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The "power" of community renewable energy enterprises: The case of Sustainable Hockerton Ltd.

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ABSTRACT

We explore how a community renewable energy enterprise may monitor and improve its functioning by using a quantitative model.

This model is designed to reflect the desired objectives of the community in terms of the overall returns to the enterprise's environmental, financial and social stakeholders. Since a community renewable energy enterprise is part of a broader class of small, social enterprises, based on local intention, action and control, the ideas on which this model is based may be useful to other similar firms.

The conceptualisation of the model depends not only on extant literature, but also the need for the enterprise to be effective, democratic and display ethical values. Thus, it has to be firmly embedded in its members' lived experiences.

The use of the model is illustrated through data, over an eight-year period, from Sustainable Hockerton Ltd.'s (2018) financial accounts, spreadsheets on electricity production, minutes of meetings and industry reports. Two types of indicators: RoSC and CoSC are identified. The model facilitates choices related to energy use; in this sense it affects the national energy policy and is also affected by it. The model may lead to changes in the manner funding bodies support local initiatives.

1. Introduction

Raworth (2017) argues that business and economics are inseparable from environmental concerns as well as from the need to satisfy a basic standard of living for all, suggesting that all business activity should be aimed at working between the two constraints. While many businesses embrace this more-than-profit idea, there is a lack of understanding of how firms can define and implement practical measures and thereby embed multi-agent objectives systematically in their business models (Siegner et al., 2018; Bocken et al., 2014) – even though some positive experiences have been reported. This is particularly crucial for social enterprises such as community renewable energy enterprises (CREEs). In this paper, we aim to answer the question: "how can a community renewable energy enterprise monitor and focus on its functioning – regardless of its scale?"

The processes that define and maintain CREEs tend to allow their members greater freedom of participation than large companies do. Members usually are not employed but benefit from what a CREE generates. This implies that collective activities such as decision-making, conflict resolution and improvement of lifestyles have to proceed in relatively democratic and ethical ways (Walker et al., 2007; Cass et al., 2010).

CREEs obviously face difficulties that require special strategies to survive; the present research question focuses on a way to support the development of such strategies. It differs from the usual research question. For example, most approaches consider financial capital as the sole resource when doing business. However, a community is itself a rich resource. The values and abilities of its members provide a powerful means to shape local solutions and ensure that developments are sustainable (Roseland, 2012). This suggests a need to make these resources visible. One obvious possibility is to extend the number of stakeholders and explore how they benefit or contribute. The model we propose identifies three types of stakeholders' contributions: those of the community, of the financial world and of the natural environment (Starik, 1995; Schoor van and Scholtens, 2015; Hicks and Ison, 2018). These stakeholders are taken to serve as key actors, the contributions of which a community will wish to engage to ensure the smooth functioning of the CREE (Süsser and Kannen, 2017; Driscoll and Starik,

Abbreviations: CREE, Community renewable energy enterprise; SHOCK, Sustainable Hockerton Ltd.

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2004; Mitchell et al., 1997).

The stimulus to the present paper is the authors' experiences in a small community renewable energy enterprise, i.e. Sustainable Hockerton Ltd. (2018) (SHOCK) . Our contribution falls under three categories. Firstly, it involves a model that is intended to be of value to other similar CREEs and therefore should contribute to energy policy. Secondly, we contribute by exploring notions of partnership accounting and value creation for stakeholders (Mitchell et al., 2015, 2016). Thirdly, we aim to clarify the role of various types of resources when dealing with the development of loose collectives. These include the lived experiences of individuals when participating in a CREE – something that we argue is often lacking in reports in academic journals.

Some background information on the role of energy and the CREE sector is provided. Next, we introduce our research methodology including a model to measure and account for the economic value created by CREEs. We describe data from SHOCK and estimate the parameters of our model. A discussion follows regarding results and what our model contributes. Lastly, we conclude.

2. Background and literature on the characteristics of CREEs

Climate change is at present one of the largest threats to humanity (Attenborough, 2019; NASA, 2018; EuroStat, 2010). All nations need to contribute to dealing with this threat but not all have advanced to the same degree (United Nation's Framework on Climate Change, 2018). In the UK, government agencies such as the Department for Business Energy and Industrial Strategy (DBEI) (or its predecessor, the Department of Energy and Climate Change (DECC)) have been trying to stimulate the replacement of fossil fuels by renewable energy through financial incentives, such as grants and a feed-in tariff policy that rewards producers of renewable energy. This has resulted in a change in the way energy is currently supplied – from originally a trickle, in the third quarter of 2017, renewable energy constitutes 30% of the mix (DBEI, Energy Trends, 2018 p. 48). Currently, there are 228 community energy organisations in England, Wales and Northern Ireland which are involved in 304 distinct energy activities; they have 48,000 members supported by over 1800 volunteers (Community Energy England (CEE) (2018, pp.15–16)). CREEs are defined as "*organisational bodies owned or managed (entirely or in part) by individuals from a community to the benefit of a defined area or group. This may include communities within defined geographical boundaries or more dispersed communities of mutual interest*" (CEE, 2018, p. 8). The notion of "*defined geographical boundaries*" is emphasised by the Department for Business Energy and Industrial Strategy (DBEI), where it is stated that: "*Community energy projects have an emphasis on local engagement, local leadership and control and the local community benefiting collectively from the outcomes*".[1] Thus CREEs appear value based rather than profit based; they comprise participants that are "*strongly driven by normative principles of empowerment, participation and capacity building*" (Walker and Devine-Wright, 2008, p.498). Indeed, community development involves action – on the level of individual members as well as on the level of their collective which implies that it is constrained by values and principles (Kenny et al., 2018).

