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How to cite this publication

Please cite the final published version:

Brandt, U. S., & Svendsen, G. T. (2016). When can a green entrepreneur manage the local environment? *Journal of Environmental Management*, 183(3), 622-629.
DOI: 10.1016/j.jenvman.2016.09.007

Publication metadata

Title:	When can a green entrepreneur manage the local environment?
Author(s):	Brandt, U. S., & Svendsen, G. T.
Journal:	<i>Journal of Environmental Management</i> , 183(3), 622-629
DOI/Link:	https://doi.org/10.1016/j.jenvman.2016.09.007
Document version:	Accepted manuscript (post-print)

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When can a green entrepreneur manage the local environment?

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Abstract

How do we deal with environmental management issues at the local level? Traditionally, the approach proposed from an environmental management perspective has involved various kinds of “top-down” regulatory measures, such as defining a standard that must be satisfied or a tax on pollution. Conversely, there has been less focus on the analysis of local, bottom-up approaches, as for example the effectiveness of various ways of organizing a local environmental transition process. Our focus is on analyzing of under what conditions it is possible for a “green entrepreneur” (GE) to manage a transition from brown to green energy? Theoretically, we consider four entrepreneurial skills, at least two of which must be present for the GE to succeed. In the case of the Danish island of Samsø and its rapid introduction of renewable energy, three of these skills are found to be present: profits, communication, and trustworthiness. The GE, however, failed to activate the fourth skill concerning the ability to persuade local non-green actors regarding the value of the green component. Thus, a main result is that it is crucial to convince non-green locals about the profitability of local environmental management rather than its potentially green components.

Keywords: Local environmental management; profits; communication; persuasion; trustworthiness; entrepreneurship; sustainability; Samsø; Denmark; renewable energy.

1. Introduction

Local environmental engagement and management is required to make the global economy less polluting, as described in the ENEP green economy initiative (UN, 2009). Among other things, this covers investments and innovation in natural capital (agriculture, fisheries, water, and forests) and in energy and resource efficiency (renewable energy, manufacturing, waste, buildings, transport, tourism, and cities). This is an application of the so-called “Hardwick’s rule” (also known as the “weak sustainability hypothesis, see Perman et al., 2011): In order to sustain a non-declining consumption path over time in the presence of non-renewable resources, it is necessary to invest all resource rent into productive capital to achieve a non-declining total capital stock (natural and man-made).

Likewise, numerous books that sound dire warnings of environmental disaster often end on an optimistic note, concluding that the salvation of civilization rests on the shoulders of heroic social and environmental entrepreneurs (Hall et al., 2010). In particular, entrepreneurship combines an understanding of social and technical expertise with the experience of non-profit and for-profit projects to improve the practice of green and/or sustainable design and development (Sustaineship, 2012). In the literature, however, it remains an open question as to what extent entrepreneurs are able to promote a greening of the economies, how they are motivated, whether there are structural barriers to the capture of economic rents for green ventures, and whether environment-oriented entrepreneurs differ from traditional entrepreneurs (Hall et al., 2010).

We try to fill this gap by considering a situation where the “Green Entrepreneur” (GE) may have the required knowledge and coordination skills to initiate local environmental management. The issue of optimal group size in relation to sustainability is addressed in Brandt and Svendsen (2013), who find that the implementation of local Agenda 21 is problematic if consensus in a given group is needed. When a GE is included, however, the probability of successful environmental management at the local level may be increased significantly.

Thus, our main research question is:

When can a green entrepreneur successfully manage the local environment?

This research question is investigated using a model examining the conditions under which GEs can overcome informational shortcomings and coordinate collective action. The four entrepreneurial skills we identify are: 1) *profits* and the ability to secure the high private financial performance of a given environmental management and, at the same time, deliver a sufficiently green component (a high-performing GE); 2) *coordination* skills (the ability to bring people together and convince them about the values of the proposed environmental management scheme, thereby fostering the willingness to corporate) (a unifying GE); 3) *persuasion* and the ability to convince those who initially only derive value from the private income of the proposed management plans about the value of the collective benefit (environment-friendly part) of the project (a persuasive GE); and 4) *trustworthiness*, so that potential participants will trust the GE to in fact be able to deliver an environmental management scheme that is profitable for all participants (a trustworthy GE). The theoretical model describes the circumstances in which a combination of these skills is necessary and examines a situation where the GE must at the same time be high-performing, unifying, persuasive, and trustworthy in order to be able to initiate and manage local environmental projects.

