Vestas in Brazil

A case study on the effects of local content requirements on firm operations

Master thesis

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Executive summary

This thesis seeks to answer the research question **How do local content requirements in Brazil affect Vestas' operations in the country?**

Methodology: The study is a single-case study of Vestas, and provides a mixed method approach to a longitudinal analysis of secondary data on Vestas and Brazil's local content requirements. In doing so, I abductively test the theory on the topic and adjust it to the findings in the thesis to propose an adjusted framework for analyzing local content requirements from a firm perspective.

Theoretical framework: The thesis builds on the theoretical framework of Kuntze & Moerenhout (2012), who determined 4 factors for the effectiveness of local content requirements for governments. In this thesis, the dimensions are applied to a firm perspective, thus analyzing the operations of Vestas in Brazil according to the following 4 dimensions: *Market size and stability, Policy design, Cooperation and financial incentives,* and *Learning-by-doing potential and degree of current technological knowledge.* As a result the theoretical framework is tested in a different context and nuanced.

Findings: In this thesis, I find that the operations of Vestas in Brazil have been affected drastically by local content requirements. In particular the most recent FINAME II requirements pushed Vestas to adapt a new strategy in the Brazilian market. In the study, I find that while Vestas was placed under pressure and lost its accreditation with the Brazilian Development Bank (BNDES) in 2013 as a consequence of increased requirements, a change in strategy facilitated by a change in Vestas' global strategy towards growth markets, allowed Vestas to regain accreditation in 2015 and continue operations. In particular, the new strategy saw a significant change in Vestas' value chain configuration, as the local content requirements pushed Vestas towards a more horizontally integrated approach than vestas had typically employed. The change of value chain configuration included increased investment in local factories as well as intensification of collaboration with suppliers. The ability to source production while maintaining quality was the result of a mixture between improved industry sophistication and efficiency in Brazil as well as internal innovation of the design of blades, which allowed for a more flexible and standardized production process. Based on these findings, this thesis thus proposes a framework for evaluation of a country's attractiveness as a function of its local content requirements. The adjusted framework should be applied as a supplement to established market analysis frameworks, and be applied insofar as local content requirements are a factor in the analysis, in order to expand upon that analysis. It is proposed that companies analyze the attractiveness as a consequence of the requirements by asking *four questions*, which pertain to the analysis of **four dimensions** of analysis:

- Does the market potential justify local investment? **Market size and stability**
- *Is there a fit between the localization required by the policy, and the firms value chain configuration?* (**Policy design and degree of integration allowed by firm strategy)**
- *To which degree do the incentives provided for localization outweigh the costs?* (**financial incentives for localization)**
- *How capable is the local industry for cooperation?* (**Cooperation and current degree of technological knowledge)**

Implications for further research: Based on the findings of the study, I have suggested an adaptation of the applied framework. The framework builds on Kuntze & Moerenhout's dimensions, but adapts its dimensions and their application to become a more instrumental for companies to evaluate the effects of local content requirements as part of a potential market analysis. As this adapted framework is based in the findings of a single-case study, further testing adjustment of the framework is required to corroborate its validity and usefulness, and as such, more research needs to be done on the effects of local content requirements on firms to more accurately determine the dimensions for analysis. In particular this involves testing the causality between the 4 proposed dimensions and operations in the context of local content requirements.

1: Introduction

In a world with a growing focus on the threat of global warming, countries and organizations are constantly looking for ways to reduce their carbon footprint. Increasingly green energy is becoming mainstay, and In certain areas of the globe, renewables have almost become mainstream (Tawney 2012, Backwell 2015). Green energy is not only a source of clean energy, but also increasingly a way of stabilizing electricity supply by diversifying the power supply (Tawney 2012). As such, wind energy in particular has become one of the world's fastest growing industries, and has in recent years grown from being a niche energy source, dominated by "a couple of small, mainly Danish firms" (Backwell 2015 p.1) selling mainly to farmers and cooperatives, into being one of the key investment areas for many large industrial players such as Siemens, General Electric, and Mitsubishi (Backwell 2015). Countries are therefore flocking to capture the potential of expanding global wind market, seeking to build up competitive domestic, locally owned wind turbine manufacturing industries with the goal of expanding and competing globally (Lewis & Wiser 2006).

Countries therefore amply various strategies for capturing this value and localizing production – one of these ways is through local content requirements. While the goal of local content requirements is to build improve domestic welfare through the creation of a globally competitive local industry (Kuntze & Moerenhout 2012). These local content requirements also pose challenges for companies seeking to expand to markets with the protectionist policy. Especially in Brazil, where the local wind industry has seen tremendous growth, the local content requirements have been particularly cumbersome for many firms – in particular Vestas, who due to an inability to comply with local content requirements saw itself lose important deals to competitors (Windpowermonthly.com 2014).

This shows the importance of navigating local content requirements, and understanding their effect on companies operating under them. As such, this thesis seeks to understand the effects of local content requirements on wind manufacturers, and in particular:

How do local content requirements in Brazil affect Vestas' operations in the country?

To answer this question, this thesis will first seek to answer the following sub-questions:

- *What are local content requirements, and how are they being used in the wind sector?*
- *How and why are local content requirements imposed in Brazil?*
- *What are the perspectives on the usefulness of local content requirements?*

- *How can the effect of local content requirements on company operations be determined?*
- *What challenges has Vestas faced in Brazil due to local content requirements, and how did Vestas respond to these?*

In the following chapter, I will elaborate on how I intend to go about answering these questions.

2: Methodology

In this chapter, I will outline the methodological approach of this thesis. This includes firstly an outline of the structure of thesis, secondly, some reflections on the research philosophy underpinning the thesis and its approach to the use of theory, and finally a presentation of and reflections on the research design of the thesis.

2.1 Structure

In order to answer how local content requirements in Brazil affect Vestas' operations in the country, this thesis will be structured as follows: In this chapter (2), I will present the methodological approach of the thesis. This includes reflections on how my study places itself within the space of research philosophy, as well as how the scientific approach taken will help me answer my research question. After this, I will in chapter (3) present an overview of local content requirements by firstly providing a description and classification of local content requirements in terms of related policies. This will answer the question **what are local content requirements?** This will be followed by an overview of policies created by the Brazilian government to support local industry growth, and thus **how local content requirements are imposed in brazil.** Finally, the chapter will review the literature on local content requirements to provide **perspectives on the usefulness of local content requirements.**

In chapter (4) I will then proceed to present the theory and framework that will be used in the analysis of Vestas' operations in Brazil. As most of the literature on the topic is based in a government perspective, this chapter draws on and elaborates on the elements in the literature that can be relevant for the analysis of local content requirements from a firm perspective. This will serve to outline the framework for the analysis, and in this way determine **how the effect of local content requirements on company operations can be determined.**

Chapter (5) presents the bulk of the thesis, and will analyze Vestas operations in Brazil using the framework presented in the previous chapter. The analysis will seek to answer **what challenges Vestas has faced due to content requirements, and how Vestas responded to these challenges.** The analysis will be structured around, firstly, an analysis of Brazil's environment in terms of local content requirements in the wind sector, and secondly, an application of these findings to an analysis of how Vestas has been affected and has reacted to these local content requirements in particular.

In Chapter (6) I will discuss some of the findings from the analysis in the previous chapter, as well as some reflections on the approach and methodology used in the thesis. This includes some of the implications of limitations from using applying a framework originally designed for policy-evaluation to a firm analysis, as well as the implications of my findings for further research.

In Chapter (7) I will conclude the thesis, including a tentative answer to my **research question.**

2.2 Research philosophy and approach

The purpose of research is to develop knowledge within a particular field (Saunders et. al 2009). As such, with this thesis in particular, I seek to contribute to the field of global management studies, through a case based study on Vestas' operations under Brazil's local content legislation. As Saunders and colleagues (2009) argue, however, it is important to understand the research philosophy behind the choices taken in a study to understand which "assumptions will underpin your research strategy and the methods you choose as part of this strategy" (Saunders et al. 2009 p. 108). As such, Saunders and colleagues present a model for understanding the approach research philosophies and design, labelled the *research 'onion'* illustrated below in figure 2.1:

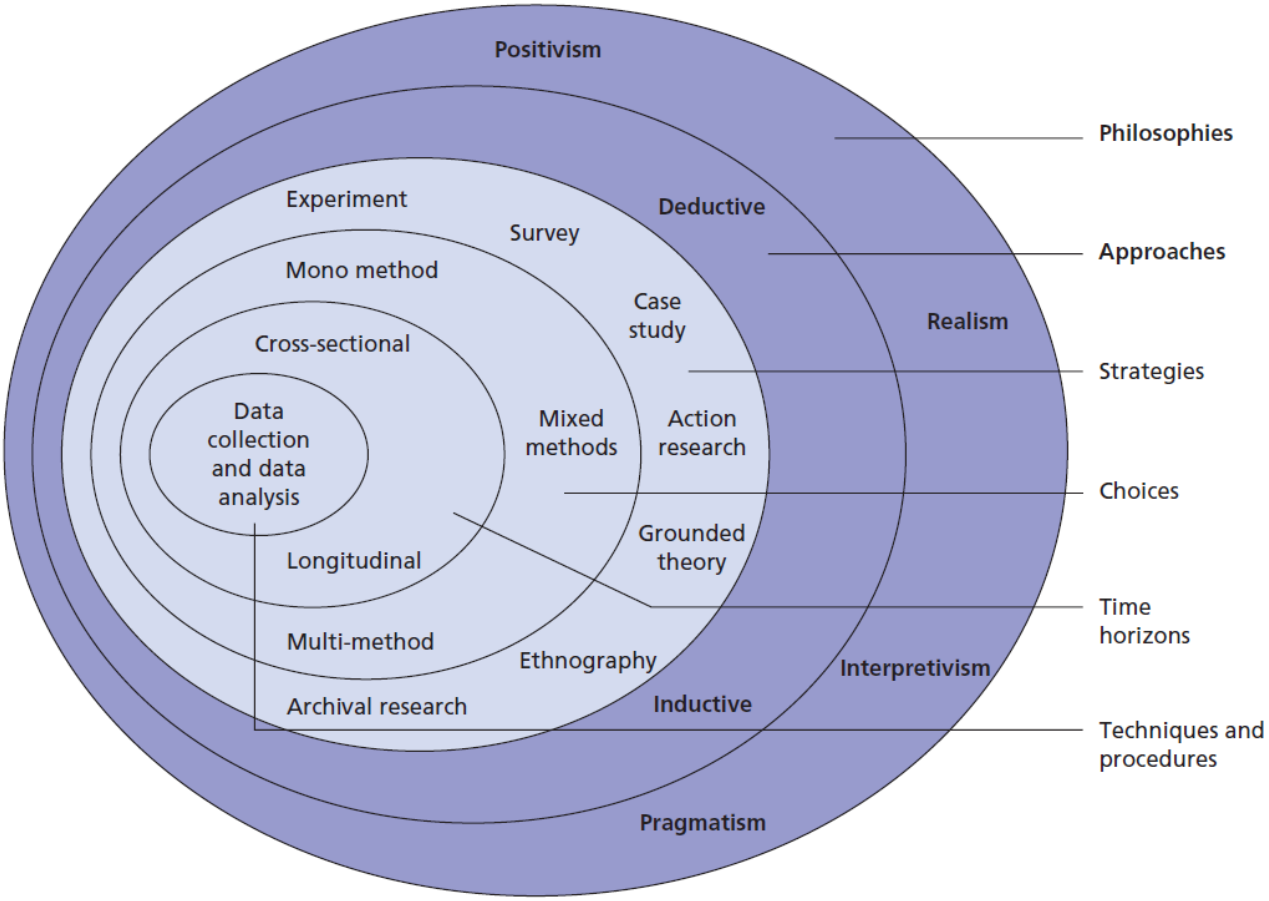

Figure 2.1: The research 'onion' – Source: Saunders et al. (2009)

In the following section I will explain my research philosophy and approach by applying Saunders' framework illustrated above to my method. In this way, I will firstly reflect on the philosophical science underpinning this study, as well as present how my study approaches the use of theory in the analysis. Secondly, I will dive into the research design of the thesis, to answer how I will approach answering my research question. This will include reflections on my choice of research strategy (i.e. the case study), my research choices (the role of qualitative and quantitative data in my study) as well as the time horizon of the study. Finally I will elaborate on my data collection, including the type of data and how it was collected.

2.2.1 Research philosophy and approach to theory

Before diving into the specific research design of this thesis, I will first provide some reflections on the position of this thesis in the space of research philosophy, as well as how I approach the use of theory in my study – that is, the first two outer layers of the research 'onion' (Saunders et al. 2009). In general, this thesis places itself within the tradition of critical realism. As such, this thesis accepts the ontological view that observations made in the data objectively depict reality, while at the same time acknowledging that

the phenomena observed occur within a social context that affects the actions of the actors (Saunders et. al 2009). In this way, the analysis of Vestas actions occurs as a multi-level study, which analyzes not only the operations of Vestas at a firm-level in relation to local content requirements, but also a country-level analysis of the Brazilian economic and political context in which they are implemented. As such, the approach acknowledges how the development of the context also carries importance in understanding Vestas' operations.

To reach an understanding of Vestas in the context of Brazil, this study applies an *abductive* approach to theory. Abduction is, according to Saunders and colleagues (2012), the combination of the two basic approaches to theory development: the deductive and the inductive. The exact definition of the term is not completely agreed upon in the literature, and it is also referred to by other authors as the *retroductive* approach (Chiasson & Tristan 2012). According to Chiasson & Tristan (2012), a reproductive approach implies that researchers "go back and modify an earlier model of something with an improvement of some sort" (Chiasson & Tristan 2012 p. 202). In this way, I apply both deductive and inductive approaches in developing and applying theoretical framework for analyzing the case of Vestas in Brazil. as such, in the first part of my analysis, I deductively apply theory to the case. In the second part, I then inductively adjust this theory according to the data analyzed. In particular, I choose to apply the theoretical framework of Kuntze & Moerenhout (2012) in order to analyze the local content requirements of Brazil. Their framework, however, does not directly take into account how firms are affected, and thus does not take firm operations into account. In order to answer my research question, I therefore based on the data collected on Vestas adjust the theory, and retroductively apply a firm level, which is then again deductively applied to the case of Vestas.

In this way, I express a critical realist view in my study of the effect of Brazil's local content requirements on Vestas' operations, which, in order to take both country- and firm-level into account, calls for an abductive approach to theory application.

2.2.2 Research design

In the following, I will explain the research design of this thesis. According to Saunders and colleagues (2009), the research design is the "general plan" (p. 136), with which the researcher seeks to answer the research question, and as such the design is formed by the research question and the purpose of the study. I will in this way now center my focus on the next three layers of the research 'onion', which are the research strategy, research choices and the time horizon of my study (Saunders et al. 2009).

Before diving into an explanation of the research design, however, I will first clarify the purpose of my study, as this along with the research question, will influence the design of the study (Saunders et al. 2009). Saunders and colleagues present three classifications of research purpose most often used in the literature on research methods: exploratory, descriptive, and explanatory. This study seeks to establish the causal relationship between two variables: the local content requirements in Brazil and the operations of Vestas. As such, this study is characterized as an explanatory study. As such, the approach calls for determining the independent variables that may have an effect on Vestas' operations.

The strategy of my research will thus be a case study. Case studies lend themselves very well to studies where the researcher may "wish to gain a rich understanding of the context of the research and the processes being enacted" (Saunders et al. 2009). In this way, the case study follows the philosophical underpinnings of this thesis. In particular, to classify by the dimensions of Yin (2003; in Saunders et. al 2009), this will be a holistic single-case study. In this way, The study will be focused on the single case of Vestas in brazil, and will analyze Vestas as a whole, i.e. not look at decisions made in or relations in or between different units of Vestas. A single case study approach gives the researcher "an opportunity to observe and analyze a phenomenon that few have considered before "(Saunders et al. 2009 p. 146). As will be explained later, the literature on effects of local content requirements on a firm level is virtually non-existent, and as such, the single case study allows me to go in depth with the case and the context and thus determine variables that have not yet been applied to the literature before. Furthermore, as Saunders and colleagues (2009) argue, "a case study strategy can be a very worthwhile way of exploring existing theory" (Saunders et al. 2009 p. 147), and as such, this study will therefore also serve as a basis for testing out existing theory on an up to date case as well as with a new firm perspective.

As such, while the case study provides excellent conditions for doing an in depth analysis of a context, the case study approach has been contested in much of the general literature on methodology (Flyvbjerg 2006). One of the main arguments against case studies is that it provides very little basis for scientific generalization, and thus is not valid as a research method in and by itself (Flyvbjerg 2006, Dubois & Gadde 2002). Being a single-case study, the purpose of this paper is however not to provide a generalizable theory on the topic of local content requirements by itself. In the words of Flyvbjerg (2006), inspired by Thomas Kuhn: "That knowledge cannot be formally generalized does not mean that it cannot enter into the collective process of knowledge accumulation in a given field or in a society" (p. 227). As such, this study is based on Flyvbjerg's (2006) notion that research and learning builds on context dependent knowledge, and thus furthermore adheres to the critical realist notion that there only exists context dependent knowledge. In this way, this thesis serves to provide contextual knowledge to the field of local content requirements, in

particular, how a large wind manufacturer such as Vestas has been affected and has adapted to local content requirements in the large developing country of Brazil.

