Universiteit Utrecht

Social business model for sustainable energy

Danish community energy

Supervisor: Dr. Elena M. Fumagalli (e.m.fumagalli@uu.nl)

Second reader: Dr. Jacco C.M. Farla (j.c.m.farla@uu.nl)

Course: Master Thesis (GEO4-2606) - 45 ECTS

Student: Chau Tran Thi Minh - 6540562

(c.tranthiminhchau@students.uu.nl)

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SUMMARY

This study is initiated by the observation of two phenomena in literature: social business and community energy. The community energy was studied as the grassroots social innovation responding to sustainable energy transition by promoting the engagement of civil actors in the renewable energy setups. Meanwhile, the notion of social business implies a new business form that engages in social missions to capture and deliver social values. The two phenomena share not only the same exhibition in the social embeddedness but also business characteristics since the community energy is guided to enter the energy supply market, directly competing with incumbent energy utilities. However, the understanding of mechanisms for creating, capturing and delivering social values from community energy is still lacking. The thesis aims to deliver a systematic operationalization of community energy by conceptualizing social business in the context of community energy. Four case studies in the Danish community context were analyzed on the components of the social business model, including value proposition, value constellation, social profit equation, and economic profit equation. Based on the findings from the investigation of the four cases, it is concluded that the conceptualization of social business can be reflected in the context of community energy. Their emergence is driven by social and environmental concerns such as the promotion of local empowerment in energy supply, regional development, the reduction of greenhouse gas (GHG) emissions and replacement of fossil fuel resources. Strong community engagement plays a critical role in project emergence and implementation. It reflects on efficient and transparent management of project operators and democratic decision-making process with the involvement of local actors to stimulate project development. The case studies found different financial means to maintain the operation. Most of them rely on the revenue of energy sales to be self-sustained, however, the commitment of the local community to the financial duties of the project proves a more sustainable business model.

PREFACE

The following presents my Master Thesis: Social business model for sustainable energy: Danish community energy which has been conducted to obtain a Master of Science degree in the program Sustainable Business and Innovation at the Utrecht University.

First, I would like to express my gratitude to my supervisor, Dr. Elena M. Fumagalli for giving me the opportunity to do this research under her supervision. Her expertise, constructive criticism and guidance helped me throughout the process of writing my thesis.

Second, I would like to thank the interviewees who engaged in very interesting stories and provided me with insights into the topic of my thesis.

Lastly, I would also like to thank my second reader, Dr. Jacco C.M. Farla, for giving valuable recommendations during the proposal phase.

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List of Abbreviations

CE	Community Energy
DH	District Heating
DEA	Danish Energy Agency
GHG	Greenhouse gas
kWh	Kilowatt-hour
MWh	Megawatt-hour

1. INTRODUCTION

Entailing potentials to promote more sustainable energy generation and socio-ecological goals, community energy (CE) has gained increasing attention from policy-makers and societal groups. CE, which refers to renewable-energy-generating organizations led by civil society members is among initiatives that have been promoted in calls for the transition towards a decarbonization and decentralization energy system (Hicks & Ison, 2011; Seyfang et al., 2013; Süsser et al., 2017). Its emergence is rooted in the phenomenon of grassroots-led innovation, aiming to generate locally responsive solutions for the small-scale renewable energy provision while yielding collective benefits on a community level such as local energy security, local economic development and community resilience (Hicks & Ison, 2011; Martiskainen, 2017; Richter, 2013; Seyfang et al., 2014). Various forms of CE are found throughout Europe, including wind and solar farms co-owned by municipalities and commercial developers, district heating plants in cooperation ownerships, or sustainable co-housing complexes that promote clean energy self-sufficiency and energy efficiency.

However, some CE projects are weakly reflected in either practices or outcomes, resulting in the local opposition to projects, the hindrance of community value creation or even the failure of some projects (Hicks & Ison, 2018; Taylor Aiken et al., 2017). The observation of scholars on the implementation CE projects suggests that the low degree of local community engagement significantly attribute to the poor performance of CE (Curtin et al., 2018; Hicks & Ison, 2018; van Veelen, 2017). Local societal groups should relate very closely the ownership model as well as the operation of projects. Strong engagement of the local community in CE projects facilitates the local acceptance for their development and the generation of contextualized solutions to adequately address local issues. However, the lack of adequate understanding of how local actors should engage in the CE projects hinders their commitment to the projects. As a result, an integrated picture of how local

groups manage to create, deliver and capture value from CE is needed. A framework on the systematic operationalization of CE might offer guidance on the execution of CE, thus facilitate the active engagement of local actors in the CE development.

Even though scientific attention is increasing around the community projects, there is no systematic operationalization of CE that has been developed. This can be attributed to the ambiguity around the CE concept displayed as a gap between social and economic value in the grassroots innovation literature.

Initially, CE emerges as a grassroots innovation which is driven by local societal groups to create social goods rather than pure monetary profits. It is assumed to be a form of a non-profit organization and be divergent from business entrepreneurship (Seyfang & Smith, 2007). However, the actual performance of CE triggers a criticism to the assumption of grassroots innovation's scholars by the following reasons. First, the motives of local groups to establish CE encompasses not only social, environmental but also financial viability of the projects to at least recover its initial investments and cost of its operation (Blokhuis et al., 2012; Steenhuisen & de Bruijne, 2015). Second, CE is an alternative mean of energy production, being guided to penetrate to energy provision market and compete with incumbent energy suppliers. These natures of CE suggest its conceptualization should not considerably diverge from business notion as assumed. However, CE could not be observed as profit-maximizing businesses, whose purpose is to maximize shareholder values. CE might be conceptualized somewhere between the notion of non-profit organizations and profit-driven businesses. This gap in literature results in an incomprehensive understanding of CE.

On the other hand, the emergence of the social business concept is potential to serve as a bridge between grassroots social innovation and business literature (Yunus et al., 2010). It is proposed as a hybrid form of business that aggregates the social mission traditionally associated with non-profit organizations with the commercial purpose and market-based methods traditionally associated with profit-driven firms (Wilson & Post, 2013). Social business seeks to solve social problems and benefit the

community by finding a disruptive value proposition, value constellation and their combinations to create social values (Yunus et al., 2010). It includes "organizations involved at least to some extent in the market, with a clear social, cultural and/or environmental purpose, rooted in and serving primarily the local community and ideally having a local and/or democratic ownership structure" (Johanisova et al., 2013, p. 11). With these acknowledgements, social business exhibits several similar characteristics with CE, thus being potential to deliver an appropriate interpretation of CE that is not fulfilled in the grassroots innovation literature. Furthermore, a social business model including four components: value proposition, value constellation, social profit equation and economic profit equation offers a consistent and integrated picture of organization activities and the way civil stakeholders manage the organization to generate social profits. Analysis of CE pertaining to the four components of social business model might grant a comprehensive mechanism of citizen-led projects for creating, capturing and delivering values. The thesis aims to offer an integrated operationalization of CE by proposing to characterize social business in the community energy context, thereby asking the following question:

To what extent are the components of the social business model conceptualized within the context of community energy?

To help answer the main research question, four sub-research questions are formulated based on the framework of the social business model to explore the integration of CE's characteristics into a social business perspective.

1. Who are the CE project's customers/ beneficiaries, and what does the project offer them as values?
2. How does CE deliver value to their customers/ beneficiaries?
3. Which kind of value that is created in solving the social issue?
4. How does the financial model look like to sustain CE's social mission financially?

By putting forward an analytical perspective on community energy initiative as a social business model, the thesis contributes to the discussion of how to bridge the gap between business values and activities, and social values. That also may help build up a business model of CE as a social business, thus contribute to the diffusion of CE within energy transition movement since successful business models are seen as examples to be replicated and imitated (Chesbrough, 2010; Teece, 2010). In particular, the findings on the involvement of CE internal and external stakeholders pertaining to its value constellation offers an understanding of the proper degree of community actors' engagement in CE project, thus consulting policy-makers to properly design CE policy which facilitate their engagement.

The investigation was made in Denmark as the Danish community energy possesses a long history of development with strong engagement of the local community and the establishment of supportive governmental schemes tailored to CE projects. Gorroño-Albizu et al. (2019) estimate that 52% of the total existing installed wind capacity in Denmark in December 2016 owned by community energy, while 89% of district heating system is formulated as citizen-owned cooperatives. Danish CE covers a variety of activities, renewable energy technologies, the scale of projects, governance structures, financial models and citizen ownership forms, making a compelling case for the exploration of a holistic and integrated understanding of social business conceptualization within the energy context.

2. THEORETICAL FRAMEWORK

2.1 Social business

Yunus (2007) introduces the concept of 'social business' as a market-based approach to pursue social or environmental goals. Social business appears to straddle the line between for-profit and not-for-profit organizations by integrating economic value creation with social value creation.

On the non-profit side, the social business engages in social action to generate positive social value. Typical social missions encompass the reduction of poverty, inequality, greenhouse gas (GHG) emissions and unemployment (Doherty et al., 2014). In this context, social value is not merely a byproduct of entrepreneurial activity but an intended primary outcome (Yunus, 2007).

On the for-profit side, the social business is structured and operated like a conventional business which involves in the provision of goods or services, market expansions and competitions (Blount & Nunley, 2014; Wilson & Post, 2013; Yunus et al., 2010). The economic and market-based characteristics of the social business do not entail the purpose of maximizing shareholders profit values but ensuring that the business can be financially self-sustained to achieve its social missions.

Being positioned between the concepts of non-profit and for-profit entities, a social business organization requires a novel business model that allows them to achieve economic value creation and social value creation simultaneously. In the following section, the components of a social business model are presented, offering an understanding of social business organization's mechanism for vale creation, delivery, and capturing

2.2 Social business model

2.2.1 Business model

The popularity and importance of business models have risen considerably for ages. There is no strict definition for a business model, but a wide-known definition

indicates that "a business model articulates the logic and provides data and other evidence that demonstrates how a business creates and delivers value to customers" (Teece, 2010, p. 173). The purpose of the business model is then to show an overview of the interlinkage between different aspects of the firm and the value it creates for its target customers in order to provide a competitive advantage, thus maximize profit (Osterwalder et al., 2005; Teece, 2010; Zott et al., 2011). Hence, the analysis of a business model can be helpful when determining if a company will be profitable and valuable (Schaltegger et al., 2016). Yunus et al. (2010) introduce a business model, including three pillars: value proposition, value constellation and profit equation, describing the logic of how the business creates, delivers and captures values

The value proposition pillar aims to explain what type of value the company is creating for its customers through its products or services (Al-Debei & Avison, 2010; Chesbrough, 2010; Osterwalder et al., 2005; Yunus et al., 2010). The value constellation includes descriptions of the company's internal and external value chain to answer the question of how to deliver value to the target customers (Osterwalder et al., 2005). Profit equation consists of two building blocks: cost structure and revenue streams (Osterwalder et al., 2005). The company's cost structure displays fix and variable cost items, economies of scale and profit opportunities. The revenue stream offers an evident insight into how and by which pricing mechanisms, the business model captures value from its services and products.

2.2.2 Conceptualization of social business model

The business model concept delivers a consistent and integrated understanding of a company's mechanism for economic value creation. Hence, it is adequately served as a base for the formation of a profit-driven business but seems to be inappropriate when it comes to social business. Yunus et al. (2010) emphasize that business models are distinct between social and for-profit business due to the differences not only in their conceptualizations but also in their purposes and markets (Austin et al., 2006). However, the deployment of the market-based approach for the engagement in social missions and solve social issues suggest the social business model is slightly related

to the for-profit counterpart. Following Yunus et al. (2010), the building blocks of a social business model are presented (Figure 1).

