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Biogas and modus operandi of sustainable business models in developing and developed markets.

by

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Abstract

The need for adapting business models to sustainable business models is revolutionizing many industries where business as usual stops being an option from a social or environmental perspective. The adoption of sustainable business models occurs in both developed and developing markets however, due to the nature of the two environments being notably different, it is expected that the sustainable business models will look very different in the two markets. With western businesses seeking to expand, and developing businesses looking to grow, the two markets are connected in many industries, like the biogas industry, where approaches for renewable energy occur for different financial, social, and environmental efforts. For these reasons, the purpose of this research is to perform a qualitative explorative case study of the two markets with 13 minimally structured interviews with European companies, institutions, and associations that have notable operations in both markets to try to understand how sustainable business models differ between the two markets in the biogas industry.

The findings revealed that although it is complicated to simply divide the concepts into just developed and developing markets, the incentives that revolve around biogas, whether they be financial from policymakers, social from helping others access energy or environmental by taking on renewable energy approaches, truly shape the opportunities of biogas being a sustainable business model in a given region. The shapes of these incentives further trigger the scale of the plants, complexity of the supply chains involved, trends with human behavior, opportunities for sustainability and biomethane. Thus, it can be concluded that the opportunity of a business model to be sustainable, through a collaborative effort of social, economic and environmental efforts is directly connected to the availability of various incentives in a region in the studied industry. This suggests that individuals working in the industry should keep promoting and presenting the social and environmental incentives to further grow the opportunities of sustainable business models in the biogas industry and that policymakers should realize these non-financial incentives and promote their prosperity with financial incentives whenever possible.

Keywords: Sustainable Business Models, Developing Markets, Developed Markets, Biogas, Renewable Energy.

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Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Biogas and Business Models

Recent years have been witnessing great contributions in literature on business models and more specifically, sustainable business models (Zott et al. 2011; Richardson, 2008; Casadesus-Masanell and Ricart, 2010; Demil and Lecocq, 2010). A sustainable business model is a business model that, with sustainability as the driving force, creates value, for both the customer and society through a collaborative effort of social, environmental and business activities to provide more sustainable services and products (Stubbs and Cocklin, 2008; Garetti and Taisch, 2012; Schaltegger et al. 2012; Bocken et al. 2014; Boons and Lüdeke-Freund, 2013; Wells 2013; Abdelkafi and Täuscher, 2016; Geissdoerfer, Vladimirova and Evans, 2018; Bocken and Geradts, 2020). The adoption, and a more commonly found focus on working around sustainability, have been critical with the rising problems around climate change that are increasingly affecting how businesses operate. This can be appropriately exemplified in industries traditionally relying on fossil fuels switching to alternative methods which most commonly take advantage of renewable energy sources. Biogas specifically, however, given that it is not limited by sunny or windy days, is receiving a lot of attention because it provides a lot of adaptabilities, with biomethane-fueled buses and trucks, with farmers using their organic waste, and with factories taking advantage of their leftovers to fuel these factories (Lantz et al. 2007; Scarlat, Dallemand, Monforti and Motola, 2018; Scarlat, Dallemand and Fahl, 2018; Surendra et al. 2018). While it is possible to understand biogas as simply a more sustainable industry in comparison to fossil fuel burning ones and not a sustainable business model in the energy industry, it is helpful to consider that industries are more of adapting social movements (Carroll, 1997) and that business models around renewable energy have the potential of creating environmental, social, and financial value that allows them to be perceived as sustainable business models (Russo, 2003). For these two reasons, there is an opportunity of analyzing biogas as a sustainable business model in the energy industry, which is going through a sustainable social movement, and how it can create values that non-renewable energy cannot. Reports from the European Biogas Association (EBA) are showing that biogas opportunities in Europe are still growing; the biogas and biomethane sector can nearly double by 2030 with the biomethane market specifically being 15% larger in 2020 than it was in 2019. The report further analyzes the potential in the industry with the development of a booming bioeconomy and the

expansion of the industry with opportunities with bio-LNG, a highly sustainable liquefied natural gas (EBA, 2021). The industry's development seems quite unavoidable. With the increased awareness of the general public to environmental problems, also increased by the publicity of figures like Greta Thunberg and the Fridays for future movement, businesses are called into action to solve environmental problems and can use these as an opportunity for their business development (Nidumolu et al. 2009; Michelini, 2012). For companies to survive they must recognize global sustainability as a catalyst of creative destruction. This should not however be seen as a threat but more of an opportunity for firms to rewrite the industry in their favor. Together with awareness and foresight, companies need to set new metrics to catch the managerial attention towards sustainability (Hart and Milstein, 1999). With the continuous growth of the biogas industry, which is lacking any signs of decline, the presence of sustainable business models in the industry makes biogas a notably relevant aspect of today's world.

Different opportunities however exist for sustainable business models in developed economies and those that are still developing (Ali et al. 2017). With the rising popularity of studies on developing economies, it seems very logical to look at what biogas truly means in both developed and developing markets (Aidan, 2013; Amaladoss and Manohar, 2013; Guillotin, 2015; Kocourek, 2015).

Developing countries, due to their multidimensional growth, are contributing more to global issues and thus are capable of enacting environmentally friendly policies and approaches to aspects of everyday life like cooking and heating. Scholars support the growing trends in developing countries to shift away from burning wood in homes for heating and cooking to more sophisticated methods like those incorporating elements of biogas (Ravindranath and Balachandra, 2009; Bansal et al. 2013). It is however notable, that renewable energy dissemination in developing countries is facing many obstacles (Kaniyamparambil, 2011; Bansal et al. 2013; Rao and Ravindranath, 2002). Developing economies thus are considering renewable energy sources for many reasons including, finding affordable, communal ways of generating electricity and heat for growing populations, and where possible and sufficiently developed, to support the fight versus climate change.

Academia further suggests even more reasons supporting the importance of sustainability. From a Corporate Social Responsibility (CSR) perspective, it is every stakeholder's responsibility to get

involved in incorporating sustainability factors into business models. However, this can be challenging for many other reasons. Literature on the supply chain management perspective for example provides many obstacles including the need for cross-functional integration and efficient marketing (Lambert and Cooper, 2000; Hugos, 2018). The large variation concerning different renewable energy sources, like biogas, requires specialization, and this creates many supply chain obstacles. In the developing economies, where companies are less developed and business networks are less established, this issue of the supply chain is even exponentiated. This causes, as suggested by scholars, a much more vertically integrated supply chain in these economies (Jones, 2012).

1.2 The Effects Energy Consumption has on Biogas' Feasibility

The world's energy consumption is growing year on year, and reached over 580 exajoules in 2019, in comparison to being less than 400 exajoules in the year 2000 (BP, 2020). Finding ways to satisfy this growing demand alone, without even considering the sustainability aspect is already challenging. However, with the growing concerns and impact, climate change has on the environment, thinking of this issue independently is no longer an option. In recent years, developing economies have been creating opportunities for investors, and improving the lives of their inhabitants with more spending power and access to necessities and more wants. Developing countries getting more access to energy has likely contributed to the increase in global energy consumption. The BRICS countries for example represent the most rapidly growing economies in the globe. These countries, because of their growth as well as size (25% of the world's area and 20 % of global GDP) are receiving a lot of attention from the West for purposes like new markets and new key players in global politics (Kocourek, 2015).

Biogas is a renewable approach to creating energy that through some upgrades can even produce biomethane that could be used as fuel for vehicles and machinery. Although knowledge about its capabilities is growing and spreading, it is not a new concept. In developed countries, like the European Germany and Italy, or those of North America, like the United States and Canada, biogas has been seen as an approach that minimizes the harsh effects on the environment while effectively utilizing organic waste. In developing countries, biogas is also perceived as an opportunity to support the environment though it notably serves the purpose of providing energy more effectively

and safely to individuals in rural areas that have not had this level of access before (Saravanan, Pugazhendhi and Mathimani, 2020; Mittal et al. 2018; Simbirskikh, 2020). However, comparing biogas in the two markets poses a fascinating challenge as the cultural factors heavily affect the *modus operandi* of different players.

Transnational initiatives like the Paris Climate Agreement, or the European Union's Red II require action, innovation, and the pursuit of renewable energy sources. The EU also calls for international support to help developing countries adapt to renewable energy. The biogas industry, especially with an increasing population growing more food and raising more animals, will face large obstacles in meeting these, or similar, goals. Since the developing countries, with BRICS alone having 40% of the global population, need to feed large populations (Kocourek, 2015), biogas has a very notable opportunity with large amounts of biomass available to provide energy for the inhabitants while also beneficially, being carbon neutral.

A lot of aspects of developed or developing nations also contribute to the opportunities of their markets. Politics, for example, because they bear the opportunity to make a difference in shaping a country, make it important to consider the political influences that are present in desirable markets. In European Union, tougher emission regulations and encouraging local farmers with renewable energy incentives can contribute to supporting renewable energy like biogas (Jordan and Adelle, 2012). Developed nations, like those in the European Union, are also rather wealthier and have more stable economies; according to reports of the European Union, in 2019 the EU's GDP per capita, at over 37,000 USD, was more than the world average country's GDP per capita twice over (Eurostat, 2021). From a social perspective, according to the United Nations Development Program, individuals in developed countries are more educated on average, (UNDP, 2020), have lower unemployment rates than in some developing countries. Furthermore, most of the sustainability-leading countries are also those of the European Union. This creates the potential for working with sustainability in the EU's market with industries like those of renewable energy.

1.3 Research Questions and Purpose

This study serves to explore the differences in sustainable business models for the biogas industry in developed and developing markets. To achieve this, with the help of market experts from various

biogas companies originally based in Europe, analysis of the biogas industry through the collection of primary data was performed. This study promotes the exploration and dissemination of sustainability, through embracing a renewable energy source that urgently needs consideration due to the negative effects fossil fuel burning has on the environment and health. Furthermore, given that this study takes a perspective on developing countries that are exponentially growing in spending power, it is also very relevant from a traditional, capitalistic, business model point of view. Given that it could serve as a sustainable business model, with financial stability, and increase the exposure to energy for individuals living in rural areas of developing countries, analyzing biogas as a sustainable business model serves a valuable purpose.

This thesis also aims to bridge literature between biogas in developed markets (Scarlat, Dallemand and Fahl, 2018; Scarlat, Dallemand, Monforti and Motola, 2018), biogas in developing markets (Saravanan, Pugazhendhi and Mathimani, 2020; Mittal, et al. 2018; Simbirskikh, 2020) and opportunities for sustainable business models in both as currently, research seems to be lacking on the difference of biogas in developed in compared to developing markets. This research is likely to be valuable as general studies comparing developing markets and developed markets show notable differences in approaches to sustainability, which suggests that this may also be the case with the biogas industry specifically. To analyze these components, this thesis assigns the following question and subsequent sub-questions:

How do sustainable business models differ in developed and developing markets in the biogas industry?

- How do the differences of SBM in the given markets affect their dissemination?
- How do business models differ in the balance between social, environmental and economic efforts depending on the level of market development?

1.4 Research Delimitations

This research will specifically consider the sustainable business model opportunities for the biogas industry in Europe as a developed region and in various developing markets. This could mean that

the research's applicability might be limited to these markets though a perspective with analytical generalization will be used as widely as possible in the discussion. Furthermore, mostly Europe-based companies were interviewed which could present a less global perspective however all these companies have participated in biogas operations outside of Europe at a notable scale. Perspectives of developing markets in the biogas industry are being established from traditionally Europe-based companies which could mean that cultural factors that more accurately describe the developing markets might be affected.

1.5 Outline of the Thesis

This thesis consists of six chapters. The first chapter, the introduction, aims to provide a background into the idea of biogas as a sustainable business model in developed and developing markets. The following chapter, the literature review, considers the literature on the key topics for this thesis like sustainable business models, CSR and sustainability, a juxtaposition of developing and developed markets, a preliminary framework, and a theoretical background on biogas that this thesis applies the framework to. The third section is the methodology chapter which considers the research design and specific approaches selected. The fourth chapter presents the empirical findings, and the fifth chapter is the discussion that analyzes the differences of sustainable business model opportunities in developing and developed markets. In the sixth chapter, the conclusion reflects by discussing the actual implications (both theoretical and practical) and how further studies can expand this one.

2 Background: Literature Review and Theory

This literature review, to make a preliminary connection between literature, will first present academic contributions on sustainable business models and that of developing and developed markets. Understanding aspects of markets and characteristics of sustainable business models can exist independently therefore this chapter discusses the topics separately before proposing a preliminary framework. This chapter first considers CSR and sustainability to advance the ideas of business models into sustainable business models. From there on, perspectives from both the developed and developing market angle are presented, through a consideration of purchasing power, economic differences, recognition of developing countries, sustainability, technological innovations, and the supply chain, to juxtaposition the two markets. The concepts are then represented by the preliminary framework that suggests how the characteristics of developing and developed markets affect how sustainable business models shape in the given markets. Finishing the chapter, literature on biogas and its entry barriers, as well as its position in developing markets, provides relevant literature to support the understanding of the preliminary framework in the context of this thesis.

2.1 Sustainable Business Models

A sustainable business model (SBM) is a business model that with sustainability as the driving force, creates value, for both the customer and society through a collaborative effort of social, environmental, and business activities to provide more sustainable services and products (Stubbs and Cocklin, 2008; Garetti and Taisch, 2012; Schaltegger et al. 2012; Bocken et al. 2014; Boons and Lüdeke-Freund, 2013; Wells, 2013; Abdelkafi and Täuscher, 2016; Geissdoerfer, Vladimirova and Evans, 2018; Bocken and Geradts, 2020).

To better understand the concept of an SBM, this thesis will first have a look at business models in general and then move into Corporate Social Sustainability (CSR) and sustainability as megatrends and drivers of SBMs. Then, this thesis will fuse these elements into the idea of an SBM.

2.1.1 Business Models

Many studies and frameworks in strategic management have discussed the concept of a business model from different perspectives (Foss and Saebi, 2016; Björkdahl and Holmén, 2013) therefore, there is no distinct definition for it (Chesbrough, 2010; Zott et al. 2011; Wirtz, 2020, Johnson et al. 2008, Richardson, 2008). The key aspects, however, seem to be that a business model focuses on the concept of value (Chesbrough, 2010; Achtenhagen et al. 2013). It defines the value creation for the stakeholders by linking factor and product markets with each other in a specific architecture to create, deliver and capture this value (Zott et al. 2010; Johnson et al. 2008; Teece, 2010). It is therefore built out of three pillars: value proposition, value creation and value capture (Richardson, 2008; Johnson et al. 2008; Teece, 2010):

- The value proposition is defined by what the company delivers (the offering) to its customer, and why that customer is willing to pay for the offering (target customer). It also contains the basic strategy for gaining a competitive advantage and winning the target customer.
- The value creation/ delivery system is the source of the competitive advantage and is about creating and delivering this value proposition to the target customer. This is done by the company's resources and capabilities, value chain and business processes as well as its position in the value network and links.
- The value capture entails the capturing of the economic success of its efforts and describes how the profit and revenue are made through its revenue sources and the economics of the business.

This definition can be widened to also include the activities done by the company with or by customers, suppliers, and partners and how these are connected in an activity system (Zott et al. 2011).

When a company is in a stable competitive environment, the business model and the strategy are closely linked to each other, but when a need for a new business model arises by outside forces, strategy and business models can differ (Casadesus-Masanell and Ricart, 2010). Due to factors like globalization and digitalization, market dynamics sped up and have become more complex. This changed the competitive environment and therefore increased the need to continuously adapt

business models (Wirtz, 2020). This also led to more attention being given to business models (Foss and Saebi, 2016). To be able to change the business model and to sustain the firm's performance, the company needs dynamic consistency to survive this change, which highly depends on its ability to anticipate and react to changes in its environment (Demil and Lecocq, 2010; Wirtz, 2020).

By realizing when "established business models are running out of steam" (McGrath, 2010) and that the business models need to continuously be modified to fit environmental changes in a fast-moving and uncertain environment, a company can quickly shift into gathering insight, rapid experimentation, and evolutionary learning to gather knowledge for the adapted business model and strategy (McGrath, 2010). Only this way a company can attain sustained value creation in the long term (Achtenhagen et al. 2013). The company should try to figure it out as early as possible to be able to still earn short-term profits from the existing business model, but also be able to start to accumulate learnings from the new business model to be able to create a considerable competitive advantage from it for the future and to have time to modify its capabilities for the changing environment and new challenges (Itami and Nishino, 2009).

Although vitally important for the company's long-term success, this business model development can be difficult, as many incumbent firms fall victim to their internal dominant logic and cannot envision such a drastic change (Chesbrough, 2010; Zott et al. 2011). This path dependency is often seen in larger, long-established companies. Companies can also lack an understanding of the components of their business model, which leads to missed opportunities to counteract weakly and emphasize strong elements when adjusting or building a new business model (Christensen and Johnson, 2009). To increase its organizational agility to be able to conduct a strategic evolution of a business model, a company needs to be aware of three of its core meta-capabilities:

- Strategic sensitivity: sharpening one's foresight, gaining insights and perspective, being aware of the change and being open and seeing the need for possible business model renewals to maintain competitive advantage (Chesbrough, 2010).
- Leadership unity: having open, clear and honest dialogues by sharing a common interest and team-feeling, while also being able to make bold and fast decisions without getting caught up in firm politics (Chesbrough, 2010; Zott et al. 2011)

- Resource fluidity: the internal capability for modularity and reconfiguration of capabilities and using multiple business models at the same time to free up capabilities for the new design of the business model (Doz and Kosonen, 2010). By good leadership, clear commination, mapping, learning by doing and trial and error, internal traps of confusion and obstruction can be avoided (Chesbrough, 2010; Sosna et al. 2010).