In order to carry out the case study, I will apply a mixed-method approach to my data collection and analysis, that is, a mix between a qualitative and quantitative approach (Saunders et al. 2009). More specifically I will carry out what Saunders and colleagues coin *mixed-model research*, which in particular takes quantitative and qualitative data and combines it, rather than keeping it separated. In particular, my analysis will mainly be qualitative, however, I will apply quantitative data to the study as well, by *qualitizing* it, meaning that I will "convert [the quantitative data] into narrative that can be analysed qualitatively" (Saunders et al 2009 p. 153). Using qualitative data such as news articles and announcements and combining it with quantitative data such as numbers on wind energy capacity and growth rates in this way allows me to further elaborate the context for Vestas' operations.

Finally, in order to analyze the change in vestas' operations due to local content requirements, the case study will be carried longitudinal. This allows me to "exercise a measure of control over variables being studied" (Saunders et al. 2009 p. 155). Indeed, the changing nature of Brazil's local content requirements over time will allow me to correlate changes in changes in legislation with company behavior, thus tentatively isolating some of the variables for study and their effect.

In sum, this study is designed as a longitudinal holistic single-case study, applying a mixed-model research approach. This will allow me to analyze quantitative and qualitative data in an in depth study of the context specific factors related to local content requirements that may have had an effect on Vestas operations in Brazil. In the following section, I will elaborate on how I have approached data collection in particular, including which types of data I have collected.

2.2.3 Data

In this analysis, I will be applying my *secondary data* in may analysis. This includes a mix of documentary and multiple-source data. In particular, the data analyzed in this thesis consists of news articles, reports and announcements that have been collected through systematically reviewing various different sources, as well as government, and annual reports, and data from journal articles. The sources and approach for data collection has been elaborated below.

The data in this thesis has been collected through various sources. I have gathered data through a systematic search of "Vestas", "Brazil", and "Local content requirements" in various news media and other outlets. This includes large wind energy outlets and organizations such as Windpowernonthly.com,

Rechargenews.com, Energiwatch.dk/Energywatch.com, awordaboutwind.com, the homepage of the Global Wind Energy Council, where I have also gathered numerical data, as well as the homepage of the Brazilian wind energy association, where I have collected data from recent annual reports as well as monthly reports from 2017, which provide up to date data on wind energy in Brazil. Data has also been collected through the webpage of datamark.com.br which provides market intelligence for Brazil in particular. Longer publications such as Backwell's (2015) book *Wind Energy* which provides an industry-wide overview of wind energy, including wind energy in Brazil, has also provided empirical data for my analysis, along with the data compiled in many of the journal articles on the topic.

The data collected from these sources has then been combined with data collected from announcements and annual reports by Vestas themselves. On Vestas' homepage it is possible to search in announcements that go all the way back to 2011, where I have thus also searched the key word "Brazil". Combined with annual reports from Vestas, this has allowed me to, in combination with the news outlets listed above, create an updated timeline for Vestas operations in Brazil, on which to apply the theoretical framework explained in the theory section

Throughout this thesis, I will apply established theory to a recent case study of Vestas in Brazil. I am in this way combining literature mainly written before 2013 (my main theory, Kuntze & Moerenhout was e.g. published in 2012) with more recent empirical data (written within the last five years, i.e. in 2013 or after). The rationale behind this is, firstly, to apply existing theory to a dynamic and changing situation (Brazil's local content requirements) to analyze recent developments and provide updated data to the theory. I have in this way very deliberately limited my data collection to mainly cover the past five years. Moreover, I will apply, and potentially nuance, this theory by testing it with a different, and quite contemporary, perspective – namely the firm perspective. This is again accomplished by focusing on recent data (on Vestas in Brazil), thus underpinning the rationale for focusing on post-2013 data.

3: Literature on local content requirements

In this chapter I will provide an overview of local content requirements. To do this, I will firstly introduce local content requirements as a policy mechanism. Secondly I will provide an overview of how they are being applied in Brazil. Finally, I will provide a review of the perspectives on local content requirements in the literature as well as how this thesis places itself in the field.

3.1 What are local content requirements?

According to Kuntze & Moerenhout (2012) "local content requirements are policy measures that mandate foreign or domestic investors to source a certain percentage of intermediate goods that are being used in their production processes from local manufacturers or producers" (Kuntze & Moerenhout 2012 p.4). They are implemented with the aim of creating rent-based incentives for local investment and import substitution (UNCTAD 2014). One of the earliest descriptions of local content requirements is provided by Grossman (1981) in his highly influential paper *The Theory of Domestic Content Protection and Content Preference*[1] where he writes that "A content protection scheme requires that a given percentage of domestic value added or domestic components be embodied in a specified final product" (Grossman 1981 p. 583). In this way, legislators essentially create a market demand for locally sourced goods through legislation, often to ensure development within a strategic sector. The idea is thus to encourage investment from foreign firms, while at the same time supporting or developing the local industry (UNCTAD 2014).

Local content requirements can be explicit or implicit and may take different forms. As an explicit requirement, a minimum threshold of local content can be specified in national legislation or industry specific regulation, whereas implicit requirements as an example could have local content be part of a balanced scorecard, weighing in on the company's overall "score" either for approval to operate or as a recipient of benefits associated with the score (UNCTAD 2014), as such combining different tools.

Local content requirements are usually paired with other policy tools in order to provide a positive incentive for local investment along with the restriction – a "carrot and stick" approach (UNCTAD 2014). As such, although this thesis focuses on local content requirements specifically, these are inseparably bound to other support policies for localization. Lewis & Wiser (2006) in particular specify these policy tools for supporting localization in the wind industry and categorize them under two main categories: direct and indirect support mechanisms.

In table 3.1 below, I have provided an overview and synthesis of the different direct and indirect support mechanisms that Lewis and Wiser (2006) have found being used for promoting the localization of wind turbine manufacturing, including local content requirements. The first column lists the support mechanism, the second column provides a short description of the mechanics of the tool, and the final column is a short explanation of their intended effect on localization.

[1] "Domestic content protection" and "Local content requirement" is used interchangeably in some of the literature, and has the same meaning (Negara 2016) – In this thesis, I will however only be using the term "local content requirement" or "local content regulation", unless explicitly quoting an author doing otherwise.

Support mechanism	Short description	Policy goal
Direct support mechanisms		
Local content requirements	Most common form mandates a certain percentage of content for wind turbines installed in a country to be sourced locally.	To force companies interested in selling in the market to shift their manufacturing base to the country or outsourcing to domestic companies.
Financial and tax incentives	Financial subsidies, low interest loans or tax advantages for companies that choose to source or invest locally.	To encourage local manufacturing without mandating it and/or increasing competitiveness of companies working with domestic wind turbine technology through tax reductions or exemptions.
Favorable customs duties	Manipulation of customs duties to favor import of turbine components over entire turbines.	Creating a favorable market for companies trying to manufacture or assemble turbines locally.
Export credit assistance	Low-interest loans or ‘‘tied aid’’ given from the country where the turbine manufacturer is based to countries purchasing technology from the country providing the credit.	Supporting the expansion of domestic wind power companies that are operating in foreign markets
Quality certification	Participation of emerging wind power companies in a testing and certification program that meets international standard for wind turbines, e.g. the Danish ISO 9000certification.	Promoting the quality and credibility of emerging wind power companies’ turbines.
Support for research and development	Funding for R&D and e.g. support for coordination between companies and public institutions such as laboratories and universities.	Increasing the chance of success for the local wind industry.
Indirect support mechanisms		
Feed-in tariffs	Also called fixed prices – securing a fixed purchasing price through subsidies on purchases	Securing a profitable and stable market for investment
Mandatory renewable	Also known as renewables portfolio standards (RPS), mandatory market shares, or purchase	Creating a larger market for renewable energy

energy targets (MRET)	obligations - Most commonly requires a that a fixed percentage of electricity in retail suppliers' portfolio must be generated by renewables	
Government tendering	Running competitive auctions for wind projects or resource tenders, accompanied by benefits such as long term power purchase agreements.	Facilitating wind development
Financial and tax incentives	Financial and tax incentives based on electrical production or capital investment	Encouraging renewable development

Table 3.1 – Source: Lewis & Wiser 2006

Direct support mechanisms "can be crucial in countries where barriers to entry are high and competition with international leaders is difficult" (Lewis & Wiser 2006 p. 1851). These mechanisms do not all have the same support recipients, as some provide mechanisms aim at providing support for both foreign and local industries to invest locally, whereas others, such as *export credit* assistance provide differential support for domestic manufacturers. Whereas direct support mechanisms aim at providing a demand for local production or assembly, indirect support mechanisms aim at creating a higher demand for, in this case, wind energy in the domestic market in order to incentivize investment. (Lewis & Wiser 2006)

The use of and combination of these tools depends on the overall short- and long-term goals of the policy makers. Where some tools are targeted towards supporting domestic and international players alike to manufacture locally, others are more aimed towards supporting locally owned wind turbine or component manufacturers. In most cases, a combination of the above tools is applied (Lewis & Wiser 2006, Kuntze & Moerenhout 2012). This includes Brazil, which I will elaborate on in the next section (3.2).

As such, while the main focus of this assignment is local content requirements and their effects, the nature of local content requirements, and their use in combination with other policy tools, calls for applying a somewhat more holistic view on these policy mechanisms. As such, my analysis of local content requirements will also touch upon the use of other incentives in tandem with local content requirements in particular, as will be specified in the *theory* section of the thesis.

3.2 Local content requirements in Brazil

Brazil has implemented various mechanisms for supporting localization of production. In this section, I will present how local content requirements are implemented in the Brazilian wind sector, and which support mechanisms accompany them.

The government has had two main support programs with policies aimed supporting localization of renewable energy, including wind energy: The PROINFA (Incentive Program for Renewable and Alternative Energy) and the Brazilian Development Bank's (BNDES) FINAME program. While Brazil has a long history of industrial policies, including import substitution since the 60s (PWC 2013), this thesis will only focus on the industrial policies of the PROINFA and the FINAME. This is because they are the only industrial policies with a particular focus on the localization of wind energy production, and thus they are the most relevant industrial policies for the analysis of Vestas' operations in Brazil.

3.2.1 PROINFA

The Incentive Program for Renewable and Alternative Energy (PROINFA) was announced by the Brazilian government in 2002 as the first support system for wind (Backwell 2015, Rennkamp & Perrot 2016). The announcement was a reaction to recent shortages in electric power supply (Rennkamp & Perrot 2016). The shortages were caused by lack of rain in 2001-02, leaving dry the countries' hydropower plants, which provide the vast majority of Brazil's electricity supply. The PROINFA was thus implemented with the aim stimulating the development of other renewable energy sources, and thus diversifying Brazil's energy matrix to avoid future blackouts (Rennkamp & Perrot 2016, Backwell 2015, MEAN 2014). In particular, the PROINFA sought to add 3,300 MW of power generation capacity from renewables, of which 43% should be generated by wind (Rennkamp & Perrot 2016).

The PROINFA introduced explicit local content requirements on equipment and services mandated at 60%. This requirement was combined with a feed-in tariff on consumer electricity bills offering a power purchase agreement on electricity at a fixed price (MEAN 2014, Rennkamp & Perrot 2016), in this way combining a mix of direct and indirect support mechanisms. From its implementation in 2004 to 2009, the PROINFA program provided approximately 600 GW of wind power capacity to the Brazilian wind market (gwec.net).

In spite of the policy mix, the PROINFA did not result in the desired effect: "For a variety of reasons, this programme did not result in either the development of a local industry, or substantial growth in the wind market" (Global CCS Institute 2013). One of the reasons for this, was the "…slow implementation of PROINFA…" caused by "sluggish bureaucracy, which issued environmental permits very slowly, and the local content requirements of sixty per cent" (Rennkamp & Perrot 2016 p. 784), the latter of which was too

difficult for new companies to fulfill from scratch, and as such, PROINFA was not as effective in attracting foreign OEMs as intended (Rennkamp & Perrot 2016, Gwec 2013).

3.2.2 FINAME and FINAME II

Due to the slow implementation of the PROINFA, in 2009 the incentive system for localization of wind power production was changed. In particular competitive auctions for wind energy in particular were introduced (Rennkamp & Perrot 2016, GWEC 2013)). These auctions worked from the opposite principle than the feed-in tariff of the PROINFA, as they set a fixed quantity that manufacturers could then bid on, rather than a fixed price (Rennkamp & Perrot 2016, GWEC 2013). The explicit 60% local content requirement stayed as a main component of the policy, although now it was no longer mandatory, but rather tied to favorable loans provided by the development bank's FINAME program.

FINAME is one of the Brazilian Development Bank's two integral subsidiaries and is tied to "financing purchase and sales operations and exports of Brazilian machinery and equipment, as well as imports of goods of the same nature produced overseas" (bndes.gov.br 2017), and as such provides credit which is used by many parties in the wind industry (MEAN 2014). To qualify for these loans, however, companies must first comply with various financial, social and environmental parameters stipulated by the BNDES. In this way, to receive the cheap credit through the FINAME program, companies must (from bndes.gov.br 2017):

- Be up to date with the tax and social contributions
- Present satisfactory record
- Have ability to make repayments
- Have sufficient guarantees to cover the operation risk
- The company must not be under credit recovery regime
- Comply with environmental legislation
- Comply with the legislation related to imports, in the case of financing to import machinery and equipment

Complying with local content requirements is thus only one of several requirements for receiving financial support from the BNDES. While other requirements on this list are legally equally important in terms of obtaining the loan, it is the final point – complying with legislation related to imports – that is the most critical for wind turbine manufacturers (MEAN 2014). Furthermore, the local content requirements where

updated in the FINAME II in 2013, which saw the general percentage of local content requirements go up from 60% to 70% on wind turbine manufacturing along with other specific requirements to wind the different components of the wind turbine. These points and their effect on Brazil's wind industry will be elaborated on in the analysis.

In this way, the current localization policy in Brazil applies a variety of support mechanisms. Applying Lewis & Wiser's (2006) classification of these mechanisms, direct support mechanisms used in Brazil include the financial incentives conditioned by the explicit local content requirements described above as well as tax incentives. Also indirect support mechanisms such as a competitive auctioning system are put in place to with the purpose of providing a stable long-term demand at competitive prices.

Being the current local content regime in relation to wind power in Brazil, and with the relevance of the local content requirements on wind turbine manufacturing, the requirements tied to the FINAME program, and especially the FINAME II, will be the main policy focus of my analysis of local content requirements and the their effect on Vestas in Brazil.

3.3 Perspectives on local content requirements in the literature

In the following section, I will outline some of the positive rationales for using local content requirements presented in the literature. These rationales can roughly be divided into three categories listed below (Kuntze & Moerenhout 2012, UNCTAD 2014):

- development arguments
- economic arguments
- environmental benefits

The elaboration of these will be followed by an overview of some of the critiques of local content requirements in the literature.

3.3.1 Development arguments

The first group of arguments is aimed at development. One of the primary reasons for governments to impose local content policies is to "strengthen a weakened or infant industrial base" (UNCTAD 2014 p. 4). In a free market, market failures and market power of large players make it difficult for small players to compete or get a foot in in the industry. This includes for example coordination failures, where companies

fail to take the value created from positive externalities into consideration in their investment decisions, and as such, these decisions do not reflect the highest societal welfare gain (Tomsik & Kubicek 2006). It is in this way argued by some economists that, historically, almost all successful development in the last decades has been caused by different protectionist policy measures (Moon 2009). Proponents of local content requirements thus argue that, especially for developing countries, it is better to protect infant industries from foreign competition using protectionist policies until they are ready to face global competition (Kuntze & Moerenhout 2012, Moon 2009), in particular where developing countries have historically been engaged in low value-added activities (UNCTAD 2014).

Similarly, local content requirements are also used to ""leap-frog" existing barriers to technological transfer" (UNCTAD 2014 p. 5). This refers to developing countries – or in some cases developed countries, who seek to quickly develop a new strategic sector – using local content requirements to speed up the process of learning, adopting and adapting new technologies. Especially in the energy sector, which requires a high level of technological knowledge, local content requirements can be key in overcoming high entry barriers as well as developing technological knowledge (UNCTAD 2014).

It is also argued by proponents of the policy, that local content requirements are preferable to other forms of protection. Some observers suggest that particularly in a developing country setting, local content requirements provide higher overall welfare than other types of protection such as tariffs and subsidies. It is for example argued that tariffs create a cost penalty on imported inputs that does not exist with local content requirements (UNCTAD 2014).

3.3.2 Economic arguments

While the above group of arguments is mainly used in relation to developing economies, the second group of arguments – economic arguments – is more often used by industrialized countries as the development arguments are often harder to support in the context of an already industrialized country (Kuntze & Moerenhout 2012). As such, Western countries also often refer to more practical, or economic, benefits to local content requirements. These arguments, however, are still very similar to the development argument in terms of what they seek to achieve (Kuntze & Moerenhout 2012).