Our definition fit well into the more general characterization of a GE in the literature, as for example expressed by Walley and Taylor (2002), who state that current approaches to understanding the nature of entrepreneurship take an integrated socio-psychological approach. This implies suggesting that the interaction between personality and such factors as past experience, existing competence and the immediate context have proved to be decisive for the performance of the entrepreneur.

When linking these theoretical findings to the Danish case of Samsø, we find that the local GE is an idealistic rationalist and that the proposed local environmental management project succeeded not because of its green components but rather because the GE convinced “ordinary” people with no specific environmental preferences to join the project—a result also found in Sandler (1997), who points out the necessity of creating policies that are both environmental friendly and profitable. Furthermore, by acting as a first-mover, the GE becomes trustworthy.

In the following, Section 2 develops the model and presents the potential skills of the GE along with three versions of the model, which require different skills to initiate local environmental management activities. Section 3 introduces asymmetric information, where, for example, those

involved from the outset do not know the type of GE and management project they will be facing. We describe how a high-performing GE can signal its true type and be perceived as a trustworthy GE, capable of delivering a high-performing project. Section 4 then considers how entrepreneurship made non-polluting energy production work in the Danish case of Samsø. The conclusions are presented in Section 5.

2. The Model

In this section, we set up a theoretical framework and introduce another GE before elaborating on which skills a GE requires to overcome the coordination and knowledge problems that possibly prevent a group of people from voluntarily producing a particular type of environmental management.

The focus is on local environmental management that generates both a private benefit, for example power or biogas (valued either for its salability on the market or its opportunity costs from the members' own use of the produced power or biogas) and non-market values such as less pollution, more sustainable use of resources, and public goods such as cleaner air, more tourists, and so forth, which may also directly or indirectly benefit non-members.

We restrict our attention to situations in which many local investors are needed to realize a management scheme that improves (local) environmental performance. We define $I = \{1, 2, \dots, n\}$ as the number of participants, with $(i \in I)$ denoting the individual participants. Many local investors are needed in situations where each potential participant has a budget constraint, b^i , assuming that the person will use their budget constraint to participate in a good project but also that the individual budget is small compared to the fixed costs of the project.

A first, important characteristic of the good in question (the good that the local environmental management plan is supposed to provide) is that the development of the private and collective benefits increase with the project size. The vital assumption here is that, for each added participant, the capacity of the project increases in such a manner that the financial return for all of the

participants remains constant. Similarly, the collective benefit of the project increases when project size increases: The greater the number of participants, the greater the public goods component of the project.

A second characteristic of an environmental good is economy of scale in the form of particular network externalities and knowledge together with infrastructure sharing. For example, building the first wind turbine requires considerable infrastructure, including roads and power grid connections together with the extensive negotiation of contracts required merely to sell the power. The cost per capacity installed diminishes for the following turbines, as some of the required infrastructure already exists.

More formally, the total costs of the specific local environmental management in question will be described as $C^{Total}(n)$. Since the project size increases with the number of participants, the total costs are a function of n . Thus, $C^{Total}(n)/(n)$ is the average costs of the project and $AC(n) = C^{Total}(n)/(n)$. For a given n (probably up to a certain n size), adding another participant will reduce the project's $AC(n)$, so that $AC(n) > AC(n + 1)$.

The analysis is simplified in the following two ways. First, we will only look at equal cost-sharing arrangements. This implies that for any group of n people that accept the environmental project, each will pay $C^{Total}(n)/n$ of the total costs. This is not an important assumption, since other sharing rules could also have been used, but the equal sharing rule remains a focal point.

Second, the private benefit provided by this local environmental management is also shared equally. Let the total revenues of the given project be $R^{Total}(n)$. Since the project size increases with the number of participants, the total revenue is also a function of n . Let $AR(n) = R^{Total}(n)/(n)$ be the average revenue of the project, which is constant and not depending on n . The collective benefit is non-market in type and valued according to individual preferences. Let $G(n)$ be the size of the collective good, so that $G(n + 1) > G(n)$.

We now try to replicate how a population can be described by its preferences toward environment-friendly behavior. Assume that a relatively small fraction of the population values environment-friendly behavior but that the majority is only interested in the private benefit and that their decision

is unaffected by whether or not the final outcome contains an environmental performance component. While this is a very simple partition, we believe our assumption captures the essence of a normal population.