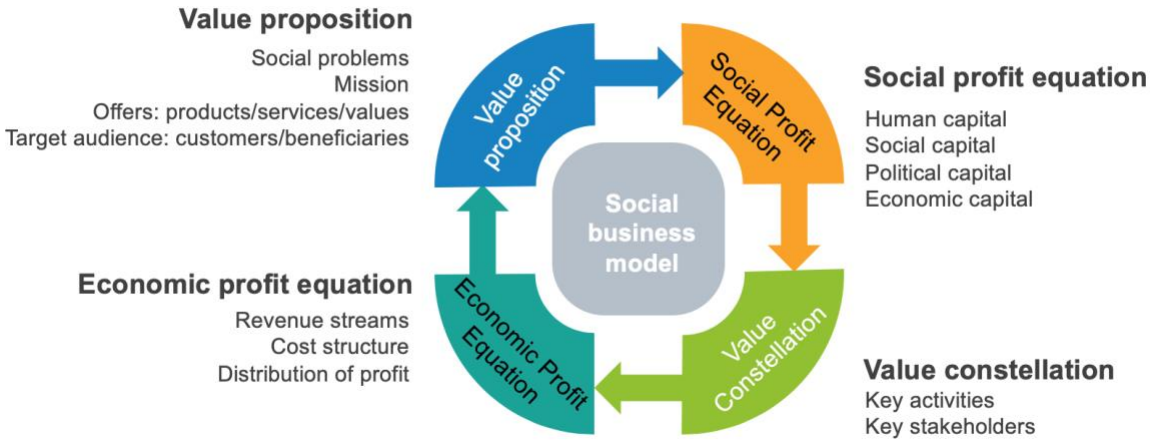


Figure 1: Social business model components (Adapted from Yunus et al., (2010))

Value proposition

Similar to commercial business models, social business models consist of a *value proposition component* that answers to the question of what value is provided and to whom. However, the value proposition itself entails a critical distinction between commercial and social business. For the commercial business, the value proposition is offered in the provision of products or services to satisfy the needs of targeted market segments which can comfortably afford those offers. The value proposition is, therefore, designed to create financial profit for commercial business. The social business, however, entails social problems the firm manages to address and the mission it pursues, thereby aims for delivery of non-profit driven and large-scale benefit through the offer of products or services that accrues to a significant segment of society (Blount & Nunley, 2014; Martin & Osberg, 2007; Yunus et al., 2010). Blount et al. (2014) classify the target population that gains social benefits from social business into two types: a beneficiary who involves in client segment of the business, and a beneficiary who is different from the customer segment. In the former case, the intended beneficiary usually falls under challenging situations to afford, access or lack perception to purchase goods and services. As a result, by offering lowering costs or providing novel means of access, the social business organization fulfils their social

mission while transacting with their target beneficiaries as customers. Meanwhile, in the latter case, the social business organization needs to serve both the social target group who are the beneficiary of business' social mission and the market target group who pay for the goods and services.

Value constellation

Another similarity with commercial business models is that social business models also include a *value constellation component.* It describes how the company exploits resources to deliver social values. This component not just exhibits the internal business activities and operation performed by key stakeholders, but also the external partners who are involved in the business processes (Weis, 2016). Among internal functions within value constellation of the social business, internal governance mechanism which usually presents a democratic structure is highlighted as one of primary operational function to extract a competitive advantage to social business (Johanisova et al., 2013). The democratic governance structure often includes the involvement of beneficiary community or municipal representatives who offer different perspectives in social business's operation to address social issues appropriately.

In contrast to commercial business models, the social business aims for achievement of social mission and the recovery of costs and the utilized capital, not for financial profit-maximization, social business model entails different other components (Yunus et al., 2010).

Social profit equation

The *social profit equation* defines forms of values that are created to achieve business' social missions. Based on the analysis of a sample of 200 social businesses, Mair et al. (2012) identify four forms of capital which are potential to be created and leveraged by social business performance. They include political, human, economic and social capital. Social businesses create political capital in their social mission by involving the formulation of collective policies, endowing and empowering citizens, and

fostering their political identity (Sørensen & Torfing, 2003). Human capital is regarded as an individual improvement of knowledge and skills through training programs and capacity building activities offered by social businesses. Economic capital is created by retaining business resilience, while social capital refers to the establishment of relationship networks through which citizens can mobilize power and resources.

Economic profit equation

The *economic profit equation* defines the financial model, which is employed by the venture to sustain itself and its social mission financially. Some firms exploit traditional donation-model in the non-profit sector to maintain their operation by receiving grants, private donations and other forms of philanthropy. Meanwhile, others use market-based financial model to be self-sufficient. It implies that the generated market-based revenue is expected to cover costs needed to create and transfer social values to the intended beneficiary. Wilson et al. (2013) claim that the financial sourcing from commercial revenue is a more reliable approach to ensure the long-term development of social business. In addition, any possible profits generated should be reinvested in the business, being passed on to the beneficiary group in such forms as lower prices, better service or greater accessibility (Yunus et al., 2010).

2.3 Community energy

2.3.1 Conceptualization of community energy

The conceptualization of CE entails the aggregation of market-based and societal-oriented characteristics. Indeed, CE projects have become an increasingly important element of energy markets in many European countries (Herbes et al., 2017; Viardot, 2013). They have changed the incumbent structure of the energy market by adding a new type of player, promoting energy systems transition from centralized and fossil fuel dominated towards decentralized energy systems based primarily in renewable energy. In addition to the participation in the energy market, CE aims to address other

social and environmental problems by creating added value for regional development (i.e. community resilience, energy security, empowerment of social groups, local economic development or job creations (Becker et al., 2017)) and contributes to national sustainability agenda (i.e. increase in the share of renewable energy in energy provision, mitigation of climate change, the protection of biodiversity, or social justice (Hoffmann, 2009; Martiskainen, 2017; van Veelen, 2017)).

2.3.2 Forms of community energy

Although the popular conceptualization of CE places one of the priorities on value creation for regional development, in reality, not all projects regarded as CE are entitled to achieve this mission. This is attributed to the lack of clarity in the term 'community' (Dóci, 2017). Brummer (2018) differentiates between '*communities of localities*' and '*communities of interest*', triggering a significant discrepancy arising from the geographical dispersion of stakeholders involving in the projects. The stakeholders engaging in CE projects regarded as 'community of interest' can be widespread, including private business ventures and non-local actors. The establishment of these CE projects aims to fulfil the interest of projects' developers rather than delivering collective benefits created from projects to the local community. Meanwhile, the stakeholder in '*communities of localities*' form of CE is locally confined. The distinction bears relevance when revealing a stronger or weaker local community-oriented form of CE projects. The CE projects which show a stronger form of local community orientation are more aligned with the acknowledged conceptualization of CE (Hicks & Ison, 2018), which exhibits some similarities with the conceptualization of social business. Hence, they are more relevant representatives for the interpretation of the CE operationalization under social business perspective.

Two criteria are provided to assess a more or less community-oriented form of CE: (1) the degree of local actor involvement in project ownership; (2) relation between the scale and motivations of the project (Hicks & Ison, 2018; Süsser et al., 2017). Hicks

& Ison (2018) indicate that the strong form of CE projects tends to involve local members as the dominant owners, with limited participation from commercial-led developers, public institutions or individuals elsewhere. At the same time, the strong form of CE projects is likely to be scaled to satisfy local energy demand other than achieving commercial motivation of maximizing economic profits.

3. RESEARCH METHOD

3.1 Research design

To investigate the characteristics of the social business model within the Danish community energy context, this thesis employs an in-depth and qualitative case study research. The case study approach is deemed suitable for this research as it provides a powerful tool to study social entities such as communities and social groups (Hakim, 2000), allowing for the "development of a nuanced view of reality" (Flyvbjerg, 2011, p. 303). Case studies are considered suitable for reporting in-depth information, and thus offer a firm empirical grounding for a hypothesis (Odell, 2001).

3.2 Case study selection

The thesis looks for the case studies that represent a strong community-oriented CE based on two criteria mentioned in the theoretical background section. This guidance for case selection aims to target proper CE case studies that are more aligned with the popular conceptualization of CE, thus showing higher relevance to the conceptualization of the social business.

The case selection process was performed through desk research by the collection of existing data on technology, ownership model and the relation between scale and motivations of community energy projects. With this, the purpose was to find information that reveals which project shows a strong form of CE in the field of renewable energy. Different databases were used to derive relevant data. In this thesis, desk research resulted in four proper cases. The following section presents the process of case study selection.

3.2.1 District heating plants

The research on Danish District Heating Association's database, which provides names and ownership forms of all district heating (DH) in Denmark resulted in a shortlist of 100 per cent consumer-owned district heating cooperatives. Those

decentralized consumer-owned DH cooperatives were established to satisfy regional heating demand. Those features imply a high degree of local ownership and a commitment to local energy demand, thereby might entail a strong form of CE for DH plants. However, based on information on the plants' websites, only more than 20 cases partially or fully engage in renewable heating generation, while other rely on fossil fuels (mainly natural gas and coal) or incineration waste to supply heat. Out of more than 20 suitable cases, two DH plants, namely Marstal Fjernvarme and Ebeltoft Fjernvarme were chosen since they show the highest deployment of renewable energy technologies.

3.2.2 Solar energy collective project

In Denmark, solar photovoltaics are rather unpopular compared to other renewable energy technologies. This is due to limited subsidy schemes, financial incentives and supportive legislation on photovoltaics. Their installations are mainly applied for retrofitting projects to meet new building's energy standards. However, by the introduction of experts from Green Island Organization, a rare case of solar energy collective project, namely Svalin co-housing complex, was contacted. The general information regarding features of a CE strong form was collected via short conversation with one member of the project. The information indicates the appropriateness of the project to become a case study in this thesis since their renewable energy infrastructures were set up for their energy demand and owned by the members of the project.

3.2.3 Onshore wind turbine project

Data of wind turbine's CE form was collected via literature review, and contact to experts (Technical University of Denmark, Nordic Folkecenter, Samsø Energy Academy and Green Island Denmark). An outstanding community onshore wind turbine project, namely Hvide Sande was chosen for further investigation. Through the desk research, the project exposes a high degree of local engagement in its ownership model. In detail, local residents hold 20 per cent of the project's ownership, while a community foundation founded by different local unions makes

up the rest of 80 per cent. The project running on 3MW three onshore wind turbines aims to support the economic development of the Hvide Sande region.

3.3 Data collection

Four cases were chosen as they presented a strong community-oriented form of CE, which show a higher relevance for the conceptualization of social business. Data on motivations for the emergence of the cases and practices and activities that the cases perform to create, deliver, and capture social and economic values were, then, further collected to explore to what extent the characteristics of the social business are verified in CE cases. Data collection was mainly conducted through semi-structured interviews with the managers/coordinators of CE projects and supplemented by analysis of reports on financial or sustainable performance, records on general meeting with the full involvement of stakeholders, and related-information articles (See Table 1). Interviewing with the managers/coordinators could provide answers to various questions regarding internal and external activities of the projects as well as reveal barriers to the project implementation. The leaders are considered to have a thorough knowledge of how their organization is managed for sustainability transition; they are, thus, the most reliable source of information (Walker, 1997). Three in-depth interviews were conducted with three managers of the Marstal DH, Ebeltoft DH, and Svalin co-housing complex. The interviews ranged from 45 to 60 minutes. All of the interviews were made online and digitally recorded so they could be transcribed, and no critical information was left out. An interview guide (See Appendix) was developed as a part of interview strategy for the investigation of the motivations, practices and activities of case studies (Appendix). As the interviews were semi-structured, the actual line of questioning differs among interviewees. For the data collection of the Hvide Sande wind turbines project, no in-depth interview was conducted due to the limited availability of the project's manager. Nevertheless, the large number of articles published and internal reports such as general meetings, financial reports regarding the project management and performance offered

necessary data for the analysis, while short conversations with the manager was made to recheck uncertainty.

