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Local Energy: Perspectives on Scotland and Brazil

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Summary:

Policy support for climate change and sustainable energy deployment in the EU and Scotland has enabled Communities to implement and benefit from local energy schemes, there would appear to be potential for similar schemes in Brazil. There have however been miss-steps due to narrow criteria being applied in assessment of carbon emissions and sustainability, there is a need for more detailed environmental assessment. The ability of a Community to adopt a local energy scheme depends on its Governance, financial and technical capacity. A new multi-disciplinary assessment process is being developed and piloted in Scotland and Brazil which includes technical, environmental and socio-economic factors. The output will be an identification of appropriate energy systems and technical and socio-economic gaps to be addressed. The focus here is on local energy due to global funding availability however the Community capabilities developed for energy schemes can be applied to other projects and have wide benefits.

1. Policy support for Sustainable Energy systems in Scotland.

The EU, in common with many countries globally, has significant policy aimed at tackling global warming [1]. The Europe 2020 Strategy on Climate Change aim is for 'smart, inclusive and sustainable growth'; measures include binding legislation on: 20% emissions reductions, carbon trading, 20% energy efficiency and 20% of energy production from renewable sources [2]. The EU policy has impact outside of the EU borders as renewable energy sources include imported biomass and biofuels from countries such as Brazil.

Scotland has set more aggressive internal targets for emissions reductions than required by the EU i.e. 42% reduction in emissions by 2020 and 80% by 2050 [3]. Much of Government funding has gone to organizations which operate at large scales with no Community involvement however the Scottish Government has promoted Community owned and locally run energy schemes, over 400 are established including micro hydro, photovoltaic, solar thermal. wind, and biomass energy sources [4] (figure 1a). The Scottish Government Policy is intended to ensure revenues from renewable energy schemes flow to local Communities, either through Community or joint ownership of the renewable systems, or through payments to the local Community by commercial organizations who exploit renewable energy in the local area (figure 1b). Through these mechanisms local energy production can provide income to fund other local initiatives. Some Communities have been very successful in exploiting the available incentives while others have found the process difficult.

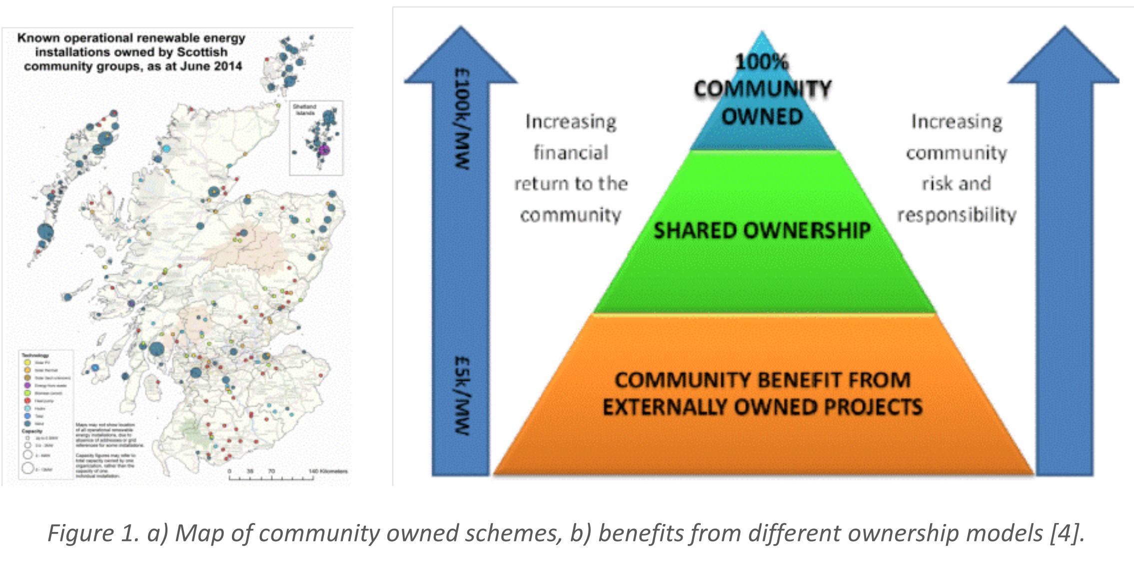

Figure 1. a) Map of community owned schemes, b) benefits from different ownership models [4].