We therefore consider two types of participants: One group that does not value the environmental performance of the proposed environmental management scheme, caring only about the private stream of income they gain from the project. We call this type of participant the F-type (“F” for financial type (= homo economicus)). The second type is the G-type (“G” for green). This G-group also derives utility from the public goods and the environmental components of the project. Since we are considering a relatively local (or small-scale) environmental management project, let there be a limit of potential participants of n^{G+F} . All of the participants are equipped with the following quasi-linear utility function:

$$u_i^t(n) = u_i^t(G(n)) + AR(n) - AC(n), t = G, F$$

The distinguishing factor between the two types is:

$$\begin{aligned} u_i^G(G(n)) &> 0 \text{ for } G(n) > 0, \\ u_i^F(G(n)) &= 0 \text{ for } \forall G(n) \end{aligned}$$

Another important distinguishing factor between the two participant groups is that the G-types will not participate unless doing so involves a significant environmental consideration, whereas the F-types will participate if they receive a positive net benefit from participating. This leads us to two relevant types of participation constraints:

The financial participation constraint (PCF): $u_i^t(n) \geq 0$

Green participation constraint (PCG): $G(n) \geq \bar{G}$.

In order for a G-type to participate, we assume that both the PCF and PCG must be satisfied, whereas only the PCF needs to be satisfied for the F-type. Note that this implies that the G-type can accept lower net revenue from the local environmental management project provided that the G-component is large. We summarize the model in Figure 1.

Figure 1: *The basic structure of the local environmental management model*

In Figure 1, $\bar{n}^G$ represents the number of G-types needed for that group to collectively provide the good, given that $G \geq \bar{G}$. A formal definition is: $\bar{n}^G = \arg\{u_i^G(n-1) < 0 < u_i^G(n) \wedge G \geq \bar{G}\}$. Moreover, $\bar{n}^{G+F}$ is the number of participants, including both G-types and F-types, needed for that group to be willing to provide the good. Here, the formal definition is: $\bar{n}^{G+F} = \arg\{u_i^t(n-1) < 0 < u_i^t(n) \wedge G \geq \bar{G}\}$, $t = G, F$. The consequence hereof is that if, for example, the number of potential participants n^{G+F} is smaller than $\bar{n}^{G+F}$, then the participation constraints will not be satisfied.

Given this structure, why is the local community unable to implement the project without help from a GE? We point to two main reasons. First, knowledge is needed about the given environmental project. Opportunities must be identified and potentials quantified into benefits and costs. Second, there is a great need for coordination. Due to the falling average costs, such projects involve many participants, and someone therefore needs to be the first-mover to gather people, initiate meetings, information sharing, etc.

This logically leads to a discussion of the skills with which a GE could or should be equipped. A GE is someone who possesses extraordinary skills and abilities that can be used to get a group of people to provide or produce a good with a greening component; a good that would not have been provided without the GE's presence.

First, what are the GE's objectives? Being a "green entrepreneur," it is reasonable to assume that their objective is to maximize the size of the project or the green component hereof. The GE therefore acts as an idealistic realist in order to meet the objective, also considering how to involve those who have no preference for the green part of the project.

So how can a GE turn an otherwise non-realized environmental project into a success? Let us look more formally at which skills the GE needs, depending on the type of situation. We identify four distinct abilities, all of which may be relevant depending on the specific details of the above set-up:

- 1. The ability to secure high private economic performance and deliver a sufficiently high green component (a high-performing GE).*
- 2. Foster willingness to cooperate (a unifying GE).*
- 3. The ability to convince those who initially only derive value from the private income of the proposed management plans about the value of the collective benefit (a persuasive GE).*
- 4. Enable trust that the GE in fact able to deliver an environmental management scheme that is profitable for all participants (a trustworthy GE).*

Ad 1): The GE may have better knowledge than the locals about which types of investments are the most relevant and profitable for their specific location. These profits can be realized through personal networks and the ability to identify the necessary production facilities and initiate the transformation needed to successfully implement the environmental project.

Ad 2): The second skill is rooted in the GE's personality and their ability to communicate and coordinate. They must be sufficiently dedicated, have natural leadership abilities and be an inspiring, driving force.

Ad 3): Under certain circumstances (to be explained below), local environment management can only be realized if some F-types (economic) are transformed into G-types (green). Here, the GE needs to have persuasive powers to generate awareness of and interest in the non-personal benefits of the project.

Ad 4): The GE needs to be trustworthy; that is, the locals who invest in the environmental project must believe that the GE can in fact manage and implement a profitable project.

