MASTER

Local content requirements as a policy instrument to foster green industrialization in developing countries
the case of the Turkish wind turbine manufacturing sector

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Award date:
2021

Local Content Requirements as a Policy Instrument to Foster Green Industrialization in Developing Countries: The Case of the Turkish Wind Turbine Manufacturing Sector

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April 2021

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Preface and Acknowledgement

This thesis is written for the fulfilment of the Master Innovation Sciences of the department of Industrial Engineering & Innovation Sciences at Eindhoven University of Technology. I'm glad to be able to finish my Master Innovation Sciences with such an interesting and challenging study, and I am grateful for the opportunity that was provided to me by Ulrich Elmer Hansen of UNEP DTU Partnership. Without Ulrich, this study would not have materialized. Furthermore, I would like to thank Ulrich for the interesting discussions we have had during the study, and his valuable substantive input and ideas.

Furthermore, I would like to dearly thank Henny Romijn. I approached Henny to become my first supervisor after realizing that each of my favorite courses was taught by Henny. I am grateful to Henny for her contagious enthusiasm, the interesting discussions we had so often, and for providing good guidance in the theoretical, empirical, and structural areas of this study.

In addition, I would also like to deeply thank Asli Tuncay Celikel of Isik University. Without her, the empirical part of this research would not have been successful, and I am grateful to her for all the time and effort she has put into this study.

Finally, I would like to thank my second supervisor, Heleen de Coninck, and third supervisor, Floor Alkemade, for their input during the study. I would also like to thank Eindhoven University of Technology and UNEP DTU Partnership for providing the necessary flexibility in arranging this study, which was needed in these strange times as a result of the COVID-19 pandemic.

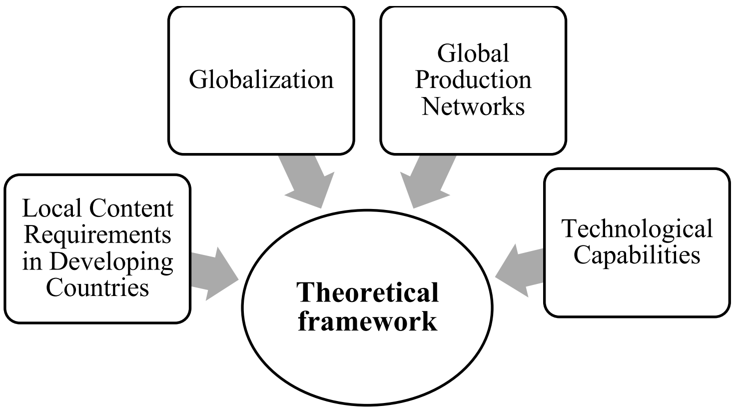
Summary

This thesis is a study into the role of Local Content Requirement policies in the localization of wind turbine manufacturing companies in Turkey. Local Content Requirements are complex industrial policy tools which are used with increasing regularity in developing countries to achieve green industrial growth. In Turkey, Local Content Requirements are used to foster the establishment of a domestic wind turbine manufacturing sector. But although the wind turbine manufacturing sector is growing alongside the increasing wind-powered electricity generation capacity in Turkey, it is unclear as to what exactly the role of the Local Content Requirements have been, and how these have contributed to the increased wind turbine manufacturing and wind energy generation capacity. To investigate this, the following research question has been formulated:

'What has been the role of Local Content Requirement policies in the development of a domestic wind turbine manufacturing sector in Turkey and how can this be improved?'

Theoretical framework

The theoretical framework is formed by insights from four theoretical perspectives. Firstly, literature on the use of Local Content Requirements in developing countries explains what Local Content Requirements are, what arguments in favor or against their use are, how they are used in different developing countries and how effective their use in these countries has been. Secondly, literature on Globalization is elaborated upon to explain localization processes and how the reshaping of the global economic map has led to Global Production Networks. Subsequently, insights from literature on Global Production Networks subsequently adds a focus on regional development as well as insights with regards to competitive drivers and the role and dynamics of the state within GPNs. Lastly, literature on technological capabilities is explored, as this provides room for interpretation about the links between globally and locally occurring practices, as well as introduce a perspective on the technological capabilities present in the Turkish wind energy sector. This theoretical framework is operationalized in the Methodology of this study for application in an empirical case study.