While in typical business model the maximization of the value for the stakeholder is the main focus (Freeman, 2015) with environmental and social goals only being of lower concerns (Stubbs, and Cocklin, 2008), emerging business models increase this economic view of firms to a more holistic one, that also considers other factors (Boons and Lüdeke-Freund, 2013; Doppelt, 2010), like supplementing the social and environmental obligations into the existing economic business model (Hardjono and de Klein, 2004). Others call for a complete transformation of the existing business model (Benn et al. 2006).

2.1.2 CSR and Sustainability

Corporate social responsibility (CSR) describes the relationship between companies and society, including all stakeholder groups they interact with and the responsibilities born out of this interaction. Even though businesses create a lot of good aspects, making lives increasingly comfortable by producing goods and services to satisfy customers' needs, they also can create harm, like pollution, layoffs, industrial accidents, or economic crisis, and need to be held accountable for that (Chandler, 2020; Werther and Chandler 2011). In this interdependence relationship it is the responsibility of the firm to meet the needs of the stakeholders and their impact on society, and the stakeholder's responsibility to hold the company accountable (Chandler, 2020).

While CSR describes the total operations, sustainability only concentrates on the aspect of the natural environment. Sustainability is defined as "the ability of the current generation to meet its needs without compromising the ability of future generations to meet theirs" (Hart and Milstein, 1999). Due to the issues of resource utilization and unsustainable rates of extraction of resources, there has been an increase in discussions about sustainability (Chandler, 2020). Sustainability is an emerging megatrend since it affects everyone globally (Lubin and Esty, 2010). As of right now, humanity is exploiting way too many resources and therefore is jeopardizing the ability of future generations to meet their needs (Chandler, 2020; Hart and Milstein, 1999). This, however, also

raises important questions that need to be addressed. When the stakeholders are supposed to hold the companies accountable a question arises on how that is feasible. Environmental sustainability is a prime focal point of the 21st century and firms are an integral part of society, as they employ people and produce goods that satisfy the needs of people (Kanter, 2011). Consequently, companies also need a stable society as much as society needs companies. Therefore, businesses cannot close their eyes on this topic as the companies are both the main cause of problems like climate change, but also the main hope for a solution. Stakeholders' demand for transparency and change in companies' environmental performance is expected to further increase with the urgency of the climate crisis (Chandler, 2020).

The challenge of global sustainability can be seen as a major discontinuity with the potential to radically transform the structure of whole industries. Companies have an opportunity to shape the redefinition of their industry towards sustainability and in their favor (Nidumolu et al. 2009). The term corporate social opportunity takes the perspective emphasizing the benefits of adopting CSR and mitigating the perception of CSR as a cost factor (Chandler, 2020). Unexpectedly, following CSR guidelines can even save money for the company, because the supply chain is monitored more closely, which automatically can lead to fewer cost factors, like waste or unnecessary deliveries. When operating in numerous countries with different legislations, it is easiest just to follow the strictest one in all other countries as well and profit from economies of scale and simplified supply chain operations (Nidumolu et al. 2009). By pricing the natural resources consumed, the company can prepare for future legislation and learn about its value chain (Chandler, 2020).

Recognizing that global sustainability is a catalyst full of creative destruction for new business developments will prove crucial to survival for the company (Hart and Milstein, 1999). The term creative destruction illustrates the "process of industrial mutation […] that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one" (Schumpeter, 1994, p. 83). This creative destruction will be fatal for companies that only conduct *greening*, incremental improvements, to their products and services but no real changes. A reinvention of fundamental manners in production processes and services is needed as early leaders are not guaranteed to stay ahead in the long run (Hart and Milstein, 1999; Lubin and Esty, 2010). Foresight will be the key for survival as early reaction by managers can help make moves for incumbents before new entrants become a serious threat. The resilience ability of firms is also put to the test, as climate change threatens business operations, it is important for firms to

adapt and innovate to the new environment (Lubin and Esty, 2010; Chandler, 2020) and to not be held hostage by current positions and markets.

2.1.3 Sustainable Business Models

By exploiting the megatrend of sustainability as a source of differentiation in business models, the company can fundamentally reposition itself and redefine its strategy for competitive advantage (Lubin and Esty, 2010). Therefore, only when making sustainability a goal, companies can create a competitive advantage by rethinking their business models (Nidumolu et al. 2009). Hence, an SBM is a business model that with sustainability as the driving force, creates value, for both the customer and society through a collaborative effort of social, environmental, and business activities (Stubbs and Cocklin, 2008; Garetti and Taisch, 2012; Schaltegger et al. 2012; Bocken et al. 2014; Boons and Lüdeke-Freund, 2013; Wells 2013; Abdelkafi and Täuscher, 2016; Geissdoerfer, Vladimirova and Evans, 2018; Bocken and Geradts, 2020).

In an SBM, sustainability is not only seen as a CSR but as a core business strategy itself by taking a holistic view and incorporating economic, environmental, and social value forms: the triple bottom line of business sustainability (Elkington 2013; Hart and Milstein 1999; Willard 2002; Evans et al. 2017). This means that a company cannot separate its economic sustainability from the others. It needs to balance its economic actions with environmental and social values and make them compatible with each other. This brings the need for organizations to perform activities that have positive effects on the environment and society, and do not only accentuate financial aspects (Pagell and Wu, 2009; Porter and Kramer, 2006; Dao, Langella and Carbo, 2011).

By adopting a more holistic view and prioritizing not only economic but also environmental and social factors, companies can create a societal purpose for themselves and become more than a solely financial investment as a company´s basic idea is to create value (Kanter, 2011). The question is how and for whom this value is created. Thus, CSR is deeply embedded in every company. Because all companies create value and involve stakeholders, all companies practice some kind of CSR, but the way they do differs (Chandler, 2020). Simply rethinking the value proposition and changing the way to deliver this value alone does not create a sustainable business model. Instead, by questioning the status quo and taking an entrepreneurial view one must explore

different alternatives to current ways of doing business and how customer needs can be met (Nidumolu et al. 2009).

Consequently, in an SBM the value proposition contains all three values of the triple bottom line: economic, environmental, and social, while having the interests of the society as a whole and the business in mind (Porter and Kramer, 2011; Schaltegger et al. 2016). When developing a new SBM there is a need to understand what the consumers want, how to meet these demands and how partners can help to increase the value of the offering (Nidumolu et al. 2009). Corporations that incorporate CSR at all levels of operation and involve stakeholders to meet their needs will create the most value over the medium to long run (Chandler, 2020).

Value creation is creating value for all stakeholders, including the society and environment, as well as the employees and suppliers (Eccles and Serafeim, 2013). The main challenge when creating an SBM is to find new ways to deliver and capture the value to change the foundation of the competition and to create new delivery technologies that modify value chain relationships in a meaningful way (Nidumolu et al. 2009).

Value capture is described as the way the economic value is absorbed and fairly distributed among the involved parties (Schaltegger et al. 2016) while maintaining or even restoring social and environmental capital (Dentchev et al. 2018). The optimal process for value capture regarding the megatrend of sustainability is described by Lubin and Esty (2010):

- Stage 1: Do old things in new ways.
  Focus on outperforming competitors on regulatory compliance and environment-related cost and risk management. In doing so, they develop proof cases for the value of eco-efficiency.

- Stage 2: Do new things in new ways.
  Firms engage in a widespread redesign of products, processes, and whole systems to optimize natural resource efficiencies and risk management across their value chains.

- Stage 3: Transform core business.

As the vision expands further, sustainability innovations become the source of new revenues and growth.

- Stage 4: New business model creation and differentiation.
  At the highest level, firms exploit the megatrend as a source of differentiation in business model, brand, employee engagement, and other intangibles, fundamentally repositioning the company and redefining its strategy for competitive advantage.

When introducing sustainability into the value chain, the biggest challenge is to increase efficiencies throughout the value chain. Expertise in areas like carbon management and life-cycle assessment is needed, as well as the ability to redesign operations to use fewer natural resources and produce fewer emissions and waste. Companies can uncover the monetary benefits that energy efficiency has. It is also important to create a capacity allowing to determine that the actors in the value chain before and after the company comply with creating more eco-friendly activities as well. There is a large opportunity for companies to develop sustainable resources and increase the use of clean energy. Companies can learn to build mechanisms that link sustainability initiatives to business results, so environmental values are lived within business units (Nidumolu et al. 2009).

SBMs with the driving force of sustainability can therefore be seen as an opportunity for business development that generates value for the company as well as the society as a whole (Nidumolu et al. 2009; Michelini, 2012; Rodriguez, Ricart and Sanchez, 2002) and ensures a long-term survival in an increasingly complex and fast-changing environment. Organizations must recognize global sustainability as a catalyst of creative destruction. However, this should not be seen as a threat but as an opportunity for firms to rewrite the industry in their favor, but there is a need for a clear understanding of chances for senior managers to commit the necessary resources. Together with awareness and foresight, companies need to set new metrics to catch the managerial attention towards sustainability (Hart and Milstein, 1999).

2.2 Developing and Developed Markets Juxtaposition

To best be able to understand aspects of developing and developed markets, it is helpful to contrast them to see how they differ from one another. Although one agreed-upon definition seems to be lacking, a developing country tends to be one with a low Human Development Index (HDI) and a less developed industrial base, where a higher HDI and more developed industrial base indicates a more developed country (O'Sullivan et al. 2014). Generally, a lot of differences can be expected from these two economies; many of these differences are fueled by purchasing power. In a developed economy, it is estimated that nearly one billion customers hold the purchasing power to financially acquire any of their desires that society has the infrastructure of manufacturing and distributing at high consumption levels. In the emerging economy, this number would be significantly smaller, because approximately only two billion people have the opportunity of meeting their basic consumer needs. In other words, in developing markets, customers have a weak purchasing power to acquire their wants (Hart and Milstein, 1999). Although many of the differences related to developing markets can be summarized using this perspective of purchasing power, more thorough consideration is essential to understand the markets more thoroughly.

2.2.1 Economic Differences

Developing economies are growing much faster than developed ones. As specifically the case of China, due to its rapid growth, it has the potential of becoming an anchor economy (Jones, 2012). In this phenomenon, the economy of a country becomes a major player in the world economy which causes other countries to revolve around the anchor economy, attracting potential suppliers and other partners. This can contribute to greater, and quicker growth.

Developing market businesses, unlikely their Western counterpart, were also significantly more willing to do business with individuals and consumers from the bottom of the pyramid (Jones, 2012). This includes various products, telecoms, and banking services. This lack of hesitance in doing business with the poor is likely to affect the social aspects of developing markets. This phenomenon, sometimes also referred to as reaching the unreachable, is significantly connected to corporate imperialism, where Western companies would not adapt to consumers in developing markets (Jones, 2012).

It is however notable that some developing countries are also financially riskier than others. The financial risks in developing markets can also be explained through institutional voids (Khanna et al. 2004; Peng and Jiang, 2010; Jones, 2012). Institutional voids are the gaps in market-supporting institutions. This can include market intermediaries and various legal protections for shareholders which tend to be present in the developed markets. Because the developing countries are still in the process of emerging, different institutional bodies or systems can be absent or still in the process of formal establishment; Western companies and investors are commonly expecting these lacking aspects and thus they can be hesitant in investing in these markets (Jones, 2012). This potential lack of security can also discourage local entrepreneurship (Faccio et al. 2001; Morck et al. 2005).

In China, however, the rate of inflation is also above what observers expected but with the country's economy growing rapidly, and with the Chinese government raising the income tax threshold the situation seems much safer (Jones, 2012). Certain groups of people in developing countries, like the poorest group, also are important to consider. Data from Worldbank (2020) shows that the rapidly growing countries, like the BRICS, do not have a mentionable population living with the minimum threshold of $1.90 a day except for Brazil that does have a 4.6% population with that financial characteristic. These countries have however had individuals in that financial situation within the last 12 years (Worldbank, 2020). It could be more appropriate to think of the rapidly developing countries as ones that are coming out of notably unfortunate poverty within this generation. Unemployment, however, is still a larger issue in developing countries than in developed ones (Mucuk and Demirsel, 2013). South Africa's most published unemployment rate, for example, is at 32.5% (South Africa Statistics, 2021). In Brazil, the figure, as of October 2020, is 14.3% (Statista, 2021).

In developing markets, corporate social responsibility, (CSR) can occur both from multinational companies entering new markets and firms that originate in the developing markets. Regarding multinational firms expanding, it is important for them, due to socio-cultural factors, to adopt CSR practices in the new markets from the approaches they take back home (Öberseder et al. 2014; Jamali et al. 2009; González-Rodríguez et al. 2019). Recent research suggests however that this adaptation should not follow ethnocentric approaches and rather follow an approach embracing national characteristics, culture, and experiences to the specific developing market (Contini et al. 2020).

In Asia for example, companies are awarded scores on best CSR approaches. This has been assessed for over a decade, with a company in India commonly receiving the best company in terms of CSR award (Amaladoss and Manohar, 2013). Furthermore, surveys conducted by industry experts like those at McKinsey management consulting found that even in the early 200s, Indian executives were most supportive for wider social responsibility of businesses and more specifically, 90% of them supported the 'public good dimensions' (Amaladoss and Manohar, 2013).

2.2.2 Recognition of Developing Countries

Previously, global governance was following very Western *modus operandi* with counter institutionalization (Zürn, 2018), an unbalanced Western-style dominant organization of global institutions like the International Monetary Fund (IMF) and the World Bank (WB). With their growing power, the most rapidly developing nations are notably fighting back how global operations are very Euro-American and are helping bring a voice to smaller nations that do not normally get to speak about issues without passports. This power to affect global environmental approaches is further portrayed by the quick appearance of BRICS banks like the New Development Bank (NDB) and the China-dominated Asian Infrastructure Investment Bank (AIIB) (Liao, 2015; Petrone, 2019). This global push for recognition can also be considered with the end of corporate imperialism, (Prahalad and Lieberthal, 2003; Jones, 2012) which makes social and cultural aspects of rapidly developing countries impact how Western companies are approaching the quickly developing nations. Furthermore, this provides room for non-Western cultural norms accordingly and appropriately as developing countries are not interested in the same products and services the West provides but rather in products fitting their norms.

2.2.3 Sustainability, Environment and CSR

In especially rural parts of developing countries, biomass, such as firewood, coal, and charcoal is commonly used to meet the energy requirements of cooking. This, however, produces more carbon monoxide, hydrocarbons and since cooking is most commonly done indoors without proper ventilation, many diseases and other health issues are likely to arise (Surendra et al. 2014; Dherani et al. 2008; Pathak et al. 2009) In metropolitan cities of developing countries, a lot of the energy comes from expensive imported fossil fuels. This further has negative effects on health and the

environment (Surendra et al. 2014). In developed countries, houses more commonly tend to be connected to energy sources that do not directly require direct usage of biomass for heating or cooking.

Elaborating on the environmental differences between the two markets, it is important to consider that environmental concerns such as climate change affect the entire globe. For this reason, climate change is considered an issue without passports (Annan, 2009; Petrone, 2019). Given that developing countries are growing in power economically, they hold the opportunity to affect the way global governance shapes concerning sustainability. In 2013, during the BRICS summit, the delegates from BRICS countries admitted that climate change is and will continue to be one of the most significant threats towards achieving sustainable development (Cowan et al. 2014). This shows that developing countries are increasingly valuing economic growth with environmental vigilance which is already notably considered by sustainability literature in the developed markets. This vigilance is essential because, in comparison to Western economies, developing ones have been growing much more rapidly in recent years (Jones, 2012; Cowan et al. 2014) and literature tends to suggest that an increase in economic growth reduces an increase in electricity consumption and that energy conservation policies may have adverse effects on the economic growth (Apergis and Payne, 2009; Narayan and Smyth, 2009; Odhiambo, 2009; Bildirici, 2012; Shahbaz et al. 2012). This portrays how dangerous it would be for developing markets to disregard sustainability while developing. Although not all research suggests that economic growth is connected to the usage of electricity, the fact that developing countries heavily rely on fossil fuels for electricity generation, suggests that emissions are likely to increase (Cowan et al. 2014). This brings the need for more eco-friendly approaches to generating heating and electricity in developing countries.

It is also helpful to consider the difference in the waste and sewage systems between the two markets. Developing countries, but also underdeveloped ones, lack an efficient and effective waste and sewage system which is hurtful for health and the environment. This problem needs attention as in Asia for example, waste generation has reached one million dry tons per day, with 70% of the solid waste being organic (Surendra et al. 2014; Asian Productivity Organization, 2007; Voegeli and Zurbrügg, 2008). This in contrast to the developed market, where sewage systems tend to be efficiently present, crates problems and perhaps opportunities regarding where this waste should go and what can be done with it.

2.2.4 Technological Advancements and Innovation

The growth of some of the developing markets has also accelerated the development and sophistication of the manufacturing of these countries. Previously, the produced merchandise had low added value but in more recent years, this has changed and products with value are now coming out of the rapidly developing countries (Cui and Syed, 2007; Kojima, 2000; Kocourek, 2015). Previously sophisticated production was coming out of more developed countries only. This growth and sophistication of production in developing markets is supported by the flying geese model. Following this model (Akamatsu, 1962; Kocourek, 2015), developing countries go through phases of "wild geese flying" (Akamatsu, 1962, p. 25) and use up resources in specific areas, and when wages and conditions in these areas improve, they move on to other developing countries. Furthermore, this process leaves the developing countries more capable of providing sophisticated products which each phase. As the case of China and India, their development is rapidly growing, and this predicts that in comparison with the flying geese model, and the observed rapid growth of all the developing economies, these countries are likely to even catch up to the more developed West and be able to provide equal sophistication in the reachable future.