This section focuses exclusively on the case of full information, where “trustworthiness” is irrelevant. We will devote the next section to the asymmetric case and include the trustworthiness issue. In the following, full information implies that the GE always presents the true costs and benefits of the local environmental management project.

We will now identify three versions in which the GE’s skills are required to implement the project. These situations represent three versions of the set-up described above. There are many more possibilities, of course, but the situations presented here show how the finer details of the problem define which types of skills the GE must possess. In the following, we focus on skills 2 and 3 while skill 4 will be handled in the next section. This leaves out skill 1 because in what follows we implicitly assume that there exists a best project and that a GE is available for providing it. Given this, we can assess the importance of skill 1. This will be clear at the end of this section.

VERSION 1 is defined as a situation where $n^G < \bar{n}^G$ and $n^G + n^F < \bar{n}^{G+F}$. Here, neither of the participation constraints are satisfied. This might be caused by 1) high costs, which only fall slowly when n is increased, 2) relatively low benefits resulting from an insufficient number of potential participants, or 3) a limited project size, which leads to capacity constraints. In any case, this is the most complicated situation for the GE to initiate a full-scale environmental project. An illustration of Version 1 is given in Figure 2.

Figure 2: *A situation where the GE needs considerable skill to succeed*

Here, the GE needs to have skills 2 and 3 in order to manage a project in which everyone participates. In particular, the only way to manage such a project successfully in this situation is if the GE can “transform” some of the E-types to G-types. We refer to this sort of GE as a persuasive GE, since they must be able to persuade a sufficiently large number of E-types to also value the G-benefits.

One way to model this is to redefine the utility function of the F-type as follows: $u_i^F(n) = \alpha \cdot u_i^G(G(n)) + AR(n) - AC(n)$. Initially, the parameter $\alpha = 0$. A persuasive GE is then able to increase α above zero assuming that all E-types have the same α . This situation is specified in Figure 3. For a sufficiently high α , it now becomes possible for the group to realize the project if faced with a persuasive, multi-skilled GE.

Figure 3: *The GE influences F-type preferences to also value the environment*

Numerous studies discuss how behavioral choices can be initiated. Within environmental education, Finger (1994) provides the following chain of links to show how information provision can foster

behavioral changes: More information $\rightarrow$ more knowledge $\rightarrow$ larger concerns $\rightarrow$ higher awareness $\rightarrow$ changes in values $\rightarrow$ changes in attitudes $\rightarrow$ changes in behavior (see also James, 2010). Some studies indicate that persuasion can have an impact on people's behavior (Kraemer and Mosler, 2010).

The first skill, the ability of the GE to move the “economy” as closely to the best situation as possible, also is important here. If Figure 3 portrays the most efficient situation, we can e.g., consider a less skilled as producing higher AC (AC^{INEF} as indicated by the dashed AC-line) in Figure 3a, then in order to get the project accepted, the GE needs to being able to increase α even more.

In this case, the two abilities are supplementary.

VERSION 2: Consider a less demanding situation (compared to Version 1) in which $n^G < \bar{n}^G$, but $n^G + n^F > \bar{n}^{G+F}$. This implies that even if all of the G-types go together, they are unable to realize the project; however, if all of the participants, G-types and F-types go together, then the individual rationality constraint is satisfied for all players. An example of this is presented in Figure 4.

Here, in principle, the GE does not need to change the preferences of the F-types and can instead focus on coordinating and communicating information about the benefits and costs of environmental management. We can call this type of GE a unifying GE in that they must be able to combine the financial potentials of the project with its environment-caring potentials and, in so doing, get all of the G- and F-types to join forces.

Figure 4: A situation where the GE needs coordination skills to succeed

VERSION 3: Here we have a situation where $n^G > \bar{n}^G$, but $n^G + n^P < \bar{n}^{G+E}$ (see Figure 5). Due to the definition of $\bar{n}^G$, the G-types as a group will be able to create a project of size n^G . In this case, a GE who is able to provide the G-component is sufficient; they do not require any additional skills when the G-types are able to coordinate themselves.

Figure 5: A situation where the GE has different options

However, another possibility opens up when we introduce the pervasive GE; if the GE is sufficiently pervasive, a larger environmental project of the size $\bar{n}^{G+E}$ can be realized. To sum up, here the GE only needs skill 2 or skill 3.

We have thus far assumed that any GE can produce the same costs and benefits for the project. However, skill 1 and the ability to provide a high net benefit is crucial. In the next section, we assume that there are different types of GEs—one type capable of managing high environmental

performance and another which cannot. We also assume that the potential participants are initially unable to identify which type of GE they are facing.