2. Local Sustainable Energy Systems in Scotland with potential for replication in Brazil.

Although there is an economy of scale associated with large scale energy generation, there are costs associated with the distribution of this energy to the point of use. Avoidance of grid distribution costs can make local generation at smaller scale cost competitive particularly where incentives for such schemes exist. Financial incentives from Government are generally being reduced over time but this is partly offset by the reducing capital cost of renewable systems [5]. From the many examples of Community energy schemes in Scotland two are highlighted here to illustrate the potential for replication in the context of Brazil.

The first of these is the Isle of Eigg which is a remote island with a population of around 200 people, the main employments on the island are tourism and agriculture but there are many other enterprises including music, art, and brewing, the island also has the benefit of good internet access. The island electricity supply was historically from diesel generators which ran with imported diesel from the mainland, this was replaced with a renewable scheme which now generates 93% of the energy required through small scale hydro (140kW), wind (24kW) and photovoltaic (50kW) the diesel generators have been maintained as a backup (Figure 2, figure 4) [6]. The new system has reduced the electricity costs from 40p per kWh to 17p per kWh and is supported by a Community nonprofit organization which employs 6 islanders on a part time basis, there is also remote support from the system installers. While the island electricity is mainly supplied through renewables the heating, cooking and transport energy demands are currently supplied by imported fossil fuels (coal, bottled gas and diesel), there is potential to develop further local energy efficiency plans (building insulation etc) and local renewable energy sources (biomass, wind) to address these also.

Findhorn is an Eco-village of around 200 people in the Scottish Highlands and consists of 75 buildings, mainly dwellings but also offices, shops, community hall, cafe and restaurant. Findhorn has 4 wind turbines (750kW), photovoltaics (25kW), solar thermal systems, biomass district heating systems, heat pumps, electric vehicles, a waste treatment plant, and runs its own private wire electricity network through a nonprofit company (figure 2). Findhorn has implemented advanced standards for energy efficiency. Findhorn is investigating further renewable energy and storage options to help balance supply and demand for the intermittent renewables and increase local autarky and financial returns [7].

In common with most Community energy schemes, decisions have been strongly dependent on the financial context including relationships with large scale energy companies and Government incentives.

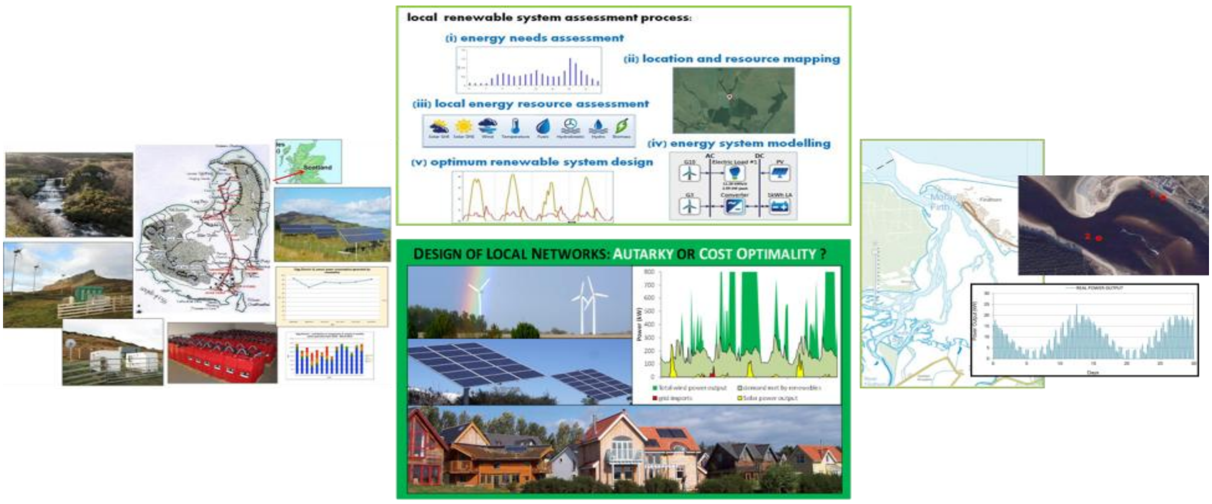

Figure 2. Eigg renewable energy scheme (left image), Findhorn ecovillage location, buildings and renewables (bottom and right), Current standard renewable energy assessment process (top).

3. Issues with Current and Historical Policy and Process

There are problems with the current policy implementation, which impact both Scotland and Brazil.