This rapid growth in sophistication can also be understood from another angle concerning developing markets. Technological advancements in developing countries do not necessarily follow the same path as they do in developed countries like Europe mentioned previously. The fact that developing countries did not go through the development phases that the developed West did, allows for them to leapfrog and grow using the springboard approach (Jones, 2012). The springboard approach is a way for developing countries to overcome market and institutional constraints by acquiring resources from the already developed West; this can but is not limited to, purchasing critical assets from already developed global corporations (Jones, 2012, pp. 153,265; Luo and Tung, 2007). This contributes to the rapid development of developing markets. Reverse innovation[1] (Jones, 2012) in developing countries also provides the momentum or the opportunity of adapting established and existing products already available in the West to developing markets at prices that are more affordable for these individuals. Developing markets and especially those in India are also known for their way of Jugaad[2], a form of frugal innovation and engineering to work with the available resources. It is a form of creating "what we need from what we have" (Jones, 2012, p. 264). This form of thinking goes hand in hand with the mentioned reverse innovation to create what is needed, with what is accessible for an affordable price.

2.2.5 Supply Chain

Supply chain management (SCM) has been widely studied and several aspects have been presented in the developing markets. Supply sourcing in developing countries tends to consist of three major issues: lack of infrastructure for communication, imperfect business practices and unsatisfactory production suppliers (Ruamsook et al. 2009). On the 'green' side of SCM, research suggests that in developing but specifically South East Asian countries, environmentally friendly management is helpful in the integration of different SCM phases and can be used to increase economic competitiveness (Rao and Holt, 2005). Studies have also looked at the relationship between per capita income and the quality of logistics services and found that there exists a bidirectional relationship (Aldakhil et al. 2018). This would suggest that with the rapid economic growth of the developing countries, it can be expected that supply chains will also improve significantly in these developing economies. This is of critical importance as several supply chains require advancements to limit adverse effects on health once the products finally reach customers (Jones, 2012). Vertical integration in supply chains is also common in developing markets because businesses in these markets have smaller social and network circles, due simply to fewer businesses being present in developing markets (Jones, 2012).

2.3 Sustainable Business Models in both Markets

To succeed in a time of creative destruction driven by sustainability, awareness and foresight, new metrics are needed for focusing the attention of managers and the processes on sustainability. Sustainable development is one of the biggest business opportunities in the history of commerce. Without an understanding of the possibilities and the economic payoff of the creative destruction of sustainability, managers will not vacate the necessary resources necessary. This leads to the need for a sustainable business model when using environmental and social values to create the economic values (payoffs), that often drive companies into action (Hart and Milstein, 1999).

The new metrics necessary differ depending on which market, developed or developing, is looked at, and therefore also the business model approaches, depending on the different set of demand and supply conditions they face in the market (Hart and Milstein, 1999). In developed consumer

economies, with customers that have great purchasing power and infrastructure that allows quick production and distribution, there is a high consumption rate. In such an environment the driver for new metrics and improved payoffs is the reduction of the corporate footprint. By using metrics like greenhouse gas emissions per sale, but also corporate reputation, payoffs like earning growth and an increased Economic Value Added are possible (Hart and Milstein, 1999).

Developing markets meet the basic needs of their consumers, which have minimal purchasing power. Regardless, these markets are getting increasingly interesting for companies due to the rapid industrialization and urbanization which drastically increase the demand and lets the market grow very rapidly and therefore hold tremendous growth potential compared to the developed markets, which are mostly saturated. Old technology will be insufficient to meet future demands without surpassing nature's capacity (Hart and Milstein, 1999). Therefore, the biggest challenge for companies in these markets will be to avoid collision between the rapidly growing demand and overburdening the natural and/or social systems. To succeed in this, businesses need to reinvent their old strategies and business model from the primary economic business models used in developed markets into more sustainable business models regarding also environmental and social values. Only using economic values is not suitable in EMs facing different challenges and demand and supply conditions (London and Hart 2004; Prahalad and Hart, 2002). To direct the attention of managers into this direction, metrics like the number of jobs created (social factor), or water use per sale (environmental factor) can be introduced to boost sales growth. By redefining and analyzing each element in the value chain, more sustainable strategies can be created to harvest all of the available payoffs of sustainable business models (Porter and Kramer, 2011; London and Hart, 2004).

In some developing markets, primarily in more rural areas, survival economies are found. It is categorized by poverty and desperation and the basic needs are satisfied directly from nature. Companies need to meet these basic needs to be able to create a basis for a solid economic foundation. Those needs are often ignored by managers but are crucial to be able to build a social infrastructure to increase the quality of life. To meet these needs the use of up-to-date technology in profoundly new ways is necessary. By introducing products or services on a smaller scale, local communities can be enhanced, and further urbanization can be avoided. Bigger scale products will have the effect of degrading rural communities and should be avoided. By using metrics like

percentage of sales in survival economies and small scale vs. large scale applications, price-earnings ratios can be improved (Hart and Milstein, 1999).

2.4 Sustainable Business Model Antecedents

The structure of this chapter, the literature review, was constructed to present the relationship most appropriately between aspects of developing and developed markets and how those respectively contribute to what sustainable business models could look like in the specific market. Understanding aspects of markets and characteristics of sustainable business models can exist independently without one another hence why this literature review first considers sustainable business models, followed by a juxtaposition of developing markets and developed ones, and combines this connected phenomenon into the preliminary framework.

This chapter defines sustainable business models as those that always include, through a collaborative effort, some level of social, environmental, and economic effort thus all sustainable business models, by definition, and disregard of the market that they are considered in will value these. Therefore, this collaborative effort is connecting the sustainable business models in the preliminary framework below.

While considering the developing and developed market, this literature review finds that aspects related to purchasing power, economic differences, recognition of developing countries, sustainability, the environment, CSR, technology, innovation, and the supply chain are all notable in both markets. What these aspects mean in the relative market, however, differs. This is why in the preliminary framework below the level of market development is represented by a box with a varying gradient to represent less and more developed markets. The mentioned six aspects that help explain what a sustainable business model can look like in a given market follow the gradient and eventually add up to a sustainable business model. This sustainable business model, however, will vary, as this literature review suggests, depending on the “gradience” or level of market development. This suggests that sustainable business models, because of the six different aspects, are different in different markets. This however does not aim to suggest that all sustainable business models in the same market are identical. This was all constructed and placed this way because this

research further intends to explore the gap in literature where sustainable business models are compared between developing and developed markets.

Fundamentally, the preliminary framework can be understood as one describing sustainable business models through two separate perspectives: the developing market perspective and the developed market perspective. Both models will be characterized by a collaborative effort of social, economic, and environmental factors, as this is always true of any sustainable business model, however, the models will differ concerning what the six mentioned aspects mean in the given market.

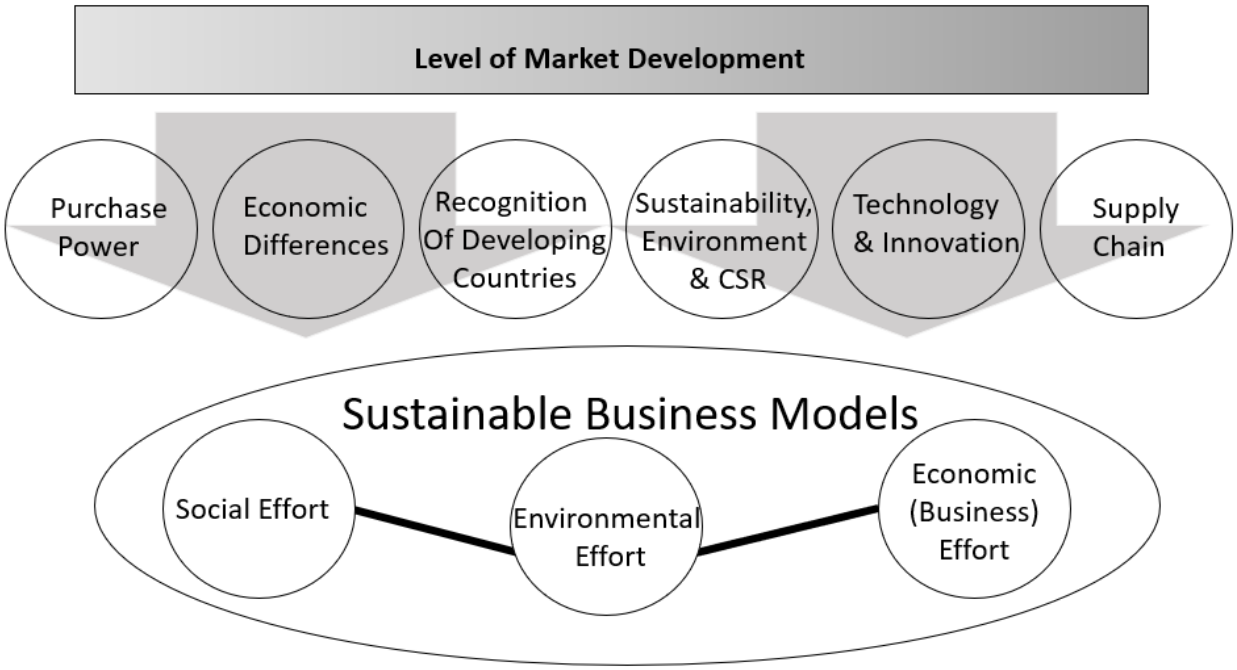

Figure 1: Theoretical Framework of the Literature Review proposed by the Authors

2.5 Biogas Market Characteristics

This section considers the market of biogas for sustainable business models; it points out key characteristics of both developed and developing markets concerning the above framework.

Biogas is an energy source consisting of renewable energy that can be generated with anaerobic digestion comprising of biodegradable organic feedstocks like municipal and industrial wastes, agricultural and animal residues. It is high in methane content, and can further be upgraded to natural quality, increasing the methane content for purposes like fuel with biomethane (Mittal et al. 2018). An example diagram of the biogas process can be found in Appendix A.

The uses of biogas include heating and combined heat and power generation (CHP). With upgrades, like biomethane or natural gas quality, it can also be used for transportation fuel and other diverse applications (Surendra et al. 2014). Biogas is a more environmental approach because it helps reduce the negative externalities that are associated with releasing gasses into the atmosphere. This includes but is not limited to groundwater, emission of air pollutants like dioxins, furans, and methane as well as soil contamination (Kumar and Sharma, 2014; Lewis et al. 2017; Mittal et al. 2018). Therefore, the solutions of the core of the biogas market are more sustainable than the alternatives. The biogas potential, however, continues to develop in both developed and developing markets.

In European countries like Sweden, biogas dissemination has been growing in the last two decades (Lantz et al. 2007) but as tends to be the case all through most developed countries, the spread of renewable energy sources relies heavily on policies, at both national and international level. Research also suggests that the dissemination of biogas in Europe heavily relies on policy objectives, legislation against landfilling, taxation on waste incineration, financial subsidies and barriers economy (Lantz et al. 2007). However, opportunities related to biogas can be seen globally. Biogas plants, treating wet-waste biomass is expanding in many countries worldwide, with biogas upgrading to biomethane following the trend (Scarlat, Dallemand and Fahl, 2018). In the developing countries specifically, biogas tends to provide more opportunities related to domestic-scale digesters that help cook, or light up the houses. This approach of biogas in developing economies, like those of China, India, and Bangladesh, helps reduce firewood consumption, further descale deforestation, and decrease indoor air pollution (Scarlat Dallemand and Fahl, 2018).

The approaches taken with biogas, however, need to be appropriately adapted to the circumstances of the region where the plant is to be applied. Research suggests that the technology, and thus best type of biogas plant to be used in a particular region, can be determined by its strength, airtightness, the availability of construction material nearby and the cost of this construction, the ease of operation, and maintenance, the efficiency, and also the feasibility of insulation and reliability (Mutungwazi et al. 2018). This criterion specifically can help determine the best type of digester that can be used in a region, or to assume the best kind for a country, however in many cases, finding the best fit a region as large as a country may not be the most tailored approach. Small, domestic, also referred to as residential, digesters are intended for supplying energy for cooking, lighting, or sanitation in more rural areas. Small to medium commercial digesters tend to be used for heating or the generation of electricity (Mutungwazi et al. 2018; DEA, 2016). Whether a plant is considered large or small can also depend on what is normal in that region. Innovations can be centered around various key aspects, such as digesters that benefit from solar radiation, in hot regions, that can trap heat to support the digestion overnight (Mutungwazi et al. 2018). Therefore, biogas digesters need to adapt to the specific context in which they operate, especially in various markets and economies.

2.5.1 Biogas' Position in Developing Markets

Biogas, by being more efficient than biomass in rural areas and healthier than fossil fuel in metropolitan areas of developing countries, provides opportunities for sustainable business models (Surendra et al. 2014). In developing Brazil, e.g., biogas has the capability of generating energy and reducing the notable environmental impact of disposing of biomass (Mathias and Mathias, 2015). In Russia, bioenergy is perceived as the most promising type of renewable energy, with powerful potential with agricultural waste, food processing, wood processing and urban treatment facilities (Simbirskikh, 2020). It is notable, however, that Russian experts working with biogas are concerned about the profitability aspect. More specifically, they are concerned about how it can be very expensive in comparison to wind-powered energy and coal-fired power plants. The issues around a free and uninterrupted supply of waste are also notable because not all facilities have enough raw material at their disposal. Finally, for it to be affordable and profitable, all the energy produced must be sold (Simbirskikh, 2020). This criterion currently suggests that biogas is an affordable option in Russia at farms with pigs, cattle and poultry, meat processing enterprises with large slaughterhouses, distilleries, sugar factories, breweries, and urban water utilities

(Simbirskikh, 2020). All these options must also be at a large enough scale for it to be an approachable option. In India, the macro environment, utilization area, feedstock type and scale of production all differ based on whether a small family biogas plant is considered or a large commercial plant (Mittal et al. 2018; He et al. 2013; Song et al. 2014). The Indian government has implemented various programs to develop biogas processes in the country (MNRE, 2015; Shukla, 2007). Biogas in India, however, has been constrained by various factors including social, institutional, and financial (Rao and Ravindranath, 2002; Schmidt and Dabur, 2013). In China, bio-based energy has been promoted since the 1950s, especially to support cooking in villages that had no access to other energy sources (Het et al. 2013; Liu et al. 2008). In recent years, both centralized systems and household bio-digesters have been used, without any obvious benefits of using one system versus the other. In general, however, studies recommend that to further develop the opportunity for bioenergy in China, investment mechanisms need to be improved and streamlined and that current funding channels can collaborate to incorporate governments, villages, and households working together to fit appropriately in both poorer and richer areas. Furthermore, these studies also encourage better relations between long-term environmental goals and both social benefits and financial incentives. Finally, it is also important to consider everything in the context. It seems that there is not a perfect system that could be incorporated nationally in China, villages, towns, and cities need to consider the local circumstances to at most appropriately (He et al. 2013). Another example includes the case of South Africa. Although biogas has officially been used for electricity since 1958 with 700 digester installations already in South Africa, the cheaper alternatives, have created limited market penetration for this technology. Many various digesters can be found in South Africa with each having its benefits for the scale and region it serves. More specifically, in South Africa, digesters that can achieve higher slurry temperatures through solar radiation during cold seasons are desired (Mutungwazi et al. 2018).

The utilization of biogas in Europe has shown, that although it is possible to ensure the profitability of the biogas business model, it is usually only achievable with a free and uninterrupted supply of waste. However, because not all facilities always have sufficient amounts of raw material, it might be difficult to use this as a profitable business model (Simbirskikh, 2020).

2.5.2 Entry Barriers into Biogas

Different countries are facing different barriers regarding biogas dissemination (Mittal et al. 2018); these issues can include problems from the stakeholder perspective (Adams et al. 2011), the system perspective (Lantz et al. 2007), some from the multi-level perspective (Kamp and Bermúdez Forn, 2016) and some from the difference in the functionality of the biogas system operating at different scales (Mittal et al. 2018). These problems, or barriers, also differ in regions depending on factors including the degree of the maturity of the market and how available natural resources like land, water and biomass are. These issues can further be divided down into area-specific barriers, like water unavailability and low ambient temperature (Shane et al. 2015) or perhaps technological scale barriers like inefficient distribution infrastructures hindering the expansion of biogas in a centralized system (Lantz et al. 2007).

From a technical and infrastructural perspective, many barriers can also be noted. Inadequate coordination between various government agencies, inconsistently scattered cattle waste, lacking access to skilled workers for both the construction and repairs aspect as well as a low output of usable material during winter, all slow down the manifestation of biogas (Mittal et al. 2018; Bansal et al. 2013; Kaniyamparambil, 2011; Bhat et al. 2001; Rupf et al. 2015). The lack of awareness, of both the technology extensively or substrates that do not only include cattle dung, accompanied by a lack of incentives from the government, further make it more difficult for biogas disseminating (Rao and Ravindranath, 2002; Ravindranath and Balachandra, 2009; Raha et al. 2014).