3. Asymmetric information and signaling high performance

Because such investments are made up-front, the participants must know what type of GE they are dealing with. Does the GE have the skills needed?

We have thus far only considered which skills the GE needs when full information is provided. Consider now a situation in which the potential participants do not know what type of local environmental management scheme they are supposed to be part of. For example, if the GE claims that Version 1 prevails so that the GE has the necessary skills (2 and 3) and if everyone chooses to participate, the project will be profitable for everyone. But what if the GE overstates the green and/or financial components of the project and in reality wants to force the project through for their own sake? The presence of a potentially bad GE who does not possess skill 1, will challenge a good GE who can truthfully deliver the necessary green and financial potentials.

Consider a situation in which there are two possible G -components, G_L and G_H , and where $G_H > G_L$. There are also two possible F -components, F_L and F_H , where $F_H > F_L$. We link this to the GE by defining four possible GE types: SE_{HH} , an GE who both provides G_H and F_H ; GE_{HL} , who both provides G_H and F_L ; GE_{LH} , who both provides G_L and F_H ; and finally GE_{LL} , who both provides G_L and F_L . The incentives are now such that an L-type GE also exists, who untruthfully announces the green and financial potentials of the project and, consequently, fails to make the environmental management solution profitable for the participants, even though the GE has promised to do so.

Imagine a situation with an information structure where the participants initially do not know with which skills the GE is equipped. Instead, they have certain beliefs about the given type of environmental project and a given type of GE. Such prior beliefs depend largely on history, such as the record and reputation of the GE. Past successes increase the belief among potential participants that the GE will also manage a successful project this time. Let $\rho^{G_o} = \text{prob}(G = G_H)$ be the common prior belief (that is, all participants hold the same belief) that the GE can achieve high

green performance. Similarity, let $\rho^{F_o} = \text{prob}(G = G_F)$ be the common prior belief that the GE can achieve high financial performance. We assume that beliefs differ between types but are identical between the members in a group. Moreover, ρ^{G_o} and ρ^{E_o} are assumed uncorrelated.

Let the people be able to form expectations and calculate the expected utility. The expected utility function is therefore:

$$E_{\{\rho^G, \rho^F\}} u_i^t(G, E; n) = \rho^G u_i^t(G_H(n); n) + (1 - \rho^G) u_i^t(G_L(n); n) + \rho^F AR(F_H; n) \\ + (1 - \rho^F) AR(F_L; n) - AC(n), \quad t = G, E$$

An interesting case is when the potential participants refuse to participate due to prior beliefs but where everyone would in fact profit from participating if the GE turns out to be an H-type GE. In this case, the GE must try to convince the participants that they represent an H-type GE.

Due to their objectives, all of the types of GEs want to manage the project, and they therefore want people to believe that they possess certain skills. We assume, however, that there exists no costless verification technology by which the GE can reveal their type. In order to change the beliefs of the group, the GE must therefore act or send a signal that will render it more likely that they are a “skilled” GE and able to achieve high green and/or financial performance.

A skilled GE must act in a manner that would not be in the interest of (or feasible for) an unskilled GE, even if it would increase people’s beliefs that they are indeed skilled. The characteristics of such an action could, for example, be that it is either easier (cheaper) for the skilled GE to produce or that it can be produced in a larger amount. The logic of a formal signaling game model is therefore relevant here.

A signaling device carries with it information about the type of sender that might have issued the signal. For example, a GE investing own resources in the local environmental project signals profitability. Formally, let a^j be the signal device j and assume that the range of a^j is discrete (and finite), $a^j \in \{a_1^j, a_2^j, \dots, a_k^j\}$.

Formally, write $SE_{G_\theta, F_\theta}, \theta = \{L, H\}$ and define $p(a_l^I | SE_{G_\theta, F_H})$ as the conditional probability of SE_{G_θ, F_H} , given observing a_l^I . Let the Bayesian updating, after observing a_l^I , be:

$$\rho(SE_{G_\theta, F_H} | a_l^I) = \frac{p(a_l^I | SE_{G_\theta, F_H}) \cdot \rho^{F_o}}{p(a_l^I | SE_{G_\theta, F_H}) \cdot \rho^{F_o} + p(a_l^I | SE_{G_\theta, F_L}) \cdot (1 - \rho^{F_o})},$$

$\rho(SE_{G_\theta, F_H} | a_l^I)$ is called the posterior belief.