The first argument is job creation. Whereas, from a development perspective, this argument is tied mainly to welfare gain and increased development, the economic reasoning here is also using job creation as a tool to gain political support for green industrial programs by ambitious governments. As such, by applying local content requirements to a green initiative, local employment should go up, and the government will more easily gain support for the project (Kuntze & Moerenhout 2012).

Second, similar to the development argument, “Support is aimed at fostering infant industries by protecting them from foreign competition until they can realize their latent comparative advantage” (Kuntze & Moerenhout 2012). Support is in this way linked to longer term aspirations for sector growth in fast growing sectors with increasing demand – such as for example the renewable industry (Kuntze & Moerenhout). As such, industrialized countries have the same long-term goals as developing countries, that is, an internationally competitive industry (Kuntze & Moerenhout 2012).

Third, some argue that local content requirements allow certain tax-based benefits for the government, both in terms of an increased tax base (Kuntze & Moerenhout 2012), and the ability to redistribute these taxes to fit local needs to a higher degree (UNCTAD 2014). This is both relevant to developing and industrialized countries. Firstly, a larger local manufacturing base caused by local content requirements allows for a larger tax base, providing a government more economic leverage in for example a time of financial need (Kuntze & Moerenhout 2012, Lewis & Wiser 2006). Secondly, local content requirements allow governmnents to re-direct income from increased economic activity. This can for example be aimed at ensuring that profits and employment from extraction of resources goes to the local communities where this extraction occurs. The increased income, however, does also run the risk of fueling corruption simply by redirecting the income towards individuals in exchange for certain favors or permits (UNCTAD 2014

3.3.3 Environmental arguments

The third group of arguments is the environmental benefits related specifically to local content requirements in green sectors – or the “green economy” argument (Tawney 2012). The argument is quite straightforward, but still a compelling one. The argument is based on the idea that local content requirements will increase the number of green companies in the industry. This will increase supply and competition in the sector, pushing green companies to become more and more competitive and efficient, thus increasing total environmental benefits (Kuntze & Moerenhout 2012).

3.3.4 Critiques and caveats of local content requirements in the literature

The main critiques of local content requirements are centered on the market distorting effects related to the policy. The center of the discussion is thus whether or not the intended long term positive effects of localization outweigh the negative impact local content requirements have on efficiency.

Grossman argues that while content protection is not very dissimilar from tariffs on intermediate goods, he states that protection effects and extent of content protection are more difficult to predict and measure, and thus that “…content protection and content preference may fail to attain the noneconomic objectives of the policy maker”. As such, he argues that aiming at an increased domestic value added through local

content policies might actually run the risk of having the complete opposite effect through what he refers to as a "negative effective preference" as an analogy to what is known in the tariff literature as negative effective protection. This negative effective preference occurs as the local supplier gains monopoly power from the policy. The local supplier thus raises the prices and, in the name of profit maximization, might actually finally reduce output, causing a deadweight loss to the economy.

Beghin & Sumner (1992) build on Grossman's model, focusing on how the bargaining scenario between between both a monopolistic supplier and manufacturer affects the price and quantity of input. The authors analyze two scenarios: Minimum domestic content requirements equal to and requirements below the free trade level. In their analysis, they find that "a nonbinding or just binding minimum content requirement increases the profit of the domestic input supplier compared to its free trade level without distorting production" (Beghin & Sumner 1992 p. 314).

Belderbos & Sleuwegen (1997) likewise focus on the market power between up- and downstream firms under a local content requirement regime, and argue that "Although in this setting a LCR de facto only affects foreign downstream firms and 'raises rival's costs', the LCR increases market power of domestic upstream firms, raises the market price for intermediate goods and so substantially increases costs for domestic downstream firms" (Belderbos & Sleuwegen 1997 p. 116). Under market successive market power, local content regulation is thus argued to reduce efficiency of the industry and have "substantial anti-competitive output reducing effects" (Belderbos & Sleuwegen 1997 p. 116), and thus argue that local content requirements are generally inefficient in terms of increasing domestic welfare in the host economy. Similarly, Richardson (1991) even argues that this increase in domestic prices actually reduces competitiveness of the local firm vis-à-vis the foreign firm in the case of a foreign duopsony.

The argument of Belderbos & Sleuwegen (1997) is partially supported by Rivers & Wigle (2011), who analyze the effects of local content regulation on employment in the renewable industry. They argue that under certain circumstances – such as content requirements increasing the cost of equipment and thus reducing the amount of energy production – "content requirements could backfire, causing an overall reduction in green employment" (Rivers & Wigle 2011 p. 22). While their paper only focuses on the short term, it highlights the risk of negative spill-over effects occurring from local content requirements.

As such, while certain proponents of local content requirements argue that a longer term perspective needs to be taken into account, as for example learning-by-doing will reduce these inefficiencies in the long run, authors such as Tomsik & Kibucek (2006) counter that even in the long run it is very uncertain whether these benenfits will actually outweigh the inefficiencies caused by local content requirements. They argue,

among other things that for local content requirements to be effective, components must logically be more expensive to produce locally. And while local content regulation might sometimes work in terms of correcting market failures such as coordination failures, the circumstances for such a coordination failure where local content would outweigh are very specific and unlikely. They continue that even taking learning by doing into account, it is very uncertain whether the benefits will outweigh the costs.

Even if subsidies and local content requirements are proposed as only a temporary measure, meant to be removed once an infant industry has matured to a globally competitive player, certain critics argue that in practice this will not be the case (Moon 2009). Critics are worried that subsidized companies will not become competitive enough to be able to compete without removing the subsidies, and that governments will not be able to roll back the protectionist policies, thus making them permanent (Moon 2009).

Tawney (2012) similarly argues that inefficiency of the local industry might become one of the obstacles for successful local content regulation in the renewable industry. Her analysis takes departure in the successful local content regime of the Chinese renewable industry. She argues that while China proved a successful attempt at local content regulation, China enjoyed circumstances that are very different from other developing countries attempting to impose similar policies, such as a large and stable market, and that content requirements are too focused on the manufacturing parts of the supply chain, thus limiting the chance for technology innovation. Instead she argues that policy makers need to use an approach that engages fully with the global sector and competes based on existing strengths and innovation. The author thus recommends that instead of imposing local content requirements, governments should invest in innovation in the segments of the value chain in which the country might be competitive, and build a domestic or even regional market that supports new technology while keeping competitiveness up. This argument is similar to that of Lewis & Wiser (2006), who argued that a large and stable market was necessary to foster a strong local industry. In this way, while they do not disregard local content requirements as a way of promoting local industry, they do argue that a significant and stable demand must be present in the local market for it to have the desired effect. In the same way, Rennkamp & Perrot (2016) argue that local content requirements “fall short as a stand-alone industrial policy instrument” (Rennkamp & Perrot 2016 p. 776), and as such must be combined with other incentive mechanisms to spur innovation in wind energy technology transitions.

Similar to Tawney (2012), Hufbauer et al. (2013) argue that governments need to focus on alternatives to local content requirements. It is simply too difficult to measure the effects of domestic requirements on the

economy, and runs at too high a cost to the economy compared to other alternatives such as improving logistics, investing in infrastructure, promoting a business friendly environment or simply using tariffs or subsidies, which they argue have the same effects as local content requirements all the while being more transparent.

The perspectives presented above can be summarized and synthesized as done in table 3.2 below. The first column lists the different arguments for using local content requirements, categorizing them in the three groups presented in the beginning of this section – development, economic and environmental arguments. In the second column, I elaborate on the rationale behind these arguments, while the final column summarizes some of the critique and caveats of the argument.

Purpose of LCR	Arguments for	Caveats/Critiques
Development arguments		
Strenghtening a weakened or infant industrial base in developing countries	Promoting domestic development, Neo-liberal WTO paradigm restricts opportunities for developing countries, due to high entry barriers especially in high tech areas such as green energy. Less importation also provides a better balance of payments.	"...they lead countries in entirely the wrong direction, distorting trade and development and drawing resources into inefficient sectors" (Moon 2009 p.7) Critics of the approach also fear that subsidies, which are meant to be temporary, could end up being permanent
Addressing market or policy failures	Addressing market failures, where for example positive externalities such as vertical spill-overs are not being reflected in companies' investment decisions	The situation in which the inefficiencies from local content requirements outweigh the gain from correcting market failure is highly unlikely
Technology transfer	Market failure and market power make it difficult for local firms' need to catch up and thus to compete internationally	Requirements usually are overly focused on manufacturing, and not high value creating activities, thus limiting the potential for knowledge diffusion (Tawney 2012)
May be preferable to other forms of protection	Overall welfare increase especially in developing countries, without e.g. cost penalty from tariffs	Difficult to measure effects of LCR Same outcome as e.g. tariffs, but less transparent
Economic arguments		
Redistribution/ increased tax base	Redistribution to e.g. communities where extraction occurs	May also be distributed to individuals - corruption
May be preferable to other forms of protectio	Overall welfare increase especially in developing countries, without e.g. cost penalty from tariffs	Difficult to measure effects of LCR Same outcome as e.g. tariffs, but less transparent
Job creation	Short term job creation in the green sector. Helps create support for green industrial programs.	Inefficiency caused by LCR leads to lower production and thus actually to job losses in the short run
Environmental argument		
Increased competition in the green sector	More green companies --> more competition --> more efficient green sector	Inefficiency of forcing companies into local value chains may result in expensive low quality green energy (Tawney 2012)

Table 3.2 – overview of arguments for and against local content requirements in the literature – Sources: Lewis & Wiser (2006), UNCTAD (2014), Hufbauer et al. (2013), Kuntze & Moerenhout (2012), Grossman (1981), Rivers & Wigle (2011), Belderbos & Sleuwegen (1997), Tomsik & Kubicek(2006), Tawney (2012)

As such, most of the literature in this section does acknowledge positive effects local content regulation can have on localization – Indeed, Rivers & Wigle (2011) also acknowledge that the negative effects of their study on domestic employment only applies in the short term). However, the authors listed above generally find the market distorting effects and inefficiencies imposed by local content requirements to outweigh the benefits.

Some authors such as Veloso (2006) and Lewis and Wiser (2006), Kuntze & Moerenhout(2012), and Johnson (2013, however, present a more optimistic approach. As such Veloso (2006) in his study of the automotive industry, found that under the right circumstances, and if the domestic requirements were not too restrictive, the opportunities for learning-by-doing as well as linkages in the industry could provide positive results to the domestic welfare. Lewis & Wiser (2006) likewise argue that given the right circumstances, such as a large and stable market, and with the right support mechanisms to create these circumstances, local content requirements can have a net positive effect.

Kuntze & Moerenhout (2012) and Johnson (2013) build on the idea of circumstantial success of local content requirements. Instead of arguing whether local content requirements are right or wrong for a government to use, they seek "to move beyond this stalemate to understand under which conditions LCRs might be a legitimate and effective tool for promoting local manufacturing" (Johnson 2013). Kuntze & Moerenhout (2012) in this way created a framework for analyzing the basic conditions for the effectiveness of local content requirements in the renewables sector, which authors such as Johnson (2013) and Stephenson (2013) have later applied on other research on Solar energy India and for assessing local content requirements in a sustainable energy trade agreement respectively.

Similar to the work done by Kuntze & Moerenhout (2012) this thesis also does not seek to address the general appropriateness of local content requirements, but rather to analyze what effects the local content requirements in Brazil have on the industry. However, While Kuntze & Moerenhout created the framework to analyze the potential for welfare benefits from local content requirements, this thesis moves away from the societal perspective, and looks at the effects of local content requirements from a firm perspective. In this way, this study differs from most of the literature in the field by not focusing on local content

requirements in terms of its efficiency as a policy for increasing welfare, but rather in terms of the effects they have on the operations of a specific firm in the wind industry, in this case Vestas in Brazil. On other words, the thesis will move the focus on local content requirement from a macro-level analysis on policy and welfare creation to a micro-level perspective on firm decisions and operations.

4. Theory

In the above literature review, I have accounted for the general theoretical perspectives on local content requirements, and how my study will place itself in this field. In the following section, I will explain the theoretical basis of my thesis, as well as how I will adapt it to a firm level analysis of Vestas in Brazil.

4.1 Introduction to the framework of Kuntze & Moerenhout

This thesis is theoretically based on Kuntze & Moerenhout (2012), who combine the arguments of Veloso (2006), Lewis & Wiser (2006), Rivers & Wigle (2011), Tomsik & Kubicek (2006) and more to create a framework for establishing the potential for welfare gains from local content requirements in the renewable industry. They provide four dimensions to determine the efficiency and therefore potential welfare gain. They argue that a potential welfare gain depends on (1) the size and stability, (2) the domestic requirements not being too restrictive and to be gradually phased in, (3) the cooperation opportunities and financial incentives, and (4) the potential for learning by doing in the local industry.

Kuntze & Moerenhout's framework was originally created to determine the efficiency of local content requirements in a particular country. Determining the *market size and stability*, the *restrictiveness of the requirements*, the *cooperation and financial incentives*, and the *potential for learning by doing and degree of current technological knowledge* will then help determine the efficiency with which local content regulation in a given county could spur local industry growth and competitiveness and raise domestic welfare. In this way, the dimensions would measure a country on the four dimensions to determine the local content requirements' efficiency from a government, industry, or welfare perspective. The figure below shows a quick overview of Kuntze & Moerenhout's framework. Please note that by inspiration from Johnson 2013 I have, adjusted the framework slightly, most notably renamed the second dimension to better reflect complexity of local content regulations – this I will also elaborate on later in the chapter

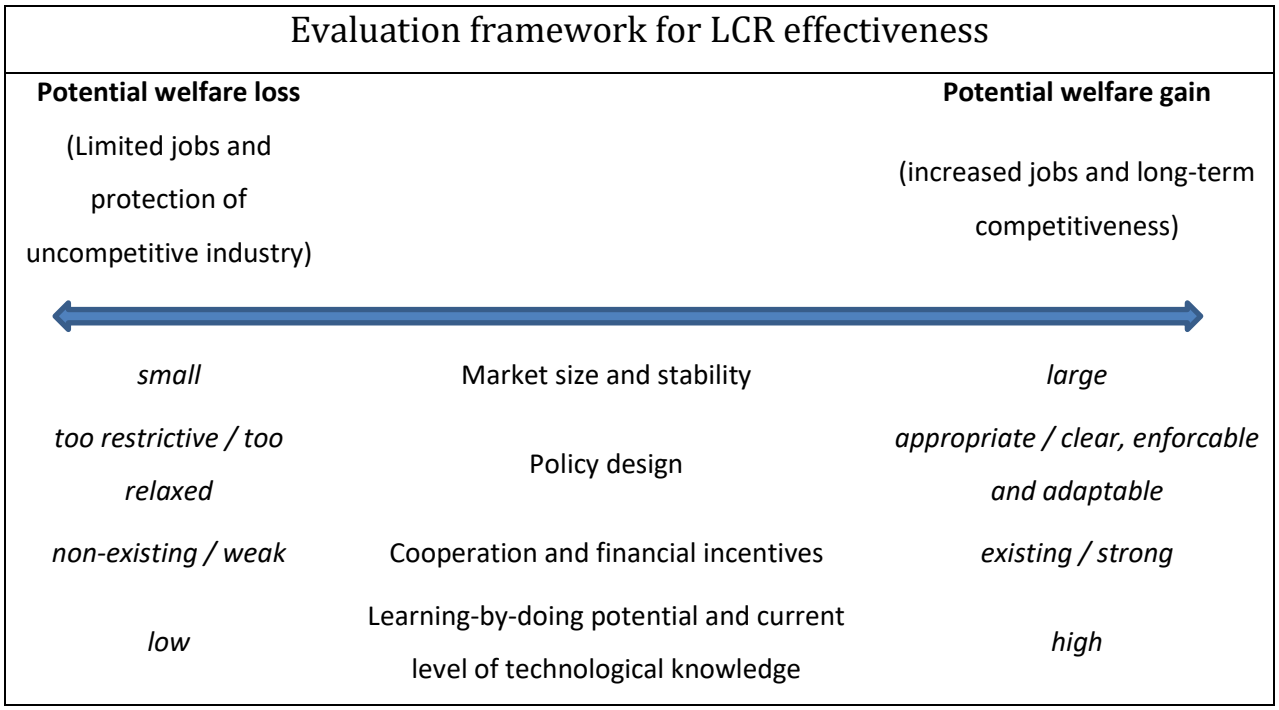

Figure 4.1 – Sources: Kuntze & Moerenhout (2012), Johnson (2013)

In this thesis, I will use Kuntze & Moerenhout's framework to analyze the Brazilian local content regulation from a firm perspective. To do this, I will firstly use the dimensions as traditionally intended, to analyze the Brazilian context. The analysis of Brazil, however, will not serve to determine the efficiency of the local content policies of Brazil per se. Rather, it will serve to outline the context in which Vestas operates, and each dimension will then serve as a factor with which to analyze the challenges and opportunities faced by Vestas while operating in Brazil, and how they have affected the operations and investment decisions of the firm. In the following, I will outline the specific approach I will take in my analysis in applying the framework.

In the analysis, I will focus on each dimension individually, and the analysis will in this way be divided into four main sections. The analysis of each dimension will consist of two parts: (1) a part focusing on Brazil and then (2) a part focusing on Vestas in Brazil. The first part will, as mentioned, analyze the country according to the specific dimension to outline a context for the Vestas analysis. The second part will then focus on Vestas and more specifically how the Brazilian context may have affected Vestas' operations and decisions in the country. The structure and theory behind each dimension will be explained below.