3.1 Performance Gap between Reported and Actual Results

There are gaps between the reported emission savings and actual savings due to: (i) over optimistic performance prediction calculations or tests; (ii) poor quality implementation and operation of systems; (iii) actual results not measured or reported correctly so that gaps are not recognized. An example of this is the Volkswagen emissions scandal [8], another is the reported performance gap for sustainable buildings [9]. The solution to this issue is to measure actual performance, or have tests that simulate realistic conditions, there is a reluctance in Government and Industry to adopt such rigorous practices however there are gradual improvements being made [10].

3.2 Limitations in Technical Assessment Methods

While there are many available tools for assessing local renewable potentials [11, 12, 13] there is a lack of an overall methodology which allows a complete assessment of the local energy potentials [14].

The calculations used to assess potentials and impacts of energy systems and fuels, and make decisions on funding for energy efficiency or renewables have largely been limited in scope to the simple engineering / financial models considering operational energy and carbon and simple financial parameters [15, 16, 17]. This approach excludes significant lifecycle, environmental and socio-economic factors which retrospective evaluation often show to be critical. Many historical decisions based on these simple calculations are subsequently found not deliver the intended results. Examples of erroneous historical decisions have been in the fields of woody biomass, use of wet peat lands, bioethanol and biodiesel.

Wood biomass has been heavily promoted across the EU and Scotland as a sustainable and renewable fuel, and based on a very simplistic model of forestry is assigned a carbon factor of 0.016 kgCO2 per kWh, more than 10x less polluting than natural gas and 25x less polluting than grid electricity [15, 16, 17]. A raft of Government incentives led to widespread adoption of biomass firing for electricity generation and for heating. More recently there has been a recognition that this simplistic view of biomass is incorrect and in fact has encouraged forestry that is unsustainable and results in equivalent carbon emissions higher than the fossil fuel it replaces [18]. The Government has had to revise its regulations to only incentivize biomass which delivers emissions savings taking into account the direct carbon impacts of land use change but these new regulations do not necessarily consider the indirect impacts of land use change such as displacement of food production to previously natural environments, more work needs to be done in this area and the true sustainability of large scale international trade in biomass has significant uncertainties.

Another area where the direct impact of land use change has historically not been considered in renewable energy decision making in Scotland is in the use of wet peat lands. These wet organic areas have accumulated vast amounts of carbon in the organisms that make up the peat, where these areas are drained and planted with trees or indeed partly drained due to the installation of wind farms the carbon bound up in the peat is released into the atmosphere as organisms break down. These carbon emissions can override the supposed benefits of the displacement of fossil fuels [19, 20]. This late realization means that many historical schemes are flawed and remedial measures have to be undertaken such as restoration and maintenance of water systems or removal of trees and reinstatement.

The EU policy on transport is for replacement of fossil fuels with renewables. Targets had been set for 7% of petrol to be replaced with bioethanol. However, similar to the cases for forestry and peat lands, it has now been recognized that the type of land and process used for bioethanol production is key and that it is not always a low carbon fuel [21] (Figure 3). Targets have been reduced to 5% petrol replacement and policy statements and calculation methods instigated that are to be used to demonstrate carbon emissions savings of 35% and then 50% compared to fossil fuels. However these methods do not fully account for indirect displacement effects and secondary land use change, and are currently being applied only at high level rather than at local scales. Other sources of transport fuel replacements which do not compete with food production are being investigated [22].

