy projects where the 500MW target is reached. Over half of this is returned from wind energy projects (£265.5 million) while biomass projects are responsible for £141 million of the total. Hydro, heat pump and solar projects deliver £18 million, £20 million and £15 million of net income respectively. This overall figure assumes, as stated earlier, that net income per (MW) capacity for each technology is as in our illustrative analysis in Section 3 and that this remains constant out to 2020.

5.2 Projections over lifetime of devices – net and gross income

Taking the scenario from section 5.1 forward, we can estimate the net incomes over the lifetime of the operational installed devices. In addition to the same assumption regarding a fixed net income per (MW) capacity, we assume the lifetime for each technology is 20 years, and use the database to estimate the age of (currently) operational capacity for each technology. For wind, for example, it is seen from the database that the modal operational date for current operational wind capacity (for which operational dates are available) is 2008. For this technology therefore we assume that in 2028 (after 20 years of operation) this capacity is no longer operational. For all technologies, capacity installed in the years subsequent to 2012 is decommissioned after a 20 year lifetime, with the last device ceasing activity in 2040.

Table 6 shows the total net income figures, by technology over the lifetime of the devices. This shows that over the lifetime of the operational capacity as of 2012 and devices installed to meet the target of 500MW in 2020, there could be net income of £1.932 billion. Wind and Biomass facilities comprise 87% of this total, with Wind capacity constituting 55% of the total income over the period.

Total income is perhaps a better measure of the scale of economic benefit potentially accruing to community and locally owned renewable energy capacity in Scotland, as it reflects the scale of income which could be obtained.

Using the figures obtained from the survey by CES we have obtained gross income figures per MW of capacity, broken down by technology (Community Energy Scotland, 2013). Applying these (fixed) values to the projections of lifetime capacity described in Section 5.2 we have obtained lifetime gross income figures, which are also given in Table 6 below. This totals £3,361 million of gross income.

Table 6: Total net and gross income by technology over lifetimes, 2012 to 2040

	Net income	% share	Gross income	% share
Wind	1,078.23	55	2,432	72
Biomass	612.26	32	612	18
Hydro	75.97	4	149	4
Heat pump	117.30	6	117	3
Solar	48.05	2	51	2
Total	1,931.82	100	3,361	100

Note: Totals may not sum due to rounding.

5.3 Present value of incomes over lifetime of devices

Given the length of the timespan covered by this report, it is useful to calculate the present value (i.e. the value "today" (or the start of our sample in 2012)) of these income flows. This reflects the notion that income earned sooner has a greater utility than the same income earned in the future, with the time value of money given by the discount rate. For this calculation, we have use the value of discount rate from the HM Treasury's Green Book of 3.5% to reflect this time preference value for money. This will have the impact of reducing the gross and net income total figures, as incomes which occur further into the future have lower present value. The present value of the estimated net and gross income streams are provided in Table 7.

Table 7: Total net and gross income, 2012 to 2040 in nominal and present value terms

	Cash value (£m)[1]	Present (2012) value (£m)
Net income	1,932	1,300
Gross income	3,361	2,217

Note: The "cash value" figures are the same as the totals from columns 2 and 4 in Table 6 and reflect the undiscounted sum of gross and net income respectively.

6. What has this report not considered?

This report has considered the current development of community and locally owned renewable energy projects in Scotland. It has estimated the scale of net incomes from that current scale of development, and the likely net incomes to 2020 and over the lifetime of projects developed to meet the target of 500MW of community and locally owned energy in Scotland, drawing on limited surveyed information on existing community renewable energy projects in Scotland.

First, the report has not considered the economic impacts on local areas, or Scotland as a whole, of the expenditure of the identified incomes. It is possible, for instance, that revenues would be spent, and therefore contribute to economic activity, in the region close to the project and the Scottish economy as a whole. As CES notes, "careful reinvestment of the additional income, demonstrated by CES supported communities in the development of priority investment lists and reinvestment in their facility, and use of local services and materials can lead to knock on effects through retained spending in the local economy and the multiplier impacts this brings" (CES, 2012, p. 42). These consequences have not been considered in this report for two reasons:

1) There is only limited evidence on the uses of incomes from renewable energy projects. Some recent evidence points to these incomes being employed to finance a range of local charitable and business activities (CES, 2012[9]).

It is likely that the local economic impacts would vary significantly depending on how the funds from such renewable energy investments are spent. It would be useful to conduct a study of the extent to which such alternative expenditures contribute to economic activity in the local area (ideally using modelled and empirical data). Existing modelling of the *ex-ante* economic impacts of renewable energy expenditures have typically made simple assumptions about the uses of such funds, e.g. Allan, McGregor and Swales (2011) and Phimister and Roberts (2012).