4.2 Dimension 1: A sizeable and stable market

The first dimension of Kuntze & Moerenhout's (2012) framework for analysis of local content regulation effectiveness is based partially on Lewis & Wiser's analysis of wind industry support mechanisms (2006) as well as Veloso's analysis of the automotive industry (2006). In their paper, Lewis & Wiser (2006) seek to determine the policy tools necessary for successful localization of foreign companies. They conclude that "Regardless of which of these direct incentives are used, a sizable local market appears to be a pre-requisite to achieving successful localization" (Lewis & Wiser 2006 p. 1855), and Veloso (2006) likewise argues that "With very small scales, the rise in the cost penalty curve is so steep that it rapidly reaches the marginal benefit generated by forcing domestic purchases through regulation" (Veloso 2006 p. 767). A consensus in this literature is thus that market size in terms of demand has an effect on the possibility of successful and beneficial localization. Lewis & Wiser furthermore emphasize the importance of not only a large, but also a stable market for successful localization to occur (Lewis & Wiser 2006). To back this up, Lewis & Wiser (2006) present a study by CanWEA made in 2003 which shows that "a minimum steady demand of 150–200MW per year for three or more years is crucial to developing a nascent local wind technology manufacturing industry" (Lewis & Wiser 2006 p. 1849).

Lewis & Wiser (2006) argue that the importance of market size and stability for the success of local content requirements are twofold. Firstly, a sizeable and stable market is important for local industries to be able to grow competitive in an environment of growth and stability. Secondly, a sizeable and stable is more likely to attract foreign investors, as high market growth and stability may incentivize foreign investment in local value chains in spite of the higher cost occurred by local content regulation, and thus the probability of knowledge diffusion is more likely. As this thesis is aimed at analyzing a foreign company – Vestas – and not at analyzing local industry growth, the analysis will focus on the latter, that is, how the size and stability of Brazil's market may have been attractive to Vestas in terms of investment.

The first part of the section will therefore focus on (1) the market size of the Brazilian wind market, and (2) the stability of said market. Analyzing the size will happen both in terms of the estimated potential for wind energy in the market, as well as the demand in the sector. The stability of this the market's growth will then be analyzed in terms of policies put into place to spur stable growth. In particular, this includes indirect support mechanisms, such as auctions, as these are implemented with the intent of creating a stable demand in a market, and thus attract investment (Lewis & Wiser 2006).

The second part of the section market size and stability will then move to a focus on Vestas. The analysis will focus on how the factors from the previous section may have affected Brazil's investment decisions in Brazil. In this way, the analysis will focus on how the size and stability of Brazil's market has affected Vestas' investment decisions and operations in the country in terms of both challenges and opportunities.

4.3 Dimension 2: Policy design

The second dimension to the framework of Kuntze & Moerenhout (2012) pertains to the restrictiveness of the local content requirements. This condition was pointed out by Veloso (2001, 2006) and Lewis & Wiser (2006). Restrictiveness of the local content requirements, in this case, relates to the degree to which content must be produced locally, be that as a percentage of price, weight, parts, or a similar measure pertaining to local manufacturing or of the workforce. In this thesis, I will use the term *policy design* for the second dimension of the framework (inspired by Johnson 2013) instead of *restrictiveness,* as Kuntze & Moerenhout originally named the dimension. This I do, because it to a higher degree reflects the complexity of the restrictions imposed by governments. For example, Brazil's current local content requirements do not only consist of a percentage which can be higher or lower, but also specifies which parts of the value chain must include locally sourced components and to which degree. Furthermore he argues that the clarity and transparency of the restrictions also play a part in their success. In this way, although basically being a question of semantics, as the overall purpose of the dimension does not change, "restrictiveness" reflects somewhat of an oversimplified expression of the design of the local content requirements.

Lewis & Wiser (2006) add on their argument of market size and stability with the degree to which local content requirements are applied. They argue that, aside from only being applied to markets with sufficient stability and market potential, local content requirements "should generally be applied in a gradual, staged fashion" (Lewis & Wiser 2006 p. 1852). If too restrictive, they run the risk of offsetting the advantage provided by attracting local manufacturing by negatively affecting the market competitiveness with higher cost of wind equipment.

Similarly, Veloso (2006) also finds that local content regulation works best when the government required domestic proportion is not set too high by the government. If too restrictive, local content requirements "shelter local firms from competition, leading to large monopolistic rents and equally sizable price distortions" (Veloso 2006 p. 749). Conversely, successful local content effects, he argues, "... are linked to

reasonable content policies, which induce favorable economies of scale and maintain a clear context of competition for individual component suppliers" (Veloso 2006 p. 749).

While no specific model to determine the right proportion of local content required is presented in economic literature (Kuntze & Moerenhout 2012), there still "seems to be a consensus in the literature that LCR percentages cannot be too high at first" (Kuntze & Moerenhout 2012 p. 8). As such, this dimension calls for a case by case approach, not dissimilar from the other dimensions. The dimension is relevant to analyze as the design of the policy has effects on the decisions which companies make in terms of investing in the local value chain (Lewis & Wiser 2006, Kuntze & Moerenhout 2012, Johnson 2013). This thesis will in this way serve to provide context from a firm perspective on how the policy designs of Brazil may have affected Vestas' operations.

In the first part of the section on policy design Brazil's local content requirements will be analyzed. Policy design includes the general percentage, and the specific requirements in the legislation, as well as the clarity and transparency of the requirements. The clarity and transparency of the local content requiremtents are relevant to analyze as a vague and opaque policy design may have negative effects on their outcome (Johnson 2013, Hufbauer et al. 2013). The restrictiveness of the policy design is relevant since a too restrictive policy might deter certain companies from investing, and thus hamper local investment, while one that is too lax will simply create bureaucracy with no real effect (Kuntze & Moerenhout 2012, Johnson 2013). Most of the literature on the topic agrees that for local content requirements to succeed in spurring local industry growth, they must at least start low, and then increase slowly in order to allow companies to adjust (Kuntze & Moerenhout, Veloso 2006, Lewis & Wiser 2006). I will also analyze how the current policy design differs from previous iterations, both in terms of design and efficiency. As Johnson (2013) argues "there is a need to continuously reflect upon and adapt policies as previous rounds of the policy cycle reveal areas for improvement, new scientific evidence emerges, stakeholder alliances change, or financial scope shifts" (Johnson 2013 p. 13). More importantly, identifying changes in policy will help me isolate and analyze how differences in policy design may have affected firm operations.

In the second part of the section on policy design, I will in this way focus on Vestas, and in particular, how changes in policy design may have affected its operations. This provides a clearer correlation for analysis in terms of the impact of the restrictiveness on Vestas' strategy, and the effect it may have had on the company's competitiveness, and on their investments in a local value chain. In the literature, one of the

main gripes with using local content requirements is their market distorting effects, such as decreased output due to higher costs, be those for reasons of market power or just local industrial inefficiency (Moon 2009, Rivers & Wigle 2011, Tomsik & Kubicek 2006, Belderbos & Sleuwegen 1997, Grossman 1981, and more). This part of the analysis therefore serves to analyze these effects from a company perspective.

4.4 Dimension 3: Cooperation & financial incentives

The third dimension, Cooperation and financial incentives focuses on other direct support mechanisms accompanying the local content requirements in Brazil and their effects on cooperation between foreign investors and the local industry. For local content requirements to be effective in creating links between foreign investors and local manufacturers, they should not be applied in a vacuum, as that would then most likely only deter investment due to higher costs of production (Lewis & Wiser 2006, Kuntze & Moerenhout 2012, Johnson 2013 and more). However, supply chains are complex, and Kuntze & Moerenhout (2012) state that while the general literature on financial incentives in relation to local content requirements Indeed does state that there needs to be financial incentives for the requirements to be effective, they lament that there is not much literature on which specific policy mechanisms are most efficient in terms of supporting which parts of the supply chain.

In this part of the analysis, I will therefore analyze Brazil's financial and tax incentive programs on local content requirements in the wind sector to determine their effect on creating cooperation between foreign turbine manufacturers and local suppliers, and in which parts of the value chain. Determining which parts of the value chain are being supported by the requirements is relevant to analyze, as the efficiency of the local industry may have an effect on company decisions in terms of sourcing or investing. The analysis of Brazil will then provide context for the following analysis of Vestas in Brazil, where I will analyze how these incentives may have affected Vestas' strategic decisions in terms of local investment and sourcing.

4.5 Dimension 4: Learning by doing potential and degree of current technological knowledge

Finally, I will analyze learning by doing potential and current technological knowledge in the Brazilian market in relation to local content requirements. The literature argues that long term welfare benefits of local content requirements can only be achieved if there is potential for learning by doing and innovation in the industries that receive the support (Johnson 2013). Local content requirements are a protectionist measure meant to protect infant industries until they grow strong enough to compete on equal terms with

other global industries. If there is no potential for innovation in the protected industry, however, critics argue that governments are simply pouring resources into an inefficient sector, and there will be a high risk that governments will not be able to roll back its subsidies (Moon 2009). If the technological capabilities in a country are too low for learning and innovation, local content requirements might therefore only serve to sustain an inefficient industry rather than help build capabilities.

The final dimension of the Kuntze & Moerenhout's framework involves the ability of producers to reduce manufacturing costs over time through learning and innovation. While in the short run, higher production costs caused by local content regulation might actually diminish the domestic production in the short run (Rivers & Wigle 2011), the idea is that in the longer run producers will hopefully be able to innovate and learn, which will reduce the production cost, thus offsetting the initial negative effects caused by local content regulation. (Kuntze & Moerenhuot 2012).

While this dimension is very closely related to the previous one (cooperation and financial incentives) in the sense that it focuses on linkages between foreign manufacturers and local suppliers, it differs in its focus on the opportunities for cost reduction and mitigation of the inefficiency caused by local content regulation through learning by doing, rather than how in which different parts of the value chain are targeted. The focus is on experience – "a side effect of production" (Tomsik & Kubicek 2006 p. 12). As such the focus is not on "technology growth" itself, but on "technology catching-up" from the host economy to the global standard. Tomsik & Kubicek (2006) argue that, while learning-by-doing reduces the inefficiency arising from local content regulation, it is very uncertain whether it actually offsets it. Veloso (2006) also addresses the issue of learning by doing, and finds that "Domestic content requirements are likely to be effective in regions where the gap in manufacturing conditions for components forced into local production is small" (veloso 2006 p. 768). That is, the higher the degree of current technological knowledge, the higher the chance of learning by doing and an economic gain.

Kuntze and Moerenhout thus present two different technology-related effectiveness factors: a technology specific one of "How much and at what rate can the technology still surf down the learning curve?"; and one specific to firms in the host country: "Do those firms have adequate base knowledge of the current state of technology?" (Kuntze & Moerenhout 2012 p. 9). With the latter being a precondition for the first, the authors put them both under the same dimension of learning by doing potential in their framework.

As Kuntze and Moerenhout (2012) state, results depend on the context, and thus analyses must be made on a case by case basis to determine whether the learning by doing potential and degree of current

technological knowledge is either low or high – with local content regulation being much more effective if the latter is the case. In the following I will therefore examine the Brazilian context in terms of pre-existing technological knowledge and learning by doing potential. This will hopefully expand on the "relatively little analysis [there has been] of the spillover effects that LCR might have on green technology costs and innovation" (Kuntze & Moerenhout 2012 p. 9). This however, will again not be the main focus of the analysis, but rather provide the context for Vestas venture in Brazil.

In this dimension of the analysis I will therefore analyze firstly the degree of current technological knowledge and potential for learning by doing of the industries that are being protected by Brazil's local content regulation on wind energy, and then secondly analyze what effect the content regulation has had on spurring innovation and competitiveness in the local industry. It should still be kept in mind, however, that the purpose of this will not be to determine whether Brazil's support mechanisms will be effective for creating an export good, but rather the challenges or opportunities the sophistication of the local industry might bring for Vestas. As such, the higher the potential for learning-by-doing, the higher the gain for Vestas, as it will determine Vestas' ability to lower costs in the long run through investing in local markets vis-à-vis simply importing. As such, the analysis of Vestas in this dimension will then focus on the challenges and opportunities created by the level of technological knowledge in the local industry, and how Vestas has reacted to these in order to comply with local content requirements.

4.6 Framework summary

Table 4.1 below outlines the framework as it will be applied in my analysis. The first column contains the 4 dimensions for analysis; the second column provides the subjects of analysis on a country level, in this case Brazil, and the third column describes the subjects I will be analyzing on the firm level in relation to Vestas.

Dimension	**Country level (Brazil) – subjects of analysis**	**Firm level (Vestas) – subjects of analysis**
Market size and stability	Market growth potential Indirect support mechanisms (Lewis & Wiser) for market growth Economic climate	Challenges and market opportunities
Policy design	Design and restrictiveness of local content requirements Effect on local investment Adaptation of policy design to context	Impact of restrictions on competitiveness Changes to value chain organization due to requirements
Cooperation and financial incentives	Direct support mechanisms (Lewis & Wiser 2006) such as financial and tax incentives Effect of incentives in spurring cooperation between	Incentives for investing in spite of restrictions for Vestas in particualr
Learning by doing and current degree of technological knowledge	The potential for innovation and development in targeted areas of value chain Effects of local content regulation on innovation	Challenges and opportunities for efficiency stemming from current local technological knowledge

Table 4.1 – The framework for the analysis of Vestas in Brazil - Based on framework by Kuntze & Moerenhout (2012) with added firm perspective

It is important to note that these factors are not independent of each other; especially in the firm analysis, it is difficult to analyze one factor without taking another into account. For example, the effect of the restrictiveness on company decisions depends heavily on both the market opportunities in the country as well as the incentives provided to counter the hampering effects of the requirements, with restrictions serving as a *push* factor and market opportunities and incentives serving as *pull.* Furthermore, adapting a framework made for policy evaluation from a welfare and government perspective to a firm perspective

might provide certain complications and limitations. These considerations will be deliberated in the discussion chapter of this thesis.

5: Analysis

In this part, the framework outlined in the previous section will be applied to the case of Vestas in Brazil. This entails applying Kuntze & Moerenhout's (2012) framework firstly on the context of Brazil and then applying these findings on the case of Vestas in Brazil. The overall structure will thus be as follows. In section (5.1), I will firstly analyze the market *size and stability* in Brazil. Secondly, I will apply the dimension to the specific case of Vestas (i.e. to a firm rather than a country case), using the analysis of Brazil as the context for this. The same approach will be taken with the second dimension *policy design* in section (5.2), *cooperation and financial incentives* in section (5.3), and finally *learning by doing and current degree of technological knowledge* in section (5.4). The findings of this analysis will be discussed in chapter (6).

5.1 Market size and stability

As outlined above, I will in the first section (3.1.1) analyze the Brazilian market's size and stability. This will then provide the context for section 3.1.2, where I will analyze the market potential and the stability of its growth from Vestas' point of view, thus turning the points found in the country analysis from a country perspective to a firm perspective.

5.1.1 Brazil – Market size and stability

In the following, I will analyze geographical, economic, and policy factors pertaining to the market size and potential of Brazil's wind sector. Firstly I will analyze geographical factors for wind energy growth, that is, climate conditions for wind energy, such as wind conditions and wind energy potential. Secondly, I will look into economic factors, such as energy demand growth, market growth, as well as the political factors for wind energy. These include the policies put into place to support wind market growth, in particular indirect support mechanisms. The analysis will also include an assessment of the effects the recent political and economic turmoil in the country may have had on market stability.

Geographical factors for wind energy growth

Brazil's climate is very attractive to wind power, and its geography provides a very high potential for wind energy production. The North Eastern part of Brazil contains large areas with constant steady wind, and is compared, by industry officials, to "a vast warm hair dryer" (Backwell, 2015 p. 70). These conditions provide arguably some of the best conditions for windmills in the world. Especially the North Eastern part of Brazil is described by some as "…the best winds in the world" (Camargo in windpowermonthly.com 2016), and the industry has currently just begun tapping into the potential of the country. For example, The North Eastern state of Bahia, which in April 2016 had an installed capacity of 1652 MW (see graphic for installed capacity in different Brazilian states in April 2016) estimated a wind potential of 195 GW. Similarly, the South Eastern state of Rio Grande do Sul estimated a potential of 217 GW of wind power. This, however, included more than half being off shore, and although the potential there is promising, experts do not see off shore as an area for investment in Brazil: "there is simply no reason for Brazil to opt for the more expensive energy soon. Actually, I do not foresee any bright future for offshore wind energy in Brazil in the next 10 to 20 years" explains Camargo-Schubert, a wind energy consultant, in a market study by Dutch Ministry of Economic Affairs on Wind energy in Brazil (2014). In total, Brazil's on shore potential is estimated to be around 300 GW (MEAN 2014).