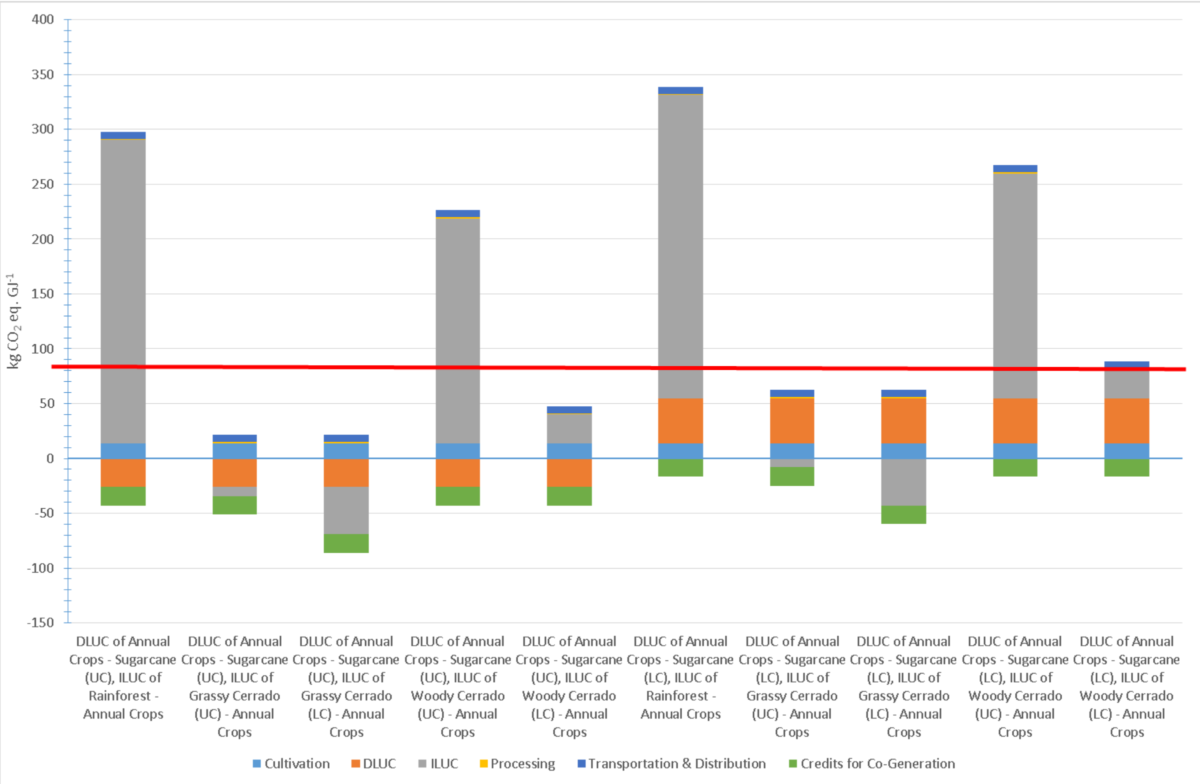

Figure 3.Variation in CO2 emissions per GJ of fuel for different bioethanol direct and indirect land use scenarios vs. fossil fuel (= red line) [23].

These examples are just a snapshot but highlight that current assessment methods are problematic, and suggest that environmental factors such as soils, vegetation, land use and water need to be accounted for in assessing local energy.

In other fields e.g. green buildings there are broader assessment methods that consider other environmental factors such as emissions, contaminants, pollutants, whole lifecycle, ecology etc. [24] elements of which could also be useful in assessing potential local energy systems.

3.3 Non technical aspects of Assessment Methods

It is apparent in the Scottish context that uptake by Community groups of the opportunities afforded by their local resources and the green funding streams available depends on the local socio-economic capabilities, skills and structures. Governance structures, available financial and technical capabilities and support structures, and availability of people resources, would all appear to be essential for projects to succeed. Issues of land ownership and access, permissions, and rights can pose significant barriers to success even when the other resources and capabilities are in place.

The benefits of the local energy scheme implementation are broader than the financial returns of the scheme itself. The communities which successfully implement local energy schemes have structures in place which can then enable them to be successful in other local development initiatives. The capacity of individuals involved in

Governance, financial appraisals, employed in construction or operation is increased, as is the energy and sustainability literacy of the Community.

These non technical capabilities, barriers and wider benefits are not well represented in current assessment methods.

4. An Improved Process for Local Renewable Energy Deployment

To address the highlighted problems in assessment methods for local sustainable energy systems two multi disciplinary projects have been funded with the aim of developing and piloting a new methodology in both Scotland and Brazil. Energy, environmental, socio-economic and cultural researchers are to work together with Communities to develop and apply the new methodology in 4 Scottish locations and 3 Brazil locations, some characteristics of these Communities are illustrated in Figure 4.

Figure 4.Top: Brazil, bottled gas and diesel generators. Bottom: Eigg, Solar, photovoltaic and micro-hydro.

The new methodology will include mapping of the Community and local area to establish energy demands, energy efficiency, generation and storage potentials, environmental parameters, and socio-economic parameters. These will inform a status report capturing the most appropriate opportunities for sustainable local energy systems, and the technical, environmental and socio-economic gaps that need to be addressed in order for the opportunities to be realized. The methods will be captured in a toolkit to enable it to be replicated elsewhere (Figure 5).