3 Methodology

Methodologies in research can be understood as “a strategy or architectural design by which the researcher maps out an approach to problem-finding or problem-solving” (Buckley and Chiang, 1976) thus this chapter serves to describe the chosen methodology and how this thesis aims to answer the research question. Furthermore, it describes the process of data collection and analysis. The approach taken for this thesis can be described as a qualitative explorative case study, where the developed and developing markets are contrasted regarding how sustainable business models look in the relative markets. An approach combing strategy literature, biogas and renewable energy literature was taken, hence the chapter on biogas market characteristics in 2.5. This was performed to provide sufficient knowledge into the industry of the study and see how it can be related to the literature on the sustainable business model, as well as to enrich the analysis capabilities in later chapters. Our data collection includes primary data collected from various Europe-based companies either part of, or heavily associated with, the biogas industry. Since biogas expertise is based in Europe, all of these companies know the operations in the biogas industry through their businesses operating in these countries, or partnerships in the developing countries. An open mind has been kept to see the bigger picture of biogas while collecting data and to not limit data to the relevancy of the specific case study as a perspective on analytical generalization is taken in the discussion. This section acknowledges and elaborates on these points while further describing the way the data was analyzed, and issues related to the validity and reliability of the data.

3.1 Research Approach

The aim of this thesis is to consider, analyze and find out more about biogas because it is a sustainable approach to energy generation that can significantly improve the wellbeing of the environment, while thinking of it as a sustainable business model. The study looks at different players of the biogas industry in Europe and considers the uses and practicality of biogas in other developing economies based on the expertise of those interviewed. Developing countries have been selected as a lot of research and reporting is currently going on around these countries due to their rapid growth and quick relevance on a global scale, and since biogas expertise is mostly present in Europe, a developed region, an opportunity to compare the two markets with this sustainable business model arose. Contacts were established through the European Biogas Association (EBA)

of companies originally based in Europe with very notable international operations for data collection.

The study benefits from a qualitative explorative approach as it was wanted to first identify industry experts and deeply analyze what they can describe concerning the biogas industry. This is why a quantitative approach was not selected, and why the study is explorative. Furthermore, research suggests the feasibility and appropriability of qualitative data when the desired outcome of a study is to elaborate on findings while using primary data (Yin, 2011). The methodological approach was not the leading factor of the study and was rather a consequential approach relevant to the research philosophy (Holden, 2004). The realism worldview (Creswell and Creswell, 2018) is significant to the qualitative and explorative nature of this research. All of these components contribute to the shape of this study comprised of: the construction of very general questions that ensure the explorative nature is within a reasonable spectrum of interest, data collection through interviews with companies heavily associated or directly part of the biogas industry, and analysis of the data and an interpretation of the data collected. While literature commonly supports following inductive approaches with qualitative studies and deductive approaches in quantitative approaches (Creswell and Creswell, 2018; Bryman & Bell, 2011) this study needed an approach incorporating elements of both. The ability to pull on aspects of both approaches allowed to deductively research relevant literature on key ideas of this thesis and an inductive approach allowed to analyze what elements of this study meant in the context.

3.2 Research Design

Besides selecting a qualitative, quantitative or mixed-methods approach, it is also essential to pick a research design, a type of inquiry that paves the direction for the research study. For this study, an explorative case study seems most appropriate as most valuable information about biogas will be held by individuals working with the industry closely and it might be difficult to predict what is most notable about this particular industry, hence the explorative nature.

This qualitative explorative case study approach considers the characteristics of sustainable business models in the biogas industry in primarily Europe as a developed region and developing countries, and how and why biogas matters in these growing markets. Case studies, like this one of the two markets, are approaches to research that focus on specific events and open the door for

finding applicability in other areas (Stake, 2005). Furthermore, they are especially useful when there is a need for in-depth details and specialized knowledge held by only industry experts hence why this approach was chosen (Creswell and Creswell, 2018). This approach is also likely to benefit from the international perspective of the companies because various perspectives will help bring the data to a general picture that can benefit from analytical generalization.

The motivation behind this study is notably driven by the lack of comparisons concerning sustainable business models analyzing how these sustainable business models differ between developed and developing markets. Furthermore, sustainable business models in the renewable energy sector tend to favor wind and solar energy and biogas are not commonly considered. The primary data collected will consist of 13 different interviews from different Europe-based companies, associations, and institutes with international operations. Many perspectives of various countries like Italy, the Netherlands, Austria, Germany and Sweden are very directly represented and various others are represented through either the company being located in that country or having a notable number of operations there. Companies in various parts of the biogas supply chain were considered as the industry has quite a large supply chain and an accurate and not too biased perspective on the entire industry was desired. In more concise wording, the companies were selected in an attempt to get both a diverse geographical positioning perspective as well as a diverse regarding their duty in the supply chain perspective. The companies vary in size notably and company size was reasonably represented in this study.

3.3 Data Collection

To support the explorative nature of our research, and since every research interview will have at least some structure, (Jamshed, 2014) a minimally semi-structured approach of holding interviews was taken. This form of structure embraces open-ended questions and is conducted only once with a specific individual. Semi-structured approaches to interview holding have been found to embrace reciprocity (Galleta and Cross, 2013) and help improve the following-up questions depending on how participants respond (Polit and Beck, 2010). This proved to be beneficial as we were very interested in hearing specifically how the interviewed desired to respond and what they found most important in this topic. To maximize the utility of the interview, a very flexible qualitative interview guide was created that incorporated material from the literature review of this report. The interview

guide needed to be used to collect similar types of data so that data from all the other interviews could be compared and not restrict what the participants could share. The interview guide can be seen in Appendix C

A total of 13 interviews was conducted. As a qualitative explorative interview in our case centered around seeking in-depth knowledge, we intentionally selected individuals of experienced positions in companies working with the industry closely. More specifically, members of the European Biogas Association were selected primarily based on working in various markets and on wanting to get a perspective of individuals working with different parts of the supply chain. The EBA classifies its members based on their roles in the biogas industry and the country of operation (see Appendix D). Given that biogas expertise is mostly present in Europe, with a majority of the global biogas operation being in the EU alone, contacting the European Biogas Association seems like an efficient way of getting in touch with industry experts (Scarlat, Dallemand and Fahl, 2018). To further supplement a sufficient number of interviews for data that could represent an actual trend or average and perhaps not an outlier perspective from an insufficient number of interviews conducted, other European Biogas Association members were later contacted.

The European Biogas Association is a European group founded in 2009 that aims to represent the voices of renewable gas in Europe (EBA, 2021). The information and contact details about specific companies that hold membership in the association are easily available on the website of the group. This source was thus used to contact members. It is also notable that the association has two kinds of membership: full and associate; only full members were contacted to hold the interviews as this allowed for hearing information from individuals that are more closely related to the industry and current trends that could be observed within biogas. General inquiry emails were initially used to contact the company and those were passed to the most appropriate individual within the company to hold the interview.

Only one interview guide was created as our research wanted to prioritize hearing the experts speak. The purpose of the interview guide was only to ensure that topics such as sustainable business models, size variants of biogas plants, B2B relationships along the supply chain, and differences between developed and developing markets were discussed within enough similarity that the data could reasonably be compared. This supported the desire of having minimally structured interviews

that promote the explorative nature of the interviews. The interview guide can be seen in Appendix B. Recently a surge of various platforms for business communication has occurred and thus different platforms were used to conduct the interviews. All the interviews were conducted over online platforms like Zoom, Microsoft Team or Google Hangout or by a telephone call. As those, we interviewed varied tremendously in their geographical positioning, and because of the strict travel restrictions resulting from the COVID-19 pandemic, in-person interviews were not a plausible approach for this research. Research suggests that the main disadvantage of holding interviews in a non-face-to-face manner is the absence of visual cues which could hurt the contextual and nonverbal data as well as the interpretation of responses (Novick, 2008). Given that majority of the interviews were conducted with the video call option, this issue was significantly improved. Furthermore, research does suggest that interviews held remotely either by phone or other methods give the interviewed individuals the opportunity of feeling relaxed in a self-picked environment and feel more comfortable sharing information (Novick, 2008). For these reasons, the nature of how the interviews were conducted did not seem worrying and appropriate.

The interviews were predetermined to be approximately 35 minutes however time was given appropriately to allow the respondents to answer however they felt fit. This resulted in the interviews being between 25 and 43 minutes. To best benefit from the opportunity of discussing the relevant information with those interviewed, as we were restricted to a reasonable time limit and only one interview, the interviews were transcribed using voice recognition software, and later double-checked to ensure all the heard words were accordingly transcribed into text. We had previous experience working with a software known as Otter.ai and decided to use it again. Once the transcripts were corrected and checked to make sure the software did not leave any discrepancies in what was said, the text was sent to the individuals interviewed and asked to be checked to the best of their recalling. All those interviewed were aware of the interview being audio recorded and there was not any opposition to this process being followed. A table has been constructed below with the name of the company, country, and its relevance to the biogas supply chain to best present the individuals that were interviewed.

Company Name	Origin Country	Individual Title	Date	Length of Interview
Planner, Manufacturer, Operator, Supplier of Components, Service, Consulting, Training	Austria	Head of Market Development	14 April 2021	34 minutes
Planner, Manufacturer, Operator, Supplier of Components, Service, Consulting, Science and Research, Training	Italy	Head of International Sales	14 April 2021	31 minutes
Planner, Manufacturer, Supplier of Components, Service, Consulting, Training	The Netherlands	Business Development Manager	15 April 2021	31 minutes
Planner, Manufacturer, Supplier of Components, Service, Consulting, Science, Research, Training	Italy	General Manager of Italian Operations	16 April 2021	26 minutes
Substrate, Service, Consulting, Training	Germany	Key Account Manager for UK, Republic of Ireland, Baltic States, Greece, The Netherlands, Belgium, Switzerland, USA, Canada	19 April 2021	37 minutes
Science, Research	The Netherlands	Biomass program manager, Senior Business Developer Energy Transition	20 April 2021	43 minutes
Service, Consulting, Science, Research	Sweden	Executive Managing Director Baltic Energy Innovation Centre, CEO Renewable Energy Technology International AB	20 April 2021	Email
Service, Consulting, Science, Research, Training	Austria	Working group leader of research related to biogas dissemination in a European university	21 April 2021	34 minutes
Manufacturer, Supplier of Components, Service, Consulting, Training	Germany	Director	22 April 2021	25min + email exchange
Planner, Manufacturer, Supplier of Components, Service, Consulting	The Netherlands	Business Developer Renewable Gas	23 April 2021	34 min + email exchange
Planner, Manufacturer, Supplier of Components, Training	The Netherlands	Manager Business Development	26 April 2021	41 minutes
Planner, Manufacturer, Supplier of Components, Training, University Researcher	Germany & Netherlands	Researcher of Biogas in Germany. A collaborative work between a university & a Dutch biogas-centred company	6 May 2021	34 min
European Biogas Association (EBA)	Europe Wide	Project Officer	10 May 2021	32 minutes

Table 1: Interview Information

3.4 Data Analysis

Collected data needs to be analyzed to make sense of what was said and what implications it has (Creswell and Creswell, 2018). Transcription was kept to a verbatim standard as closely as possible so that the coding software can identify actual trends and perhaps not biased ones. To perform analysis, a process was followed.

Firstly, the data was prepared. This included double-checking the text produced from the audio recording transcription software and organizing it on separate PDF files. The interview transcripts were also confirmed to be accurate with the members interviewed. All texts were left identically as collected at this step as winnowing was left to be performed after the software codes and presents themes. This approach was taken mostly due to the explorative nature of this study. The data was then considered by eye; all transcripts were read, and some trends already were identified. Although the software has a valuable reputation for coding, the reading and familiarizing with the transcripts prior to running it through the software was performed to possibly spot a misrepresentation of themes should the software have any issues. The coding software, Nvivo, was then used and all the PDFs of transcripts were added to the software. The software was checked on different computers, and the order of uploading the transcripts was alternated to make sure the software did not have any anchoring issues. Coding is the approach of organizing data by including relevant quotes from transcripts, which serve as subcomponents of parts of a label, or theme, to categorize data (Creswell and Creswell, 2018). This was performed using the software which created a digital canvas that organized specific quotes from transcripts based on a bigger theme they identified with. Coding was done by sentences with themes, rather than paragraphs. The software was able to construct themes based on keywords identified however the data was further looked at at this point, and some minor restructuring of the themes was then performed as more connections were identified. Descriptions were used to identify aspects of the data analyzed that software did not have as much knowledge about. This included information about the individuals interviewed such as job positions, and their location and what market they have experience with. This was performed to be able to consider if certain trends were more dominant in specific categories of individuals. Research recommends that a small and manageable number of themes should be used ranging from between five and seven themes (Creswell and Creswell, 2018). This research thus identified six themes.

This qualitative approach to collecting data created the opportunity of analyzing beyond the possibilities of just identifying themes.

An expectation with the codes, as suggested by the literature, suggested that the codes found should include: expected codes, ideas that were already noticed to be trending prior to performing analysis, surprising codes, the ones that were not anticipated, and codes of unusual or conceptual interest, which include themes that are interesting for the purpose of the research and stand out from the rest for their specific quality or for how they came to be (Creswell and Creswell, 2018).

3.5 Validity and Reliability

When performing research, it is vital to assess the quality of research performed (Noble and Smith, 2015). For this purpose, it is essential to assess the reliability and validity of the data this thesis collects. In qualitative research, validity refers to ensuring the accuracy of the findings and reliability is the confidence that the approach taken is consistent across various researchers and different projects (Creswell and Creswell, 2018). This section will elaborate on both of these.

Assessing validity in qualitative research relies on assessing trustworthiness, authenticity, and credibility (Creswell and Miller, 2000). One approach this research uses to support the validity is that of triangulating. Themes have been considered and looked at to ensure these concepts are coming from multiple sources and not necessarily one interviewee. Furthermore, these themes have been further researched online to check if they are a rather notable trend. Since all the mentioned themes seem to exist from a convergence of speakers and sources, the validity of these themes seems improved. All of those interviewed were further made aware of the themes constructed from the transcripts and invited to comment on whether this seems like a theme of what they are experiencing, this served as an approach of utilizing member checking (Creswell and Creswell, 2018). An element of peer debriefing, through discussing the findings with both the supervisor of this research and the case company interested in biogas was used to further support the validity of this report.

On the reliability side, several steps were also followed to support the quality of this study. All the transcripts were checked before the analysis. To prevent drifts with the definitions of codes, frequent data comparisons were made with the codes.

All processes while conducting the research were made with as much consideration of possible bias errors that may be made. Sampling bias (Sandelowski, 1993; Noble and Smith, 2015) was addressed by critically reflecting on whether a diverse enough portfolio of the EBA members has been selected. To minimize personal bias, coding software was selected instead of hand-coding and finding themes. Since the study is explorative and semi-structured, and since the questions were only used to ensure that comparable data could be collected, this did not necessarily cause questions to be worded in a particularly biased way thus biases errors there were minimized. All of the individuals interviewed were approached and informed that all the information collected will only support and bring awareness to the benefits of biogas thus it is unlikely that participants would answer dishonestly as answering accurately only brings recognition to the work they perform. The approach to validity and reliability of this thesis, in a multipurpose manner, also supported the ethical considerations ensuring the companies interviewed were aware of the analysis performed and that any results will not have negative effects on them. This research does acknowledge that since companies operating in and out of Europe were the ones interviewed, a perspective on developing markets that is characterized by elements of this region can affect the bigger picture however given that many of the companies interviewed had large operations in developing markets with many locals working for the company in these countries, this does not invalidate the perspective of these markets.

4 Empirical Results

This chapter is organized to present the empirical findings. To do this, it commences with a case description considering biogas and its industry, and then both developed and developing markets. Following this, the results of the interviews are presented organized by the thematic codes used in this research.

The following chapter will focus on the empirical data from the interviews with the subsequent chapter analyzing and putting the results in perspective to literature.

4.1 Case Description: The Two Markets

This thesis takes the case of the two markets, the developed market and the developing market and how they differ concerning sustainable business model opportunities in the biogas industry. For this reason, this section will present the empirical results collected on biogas, developed markets, developing markets. An introduction to the industry will commence this chapter to support the understanding of the empirical data collected.

4.1.1 Socio-Economic Context: Developed versus Developing

Different elements help understand what market is already developed or developing. The Human Development Index (HDI) has a value between zero and one and can help distinguish between developing and developed countries. High-scoring countries, those with a value between 0.8 and 1, are some of the most developed nations, this includes countries like Australia, most of the European Union, the USA, Canada, Brazil, and the United Kingdom. This factor alone cannot be independently used to determine what a developed country is. According to the World Bank, the global average gross domestic product per capita was at 11,428 US dollars in 2019 (World Bank, 2020). With Brazil's GDP per capita, for example, expected to be below 10,000 US dollars until 2026, the country seems to be rather still developing even though it scored highly on the HDI (IMF, 2021). This is why it is important to consider a large range of factors when determining which markets are considered developed or still developing and that not all developing markets are at the same phase of development. Having these elements in mind can help understand the following interview data that pulls on empirical information concerning developed and developing markets.

4.1.2 Interview Results: Developed Markets

Interview participants commonly referenced Germany as the founding country of biogas in Europe. The growth in Germany seemed to trigger the development of biogas in other countries and started a momentum that led to Europe becoming the hotspot of biogas knowledge. One interviewee portrayed this by stating that:

> "What I learned is that the other countries learned of the German mistakes because the Germans were the first ones. They had the boom and this led to a booming industry."

When referring to Germany furthermore, especially regarding observable trends in recent years, however, it was noted that Germany is not the biogas leader in Europe any longer and most biogas developments are currently observable in Italy, France, and Denmark.

In developed markets, the biogas business model is increasing, as observed by the interviewees, related to liquefying into liquid natural gas. Trends in the developed markets seem to acknowledge that biogas is not a competitor to other renewable sources like wind and solar but is rather a complementor to do what cannot be done with other sources. This was exemplified by an interviewee when claiming that:

> "In general, we assume that electricity will be available through solar and wind and other technologies. But what we do see as very important is that gas is much easier to store than electricity and it's much cheaper to store than electricity. We don't need the famous and expensive batteries that are needed for electricity."