Methodology

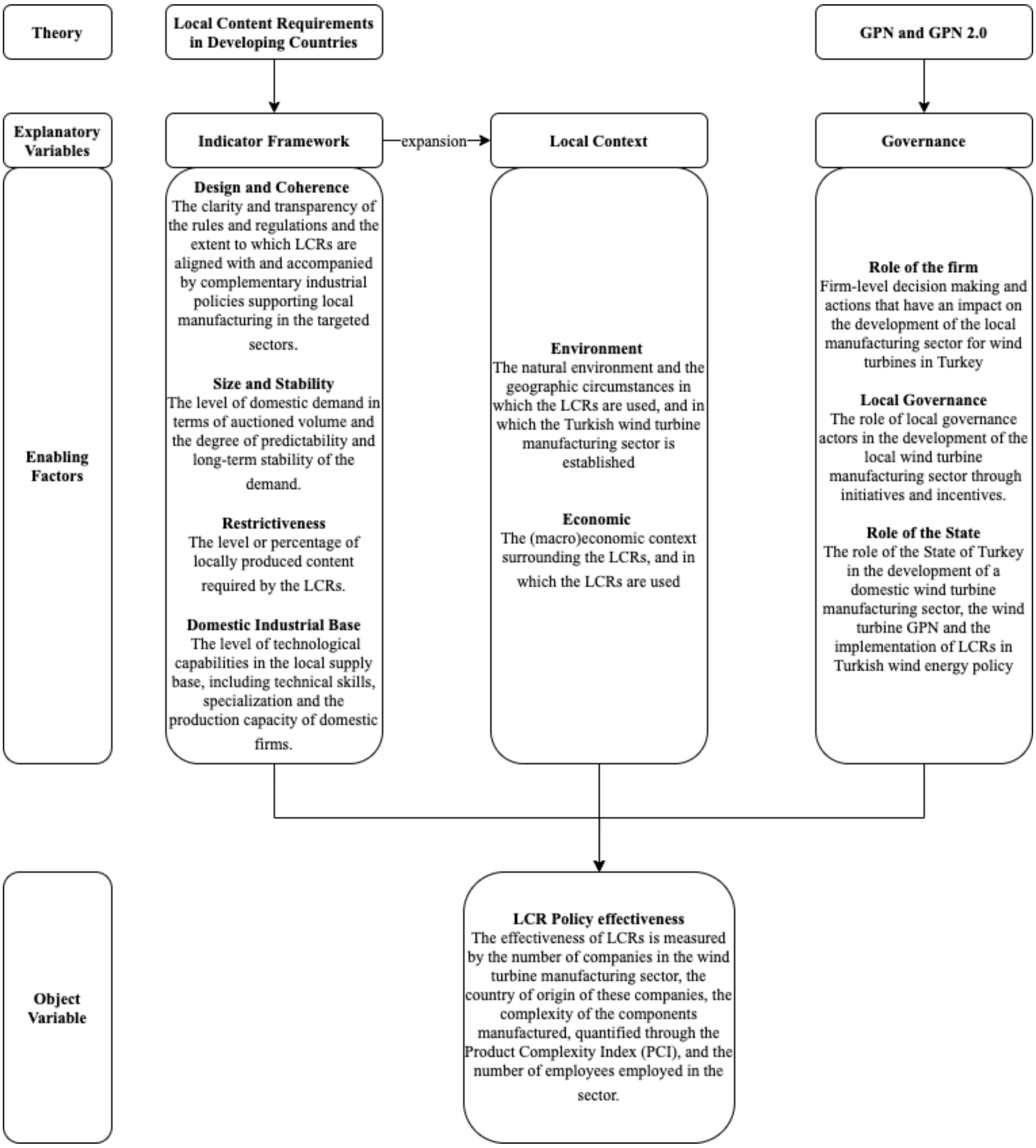
The theoretical framework has been operationalized to seek answers to the research question. To this end, the object variable is defined as the effectiveness of Local Content Requirements in the Turkish wind turbine manufacturing sector. The effectiveness of Local Content Requirements is captured by assessing the number of companies in the wind turbine manufacturing sector, their country of origin and the complexity of the components they are manufacturing, and the number of employees in the wind energy sector, before and after the implementation of the Local Content Requirements. The complexity of the components they manufacture is quantified through a Product Complexity Index.

The object variable is explained by three explanatory variables which are based insights from the four theoretical perspectives which form the theoretical framework. These three explanatory variables are called 'the indicator framework', 'local context' and 'governance'.

The first explanatory variable called 'the indicator framework', is a reference to the indicator framework developed by Hansen et al. (2020) and consists of four enabling factors that partly explain for the effectiveness of Local Content Requirements. These enabling factors are design and coherence, size and stability, restrictiveness and the domestic industrial base. Operationalizing this indicator framework in an empirical setting added structure to this research and its application in the context of the Turkish wind case was seen as an opportunity to contribute to the further enhancement of such frameworks.

An expansion was made upon this framework by also including the effects of the local context in the analysis of Local Content Requirements in Turkey. This has been included as a second explanatory variable and seeks to explain for the effectiveness of LCRs through investigating the environmental and economic setting in which the LCRs are applied.

The third explanatory variable assesses the role of governance on the effectiveness of Local Content Requirements, and addresses governance on the firm level, the local state level and the national state level, as different actors and expressions of governance are active on these three levels. The operationalized theoretical framework is provided in the figure below.



The literature on Globalization and technological capabilities are explicitly not mentioned in the operationalized theoretical framework, as they have not directly led to the establishment of one of the explanatory variables. However, they play a significant role in several of the enabling factors captured in this framework. This operationalized framework connects theoretical insights obtained by combining different fields of literature with the empirical findings from the case study. The operationalized framework allowed for the empirical findings to be confirmed against theorical insights.

Data Collection and Analysis

Primary data collection was executed through ten semi-structured qualitative interviews to develop an understanding of the extent of localization of the Turkish wind energy sector and the role of Local Content Requirement policies in bringing this about. Eight interviews were conducted through online videoconferencing, and two other interviews did not take place via videoconferencing tools but rather a list of predefined questions was sent to the interviewees who answered those questions in their own time. Extensive secondary data from gray and academic literature were also collected and utilized since many announcements about new wind energy incentives in Turkey are found in news articles and on websites. Academic literature has been used to establish the theoretical framework, to provide background data for the empirical case study and to confirm the empirical findings against theoretical insights.

Results and Conclusions

This study shows that the Turkish government has implemented the Local Content Requirements as part of an economic strategy to strengthen the balance of payments and decrease its foreign energy dependency. It is creating domestic wind energy capacity so that it can procure the domestically generated wind energy and decrease its energy dependency and aims to establish an internationally competitive position with their promising wind energy industry. As such, the Turkish government is pursuing green industrialization as a strategy to improve their economic situation.

The effectiveness of the Local Content Requirements has quantified by comparing the situation before and after the implementation of the Local Content Requirements. This shows an increase in the number of OEMs from 5 to 9. The number of turbine component manufacturers has increased from 5 to 16, whereby the number of manufacturers for lower complexity components have gained the most. There seems to be a certain extent of technological upgrading to be taking place, as more recently, more complex component manufacturing is also being localized. However, it is interesting that for higher complexity components, the manufacturers are generally foreign companies, whereas in lower complexity component manufacturing, mostly Turkish companies are active.

The Local Content Requirements in the Turkish wind energy sector are two-fold. In the YEKDEM mechanism, a premium for local content is provided on top of the Feed-In Tariff, as such, it is more of a carrot policy than a requirement. In the YEKA auctioning mechanism, the incentives for local content are actual requirements, as the winning bidders have to comply with the rules for local content after winning an auction.

The first key condition that has contributed to the effectiveness of the Local Content Requirements is the favorable locational conditions in Turkey. The country is located in a strategic position in the Global Production Network for wind turbines, and the western part of Turkey has good environmental properties for wind energy generation as well as the right capabilities for hosting a wind turbine manufacturing sector through its present industrial base and technological capabilities.

Secondly, the pricing of the Local Content Requirements in Turkey have been essential in attracting the interest of investors, as well as the provision of price and purchase guarantees provided with the Local Content Requirements.

A third key condition has been the role taken up by a local development agency, which has taken up a pro-active role in policy creation and implementation and has thereby yielded positive results for the fostering of a domestic wind turbine manufacturing sector.