Political and economic context for wind energy

Not only does Brazil have excellent wind conditions and potential for on shore wind turbines, there is also a large political will to invest in wind energy (Backwell 2015), which serves to create a large demand. One of these reasons is the fact that wind energy also serves to mitigate some of the disadvantages of Brazil's hydroelectrically based energy matrix. Brazil has a very high growth potential and thus the demand for power has seen a projected rise recently and in the coming years. Producing new dams is very costly and time consuming. There are also various environmental concerns related to the construction of new dams such as preservation of the Amazon and dislocation of adjacent communities. Furthermore, during droughts, Brazil struggles to sustain a sufficient level of electricity (Backwell 2015, Ministry of Economic affairs 2014). However, wind energy turns out to be a perfect fit for Brazil's energy demands: The areas with the highest power demand are located conveniently next to the windiest areas, and, coincidentally, wind power supplements hydroelectric power during dry winters perfectly to help avoid power surges (Backwell, 2015). Furthermore, the energy crisis of 2001-02 proved the importance of the Brazilian government to focus on a diversification of the Brazilian energy matrix, as a drought left the country's vast array of hydropower plants dry, which "…cut output at factories, lopped about a percentage point off economic growth, and led millions of people to spend their nights by candlelight" (Reuters, 2013).

Political targets for market growth

The Brazilian Ministry of Mines and Energy set out an ambitious 10 year plan which sought to increase the wind capacity from 2010 to 2020 more than tenfold from 1 GW to 12 GW (Vestas, 2011) a targeted growth rate of an average of above 1 GW per, a target that has since increased to 20 GW by 2023 (Windpowermonthly.com 2015). This is a demand much higher than the minimum of 150-200 MW estimated by Lewis & Wiser (2006) as the minimum annual demand required for industry growth and for a much longer period than the two to three years suggested – it even doubles the minimum of 500 MW of annual demand required for "a more capable and aggressive local industry" (Lewis & Wiser 2006 p. 1849). In this way, setting this high target was, according to the EPE[2] a solution to creating a large market (Rennkamp & Perrot 2016).

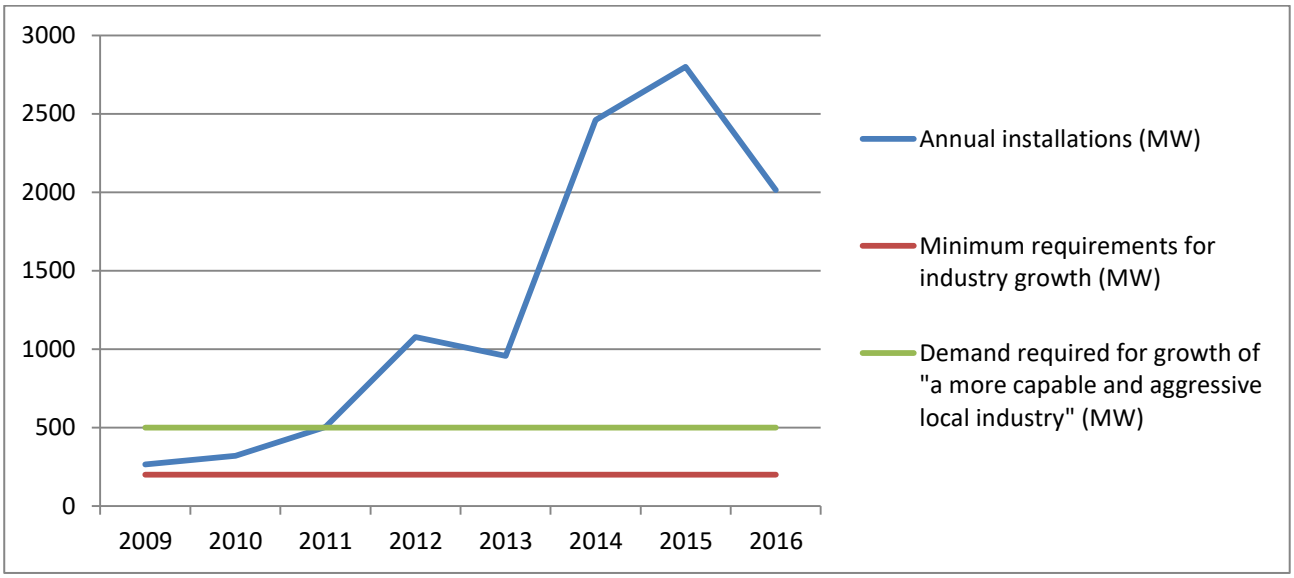

Figure 5.1: Annual installations in relation to the Lewis & Wiser's (2006) minimum requirements for market demand per year – Data: gwec.net 2017

The target of 12 GW was even almost reached in 2016 where the accumulated wind capacity reached 10.7 GW of power, and as of May this year installed capacity has surpassed the 13 GW mark (ABEEólica 2017). While this does not seem like much compared to giants such as China (168,7 GW), the US (82,1 GW), and Germany (50 GW) in 2016, it is well worth noting that wind energy is the fastest growing source for electricity production in the country (See figure 5.2), and Brazil is currently by far the largest producer of wind energy of Latin America followed by Mexico with an accumulated capacity of 3,5 GW in 2016

[2] Brazil's federal energy planning company

(gwec.net 2017). by May 2017, ABEEólica estimates that wind energy to supplied 11% of the Brazilian electrical matrix in May this year (ABEEólica 2017). In December 2016, Brazil was the world's 9th largest in terms of cumulative wind capacity (gwec.net 2017) and with projects in the pipeline for an expected accumulated capacity of 18GW, Brazil expects to be the world's 6th largest wind market in the world by the end of 2019 (Windpowermonthly.com 2016).

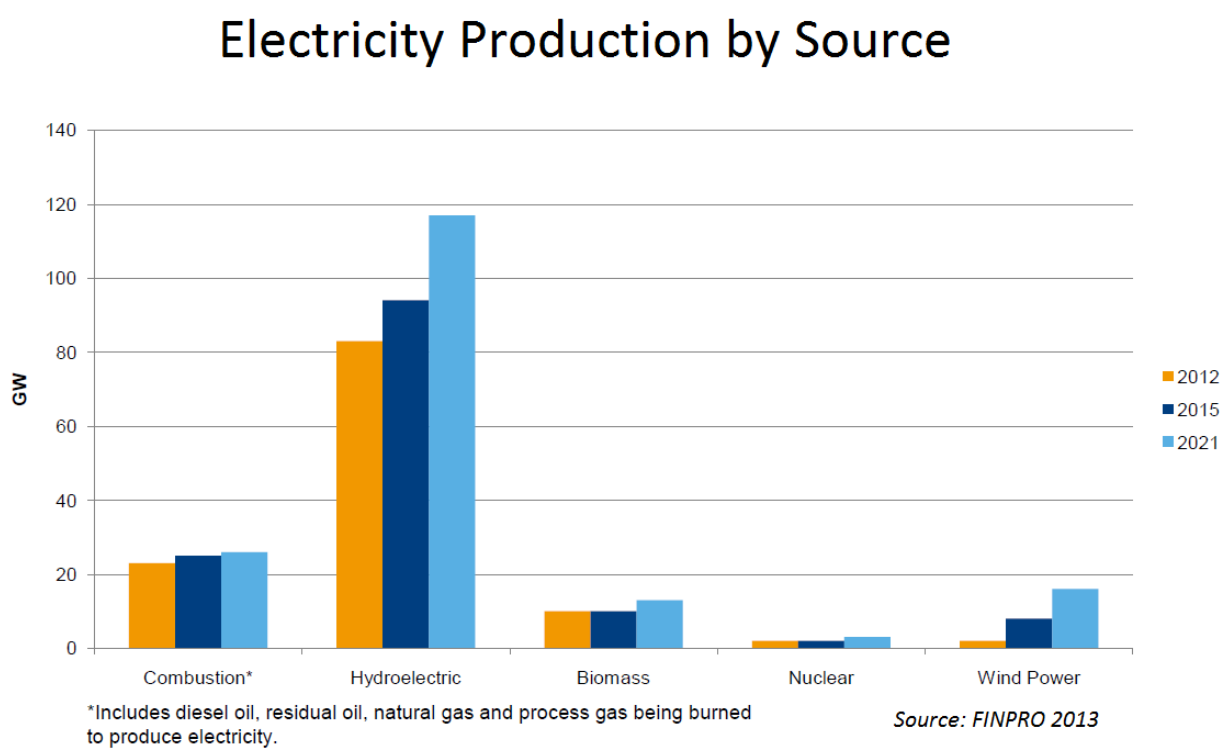

Figure 5.2 – Wind power is the fastest growing source of electricity for Brazil's electrical grid

Indirect support mechanisms for supporting stable market growth

In order to spur the growth of the wind market, Brazil implemented energy auctions in 2004, and in 2009 auctions for wind power where introduced (Backwell 2015). One reason for the introduction of these auctions was transparency, and the auctioning system has done very well in terms of price disclosure, efficiency in the procurement process as well as reducing asymmetrical information (MEAN 2014). The introduction of the auctioning system also did spur a huge growth in wind energy installations: from 2004, with the implementation of PROINFA, until 2009, when the auctions were introduced, installed wind was approximately 1GW – after the introduction, competition and development in the sector increased the amount of installed wind capacity, which has now increased tenfold to over 10GW (MEAN 2014, GWEC 2017). As shown in figure 3.2, wind power installations really seemed to take off after the first competitive

wind auctions of 2009, and have almost increased exponentially since, after sluggish growth from 2004-2009.

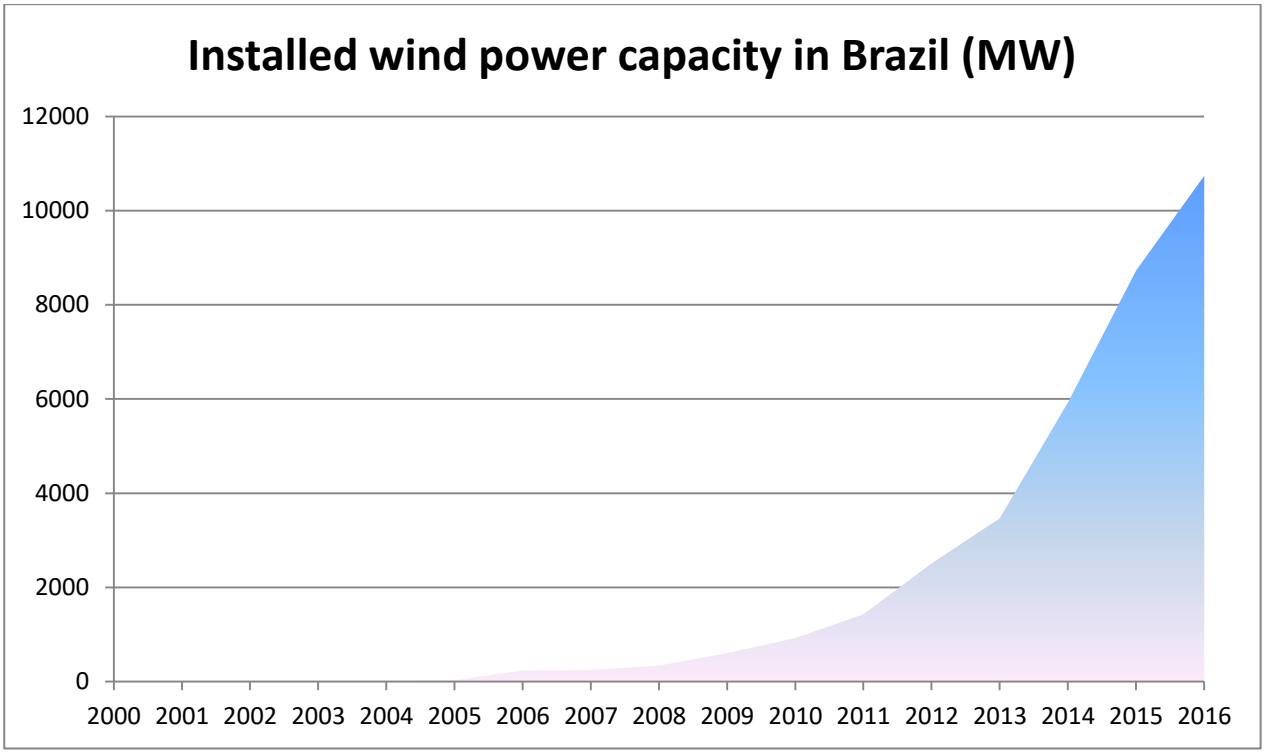

Figure 3.2 - Data from Global Wind Energy Council (GWEC.net) 2017

Although the auctioning system has indeed provided large growth in the sector, Lewis and Wiser (2006) argue that tenders through auctioning "have historically not provided long-term market stability or profitability, due in part to the often uncertain or long lead times between tenders and the fierce competition among project developers to win the competitive process" (Lewis & Wiser 2006 p. 1854). In the case of Brazil, however, a combination of strict completion guarantees and sanctions in case of delays works to assure that all projects in the auctions will be carried out, and in the timespan promised (MEAN 2014).

There is however still some concern related to the competitiveness of wind energy in the auctions. On the one hand CEO of the Brazilian Wind Organization (ABEEólica) Dr. Elbia Melo states that "the Brazilian auction system is bringing down the cost of energy, creating an attractive environment for foreign investment. The country opted wisely for a competitive energy market model for contracting renewable energy sources. We welcome and encourage the additional competition this investment brings." (Vestas 2014). On the other hand, while the auctions have been very successful in making wind energy highly

competitive in Brazil, due to fierce competition caused by the swift development of the sector, there are some concerns that the low price in which wind energy is competing might actually prove a threat to the industry (MEAN 2014, IRENA-GWEC 2013). Competition in the industry has in fact forced the energy price below cost prices, which only proves favorable for big investors, who "are able to offer lower prices due to economies of scale and hence compete with other electricity generating technologies" (MEAN 2014 p. 16).

Brazil's auctions have nonetheless up until 2016 proven quite stable. The strict screening of both the projects and auction participants as well as completion guaranties has increased transparency in the bidding (MEAN 2014), and with wind energy even beating fossil fuels in cost efficiency due monetary incentives from the Brazilian Development Bank (Backwell 2015, Vestas årsrapport 2016) some of this concern may be somewhat appeased.

Another caveat from the fast growth is the challenge of the power grid keeping up the pace with the installation of wind farms. Windpowermonthly.com reported that "The rapid expansion of wind power outpaced the extension of transmission lines, and in 2013 many completed projects were left unconnected" (Windpowermonthly 2015). Brazil's energy planning agency EPE, however, has been expanding the transmission lines in the last few years through auctions (Windpowermonthly.com 2015, GWEC Global Wind Report 2015), as well as making new projects responsible for their own transmission connection (MEAN 2014).

Effects of current economic and political crisis on market stability

Due to the recent political and economic crisis in Brazil, however, both the planned auctions of 2016 were cancelled, and fear arose in the industry that the BNDES might cut on their credit subsidies for the sector , which are crucial for the competitiveness of the sector (Datamark.com 2016) – SEE BNDES AFNSIT SAMT 3.3 for more on BNDES credit assistance. Entering the second year of recession, 2016 saw demand for electricity in Brazil fall creating "too much electricity in the system" (awordaboutwind.com 2016), and thus a supply for energy much higher than the demand (awordaboutwind.com 2016). This resulted in the government cutting down on auctions, planning only one at the end of the year (awordaboutwind.com 2016), which then even got cancelled, thus leaving 2016 with no wind energy auctions (windpowermonthly.com 2016). This is also reflected in the projections by the Brazilian Wind Power Association on installation of wind energy in the coming years (figure 3.2), with a significant reduction in installations from 2019 and forward, due to the recent lack of tenders (Rechargenews 2016).