This fits in with the commonly described renewable energy mix phenomenon described by all the interviewees that one solution, at least in the foreseeable future, is unlikely. The participants commonly referred to the fact that wind energy requires windy days and solar energy sunny days and that these factors limit the opportunities of only having these approaches to energy. Furthermore, the degree of importance with this was explained in interviews by presenting the example of northern Scandinavian countries where not only solar exposure is tremendously weaker but also there is a less developed/ undeveloped gas grid.

The most mentioned concept connected to biogas in developed markets is the connectivity of the industry disseminating and the presence of incentives or governmental help. Participants commonly stated that it is very easy to use fossil fuel-related approaches to generate energy. They in Europe, as claimed by the interviewees, are inexpensive approaches that on a basic cost comparison, biogas cannot compete with. This was exemplified with one expert claiming:

> "You cannot compete with the fossil prices, forget about it, you cannot. So the only option is that there is a mandate. So that there is an obligation, from Europe, or that is the crazy part of Europe. It has to be then translated for every member state, […] then you have a fighting chance because then you don't compete with the fossil prices."

This idea was connected generally to the concept that in developed markets, the resources needed for all possible approaches to energy are present and that for the renewable and sustainable ones to be embraced, the environmentally unfriendly ones need to be discouraged, or the sustainable ones need heavy encouragement.

4.1.3 Interview Results: Developing Markets

The most commonly shared description of developing markets concerning the biogas industry that was present in the data collection, included the concept that there is a tremendous amount of potential in these markets through the availability of the needed resources. One interviewee portrayed this by stating that:

> "Organic sources for the biogas production are manifold and globally available. What is lacking in most areas is the public awareness and therefore also political support."

This concept was repeated several times with specific markets including the markets of India, Russia, and several South American countries like Brazil and Argentina. All interviewees that discussed developing markets felt certain that what is hurting the dissemination of biogas in these countries is the support from government or other recognizable bodies and not the lack of resources as all living beings work with organic material and thus waste. Some of the interviewees believe that the lack of governmental support for the industry is more present in countries that have an abundance of fossil fuel resources like in Russia.

It was also very notably stressed that the opportunities of developing a sustainable business model in a developing market will usually not have a universal formula that will work in all developing markets as regional and local considerations, like what grows in these areas and the climate impact how biogas should be approached. Napier grass received a lot of attention in Asian markets as a potent approach to biogas because of its common and frequent harvesting. In areas that are less accessible to import oil to, like some of the inhabited islands of Indonesia, where grass and other greens grow rapidly, it can be much more approachable to construct a biogas plant to produce energy than to import resources to construct it that are not renewable. In South America, where huge slaughterhouses are common, in Brazil and Argentina especially, taking advantage of the waste has lots of potential for constructing a sustainable business model around biogas with benefits of economies of scale. This was notably mentioned for the American market in general. One participant of the interviews that went to study some of these biogas plants in Mexico stated:

> "In Mexico […] they're [the biogas plants] just unbelievably huge we're talking millions of pigs. So we're talking millions of cubic meters every year. It is amounts that are just for us Europeans they're unbelievable. it's all picking up speed […] in Mexico, they don't really have biowaste curbside collection, they don't recycle, they don't separate waste streams. So, this is just picking up, but it's something they want to do."

This interviewee also brought up the idea of the rapid growth in these markets. An example from China, from the interviews conducted, shows that the growth capabilities in the Chinese market are unmatchable. The Chinese government was capable of suddenly placing massive amounts of biogas plants without having one previously.

The sophistication of the approaches developing markets tend to work with regarding biogas was also notably mentioned. Interviewees confirmed that from a European, or generally, biogas developed market perspective, the sophistication of the digesters and plants is lower with membrane technology in developing countries, that in theory, should be less efficient. The approaches taken by these countries are still producing great quality biogas, to standards that commonly surprise more developed companies working with biogas. The technology can include holes in the ground in a kind of lagoon as observed in Mexico, or the currently discussed portable biogas plants that aim to serve several households in rural places like in parts of India.

It is also important that biogas in developing markets is simply different but cannot be classified as worse, or necessarily better in developing markets. One interviewee portrayed this by stating:

> "China and India, to be more exact, are not valuing the biogas and biomethane the way it's done in Europe […] because these people have been doing biogas from way before Europe even started."

As stated by several of the interviewees, in developing markets, the opportunities of biogas are also related to whether a gas grid is present in a given region. Biogas commonly is seen as a more suitable option in places where there is not a gas grid that communities can count on.

4.2 Thematic Findings

4.2.1 Incentives and Company Action

Most of the interviewees described the monetary incentives of the government as one of the main drivers of the biogas industry in the past 20 years as:

> "The main incentive from biogas is to earn money […] or save money. […] Nobody runs a biogas plant, because they want to do good for the environment. I'm sorry. They all want to earn money at, at some point in the process."

The given incentives differ mainly regarding the country, size and feedstock used for the Biogas production and shape the industry depending on the support schemes given. Depending on the monetary incentives, the activity of players on the market is higher or lower. Many interviewees described a boom in the biogas industry in the early 2000s when many European governments introduced fixed feed-in tariffs (FIT)[1], which helped to introduce and mature the market. "The industry has needed some incentives to start, basically" as interviews revealed that the competition of biogas, coal and nuclear energy and the gas sector with fossil gas, is too cheaply available, as it is not reflecting the related carbon emissions and inevitable climate-changing consequences, which makes biogas production economically unprofitable and monetary incentives necessary. Many interviewees expect a change as soon as CO2 emissions of alternative energy and gas production will be made visible with a CO2 tax in the years to come.

[1] The minimum price per kWh that is guaranteed by the national government (Pablo-Romero et al. 2017).

Therefore, the estimate is that a biogas plant cannot work without subsidies at this point, as "the price [of biogas] is three or four times as high as a normal natural gas price." When the gap between biogas and natural gas becomes narrower due to the increased price of the natural gas via the CO2 prices, the industry will be less dependent on subsidies by the government and new energy projects would flourish. When this point will be reached the respondents were not agreeing on. Therefore, many predict the future of biogas very much connected to the expectations about future support schemes. Some respondents argued that for a continuation of growth there is a need for stable and effective support schemes to increase the plannability for investors, as biogas plants are a resource-intense project, that needs investors to be sure of future sources of capital.

The monetary incentives in Europe already created a market for biogas, which differ between the countries, depending on the incentive scheme driven by the government. The interviews revealed the large influence of Germany in the biogas industry. This is due to the fact, that Germany was one of the first countries to start with the Erneuerbare-Energien-Gesetz (EEG) of 2000, the German Renewable Energy Sources Act, which encouraged the production of renewable energies. This made biogas profitable and therefore introduced a boom in the industry. The feed-in tariff was set for 20 years and depended on the technology and size of the plant with Germany having the highest FIT guaranteed but also the lowest. The energy produced by agricultural biogas, like corn, and from smaller plants receive a higher FIT than larger plants using wastewater and or landfill waste. When the EEG in Germany started to allow energy crop usage for an additional fee, the market grew drastically in a short amount of time. Other countries do not incentivize the usage of energy crops and concentrate on landfills and sewage sludge.

Italy has a fixed FIT for 15 years, but limits this to 999 kilowatts and therefore drives the sizes of the plants. In France, incentives, set for 15 years, are also related to efficiency and size (favoring smaller capacities) and promote biogas from wastewater treatment. Many interviewees confirmed that the French market is, with the Italian market, the fastest growing one in Europe at the moment. This is largely driven by government incentives, as it set a target for 2025 to hit a larger percentage of renewable gas. The United Kingdom also has fixed FITs for 20 years and promotes biogas plants with smaller capacities (less than 500 kWh).

One expert explained, that when building new capabilities, it is like a poker game to calculate how big the plant should be, as the incentive differ depending on the size of the plant.

Others describe an alternative monetary incentive for biogas next to the FIT paid by the government. The biogas plant operator can also earn their money from the gate fees of the waste

disposal. Therefore, they are not interested in the FIT by the government or the effectiveness of their plant, as the gate fees paid to them are higher than the expected FIT, or only account for a small fraction of the profit they make. All interviewees made clear, that the businesses move with the incentives. If the incentives shift, e.g., in Germany to energy crops as feedstock, or in Italy with supporting smaller capacity digesters, the whole business operation shifts in the direction of the incentives to be able to exploit most of the incentive.

Even though the majority of the interviewees agree that the main incentive of biogas plants is to make or to save money, many also mention secondary incentives that come automatically when producing biogas. One of these incentives is the possibility of reducing fossil fuels and energy demand, as they use resources from their industrial processes to create biogas. Examples given were dairy farms, breweries, food processors and slaughterhouses. This creates greener products that society asks for. Others need to meet targets regarding their wastewater and can use this as an opportunity to use their resources effectively and not pay for the disposal. Sustainability is only a subordinate cause of these efforts, even though many companies are aware of the beneficial effects on the environment. However, there is a tradeoff been made between "what they're able to invest in terms of money, and what they're willing to invest, to improve things for the environment." It was described that the respondents already see a change in the mentality of the society, and a possibility for companies to claim greener products, which society increasingly asks for.

In the developing markets the respondents acknowledged non-monetary incentives:

> "For some places [biogas] can make the difference between having energy and not having energy."

Even though not applicable to all regions, most interviewees agreed that biogas had the potential of solving energy problems in developing markets. One respondent reported about an initiative by a non-governmental organization (NGO) that created mini biogas plants, about a cubic meter of gas, used for household cooking instead of the usage of wood. This was incentivized in India to prevent the chopping of wood for firewood.

4.2.2 Supply Chain Complexity

The Supply Chain Flow in the Biogas Industry was reported as more difficult and complex than in most industries. This was explained by the fact that the plant operation touches many different

sectors, from energy, agriculture, and waste management to transport. The decision-making is broadly distributed as well. This is because biogas is a more complex technology compared to other renewable energy sources, like wind and solar.

> "From a scientific point of view, it's a very interesting process because it combines so many different metabolic pathways to one simple process. And in the end, it is very complex. So, the whole process is simple, so you just throw things in a pond or somewhere and you produce gas. But if you look into detail at all the organisms you have inside, then you see the complexity to each other. That makes it also scientifically very interesting. And you get so many different results from different people. And so, you have a huge variety of results. On the surface, it looks easy, and not complex but on the inside it's complex."

To truly understand the whole process, one needs time to dive into the topic more deeply, and many decision-makers do not have this time, which can lead to a barrier of recognition of biogas true potential. This was also stressed by insights into the many different policies in various countries that reportedly are frequently changing.

Biogas is easier storable than wind and solar energy and does not need batteries. It is also available around the clock and does not depend on wind or sun. It, however, needs infrastructure to be fed into and feedstock readily available in the needed capacities. As Feedstock is an organic matter, no one biogas plant is the same.

Therefore, highly specialized knowledge in specific areas is needed and respondents stressed the importance of partnerships to ensure the functionality and high efficiency of the plant. Interviewees also pointed out the need for a proper infrastructure around the plant to ensure infrastructure to feed the energy or gas into the grid as well as the availability of the feedstock needed, which is missing in many rural areas in developing countries. Depending on the feedstock, other requirements apply for the parts used within the biogas plants, e.g., the digestors, stirrers, or enzymes. Highly specified knowledge and expertise ensure safe and effective usage of the plant. There are many different players within the Biogas Industry: e.g., manufacturers, scientists, farmers, or operators.

Commonly used kinds of feedstock include:

- Agricultural Feedstock (animal manure, crop residues, energy crops)
- Landfill Waste (e.g., waste collection from municipalities)

- Industrial Feedstock (slaughterhouses, sugar cane, dairy, breweries, food processors in general)

All respondents pointed out the particularity of the feedstock in Germany, as the government incentives the usage of corn with an additional fee, which lead to a drastic increase in the implementation of corn as a feedstock in German biogas plants. More voices call out the problem of food vs. fuel.

> "They feed energy crops, which are exclusively grown for biogas and mostly maize, but also whole crop silages, like rye or oats or any sort of the whole crop that is harvested, and also grass in some areas. In Germany, the model is, depending on what you digest, you can't mix waste energy crops, and you get different [FIT] depending on what you feed you have either got an energy-crop plant, or you have a waste-fed plant. And according to this, your [FIT] varies. And that is very different in most other countries. Most other countries focused early on waste digestion and operators are allowed to mix feedstocks more if they want to digest a certain amount of maize, with say municipal solid waste or whatever waste they could get their hands on, brewery waste, dairy waste, anything, then they're allowed to mix that, and the [FIT] is usually staggered due, according to the capacity of the site, where it's here [in Germany] that's a bit different, very complicated. But yes, we definitely see differences and feedstock mixers."

In conclusion, in Europe the used feedstock is driven by the monetary incentives of the government.

A biogas plant is also high in equity investment and with a partnership, the risks can be more widely dispersed. As the market in Europe is more mature, most actors of the biogas industry and therefore the specialized knowledge is mainly positioned in European companies and organizations at this point.

In the developing markets, the interviews revealed that operators of biogas plants mostly use feedstock of what they can find: "they have the waste, and they have the energy demand. So it really makes sense". Pig farms in Mexico will use manure, in countries in Asia Napier grass creates great opportunities. They also use wastewater to avoid paying a fine imposed on them by the local government. "Organic sources for the biogas production are manifold and basically globally available". The problem is only the existing infrastructure. Curbside waste is not as common as "in

Mexico, they don't really have biowaste curbside collection, they don't have, they don't recycle, they don't separate waste streams."

Since much of the knowledge is centralized in Europe, the used technologies in the biogas plants are rather primitive. Depending on the feedstock, however, this is enough for a satisfying result, as e.g., pig slur is a rather uncomplicated feedstock. It is often only used a single membrane over a simple hole in the ground that collects the biogas.

> "[A] large rectangular hole in the ground you put sheeting in, slurry and cover the whole thing with a membrane and no stirring, no pumping, it just flows in and flows out. And they trap as much biogas as they can basically."

Some respondents expressed, that in the opinion of the people from the developing countries, the parts and knowledge of European countries are just too expensive and that they rather would like to work alone and figure it out themselves.

4.2.3 Scale

As already mentioned, most interviewees pointed out that the scale of the biogas plants in Europe is mainly driven by monetary incentives by the government. As most governments provide higher FIT for small capacity biogas plants (e.g., staggered FITs in Germany, favoring smaller capacities)., the are many smaller plants in several developed countries. Scaling up biogas plants is rather difficult, as the technology and feedstock are closely linked to the scale of the plant. In Germany, the average biogas plant operates with a capacity of about 500 kWh Biogas, where an upgrade would not be economically feasible. Other sources reported an average size in Italy, or Europe in general, of 1 mWh. This is also because Italy has a limit on its FIT at 999 kWh. As Italy does limit the allowed usage of energy crops farmers depend more on feedstock, they produce themselves and use this for the production of the plant, which is animal manure or waste collection from the municipalities. Therefore, the biogas plants of farmers only reach a size of about 100-300 kWh. This was echoed for biogas plants from farmers in the UK as well.

For biogas plants in the developing market larger scales as well as smaller scales, but fewer sights, in general, were reported. Larger scales were reported for Brazil, South America, and China. Most owners of companies use their production waste ad feedstock for the plant, e.g. animal husbandry farms in Mexico with millions of pigs, or sugar cane factories in Brazil. As the companies having

a large scale, and therefore a large amount of feedstock, the biogas plants also had a larger scale, even though no exact numbers were expressed.

A small-scale portable biogas plant with about a cubic meter of gas, used for household cooking instead of the usage of wood has been described in India. A similar, simple form of a biogas plant was described in South Africa:

> "Large rectangular hole in the ground you put sheeting in, slurry and cover the whole thing with a membrane and no stirring, no pumping, it just flows in and flows out. And they trap as much biogas as they can basically. Very primitive."

4.2.4 Trends and Human Behavior

The majority of interviews revealed that, after an initial drop in the biogas market, there seems to be an uplift in the industry right now, as society becomes more aware of it. This was echoed with the ruling of Germanys' top court to share the burden of reducing greenhouse gas emissions between the young and old generation and that the government needs to set more clear goals for after 2030. Therefore, many expect an uprise in efforts in reducing greenhouse gas emissions, which could lead to an uplift of the renewable energy sectors in general.

There is also a new concept introduced called Biogas-Done-Right, which has the goal of increasing biodiversity. Biodiversity is also one goal Europe tries to foster with the Green Deal in the future. After harvesting the main crop for food production use the agricultural fields in winter for a second crop, which will be used for biogas production. As it highly depends on climate conditions to grow crops in winter, an initiative in Italy looks promising.

> "In the Nordic Countries we are investigating not to have a second crop, every year, but to have like a four-year scheme in which in the end, you will have four crops for food, and then two crops for energy production during the winter."

Even though there are some setbacks in the renewable energy sector by political factors of people complaining about e.g., the noise of windmills or the smell of biogas plant, or some people that do not believe in climate change, there has been more awareness by the public. This is in part due to the media coverage of initiatives like Fridays-for-future.

Despite the fact, most interviewees revealed that they believe in the future of biogas, some were skeptical about the size of the role biogas will have. Some believe it will only have a minor role due to limited biomass, with a small percentage of the renewable energy mix of the future. This energy mix of the future (2030) will, according to the respondents, consist out of the wind and solar energy but also hydrogen. There has been extensive research about hydrogen in the last few years, but at this point, it is too expensive to seriously be a substitute for fossil fuels. But there are already efforts to transfer the natural gas backbone of the transport system to an h2 backbone in the future.

But there are also critical voices:

> "Everybody believes that hydrogen will be the solution to save us all. Which is, as far as I'm concerned, totally overrated and this will still take years, maybe centuries before we have a functional hydrogen society here."