It can be concluded that the implemented Local Content Requirements have contributed to accelerating the establishment of a domestic wind turbine manufacturing sector in Turkey. However, despite this there are also concerns about the continuity of the policy and the competitiveness of the sector compared to foreign countries. Consideration should also be given to the development of a policy exit strategy, to avoid the economic impossibility of phasing out the policy, and to the situation after the LCRs expire.

This study contributes to the academic field of studies that focus on Local Content Requirements firstly through its empirical application of the indicator framework, which has provided insights into its applicability and completeness. Secondly, it has deepened the research into the dynamics of state roles within Global Production Networks by considering the role of the Turkish state and governance in the localization of a wind turbine manufacturing sector in Turkey. Lastly, this study has used a Product Complexity Index as a means to quantify the effectiveness of LCRs in the Turkish wind turbine manufacturing sector. An innovative and refreshing approach which can be of value to future academic studies.

Policy recommendations

Although Local Content Requirements in Turkey have resulted in the localization of wind turbine component manufacturers, several concerns have been expressed by interviewees which are translated into policy recommendations.

The first concern relates to a lack of continuity provided by the Local Content Requirements. It has become apparent that continuity in the policies is important for investors and manufacturing companies, as they are looking for security and stability for their investment and manufacturing decisions. Moreover, continuity is important in the sense that a policy instrument must be in place for some time and be consistent in order to analyze the effects of its implementation It is therefore recommended that the level of continuity is increased. Policymakers have likely struggled with providing continuity as they learn over time what the results and effects of specific policies are, the contextual factors change over time and the industrial sector continuously develops. Therefore, it is recommended to monitor the effectiveness of the policies closely and adapt the policies when necessary. In addition to this, it is recommended to establish an open consultation climate between the government and companies in the sector. This provides the government with insights on basis of which policies can be tailored and provides companies and investors with a perspective to the future situation, on which they can base their investment and manufacturing decisions.

Policy makers should also consider the development of an exit strategy to be able to leave the implemented policies. In the Turkish case, this is no longer possible, so it is recommended that in the development of new incentive mechanisms for the future, such an exit strategy is at least mentioned. More in general, it is recommended that governments communicate clearly about the conditions at which the policies will be left behind before implementation of the policies, providing clarity to investors. Such an exit strategy could, for example, include considerations regarding the competitiveness of the sector compared to foreign sectors based on the amount of manufacturing output, the amount of export, or the price of produced equipment compared to foreign markets. A gradual phaseout would be an option to consider as an exit strategy.

Furthermore, it is recommended to foster both the emergence of new suppliers as well as the evolution of existing ones. In Turkey, the number of companies in the components with lower technological complexity increased the most, and there have been indications that several manufacturing firms have been working on innovation and R&D. By focusing on the emergence of new suppliers while ensuring that existing suppliers evolve, an increase in the manufacturing complexity of the sector can be realized as more sophisticated companies devote more attention on developing more complex components and concentrate more on innovation and R&D, and no longer need to consider with the manufacturing of lower complexity components. This in time leads to a more sophisticated sector with higher technological complexity. In addition, this plays into the “spinoff effect" that is occurring in Turkey, where employees of the Original Equipment Manufacturers go into business for themselves and become suppliers to the Original Equipment Manufacturers for specific components. Supporting these entrepreneurs also contributes to the development and technological upgrading of the sector.

Additionally, more attention should be devoted to the role of local development agencies. In Turkey, a local development took a pro-active role in the creation and implementation of the policies including Local Content Requirements. Moreover, it had taken up an active role in attracting foreign investors and companies to the sector. These agencies should be more actively involved in policy making to exploit the local differences and similarities between regions. These agencies can provide input with regards to the strengths and weaknesses of their respective regions, which the policies can play into. Furthermore, these agencies can play a particularly interesting role at the local cluster level, through the construction of shared facilities, by organizing course and by disseminating information about industry news and trends and organizing trade fairs. As such, better support to these agencies in terms of funding and more structured plans regarding the involvement of such agencies in green industrialization is recommended.

Lastly, more research is recommended into the role of local development agencies in the governance of Global Production Networks and the shaping of local industrialization processes. As well as additional research into the use of Product Complexity Indices to quantify the effectiveness of Local Content Requirements as well as continued efforts regarding the development of common methodologies to assess the role of Local Content Requirements in developing economies and their respective effectiveness. Furthermore, for Turkey in particular a complete landscape analysis of the companies and institutions active in the wind turbine manufacturing sector is recommended. It has been particularly difficult to get a clear overview of all the relevant companies and institutions active in the sector, and a thorough landscape analysis would provide clarity in this respect.

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Abbreviations

c-Si	*Crystalline silicon*
DTU	*Danish Technical University*
ECA	*Export Credit Agency*
ELG	*Export Led Growth*
EML	*Electricity Market Law*
EMRA	*Energy Market Regulatory Authority*
EUAS	*Ectricity Generation Company Elektrik Üretim A.Ş.*
FIT	*Feed-in Tariff*
GATT	*General Agreement on Tariffs and Trade*
GE	*General Electric*
GHG	*Green House Gas*
GML	*Gas Market Law*
GPN	*Global Production Network*
GVC	*Global Value Chain*
IRENA	*International Renewable Energy Agency*
MENR	*Ministry of Energy and Natural Resources*
MW	*Megawatt*
OECD	*Organization for Economic Co-Operation and Development*
OEM	*Original Equipment Manufacturer*
PCI	*Product Complexity Index*
PV	*Photovoltaic*
REL	*Renewable Energy Law*
SOE	*State Owned Enterprise*
TUREB	*Turkish Wind Energy Association*
WPP	*Wind Power Plant*
WTO	*World Trade Organization*
YEKA	*Renewable Energy Resource Areas*
YEKDEM	*Renewable Energy Resources Support Mechanism*

1. Introduction

This study considers the role of Local Content Requirements (LCRs) in the localization of a wind turbine manufacturing sector in Turkey. As this study will show, LCRs are complex industrial policy tools of which it is difficult to determine whether they are effective, as this effectiveness is influenced by a multitude of interrelated factors. The study itself will elaborate more on this complexity, but first a short introduction of the problem is provided, along with the specific objectives set for this research and the research questions that are developed in order to achieve these objectives. Subsequently, the justification for this research is provided, as well as the research boundaries and the reading guide for this study.