An example of this is a situation where a^I is the income that the GE invests, and $a^I \in \{a_{low}^I, a_{high}^I\}$. Upon observing a_{high}^I , it is more likely to see this among high F-types than among low F-types. Furthermore, $\rho^{F_o} = 0.5$, $p(a_{high}^I | SE_{G_\theta, F_H}) = 0.9$ and $p(a_{high}^I | SE_{G_\theta, F_L}) = 0.2$. Upon observing a_{high}^I , the participants update their prior beliefs according to:

$$\rho(F_H | a_{high}^I) = \frac{0.9 \cdot 0.5}{0.9 \cdot 0.5 + 0.2 \cdot 0.5} = 0.82$$

Given the priors, it is equally likely that the GE is of a low F-type or a high F-type. Upon observing the action $a^I = a_{high}^I$, it is much more likely that this action is produced by a high F-type than a low F-type, and if yes is observed, the group members will update their prior probability according to a posterior belief of 0.82. One reason why beliefs are not equal to 1 is that it is not completely unlikely that the GE's preferences for the green component are so high that the GE would be willing to sacrifice considerable personal financial gain for the sake of local environmental management that will not generate a significant personal gain.

We can imagine various signaling devices or verification technologies that a high-performing GE might employ to convince group members that the project is a good investment. We focus here on cases where the GE, through certain actions, can increase the probability of being a high-performing type of GE.

Such actions (signals) can be grouped as follows:

- 1) Signaling high performance by first-moving and making a “real” costly investment in the environmental project, i.e. the willingness of the GE to engage and invest in the project.
- 2) Signaling by providing convincing trustworthy information about costs and benefits, as through reliable external expert information.

Note that a GE who talks a lot but rarely acts and provides limited documentation, will not be perceived as trustworthy and will be unable to convince people to engage in the project.

It is now possible to combine this signaling approach with the model from Section Three. We consider three situations: 1) one where the GE needs to signal high financial performance to manage the project, 2) another where the GE needs to signal high green potential to manage the project implemented, and finally, 3) a situation combining the previous two; that is, where the GE must signal high performance in both domains to manage the project successfully.

The first situation is structured as follows: Consider that an L-type GE represents version one, i.e. the GE cannot provide a project that satisfies the financial participation constraint (PCF) for the given number of potential participants. However, an H-type GE represents version two. Moreover, prior beliefs support version one. This is a situation where $Eu_i^F(G, F_H; n) > 0$, where $Eu_i^F(G, F_L; n) < 0$, but where $Eu_i^F(G, F(\rho^{F_0}); n) < 0$ for n^{G+F} . This is illustrated in Figure 6. Prior belief for F_H is so low that no environmental management project is created, whereas prior belief for ρ^{G_0} is so high that if the E-types choose to participate, the G-types will join them.

In this situation, there are two routes to go for a GE to enable participation. The first is to increase α sufficiently. In this case, there is no need for the GE to try convince that he / she has a high performing skill with respect to the financial part of the project. The second is to credible signal that his/ her type is a high-performing type. (The latter is obviously only possible if the GE truly is a high performing GE).

Here $Eu_i^F(G, F(\rho^{F_0}); n)$ is the expected utility for the F-type given prior beliefs.

In any case, however, the increase in beliefs will help the GE managing the project. For $\alpha = 0$, in this case, a GE must be able to increase the group’s belief that they are an $SE_{\theta_{G,H}}$ type. Define $\bar{\rho}^F =$

$\arg\{AR(n^{G+F}) = AC(n^{G+F})\}$ as the threshold value of the probability that the GE is of a high F-type such that the value is high enough to ensure that the desired environmental outcome will be produced.

Figure 6: *The mechanism for successfully signaling a skilled E-type*

From the Bayesian updating formula and letting $p^F(\mathbf{a})$ be the posterior belief that the GE is in a high F-type after observing signals $\mathbf{a}$, the ability of the high-skilled GE to change the beliefs sufficiently such that $p^F(\mathbf{a}) > \bar{\rho}^F$ becomes easier:

- 1) The more effective the signaling device (measured by $p(a_i|SE_{\theta_{G,H}})/p(a_i|SE_{\theta_{G,L}})$).
- 2) The smaller needed change in probability (measured by $\bar{\rho}^F - \rho^{F_0}$).
- 3) The larger the number of possible signaling devices.

As noted above, if $\alpha > 0$, the GE must do less in terms of signaling to change the PCF into a positive one.