The UK renewable sector is distinct, in some ways, from those in other leading countries such as Germany and Denmark. Independent communities (i.e. CREEs) have driven the sector rather than local authorities (Hicks and Ison, 2018, p. 524; Willis et al., 2016). One of the difficulties this has generated is that the lack of a clear agenda (Willis et al., 2016 p.4). Communities do not necessarily have a stable organisational structure (Willis et al., 2016). Members flow in and out for personal reasons based on their passion and individual motivations. The literature has accordingly highlighted the need to encourage the engagement of the members (Willis et al., 2016). The "power of the people" (Schoor van and Scholtens, 2015) acts as an accelerator for reinvestment in environmental and social aspects and thus create a "*virtuous circle*" (Harnmeijer et al., 2013 p.3).

Other concepts appear ambiguous as well. An example is the "extent" of the engagement, i.e. how the members of a community share decision-making – as a function of their participation and in consideration of expected mutual benefits (Hicks and Ison, 2018; Süsser and Kannen, 2017). Walker and Devine-Wright (2008, pp. 497–98) distinguish between process and outcome. The process aspect concerns the "*involvement of local people in the planning, setting up and potentially running of the project.*" The outcome aspect concerns the benefits that may be distributed. These two concepts refer to different types of engagement. Although these definitions precede the eventual development of full strategic lore regarding CREEs, they do already capture important characteristics concerning concepts like "local" and "small", which too have been emphasised in the literature (Llewellyn et al., 2017; Strachan et al., 2015; Lakshmi et al., 2015, p.101; Seyfang et al., 2013).

Community groups have been actively involved in mitigating the negative aspects of climate change and in dealing with other social issues for many years (Kenny et al., 2018). As they are on a social mission, CREEs "*pursue new opportunities to serve that mission by engaging in a process of continuous innovation with limited resources and a sense of accountability to their stakeholders*" (Dees, 1998, p. 4). Their ability to innovate thus depends on the passion of the people involved (Seyfang et al., 2013) – although sometimes supported and sometimes impeded by the claimed culture of stability and transparency in the political arena (House of Commons report, 2016).

Recent literature notes that, while CREEs have held nebulous and sporadic ground, they have managed to punch above their weight to fill in important gaps in public policy (e.g. CEE, 2018; House of Commons report, 2016; Li et al., 2013; Walker et al., 2007; Cass et al., 2010). However, not all CREEs are similar in form and rationale, a diversity of cooperatives, businesses, charities, limited companies and industrial provident societies with varying technologies exist (Hicks and Ison, 2018; CEE, 2018; Seyfang et al., 2013).

A survey by Seyfang et al. (2013) explored the origins, development and objectives of CREEs in the UK and their emergence as a sector. Challenges such as the acquisition of capital, the uneven levels of engagement and lack of specialised skills were listed. Hicks and Ison (2018) propose some conceptual tools to deal with these challenges, noting that CREEs are "*projects (which) develop in different locations at different times with different sets of actors and thus* different contexts*; and, secondly, that the actors developing different CRE projects are driven by different motivations*" (p.525). This diversity implies that the notion of capturing and improving practice in CREEs may prove difficult using standardised measures. Nonetheless a common approach may be possible. While CREEs need to adapt as they grow, they may wish not to forsake their stakeholders. In this paper, we focus on the latter possibility, proposing a model to monitor and improve the performance of CREEs that incorporates a role for stakeholders.

3. Research methodology and data collection

3.1. Practice and use of knowledge

The authors of this paper have been part of the development of SHOCK as well as their primary promoters; they continue to be involved. Concurrently, they lecture in two UK universities with research responsibilities. The combination of practice and academia appears important, as Waterson and Sell (2006, p.773) note in their study of published research during 1975–1999; datasets in mainstream research may exclude personal intentions and objectives (Ghoshal, 2005) even though these appear to be essential to understand practice in local and small organisations. Walker and Devine-Wright (2008, p.497) confirm this noting that CREEs and similar organisations rely on local

[1] https://www.gov.uk/guidance/community-energy#what-is-community-energy.

involvement, experience and resources, which standard methods of inquiry often ignore.

3.2. "People power"

The insight in the resulting dilemma is neither our own nor new. It has been elaborated upon in the early resistance (Freire, 1970) and management (Lewin, 1946) literature. Later developments appear to have required either that one ignores the role of subjective contributions or that one attempts to include them in some way. Attempts to include them have led to operationalisations like those of Likert (1932) and Edwards (1954) and many others. Our work falls into this category, being inspired by West (2015, p. 599) as financial models suffer from "*a sense of detachment from moral obligation, there is a growing need to convert moral detachment into engagement*". We also follow the approach of Zyphur and Pierides (2017, p.13), who claim that "*the primary purpose of research should in some way be centred upon humans and their conditions*". These principles suggested modelling our approach on that of the decision sciences.