4.2.5 Sustainability

The concepts of sustainability were also heavily mentioned and discussed during the interviews. Many of those interviewed portrayed their perspective with biogas as a competitor of producing energy to traditional fossil fuel approaches. The problem however is that biogas is more expensive usually, and its sustainable impact on the environment is not reflected in the price. One expert claimed:

> "Natural gas is just sold too inexpensive, not reflecting the related carbon emissions and inevitable climate-changing consequences."

This concept was commonly repeated throughout the interviews that sustainable approaches, notably biogas, need to get additional credit or consideration, in some way, for the fact that they are not hurting the environment and human health like fossil fuel emissions are. The industry experts, however, stressed how important it is for all the sustainability thinking and business approaches to be approached and considered on a global scale. If one company tries to be courteous of its effects on the environment, and thus incurs expensive additional costs, it can only stand a chance if all the other companies are also taking care of its bad effects on the environment. It was stated by the experts that is essential that all companies realize that business as usual, when not

approached sustainably, cannot be an option any longer. A key message all of those interviewed portrayed was that a transition to renewable energy sources is essential.

The concept of fighting back versus fossil fuels and using renewable energy sources was not the only key aspect of sustainability mentioned in the interviews. It was also very commonly mentioned that the consumption of energy generally needs to be reduced globally. One individual claimed:

> "First of all, we need to, of course, transition the energy sources, right. So, we need to go to renewables and shut down and replace the fossil, that's one thing. But we need to reduce energy consumption in general. So, we need to reduce things in general."

These concepts of reduction, in general, were further supported by more of those interviewed that claimed that everything we as a society have is currently plugged in, taking electricity and that it is simply not sustainably possible for everyone to live with such energy consumption as people in the developed world do. Key messages of acting now and relying less on energy were stressed. Another key aspect mentioned included that of circular economies. Biogas, according to those interviewed, has a lot of potentials, based on what it is and how it operates, to contribute to a circular economy and thus a sustainable economy.

It was however also mentioned that the sustainability of biogas needs more recognition from the government still. The Red II, the European Union's approach to sustainability criteria that member states must comply with was repetitively mentioned, however those interviewed still believed that biogas (and biomethane) is still primarily considered as a source of energy that just luckily happens to be sustainable. Generally, the interviewees believed that the shape of the biogas industry in the future heavily relies on the governmental support schemes present in a given market.

It was also mentioned by those interviewed that in developing markets, there seems to be a trend between how widely available natural gas is, and how widely taken on board biogas is. This was by one example, presented with Russia, and how they are not embracing biogas much due to their large scale of natural gas operations.

Interview participants also heavily supported the idea of an array of renewable resources. Those in the industry do not believe that one renewable energy solution, whether it be biogas, wind energy or solar could solve the sustainable energy challenge in the future. One participant exemplified this by claiming that:

> "Diversity of options, especially when we divert from anything that is fossil. There's not going to be a one size fits all, it's going to be a multitude of different options, and not only in gas but also in, the field area and in the chemicals area, you will see that there will be some changes. […] but still, there is a long way to go."

4.2.6 Biomethane

Majority of those interviewed heavily supported the biogas upgrading process that can be used to create biomethane. The concept of biogas alone was supported by those interviewed and they claimed that it can be a successful sustainable business model but there are several other benefits to going through the upgrading process that cannot be realized with biogas alone. Describing the process, those interviewed described that upgrading can either produce the biomethane and connect to the gas grid if a country has one or go through liquefication and make biomethane into a liquid natural gas (LNG) that allows for both easy logistics of the fuel but also great potential for fueling bigger trucks, and marine vehicles that currently are very difficult to defossilize and decarbonize and do not seem to have the option of going electric. Some individuals and companies do not even think of biogas alone but rather just think of it as a step required to make biomethane. One interviewee described the opportunities of biogas as an LNG by stating that:

> "We value and promote particularly the use of renewable biomethane as alternative fuel to replace fossil fuel-based diesel and petrol. This is actually the only technical and commercially viable solution to reduce environmental emissions in heavy goods transport on land and sea."

An expert on the French market however portrayed biomethane as very beneficial when connected to the gas grid by saying that:

> "France is […] one of the fastest-growing regions [for connecting biomethane to the gas grid]. I think that's driven by government incentives to make more green gas and feed it

> into the gas grid because they have a target for some percent of renewable gas into the gas grid, made by 2025. And, and because of that, there is a need for biogas plants that upgrade to biomethane. […] Most of those plants now want to connect to the gas grid, which also requires some skill, right, because the upgrading technology is quite expensive. It's quite an investment, you could say."

The concept of the upgrading process being expensive was very commonly described when those interviewed discussed the biomethane process. It was also discussed that this is the rapidly growing area of biogas and biomethane in Europe especially, with many trying to bring the costs down as appropriately as possible to encourage it, due to the belief, held by those interviewed, that biomethane has incredible potential. It was however commonly mentioned that the size of the plant needs to be rather larger for the upgrading process to be economically feasible.

Many of those interviewed, however, saw opportunities for biomethane could be further supported, in Europe especially, if the government went ahead and spread awareness and pushed the citizens to utilize it. Some simply claimed that the government needs to create and support the biomethane utilization while others went ahead claiming that the government needs to take ownership and just put biomethane upon people by saying that:

> "In Austria, you can pay an additional fee to get biomethane as a household, but people are too lazy to use it […] the Swiss context […] you get automatically 20% biomethane. And, you know, you need to be active, to get 100% of fossil fuels. Most people are too lazy, so you have a tremendous increase in biomethane demands. And that's why the industry is increasing so you need to develop new systems. To get this implementation and to get these ideas, and to do to get to people to use it because if it's too complex, then you don't do it […]."

Biomethane, from the perspective of those interviewed, seems to be very hopeful and has lots of opportunities. Company experts are even now openly claiming that they are "[…] convinced that biogas, especially upgraded biogas, has a bright future in Europe […] and the world."

4.3 Chapter Summary

Topic	Summary
Developed Markets	• Germany was the market founder in Europe. • Electricity can be supported with wind and solar, but biogas has benefits as it is easier to store gas and it does not need batteries. • Biogas cannot compete with fossil fuels on price alone.
Developing Markets	• Organic waste can be found everywhere. • Massive economies of scale possible. • Different value for society than in developed markets.
Incentives and Company Action	• Biogas is used to make or to save money usually. • Monetary incentives in Europe created the biogas market. • Feed-in tariffs create opportunities and affect scale. • Social incentives to bring biogas to remote areas that cannot have other access to energy.
Supply Chain Complexity	• A lot of variables in the process of providing biogas. • Adequate infrastructure needed to connect to gas grid. • Feedstocks and energy crops further bring elements of variation. • In developing countries, whatever can be brought in is used.
Scale	• Monetary incentives determine scale. • In developing markets, scale varies based on where the plant is.
Trends and Human Behavior	• Changes and cultural appropriations that fit specific regions. • Hydrogen brings a lot of hype of hope into future energy mix.
Sustainability	• Natural gas is too inexpensive, but we need to transition to renewable sources. • Countries and unions care for environment (ex. Red II). • Energy sustainability will not have a one-size-fits-all anytime soon.
Biomethane	• Biomethane market on the rise. • It is helpful in industries that struggle to defossilize. • Has a bright future however there is not much movement in developing countries yet.

Table 2: Summarizing Table of empirically collected Data during Interviews.

5 Discussion

The aim of this thesis is to answer the question of how sustainable business models differ between developed and developing markets in the biogas industry. To answer this, data collected from interviews held with industry experts indicate that incentives, which can take on forms not just limited to financial support, shape how any business model looks. Furthermore, these incentives establish the trends and human behavior, which decide what sustainability opportunities exist in a market, with biomethane being a dominant example for these new sustainable services within the biogas industry. These Sustainability Opportunities can also create an incentive themselves. The incentives also shape the scale of biogas plants in various markets which ultimately, in a reciprocal manner, shape the supply chain, and its complexities. Different incentives, tend to exist between the developed market studied and the developing ones thus all the subsequent aspects differ between the two markets, which changes what sustainable business models are in different markets within the biogas industry. The relationship of the themes mentioned creates an opportunity to visualize a framework of how the themes are all related that has been constructed in Figure 2 below.

5.1 Thematic Relationship in both Markets

To best understand the relationship and connectivity of the themes, as is depicted by the constructed framework in Figure 2 below, it is best to first consider the incentives, as this thesis comprehends the entire movement of the themes from the way the incentives are. As it is the case in all businesses, some financial incomes are required to sustain operating; given that biogas cannot compete with its fossil fuel competitors on price, the rapid growth of biogas in developed markets especially but not only in those resulted from various forms of incentives being introduced from different policymakers. In Europe, these incentives, when financial, include various initiatives, but notably the previously mentioned FIT. The incentives around the FIT, in countries like Germany and Italy, financially support working with smaller plants which heavily affects the scale of plants in these specific countries. From this argument, it can also be seen how trends and human behavior are affected but this will be discussed in detail later. The relationship between scale and the supply chain, especially given that the biogas supply chain is quite complex with a lot of different parties

involved including manufacturers, scientists, farmers, depends tremendously because different feedstocks are capable of producing varying efficiency biogas and if specific feedstocks are supported by incentives, they likely are preferred and therefore moved and transported for their use. It is also notable that ideally, biogas would take on what is locally available to produce the energy, however, the incentives decide what becomes more profitable and this further affects what will be coming from which place to which places, further affecting the biogas plant. Given that easier access to resources can support larger-scale plants, and vice versa, there is a back-and-forth effect between scale and the supply chain which is depicted in the above model.

In developing markets, financial incentives are not as widely available, although in some countries, like India, various schemes have been introduced to support biogas. Biogas does however have the opportunity of working there through incentives that are not necessarily financial. Incentives can also include social and environmental ones, where less effort is necessarily placed on making money and more is placed on helping individuals meet their energy needs and have cleaner, healthier approaches to meeting their energy needs than they traditionally used. In various parts of the developing world, like numerous areas of Asia, Napier grass, which grows quite quickly and commonly in several Asian regions and can be harvested much more regularly. Given that these fields of grass commonly grow in rural places and not cities, gas grids, or other means of acquiring energy tend to be less developed. Thus, the social incentive of providing energy to individuals, that do not necessarily have access to traditional energy sources and the environmental incentive of maintaining the land through harvesting, arises. The social and environmental value meet economical ones in some regions even like that of Indonesian islands, where importing oil to produce energy through fossil fuel processes is expensive to import and has more hurtful emissions in delivering the oil to these regions. In this case of rural areas of developing markets, the scale and supply chain are less sophisticated and extensive, as simply the needs of the inhabitants need to be met, and only what is available locally can be considered, however, the same relationship can be observed where the incentives, social and environment primarily, in this case, shape the scale, complexity and length of the supply chain.

It is also helpful to look at the effect that incentives have on the trends and human behavior, which is on the left side of the diagram. The incentives encourage certain behavior and normalize specific actions. This is notably related to encouraging specific types of feedstock and capacity of the biogas plants through e.g., the FITs, which further, as mentioned previously, affects the scale and supply

chain hence the arrow from trends and behavior to that part of the diagram, too. However, the trends and human behavior can include a lot more than financial aspects. Biogas-Done-Right is a concept first introduced in Italy, that encourages specific crop cycles that bring out the benefits of the technology. The trend acquired a lot of momentum, however, this specific approach cannot be replicated identically in all regions, like in the cold Nordic countries where slower and longer cycles with crops are being used that bring beneficiary crops in the warmer months and energy in the colder ones. These trends and human behavior are triggered by the incentives because the Biogas-Done-Right concept gets financial, social and environmental incentives; it is the most efficient, eco-friendly approach that benefits stakeholders and brings an end to the fuel vs. food discussion. The incentives in the colder regions, however, are more strongly related to providing energy in the colder months, especially since other renewables are less of an option in these areas. This increases the social incentive, which ultimately changes the trend and human behavior. Furthermore, whatever task becomes normalized and embraced determines what opportunities for sustainability arise.

Given that the context of this analysis is that of sustainable business models, trends and human behavior that occur as a result involve some element of sustainability. The incentives trigger a certain norm and *modus operandi*, it receives momentum and becomes a trend, and given that it becomes an efficient way of operating, it receives further incentivization, through either policymaker financially supporting the program to increase the attractivity of these prospects for investors, through other stakeholders getting involved through a newly realized social or environmental incentive to operate or through increased awareness of the general public due to initiatives and movements like Fridays-for-Future. This creates opportunities for Sustainability, as the public demands a behavior change. These sustainability opportunities are often translated into (monetary) incentives by the government to increase the attractivity of these prospects. One very notable sustainable opportunity in allowing a new sustainable service in the biogas industry has been that of biomethane. Discussion about going electric, getting rid of fossil fuels, and reducing energy consumption generally is common. However, in certain industries, at least with modern-day's observable technology, this simply is not possible. The industries, like heavy transport and various marine-involved operators especially, needed to continue to provide their services and they could not entirely decarbonize their operations. Thus, the ability to defossilize became a norm which creates the benefits and opportunities of biomethane. In developing markets, opportunities

for biomethane are also being realized, with rather larger incentives on the financial side, than the social and environmental ones currently being explored and adapted in the developed West.

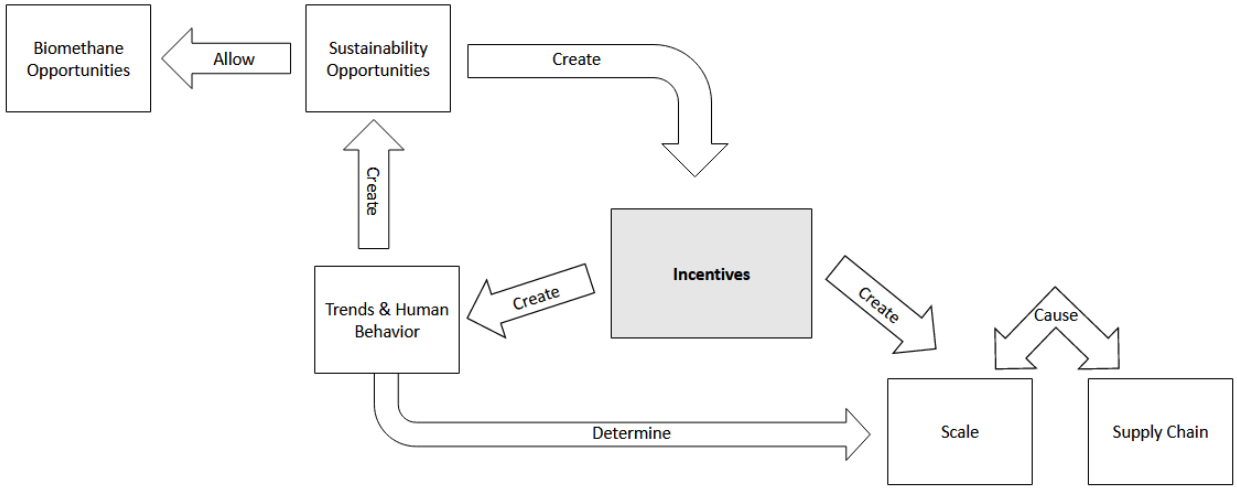

Figure 2: How the Themes connect. Framework by the Authors

The described relationship makes up Figure 2: How the Themes connect. Framework by the Authors and describes key themes related to sustainable business models in the biogas industry that are relevant, in their unique ways, to both developed and developing markets. It is however important to relate how these thematic findings and the shape of a sustainable business model in the biogas industry relate to literature on sustainable business models, developing and developed markets and the biogas industry. The thematic patterns were intentionally first described to gradually increase the complexity of the analysis and to further perform analysis, a compound model of the thematic patterns and the preliminary framework has been constructed below.

5.2 Incentives as the Driver of Sustainable Business Models

The main driver of the biogas industry was found out to be the incentives within the market. These do not need to be of financial nature, but also can be understood to have different values. These can be related to the findings in the literature, as the driver of sustainable business models are the three values of the triple bottom line that cannot be separated from each other: economic, environmental and social values, (Pagell and Wu, 2009; Porter and Kramer, 2006; Dao, Langella

and Carbo, 2011) as presented in Figure 1. Therefore, the found incentives of the biogas market can be translated into the values of the SBM as seen in Figure 3.

By creating incentives of one value, the other values are obtained nonetheless, without needing an extra push. Therefore, this can be called an SBM, as not one value can be fulfilled without automatically fulfilling the other aspects as well (Porter and Kramer, 2011, Schaltegger et al. 2016). There can be a focus on one element, but the other two values will be accompaniments. However, it became visible, that, to start an SBM, one kind of incentive needs to be made to prompt the initial creation of an SBM. Depending on the level of the development of the market, the focus of the initial incentive was seen to differ. Our results show examples like FIT in Europe or activities of NGOs in India.

In rural parts of developing markets, the opportunity of having biogas as a sustainable business model puts more weight on and provides more social value than economic and environmental value. Nidumolu et al. (2009) describe the entrepreneurial view of an SBM to explore different alternatives to current ways to fulfill customer's needs. The fact of not being connected to the gas grid and not having another opportunity for having/using energy creates a social incentive, but with using biogas to solve this social aspect, the biogas plant is more sustainable than the alternatives of fossil fuels or nuclear power, and economically profitable, as the building of the infrastructure to be able to use the alternatives are comparably more expensive than the biogas plant. Lubin and Esty (2010) also describe sustainable solutions as a source of potential growth.