Table 1: Overview of CE case studies

No.	Name	Energy generation	Energy sources	Used data sources	Interviewee
1	Marstal Fjernvarme A.m.b.A.	Heat	Solar thermal, biomass	Interview, desk research	Mr. Lasse Larsen (Manager)
2	Ebeltoft Fjernvarmeværk A.m.b.A.	Heat	Biomass	Interview, desk research	Mr. Niklas Bitsch (Manager)
3	Svalin co-housing complex	Electricity	Solar energy	Interview, desk research	Mr. Pierre-Elouan Réthoré - Coordinator
4	Hvide Sande wind project	Electricity	Wind energy	Desk research, communication for rechecking uncertainty,	Mr. Henning Davidsen (Manager)

3.4 Data analysis

The data analysis was performed in two stages: a within-case analysis and a cross-case analysis.

First, the within-case study analysis emphasized the exploration of individual case operationalization. Analyzing the individual case along the four components of the social business model is beneficial to explore the extent to which social business model is conceptualized in each case study. Given that the four components of a social business model include: value proposition, value constellation, economic profit equation and social profit equation, for the data analysis, these abstract components need to be broken down into representational sub-components (See Table 2). All semi-structured interviews were transcribed. The interview transcriptions and secondary data from desk research were coded manually pertaining to the sub-components of the social business model. The components of social business show a large extent to be presented in each case study when their acknowledged characteristics defined in the theoretical background section appear in the within-case analysis (See Table 2).

Table 2: Operationalization of social business components

No.	Components of social business model	Sub-components	Acknowledged characteristics
1	Value proposition	Social problems	• Delivery of non-profit driven and large-scale benefit through provision of product or service • Target audience encompasses either a significant segment of society or to society at large.
		Missions	
		Target audiences	
		Product/service	
2	Value constellation	Key activities	• Democratic governance mechanism
		Key stakeholders	
3	Social profit equation	Political capital	• Building or leveraging one or more capitals
		Human capital	
		Social capital	
		Economic capital	
4	Economic profit equation	Revenue stream	• Market-based approach to retain self-sustainability and mission achievement.
		Cost structure	
		Distribution of profit	

Second, the cross-case analysis was conducted in an attempt "to build a general explanation that fits each of the individual cases, even though the cases will vary in their details" (Yin 1994, p. 112). The common factors and differences in the degree of social business conceptualization derived from the within-case analysis are in-depth examined in cross-case analysis to support empirical generalizability and theoretical predictions.

4. Results

4.1 Within case study analysis

In this chapter, the thesis provides operationalization of the community energy projects pertaining to the four components of the social business model.

4.1.1 Marstal and Ebeltoft District Heating

4.1.1.1 Value proposition

Both DHs came into operation in the early 1960s, motivated by environmental and economic considerations. L. Larsen (personal communication, 30th March, 2020) reveals the contemporary issues which became the driving force for its establishment in 1962:

By the 1960s, the problem at that time was that everybody had individual coal or oil boilers or something like that to supply their heating needs. A lot of pollution in the city. So citizens wanted to have a joint [cooperative], then they could only have one place where it was filled with oil or coal so they could put a big filter, something with a lower cost than individual expensive boilers.

Interested in the idea of a cooperative, approximate 300 civil actors, including households and small businesses held a general meeting and decided the foundation of Mastal DH cooperative that would minimize the severe pollution in the city and provide a cheaper heat supply for the citizens. Similarly, the Ebeltoft DH was founded in 1963, aiming at solving the same problems confronted by the Marstal DH. After about 60-years operation, the environmental and economic issues have remained their significances in motivating the performance of DH plants but being diverted to different implications. The current environmental problem is the considerable GHG emissions from the Danish energy sector, contributing to the phenomenon of climate change that poses severe consequences on the ecosystem. Meanwhile, the economic issue is the business resilience affected by the cost fluctuation of fossil fuel resources,

implying the company's fragile health and adverse effect on consumer's welfare regarding energy security. Table 3 illustrates the current value proposition of the DH plants.

Table 3: The DH value proposition

Problems	• **Business resilience** • **GHG emission issue** • **Energy security**
Mission	• **Supply reliable and affordable heat to local residents** • **Intensive use of renewable energy in supplying heat**
Products	• **Heat in form of hot water**
Customers/ Beneficiaries	• **Customers:** building owners including households, private businesses and state-owned institutions • **Beneficiaries:** ✓ All customers of the plants, benefiting from sustainable and low-cost heat supply ✓ Danish government, benefiting from the plants' contribution to green agenda

Fully acknowledging the problems and desiring to address them, the DH plants defined their mission which is the delivery of reliable heating supply to consumers through the extensive use of renewable energy technologies. Pertaining to these missions, the product that the decentralized DH plants offer the customer is affordable and clean heat from renewable energy sources.

Heat sourced mainly from solar thermal and biomass is supplied to customers for the hot water needs. The customers of both the Marstal and Ebeltoft DH are their local building owners, including households, private businesses and state-owned institutions.

In both cases of the Marstal and Ebeltoft DH, the direct beneficiary of the company's social missions is regarded as the customer who consumes heating supplied by the companies. Values are passed to the beneficiary in forms of low-cost and renewable heating. In addition, the Danish government is considered an extended beneficiary

since they benefit from the plants' contribution to the national green energy agenda through renewable energy exploitation.

4.1.1.2 Value constellation

Figure 2 shows an overview of the DH functions in delivering values to consumers and descriptive activities that key stakeholders perform at single stage along the value chain. In achieving the mission of supplying low-cost and clean heat to the consumer, the DH value chain presents four main segments: project development, heating generation, governance and operation, and consumption. The subsequent sections reveal how the functions are managed by key actors to achieve the DH's missions.

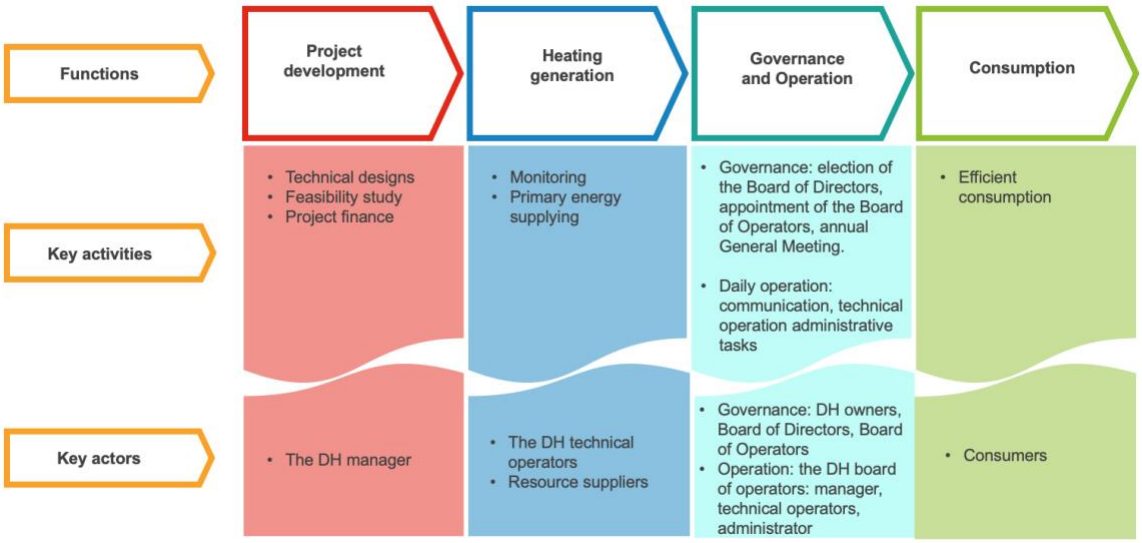


Figure 2: The DH's value constellation

a. Project development

The managers emphasized that this stage was crucial to attain the DH mission, as necessary expansion and improvement of plants or application of new renewable technologies would return in a new, cheaper source of energy or more efficient operation, thus ultimately lowering the heating price. The Marstal manager stated: "We're not doing any investment unless we see their possibilities of lowering the heating price." (L. Larsen, personal communication, 30th March, 2020).

The DH managers are in charge of preparing a comprehensive proposal relating to new development. The proposal must transfer the demonstration of key activities such as technical designs, feasibility study, and project finance.

On preparing technical designs, the managers need to consult national and regional frameworks and policies which guide the local heat plans. This performance ensures that the new technical designs comply with GHG emission limits, energy efficiency requirements, energy reduction goals, and share of renewable energy in DH sector (DEA, 2016) as well as be integrated with regional holistic development.

The managers also take responsibility for developing the feasibility study that presents the new project's socio-economic effectiveness. In supporting the decentralized DH, the Danish Energy Agency (DEA) provided a general socio-economic assessment on the heat supply possibilities based on forecasts for future energy prices, forecasts for future energy use, costs of emitting certain pollutants, subsidy scheme and tax exemption for certain types of fuel and other considerations (Chittum & Østergaard, 2014). Based on the reference, the DH plants create their own analysis, appropriately reflecting local contexts.

The preparation of project finance is also an important activity, considering a total investment, financial resources, and pay-back period. The cost-benefit assessment is performed in the most advance to mitigate the fluctuation of the heating prices offered to consumers. For example, it took five years in preparation for the Ebeltoft DH to construct new biomass boiler in 2014 replacing the old one that had been used since 1990, allowing the heating price to remain the same after the new investment (N. Bitsch, personal communication, 31st March, 2020).

After finishing the proposals, including necessary assessments, the manager presents them to the board of directors and citizens who are the co-owners of the DH in the annual general meeting to get the final decision.

b. Heat generation

The key actors involving in this process are the DH operators and energy-resource suppliers.

- DH operators

With the assistance of technological advances such as SRO computer monitoring system, the technical operators ensure the generation process be performed on a setup basis that presents an efficient and effective production.

- Energy resource suppliers

A strategic partnership with suppliers plays a vital role in sustaining heat generation and achieving the socio-economic viability for the DH.

The Marstal DH installed their solar plants to sustain 55 per cent heat production, while the rest of its energy supply relies on foreign biomass. A long-established partnership with biomass suppliers from Estonia and Latvia allows the plant to meet their demand for with the annual amount of approximately 6,500 tons of wood chips, contributing to 40 per cent of the heat production in 2018 (Marstal Fjernvarme, 2019). However, due to the long distance from the place of suppliers to the DH plant, the production costs relating this resource is expected to fluctuate wildly according to the shipping fees, which affects the stability of the heating price. This affection is encouraging the company to seek for other domestic suppliers or different technologies to guarantee the value proposition of delivering low-cost and green heat to consumers (Marstal Fjernvarme, 2017).

The Djursland biomass suppliers provide Ebeltoft with sustainability certified wood chips as the most economically viable and sustainable option for this DH. In 2019, the plant acquired, in total, 19,467.8 tonnes of wood chips with its 91.6 per cent coming from Djursland (NEPcon, 2019). The certified resource of biomass is legislatively defined by several parameters including reforestation and biodiversity, and protection of ecosystems and global carbon cycle, contributing to support efficient and environmentally sustainable use of biomass in the Danish energy supply. In addition, the stability of supply and biomass price from the regional area helps the company maintain the heating cost for more than ten years.

c. Governance and operation

- Governance

Governance mechanism of both DH cooperatives plays a critical role in defining the proper practices and activities to delivery values to customers. The ownership model of 100 per cent owned by consumers entails a democratic governance structure presented by the voting system of one vote per consumers (Ebeltoft Fjernvarme, 2014; Marstal Fjernvarme, 1999). This mechanism allows local residents to be actively involved in the decision-making process of the company, which, then, directly reflect their aspiration as the consumers. A general meeting is held annually to which all consumers are invited, providing the consumer with a room to assess DH performance and bring forward their proposals regarding company development. The consumers also obtain the right to cast their vote on the election of Board of Directors, including five people at each case, who act as the company's legal representatives. The board is authorized to execute general administration procedures and necessary acts for the deployment of the company's assets and raise loans on behalf of the company. In addition, the board is empowered to appoint the company's board of operators, who are in charge of managing the company's daily affairs.