We assume that the aim of the enterprise (SHOCK) is to realise several objectives – both on the collective and the individual level. The collective level refers to general objectives, such as taking the effects of climate change on into account. The individual level refers to objectives like reducing costs for individual households. These objectives determined the elements in our model. They also determined the need to visualise progress, i.e. to estimate its extent as well what modifications might be required to ensure that such progress would continue to be in the intended direction. The result of this approach thus consists of an advice: what objectives to consider and what changes to measure. Developing the model involved the following arguments.

Firstly, activities (including the development of an organization) can be described in terms of four aspects: *addressees*, those who implement the activities, *objectives*, *resources* (forms of capital) and the use of some *scheme (or model)* to rectify any deviations in the here and now of an implementation from the driving objectives (Wilson and Post, 2011). There are many terms that can be used for "scheme" including plans, tactics, strategies, ideas, policies, procedures, plots or models. In this paper, we focus on the term 'scheme (or model)' to avoid confusion with the notion of model as a description *of* something (also referred to as theory or proposition).

Secondly, we assume that schemes differ in quality and hence that we aim for a high-quality scheme. In the present paper a scheme (or model) is proposed. It may be modified in later studies to increase its quality. A scheme is considered of insufficient quality if mistakes are not recognised and become part of the end result, if it does not help to make proper use of the resources that are required and if it does not help to avoid an action's unintended consequences.

The improvement of actions such as those of the enterprise is an iterative process. According to the above it requires the possibility of modifying schemes (or models) and of introducing new resources and objectives. One source of improvement might be asking individuals which schemes (or models) they consider of higher quality – e.g. as part of a survey. Another source of improvement would be an evaluation of the effects of using a scheme (or model). This type of improvement has been referred to as a cycle of reflection "on action" and "in action" (Schön, 1984).

Our approach or methodology appears relevant whenever one has to deal with to an ever-changing set of people and preferences, enabling actions to become more orderly rather than to impose order on what is studied, as some mainstream methods tend to do. As Hartford (2016, p.3) points out, one may often prefer that the "*virtues of the messy*" overtake the "*blandishments of tidiness*". The resulting scheme is an *instruction* to maintain and improve the scheme that empowers SHOCK. It recognises the role of the individual as well as the collective in decision-making.

3.3. The experiences of community members

We follow Philips (2003, p.2) who suggests using "*bits of information*" that, when combined, generate a picture of what is happening. We refer to community indicators that could be small but must be able to reflect the status of larger systems showing changes and trends of systems over time. Nguyen and Wells (2018) suggest that organisations tend to develop such indicators in the course of time, based on the members' lived experiences and reflective practice (Schön, 1984). This type of development usually "*ensures the comprehensiveness of the indicators and reflects all facets of community wellbeing, or community sustainability*" (Nguyen and Wells, 2018 p. 161). The model we propose is intended to systematise the use of such indicators. The result should be easy to visualise. Its sources may consist of a CREE's financial accounts and spreadsheets: in the case of SHOCK they include electricity production and carbon emissions saved, minutes of meetings and industry reports. Such data can be expected to be available from other CREEs as well. Our model being a method (or instruction) rather than a theory, thus has the potential to be used elsewhere.

4. Analysis

4.1. The stakeholders

4.1.1. A choice

To develop our scheme (or model) we took our cue from Stakeholder theory (Mitchell et al., 2015, 2016; Freeman, 1984). This suggested identifying at least one stakeholder that, as usual, would be the financial capital needed to initiate the activities carried out in SHOCK. There may be more stakeholders – and in fact, strategic decision-making suggests that one must consider the expectations, interests, and competing claims of a wide variety of stakeholders. In the definition given by Freeman (1984, p.46) a stakeholder is "*any group or individual who can affect or is affected by the achievement of the organization*" – and hence can be said to have agency.

4.1.2. "People, profit and planet"

We identify three primary stakeholders as part of our scheme (or model) – the people, the planet (natural environment) and the investors. This selection is based on the vision of a triple bottom line: "*good for the environment, good for the pocket and good for the community*" (Nottinghamshire Community Energy, 2017; Elkington, 1994).

We consider the community as a key stakeholder; without its participation, the concept of enterprises such as community energy groups will be hollow (Cebotari and Benedek, 2017). In the UK individuals/small businesses and communities have been key stakeholders rather than local government (Hicks and Ison, 2018). The community is involved in the inception of the CREE and benefits are fed back to it, explicitly and implicitly. Schoor van and Scholtens (2015) discuss how this implementation of the slogan "power to the people" is transforming local energy initiatives into making entire cities carbon neutral. Roseland (2012) notes that in sustainable[2] communities, decision-making stems from a rich civic life and from shared information, thus emphasising the power of the local population in enabling change.

The second stakeholder consists of the financial investors who contribute towards the purchase and installation of renewables. This type of contribution is common to most actuarial models.