2) The impact of specific expenditures may differ based on where the expenditure is undertaken, i.e. the impact of a particular form of expenditure could be different depending on the profile of the region.

These points would suggest that economic modelling should be used to estimate the likely scale of impacts from the expenditures from renewable projects. If possible, such analysis should be undertaken at the local scale – i.e. relating to the geographic area which is affected by the project and in which the incomes are spent.

Second, empirical evidence used in this report relates to projects with specific financing models. The difference between gross and net income could be quite different if a project were funded – for instance – from either grant funding (where projects were not required to pay any ongoing charge for capital) or, at the other extreme, fully financed through commercial loans. Evidence suggests that grant funding, private equity and commercial loans were the three largest sources of funding for community projects in Scotland, for instance (SCENE Connect, 2012).

Third, incomes from community and locally owned renewable energy projects could have differing effects arising from successful "leveraging" of additional funding against the incomes from the renewable project. For instance, anecdotal evidence suggests that the total spending available to a community group, for example, could be a multiple of its receipts from the renewable energy project as funds are "matched" by additional incomes from other sources, including the Lottery Fund and public sector contributions. CES (2012) identifies a range of such additional funding sources.

Fourth, the report takes simple averages for (per MW) net and gross income for projects of a specific technology, and omits geographic features, such as the location of the facility. Whether the project is in an urban or rural location could impact on incomes, for example where resources differ or where grant funding (for example) opportunities are more available. Additionally, the specific profile of energy demand could lead to different opportunities in urban locations for community energy projects compared to rural locations.

Fifth, this study has been able to draw on only a limited sample of (mostly self-reported) data on revenues and income from community projects. The relatively small sample size may obscure some anomalies and outliers that could change the national picture[10]. The (necessarily) illustrative nature of the findings reported here is principally

[9] Appendix 6 of CES (2012) identifies uses of funds for investment, for salary costs, using funds to build up community reserves, reducing energy bills, or improving community infrastructure through reinvestment in community halls, for example.

[10] Although not included in the dataset, a project such as the Viking Energy project on Shetland, with a 50% community stake in 103 turbines, would be significantly different from the typical scale of community wind energy projects in Scotland.

due to the lack of a national dataset that provides more robust data on the economic features for community energy projects in Scotland.

7. Conclusions

This report has examined community and locally owned renewable energy capacity in Scotland, and estimated the scale of income to community organisations involved in owning and operating a renewable energy facility producing electricity or heat. Additionally, we have estimated the scale of net income which could accrue were the Scottish Government's target met, of 500MW of community and locally owned renewable energy projects by 2020.

An existing database of all operational community and locally owned renewable energy projects was utilised, identifying a total of 165MW of operational capacity at the start of 2012, and allowing for significant disaggregation of projects by technology type and category of organisation.

Further, Community Energy Scotland (2013) provides information on incomes and energy generated from a small sample of operational community energy projects to allow estimation of income. In the absence of a full survey of operational community renewable energy projects, it is likely that these figures provide the best estimate currently available of the scale of the economic incomes. These data were provided across different technologies, allowing for detailed analysis, and the results suggest that a technology-disaggregated approach is useful, and in particular could be used to understand how different scenarios of growth of each technology might impact upon the economic benefits accrued.

Our results suggest that for community renewable energy projects operational at the start of 2012, an illustrative net income figure of £42.2 million would be earned annually.

Under our scenario for the 500MW target to be met by 2020, cumulative net incomes totalling £610 million would be generated between 2012 and 2020. Nearly 90% of this would accrue to wind and biomass energy projects, given the scale of projects at operational and pre-development stage.

Over the lifetime of the current and projected capacity to meet the 2020 target, cumulative net income of £1,932 million and cumulative gross income of £3,361 million could be generated. Wind projects constitute over 56% and 72% of these totals, respectively. In present value (2012) terms, these equate to between £1.3 and £2.2 billion in incomes from community and locally owned renewable energy capacity in Scotland.

While this report has set out the potential net income for community groups involved in renewable energy projects, it has not considered a number of key points. Firstly, the use of the funds provided to community organisations could have an important impact on the local economy, but to date there is limited evidence on how such funds have been used. Moreover, similar uses of funds could have different impacts in different areas. Secondly, alternative initial funding decisions of the renewable projects will impact on the annual finance charges they face. Such charges are likely to be critical where projects have high upfront costs as they will reduce income in the early years of the project. Finally, where incomes from renewable energy projects "leverage" funds from other sources, the incomes are likely to be different from those which would arise from the renewable energy project alone. These points suggest the need for a closer examination of the existing economic details of community and locally owned renewable energy projects in Scotland.

8. References

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