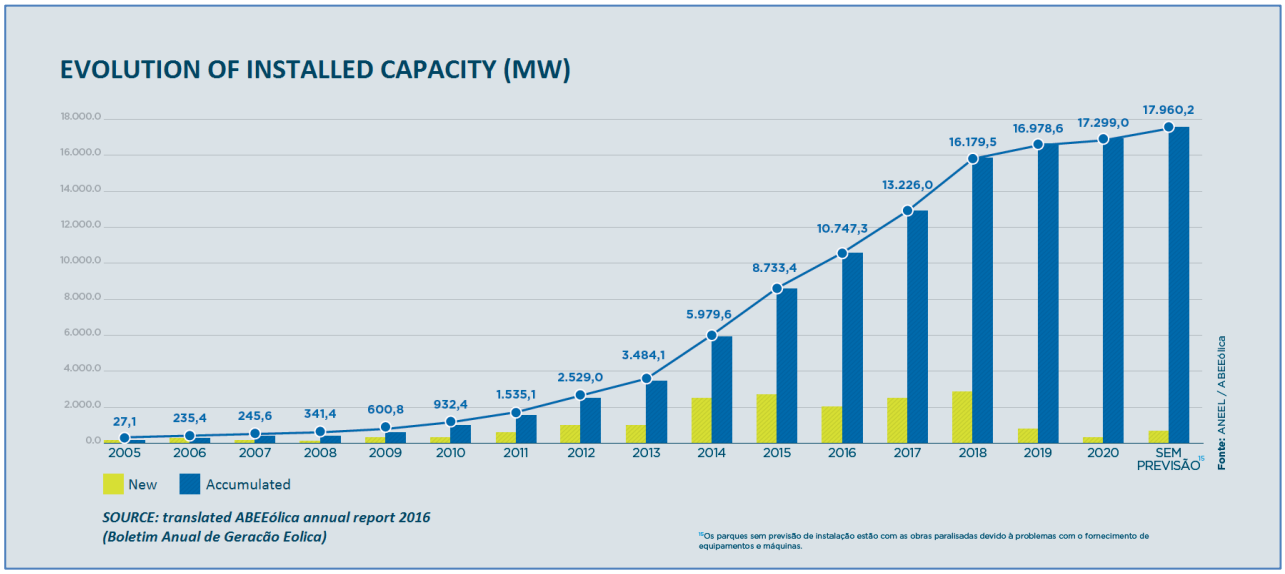

Figure 3.3 – after strong growth new installations are dropping drastically after 2018 due to lack of tenders

After the cancellation, Steve Sawyer of the Global Wind Energy council assessed that Brazil was facing "a rough couple of years" and warned that "it does not bode well, especially for the companies that have invested in plant in response to local content requirements" (in rechargenews.com 2016). Other industry officials shared the worry that this development would be detrimental to the local supply chains, with Elbia Gannoum of the Brazilian Wind Energy Association Abeeólica fearing that "we [Brazil] run a serious risk of demobilisation of the production chain and this is a near-mortal blow in a promising young industry that today generates the most competitive energy in the country" (in windpowermonthly.com 2016). Naturally, wind energy producers also lamented the development, with an unnamed wind developer stating, among other things, that "Worst of all is the uncertainty…" in response to the issue (rechargenews.com 2016). With signs appearing (although not yet materializing) that the BNDES might even cut down on its funding to renewables causing tension for manufacturers (datamark.com 2016), this uncertainty is not diminished. The growth of the wind sector had otherwise, up until the auction cancellations, been somewhat of a bright spot, as Brazil was already "suffering from the effects of a two-year drought", which had seen the countries hydropower resources suffering (windpowermonthly 2016).

As such, while the Brazilian market has had a very high demand, recent economic and political developments are signs of a currently unstable market. While this instability occurred as many companies had already invested in local plants, the uncertain prospect of activity in these factories may have adverse effects on the further development of a local industry.

5.1.2 Vestas in Brazil – Market size & Stability

In the following section, I will examine how the development of the Brazilian market has affected Vestas' investment decisions, as well as its operations in the country. This will be done by looking at Vestas' entry and operations the Brazilian market was affected by the economic, political, and geographical factors. The section will also include some brief reflections on the effects of the recent political and economic crisis on Brazil on Vestas' operations. The purpose of this part of the analysis is thus to apply the market factors determined above to an analysis of how these may have created challenges or opportunities in terms of Vestas investing in local production and sourcing.

Brazil was Vestas' fifth largest market for order intakes in 2015 (Vestas 2016), and is at the moment of writing the company's 8th largest market in terms of firm contracts (renewablesnow.com 2017). In spite of the recent recession in the country, Vestas retains a strong focus on the Brazilian market (Vestas annual report 2016), which is currently the 9th largest in the world and largest in Latin America in terms installed wind capacity (gwec.net 2017).

Market entry

Vestas' entry in to the Brazilian market was gradual. At the turn of the century, Brazil had just undergone one of the worst energy crises in its history, and was searching for alternatives to hydropower in order to prevent this from happening in the future. In this way, it was an opportune moment for Vestas to enter the market when it did, although full government support for wind power had yet to materialize (Backwell 2015). At first operations in Brazil were handled at arm's length and Vestas opened its first sales office in 2008 to handle all sales, production, and services in the country. Opening a representative office allows a company to, among other things, establish contacts, organize direct sales, negotiate distribution, and recruit local personnel, and thus allows for strong control of local operations at a very low investment cost (Lasserre, 2012; Meyer & Peng, 2011). With local contact and relationship building being very important in the Brazilian business environment (Export.gov, 2015), this option allowed Vestas to keep control of their operations and keep track of the Brazilian wind market as it grew.

In this way, having already established a representative office also allowed Vestas to act relatively fast, when the Brazilian authorities finally, in 2009, began betting heavily on wind power. Vestas had not initially invested as heavily in the Brazilian market as e.g. IMPSA and Enercon, which had placed all of its production facility in the country from the beginning (Blackwell, 2015), but following Brazil's ambitious 2020 energy plan, Vestas established a local assembly facility and operations cluster in 2011 in Fortaleza in the North

Eastern state of Ceará (Vestas 2011). In this way, the facilities would be close both to local demand centers in the area and valuable wind resources (Backwell, 2015).

While the cancellation of both wind energy auctions in 2016 where a huge blow to the industry, Vestas was still able to receive orders of 371 MW of orders during the year (Vestas annual report 2016), and Vestas president in Brazil expresses cautious optimism on the market outlook, as he states that "with the severe crisis of the last two years, the country has seen a fall in energy consumption, but it has been recovered this year. It is necessary to secure the contunation of wind power production" (energiwatch.dk 2017[3]), while also referring to the recent lack of rain as a driver for the necessary diversification of the Brazilian wind matrix, and thus of continued investment in wind energy in the country (energiwatch.dk 2017)

Adaptation to geographical market conditions

With the large onshore wind potential available in Brazil, and with the steady wind conditions provided by the climate in the coastal areas of Brazil, Vestas has focused its efforts on the on-shore wind turbine V110.-2.0 MW. The V110-2MW is the largest of Vestas' smaller 2 MW wind turbines, and was awarded "Wind Turbine of 2015" in the category of "onshore wind turbines up to 2.9 MW" (Vestas 2016). Recent design innovations have allowed for more standardization in the components of the wind turbine, which according to Vesas allows for easier outsourcing to local suppliers, and thus easier compliance with local content requirements. Furthermore, according to Vestas, the 2 MW models are very versatile both in construction and in efficiency in the Brazilian weather conditions. The use of this kind of wind turbine by Vestas is also seen in the case of India and and China, and one of its core advantages is that it is a "strong offering especially for infrastructure constrained locations" (Vestas annual report 2015). As such the V110-2MW is one of the most popular wind-mills in Vestas portfolio (Vestas annual report 2015), but is especially suited for the infrastructural challenges of developing industries. Furthermore, theV110-2MW wind turbine is excellent in the specific wind conditions of the North Eastern regions of Brazil (Vestas 2016)

[3] Translated from Danish: *Med de seneste to års alvorlige krise har landet gennemlevet et fald i energiforbruget, men det er blevet genoprettet i år. Det er nødvendigt at sikre kontinuiteten i vindkraftproduktionen.*

5.2 Policy design

This section will analyze the policy design in Brazil and its effect on Vestas' operations. In the first section, I will thus outline the localization policies implemented by the Brazilian government, and in the second part, I will analyze the effects of these on Vestas operations in the country.

5.2.1 Brazil - Policy design

In the following, I will thus analyze the local content requirements as set out by the Brazilian Development Bank (BNDES), and then analyze how the restrictiveness of these requirements may have affected the local industry. the As mentioned, the literature on the topic does not present a model for an optimal percentage for local content requirements or the like (Kuntze & Moerenhout 2012). As such, my analysis will include short comparisons with other countries with similar requirements, inputs from experts in the field as well as a view on the structure of the requirements and how it may have affected firm investments, including an analysis of the clarity of the design. The section will also touch upon the effectiveness of the legislation in activating local manufacturing. Finally, Johnson also argues that ability of the country to evaluate and adapt its support policies has an effect on their effectiveness. Throughout this section, I will therefore also take changes in the requirements into account, and analyze how they may have affected the effectiveness of the policy.

The Brazilian local content requirements started out relatively high, with initial requirements at 60%, going up to 70% in 2013 (windpowermonthly.com 2014). This was quite a high bar already from the beginning, compared with other BRIC countries such as China and India (solar), who started out with 20% and 30% respectively, with China then gradually raising it to significantly higher levels (Kuntze & Moerenhout 2012) – more in line with the suggestions of Lewis & Wiser (2006) and Veloso (2006), who argue that local content requirements should be gradually phased in, in order to allow companies slowly adjust. In 2013 Steve Sawyer from the Global Wind Energy Council expressed that "local content requirements generally drive costs up, interfere with the development of an efficient global supply chain, and often create non-competitive situations in countries where you might only have one or two manufacturers able to supply a critical component needed to meet local content requirements" (In MEAN 2014). In relation to Brazil, this was also confirmed by Camargo-Schubert, who agreed that ""the requirements for domestic content are creating bottlenecks in the supply side at this moment.." although he added that he strongly believes "…they will contribute to a more sustainable, established domestic market in the near future" (Mean 2014).

In 2004, the Incentive Program for Alternative Sources of Energy (PROINFA) was introduced to diversify the Brazilian energy matrix after the energy crisis of 2001-02. It introduced local content requirements of 60%

(Global CCS Institute 2013), and subsidized the higher price of energy caused by these requirements through a feed-in tariff in the form of a levy on consumer electricity bills (MEAN 2014). However “for a variety of reasons, this programme did not result in either the development of a local industry or substantial growth in the wind market” (Global CCS Institute 2013). As such the program was not initially very effective in terms of localization (Rennkamp & Perrot 2016) nor wind energy installation, and from 2002 -2009 only a total of 600 MW of wind capacity was installed (gwec.net 2017).

Adaptation of the policy design

Due to the inefficiency of the PROINFA in creating local investment, the system changed (Rennkamp & Perrot 2016). Since 2008, companies have had to comply with a 60% local content regulation in order to receive funding from the BNDES (Johnson 2013) via the FINAME program. While the requirements in this sense are not mandatory, as they were at first during the PROINFA, the value created by the cheap loans are essential to staying competitive in the highly competitive wind market of Brazil, and as such practically have the same effect as mandatory requirements (Global CCS Institute 2013). For example, only one company tried to circumvent the BNDES through its own financial scheme, and it failed in doing so (Rennkamp & Perrot 2016).

The Brazilian Development Bank’s local content requirements being coupled to the weight of production “means it is *de facto* linked to steel” (Kuntze & Moerenhout 2012 p. 23), since wind turbine towers account for around 80% of the weight of a wind turbine (Kuntze & Moerenhout 2012). However, it is estimated that the inefficient Brazilian steel industry provides steel at a 70% higher cost than imported steel, greatly increasing the cost of production (Tawney 2012, Kuntze & Moerenhout 2012). While there were talks of offering exceptions on the local content requirement to allow for more importations of steel steel for the wind sector, the Brazilian steel industry “is aiming at market growth as well and blocked this proposal" (Kuntze & Moerenhout 2012, p. 23). This left some producers considering using concrete towers instead of the expensive locally sourced steel, while other producers operated simply without fulfilling the requirements (Kuntze & Moerenhout 2012).

In 2013, Brazil’s development bank (BNDES) announced new requirements for receiving their attractive financing, which included an increase in local content requirements from 60% to 70% (MEAN 2014, Windpowermonthly.com 2013). The new requirements furthermore included specific requirements to different components of the production. These are scheduled in table 3.1. As the requirements were

scheduled to be phased in until 2016, several large wind turbine manufacturers unable to comply with the requirements specific requirements for each phase were delisted. In this way, companies such as Acciona, Fuhrlander, Siemens, Suzlon and Vestas where delisted from BNDES approved list after the inception of the new requirements. Fuhrlander filed for insolvency in September that year (MEAN 2014), and large companies, including Vestas, increased their investment in local factories and supply chains as a consequence of this.

Phase - with generators delivered from this date	A1 – Initial Step	A2 – July 2013	A3 – January 2014	A4 – July 2014	A5 – January 2015	A6 – January 2016
General rule	To fulfil the requirements for 3 out the 4 turbine parts described below	To fulfil A1 and the requirements described below	To fulfil A2 and the requirements described below	To fulfil A3 and the requirements described below	To fulfil A4 and the requirements described below	To fulfil A5 and the requirements described below
Tower	Should be manufactured in Brazil (in own facility or outsourced), with at least 70% (in weight) of its materials (steel or reinforced concrete) produced in Brazil	Not mentioned	Should be manufactured with 100% Brazilian precedence of internal components (ladders, platforms, cup-holders, electric conductors, screws)	Not mentioned	Should be manufactured in Brazil with at least 60% of quantity of forged components from Brazil	Not mentioned
Blades	Should be manufactured (in own facility or outsourced) in Brazil	Same as A1	A1 with at least 40% of materials (in weight) from Brazil	Same as A3, with 50% instead of 40% of local materials	Same as A4, with 60% instead of 50% of local materials	Not mentioned
Hub	Should be assembled in own facility in Brazil	Same as A1, but in this stage, with at least one component (housing, bearings, pitch control actuator, or pitch control panels) manufactured in Brazil in own facility	Same as A2, with two of the four main components manufactured in Brazil	Same as A3, raising to three of the four components manufactured in Brazil	Should be assembled in Brazil in own facility with all four main components also manufactured in Brazil	Not mentioned
Nacelle	Should be assembled in own facility in Brazil	Same as A1, but requiring more detailed planning	Same as A2, with even more detailed planning and certifications	Same as A3, with again more detailed planning and certifications.	Same as A4, with main structural parts manufactured in Brazil*	Same as A5, with main structural parts manufactured in Brazil*

Table 3.1: Phases of the FINAME II code instated by the BNDES in 2013 - Source: Ministry on Economic Affairs in Netherlands (MEAN) 2014

The requirements of the FINAME II code instated in 2013 thus provide very specific guidelines on the structure and the degree of localization of specific parts of the value chain. While these guidelines are very strict and are uphold firmly – as we saw in 2013 when several big wind companies, including Vestas, where delisted by the BNDES – they also provide very clear guidelines for companies to follow and be measured against. As such, they can be argued to provide a strong degree of transparency to the cooperation between state and producer. One of the critiques on local content regulation provided by Hufbauer (2013), was the argument that local content requirements provide much less transparency than for example

traditional tariffs, and that they as such are harder to legitimize. Providing such clear guidelines, although very strict, could provide some of the legitimacy to the policy that Hufbauer (2013) is requesting.

The policy design of Brazil's local content requirements has thus gone through various incarnations to reach its current form, and as such, the requirements provide very strict but clear guidelines for companies operating in the country. In the following section, I will analyze how this may have affected Vestas' operations in Brazil.

5.2.2 Vestas in Brazil – Policy design

In 2013, when sales in Brazil where taking off, the BNDES instated the FINAME II requirements, which elevated the local content limit from the previous 60% to 70%. This rise was already anticipated in 2012, and even back then, Vestas was struggling with local content requirements, causing a delisting from the BNDES accreditation in June that year (Windpowermonthly.com og ALLE ANDRE).

The failure to comply was a big blow to Vestas' operations in Brazil. A consultant who had been working closely with Vestas confided that "Vestas was caught offside", and that Vestas was in fact meeting Finame I demands through its Fortaleza assembly facility, but was distracted by its global restructuring focus when FINAME II was introduced (Windpowermonthly.com, 2014). One consequence of this problem was the loss of an order of 254 MW with CPFL Renováveis made in 2011, which was then captured by Gamesa – former partner turned main rival – who had been able to comply with the FINAME II. Unfortunately for Vestas, this switch of orders to the rival Gamesa was not solitary in Brazil, where a contract of 128 MW previously announced for Vestas by Gestamp ended up also being awarded to Gamesa (Windpowermonthly.com, 2014; Vestas annual report 2014).

With Brazil being a key market for the company, Vestas therefore announced a new strategy for the country in 2014. In May, Vestas signed a letter of commitment to the BNDES to comply with the requirements of the FINAME II (Vestas annual report 2014), and the following month, Vestas announced their new strategy, which included investment of up to €32 million. With a higher focus on local sourcing and collaboration with suppliers, Vestas sought to make production more flexible, cost efficient as well as compliant with regulations (Vestas annual report 2014, 2015; Vestas 2014). Vestas could thus in 2015 announce that they had regained accreditation with the BNDES (Vestas 2015).

While the Vestas activities in Brazil did see a short hiatus after being delisted from BNDES approval list due to an inability to follow the strict local content requirements, Vestas thus returned to the Brazilian market in 2015 (energiwatch.dk 2016) and has actually been able to continue sales in spite of the recent political

and economic crisis. Even in 2016, with all auctions cancelled, Vestas was still able to receive orders of 371 MW of orders during the year (Vestas annual report 2016). This provides some comfort that the investments in local factories and suppliers as a consequence of the policy design in Brazil have paid off for Vestas.

As such, the attractiveness of the market itself seemed to keep Vestas hooked on Brazil. Strict requirements forced Vestas to choose between investing heavily in local restructuring or see itself lose important market shares to competitors, and with the market prospects of Brazil, Vestas chose the latter. It thus seems that the strict requirements of Brazil's current local content policy has not deterred Vestas, due to a mix of market attractiveness as well other direct policy mechanisms such as subsidized loans from the BNDES – the latter will be explained further in the following section.

5.3 Cooperation & financial incentives

Cooperation and financial incentives is the third dimension of the framework. Similar to the previous section (3.2 on restrictiveness), I will go through some Brazil's localization policies, however, the focus will now be on other direct support mechanisms accompanying the local content requirement. This will primarily focus on the support mechanisms related to the FINAME program. The analysis of these will, again, provide a context for the following analysis of how incentives may have affected Vestas' decisions in terms of local investment.