The natural environment, which lends its self to act and create wealth and benefit for the CREE is the third stakeholder (Starik, 1995). The philosophy of organisational growth prior to the 1960s tended to

[2] To be truly sustainable a community must be able to use its own resources while maintaining that adequate resources are available for the future generations. Thus, it must seek a better quality of life for all its residents while respecting nature's ability to function over time (Roseland, 2012).

ignore the role of nature. This was subsequently challenged (Meadows et al., 1972). Buchanan (2011) discusses the fair and proper role of the environment from the point of legitimacy towards intergenerational equity, arguing that a small sacrifice today might afford a better life for the future generations. It has been suggested that some economic damage might be reversible but that environmental damage is not (pp. 351–352). According to this view, the present generation has a moral obligation to future generations.

Haigh and Griffiths (2009) also discuss the role of the environment as a stakeholder, drawing on Driscoll and Starik's (2004, p. 56) concept of a stakeholder as one with proximity. This concept extends Mitchell et al.'s (1997) framework of a stakeholder as an actor with legitimacy, power and urgency. Hatherly et al. (2018), Mitchell et al. (2016), Mitchell et al. (2015) argue the case that accounting for stakeholders can be developed based on principles of partnership accounting.

Schnaiberg (1980), Gould et al. (2004) claim that capitalism is driven by a search for higher profitability; survival in a competitive world increases the number of capitalist ventures that lead to consequent growth. However, businesses are proliferating at the expense of the finite planetary resources thus creating a wicked problem (Rittel and Weber, 1973; Camillus, 2008). Slowing growth impacts the business and its shareholders negatively but accelerating growth similarly impacts local communities and the wider society negatively. As Raworth (2017), Hardin (1995) and Meadows et al. (1972, 2004) point out there are "limits to growth" – even in the world of science the planet has boundaries despite economic models allowing infinite production.

4.2. The proposed model

The many resources a CREE needs tend to be available only due to being embedded in the here and now of a community: sites, experts, volunteers, a turbine and money – among other forms of capital. As indicated, these resources can be classified into three categories: environment-related resources, community-related resources and investment-related resources. They can be thought of as each offering capital to the enterprise that needs to be compensated, as these resources could have been put to better use elsewhere: they carry an opportunity cost.

The compensation is a return to the resource or to lenders of these forms of capital. In finance parlance, the cost of extending finance to an enterprise is known as 'cost of capital' or simply the cost of lending or the cost or obtaining credit. It is inversely related to the value of a business. The cost of capital is an important concept in finance and is used by all businesses, including small enterprises (Moro et al., 2012; Petersen and Rajan, 1994, 2002); it is confined to representing or measuring the interests of financial investors and thus can be termed as the "return to investors".

What is measured is the rate spent on servicing financial investors; subsequently this becomes the rate against which all potential projects are screened. If a potential project will earn less than the cost of capital/return to investors, it is considered unviable. To illustrate this, the following equation may serve as our scheme (or model) – assuming that taxes are not an issue and that there are two classes of investors (lenders and shareholders):

$$Return/cost = \frac{D}{D+E}i + \frac{E}{D+E}d \quad (1)$$

Where D: debt investment, E: equity, i = interest rate, d = dividend rate.

Part of a successful CREE is that the capital borrowed from the three stakeholders is monitored to ensure that a fair and adequate return is paid. Following the above, it is safe to assume that, "*the cost of capital, which is currently regarded as the weighted sum of costs of shareholders and lenders, …could be widened to include stakeholders and a social environment to gauge long-term rather than short-term returns*" (Lakshmi, 2016, p. 10). This means that the scheme (or model) becomes (per annum):

$$RoSC = \frac{W}{W+F+S}e + \frac{F}{W+F+S}k + \frac{S}{W+F+S}c \quad (2)$$

Where W = Environment capital i.e. Monetary value of investment by environment.

F = Financial capital invested
S = Community Capital i.e. Monetary value of volunteering invested
e = Percentage Return on environment per annum
k = Percentage Return on financial capital per annum
c = Percentage Return on community per annum
Note that Percent (.) is calculated as monetary values of environmental return, financial return and societal return on capital of these components.

Equation (2) can be named 'Return on Stakeholders' Capital' (RoSC). Measurement when using the model requires knowledge of capital and the returns to the three stakeholders. Using figures from SHOCK, we explain how to do so in one way; other possibilities exist. In the next section, we provide relevant facts about SHOCK.

4.3. Sustainable Hockerton Ltd. (SHOCK)[3]

Sustainable Hockerton Ltd. in Nottinghamshire, United Kingdom (SHOCK) is a community renewable energy enterprise jointly owned, managed and promoted by locals. An application for a small 225 kW wind turbine was submitted to the local authority on October 29th, 2007 and production began in 2010. Discussions to commence SHOCK started in July 2006. Regular meetings were held to come to a consensus about the structure, rationale and governance. Residents and their close contacts funded the project through a share issue with one vote per member irrespective of the investment size.

The village is a small parish of approximately 60 houses; nearly 50 people participated in meetings. The village is a typical commuter village although property prices are above the national average. A village postal survey, conducted in February 2007, with a 25% completion rate indicated overwhelming support for the turbine, aiming to make the village sustainable in terms of energy requirements by making it carbon neutral. As a starting step, it was felt that a community turbine would help offset the energy used by each household by selling the electricity produced to a green supplier, who specializes in renewable energy generation. Income from the energy would come from the Feed-in tariff (FIT), sales of electricity, and in the form of sales of certificates.