In the developed markets, investors are incentivized by the government's FIT to build biogas plants for renewable energy production. This promises them a profitable business and therefore monetary incentives and fulfilling the economic values. However, it also creates and matures a market for renewable energies, which fulfills the core of environmental and social values as well. Seeing environmental factors as a power for enormous change is echoed by Hart and Milstein (1999), who recognize sustainability as a catalyst of creative destruction. For companies, it is also a great marketing opportunity, as the consumer increasingly demands "greener" products from companies. This is echoed in the literature, as Lubin and Esty (2010) mention the potential of sustainability to create a competitive advantage by repositioning the company.

5.3 Conceptual Framework

This section will combine the academic ideas of the literature review with the data collected to best perform analysis on how sustainable business models differ between developed and developing markets in the biogas industry. Therefore, the authors combined the theoretical framework of Figure 1 with what was observed with the themes in Figure 2 to conduct a reflective and thorough analysis. The depicted result can be seen below in Figure 3: Conceptual Framework: Theoretical Framework connected with the Empirical Results:

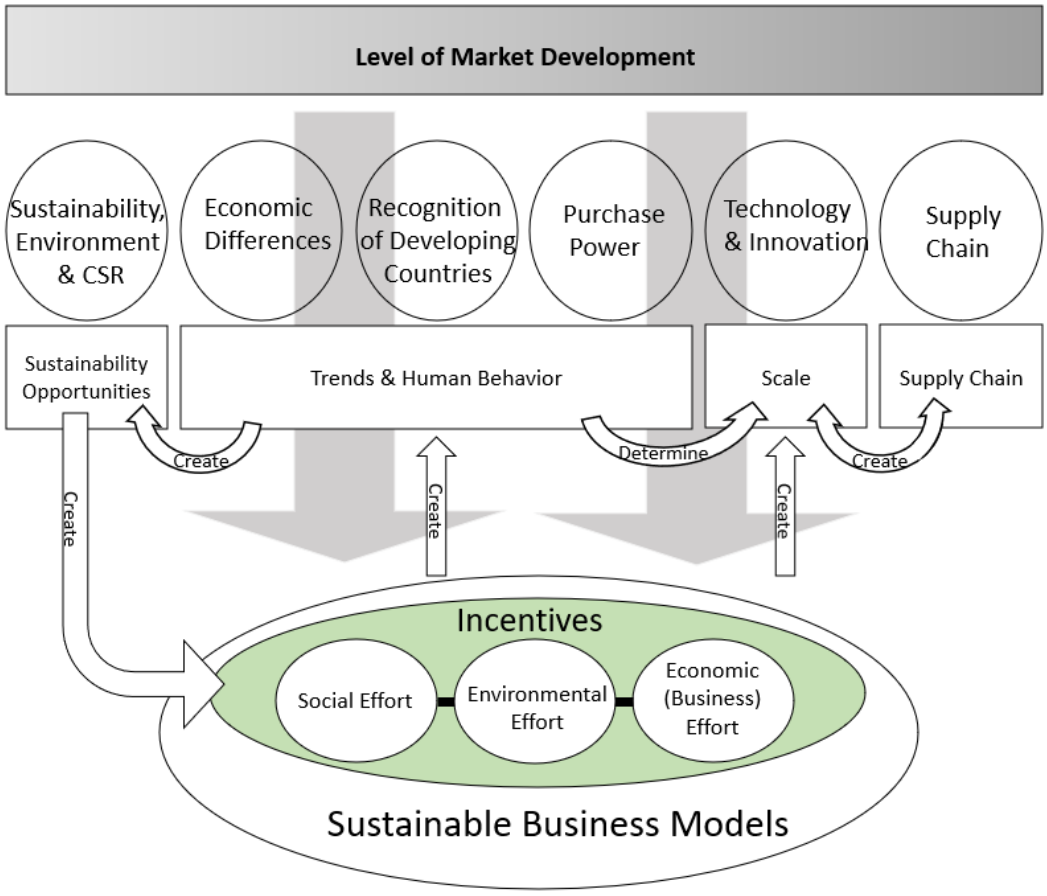

Figure 3: Conceptual Framework: Theoretical Framework connected with the Empirical Results

To best understand this final constructed model, it is important to reflect how the preliminary framework from the literature review claims that the specific six components of both developed and developing markets, through different degrees and approaches to these components, shape what sustainable business models look like in these markets. This model still has this core idea, however, it further goes on to claim that in the biogas industry, the social, environmental and economic (business) effort that is true of all sustainable business models, is true to the incentives as well, which in Figure 1, were understood as the founding element of how sustainable business

models are in the biogas industry. This ultimately means that the construction of the incentives, which can be social, environmental, and economic, shape how sustainable business models are in developed and developing markets, with varying elements of both, the thematic findings of this study, and the six characteristics that shape what sustainable business models are like in different aspects. The specific shaping of the values, however, is highly influenced by the level of market development and the six aspects mentioned in the preliminary theoretical framework, as demonstrated by the underlying gray arrows. Many of the aspects were echoed by the empirical results to have influence and an interrelationship between each other The specific relation, of connecting the themes and the literature review, will follow one by one with a red focus box on the diagram depicting which relationship is studied in the following section.

5.3.1 Sustainability, Economy and Recognition: The Effects on Trends and Sustainable Opportunities

This section of the analysis will focus on the red boxed part of Figure 4 seen below.

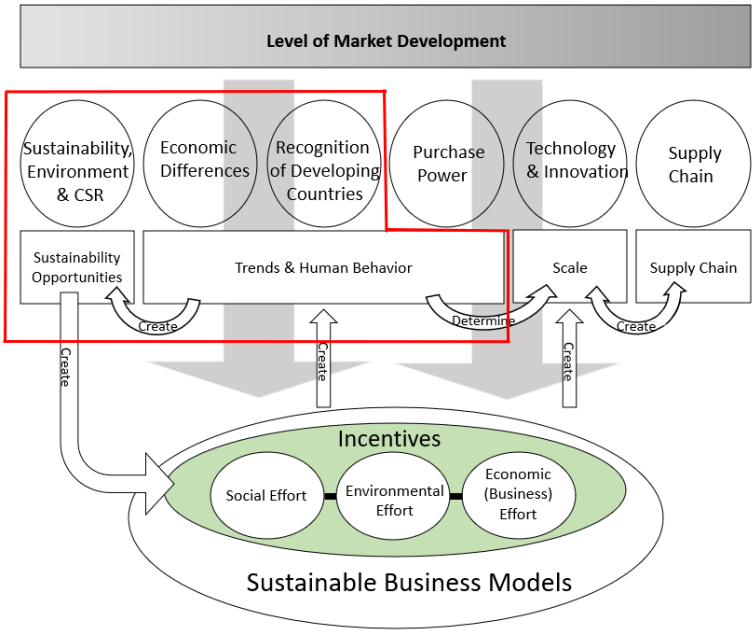

Figure 4: Analysis - Sustainability, Economy and Recognition: The Effects on Trends and Sustainable Opportunities

One of the key findings of this study regarding economic differences that determine what sustainable business models look like in both markets in the biogas industry is the mentioned willingness of developing countries to do business with the bottom of the pyramid (Jones, 2012).

In developing countries, there is a larger opportunity of providing sustainable business models that provide notable social and environmental value for the poorer inhabitants of rural areas. This reflects how in developed countries this opportunity of constructing a sustainable business model for the poorest inhabitants was not mentioned where this opportunity tends to exist in developing markets. Since data was collected from companies of developed countries, the noticed hesitation of entering the developing markets, which literature explains as the fear of the institutional voids (Jones, 2012), was also noted. This simply means that in an attempt to construct a sustainable business model in a developing country additional risks need to be considered as there are fewer institutions present that could be involved in different processes. Literature on developing markets, agreeably with our study, acknowledges the cultural appropriations that are necessary for all aspects of working in developing markets (Öberseder et al. 2014; Jamali et al. 2009; González-Rodríguez et al. 2019). This was observed in our study by specific examples of how in certain developing markets, the approaches to biogas, from a Eurocentric perspective, would be inefficiently absurd, yet they manage to provide significant value in these markets. This is further supported by the quotation found in our empirical study where an industry expert claims that China and India are not valuing biogas the way Europeans do because they have their approaches with historical and cultural reasons.

From a sustainability perspective, literature states that energy consumption in developing countries in rural areas relies on notable wood burning, which is supported by our study seeing an opportunity of providing social and environmental value with biogas in these regions, however, our data collected did not fully find that there was a need for defossilizing cities of developing countries (Surendra et al. 2014; Dherani et al. 2008; Pathak et al. 2009). Literature on energy consumption and its effects on sustainability from a developing market perspective suggests that energy consumption tends to increase for markets going through rapid growth (Apergis and Payne, 2009; Narayan and Smyth, 2009; Odhiambo, 2009; Bildirici, 2012; Shahbaz et al. 2012) this suggests that sustainability will be a major issue to monitor in developing countries. Our data did not specifically find a growing concern for environmental value while delivering sustainable business models in developing countries rather it found that social value receives a lot of recognition and tends to be supported by economic value however not significant value was placed on the environmental value in both developed and developing markets. Our data does however find that in some developing markets sewage systems are less developed, which literature supports too (Surendra et al. 2014; Voegeli and Zurbrügg, 2008). However, the literature did not seem to

acknowledge this as an element of the sustainable business model as our data collection did with large animal waste lagoons, notably in Mexico and parts of South America.

Our data did suggest that environmental value is more valued in developed markets as biomethane, a sustainable approach and example of new sustainable services to biogas that delivers very high environmental value was not as extensively desired in developing markets. This could relate to literature claiming that economic growth encourages energy consumption and that developing countries do not want to hinder their development (Apergis and Payne, 2009). In the literature, the view of seeing sustainable innovations as a source of new revenue streams (Lubin and Esty, 2010) and as an opportunity for business development, which creates value for the company as well as society (Nidumolu et al. 2009; Michelini, 2012; Rodriguez, Ricart and Sanchez, 2002) was also echoed.

Regarding recognition of developing countries on a global scale, our data did agree that there is growing awareness that in some places, *modus operandi* is simply different and that developing countries need to be understood with non-Western approaches to global problems like the need for sustainability (Annan, 2009; Petrone, 2019) and to see this as a catalyst of creative destruction (Hart and Milstein, 1999).

Fundamentally, our study tends to agree with the literature, however, a disagreement tends to exist regarding the realization of environmental value in both developed and developing markets; literature tends to suggest that is extensively more realized however our findings suggest that environmental value in the biogas industry is realized as a side effect of attempting to provide social or economic value.

5.3.2 Purchase Power, Technology, and Innovation: The Effects on Trends, Human Behavior and Scale

The following analysis will focus on the themes seen in the red boxed parts below.

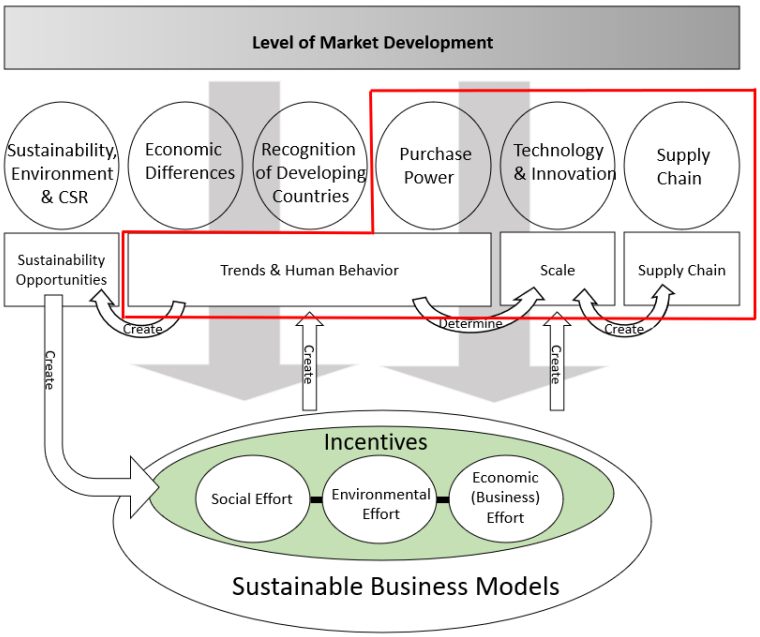

Figure 5: Analysis - Purchase Power, Technology and Innovation: The Effects on Trends, Human Behavior and Scale

Literature on developing and developed markets describes drastic differences in purchase power in developed and developing markets (Hart and Milstein, 1999), which agrees with our research. In developed markets the consumer has great purchasing power and a high consumption rate. The consumer consumes more than needed to live a comfortable life market (Hart and Milstein, 1999). Our data confirms this and states, that consumers have the luxury of being able to choose what they want to consume. Their behavior adapts to this, and increasingly more consumers value more sustainable "greener" products. Literature states, that due to this fact, new Metrics like greenhouse gas emissions per sale or corporate reputation play an increasing role for companies (Hart and Milstein, 1999). This creates trends in consumer behavior, e.g., the trend for environmental-conscious consumption, as the consumer can choose what to consume. Therefore, their behavior differs from the behavior of consumers of developing countries with less Purchase Power, which can only meet their basic needs (Hart and Milstein, 1999). Literature notes the enormous growth potential in these economies and that only economic values are not suitable in this market, as they are facing different challenges and demand and supply conditions than developed markets (London

and Hart 2004; Prahalad and Hart, 2002). In more rural areas, survival economies can be found, where consumers have almost no purchase power at all and have difficulties even fulfill their basic needs (Hart and Milstein, 1999). In line with this, our respondents reported that in developing countries there is not the luxury of being able to choose what to consume but rather a necessity to use what is accessible. Biogas is not seen as a possibility to create a greener product for competitive advantage but rather as a possibility to create energy in areas, where there is no other possibility, also due to missing infrastructure of e.g., gas grids. Therefore, the mindset behind biogas and the behavior of the consumers differs depending on the level of market development.

Jones (2012) describes the usage of frugal innovation and engineering in developing markets that work with the resources available. This goes hand in hand, as mentioned, with the approach to create what is needed, with what is accessible for an affordable price. This agrees with what the interviewees have mentioned that often, the biogas plant is constructed by only a hole in the ground and a single membrane above it, depending on what is available. This is also due to the fact of low Purchase Power, as most Technologies of Biogas Plants are produced in Europe and are not affordable for the developing economies. This goes against the literature, which describes the potential for developed countries to leapfrog to overcome market and institutional constraints by acquiring resources from the already developed West (Jones, 2012; Luo and Tung, 2007), as the technologies are too expensive to acquire. Asian economies also use the locally available Napier grass as feedstock and companies use their available process waste, like pig slur or animal cadaver. This feedstock does not need a high-stake technology to produce good quality biogas, even though it loses productivity. Depending on the availability of the feedstock and the technology needed and affordable, the scale is determined. However, literature also states that old technology will be insufficient to meet future demands without surpassing nature's capacity, as the economy is fast-growing (Hart and Milstein, 1999). Therefore, there seems to be a need for additional feedstock or better technologies to boost productivity to keep up with the increased energy demand of the increasing economy.

In developed countries, there is ongoing research on how to improve the technology of biogas plants, as most knowledge sits in Europe and the government incentives the biogas plants, which creates a market for innovation and new technologies. Therefore, this market's technology is driven by mostly financial incentives, as they create and mature the market for new technologies. As smaller capacity plants are better subsidized, the technology mainly focuses on smaller-sized

plants, as the demand there is highest. The Scale, therefore, influences the Supply Chain and vice versa. In Biogas in general, the supply chain is very complex, as biogas needs a lot of expert knowledge to have a well-working plant, and lots of organic material needs to be transported. Depending on the feedstock and scale used, the biogas plant needs different parts. In developed countries, there is a lot of knowledge available and, even though it is a rather small market, a few players per task are available. In developing countries, however, it often misses on basic infrastructure and general suppliers of parts, as most players sit in developed countries. This is mostly in line with the literature stating three main issues in the Supply Chain in developing countries: lack of infrastructure, imperfect business practices and unsatisfactory production suppliers (Ruamsook et al. 2009). A lack of necessary feedstock or components of the biogas plant can also be an issue, echoed by Simbirskikh (2020) stating that lack of supply can completely damage the business model.

6 Conclusion

The purpose of this thesis has been to contribute to research comparing differences between sustainable business models in developed and developing markets and to analyze opportunities of a sustainable business model in the biogas industry. Both of these topics, which in this thesis are fused more closely together, seem to benefit from further exploration and research. The case of the two markets of this thesis had its research question and the subsequent sub-questions answered through a consideration of the themes including incentives, trends with human behavior, sustainability opportunities, new sustainable services like biomethane, scale and supply change differences. This resulted in a framework, that essentially places financial and non-financial incentives of a market as the collaborating components of the social, economic, and environmental value of all sustainable business models. This concluding chapter will present the theoretical and practical implications and will finish with limitations and recommendations for further research.

6.1 Theoretical Implications

The findings from this thesis indicate notable implications to the literature. Firstly, and most notably, the amount and variety of research on sustainable business models from a perspective of developed and developing markets and biogas were supported. Sustainable business model literature describes the needed social, economic, and environmental efforts, (Abdelkafi and Täuscher, 2016, Geissdoerfer, Vladimirova and Evans, 2018; Bocken and Geradts, 2020), however previous literature did not seem to address the opportunities of shaping incentives that themselves are, but also support further, social, economic and environmental ways to support the dissemination of sustainable business models in the industry that further have the opportunity of changing *modus operandi* to better integrate sustainable approaches. Regarding creating sustainable business models, the literature does mention that having adequate knowledge on sustainability and finding ways to be efficient once this knowledge is acquired, will benefit the dissemination of sustainability, (Nidumolu et al. 2009) which seems to agree with our research, where biogas expertise has been mostly located in Europe, which allowed for its quick spread in the entire region. This has also been supported by the fact that experts to conduct interviews with from Europe were

very knowledgeable about the way biogas operates in other regions, given that all the European companies have some influence or stakeholder partnership with biogas in other regions.