- Operation

The achievement of DH mission also relies on the efficient and transparent management of the companies based on their regular performance, which would avoid unnecessary cost made up the heating prices. The board of operators at both the Marstal and Ebeltoft DH share the same structure and functions. Each team includes five people, including a manager, three technical operators and an administrative officer.

The manager manages the general performance of the facility and performs the outreach and communication activities with stakeholders. The technical operators carry out proactive plant monitoring, repairing and maintenance activities to ensure efficient utilization of plant, pipe networks and equipment. They also attend, diagnose

and repair faults having due regard to customer care. Another employee performs administrative works and manages digital platforms such as SMS and Facebook to inform consumers the latest news from the plant and vital energy efficiency advice. In addition, each company employs self-service applications available on mobile phones, letting consumers keep track of their heat consumptions, price descriptions, energy bills and annual financial reports on their user accounts. The annual financial report, in particular, provides crucial information about the company's financial management that is performed by a third-party audit to ensure reliability and transparency. The online services are such an economical and environmentally-friendly initiative to disseminate information to large proportion consumers. They also help the plant be more transparent towards consumers with the knowledge that the plants do no take advantage of through their monopolistic position.

d. Consumption

The heat in form of hot water is distributed directly for citizen's consumption through the pipeline networks. As the end-users, citizens contribute to the achievement of the DH mission by an energy efficiency consumption. For example, reducing the demand for high temperature water used allow the DH supply lower temperature in the grid, thus increasing efficiency of the network. The DH added this acknowledgment to consumers by sending energy efficiency advises to household via the user accounts.

e. Barriers to the DH management

The interviewees were asked to present challenges in managing the DH to achieve their mission. The two DH representatives expressed there were no major challenges in the operation. However, they should perform themselves in the most efficient and transparent management to deliver a reliable heating price to consumers. This due to the fact that, sometimes, consumers were concerned about the heat prices such as why they were higher than those in other areas or whether they were the best prices offered to citizens. Their concerns come from the acknowledgment of the DH monopolistic position in local heating sectors. Although the application of non-profit principle prevents the company from generating profits, the principle does not

guarantee consumer protection from inefficient management and operation, that would bear unnecessary additional costs. Those concerns are translated into the cooperative effort of the operator boards to perform more efficient and transparent management to ensure the price reliable. Through annual performance assessment survey, it was given that eighty-five percent of consumers at Marstal are satisfied with the DH performance (L. Larsen, personal communication, 30th March, 2020), while the proportion at Ebeltoft is ninety percent (N. Bitsch, personal communication, 31st March, 2020),

4.1.1.3 Social profit equation

In achieving the DH's mission, four capitals are created and leveraged including environmental, social, economic and political capital (see Figure 3)

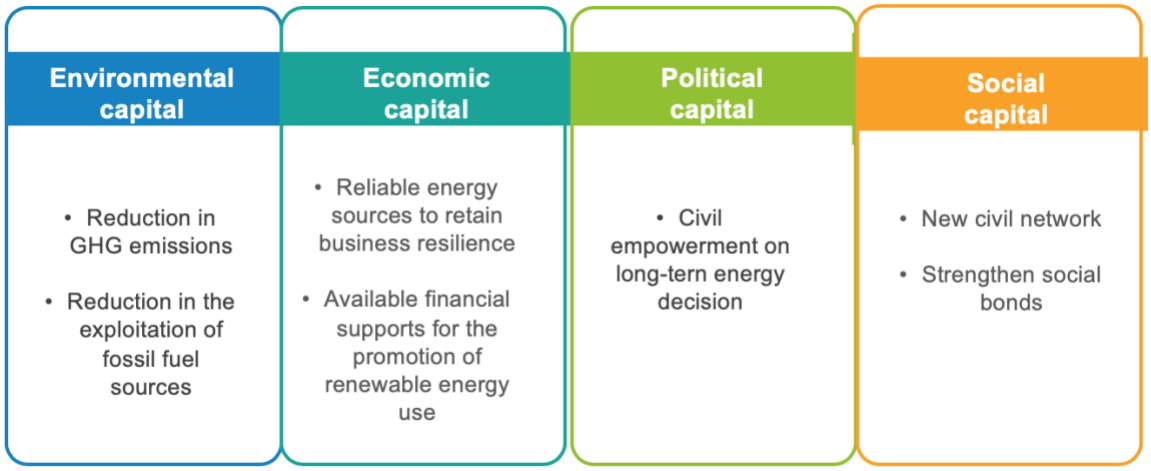


Figure 3: DH's value creation

a. Environmental capital

The DH's interviewees all agreed that the plants build and leverage environmental capital in their social mission by fostering the use of renewable resources.

Concerning when Marstal and Ebeltoft DH came into operation in the 1960s, their initial aims were about an establishment of a DH network that was more efficient than the household oil boilers in providing the necessary heat to all consumers at a reasonable price and minimizing air pollution. Efficiency and easy solution for each

resident were decisive for the project's progress, whereas the agenda paid little attention to other environmental concerns. Heat supply was still run on the oil-based consumption, delivering a poor performance in tackling GHG emissions. However, since the substitution with renewable energy sources from the 1990s and related renewable power-based energy innovation to supply heat, the two plants strongly leveraged environmental value. The green transition brought about a reduction of GHG emissions and a decrease in the exploitation of the fossil fuels by the alteration from oil supply to sustainability-certified biomass supply in the Ebeltoft case and solar and biomass supply in the Marstal case.

According to NEPcon (2019), Ebeltoft emits 20.2 kg CO2-equivalent per one megawatt-hour (MWh) of heat, which corresponds to a calculated reduction of 93 per cent to the EU's fossil fuel emission of 288 kg CO2 equivalent per one MWh of heat. The Ebeltoft's figure is even significantly better than the 2015 EU's 70 per cent GHG reduction recommendation in energy generation, which is, in number, equivalent to 86.4 kg CO2- equivalent per one MWh. In addition to the reduction of GHG emission by the use of biomass as heat supply, the particular use of wood chips from sustainability-certified forest contribute to other aspects of environmental value created by Ebeltoft such as preservation of the ecosystems and maintenance of the forest productivity (Dansk Energi, 2014).

Heat supplied by the Marstal DH comes from renewable energy sources, contributing yearly savings in GHG emissions approximately 1250 kg SO2, 1400 kg NOx and 1070 tons CO2 compared to its previous oil-based instalments (L. Larsen, personal communication, 30th March, 2020).

b. Economic capital

The decentralized DH system also captures economic capital while providing cheap and clean energy for citizens. The exploitation of renewable energy sources such as solar and biomass supports business resilience by addressing resource constraints associated with non-renewable resources. Indeed, with the consequences of the oil

crisis in 1973, the value proposition of delivering low-cost heat was seriously violated as the DH plants relied heavily on imported oil. The economic burdens of the soaring oil price bore mainly on the consumers who were owners of the plants. The switch to renewable energy sources and technologies were promised to keep the business in progress by discarding related fossil-fuel-resource constraints such as the price fluctuation and their limited supply. Furthermore, while renewable energy technology is getting cheaper (DEA, 2016), various national and EU financial support schemes have been available for renewable heating installations. These supports contribute to the mission attainment of the plants to offer a reasonable heat price to consumers. The two DH's managers proudly shared the plants' achievement in the interviews that they have retained the same heating tariff for the last ten years while ensuring the abundance of heat supply.

c. Political capital

The performance of decentralized DH leverages the political capital by stimulating a social movement toward energy democracy (Stephens, 2019). The local communities are empowered to make their long-term decisions about their decentralized energy system relating to heat. They decided the dominated use of renewable energy technologies in the local energy provision and claimed locally controlled energy system that was managed by consumers, resulting in more power distribution to people.

d. Social capital

Social capital is strongly leveraged in the DH cases since the local community network, including all households and building owners, was organized to establish DH, resulting in a new societal relationship. The residents are the owners and direct beneficiaries of the plants' mission, so they are motivated to be more engaging in the plant's activities to devise optimal solutions to the local issues, thus increasing the social bonds among citizens.

4.1.1.3 Economic profit equation

a. Financial resources

District heating plants, in general, require a substantial upfront investment on tangible assets such as buildings, lands, pipe networks, pumps and thermal systems. The finance came mostly from bank loans or public leasing funds, while some sorts of subsidy or grant also contribute to cover the investment into the plants.

Since their establishment, the Marstal DH has received some government grants to finance a small part of the investments, while the rest of financing has come from the bank loans guaranteed by the Marstal municipality. Their first 8,000 m2 solar heating plant completed in 1996 consisted of 640 solar panels with a size of 12.5 m2 each, which were lined up in 32 rows at a 20,000 m2 land area (Marstal, 2000). The plant cost in total EUR 2.8 million of which EUR 697,597 was granted by the DEA as a financial incentive for the citizen-owned renewable energy project, while the remaining amount was borrowed from the local bank with a municipal guarantee. The solar plant continued to be upgraded and expanded in 1999, 2003 and 2010 to become one of the largest solar installations worldwide with 33,000 m2 of solar panels. The investment on the latest extension together with the inclusion of new 75,000 m3 pit heat storage, a 4MW wood chip boiler, a 1.5 MW electrical heat pump, and 750KW Organic Rankine Cycle turbine started in 2010 was EUR 15.1 million of which EUR 6.1 million was financed from the FP7 program, whereas the rest came from bank loans (Baerbel, 2014).

At the Ebeltoft DH, their latest more efficient 12 MW wood chip plant which cost EUR 6.3 million was constructed in 2013 to replace the old 10 MW boiler which had been in operation since 1990. The plan for construction of the new 12 MW boiler and the extension of the facilities had been prepared for the five years in advance with the financial resources from bank loans and loans of the Danish municipal fund (Kommunekredit) with a municipal guarantee provided by the municipality of Ebeltoft (N. Bitsch, personal communication, 31st March, 2020).

b. Cost - Revenue structures

The revenue stream of the plants come mostly from the direct heat sales for consumers, while other small proportion incomes are likely to be generated from facility rental, subsidy sources, and other extra operating services. Table 4 and 5 show the revenue structure of the Marstal in 2018 and Ebeltof in 2019, respectively.

Table 4: The Marstal DH's revenue streams in 2018 (Derived from (Deloitte, 2018))

Heat sales (34,809 MWh)		23,182,703
Other incomes	Insurance claims	778,143
	Received operating loss insurance	318,461
	Fees	19,700
	Other operating income	264,433
	Rental	44,352
	Reberbanen 68 (operation)	24,000
Total		***24,631,792***

Table 5: The Ebeltoft DH's revenue streams in 2019 (Derived from (Kovsted & Skovgard, 2019))

Heat sales (47,090 MWh)		23,275,041
Other incomes	Reminder charges	21,600
	Rental	53,311
	Scrap sales	13,933
	Other operating income	7,900
Total		***23,371,785***

The revenue from heat sales is generated through the payment of consumers following the heating tariffs. The DH takes an active role in developing the heating tariff design. The design consists of two parts: fixed charges including subscription fee and capacity payment, and variable charges referring to consumption expense (see Table 6). The subscription fee is applicable for all buildings connected to the DH in both cases, while the capacity payment uses the floor area of the building as a proxy. Heat consumption payment relies on the volume of DH water flowing through the building yearly, varying with consumer's heating demand.