Residents agreed on the name of "Sustainable Hockerton Ltd." and on the format of a cooperative in the form of an Industrial and Provident Society. SHOCK was created with the help of Cooperatives UK, a local resident solicitor and local business professionals who approached local authorities for small grants to help with legal and accountancy costs in setting up the Society.

The return on invested capital was agreed by prospective members at a premium above prevailing bank interest rates; all residual profit would be channelled primarily to aid sustainability in the local community or to undertake fresh environmental projects. Accordingly, a village fund is allocated every year to give money to the community to spend on energy home improvements, village socials and educational gatherings.

Initially, the estimated figures of energy produced, and carbon emissions offset were derived from the DTI (NOABL wind speed data) and technical knowledge of local engineers. The income stream accrues from sales of electricity via the National Grid and the Green FIT payments to SHOCK. The turbine has been successful in meeting its objectives of clean energy production and has enabled a variety of other

[3] Most information on this can be found on the website www.sustainablehockerton.org.

projects – three of which were on solar energy generation schemes. It has also successfully delivered surplus profit money to the community in the village each year to achieve sustainability.

Governance is through a rotating board of voluntary directors who are in-situ for three years and then are replaced or re-elected. The organization is run as a small business and is managed day to day by another local community enterprise, Hockerton Housing Project Trading Limited. It files its accounts under the Financial Services Authority.

All major decisions are made through wider consultation with members of SHOCK as well as in conjunction with the Parish about money spending and desires of the Parish residents, thereby adhering to democratic principles of governance and inviting the views not only of members but also of those who are impacted by SHOCK. A village survey was carried out to enable directors to prioritize what the Parish wanted the first proceeds to be spent on.[4] The Parish chair is invited every year to suggest where the spending for that year would be best used. This active voice or "vox populi" is the basis of democracy: putting people at par with profit to create power. The village sustainability fund is offered to all Parish member households and businesses, irrespective of their membership in SHOCK. Spending is approved on a case-by-case basis and contentious cases are discussed openly amongst the directors. The spending is seen as beyond a monetary compensation; it acts as a nudge to encourage a change towards more social and environmental behaviour.

The emphasis on ground-level ethics and equality enables the prevention of the monopolisation of profits. It consists of realizing three aims: a) ensuring that every individual is invited to the discussion and has a say in the collective decision-making; b) resolving conflict through an open and fair process and by clarifying the collective benefit and; c) improving the lifestyles of all (Cass et al., 2010; Walker et al., 2007).

4.4. Estimation of the model

As discussed previously, our data set consists of the minutes of meetings to set up the CREE during 2006–2009, the website of SHOCK and its monthly financial accounts, spreadsheets on electricity production and on the savings on carbon emissions. In addition, we rely on published information in industry journals such as data on the performance of the wind turbines. These data are in accordance with the approach of looking for a preferred scheme (or model) and are used to test its application. We explain below how we estimate the model in practice.

4.4.1. Calculations for F and k

SHOCK invited capital from local villagers and wider community in the form of members' holdings – worth between £250-£20,000 each. In total, £235,250 was raised for the purchase and installation of the wind turbine. The village decided that the range of financial return should vary between 5% and 8% based on the Bank of England rate. Thus, F is £235,250 and k is computed from the accounts of the company made every financial year.

4.4.2. Calculations for W and e

The figure for W denotes the environmental capital cost of the project. This cost is not easily available and refers to the monetary value of environmental resources taken to construct, commission and decommission the wind turbine. The figure for e refers to the annual per cent imputed returns for the environment's role as a reward in exchange for the environmental capital. In other words, by borrowing the capital from the environment, economic rent accrues toward its use. This number may be proxied in many forms but is essentially the opportunity cost. We use the figures from SHOCK's monitoring spreadsheets in relation to carbon emissions[5] saved in tonnes per month. These are converted by a time varying greenhouse gasses conversion factor (GHGs), (set by DBEI), which measures the value of renewables in the set of energy sources. We next multiply this by a monetary value of carbon dioxide as put together each year by the Secretary of State for Climate change[5] (DBEI, 2018). This value has typically varied between a high of £5.611 (2016) and £4.27 (2014)[6] and allows us to calculate the monetary value of carbon emissions saved for the time in operation. If we trend this for the remaining life of the project, say for 15 years, we can obtain the estimated monetary value of returns in the form of savings in carbon emissions. Totalling these numbers will allow us to calculate the cumulative monetary returns.

To actually obtain a value for W, we look towards the scientific literature for help. A technical estimate for the efficiency of use of energy is EROI, i.e. the ratio of energy delivered to energy cost. Kubiszewski et al. (2010) calculate the EROI for many wind turbines, estimating it in the range of 19.8–25.2. This translates to stating that wind turbines, on average, generate between 19.8 and 25.2 times the energy they take to be manufactured and commissioned. If we take the EROI figure (say 19.8) to be correct and we use our estimated cumulative monetary value of carbon emissions saved, we can work out the figure for W, i.e. the environmental cost. Using annual figures for the monetary value of carbon emissions saved and dividing by W allows us to estimate the various annual values for e.