5.3.1 Brazil – Cooperation and Financial incentives

As part of the current FINAME program, the Brazilian government has instated several direct support mechanisms to promote local investment. The most decisive of these is the BNDES loans given for upholding the FINAME II code, as this incentive practically makes the local content requirements mandatory (Global CCS Institute 2013). With the higher price caused by the requirements (e.g. Kuntze & Moerenhout 2012), it is crucial for wind companies to be able to access these loans to be able to stay competitive in the market. As such the requirements have indeed incentivized local investment and as argued by the Global CCS Institute, "The immediate result of this has been a rapid expansion of the local supply chain" (Global CCS Institute 2013), as the BNDES funding has attracted manufacturers "who have become eligible for BNDES funding by fulfilling the local content requirements, as well as meeting deadlines for implementation and other conditions" (Global CCS Institute 2013).

Furthermore, the Brazilian government provides other incentives to renewable energy creation in Brazil in particular for wind. The governments of some of the more wind heavy regional states, such as Rio Grande do Sul, Bahía, Rio Grande do Norte, Ceará, and Piauí have established certain tax incentives for wind investors in wind energy in particular. For example, wind energy companies can be exempted from income taxes on products not available in Brazil. Also, wind energy specific products were exempted from the ICMS – the tax over circulation of goods and services – until December 2015. In general taxes are a cumbersome process when entering Brazil and these incentives serve to help out on this issue (MEAN 2014). However, according to a market study made for the Ministry of Economic Affairs in Netherlands, these tax incentives are not particularly decisive factors for investors in Brazil's wind sector (MEAN 2014).

Cooperation with local intermediary suppliers

The incentives for local investment have contributed to making Wind energy even more competitive in energy auctions than fossil fuels (Backwell 2015, Vestas Annual Report 2016). Combined with the attractiveness of the Brazilian wind market (see section 3.1.1), large companies, including Gamesa, General Electric, and in 2015, Vestas decided to invest in local factories thus building relationships with local suppliers (Vestas Annual report 2014, Vestas 2014, Kuntze & Moerenhout 2012).

The specificity of the local content requirements related to wind energy are aimed very precisely at specific parts of the value chain. As mentioned above (3.2.1), Brazil has moved from a simple percentage of weight for calculating local content to a more complex and "through the turbine" (Backwell 2015) approach. This specifies very clearly which parts of the value chain need to be localized, which may have had an effect on local component manufacturers. For example, Tecsis, Brazil's largest and oldest blade manufacturer has expanded much in recent years, having supplier relationships with several large wind turbine producers, including GE and, until recently, Alstom (Rechargenews.com 2016). Also newer rivals such as Aeris and the Brazilian unit of LM are joining the market, with Aeris recently securing contracts on blade manufacturing with Vestas (dwea.dk 2016).

Especially Tecsis is growing towards becoming a global player. With a capacity of producing 6000 blades per year – four times more than its closest rival LM Windpower, and four times more than Enercon's in house factory in Brazil, Tecsis is increasingly becoming a global player, blossoming under the regulatory framework of Brazil's wind sector. As such the manufacturer is planning on expanding with factories abroad in 2018(rechargenews.com 2015 – I will explain further on how especially Tecsis has been pushed to grow and innovate under the legislative framework in Brazil in section 3.4.1.

Pressure from political and economic instability on support for wind localization

In this way, Brazil's local content requirements have to some extent been effective at incentivizing cooperation with local suppliers, making an otherwise very restrictive local content regime attractive to many investors. As mentioned before, however, the local industry is at the same time facing a squeeze of the domestic market, as the recent political and economic crisis creates instability in the sector (rechargenews.com 2017, datamark.com 2016, windpowermonthly 2016).

In February, Rechargenews.com reported that "According to projections by the Brazilian Wind Power Association (ABEEólica), in 2017 and 2018 some 2.3GW of new wind will be installed, but in 2019 demand will drop to some 1.2GW, declining further to 500MW and 600MW in 2020 and 2021. After that, no significant orders are seen due to the lack of tenders" (Rechargenews.com 2017). In order to keep the local supply chains alive, local producers are looking abroad for export revenue. As CEO of Tecsis Fabiano Mori explains, "The supply chain, especially the units of foreign companies here in Brazil, will have to export to fill the order gap, but some may close up shop. So a tender in 2017 is needed to give a positive signal to the supply chain" (Rechargenews.com 2017), For example, Tecsis is planning on increasing its share of export in its output from 45% over the last two years to around 70%. Yet, Tecsis is expecting to see more than a 50% decline in output from 2016 to 2017, and has already faced layoffs last year. (Rechargenews.com 2017).

As such, direct support mechanisms seem to have been very good at fostering local supply chains and creating relationships between international wind turbine manufacturers and local component suppliers. Recent developments in the economy, however, may jeopardize the value chains that are dependent on the orders provided by the auctions.

Although the public tenders have led to a surplus in the supply of power, forcing suppliers to focus on export markets, it could a testament to the success of the Brazilian local content requirements in building a strong and competitive domestic industry if suppliers are actually capable of expanding and competing globally in times of crisis in the domestic market. OEM's, including blade producers, are facing the challenge of "keeping the supply chain alive for when Brazil's wind market revives after 2020" (Rechargenews.com 2017), and being able to do so via competing globally would indicate that the protection from local content requirements has in fact succeeded in fostering a strong domestic base. As such, it will be interesting to follow in the next few years after 2018, how well Brazilian OEM's are capable of recovering from this crisis.

5.3.2 Vestas in Brazil - cooperation and financial incentives

In the following I will apply the findings in an analysis of Vestas operations. In particular, I will focus on how Vestas strategy on local investment changed around 2013 when the new FINAME II regulation was implemented.

As mentioned, Vestas market entry started out small through a representative office. While this mode of entry allows for strong control with little intensity of investment (Lassere 2011), the local content regulations, in particular the FINAME regulations forced Vestas to invest more strongly in entering the market – especially after the tightening of the requirements in 2013, Vestas saw major restructuring in the form of higher local investment as well as increased cooperation with local suppliers (Vestas annual report 2014, 2015; Vestas 2014).

Integration of local supply chain due to local content policy

In relation to production and manufacturing in particular, Vestas announced several specific actions aimed at compliance with the phasing in of the new requirements (table 3.1). In terms of hub and nacelle manufacturing for their 2MW model, Vestas would localize 70% of production for the Brazilian market in their new factory in Aquiraz in the North Eastern state of Ceará, as well as sourcing the production of blades and towers from local producers. Furthermore, Vestas would focus intensively on training of employees and sourcing partners with a large focus on the flagship V110-2MW-model to develop local knowledge on Vestas' technology. Currently, Vestas has sourcing agreements with local manufacturer Aeris, one of the top local Brazilian blade manufacturers[4] , and with ABB for sourcing of generators (Vestas announcements 2014, 2016).

Change in Vestas' general strategy to increase cooperation

Traditionally, Vestas has been a very vertically integrated organization compared to most others in the industry (Hansen et al., 2010). Producing the blades, towers and control systems in-house has according to themselves provided several advantages such as learning and easier quality control. It also provides a

[4] The others being TECSIS – the first and largest – and the Brazilian unit of LM Windpower. Enercon also has an in-house blade facility in the country as part of their vertical value chain (Rechargenews.com 2017).

degree of flexibility and reduced reaction time when facing problems, as former CEO Johannes Poulsen points out: “When something is about to go wrong, we are faster and better at finding solutions because we do not have to start a discussion on whose fault it is” (in Hansen et al., 2010). On the other hand, the high capital costs of producing in house also reduce flexibility if any dramatic turns occur in the market (Hansen et al., 2010).

The focus on a higher degree of local sourcing was not only a choice made in Brazil, however. It also reflected a change in Vestas global strategy, in particular in growth markets, caused by a market slowdown at the turn of the decade, which had caused Vestas to miss its 2011 revenue target by 16%, with a drop in share price of 65% as a result. Vestas suffered a series of lawsuits, saw numerous board changes including departure of two top managers within one month in 2012, and lost their spot as top manufacturer (windpowermonthly.com, 2015; renewableenergyworld.com, 2013, Vestas annual report 2011). After several layoffs and the appointment of a new CEO, Anders Runevad, in 2013, the company finally managed to turn the ship around. One strategic change was a higher focus on local sourcing, both in order to increase flexibility of the supply chain and reduce costs in an increasingly more competitive market (Vestas.com, 2014), as well as being a part of their growth market strategy of proximity to customers, and fulfillment of increasingly higher demands for local content (Vestas annual report 2015).

5.4 Learning by doing potential and degree of current technological knowledge

In the following, I will analyze firstly the degree of learning by doing potential and current technological knowledge, and then apply the findings to an analysis of Vestas operations. The latter will include effects on localization as well as opportunities stemming from a need for knowledge in the sector.

5.4.1 Brazil – Learning by doing potential and degree of current technological knowledge

As shown in the previous section, the specificity of the requirements very clearly target specific segments of the local industry. For example, one of the beneficiaries of the FINAME code is local blade manufacturers, as the requirements state that by 2016 all blades should be manufactured in Brazil, either in house or sourced, with at least 60% of weight in local materials. The beneficiaries of this requirement are then two-fold. Firstly, the coupling of weight to the requirements clearly tilts the benefit towards the steel industry. This places a high cost on the production process with an arguable effect on spurring local industry, as the

focus is primarily manufacturing based (Kuntze & Moerenhout 2012). At the same time, however, intermediary local blade producers who are then hired for sourcing might gain valuable experience in becoming global players on the market.

As Brazil's local content requirement are primarily linked to the steel industry, Kuntze & Moerenhout (2012) argue that "The cheap BNDES loans might serve as a pull factor for now, but it is undisputable that high steel prices have hampered and will hamper the delivery on the full wind energy potential in Brazil" (Kuntze & Moerenhout 2012 p. 23), since focusing on a manufacturing based industry such as steel hampers the technological innovation potential. By focusing on a matured and quite uncompetitive manufacturing industry as the steel industry in the requirements, Brazil thus provides a very low learning by doing potential to the wind sector on that regard.

Blade manufacturing innovation and growth

While the focus on the steel industry on one hand may provide little opportunity for innovation and increased competiveness, the focus on local blade manufacturing in the FINAME II code, seems to have spurred a change in the sector. For example in 2013, Tecsis, the largest blade manufacturer in Brazil, providing 90% of the blades for the industry, faced large organizational changes due to strict policies on upholding the deadlines set in the energy auctions (winpowermonthly.com 2013). With one of the strengths of the Brazilian auctioning system being its strong focus on upholding deadlines, a lot of pressure was put on local manufacturers. In this way, in 2013 the industry faced a very large amount of in total 2.4 GW to be delivered within two years, risking fines if the deadline was not kept (Windpowermonthly.com 2013).

One of the main bottlenecks faced by companies such as Tecsis in this case was qualified labour, "so much so that companies connected to Brazilian wind energy association Abeeolica have been in talks with the government to set up a nationwide training programme" (Windpowermonthly.com 2013). The other main bottleneck, claimed Tecsis' de Souza, was logistics. "It takes 12 days to take blades from São Paulo to Bahia in the north-east [a distance just under 2,000 kilometres[5]]", and as such he continued that "Last year we developed a new truck to carry two blades at a time and are now trying to develop one that carries three, but we are facing a lot of red tape because of state boundaries" (Windpowermonthly 2013).

The deadlines put on local blade manufacturers, thus force them to improve, all the while protecting them

[5] Brackets in quote also from Windpowermonthly.com (2013)

via local content requirements on the wind turbine construction process. Lewis & Wiser (2006) argue that the origin of a wind company may be becoming less and less relevant for its success as a global competitor. Instead they argue that it is especially important in the early years of a company's development whether the home market – which is likely to take up the majority of the company's market share – is large and stable enough to sustain development (Lewis & Wiser 2006). As such providing stability for a company such as Tecsis through local content requirements on its customers, which in turn crate a demand for local suppliers, may have allowed Tecsis to develop capabilities through experience that may not have been possible without the support policy.

For example, Tecsis has now "outgrown Brazil" (Rechargenews.com 2015), and announced in 2015 plans to expand to other continents, in this way becoming more of a global player. As mentioned earlier, this development has been pushed even further as the crisis squeezes players like Tecsis out into the global market for them to keep their production alive Rechargenews.com 2017). While the fines for missing deadlines mentioned before may have put pressure intermediary producers such as Tecsis, there is little doubt that this push was enabled by the local content requirements put on large producers to source from companies such as Tecsis, as this has could arguably have given them orders much larger than what they might have received in the absence of requirements.

Limitations of policy on innovation

While the local content requirements through the auctioning system in this way did incentivize local manufacturing and knowledge diffusion through investment, the effect was unfortunately still somewhat limited. As argued by Rennkamp and Perrot, "The content requirements, however, only incentivized the local manufacturing of low to medium technological content, namely the infrastructural components of the balance of plant, the tower, blades, nacelle box and the hub" (Rennkamp & Perrot 2016 p. 787), whereas high-technology components with high-quality jobs such as production of gearboxes and other micro-electrical components would still be imported (OECD 2015; Rennkamp & Perrot 2016)

Furthermore, they state that the local content requirements themselves are the only support mechanism for knowledge creation in the auction programme, while there were no R&D related support mechanisms in the auctions. As such they also argue that significant capabilities where created through policy independent firm strategies. Indeed, Tecsis started out in the 90's, well before the PROINFA programme, as a spin-off from the aviation industry, and as such was able to apply much of the necessary know-how from that industry to blade manufacturing (Rennkamp & Perrot 2016). In the same way, Enercon's investment in

a local supply chain in the mid 90's also occurred much earlier than the local content schemes. Not only did this provide them a large advantage when local content requirements finally were implemented, Rennkamp and Perrot (2016) also attribute them legitimizing wind energy in the country by setting up wind farms and showing and thus showing government officials the potential. Importantly, "resource mobilization into local production and staff helped build innovation capabilities in the firm and in the country" (Rennkamp & Perrot 2016 p. 782), and as such, once local content requirements were put on place, companies were able to draw on the already established resource base of Tecsis and Enercon, thus facilitating the evolution of the industry (Rennkamp & Perrot 2016). Policy independent strategic choices in this way paved much of the way for the innovation in the sector.

5.4.2 Vestas in Brazil - Learning by doing and degree of current technological knowledge

In this section, I will examine Vestas's operations in Brazil from two angles. Firstly, I will analyze how the current degree of technological knowledge affected Vestas' operations in Brazil in terms of adjusting to local content requirements. This part will not focus on current capabilities from a point of view of technology learning, but rather from the view of Vestas, in the sense of how the technological knowhow affected Vestas' ability to source locally as a consequence of local content requirements. Secondly I will focus on challenges as well as opportunities caused by the current knowledge in the sector in terms of further investment.

Effects of degree of current technological knowledge on Vestas' operations in Brazil.

After losing accreditation with the BNDES, Vestas switched to a new strategy. As mentioned before, Vestas had traditionally been a very vertically integrated company, creating its own very specialized components in house. The only exception was the gearboxes which were sourced to "close, well-nurtured suppliers" (Hansen et al. 2010 p. 140). This allowed the company to keep a close eye on quality as well as take care of proprietary knowledge. For these reasons, Vestas for example was very reluctant in sourcing its blade production when entering India, and have as such been importing blades until the opening of their own blade factory in the country, which was announced in 2015 (Hansen et al. 2010; Vestas Annual Report 2015). In this way, as mentioned earlier, the sourcing of all the various components required to fulfill the specific requirements of the FINAME II, was a very sharp change of direction for the company.

This change, however, was facilitated by several factors. Firstly, the capabilities already present in particular in blade manufacturing. Secondly, design innovations made by Vestas in their blades allowed for less specialized components in the construction, thus facilitating sourcing, thus further facilitating the use of local suppliers.

As touched upon earlier, innovation capabilities in the Brazilian wind sector had emerged through investment and experimentation from Enercon as well as knowledge diffusion from the aviation sector through the spin-off firm Tecsis. Investing resources into local production and staff helped not only in building innovation capabilities in the firms, but also in the country (Rennkamp & Perrot 2016). As such more blade manufacturers emerged. One of these was Aeris, which was formed in 2012 by former Tecsis employees and as such is a relatively new player in the field (MEAN 2014), but with experience from Tecsis in its portfolio.

At the same time, Vestas had been innovating the design of their V110-2MW blades. In 2015, new molds and production lines for the V110 (as well as the V126 blades) were rolled fully out. According to Vestas, the new blade design reduced capital investment "because of a much-reduced use of equipment required in the production" (Vestas Annual Report 2015 p. 43). Notably in relation to local sourcing, they add that the less specialized materials needed in the the new design of the blades "make production more flexible and outsourcing to third party suppliers an option" (Vestas Annual Report 2015 p. 43).

Vestas was therefore able to source their blade manufacturing to Aeris. Similarly, the standardization of the production process of their blades also allowed Vestas to outsource their blades to TPI Composites in their market in China. The change in the value chain from vertical to more horizontal by Vestas was also part of their global strategy, especially in emerging high growth markets such as India and China, where local sourcing and presence according to Vestas would be important, not only for reasons of increased local content requirements, but also for reasons of proximity to customers, and cost-effectiveness in terms of e.g. transportation (Vestas Annual Report 2015). Vestas therefore also invested heavily in the training of Brazilian employees in wind facilities in USA and Europe in order to transfer knowledge on the V110-2MW turbines (Vestas 2014).