Now consider a case where ρ^{E_0} entails that the local environmental management scheme will be initiated if only the G-types choose to participate. The G-types will not participate for ρ^{G_0} , however, will do so if $1 > \rho^G(\mathbf{a}) \geq \bar{\rho}^G > \rho^{G_0}$. Here, $\bar{\rho}^G$ is defined in the same way as $\bar{\rho}^E$.

Compared to the above case, the GE can now only hope to manage the project if the probability that the GE is a green H-type GE can be increased. In this case, the task of a truly high green GE is to signal the true type and thus increase $\rho^G(\mathbf{a}) \geq \bar{\rho}^G$. This could be achieved by initiating a small operation that produces green energy or is truly organic.

In the final case, ρ^{G_0} and ρ^{E_0} implies that unless posterior beliefs are increased sufficiently for both dimensions, the proposed environmental management scheme will not be initiated. In this case, the GE needs to signal a high type in both the G and E dimensions; that is, combining the signaling proposals from the two cases above $\rho^G(\mathbf{a}) \geq \bar{\rho}^G$ and $\rho^E(\mathbf{a}) \geq \bar{\rho}^E$. Only a truly multi-skilled GE (representing a high E and G type) can manage this type of project. It also follows that when a signal increases belief in one dimension it might reduce belief in another. In other words, signaling high green performance might reduce beliefs that high financial performance is also feasible.

Some of the lessons learned from the theoretical section is that both the circumstances (indicated by the versions of the model) and the skills of the GE are decisive for the possibilities of realizing the project. Very demanding circumstances require a multi-skilled GE. On the other hand, some skills can act as substitutes, e.g., trustworthiness on finance trades-off by high persuasive power. Finally, a possibility exists that when a signal increases belief in one dimension it might reduce belief in another. In other words, signalling high green performance might reduce beliefs that high financial performance is also feasible.

4. The Danish Case of Samsø

The island of Samsø is located in the middle of Denmark. Due to its geographical position, it was an important meeting place in the Viking era (Hermansen et al. 2010). Today, Samsø has become a renewable energy island and attracts energy specialists from around the world. They want to see how such a small community has been able to manage an environmental shift from being energy consumers to energy producers. Earlier on, Samsø was entirely dependent on oil and coal, both of which are imported from the mainland; the island had no conventional energy resources of its own. All of the fossil fuel had to be transported by tankers, and electricity was secured via connection to mainland grids (Richardson, 2015; Marano 2010; Energy Academy, 2007).

In 1997, however, the Samsingers joined forces bottom-up due to local entrepreneurship and initiated a rapid transition to renewable energy, especially by erecting wind turbines. Eight years

later, they produced more renewable energy than they were able to consume, rendering them climate-neutral (Höges, 2009a).

Remarkably, the population of Samsø is a mere 4,000 residents scattered between 22 villages. In the words of an obviously impressed Egyptian ambassador, “the number of people living on Samsø could fit into three apartment buildings in Cairo!” (Höges, 2009b). In the following, we analyze whether the GE on Samsø carry the four skills derived from theory: 1) profits, 2) communication, 3) persuasion, and 4) trustworthiness.

Skill 1: Identifying a beneficial and greening project

As an ex post evaluation, since the project has succeeded the circumstances must have existed. It is, however, remarkable that none of the projects have been imposed by outsiders or funded by major energy companies. Hermansen’s financial argument was based on a report produced by an engineer from the city of Aarhus (situated just across the sea from Samsø). He calculated that it would pay to introduce renewable energy on Samsø, work which won him a contest in 1997 arranged by the Danish Ministry of Energy (Höges, 2009; Guevara-Stone, 2013). His calculations ultimately proved correct. This puts forward the importance of the first skill: To identify the opportunities and this must be attributed to the high-skills of the local GE.

Skill 2: Enable communication / coordination

Hermansen initially struggled to convince local investors of the profitability of the renewable energy project and spent months talking up renewables at community meetings. He went from door to door, promoting his plan. He then bought a cider press, as almost everyone on Samsø has apple trees. Offering to press their fresh apple juice was a way of getting them to listen. His main argument was how people could continue to live on Samsø after the “Great Depression;” that is, the closing of the slaughterhouse, which would put many people out of work. He argued that the new environmental project was more profitable than the slaughterhouse, and his arguments and the information he provided soon began to have the desired effect (Höges, 2009a; DAC, 2013).