The method identified this way assumes neutrality; it is the ratio between savings and imputed capital. Other options would be to use a shadow price of the land where the turbine has been set up and accounting for displaced bio-diversity including rare habitats. A preliminary survey for planning permission showed no evidence for them.

4.4.3. Calculations for S and c

The community capital, S, is the imputed capital invested by members of the community and encompasses all the monetary value of meetings during 2006–2009, the survey taken, the appeal by the Parish and the legal, technical and consensual framework adopted by the community and its various actors. Ten meetings took place during this period, of approximately 2 h duration each, and on average 20 villagers attended these. In addition, we can estimate the man-hours invested in various other activities. The total man-hours can be estimated by converting to a monetary value using the UK median wage rate. (Haldane, 2014 uses this for volunteering valuation). The choice according to one of the websites was to use the UK average wage rate. However, given the socio-economic demographic parameters of the residents, the median wage was used (Trading Economics, 2016). The value for c was obtained from the figures for village fund allocated each year in the accounts. Dividing these figures by S allows us to estimate annual levels for c. Table 1 shows the estimated figures for 2010–2015.

5. Discussion: concepts and results

5.1. Return on and Cost of Stakeholders' capital

Our results serve both as a signpost to see where SHOCK is and as a signal to judge where it is going i.e. to identify whether it is still going in the preferred direction. In this context, it is important to show what each stakeholder has earned over the period and their share. One may conclude that the larger RoSC (Section 4.2, equation (2)), the larger the return to all stakeholders and thus the better the performance of the

[4] http://sustainablehockerton.org/wp-content/uploads/2016/05/report-on-village-survey-dec-2012-v1-0.pdf.

[5] See https://www.gov.uk/guidance/participating-in-the-eu-ets re EU Emissions Trading Scheme.

[6] The figure is a value guessed by the policy makers and is anticipated to increase.

Table 1
Estimated capital and returns for SHOCK.

Years	e	k	c	RoSC	CoSC(1)	CoSC(2)
2010	116.60%	5.00%	1.09%	5.057%	4.539%	4.516%
2011	159.98%	5.50%	5.30%	5.791%	4.847%	4.740%
2012	127.03%	5.80%	20.10%	6.617%	4.897%	4.488%
2013	117.55%	6.20%	21.44%	7.036%	5.271%	4.835%
2014	102.28%	6.60%	95.38%	10.398%	4.180%	2.239%
2015	134.18%	7.30%	25.78%	8.298%	6.204%	5.679%
2016	116.33%	7%	94.09%	10.756%	4.561%	2.647%
2017	0.94%	6%	58%	8.106%	4.562%	3.382%
2018	100.88%	7%	50%	8.932%	5.489%	4.471%
Average	108.42%	6.27%	41.24%	7.888%	4.950%	4.111%
St Dev	41.537%	0.726%	33.439%	1.843%	0.581%	1.054%

CREE. Hence using the model also provides us with a useful accounting measure.

The total capital is (235250 + 10000 + 476.56 = 245727). On this basis, the calculations for the weights of investors, community and environment on the total sum are 235250/245727, 10000/245727 and 476.56/245727, respectively. The term "$\underline{k}$" refers to the per cent return, i.e. (monetary value of return to investors)/235250 (for 2010). These values can be computed similarly for other stakeholders. If we add all the individual terms, RoSC would be 5.057% for 2010. Some caution is needed to understand this notion. RoSC should not be interpreted as the cost of capital. Normally, the latter is inversely related to the value of the company and is the hurdle rate; RoSC is asymmetrically related to cost of capital because the returns to stakeholders are not the same as the costs to stakeholders. Unlike in larger companies there is no zero-sum game in the case of CREEs. To use the returns to stakeholders as an identical measure of the cost of capital would be counter-intuitive.

We expect the economic cost of capital of SHOCK, i.e. CoSC, to be lower than RoSC; one could argue that the return "e" should be subtracted rather than totalled – in which case, COSC(1) is valid as a concept to use as an economic hurdle rate, as there is a win-win situation whereby the environmental stakeholder and the investors (who live in the healthier environment) are both receiving returns. The environment is earning a return in the form of reduced carbon emissions but this is also a return for the investors in the form of a cleaner environment. The CoSC would thus be given by formula (3):

$$\frac{W}{W+F+S}(-e) + \frac{F}{W+F+S}k + \frac{S}{W+F+S}c \tag{3}$$

A similar argument holds for the return on community capital if all investors took advantage of it. We are treating the village fund here as separate from the investors' investment. This simplification may make the calculation imprecise but we could use this to tweak the model. For example, if an argument was made that x% of the village fund went back to all investors (e.g. a road was built that is used by all), then only (1-x%) of the share of the return to community capital would have to be added. If x = 0.5, the resultant figure for CoSC (1) would be 4.539% for 2010, if x = 1, CoSC (2) is 4.516% for the same year. The economic argument is that returns to the entire community engender a feeling of trust, which reduces the cost of access demanded (Moro et al., 2012).[7]

5.2. Results

5.2.1. RoSC and CoSC

The average value (over the nine-year period) of RoSC is 7.89% ranging from 5.06% at the start to over 10.76% with standard deviation of 1.84%. The table shows the estimated CoSC (equation (3)) for 2 scenarios: CoSC(1) is the anticipated economic cost that assumes that the village fund is going back directly to half of the village investors, but all live in a clean environment; CoSC(2) assumes that all the investors are benefiting from both. The more the benefits to the village investors, the lower the CoSC. Although, CoSC is an expected economic measure, it is noteworthy that recently, SHOCK took another loan from investors at 4% average interest rate over the life of the borrowing to invest in other projects. This is close to the average of CoSC(2) i.e. 4.11%.