1.1 Problem Definition

To address climate change, governments are increasingly focusing on green industrial policies to achieve sustainable economic growth, and Local Content Requirements (LCRs) are policy instruments that are used with increasing regularity in developing countries to achieve green industrial growth and to catch up from a position of economic and technological backlog in relation to leading countries. LCRs condition a benefit on the use of local goods and/or services in the production of goods and/or services (Hestermeyer & Nielsen, 2014). The use of LCRs has seen a steep increase since the Great Recession of 2008, as governments expect to gain local benefits from increased renewable energy deployment and simultaneously aim to achieve broader political or socio-economic development objectives with renewable energy projects. The increased use of LCRs in industrial policy has also led to interest of academic researchers into the usage and effects of LCRs. This is demonstrated by recent publications, as for example Baker & Sovacool (2017) have treated local content a key focus of their paper while examining the underlying conflicts between technological capabilities and global production networks in South Africa's solar photovoltaic (PV) and wind energy industries. Furthermore, Bazilian, Cuming & Kenyon (2020) have investigated whether LCRs in Brazil, India and South Africa have helped create local manufacturing capacity, and Hansen et al. (2020) have studied the effects of LCRs in auction schemes for renewable energy in South Africa, Brazil, India and China.

In the global fight against climate change, the 2015 Paris Agreement was a landmark, as parties to the UNFCCC agreed to accelerate and intensify the actions and investments needed for a more sustainable future (United Nations, 2015). Turkey, however, remains one of seven countries which have not yet ratified the Paris Agreement, and is the only G20 country to have not yet done so (UNFCCC, 2021). According to the OECD, Turkey was the fastest growing OECD economy in 2019 (OECD, 2019), and paired with rapidly increasing greenhouse gas (GHG) emissions due to the high resource intensity of its economy and its heavy reliance on fossil fuels, the environmental pressures of the country are increasing. However, the wind energy sector in Turkey has been growing steadily in recent years. The generation capacity increased to 8288 MW in 2020 and an additional 1329MW MW of projects is under construction (TUREB, 2020). In addition to the increased wind energy generation capacity, the domestic manufacturing sector for wind turbine components has also increased in terms of the number of companies active in the manufacturing of wind turbine components. In 2009, before the implementation of LCRs in Turkish renewable energy policies, there were 5 companies involved in the manufacture of wind turbine components, while in 2020 this number had increased to 16.

The increases in domestic generation capacity and domestic manufacturing capacity for wind turbines that have occurred since the implementation of LCRs in Turkish renewable energy policies are of interest to the academic field, as the question rises if or how much these LCRs have been of influence on the localization of wind turbine manufacturing companies in Turkey, and how this contributes to the green industrial development of the country. Furthermore, due to the increased interest from the academic field into the effectiveness of LCRs, a study focused on Turkey's LCR policies and their effectiveness could prove to be helpful to other academic studies by providing an understanding of what made these LCRs effective, and this information could also be helpful to other developing economies or policy makers as lessons can potentially be drawn from the Turkish case.

As such, this study focuses on the role of LCRs in the localization of wind turbine manufacturing companies and facilities in Turkey. This study will utilize the indicator framework for LCR policy effectiveness proposed by Hansen et al. (2020), which consists of a set of enabling factors that are considered to drive the effectiveness of LCRs through their design. Moreover, this study will expand upon this indicator framework by looking at the role played by the local context as a factor explaining the effectiveness of LCRs in Turkey, as well as the role played by different governance actors and how they influence the effectiveness of LCRs in the localization of wind turbine manufacturing in Turkey.

1.2 Research Objective

The main objective of this study is to investigate the role played by LCRs in Turkish renewable energy policies to develop a domestic wind turbine manufacturing sector and the constellation of factors that have influenced the effectiveness of the industrial stimulation policies, including the LCRs. In order to get to this type of understanding, the first research step involves the establishment of a theoretical framework based on literature on the use of LCRs in developing countries, globalization, Global Production Networks (GPNs) and technological capabilities. By combining insights from these different points of view, a theoretical framework is established.

Following the establishment of this framework, wind energy technology will be explained, and the historical development of the Turkish wind energy generation and wind turbine manufacturing sector will be explored, as well as the relevant policies within. By doing so, it will become clear why LCRs are used in the Turkish wind energy sector and how they are designed.

Subsequently, the theoretical framework will be operationalized in an empirical case study. This operationalized theoretical framework consists of three explanatory variables that are thought to be able to (partly) explain for the effectiveness of LCRs in Turkey. By exploring these explanatory variables in an empirical setting, it will become possible to determine the key conditions that have influenced the effectiveness of the LCRs in the Turkish wind energy sector

Lastly, the research involves the quantification of the effectiveness of the LCRs in Turkish wind energy policies, as only through quantification it can really be concluded whether and to what extent the LCRs have been effective. To that end, the extent of techno-economic development in the wind turbine manufacturing sector since the onset of the implementation of the LCRs will be assessed.

1.3 Research Questions

To guide this research, the following main research question has been formulated based on the research objective:

‘What has been the role of Local Content Requirement policies in the development of a domestic wind turbine manufacturing sector in Turkey and how can this be improved?’

By answering this research question, lessons can be drawn regarding the role of LCRs as a policy instrument in the localization of a wind turbine manufacturing in Turkey, and how the LCRs are embedded in industry stimulation policies. Moreover, this particular case may provide lessons on the use of LCRs for the fostering of a local manufacturing sector in the field of renewable energy for other developing countries and identify possible pitfalls to consider.