Table 6: The heating tariff designs applied at the Marstal and Ebeltolf DH (Derived from (Ebeltolf Fjernvarme, 2020; Martal Fjernvarme, 2020)

Heating tariff	Marstal		Elbtoft
Subscription	DKK 500		DKK 1,187.5
Capacity	the first 40 m2	DKK 80/m2	DKK 19.38/m2 regardless floor areas
	the next 40 - 80 m2	DKK 15/m2	
	the next 80 - 160 m2	DKK 8/m2	
	the rest area	DKK 5/m2	
Consumption	DKK 0.8/KWh		DKK 0.386/KWh

Despite the differences in their absolute value of heating tariffs, the calculation mechanism of heat prices must comply with the non-profit principle as required by the Danish government. In detail, the heat prices must be charged just enough to cover all necessary expenditures related to supply heating to the consumers. Costs of heat, therefore include fixed costs (DH production infrastructures, heating networks, other tangible asset investments) and variable costs (production, operation, maintenance and administration expenses, fuel taxes and prices). However, it is significant to emphasize that the cost structure also includes depreciation of assets and financing costs, so that the DH companies can be financially sustainable in the short and long term (DEA, 2016). This is due to the fact that the consumers, who are also the plant's shareholders, are responsible for paying off the loans whose interests are accounted for in financing costs.

To offer low-price heat, the two managers emphasized the importance of variable cost reduction particularly regarding the operating performance of DH and efficient consumption behavior of consumers which would affect the degree of heat loss in the DH network. Also, the cost of heating is affected by financial incentives such as CO2 tax exemption on fossil-free energy production.

c. Distribution of profit

The manager emphasized that DH companies were not permitted to make a profit (L. Larsen, personal communication, 30th March, 2020). Any surpluses made up by the

affection of cost parameters can only be used for financing future installations or for adjustment in future heating tariffs. Meanwhile, if deficits arise, they are recognized in an increase in the future tariff design.

4.1.1.5 Conclusion

To a large extent, the components of the social business model are conceptualized in the decentralized DH plants (See Table 7). It is shown by the presence of non-profit driven and large-scale benefit the DH plants provide to the community in the form of low-cost and green heat. The DH consumers who are also the owners of the plants reserve the right in the decision-making process. The DH performance leverage three out of four potential capital a social business can capture, including political, social and economic capital, and create environmental value. Finally, the DH plants rely on income from the heating sale to be self-financially sustain.

Table 7: Summary of the DH cases compatibility to social business characteristics

No.	Components of social business model	Sub-components	Acknowledged characteristics of social business	Compatibility of DH to social business feature
1	Value proposition	Social problems	• Delivery of non-profit driven and large-scale benefit through the provision of product or service • Target audience encompasses either a significant segment of society or to society at large.	• Yes (green and affordable heat)
		Missions		
		Target audiences		• Yes (the whole community)
		Product/service		
2	Value constellation	Key activities	• Democratic governance mechanism	• Yes (consumers retain an active role in decision-making process)
		Key stakeholders		
3	Social profit equation	Political capital	• Building or leveraging one or more capitals	• Political capital • Social capital • Economic capital • Environmental capital
		Human capital		
		Social capital		
		Economic capital		
4	Economic profit equation	Revenue stream	• Market-based approach to retain self-sustainability	• Yes (market-based energy revenue)
		Cost structure		

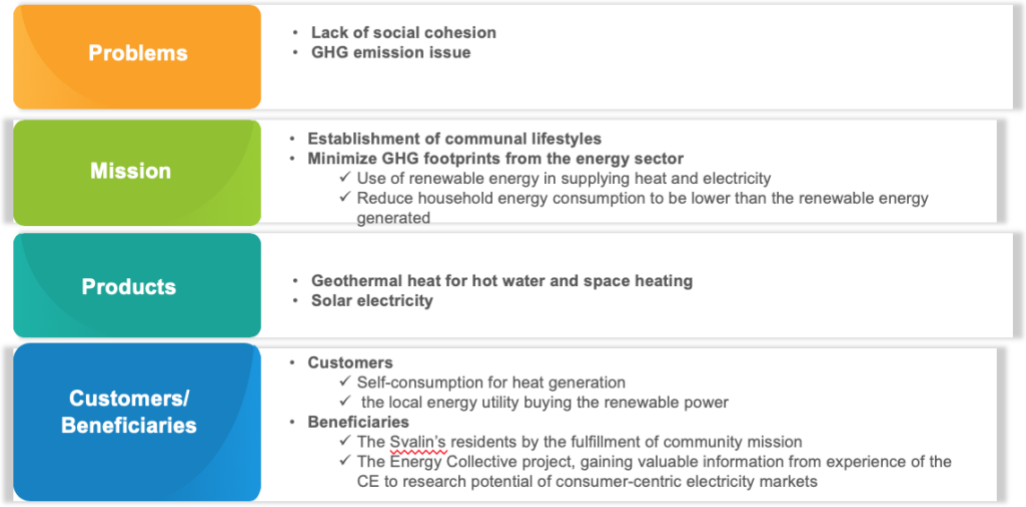
		Distribution of profit	and mission achievement.	

4.1.2 Svalin co-housing complex

4.1.2.1 Value proposition

Table 8 presents the value proposition elements of the Svalin community. The social problems behind the foundation of the Svalin community were the lack of social cohesion referring to the sense of being less connected among residents and poorly collective performance on carbon reduction from energy generation (P. Réthoré, personal communication, 6th March, 2020). With that in mind, the Savlin community gathered to experience a communal life and engage in a sustainability lifestyle in attempts to minimize GHG footprints from the energy sector. The aspiration is achieved by the use of renewable energy sources to sustain the resident's energy demand on heating and electricity and by reducing their energy consumption to be lower than renewable energy generated.

Table 8: The Svalin's value proposition



For heat supply, the community are the consumers themselves, consuming heat from their geothermal heat pump setups. In addition to heat production, the Svalin community installed solar cells generating green electricity. As it is forbidden by the Danish regulation, a household could not directly use the electricity generated from

its solar cells. As a result, the power generated from the Svalin households is fed into the regional power grid and sold to a local energy utility, while the Svalin residents consume power from the wholesale market. With this performance and due to the fact that the power consumed is much less than the renewable power produced, the community claimed that their electricity was sustained from the clean energy account (P. Réthoré, personal communication, 6th March, 2020).

The residents of Svalin, who have decided on the way they live, are the beneficiary of sustainability values brought by their renewable energy initiatives. Furthermore, by observing and evaluating the Svalin's experience in community energy, the Energy Collective project of Danish Technology University is also a beneficiary. The community's experiences and reflections on the CE performance serve as valuable resources for the project to explore the potential of consumer-centric electricity markets.

4.1.2.2 Value constellation

The value constellation of the Svalin is rather simple compared to the other investigated CE. The gathering of the residents for renewable energy generation and consumption is not bound to any regulative form or contractual relationship but a communal interest in reducing carbon footprints in the household energy sector. Figure 4 presents the main activities along the Svalin's value chain and their corresponding activities and performers.

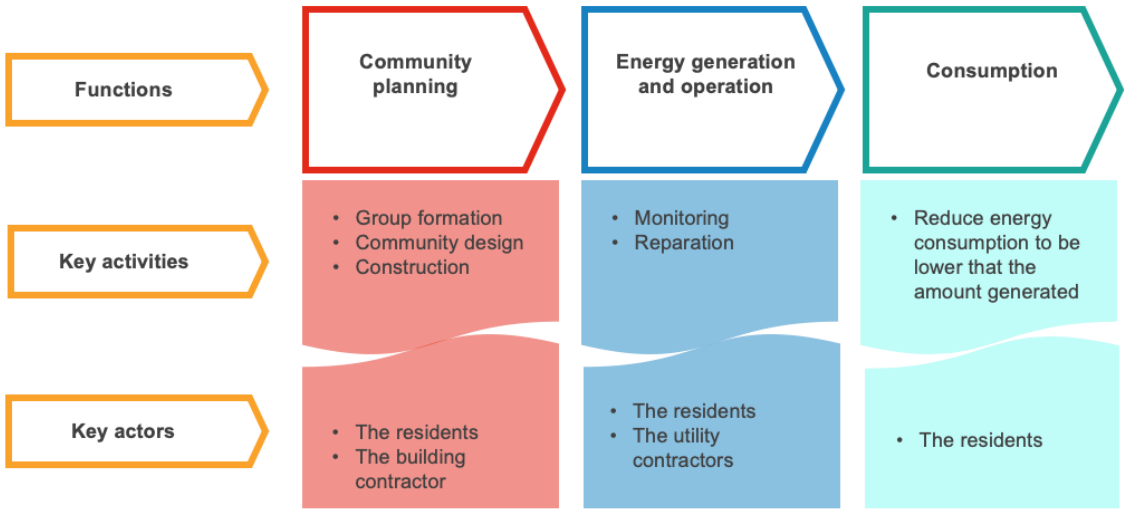


Figure 4: The Svalin's value constellation

a. Community planning

This stage translated the imagination of a green community into architecture demonstration. The first step the community formulation was to group people who share common sustainability values and similar financial conditions to adapt in the community designs. The two key actors in this stage are the resident and housing contractors. The residents decided to formulate a renewable energy community, the housing contractors designed and constructed the houses and infrastructure in accommodation with solar energy technologies and geothermic heat pumps. The wooden houses were erected to meet the requirements for energy efficiency and used environmentally building materials. The household parking lot was designed to serve electric vehicles. The climate-friendly designs actively facilitate the green lifestyle of the residents, contributing to their attainment of environmental mission.

b. Energy generation and operation

The capacity of renewable energy varies greatly with weather conditions; however, the effective operation also affects its generation performance. The solar PVs and heat pump are automatically operated, the households observe their performances with

the assistance of the monitoring application, and notify utility contractors if they are in malfunction and need of reparation.

c. Consumption

In achieving the mission, the community manages itself to retain the amount of energy consumption less than the amount of energy generation from its renewable energy facilities. Depending on certain individual situations, households have their initiatives to save energy. For example, the interviewee's family installed energy-efficient appliances, reducing the temperature of heat demand, and decided to use their electric car for urgent and essential needs while cycling is the priority choice. In the weekly meetings, the possible initiatives are brought forward, so that residents learn from each other and improve their sustainability performance.

d. Barriers to green performance

The interviewee affirmed that the community achieved its goal of reducing carbon footprint from energy behaviors with their current renewable energy setups and attempt to reduce energy consumption (P. Réthoré, personal communication, 6th March, 2020). They did not encounter any specific challenges. However, he admitted they could do even better if it were possible for them to directly use the power generated from their rooftop solar cells: *"It is more efficient to use the on-site energy than the power transmitted within a grid so that we can save the amount of energy loss. Furthermore, acknowledging the real-time energy supply, the residents are more aware of saving energy".* Despite being fully equipped with renewable energy infrastructure, this performance is out of the community decision, since it is restricted by Danish law. Therefore, the main issue of the Svalin is more about regulative resistance.