The fluctuations for RoSC can be explained by fluctuations in community and environment returns. However, the capital bases for these two (community and environment) are not particularly high.

5.2.2. Environment return

The environment return, *e,* is high because of the EROI. This number shows considerable fluctuation, as renewable energy production is highly dependent on weather and wind conditions, which are notoriously volatile. Moreover GHG, set by DBEI, which measures the value of renewables in the set of energy sources, has had an effect: in 2010, for every 1 kWh of electricity used from the grid, 0.545 kgCo2/kWh was released in the atmosphere. By 2018, for every 1 kWh of grid electricity used, 0.352 kgCo2/kWh was released. As grid electricity in UK has been increasingly replaced with increasing pure renewable energy, the amount of carbon not released in the atmosphere for each unit of electricity produced by the wind turbine has come down accounting for the lower levels of *e*.[8] A third reason for the lower *e* in 2017, was a combination of not only lower wind but intermittent breakdowns in the turbine.

5.2.3. Community returns

The community returns, *c*, fluctuate because of the varying size of the village fund on different projects each year. In recent years SHOCK has been able to fulfil a number of village needs as they emerged, because it has been able to diversify in other renewable projects and hence "*c*" has increased.

The model is thus sensitive to changes in the environment in which it operates, reflecting the needs of the community, the vagaries of the natural environment and the economic policies.

5.2.4. Supporting literature

Studies have shown that corporate investors, too, value their enterprises' attention to the environment. Chapple et al. (2013) find that the most carbon-intensive enterprises lose market value relative to other enterprises of between 7% and 10% of market capitalization. Li et al. (2014) report that the cost of debt for Australian companies is positively correlated with a company's emission intensity. Kim et al. (2015) find similar effects on cost of equity of Korean firms. Companies' efforts to improve carbon productivity by taking part in pro-environmental schemes is compensated by the reduction in the cost of capital, which then increases the firm's value. Kleimeier and Viehs (2016) find a significant and negative correlation between voluntarily disclosing carbon emission levels and the cost of bank loans for informationally opaque borrowers. Investors are willing to accept lower loan spreads for low polluting companies. Thus, investors are prepared to accept lower returns if the environmental disclosure and attention to carbon emissions are high.

Cho et al. (2013) have investigated whether the commitment to increase environmental disclosure and efforts to increase environmental performance through disclosure is related to a firm's cost of capital. Based on a sample of non-financial companies on the Tokyo

[7] The economic argument for cost of capital relates to the level of risk. The latter arises because of lack of trust and the non-alignment of agents' objectives. However, where the enterprise is operating within the community and information is transparent, default risk is minimised. Hence investors are prepared to offer subsequent tranches of capital for favourable rates. Moreover, village fund cash-flows compensate for lower returns to investors.

[8] SHOCK has invested in other solar energy projects starting from 2014; the solar carbons savings are not included in the calculations.

Stock Exchange during 2003–2009, they found a negative and statistically significant correlation. It appears that the current public mood is to support environmental practices and high disclosure.

It has also been noted that firms that indulge in high trust activities enjoy a lower cost of capital (Moro et al., 2015; Ghoul et al., 2011). These studies suggest that environmentally and socially friendly firms such as CREEs would be able to acquire further funding from the open market at lower costs.

5.2.5. Summary of results

Keeping the capital given by stakeholders, intact and returning a fair amount every year ensures the continuity of future economic and environmental prosperity (Buchanan, 2011). This implies that while overall RoSC is high, the shares of the returns to the environment and community are healthy, thus promoting sustainability. The level of sustainability is expected to be reflected in the CoSC.

Our results indicate that SHOCK is currently healthy, creditworthy and that it acknowledges its obligations to the stakeholders and fosters the adoption of renewables.

The results of our study support the existence of a metric that reflects the visual and narrative experiences of the CREE. The metric is readily available and thus acts as a signpost lending transparency to the actions of the CREE. As it is an index, it can be adjusted when required. It provides structure to the way the lived experiences of the members change – and is modified by as well as modifies their needs and constraints.

5.3. Wider discussion

Our methodology does not guarantee, of course, that our scheme has the highest possible quality (e.g. helps to avoid all unintended consequences). It is, however, guaranteed to find schemes with 'higher' quality than previously known ones where improvement is deemed possible. This improvement is the result by embedding the experiences of residents. The model and these experiences act in tandem to suggest constraints on the enterprise's activities and helps to correct unintended effects.

The model is restricted to capturing two aspects: the returns to all stakeholders (RoSC) and the economic cost of access to capital (CoSC). Unlike the Social Return on Investment, it considers not only capital but also the flows. In this sense it thus signals the feasibility of CREEs. The model embodies the objectives of individuals as well as of the community. Moreover, its use over time allows the enterprise to be sustainable in that the contributions of the community and the protection of the natural environment (apart from financial capital) are recognised.