This research question is supported by a set of sub-questions. Naturally, the first question to address relates to why this specific policy instrument is used, and the goals pursued with its implementation. Therefore, using existing literature on this subject, this study assesses the use of LCRs in other developing countries’ policies and empirically examines the goals the Turkish government is pursuing with this policy. To this end, the first sub-question has been established:

1. *‘Why are Local Content Policies utilized in Turkish wind energy policy?’*

By answering the first sub-question, the goals and objectives of the implementation of the LCRs has become clear and therefore it becomes possible to consider the effectiveness of the LCRs in Turkey in relation to its goals. The second sub-question explores the effectiveness of the LCRs, and the means of how to measure this effectiveness:

2. *'What can be said about the effectiveness of these LCRs for wind turbine manufacturing localization, and how can this be assessed?'*

If this sub-question is answered, an understanding has been gained about the extent of localization of a wind turbine manufacturing industry in Turkey. From this understanding, tentative conclusions can be drawn - indirectly - about the effectiveness of the LCRs. Subsequently, it is of interest to consider what conditions have influenced the effectiveness of the LCRs. Therefore, the third sub-question is established:

3. *'What are the key conditions that have influenced the effectiveness of the LCRs?'*

By answering this sub-question, it becomes possible to understand why the LCRs have been effective to the extent that they have been and what key conditions have contributed to achieving this level of effectiveness. From this understanding, lessons can potentially be drawn for policymakers in Turkey and potentially other developing countries regarding the use of LCRs in industrial stimulation policies and the key conditions to take into account when utilizing LCRs in order to achieve optimal results. Lastly, since this research is embedded in the growing academic field of studies into LCRs and their effectiveness, and it also aims to contribute to the continued development of this field by providing insights into this specific topic by conducting research in an empirical setting, the final sub-question is:

4. *'How can this study contribute to the academic field of studies that focus on the effectiveness of LCRs in developing economies' green industrial policies?'*

Answering this question will help to give substance to the application and use of the lessons learned, and the ways in which this study provides insights for policymakers as well as academics working on similar topics can be assessed.

1.4 Reading Guide

This study starts with the development of a theoretical framework in Chapter 2, drawing from literature on LCRs in developing economies, globalization, Global Production Networks and technological capabilities. Chapter 3 discusses relevant theoretical background information regarding wind energy technology and the policy development in the Turkish wind energy sector. The methodology of this study is explained in Chapter 4, which begins with the operationalization of the theoretical framework and subsequently explains the methods for data collection and analysis and the method used to determine the complexity of wind turbine component manufacturing. Chapter 5 discusses the results of this study. It starts with the findings related to the local context surrounding the LCRs in the Turkish wind energy industry, followed by the findings related to the empirical exploration of the indicator framework developed by Hansen et al. (2020) and subsequently showcases the findings related to different types and forms governance related to LCRs in the Turkish wind energy industry. Furthermore, this chapter also discusses the extent of localization of a wind turbine manufacturing industry in Turkey. As such, Chapter 5 discusses the results related to all three explanatory variables as well as the object variable in this study. Chapter 6 subsequently presents the conclusions of this study, followed by the policy recommendations. Lastly, Chapter 7 provides the discussion and methodological reflection.

2. Theoretical Framework

This chapter discusses the theory used to develop the theoretical framework, as well as additional theoretical background information that was not used for the development of the theoretical framework but is relevant for this study and is helpful with the empirical case.

This research is guided by works from authors who take a neo-structuralist approach to study development processes. Writers in this paradigm pay attention to processes of learning for the creation of dynamic comparative advantage and as such try to untangle the processes of technological progress and prosperity, as opposed to neoclassical writers such as Nelson (1987) and Lall (2004) which see this as a black box. First, an exploration of LCRs, their application in developing countries and the effectiveness thereof is provided, based on existing studies. Subsequently, an elaboration on theories of Globalization and Global Production will be provided. In the field of Globalization and Global Production Networks, a lot of human geographers are active. As such, this study is placed on the edge of neo-structuralism and human geography and uses insights from both literary movements. Lastly, insights from literature on technological capabilities are discussed as well as the practical application of the GPN framework. Together, these theoretical perspectives form the basis of the theoretical framework, as depicted in figure 1. In Chapter 4, this theoretical framework is operationalized for the empirical case study. Some of the theoretical perspectives result directly in an explanatory variable in the operationalized theoretical framework for the empirical part of this study, while others deliver insights or a contribution to specific parts of these explanatory variables. This will be elaborated upon in Chapter 3.

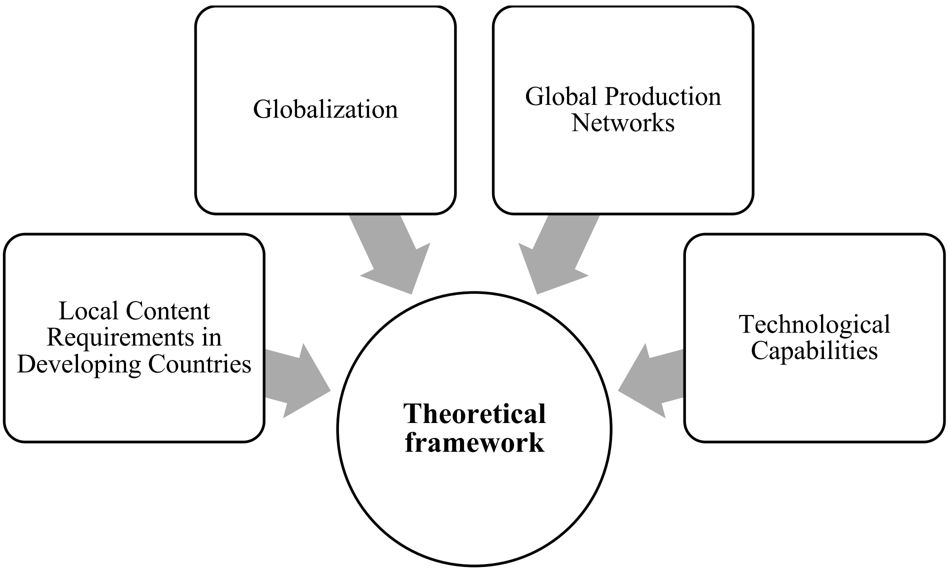

Figure 1 Theoretical perspectives used for the theoretical framework.