Regarding literature on developing markets, (Aidan, 2013; Akamatsu, 1962; Bond and Templeton, 2011, Contini et al. 2020; Jones, 2012; Kojima, 2000) our findings supported the concepts of the necessary extensive cultural appropriation in new markets, frugal innovations (jugaad), and different purchasing powers. Our research did not necessarily identify a trend of more sophisticated products and plants in specific economies that supports the model proposed by Akamatsu (1962) that Kocourek (2015) further explains. Although the study did find less sophisticated approaches in developing countries generally, a progressive line of sophistication was not identified. Our research did find that biogas plants in developing markets like Brazil, Mexico and Argentina tend to be located where the related organic waste could be found which shows more vertically integrated supply chains in these developing markets. This directly follows the expectations of developing markets that due to less developed businesses and networks certain companies often take on more tasks from the supply chain (Jones, 2012). Literature suggests that in the developing markets there is a large opportunity of fulfilling social and environmental value, like the case with biogas, where using the technology in rural parts of developing countries brings higher efficiency than firewood, and does not cause indoor pollution (Scarlat, Dallemand and Fahl, 2018). This concept was directly supported in our thesis; however, it was also noted that value can be brought with biogas in developing markets in ways that are still similar to developed markets, especially when metropolitan areas have developed gas grids.

Relating to renewable energy literature, the opportunities of biomethane were specifically realized in the conducted interviews that agree with what literature on biomethane's prosperity (Mittal et al. 2018; Surrendra et al. 2014) claims. Literature, which is similar to this thesis, claims that the dissemination of biogas depends on policies (Lantz et al. 2007); however, this thesis claims that the incentives not only affect how widely biogas spreads but also the way biogas will shape in the region where the incentives are provided. This is because of the social, economic, and environmental efforts that, when realized, shape and spread approaches to biogas. It is also noted in the literature that biogas needs adequate adaptation to given regions and climates (Mutungwazi et al. 2018). This seems to agree with the findings of this report, where different strategies need to be incorporated with local circumstances considered; the findings of this thesis, however, also interpreted this as a general finding related to renewable energy. Wind and solar energy also have

restricted capabilities on local circumstances and climates however, biogas has more opportunity of being adapted to local circumstances where wind and solar energy just needs to be placed in appropriate locations. The scale of the biogas plants is also mentioned in the literature, though emphasis in this literature is not placed on how specific aspects like incentives, as this study found, impact the scale of biogas plants in specific economies (Mutungwazi et al. 2018).

6.2 Practical Implications

It is also helpful to reflect on this thesis with a consideration of the practical implications. Most fundamentally, it is important to first mention that any market should be studied thoroughly before an attempt of launching any business model commences. However, concerning launching a sustainable business model in the biogas industry, one of the most dominant aspects to study is the availability or presence of the gas grid in the region. It cannot simply be concluded that in a developed country gas grid are thoroughly available, as this research found that areas of Scandinavian countries, especially further up north, commonly do not have an available gas grid and energy is acquired through different processes. This thoroughly changes the value that biogas can provide in the region because, in the absence of a gas grid, a lot more social and environmental value can be acquired. Just as much a one-size-fits-all strategy fails to work for developed markets, the same is true for developing ones. Gas grids are present in many parts of developing countries, however, in parts where they are not, they are in fact not necessarily wanted. It is also important to perform research into the feedstock that will be available in the long-term in the specific market, as the feedstock determines many technological factors and possibilities that need to be considered before constructing a biogas plant. Detailed knowledge of the specific feedstock, especially mixed types of feedstocks, is needed to secure the effectiveness and productivity of a biogas plant. This research further found that cultural approaches are very substantial in the biogas industry as in some developing countries, biogas has been performed for significantly longer periods of time than in the developed West. It is essential to limit the bias of thinking that the approaches of the developed countries are the best as this is not universally the case. The climate differences in many developing countries change the needs of what biogas requires, and single membrane approaches to lagoons observed in South America and Mexico, are not necessarily less adequate than stronger membranes found in Europe. The mentality and the incentive behind constructing a biogas project

also are of huge influence. Therefore, the incentives need to be aligned with the overall goal to succeed.

As repetitively mentioned by interview participants, in most cases, biogas cannot compete with traditional fossil fuels on price alone. Further incentives and recognition of biogas as a sustainable option, that can work in places that wind and solar energy cannot are needed. It is thus helpful to first check what incentive support is available in a given region for taking on a sustainable approach to energy and how individuals in this region perceive biogas. Biogas, with the Biogas-Done-Right concept first introduced in Italy, is growing, and being understood more appropriately. This seems to create further opportunities of working with biogas, where this concept has spread to and increases the acceptance of biogas in the general public as a feasible solution. In areas where energy is difficult to acquire generally, like rural villages of developing countries, there is a great opportunity of creating social and environmental value by operating a sustainable business model in the biogas industry if an opportunity to sustain the business model economically exists. This economic hurdle can be taken with the help of projects of the government or NGOs, as according to the framework when this hurdle can be taken, the social and environmental values will follow suit.

With the growing trends of biomethane, especially in developed countries, it is also helpful to consider if industries with difficulty in defossilizing their operations could benefit from this technology. Heavy transport and marine-based moving industries seem to notably benefit from this LNG.

To make biogas a feasible alternative to fossil fuels or coal, there is a need to be able to compete financially with them. There have been talks of introducing fees on commodities, that reflect their CO2-Cost to the environment. When this fee reaches a specific level, biogas will become an also economically feasible solution, which would also lead to the expected environmental and social benefits.

With the growing power of developing countries at the global level, is it important to consider that Western approaches are not necessarily the sole solutions; it is vital to consider the issues that developing countries are facing just as adequately as those of developed countries to help move forward sustainability with energy in a manner that is more equal and thus with higher social value in the biogas sustainable business model approach.

Furthermore, the involvement of policymakers in recognizing biogas as part of the solution for the renewable energy mix is essential as the shape of the incentives, which on a financial perspective generally come from policymakers, has a tremendous opportunity in shaping the industry. As policymakers are put into office by the general public to represent their will, the general public's opinion highly influences the creation of possible policies. Therefore, if the public is educated about opportunities of biogas to solve the energy problem without worsening or even doing a part to prevent the climate crisis, this would be positively influencing the policymakers into creating the incentives in this direction. This means, that creating general awareness within the public should be of high priority. This incentive does not compulsorily need to be financial, as when the incentive is strong enough, the other values will find into place automatically.

6.3 Limitations and Future Research

This subsection of the chapter aims to discuss the limitations of its research and how those can be translated into further research opportunities. Firstly, the majority of the interviews conducted were with individuals of companies working from Europe. While this may prove to help acquire information on the developed market side in Europe, having only individuals working in developing countries and not ones from these countries might have affected the responses received. Due to the COVID-19 pandemic, communication was severely affected, and this very likely influenced the lack of opportunities to discuss with local biogas workers from developing countries. A representation from these individuals might have brought forward more cultural differences that this study could have benefitted from. Describing the developing markets, it is also very time restrictive to consider what country is at what stage of development, with developing countries growing, like the mentioned BRICS previously, the time frame for seeing the opportunities in developing countries is unclear.

Second, because this thesis took on an explorative qualitative approach, to get helpful information from industry experts, there is an opportunity to support this research with quantitative data that could further support its validity. Statistical approaches could further help study the correlation this study makes in between each theme. A quantitative study might make better sense of very specific differences between the two markets that could present which factors are most strongly different.

Third, from the developed perspective, larger opportunities existed from enquiring and interviewing companies from countries like Canada, the United States or perhaps South Korea. Biogas tends to be developed in these countries as well and this could efficiently support this research. Contacts were established through the European Biogas Association and the time frame and pandemic situation impacted the opportunities of expanding the data collection to other places.

Finally, this study uses the biogas industry to study the differences in sustainable business models in developed and developing countries, however, a very notable opportunity exists to perform this study in either different industries or without considering a specific industry. This approach though was intentionally not taken as this study notably wanted to contribute to all of the key areas including sustainable business models, developed/developing countries, and the biogas industry.

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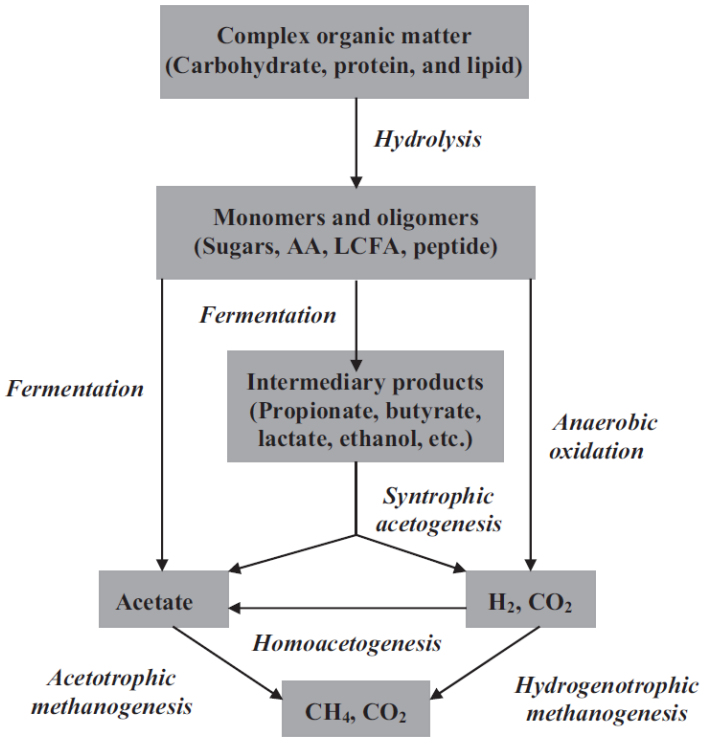
Appendix A

Major Stages of the Biogas Process



Surrendra et al. 2014. Modified from Khanal (2008)

AA=amino acids; LCFA = long-chain fatty acids

Appendix B

Email enquiring for interviews with EBA members.

Dear XXX,

I hope this email finds you well.

I and my colleague, Lysann Koppetsch, are performing research on what biogas is like in Europe. This is part of our Master thesis that we are writing for Lund University in Sweden. We know that biogas is underappreciated, and we want to discuss why it should get more attention. We would politely like to request if someone from your team could do a video call with us to discuss what this means. The discussion would not be longer than 30 minutes. If a video call is not ideal, please let us know and we can adapt to whatever fits you best.

We are quite flexible and would like to hear what you think is significant, however, based on our topic we are very interested in hearing what you have to say about the supply chain, the biogas plants themselves (and their size), and the future of Biogas. We are also interested in biogas in emerging markets, specifically the BRICS (Brazil, Russia, India, China, South Africa). If your company operates there or has some connections there, any information you can mention is highly appreciated.

Some preliminary questions that we are thinking along the lines of:

- The supply chain. How are your relationships with other members of the supply chain? (Manufacturing, Planning, Operators, Consulting, those doing research, Training)?
    - Is every member of the supply chain efficient? Is the competition high? Is it common for one company to work on several parts of the supply chain?
    - Does any specific area of the supply chain slow down the entire process of providing heating/electricity? Does any specific part of the supply chain have some superstars that work quickly to meet the needs of other members of the supply chain?
- Generally, information about your biogas plants.
    - How big are they, how far away are they from the areas where they provide heating and/or electricity for? How many users might be benefitting from your plants? Is it difficult to incorporate biogas plants in big cities?
- Do you think biogas (in Europe at least) is the future?
    - What makes it a good opportunity to provide heating and electricity in Europe?

We know this is not the most convenient time to be asking questions for research with the global situation however we really appreciate if you could take the time to help us study and appreciate the work you and your teams do.

Thank you,

Sebastian Kowalski and Lysann Koppetsch

Appendix C

Interview Guide Used

An explorative interview guide. Minimally/Semi-structured questions for members of the European Biogas Association as part of an MSc thesis by Lysann Koppetsch & Sebastian Kowalski.

Remember. Try do not directly ask these questions but encourage discussion about these topics to collect data that will later be comparable.

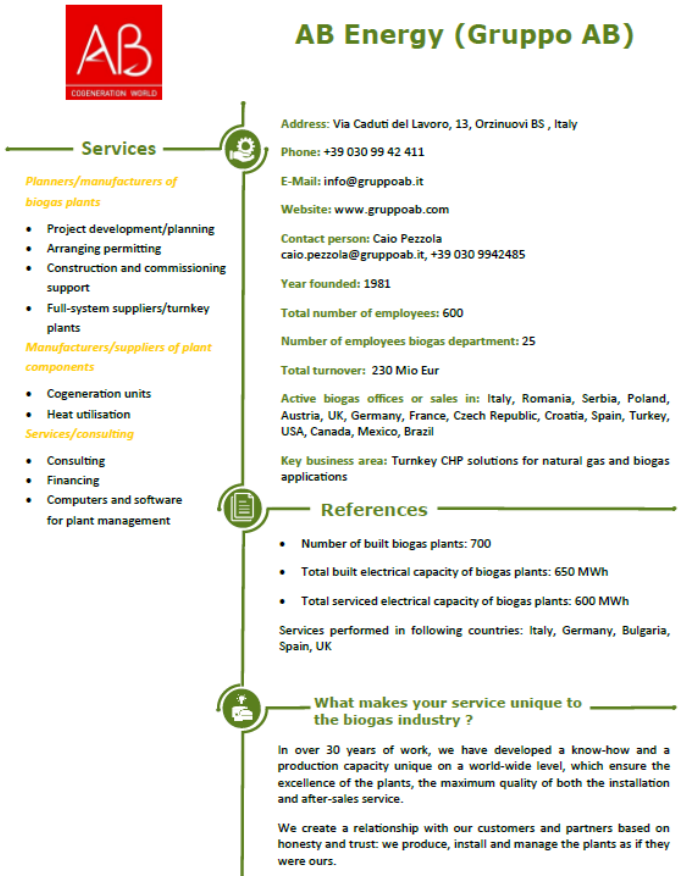
Aim for 35 minutes with these discussions.

1. What started the dissemination of the biogas industry?
2. What feedstocks do you think are most commonly used?
3. What is your company's position in the supply chain? How many partners do you work with within the delivery of the complete product/service you provide?
4. What developing countries do you work with? What can you say about them?
    a. Scale?
    b. Regional effects?
    c. Who funds?
    d. Sophistication?
    e. Surprising elements?
    f. Efficiency?
5. What stops you from getting more involved with biogas in these markets?
6. Do you consider the business model your company runs with biogas as a sustainable one? If so, how do you deliver social, environmental and financial value?
7. Can you run this exact model in a developing country identically?
    a. What do you need to change for it to work?
8. Try to enquire about circular economies.
9. Differences between specific developing countries (in regard to SBM/ Biogas)
10. Future of biogas (not just in your country but globally).

Appendix D

Excerpt from COMPANIES CATALOGUE: Members of the European Biogas Association

Name	Active company offices or sales	Planners, manufacturers of biogas plants	Operators	Manufacturers, suppliers of plant components	Substrate	Services, consulting	Science & Research	Other	Page
AB Energy (Gruppo AB)	Italy, Romania, Serbia, Poland, Austria, UK, Germany, France, Czech Republic, Croatia, Spain, Turkey, USA, Canada, Mexico, Brazil	✓		✓		✓			8
Agraferm Technologies AG	Germany	✓	✓			✓		✓	9
APROVIS Energy Systems GmbH	Worldwide			✓					10
Awite Bioenergie GmbH	Germany and partners in 25 more countries worldwide			✓					11
Balmoral Tanks Ltd.	UK	✓		✓	✓				12
Biogest Energie und Wassertechnik GmbH	Austria, Bulgaria, Croatia, Czech Republic, Hungary, Italy, Poland, Ireland, Romania, Serbia, Slovakia, UK, USA, France, Thailand	✓	✓	✓		✓		✓	13



AB Energy (Gruppo AB)

Services

Planners/manufacturers of biogas plants

- Project development/planning
- Arranging permitting
- Construction and commissioning support
- Full-system suppliers/turnkey plants

Manufacturers/suppliers of plant components

- Cogeneration units
- Heat utilisation

Services/consulting

- Consulting
- Financing
- Computers and software for plant management

Address: Via Caduti del Lavoro, 13, Orzinuovi BS , Italy

Phone: +39 030 99 42 411

E-Mail: info@gruppoab.it

Website: www.gruppoab.com

Contact person: Caio Pezzola
caio.pezzola@gruppoab.it, +39 030 9942485

Year founded: 1981

Total number of employees: 600

Number of employees biogas department: 25

Total turnover: 230 Mio Eur

Active biogas offices or sales in: Italy, Romania, Serbia, Poland, Austria, UK, Germany, France, Czech Republic, Croatia, Spain, Turkey, USA, Canada, Mexico, Brazil

Key business area: Turnkey CHP solutions for natural gas and biogas applications

References

- Number of built biogas plants: 700
- Total built electrical capacity of biogas plants: 650 MWh
- Total serviced electrical capacity of biogas plants: 600 MWh

Services performed in following countries: Italy, Germany, Bulgaria, Spain, UK

What makes your service unique to the biogas industry ?

In over 30 years of work, we have developed a know-how and a production capacity unique on a world-wide level, which ensure the excellence of the plants, the maximum quality of both the installation and after-sales service.

We create a relationship with our customers and partners based on honesty and trust: we produce, install and manage the plants as if they were ours.