The RoSC indicator captures the value of benefits to stakeholders and hence is directly related to the benefits of SHOCK. It may understate this value, e.g. the wider impact of SHOCK nationally. The CoSC, on the other hand, represents an expected economic rate: the lower it is, the more the enterprise's value. An added advantage is that RoSC and CoSC are percentages, making comparisons possible regardless of the scale of the project. This can be done in monetary form or in ratio form such as "every £1 of investor's wealth has saved "y" carbon emissions". Such results may be important when CREEs are approaching banks or investors for credit. The model is not expected to represent all possible data. It has to be modified when new data become available. This means that its data set is open – and hence that it should remain open for the model to allow for further extensions and thereby fulfil its intended function. Since the model provides a weighted average, this would not be insurmountable. It runs as an update from past experience and in that sense indicates whether the CREE is still healthy; both the model and the CREE may need to be changed in the future.

The wider implication of the model and its use, apart from the improvement of internal practice, is to inform policy makers and funders about the attainment of intended objectives towards society and the environment. As the sustainability agenda grows and multiple stakeholders' voices are added to the discourse on the normative and empirical notions of partnership accounting and of value creation for stakeholders, this kind of model should help signal the way forward.

6. Conclusion and policy implications

We propose a general approach to support the way a community renewable energy enterprise (CREE) may monitor and improve its functioning, regardless of its scale. It constitutes an instruction or strategy rather than a theory. Its helps to increase the sustainability of CREEs.

The intentions of a CREE are strongly linked to those of local participants. One would expect the intentions to be more value based rather than driven by purely by profit. Intentions are important. People flow in and out based on their desire and ability to participate at a moment in conjunction with the natural environment (Llewellyn et al., 2017; Willis et al., 2016; Strachan et al., 2015; Lakshmi et al., 2015, p.101; Seyfang et al., 2013). The key objective for the model's use is to help monitor the attainment of its objectives and recognise the value of the capital borrowed from its stakeholders: its people, natural environment, as well as its financial investors.

Our study is based on the notion that people (and enterprises) are adept, even surprisingly so, at developing activities that serve some function, including their own continued existence. This includes their ability to improve these activities. Even so they seem to require systematic support to improve the latter – as evidenced by the development of disciplinary studies such as decision-theory, operations research and cybernetics. Such support tends to consist of 'models of' parts of their environment. There is a good reason for that, of course: the better one can observe what is in one's environment, the more direct and precise one can change course when necessary. At the same time, one has to be able to make use of what is in one's here and now – what is in one's lived experience as inhabitants of Hockerton, the village, and as members of Sustainable Hockerton Ltd (SHOCK). One has to make use of one's body, of one's experience, of one's environment including other people, of one's dreams and yearnings beyond the here and now. In our model we have tried to combine these elements: the need to recognise resources in the past and from anywhere, resources in the present as well as what one is able to project to the future. The values of our model at times have been estimated from past experiences; the objectives of our model refer to what individuals in the community wish for; our stakeholders defend (metaphorically) the dreams we have for the future. Two special features of our model are: Return to Stakeholders' capital (RoSC) and Cost of Stakeholders' capital (CoSC).

Although, the model is a (first-time) approximation; it seems useful as a starting point. It refers to a process by which firms can adapt and find a way to calculate their own inputs and use them as a resource for future activities, thereby providing information to measure and improve the return and capital of their stakeholders over time. The model is capable of being adapted over time. Our second contribution is the exploration of a possible method to combine normative and empirical notions of partnership accounting and value creation principles for stakeholders (Mitchell et al., 2015, 2016). Thirdly, we contribute by attempting to go beyond theory construction by focussing on the intentional use of data as well as on linking that use to the experiences of people living in a particular place during a particular period.

The literature suggests that CREEs act as accelerators for reinvestment in environmental and social aspects, thus creating a "*virtuous circle*" (Harnmeijeret al., 2013 p.3.; House of Commons report, 2016; Li et al., 2013; Walker et al., 2007; Cass et al., 2010). Any measures to support practice in CREEs should thus directly interest policy makers. Such measures – and hence our scheme (or model) – will enable firms to not only manage their performance, but also provide a guideline to external funding bodies (e.g., Environmental Funders Network). Firms that can be demonstrated to make larger contributions to non-financial

stakeholder returns (RoSC) could enjoy easier and cheaper access to credit (CoSC). Social enterprises (e.g. Brighton Energy Cooperative, 2018) have been successful in changing behaviour towards adoption of renewables, thus filling a gap which policy makers are unable to do as such enterprises are often more cognizant of local, i.e. temporal and spatial landscapes and resources. Use of RoSC might aid policy in determining whether the state should undertake an interventionist role or give incentives to local, small organisations. As a signalling tool, the model will ensure transparency, thus enabling policy-makers to systematically control the speed and direction of the attainment of climate mitigation goals at global, national and regional levels. While CREEs have contributed to regional growth and employment they have also faced resistance; being able to recognise the latter would aid local authorities towards making quick and favourable decisions. Community groups, e.g. the Calthorpe Project (2018), London have helped to advance social cohesiveness and well-being in urban, busy environments such as inner cities; they would benefit by demonstrating their value to the wider public through a model like the one proposed.

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