2.1 Local Content Requirements in Developing Countries

According to Hestermeyer and Nielsen (2014), Local Content Requirements are measures that condition a benefit on the use of local goods and/or services in producing goods and/or services. They have provided a taxonomy of such measures, classifying Local Content Requirements according to the benefit that is granted. The granted benefit can either be a license, government procurement, financial incentives or informal requirements. There are four uses for LCRs for which the benefit to gain is a license; cultural content requirements, licenses in the exploitation of natural resources, import licenses and permission for investments. The second type of benefit that can be gained from LCRs is government procurement, as governments regularly prefer local over imported products. Thirdly, Financial incentives to grant the use of local content are a method of using LCRs. This is often done through Feed-In Tariffs, Competitive project financing or other financial incentives. Lastly, there are also informal requirements, as LCRs are often not explicitly established but still decision-makers look favourably upon the use of local content. (Hestermeyer & Nielsen, 2014)

The use of LCRs has seen a steep increase since the Great Recession (Hufbauer, Schott, & Cimino, 2013), and LCRs nowadays often depart from the classic format of mandated purchases from domestic suppliers to more complex formats which mix price and quantity signals to influence market outcomes. There are several reasons why governments choose for the utilization of Local Content Requirements, and they are part of a category of policy interventions known as industrial policies. (Hufbauer et al., 2013; UNCTAD, 2014)

In this paragraph, some of the reasons why governments use LCRs are elaborated upon. Firstly, LCRs in industrial policy are a protectionist type of policy instrument which shield domestic firms through procurement favouritism (Hufbauer et al., 2013). Often, the main rationale behind the use of LCRs is the development or strengthening of the domestic industrial base, as LCRs help the creation of a production platform focused on domestic value-added and employment (UNCTAD, 2014). Secondly, LCRs are also a way to address failures in policy or the market (UNCTAD, 2014). Local content requirements can correct situations where multinational firms fail to respond to employment or sourcing opportunities in the domestic market. Local content requirements can also compensate for business practices that hinder growth of the local capacity. Sometimes, LCRs are also used as a leapfrogging tool to overcome existing barriers to technological transfer (UNCTAD, 2014). Hereby countries speed up the tempo in which they are able to learn and adopt new technologies and processes which have come from abroad. This type of LCR is activated through performance requirements and is often seen in sectors with high barriers to entry. LCRs are also used in situations of political urgency as a measure to create jobs (Hufbauer et al., 2013). Furthermore, the use of LCRs is attractive because they can be specifically tailored to focus on a certain industry, sector or technology. Lastly, one of the main arguments in favor of LCRs is that this type of policy can result in the local ownership of important industries (Hufbauer et al., 2013). However, this is not a guaranteed result of LCRs, since foreign companies can also establish local subsidiaries or enter joint ventures and establish local companies which are under foreign ownership. However, dependent on the specific requirements and limitations of the LCRs, local ownership of important sectors can be used by governments in strategic ways in their economic agendas.

There are also arguments against the use of LCRs. The extent of assistance is often highly variable, and while LCRs may enable domestic firms to capture economies of scale they also insulate firms from foreign competition and therefore can generate a lag in the development of new technology (Hufbauer et al., 2013). Additionally, the argument is offered that officials often lack knowledge regarding the effectiveness of LCRs (Hufbauer et al., 2013). However, according to Lall (2004), LCRs and industrial policy in general should be able to overcome problems caused by infant industry protection through strengthening domestic competition, setting performance targets and by forcing firms into export markets where they have to compete with international best practices.

The effectiveness of LCRs in developing economies has been a topic of academic research for several years and several studies have presented findings on the effectiveness of LCRs in different developing economies, such as Brazil, India, China and South Africa (Bazilian et al., 2020; Hansen et al., 2020; Hufbauer et al., 2013; Johnson, 2013; Kuntze & Moerenhout, 2012; Veloso, 2001). As such, it is interesting to explore how the effectiveness of LCRs in developing economies can be assessed, and how LCRs have performed in different developing economies

Veloso (2001), Kuntze and Moerenhout (2012) and Jonhson (2013) have each investigated factors that drive effectiveness of LCRs or have explored the effectiveness of LCRs in different developing economies. More recently, Hansen et al. (2020) have analyzed the use of LCRs in competitive renewable energy auction schemes in different developing economies given their current popularity as the preferred policy instrument for supporting the diffusion of renewable energy.

It is difficult to determine the exact effectiveness of LCRs due to a lack of consistency across different studies and the fact that the effectiveness of LCRs should be determined with regard to political objectives set by governments. As such, there is no clear outcome variable in research into the effectiveness of LCRs, as there is no clear number or figure which can be taken as evidence of whether or not LCRs have been effective. Hansen et al. (2020) specifically focused on the effects of LCRs in terms of the number of new enterprises created and local value added created after implementation of the LCRs in the fields of onshore wind energy or solar photovoltaic in developing economies. However, this approach does not provide any insights into the actual localization of ownership, or the extent of technological complexity embedded in the 'localized' operations.

While there is a lack of consistency across different studies regarding how to specifically assess the effectiveness of LCRs, Hansen et al (2020) have proposed a framework consisting of four enabling factors that can influence the effectiveness. These four enabling factors are considered to be drivers for the effectiveness of LCRs, and have been determined based on elaborations on Veloso (2001), Kuntze and Moerenhout (2012) and Jonhson (2013). These four enabling factors together form the so-called 'indicator framework', which has been proposed and applied by Hansen et al. (2020) to explain the extent of effectiveness of LCRs in South Africa, Brazil, India and China.

Table 2 Determining factors for the effectiveness of LCRs in renewable energy auction schemes

Enabling Factors	***Characteristics***
Policy design and coherence	*The clarity and transparency of the rules and regulations and the extent to which LCRs are aligned with and accompanied by complementary industrial policies supporting local manufacturing in the targeted sectors.*
Market size and stability	*The level of domestic demand in terms of auctioned volume and the degree of predictability and long-term stability of the demand.*
Restrictiveness	*The level or percentage of locally produced content required by the LCRs.*
Industrial base	*The level of technological capabilities in the local supply base, including technical skills, specialization and the production capacity of domestic firms.*

In South Africa, it was found that the establishment of local production of key wind turbine components has only experienced limited progress, as indicated by the low number of low manufacturing plants established and the low value added of components that were produced locally. (Becker & Fischer, 2013; Hansen et al., 2020; Larsen & Hansen, 2020).