Hermansen basically convinced local investors that there was money in environmental management: “The reason you invest differs from who you are, but in the end it is about money, and the fact that when we show that if we do it like this we save on the import of oil. Everyone knows that price for oil fluctuates and is therefore interested in doing something else” (cited in

Jakobsen, 2010, 55; see also Richardson, 2015). Such local environmental management was also touted to bring new jobs, new businesses, and increased business from more visitors to the island. Today the island's tourism website includes a major section on Samsø as a renewable energy island (visitsamsøe 2016).

To conclude, the local GE had high personal skills to solve the coordination problem by getting people connected with the project and interested in the project.

Skill 3: Be persuasive

We found no evidence that the GE convinced local non-green people about the value of green components for their common island. Profits outweighed concern for the local environment. As Hermansen explains, "...we're not trying to save the rainforest or blue whales or the environment. We are trying to save ourselves." (Richardson, 2015). He moreover pointed out that "[i]t's important to negotiate, but then they have to go home and do something," and "'We don't wake up every morning thinking about how we're going to save the polar bears. No, people think about themselves.' But this isn't a problem according to Hermansen, it's the solution!" (cited in Höges, 2009a).

Skill 4: Act trustworthy

The local GE enjoyed a good reputation among the locals before initiating the project. People trusted him. Had he been a stranger from Copenhagen, the locals would likely have been much more skeptical toward the project. Søren Hermansen also sent an important trustworthiness signal by personally investing in the project, thereby acting as a first-mover (*Guevara-Stone, 2013; Jakobsen, 2010*).

According to Hermansen, the key was convincing the Samsingers to actively participate in the project and that it was not just another hippie project drawn up on a desk by top-down thinking politicians, bureaucrats or consultants in Copenhagen. His job then became to tear these presumptions apart and break them down to daily things that somehow related to everyone. He coined the term "commonity"—a combination of community and commons—which he referred to in his discussions with the locals, trying to persuade them to get on board and invest in local renewable energy resources.

The local GE also sent an important trustworthiness signal by personally investing in the project, thereby acting as a first-mover. Therefore, the GE invested much personal time and capital into the project to signal that the project is a high-performing project.

5. Conclusion

Motivated by a gap in the literature on why some local environmental entrepreneurs succeed, the main research question was: When can a green entrepreneur (GE) manage the local environment? Our theoretical model suggested four key GE skills: 1) the ability to make a project both profitable and sufficiently green; 2) communication and coordination skills; 3) the ability to convince non-green actors of the value of the green component; and 4) trustworthiness, that is, trust that the GE possesses reliable information. We then demonstrated how different versions of the model needed two or more of the four skills for the project to be realized.

Samsø's rapid, eight-year transition from brown to green energy offers an illustrative case. Here, the GE was embodied by Søren Hermansen, a multi-skilled GE possessing three of the four outlined skills. First, he convinced the local people about the profitability of the project (skill 1). Second, he acted as a communicator and coordinator of the green energy project (skill 2). And while he failed to persuade the non-green actors of the value of the green component (skill 3), he established a good reputation by investing in the project and was known among the locals to be reliable and trustworthy (skill 4). The GE thus used three of the four skills—which was sufficient for successfully managing this local environmental project.

Overall, the main result of our theoretical model can help explain the success of local entrepreneurs such as Søren Hermansen on Samsø. Here, the crucial argument was to convince the non-green locals that they would prosper financially in the longer run from these relatively major environmental investments and climate neutrality. In perspective, the theory and case thus demonstrate how the crucial element is the GE's ability to convince non-greens about how the project is “more profitable than green.” There is a saying that has become common on Samsø: “The weather is always good”—at least in terms of renewable energy production. When the wind blows, the rotors turn. When it rains, the straw for the heat generators grows. And when the sun shines, the solar panels get to work.

In perspective, what are the lessons learned from our analysis? Are the results obtained from the case of Samsø replicable for other local communities? First of all, we think that a discussion of scale is relevant. As suggested in e.g. Brandt og Svendsen (2013), when the group size is getting too large, then the costs of “self-organization” increases steeply among others due to coordination problems, free riding (lack of trust) and group diversity. Secondly, another observation is that in particular small communities (island, rural areas) might sometimes have an interest in controlling their own energy supply when they do not trust the centralized units. Given these observations, the transition process could, however, be replicated for many rural or small island or any small communities. Crucially, a GE with the skills outlined in this paper is necessary for the local community to succeed. Taking these considerations into account, the lessons learned from the Samsø “miracle” may indeed help the world become greener by the active use of local environmental management.

Acknowledgements: An earlier version of this paper was presented at the European Public Choice Meeting 2014 in Cambridge, UK. A special note of thanks to the other participants for helpful comments.

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