4.1.2.3 Social profit equation

Three capitals are created through the Svalin community's performance, including environmental, social and political values. (See Figure 5)

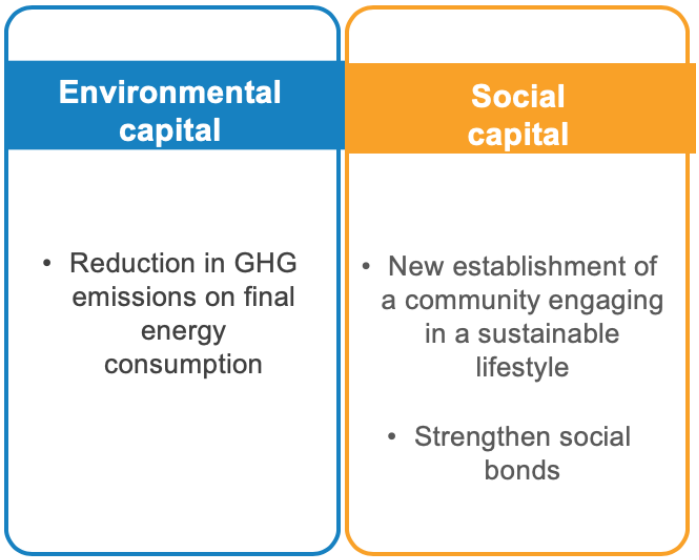


Figure 5: The Svalin value creation

a. Environment capital

Svalin's solar cells generate green electricity, which emits approximately 60g CO2 per kilowatt-hour (kWh) on a sunny day, while average CO2 emissions on the Danish power system is 157g per kWh (DEA, 2017). As a result, the community contributes to a reduction of 61.79 per cent CO2 per kWh by their green electricity generation.

b. Social capital

By sharing the same ideas of living a greener life, the community of Svalin attracted people who engage in the same lifestyle, thus strengthening the social bonds and community engagement, also raising awareness of children to sustainability issues (P. Réthoré, personal communication, 6th March, 2020).

We experience joy in this community by knowing each other. I value the sense of community and sustainability and believe they are great values to pass on to our children and I hope it can inspire them to socialize.

4.1.2.4 Economic profit equation

a. Financial resources

The Svalin households self-financed their solar cell components, metering and other equipment, heat pump infrastructure and networks. The solar cells and related

facilities are the individual household's assets, so the households paid for the facilities. However, the residents shared finances on collective energy generation facilities such as the geothermal heat pump networks and solar cells set up at the common house.

b. Revenue and cost structure

As the community produces more energy than the amount they consume on a yearly basis, the revenue stream comes from the extra amount of solar power generated. Within the current government's Feed-in-premium (Couture et al., 2010), they get paid for EUR 8 cents per kWh.

Costs regarding energy generation include maintenance and possible reparation expenses.

c. Distribution of profit

Since the income from energy generation is passed in the form of lower annual electricity and heating bills, while the maintenance costs are paid annually, no net profit is generated annually in the case of the Svalin community.

d. The financial viability of the CE

Even though the community can save energy consumption bills with the setups of renewable energy production, these savings could not make up for the significant upfront investment and expenses on maintenance and reparation within the current subsidy scheme (P. Réthoré, personal communication, 6th March, 2020). However, the CE is still a self-sustained project since all expenditures are self-financed by the residents.

4.1.2.5 Conclusion

Social business conceptualization is weakly verified in the case study of Svalin community (See Table 9). Its performance of renewable energy generation delivers social and environmental benefit. However, the scope of benefit distribution is limited

within the community. The values are narrowly granted to residents who engaged in the formulation of the community and acted on sustainability performance. Although the renewable electricity generated is sold in the energy market like other cases, this performance does not entail a market-based approach to achieve their social objectives. The renewable energy generation performance is a mean to pursue their green lifestyle. The community was developed to gather people who share the same lifestyle and can perform sustainable practice at a communal level other than acting as a business-like organization.

Table 9: Summary of compatibility of the Svalin project to social business characteristics

No.	Components of social business model	Sub-components	Acknowledged features of social business	Compatibility of Svalin to social business feature
1	Value proposition	Social problems Missions Target audiences Product/service	• Delivery of non-profit driven and large-scale benefit through the provision of product or service • Target audience encompasses either a significant segment of society or to society at large.	• Yes (climate-friendly energy use, social cohesion) • No (limited to community members)
2	Value constellation	Key activities Key stakeholders	• Democratic governance mechanism	• No (no presence of community governance relating to energy generation)
3	Social profit equation	Political capital Human capital Social capital Economic capital	• Building or leveraging one or more capitals	• Social capital • Environmental capital
4	Economic profit equation	Revenue stream Cost structure Distribution of profit	• Market-based approach to retain self-sustainability and mission achievement.	• No (self-finance)

4.1.3 The Hvide Sande wind turbine project

4.1.3.1 Value proposition

Identical to the other cases, the primary problem the project managed to solve was the GHG emission issues in the energy industry. However, another arising problem embedded in the Hvide Sande community before the establishment of the project was the strong local objection to wind turbine projects which showed a poor connection to regional development. Table 10 reveals the value proposition of the project.

Table 10: The value proposition of the Hvide Sande project

Problems	• GHG emission issue • Local opposition to onshore wind turbines
Mission	• Reduction on GHG emissions • Facilitation of local economic stability and local development
Products	• Electricity
Customers/ Beneficiaries	• Customers: the energy utility and local district heating plant • Beneficiaries: ✓ Local business and residents ✓ Danish government, benefiting from the project' contribution to renewable energy agenda

In an attempt to solve the social problems, the Hvide Sande wind-turbine project was designed and developed to perform its social missions by contributing to the national effort of GHG emission reduction in the energy industry with a target of 50% Danish electricity production coming from wind turbines in 2020 and facilitating local economic stability and local development (Gorroño et al., 2015).

The local electricity utility has been the major customer of the project, buying a yearly production of 16 GWh per turbine. Since 2017, the overproduction of electricity from

the three wind turbines has been sold to the Hvide Sande district heating company for the production of heat.

With these performances, the Danish government is the first beneficiary of the project's mission in getting closer to the national target of the renewable energy proportion in the energy sector. Meanwhile, local businesses and residents of Hivde Sande become the second beneficiary of the project, benefiting from social values such as economic and local development schemes sponsored from the project's excess profits. For example, the Hvide Sande harbor as a beneficiary got some financial support for the expansion harbor project. While a lively harbor is also a good attraction for tourists, beneficiaries are extended to the local tourism industry.

4.1.3.2 Value constellation

The value constellation of the Hvide Sande project includes three main segments: project planning, wind turbine construction and generation, and fund management. Figure 6 shows an overview of the value chain and key elements.

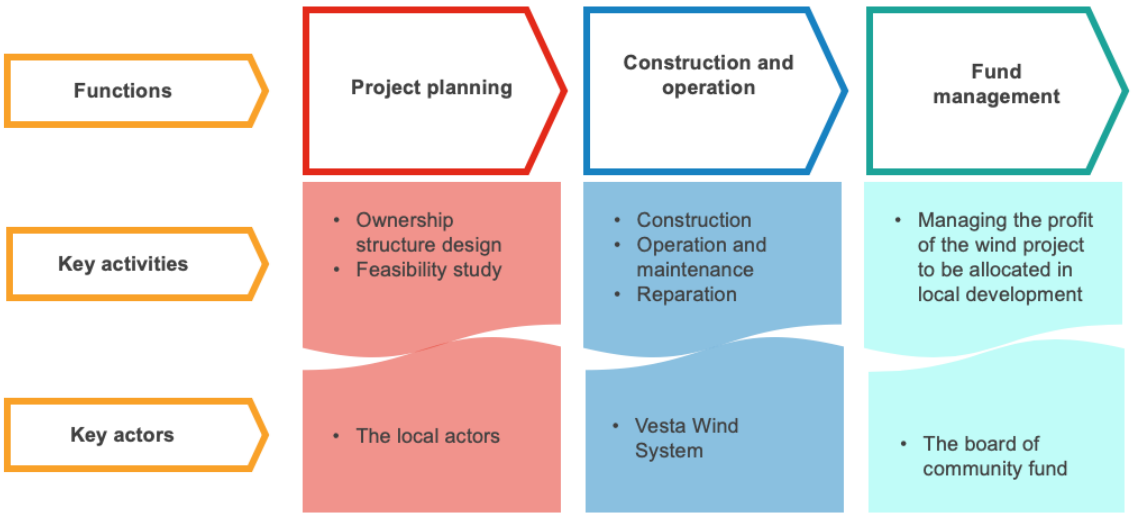


Figure 6: The Hvide Sande wind project's value constellation

a. Project planning

The project planning was processed to present support for the socio-economic development of the region, which was the key factor to the acceptance of residents for the emergence of an onshore wind turbine projects. The main activities in this process are the design of project ownership structure and feasibility study.

The community foundation was founded by the local Federation of labor unions, the local Confederation of Danish Industry, the local utilities and the tourist association to possess 80 per cent ownership of the project, while the rest of 20 per cent had to be owned by residents, as required by law. According to Danish regulation, the foundation's founders themselves cannot benefit economically from the outcome of the project so that the project's excess profit was allocated to local purposes (Bak, 2013). This design of the ownership structure guarantees the benefits of the project being passed on the local development purpose.

Analysis of social, environment and economic impact on regional development was prepared by external consultants to assess two possibilities of wind turbine infrastructures (PlanEnergi Midtjylland, 2010). The first proposal was the installation of four 3 MW wind turbines whose towers and wings get a total height of 125 meters combined with a rotor diameter of 90 meters. The second possibility presented the design of three 3MW wind turbines whose tower and wing get a total height of 140 meters combined with a rotor diameter 112 meters. The final decision went to the second proposal as the analysis showed a preference for its construction settings and economic viability.

b. Construction and operation

This stage was outsourced Vesta Wind System as the main contractor of the project. They are responsible for all construction activities and technical functions to ensure power being stably generated and fed into the electricity grid. They monitor the operation as well as provide maintenance and reparation of the wind turbines.

c. Fund management

A board of managers who presented economic and professional qualifications was democratically elected by relevant parties to manage the profit generated from the

wind project in effectively supporting local development. They decided that the profit was preferentially distributed to the activities of harbor and tourism development as they act as the economic skeleton of the region. The profit was, then, further used for energy renovation of local public buildings, local public e-mobility and other new business initiatives for the benefit of the harbor, tourism and the local municipality.