In Brazil, competitive auctions have been successful in promoting the growth of the domestic industry and LCR policy has incentivized the domestic production of low and medium technology content, as parts of the nacelle, hubs and blades have been manufactured locally. There are reportedly 15 manufacturers in Brazil, of which most are local affiliates and subsidiaries of foreign component suppliers which make components of varying degrees of complexity. At the start of the auction scheme in Brazil, only one wind turbine manufacturer was active in the country and wind energy was not included in the first round of the auction scheme. However, after the inclusion of wind power in the auction scheme the LCRs attracted manufacturers to the country. As such, the local production of wind turbine components in Brazil has been attributed to the implementation of LCRs under the auction scheme and the LCRs have been effective in the establishment of a local manufacturing industry for low and medium technology wind turbine components. (Hansen et al., 2020; Hochstelter & Kostka, 2015; Rennkamp & Westin, 2013)

Kuntze and Moerenhout (2012) have also ascribed particular significance to the role of LCRs in India, as well as China and Mexico. In India, policies including LCRs for solar photovoltaics (PV) were implemented in the National Solar Mission, as hard domestic content requirements on crystalline silicon (c-Si) PV modules were put into place to support the manufacturing of this technology domestically. However, it was only moderately effective, as LCRs have allowed domestic s-Si PV manufacturers to capture between 3 and 7 percent of the Indian solar market. Additionally, the LCRs created a situation where imports of thin-film panels were favored in comparison to domestic production of c-Si cells and modules. As a result, the market shifted from c-Si to thin film panels without the actual creation of large domestic manufacturing capacity (Kuntze & Moerenhout, 2012). However, while the LCRs did not live up to the policy makers' expectations initially, several reports agreed that the LCRs were partially successful in promoting domestic manufacturing despite the favorable situation for imports of thin-film modules. In China, LCRs have been important in the establishment of local wind manufacturing plants, and LCRs did well in the fostering of the infant wind industry sector for onshore wind, which eventually played a significant role in the development of the domestic wind industry in general (Becker & Fischer, 2013; Hansen et al., 2020; Kuntze & Moerenhout, 2012).

Despite the growing popularity of LCRs and their varying degrees of effectiveness in different developing economies, Hestermeyer and Nielsen (2014) provide a comprehensive overview of different uses of LCRs and their legality in relation to WTO, GATT and GATS Agreements, concluding that while LCRs can be constructed in a surprisingly diverse manner, with varied legal constructions, they rarely survive judicial scrutiny (Hestermeyer & Nielsen, 2014). Thrasher (2021) disapproves this discussion of LCRs legality as she believes the current regime binds policy-makers' hands in climate-change policy. She argues that international treaties should allow countries to experiment with climate adaptation policies that promote green industrial growth and discourage investments which are bad for the climate. To that end, countries could temporarily greenlight industrial policies, including LCRs, that increase competition in the renewable energy industry. This would allow countries to provide domestic support and implement industrial policies which encourage renewable energy production and to build up local renewable energy sectors and make renewable energy more accessible and affordable in the long run.

Renewable Energy Auctions

According to IRENA (2013), renewable energy auctions have become a popular policy tool in recent years, indicated by the increased number of (mainly developing) countries that adopted auctions for renewable energy. In such auction schemes, the government issues a call for tenders to install a certain manufacturing capacity for a particular type of renewable energy technology or for a group of eligible technologies. The government establishes requirements which project developers that participate in the bidding process must meet, and project developers who participate submit a bid with a price per unit of electricity at which they are able to realize the project. The government subsequently evaluates these bids based on the price and additional criteria, and the winning bid is selected. Consequently, the government signs a Power Purchase Agreement (PPA) with the winning project developer. (IRENA, 2013)

According to Tordo et al. (2013), who have published a study on auction schemes in the oil and gas sector, a tender contains the principles and processes for the procurement of goods and services by the holders of oil and gas exploration and production rights. A tender states the basis upon which contracts for oil and gas exploration and production are rewarded, and mandates whether a bidding process is based on international competitive basis or that a preference is given to domestic suppliers and contractors. Interesting to note in this definition is the notion of local content. The proper design of tendering schemes is important for them to be effective. Research has discovered several shortcomings of tenders in the past (Tordo et al., 2013):

- Investor uncertainty over the price deterred investment
- Sites were selected without regard for environmental impact
- Sites were selected with little regard for territorial distribution (leading to certain areas or regions being over-solicited whilst others were ignored)
- Where there was little or no competition, there was no incentive to lower prices.

One of the biggest issues which tends to occur in these auction schemes is underbidding. Since an incentive is created for bidders to bid as low as possible in order to maximize their chances of winning the contract, underbidding is a serious risk. In such cases, project developers bid too low and will not be able to realize the project for the price offered. This often results in project delay or non-completion.

2.2 Globalization

According to Gore (2000), the essence of development is the mobilization and allocation of resources, and the design of institutions to transform national economies and societies, in an orderly way, from a state and status of being less developed to one of being more developed. The involved agencies include governments of less developed economies concerned with development as a purpose, and the governments of richer countries which disburse a number of non-governmental and intergovernmental organizations to support and influence the development process. Gore (2000) finds it appropriate to describe the development of countries as an international practice because of the activities of these non-governmental and intergovernmental organizations, and the tendency of governments to copy successful practices elsewhere.

Many theories of development focus on industrialization as the key to economic growth and social welfare, especially after the second world war, known as national industrialization. However, shortly after the postwar period improvements in terms of transportation and communication technologies led to the emergence of the concept of globalization. Dicken (2011) distinguishes between two meanings of globalization. The first one refers to the structural changes occurring in the way the global economy is organized. The second one refers to a neo-liberal free market ideology.

Furthermore, he distinguishes between economic, political, cultural and social globalization. Often, these types of globalization are intertwined with one another and difficult to separate. According to Dicken (2011), globalization processes are influenced by geography, and the local, national and global geographies all play a role in these processes, as they interact in many ways. Several tendencies of globalization are identified, which reflect different combinations of geographical spread and integration with one another. Dicken (2011), distinguishes between internationalizing, globalizing, regionalizing and localizing processes, see table 2.

Table 3 Tendencies of globalization as distinguished by Dicken (2011)

Tendencies of globalization	**Explanation**
Internationalizing processes	*Simple geographical spread of economic activities across national boundaries with low levels of functional integration*
Globalizing processes	*Both extensive geographical spread and also a high degree of functional integration*
Regionalizing processes	*The operation of 'globalizing' processes at a more geographically limited (but supranational) scale, ranging from the highly integrated and expanding European Union to much smaller regional economic agreements*
Localizing processes	*Geographically concentrated economic activities with varying degrees of functional integration*

As a result of these processes occurring at different levels of the geographical dimension, globalization is a complex concept which consists of a set of processes that operate unevenly in time and space. The nature and degree of interconnection between different parts of the world is therefore in a continuous state of flux (Dicken, 2011). The improvements in terms of transportation and communication technologies in combination with policy strategies inspired by the free market ideology also led to trans nationalization of companies which wanted to explore new markets or seek for new assets (Castellani & Zanfei, 2006). This led to the so-called 'global shift' in the 1990s where companies in general moved from centralized production plants to more decentralized production networks (Dicken, 2011). These production networks have ever since been the topic of academic research, where Dicken (2011) also argues that the reshaping of the global economic map has been driven increasingly by the emergence of extremely complex organizational and geographical networks of production, distribution and consumption, which he has called Global Production Networks (GPNs).