In this way, it can be argued that the local capabilities created by knowledge diffusion from e.g. the aviation sector, combined with innovation in the design and production process of their blades as part of their

global strategy in emerging markets, allowed Vestas to overcome the obstacle of strict content requirements after the FINAME II was instated.

Opportunities for learning

As mentioned earlier, one of the main obstacles to development of the wind industry is the shortage of highly qualified labor in the country (Windpowermonthly 2013). While this provided a challenge to Vestas, in some aspects this was also an opportunity. The challenge of overcoming the lack of trained labor was reflected in the example mentioned above. By investing in training of employees, Vestas worked towards creating a labor force qualified to operate and construct the V110-2MW wind turbines that Vestas focused on in the Brazilian market.

At the same time, however, the shortage of know-how also provided a business opportunity for Vestas. In the market study on Brazil's wind energy sector for the Ministry of Economic Affairs in Netherlands (MEAN) it is stated that "As Brazil has a lack of knowledge and research and development regarding wind energy in the country this offers opportunities for international players" (MEAN 2014). Indeed, Vestas opened their first service center in March this year, with the goal of not only servicing own wind parks, but also those of other OEM's (Rechargenews.com 2017; energiwatch.dk 2017). Additionally, the opening of this service center, according to energywatch.com also serves as an appeal to the Brazilian government as Vestas hopes to stress the necessity of new tenders, since there are no auctions planned this year as yet (energywatch.com 2017)

6: Discussion

My discussion will be divided into 3 sections: the first part will tackle the main findings in the analysis, firstly providing an overview of the main findings of the analysis, and then synthesizing some of the key findings in relation to one another, as well as reflect on the implications some the findings may have on the case. In the second part, I will discuss implications my findings may have on future research, with suggestions for adapting the theory for analyzing local content requirements from a firm perspective – this will also include some methodological reflections on the applicability of these findings, and needs for further research.

6.1 Main findings

6.1.1 Overview

In the analysis, I have applied the framework of Kuntze & Moerenhout (2012) in order to determine how the local content requirements of Brazil have affected Vestas' operations. In the analysis I find that the **market size and stability** in Brazil provided excellent growth opportunities for wind energy, spurred by indirect support mechanisms. Most notably a of these mechanisms is the competitive auction system introduced in 2009, which has secured a high and stable demand, and thus been very successful in attracting foreign OEMs including Vestas, which sees Brazil as one of its key strategic markets, due to its high growth potential. This has therefore a contributing factor to the increasing investments in local production made by Vestas. While recent economic and political turmoil has had somewhat of a slowing effect on the wind market's growth and caused uncertainty about the stability of the market, due to, among other things, recent cancellations of wind auctions, Vestas still has been able to maintain a market share and continues receiving orders in spite of the lack of auctions.

Another factor contributing to Vestas investment decisions is the **policy design** of Brazil's local content requirements, which have become increasingly strict over time. The most recent update to the requirements, the FINAME II, even specified the localization required in each part of the production process. This has thus forced Vestas to localize increasing parts of their value chain in Brazil, including the production of hubs and nacelles in a recently inaugurated factory as well as the sourcing of blade and generator production from local suppliers, as well as invest heavily in training of employees in the technology needed for the turbines.

Cooperation and financial incentives: The increased costs to production caused by the strict local content requirements was mitigated by direct support mechanisms such as financial and tax incentives, and in particular the low rate credit provided by the Brazilian development bank (BNDES). In this way, the financial incentives in tandem with the strict policy contributed to helping Vestas to develop their value chain approach to a more horizontal structure than traditionally, and thus facilitated compliance with local content requirements.

This transition was further facilitated by innovations in Brazil's own production design, which allowed for simpler more standardized production process of Vestas main wind turbine in Brazil, as well as an increasingly competent local industry. While the potential for **learning by doing and current technological knowledge** has thus had an effect on both on challenges and opportunities in terms of localization, as well

as implementing activities taking advantage of the industry's need for knowledge development. While the effect of local content requirements on the development of the industry may have been limited in terms of development already happening independent of policies, there is also evidence for a lot of recent development of e.g. blade manufacturers, has occurred do to the rules of the wind energy auctions accompanying the local content requirements, which have placed strict deadlines on both manufacturers and their suppliers, these have increased the transparency between actors, and thus facilitated cooperation, leading to the development of local industry. At the same time, the need for know-how has presented an opportunity for Vestas in terms of providing service to the entire sector, and not just their own wind farms.

6.1.2 Implications of horizontal integration caused by local content requirements for the case

As we saw in the analysis, one of the main strategic changes made by Vestas as a consequence of the local content requirements was an increased focus on local sourcing. For production of blades, this lead to a sourcing agreement with the local blade manufacturer Aeris. This change in operations for Vestas has several implications, both for the case itself and for approaching future research on the topic.

In relation to the case itself, the switch to local sourcing was facilitated by changes in Vestas global operations. In particular, change from a vertical to a more horizontal organization, that is, more focus on local sourcing, reflected not only the development of increasingly competent local suppliers, but also a global change in Vestas strategies in growth markets (Vestas Annual report 2015, 2016). With Vestas, in contrast to most of its competitors, traditionally being a very vertically integrated company, the choice of externalizing parts of the value chain signaled a development in the global strategy of the firm. This has several implications, of which I will here outline two: (1) the evolution to a more globalized and (2) finding the balance between a global and a local approach, with the latter being a consequence of the former.

Firstly, Lasserre 2012 categorizes the evolution of a firms strategy in the globalization process into three stages: **export**, where "sales is the only key element of the value chain which is set up in foreign countries" (Lasserre 2012 p. 61), **Multinational,** where the firm "manages a portfolio of relatively independent worldwide, wholly owned subsidiaries or joint ventures" (Lassere 2012 p. 61), and **Global,** Where a company "integrates and coordinates its worldwide operations to take advantages of economies of scale, transfer of know-how, and resource optimization. The findings in the case do indeed indicate that Vestas in the case of Brazil has moved along this evolutionary curve, with initial investments in a sales office in Sao Paolo, until now having a local department with lead by Rogerio Zampronha as the President of Vestas in

Brazil, investment in transferring of know-how on specific turbines, which are produced in newly designed turbine, which is designed to be produced locally through mainly a mix of in-house production in factories in the country and sourcing and more. Furthermore, it seems that this evolution was further catalyzed by Brazil's local content requirements as, for example, a large part of the local investments, which form the more global approach were implemented as a response to the increased strictness of the FINAME II.

Secondly, this development to a more global organizations puts Vestas in a position of having to cope with what Lasserre refers to as a dual requirement: a demand for **coordination and centralization** as a consequence of need for efficiently leveraging competitive advantage across borders, and the demand for **decentralization**, due to a need for adapting to local conditions (Lasserre 2012). As such, Vestas has had to find the balance between maintaining its competitive advantage as a company producing high quality turbines, something it traditionally maintained through vertical integration (Hansen et al. 2010), and adapting to the local context in Brazil, which coincidentally called for either immense investment in factories or letting go the vertical integration. While more research is needed to determine the specific organizational design applied by Vestas in terms of decisions making and coordination in the organization, it can be argued that Vestas due to the change in its global strategy was able to adapt to the local market. In particular, a focus on growth economies, which in turn demanded a more flexible business model (Vestas Annual Report 2015) thus caused Vestas to invest in innovation of their blade design, allowing them to source their production where it had otherwise been done in-house. Given the current research strategy, however, it is difficult to determine to which degree the global change was spurred by the developments in Brazil, if the strategic change was an effect of global trends that happened to benefit the operations in Brazil, or both – this would require a more in depth study of the decision. making in Vestas. It can nonetheless be argued that the ability to adapt to Brazil's local content requirements came to a large extent from a change in global strategy that allowed for more local and regional autonomy in terms of production.

6.1.3 The effectiveness of auctions vs feed-in tariffs

Another key finding resulting from the longitudinal analysis of Brazil's local content requirements is the effectiveness of auctions in comparison with feed-in tariffs, which seems to counter conventional knowledge presented by Lewis & Wiser (2006) on the topic. Undwr the PROINFA, local content requirements where mandated at 60%, with the BNDES providing favorable financing to companies complying, and while the requirements in the FINAME were no longer mandated, they instead came conditioned by the same compliance, and with the high price of local steel, this thus de facto imposed local content requirements on firms anyway. As such, one of the decisive differences between the PROINFA and

the much more successful FINAME program was the introduction of 'wind only' energy auctions in 2009 (GWEC 2013). As such, while this is not the only factor determining the success of the FINAME over the PROINFA, the switch from steady price to steady demand, and introducing auctions specifically aimed at wind energy seems to have had a positive effect on wind power localization.

As such, this result somewhat counters the assessment of Lewis & Wiser (2006), who argue that feed in tariffs traditionally have provided the best foundation for market growth and thus domestic wind manufacturing, as "they can most directly provide a stable and profitable market in which to develop wind projects" (Lewis & Wiser 2006 p. 1853), while competitive auctions "have historically not provided long-term market stability or profitability" (Lewis & Wiser 2006 p. 1854). It is important to note, that Lewis & Wiser published the cited study in 2006. In 2009, only none countries conducted wind energy auctions, with the number growing rapidly to 64 by 2015, this indicating that auctions may be the "new norm" (Vestas Annual Report 2016), and as such they did not have much of a research base. At the same time, however, this study is only a single case, and as such should not serve to statistically infer the effectiveness of auctions, but the increase in their use around the world seems to indicate that they have a positive effect. In this way, it seems that competitive auctions implemented along with the FINAME which secured a demand for wind energy in Brazil had a more positive impact on Vestas decisions to invest than the feed-in tariff of the PROINFA.

6.2 Reflections on theoretical approach

This thesis builds on a theory intended for analysis of the effectiveness of local content requirements in a country and applies it to the case study of a firm. This has implications for the effectiveness of the framework in fully analyzing the mechanisms behind Vestas' decisions in relation to the decisions made by the firm as well as the applicability of the theory in terms of a potential strategic analysis from a firm perspective. In the following, I will therefore firstly analyze some redundancies in relation to the applied theory, secondly some deficiencies brought up by the findings by recommending the addition of a dimension to the framework, and finally I will reflect on how the theory could then be applied in as part of the decision making process of a firm entering a country with local content regulation.

6.2.1 Redundancies in the framework

Applying a framework intended for country analysis to a firm perspective brought several limitations. One of these was redundancies,by which I mean overlap of findings in the analysis. For example, the dimension

on *cooperation and financial incentives* overlapped with the dimension of *learning by doing and current technological knowledge*, when determining the motivations for Vestas' integration into the local value chain. In particular, I conclude that one of the factors for the choice of local investment was the current level of sophistication of the local industry, which allowed Vestas to source some of its production activities. In this way, the sophistication itself served as an incentive for cooperation.

Originally, the final dimension of learning by doing and technological knowledge is meant to measure how plausible it is that the industry will be able to receive the spill-overs from the foreign investment caused by the localization policy. When analyzing this effect in terms of firm decisions, the potential for learning by doing and current technology level serve the same purpose as the previous dimension, namely an incentive for the firm to invest - the higher the technological level or potential for learning, the lower the cost of localizing. As such, I propose splicing these two elements in a framework adapted by the findings in this thesis.

6.2.2 Adding a dimension to the framework: Implications of horizontal integration on further research

As argued, Alignment of Vestas' global approach to production with the local content requirements in Brazil was a large factor on Vestas recuperation in the Brazilian market. This has implications on a possible adaptation of the framework used in this thesis for analysis of Local Content Requirements on firms. In particular, this implies another dimension to analyze from, namely **degree of integration allowed by firm strategy.** The current four dimension of Kuntze & Moerenhout's framework covers conditions related to the country, that is, conditions that are *extrinsic* to the firm.

The proposed dimension in this way seeks to point the focus towards *intrinsic* factors to the firm. Specifically for local content requirements, this involves the extent to which factors related to the firm's competitive advantage allow for a localized value chain. In this way, this dimension also draws on principles from Jensen & Pedersen's (2011) notion of a *strategic fit* between attributes of location and attributes of activity. In their paper this relationship is linked to choosing the location of activities based on their attributes, that is, among other things whether the activity is standardized or advanced, and whether the attributes of the country facilitates the activity. While their theory attains to choices of location and activity, and local content requirements often dictate location and, in cases such as Brazil, the activity itself, the idea is still valid, as it brings into focus the ability of the firm to localize the activity. For example, to applying the dimension to the Case of Vestas in Brazil, Vestas was had to invest in in-house production

capabilities in the country for hubs and nacelles, but had standardized the production of blades to such a degree that the sophistication of the Brazilian industry allowed Vestas to source their production, thus demanding much less capital investment.

6.2.3 Adapting the framework to a tool for firm decision making in relation to local content requirements

The current framework is applied in an explanatory approach. That is, it seeks to understand the rationale behind and cause of operational changes in relation to local content requirements. Although applied firm perspective, the framework as applied in this thesis is not wired for creating a basis for firm decision making. However, the findings in this study do point out potential variables that may have an influence in the profitability of a firm entering a market with local content requirements. As such, I have adjusted Kuntze & Moerenhout's framework below, by synthesizing the findings and theoretical considerations made above to present a more evaluative framework for firms to apply when entering a market with local content requirements.

In table 6.1 below, I have synthesized the theoretical considerations made in this section to adapt it to a porposed tool for firm decision making in relation to local content requirements. The first column lists the dimension, the second column the variables to analyze, and the third column represents the question analyzing the variables seeks to answer.

It is important not to look at these dimensions individually. For example, both market potential and financial incentives have serve as pull factors, while the policy design itself may serve as push. Furthermore, these proposed additions and changes are based on a single case, and as such have a very tentative nature. I therefore propose that further studies are made in order to fine tune the framework.

The purpose of this proposed framework is not to substitute other models for market analysis, but rather to supplement them. As such, this model only provides variables related to local content regulation, and does therefore not take factors such as industry competition into account. Instead it works as a supplement to analyses that may determine local content requirements as a challenge facing the company, but not to which degree.

Adjusted dimension	Subjects of analysis	Evaluation question
Market size and stability	Market growth potential Indirect support mechanisms (Lewis & Wiser) for market growth Economic and political climate	Does the market potential justify local investment?
Policy design and degree of integration allowed by firm strategy	Extrinsic factor: Design and restrictiveness of local content requirements Intrinsic factor: value chain configuration, including sources of competitive advantage	Is there a fit between the localization required by the policy, and the firms value chain configuration?
financial incentives	Direct support mechanisms (Lewis & Wiser 2006) such as financial and tax incentives	To which degree do the incentives provided for localization outweigh the costs?
Cooperation and current degree of technological knowledge	Technological capabilities of potential suppliers The demand for knowledge diffusion as a business opportunity	How capable is the local industry for cooperation?

Table 6.1 – suggested adapted framework for analysis of local content requirements from a form perspective as part of a country/market analysis – Source: adapted from Kuntze & Moerenhout (2012) and Johnson (2013)

7: Conclusion

In conclusion, In this thesis I find that the operations of Vestas in Brazil have been affected in various ways by local content requirements. Most notably, however, the recent FINAME II requirements pushed Vestas to adapt a new strategy in the Brazilian market. The study sought to determine the effects of Brazil's local content requriements on Vestas' operations based on four variables independent variables: Market size and stability, policy design, cooperation and financial incentives, and learning by doing and current degree of technological knowledge. In the study I find that while Vestas was placed under pressure and lost its accreditation with the Brazilian Development Bank (BNDES) in 2013 as a consequence of increased requirements, a change in strategy facilitated by a change in Vestas' global strategy towards growth markets, allowed Vestas to regain accreditation in 2015 and continue operations. In particular, the new

strategy saw a significant change in Vestas' value chain configuration, as the local content requirements pushed Vestas towards a more horizontally integrated approach than vestas had typically employed. The change of value chain configuration included increased investment in local factories as well as intensification of work with suppliers. The ability to source production while maintaining quality was the result of a mixture between improved industry sophistication and efficiency in Brazil as well as internal innovation of the design of blades, which allowed for a more flexible and standardized production process.

The study was carried out using the framework of Kuntze & Moerenhout (2012), and adapting it to a firm perspective. While this allowed me to determine and analyze different variables related to local content requirements related to firm variables, the nature of the framework provided a few limitations in terms of analyzing firm operations. Firstly, having been developed for analyzing the effectiveness of local content requirements in generating welfare benefits rather than their effect on a firm's operations left some of the dimensions for analysis a bit unclear in their purpose, and secondly, the explanatory nature of the model provided very little in way of instrumental use for company decision-making. As a contribution to the field of local content requirements, I have therefore, based on the findings in this thesis, suggested an instrumentalized adaptation of the framework. The framework adjusts the framework of Kuntze & Moerenhout, most notably by taking factors intrinsic to the firm into account, namelt the flexibility of the value chain configuration. As such, I propose further research on the topic, both for gaining more knowledge on how firm operations are affected by local content requirements, and for adjusting the proposed framework to increase its reliability.

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