4.1.3.3 Social profit equation

In attaining of its social missions including local development, maintenance of local economic stability and growth of wind energy proportion in electricity generation, the Hvide Sande wind project also creates other values such as environmental and social capitals. (Figure 7)

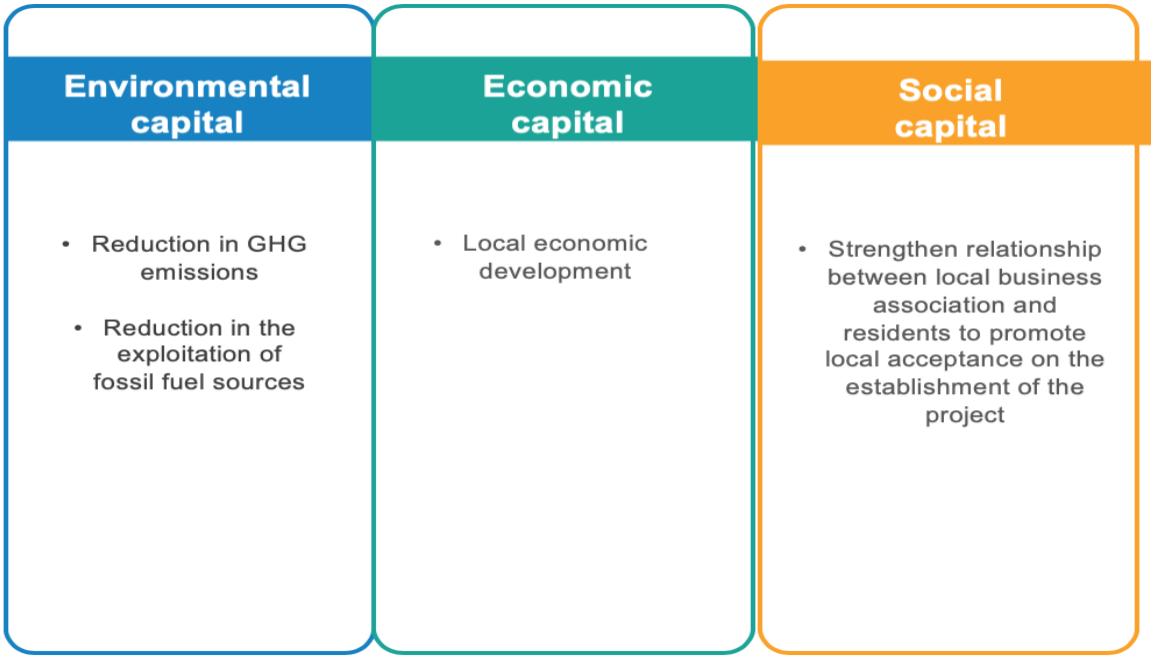


Figure 7: The Hvide Sande value creation

a. Environmental capital

The installation of three wind turbines on the beach at Hvide Sande harbor contribute to the limitation of fossil fuels' exploitation for energy generation activities, thus reducing GHG emissions and air pollutants. As estimated in the Environmental Impact Assessment report (PlanEnergi Midtjylland, 2010), the project reduced the emission of 26,100 tons of CO2 per year compared to the 2010 annual average CO2 emission

of Danish electricity generation. Meanwhile, the emission of sulfur dioxide and nitrogen oxides are diminished approximately 5 tons and 50 tons per year respectively in comparison with their annual average emissions of Danish electricity generation. In addition, the partnership with the Hvide Sande DH to provide overproduction electricity for heat production secures the DH supply with less dependency on the use of fossil fuels and reduce CO2 emissions by as much as 74 per cent from 7,400 tons to 1,900 tons per year with equivalent heat production capacity compared to the previous performance with more fossil-fuel heat generation (Osmundsen, 2019).

b. Economic capital

The economic values created by the wind project were passed on the local business actors. The annual ground lease for the wind turbines on the land owned by the harbor generates an income of EUR 0.64 million per year over 30 years of the harbor's lifetime (Willis et al., 2016). This additional stable income has allowed the harbor to obtain a large number of bank loans in a total of EUR 19.5 million for investments on further expansion. The development has allowed the harbor to accommodate a higher number of ships and provide diversification possibilities for the transport of goods and preserve landscapes which open opportunities for tourism development in Hvide Sande.

c. Social capital

Strong relationship and partnership have been established among local business associations and residents since the planning progress of the wind projects by agreement on societal benefits delivered by the project. It stimulated local acceptance which plays a significant role in the implementation of the project. Indeed, for several years, private project developers had been working to erect wind turbines in this area, but no success due to the local protest on the poor societal connection with the region.

Job creation is another social value brought by the project. It was estimated that the project could create 70 new jobs for its wind turbines construction and operation and the activities relating to harbor expansion and improvement financed by the profit generated from the project. (Gorroño et al., 2015).

4.1.3.4 Economic profit equation

a. Financial resource

The investment in the three wind turbines was EUR 12.209 million, corresponding to 39,514 shares (Hvide Sande Nordhavn Møllelaug, 2011). The community foundation owned 31,633 shares, representing 80 per cent ownership of the project. The two local banks – Vestjysk Bank (50%) and Ringkjøbing Landbobank (50%) granted the loans to cover 100 per cent of the investment related to the 80 per cent owned by the community foundation with the wind turbines as collateral. Meanwhile, the rest of 20 per cent was financed in the form of equity by Hvide Sande Nordhavn Møllelaug cooperative owned by more than 400 local residents.

b. Cost-Revenue structure

The project's cost structure consists of capital and variable costs, in which the former made up a significant proportion of the investment. The capital costs include wind turbine infrastructures, road construction, grid connection, land rental and insurance which are as much as 80% of the total cost of the project over its entire lifetime of 20 years (Hvide Sande Nordhavn Møllelaug, 2011). The variable costs bear most heavily on operation and maintenance of wind turbines, but also including other categories such as taxes or management and administration. The variable costs are relatively low and oscillate around a level of 20% of the total investment.

The turbines have come into operation since January 2012 with the yearly production of 16 GWh per turbine. The project has sold wind power into the national grid, while its revenue was affected by a power pricing mechanism and governmental financial support for renewable energy production. The power sales revenue was settled with an average annual electricity price of EUR 32.8 per MWh in the period of 2012-2015

(Gorroño et al., 2015), but has experienced a gradual decrease since 2016 due to the drop of market power price. A guaranteed bonus within the government's subsidy scheme contributed to the project's revenue an amount of EUR 80 cent per MWH for the first 22,000 full-load hours, which was equivalent to the first five years of power production.

c. Distribution of profits

The local shareholders receive 20 per cent of the profits as dividends pertaining to their accordingly shares of the project. Meanwhile, 80 per cent of the profit goes into the community foundation to repay the bank loans. Any excess profits following those repayments were, then, invested in the local area on collective projects. For example, in 2015, the amount excess profit of EUR 29,809 was allocated to the Hvide Sande service group, which was founded by more than 40 local businesses and associations for the facilitation of local business development initiatives (EY, 2016). However, since 2016 with the expiration of subsidy scheme and the drop in the electricity price resulting in unforeseen lost revenue, the community has not been in the position of supporting local development activities as no excess profit has been granted (EY, 2017, 2018, 2019, 2020).

This acknowledgement implies the risks to the financial viability of the project, which influences the achievement of the project in the social mission. Despite the estimation on the economic contribution to local development at the project planning stage, the actual outcomes could be very distinctive since the project's revenue have fluctuated with electricity market prices and activation of subsidy schemes.

4.1.3.5 Conclusion

To a large extent, the components of the social business model are conceptualized in the Hvide Sande wind turbine project despite the differences in operational mechanism with the DH cases (See Table 11). The Hvide Sande project aims to support local economic development and reduction of GHG emission with their performance of renewable electricity generation. The market-based revenue helped

them to retain the projects and follow social mission. The management board of the project include representatives of local unions so that the decision was made in the reflection of public benefit. In achieving the social missions, the project leverages four capital including environmental, human, social and economic capital.

Table 11: Summary of the compatibility of the Hvide Sande project to social business characteristics

No.	Components of social business model	Sub-components	Acknowledged characteristics of social business	Compatibility of Hvide Sande to social business feature
1	Value proposition	Social problems Missions Target audiences Product/service	• Delivery of non-profit driven and large-scale benefit through the provision of product or service • Target audience encompasses either a significant segment of society or to society at large.	• Yes (local economic development, reduction of GHG emission) • Yes (the Hvide Sande community as the social target group)
2	Value constellation	Key activities Key stakeholders	• Democratic governance mechanism	• Yes (Board of managers are representatives of local union)
3	Social profit equation	Political capital Human capital Social capital Economic capital	• Building or leveraging one or more capitals	• Human capital • Social capital • Economic capital • Environmental capital
4	Economic profit equation	Revenue stream Cost structure Distribution of profit	• Market-based approach to retain self-sustainability and mission achievement.	• Yes (market-based energy revenue)

4.2 Cross case study analysis

In the previous section, the data collected from the case studies were analyzed pertaining to the business model components. The result of within case study analysis shows that the characteristics of a social business model are well presented in the case study of DH plants and Hvide Sande project but poorly in the case of the Svalin community. This difference among cases happens, although all cases engage in the provision of renewable energy at a communal level to pursue social-ecological objectives and enter the energy market as a renewable energy supplier. This section presents the cross-case study analysis with an in-depth investigation of similarities and differences across cases to support empirical generalizability of the social business model conceptualization within the context of CE. The comparison of commonalities and differences among cases are drawn along the four components of a social business model.

4.2.1 Value proposition

The first sub-research question aims to determine the value proposition of the CE, which then is beneficial to explore the extent to which the value proposition of social business is conceptualized within the context of CE. The investigation on the value proposition of the CE cases reveals a high degree to which the value proposition of social business is conceptualized within the context of CE. Similar to value proposition of the social business, those of case studies are built to delivery non-profit driven and large-scale benefit to a significant segment of society or society at large through the provision of renewable energy. To be specific, the concrete mission that all cases aim to follow is the reduction of GHG emissions in the energy sector. Based on social issues embedded in their context, the case study designed their value proposition which engages in the supply of locally-produced renewable energy to achieve different non-profit led missions such as energy reliability and affordability, social cohesion, or local economic development. The intended beneficiaries of the CE cases encompass the whole geographical community in which the projects are

operating, which implies that specific segments of society benefit from the CE projects.

However, the relationship between the intended beneficiary and the project varies among the cases. The case of the DH cases and the Svalin community target their members as the direct beneficiaries of the social missions, while the Hvide Sande wind project acts exclusively in the benefit of the public audience. This difference implies the divergent in the scope in which the distribution of benefit offered by the CE project is oriented. The Svalin case shows a strong degree to which it is oriented toward mutual benefit as their target audience is limited to members who founded the community. By performing renewable energy generation and other sustainability activities alongside each other, the members satisfy their mutual need of pursuing a green lifestyle at a communal level. Similarly, the DH plants illustrate a case showing a strong orientation toward mutual benefit. Their intended beneficiary is the consumer-members. The projects deliver mutual benefit by offering consumers a cost-effective and climate-friendly solution for their heating demand. However, since any citizens who involve in the client membership of the DH plants will become their intended beneficiaries, the DH scope of benefit distribution is more open toward the public than ones of the Svalin case. Meanwhile, the Hvide Sande case shows a strong orientation toward public benefit by engaging with regional development. The intended beneficiaries are the local business and residents who earn social or economic benefits sponsored from the excess market-based profit of the project.

4.2.2 Value constellation

The second question looks for the answer to the way CE projects manage to deliver values to target beneficiaries. The within-case analysis not only provides the comprehensive descriptions of value constellation but also indicate similarities and differences among the management structure of the cases which are critical to assess the degree to which the social business model is conceptualized in CE context. The presence of organizational management with a democratic governance mechanism in

CE cases plays as the vital determent for a high degree of social business conceptualization.

In the case of DH plants and the Hvide Sande, they share the same logic of operating project with the formulation of structured organizational management to achieve their social mission. The DH board of operators are appointed to keep the focus on operational activities, including administration and production management. The Hvide Sande board of directors focus more on the fund management functions to effectively distribute profits to local business development activities, while the operation of wind turbines is outsourced to the professional contractors. Efficient and transparent management of the boards directly contributes to the mission completion of the projects with the avoidance of unnecessary costs for heat production (in the DH cases) and proper distribution of profits to local business development activities. Furthermore, both of the cases display a democratic governance structure in their value constellation with a strong engagement of the local community. The DH governance structure exhibits the democratic decision-making process with the full involvement of local consumers who pertain one vote per actor. The democratic trait is also presented in the Hvide Sande project in that no individual holds the absolute authority. The board of managers that was democratically elected by representatives of local unions are responsible for decision making. The strong involvement of local actors in the decision-making process assists the project in detecting local issues and generate locally acceptable solutions to address them. This crucial characteristic of the social business model is revealed in the case studies, showing a large extent to which value constellation component of the social business model is conceptualized.

On the other hand, the Svalin community disguise a performance of organizational management to achieve their missions. The community was established by people who shared the same aspiration of pursuing a green lifestyle and wished to perform sustainable practices side by side. The community architecture was designed in a structured format to satisfy the interest of members in sustainability performance.