5. Intended Outcomes: Scotland and Brazil

This methodology should help Communities understand the potentials, benefits and key gaps to be addressed for the adoption of a useful local energy scheme. The overarching aim is to aid Communities build capacity and capabilities for local sustainable development. The energy focus is important in as much as there is a worldwide focus on climate change and sustainable energy which means that Government and International support (financial and otherwise) is available making this a useful vehicle for improving the situation in

Communities. The socio-economic capabilities are in some cases quite simple e.g. photovoltaic, battery, charger, led systems but for larger scale energy projects are the same as the capabilities required for Community ownership and governance of other assets e.g. for asset transfers under land reform. There is apparent synergy with land reform in that where land reform has happened then communities may be able to exploit their established socio-economic capabilities and structures to engage in renewable energy projects, conversely local renewable energy projects may stimulate the establishment of socio-economic circumstances that provide a platform for land asset transfers etc. as illustrated in Figure 6.

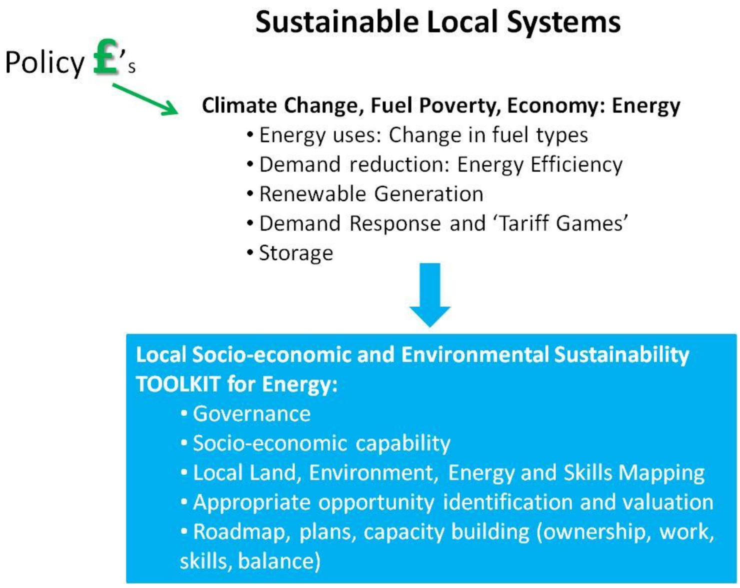

Figure 5.Toolkit to help inform local communities.

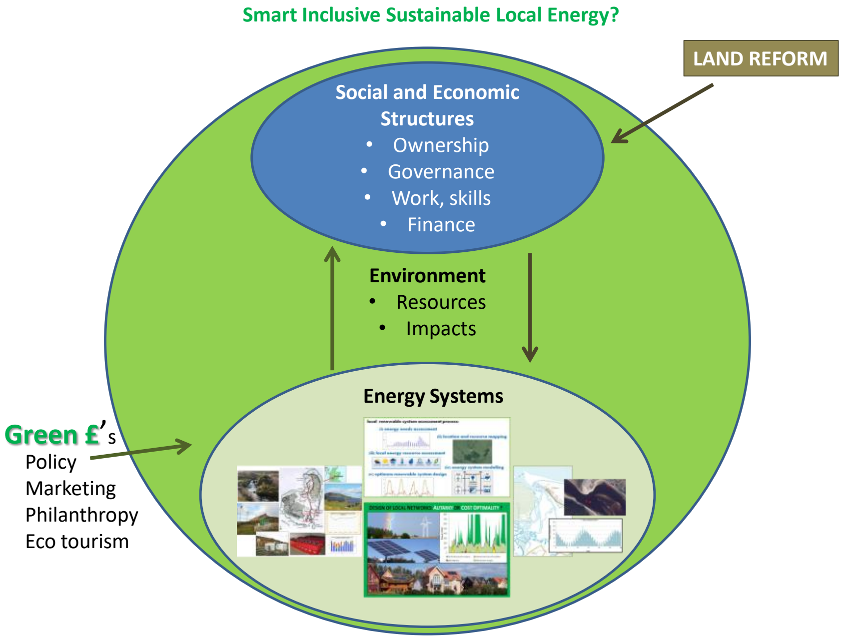

Figure 6.Potentials for synergies between local sustainability, energy systems and land reform.

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