However, from the management side, the household individually manages itself to fulfil the goal of consuming 100 per cent of renewable energy generated from their energy infrastructure. The completion of the mission bears on individual effort to green energy consumption rather than mutual cooperation that might require organizational management. As a result, to a low extent, the characteristic of the social business model is verified in the value constellation of the Svalin case.

4.2.3 Social profit equation

The social profit equation reveals value creations in achieving the social missions of an organization. As mentioned in the literature review section, four values are potential to be created and leveraged by the performance of the social business, including social, human, economic and political capital. All case studies show the leverage of social capital through the formulation of new social linkages which represent the engagement of civil actors in the renewable energy system. The emergence of this relationship thereby strengthens social bonds and enhance the empowerment of civil actors regarding energy decision. Other potential capitals to a different extent are also built by the cases depending on their contextual missions. In addition to four potential capital indicated in social business conceptualization, the CE cases contribute to leverage environmental capital. With renewable energy solutions, the CE leverages environmental values through the reduction of GHG emission and the limitation of fossil fuel energy use. In general, as the conceptualization of social business, the CE projects bring in social value creation that is beneficial to society and the environment.

4.2.4 Economic profit equation

The investigation on the financial structure of given case studies delivers the understanding of how the CE can be financially sustained to achieve their social missions. Although all CE projects engage in energy market transaction, not all of them adopt the market-based approach to retain self-sustainability and mission

achievement. The adoption of the market-based solution to the implementation and development of an organization is the crucial characteristic of the social business operationalization. This characteristic is well presented in the financial mechanism of the DH and Hvide Sande cases, but it is poorly illustrated in the case of Svalin community. The sufficient income from energy sales helps DH projects fulfil financial duties to the banks and recover the necessary costs of energy production and distribution. Similarly, the Hvide Sande project also uses revenue from electricity sales to cover costs and to perform their mission of supporting local development. Meanwhile, the Svalin community does not combine a commercial activity with the pursuit of social and environmental objectives. They fulfil their missions through self-investment on their energy facilities and related operation and maintenance activities. The income from extra energy generated is passed in the form of a lower energy bill, which does not entail a significant influence on the financial sustainability of the community.

The market-based characteristic is crucial to assess the conceptualization of social business in the CE cases. However, the other characteristics that exert an effect on the economic viability performance of both the DH plants and the Hvide Sande project are also worth mentioning.

First, bank loans or municipality loans are their primary sources of project financing for wind turbines and DH systems, and thereby the CE projects were able to cover the considerable upfront investment on infrastructures while paying back the loans in the long run. The municipalities play an essential role in facilitating the process of obtaining bank loans for CE projects by giving municipal guarantees to the loans.

Second, financial incentives offered by the Danish government significantly facilitate the economic viability of CE projects. The grants for DH development and CO2 tax exemption on fossil-free energy production plants support a reduction of production cost. Meanwhile, the guaranteed bonus for the renewable power sales within the government's subsidy scheme contributes to the reduction of Hvide Sande

project's financial burdens, so that more revenue could be generated and then distributed to their social missions.

Third, the authority to define the energy tariffs affects the degree of financial viability among the CE cases. The decentralized DH plants take a proactive role in setting heating tariffs, which reasonably reflect regional supply and demand conditions. This direct involvement in the determination of the tariff allows the DH to earn a sufficient amount of incomes to cover their costs, thus retaining their financial sustainability. In contrast, the Hvide Sand wind electricity tariffs are not set by the project owners but relying on power market mechanism, leading to the variation in annual project revenue. The fluctuation of the revenue generation directly influences the profits of the project, thus exposing the vulnerability to their viability and achievement of social missions which should be sponsored by the profits. The difference in degrees of financial viability of the cases implies a sustainable financial performance are dependent on the degree to which the CE engage in financial management.

5. Discussion

5.1 Limitations of the study

The thesis possesses some limitations which should be put into consideration. First, as one of the thesis' aims was to investigate the how social values were transferred to projects' beneficiaries, the thesis should conduct interviews with beneficiaries in addition to projects' managers to gain cross-validated results. However, findings from projects' general meetings with the involvement of significant numbers of beneficiaries and other stakeholders provided sufficient information for the study.

Second, the case study of the Hvide Sande was involved in this research without a set-up of an in-depth interview with the project's manager. Nevertheless, it is argued that a large number of articles published and internal reports such as general meetings, financial reports regarding the project management and performance offered necessary data for the analysis.

A third limitation refers to the overall generalizability of the research. While there is no consensus definition of community energy, the thesis defined the community energy within the theoretical scopes represented in the literature review section. Based on those criteria, the accordingly case studies were chosen for investigations. This entails the characteristic of the community energy within the thesis' scope might not be a representative sample of community energy defined in other literature.

Finally, the thesis pays much attention to the conceptualization of social business model characteristic to understand the logic of how CE create, deliver and capture values. However, while the local community energy projects are highly localized and contextually dependent, it can be enabled or hindered by cultural factors such as the impact of religion, social cohesion, and the level of trust within the community. The thesis excludes the cultural factors since the research focuses only on the context of Danish CE. Furthermore, the high degree of interpersonal trust and social cohesion

have been historically observed in Denmark. However, the exclusion of cultural factors might affect the external reliability of the research referring to the degree of the study can be replicated in different international contexts. As a result, the thesis recommends further research to take the cultural factors into consideration for the same investigation of the social business model within the CE context on a cross-country case study.

5.2 Implications of the findings

5.2.1 Literature implication

The findings reveal the perception of social business in the context of community energy. The thesis characterizes social business in the community energy context as a market-oriented organization led by the local community and engaging in small-scale renewable energy provision to attain environmental and social objectives. The interpretation of CE through the concept of social business not only addresses the gap between the social value creation and entrepreneurial approach in grassroots innovation literature but also enriches the literature on social business.

Grassroots innovation literature

The thesis contributes to the bridge the literature gap in grassroots innovation, showing the potential of a business-like performance for a grassroots initiative to solve social issues. Analysis of CE performance pertaining to the social business model components reveals economic and market-based characteristics of CE. The CE, thus, could be seen as a hybrid organization that aggregates the pursuit of social mission embedded in its grassroots nature with the economic value creation associated with profit-driven firms.

The literature on social business

The thesis contributes to advance the literature on social business.

First, as the thesis finds a high degree to which social business is conceptualized within the CE context, this finding, in return, offers an illustration of

social business forms which can accompany the renewable energy initiatives to attain social and environmental goals. The investigation on the mechanisms for value creation, delivery, and capture in CE projects suggests social business within the context of CE do not entail to a specific social business model. The CE projects are embedded in their contextual environment, pursuing particular social missions. As a result, they perform distinctive sets of activity that contain different network relationship, organizational logic and ownership forms. The findings imply that social business barely presents one business model that aggregates the logics of social value creation and economic value creation but involve different practices requiring configurations of logics.

Second, the study on social business within the context of CE confirms Yunus (2007) assertion that social business provides enough space for civic participation. It is argued that as a firm, social business encompasses the stakeholders addressed by its business model, but do not involve civic involvement to the degree non-profit organization does. As a result, social businesses might fail to accommodate social and economic goals or detect and satisfy the needs of local groups. However, the findings of the thesis imply the possibility of a high degree to which civil society stakeholders involved in the social business in energy context. The development of the CE projects is followed by the local community and related closely to collective benefits.

5.5.2 Policy implications

Some directives have been developed at both EU and national levels to facilitate the development of a decentralized community energy system. However, in reality, the directives are weakly reflected in either their practices or outcomes since the directives appear to be poorly designed to facilitate the involvement community actors (Hicks & Ison, 2018, Curtin et al., 2018, Veelen, 2017). Instead, the involvement of unintended political players in the CE projects with the focus on personal economic benefits poses a risk of undermining the underlying proposition of local development and community resilience which genuine CE projects aspire (Tailor-Aiken et al., 2017, Hick et al., 2018). The thesis reveals that the benefits of a CE project relate closely to

who has strong involvement and engagement with the project. This implies that policymakers should tailor energy policy design to be attractive with the local societal groups so that the benefits of the CE project can be transferred to the local community at large. For example, the non-profit principle applied for the decentralized DH entails the protection of consumers from the monopolistic position of DH while making the project less attractive to the commercial-led developer as the profit generation is prohibited.

6. Conclusion

The growing development of local renewable energy projects driven by civic groups across Europe promises community energy as a pivotal initiative in accelerating the transition toward the sustainable energy system. The establishment of CE requires a formation of new linkages among the local community groups to govern the decentralized energy system. This thesis aims to deliver an integrated picture of how local groups manage the community projects to create, deliver and capture values. The approach is to analyze CE case studies as a form of social business pertaining to the four components of social business model, including value proposition, value constellation, social profit equation and economic profit equation. Based on the findings from the investigation of the four case studies, it is concluded that to a high degree, social business is conceptualized in the CE context with the presence of the following characteristics.

First, the emergence of CE is primarily driven by social and environmental concerns such as the promotion of local empowerment in energy supply, regional development, the GHG emissions and replacement of fossil fuel resources.

Second, the strong involvement and engagement of civil stakeholders are crucial factors to the development of CE. The consumers involved in the ownership role of the DH plants, thereby actively engage in planning designs and financial duties of projects. This performance aligns with the successful development of the DH plants over 60 years since their establishment. The same observation was also demonstrated in other cases. The active participation of civil actors in the establishment of the community foundation to own the Hvide Sande wind farm led to local acceptance on its construction which had been rejected with the participation of private business developers.

Third, the internal management regarding operational effectiveness and transparency is a critical factor to the attainment of the social business within the CE context. With the help of advanced monitoring system and renewable energy technologies, the CE projects are running on a smaller amount of material and labor resources than other types of business. The management focus is paid more on

internal operational activities. Efficient and transparent management of the board of operators is significant to build the trust and strengthen the relationship between the projects and community stakeholders for the development of the projects. However, the assessment of their performance to capture and deliver values to consumers/beneficiaries is still lacking. For example, no benchmark is available to evaluate whether the heating price offer to consumers in the DH cases is the optimal one. Also, the assessment of how effectively excess profit from the Hvide Sande wind turbines is allocated to local purpose is still in question. Based on these concerns, further research could apply performance measurement for social business in the context of community energy to assess their performance.

Fourth, the market-based approach is a reliable solution for CE projects to be financially self-sustained. Revenue generation from energy sales should be able to recover not only necessary production costs but also financial costs since the CE projects require a considerable amount of investments acquired mostly from bank loans.

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8. APPENDIX – INTERVIEW GUIDE

1. Understand the people of CE project
    a. Can you tell a bit about yourself (age, nationality, background, experience)?
    b. Since when do you work at the project, how did you end up here?
    c. What is your role/function at project?
2. Understand the CE project's motivation
    a. Since CE project is considered as a bottom-up social initiative to address social and environmental issues, what problems have you identified and how did you respond to them at the first place?
    b. What are the motivations driving the formation of projects?
    c. Who is the beneficiary or customer? If both how do they differentiate?
    d. Which kinds of value that is created to solve the local issues (social, environmental, political or economic…)
    e. Under which forms (product/service…) the values are delivered to customer and beneficiary?
    f. How does the project manage to deliver the values to customers/beneficiaries?
    g. What has the project achieved so far since its establishment?
    h. How the project's outcomes relate to its motivation?
3. Understand the CE project's management
    a. Who are the stakeholders of the project?
    b. How is the project structured?
    c. How would you describe the decision-making system?
    d. How is the local engagement in the project?
    e. How often stakeholders hold the meeting to discuss arising issues?
4. Financial structure
    a. Please explain your project's history with securing funding?
    b. Where does the money (if available) go after costs are accounted for?

From above conversation, tell interviewees some similar characteristics between the CE project and social business.

5. Others
    a. Do you consider the project as a business model, to be specific a social business?