2.3 Global Production Networks and Governance

The Global Production Network approach is a broad relational framework, which attempts to go beyond the mostly linear view of the Global Value Chain (GVC) formulation and is concerned with the 'structural and relational' nature of multi-scalar network configurations that exist between the local and the global and assumes government arrangements as complex. The Global Value Chain concept tends to make linear assumptions about the nature of a production system. The GPN approach however, enables and encourages a focus which is larger and more comprehensive than solely the firm, and includes institutions and the environments in which these are embedded (Coe & Yeung, 2019).

Companies operate in these Global Production Networks. The networks reflect the fundamental structural and relational nature of how production, distribution and consumption of goods and services are organized. The precise form of these networks, how they are controlled, coordinated as well as the shape and extent of their geographies, varies greatly. However, according to Lanza et al. (2019), these networks consist of geographically dispersed production entities which are interlinked by material, information and financial flows. Furthermore, Lanza et al. (2019), argue that these networks are among the most critical forms of organization in the manufacturing sector and state that they account for almost 80% of global trade.

A GPN consists of production nodes, and any node in a GPN can be supported by a single or multi-tier system of suppliers which don't necessarily operate under the direct drive of the GPNs strategy. However, there is always a form of governance present in a network, and although the nodes in a GPN are often in competition with each other, the businesses of particular members are not necessarily aligned. This distinguishes GPNs from GVCs. In GVCs, the focus is on the step-by-step provision of a defined set of products and services to customers through linear vertical alignment of production and consumption. GPNs go beyond this linearity by involving all relevant sets of actors and relationships.

The GPN framework initially offered a flexible, geographic heuristic toolkit for mapping the shifting arrangements of global production networks and emphasized complex firm networks and the institutions involved in increasingly globalized economic activity, and the ways in which these are structured (Coe & Yeung, 2019). The usage of the GPN concept allows for the identification of different roles played by the incumbents of the Turkish wind energy industry, which is helpful in determining reasons as to if or why LCR policies in Turkey have been effective.

However, there are also voices saying that a GPN approach itself is not enough: while the GPN is well equipped for diagnosing production-network related development dynamics in a region, on its own it cannot fully explain the development of a region more broadly. In addition, there are also concerns about over-extending what GPN theory seeks to do, as there may be important dimensions of development in a region that a GPN approach cannot reveal, for example, patterns of uneven social and spatial development, environment and landscape changes or transformations in households and livelihoods (Coe & Yeung, 2019). Therefore, Coe and Yeung (2019) argue that other frameworks and lenses may be required to analyze the developmental ramifications that arise from different modes of global-production network engagement. Therefore, they argue, it is best to think of GPN analysis as a necessary but not a sufficient tool for understanding uneven development in the global economy.

In recent years, new conceptual and theoretical developments have occurred in the GPN literature, as academia have been working towards a GPN 2.0 network with enhanced capacity for causal explanation of the link between global network configurations and the uneven territorial development within the global economy. Amongst others, the works of Horner (2017), Hughes (2017), Dawley (2019) and Coe and Yeung (2019) contribute to these developments. To begin with, Coe and Yeung (2019) proposed the idea that GPN studies should seek to illuminate the causal links between network dynamics and territorial outcomes, such as industrial upgrading and labor conditions, rather than leaving those network dynamics as industry-level background contexts. By doing so, GPN studies bring a focus on regional development. Since this study evolves around the role and effectiveness of LCRs in the development of the Turkish wind energy sector and the role of different actors therein, there is interest this study regarding the links that exist between networks dynamics and its regional outcomes. This could be of added value in the further theorization of the political-economic forces shaping processes of formation and reconfiguration in GPNs as called for by Coe and Yeung (2019).

Additionally, Coe and Yeung (2019) mention three competitive drivers for global firms and their suppliers. Firstly, in order to sustain competitive advantage firms must optimize cost-capability ratios in ways that reduce costs over time and/or enhance firm-specific capabilities. Secondly, global lead firms and their network partners must continuously develop new markets for their products and services, whether in advanced or emerging economies. And thirdly, the pressures of financial discipline engender strong emphasis on short-term returns to shareholders and corporate restructuring to increase stakeholder value. Neilson et al. (2019) have expressed concern about the extent to which these drivers are represented as independent causal forces and how the role of the state is underpinning all three drivers. This is an interesting finding because it goes to show how important the role of the state actually is and shows the effectiveness of the GPN approach in incorporating the state as an active agent rather than a part of the background institutional context.

An important step in GPN theorizing is the notion to move beyond seeing the state as a facilitator which nudges actors in a GPNs through financial and fiscal incentives to seeing the state as an actor with different roles. Horner (2017) shows that an increasingly greater integration of state and firm centric approaches to understand economic development have begun to emerge in the research on GVCs and GPNs and that the state has gained recognition as an important governance actor in these frameworks.

Horner (2017) explores the possibilities and limits of government action in the frame of globalization and provides an identification of several roles of the state within GPNs: the facilitator, the regulator, the producer and the buyer. These four state roles are shortly explained in the following paragraphs as this perspective on different state roles can be useful in the empirical assessment of the institutional capacity of involved government agencies in the Turkish wind energy sector. Including this perspective also answers Horner's (2017) request to devote attention to assessing the viability of different roles of the state and how they manifest in the context of economic globalisation in the promotion of renewable energy measures.

The facilitator role involves policies and activities which assist firms in GPNs, whereas the regulator role limits and restricts the activities of firms in GPN's. Facilitating measures can include transport and communication facilities, export processing zones, credit facilities and policy incentives such as tax breaks. Examples of the regulator role include the creation of state policies which may limit the engagement with global lead firms, or by placing restrictions on ownership through performance requirements, technology transfer or local procurement.

The producer role of states within the GPN relates to how states may act as a producer via operating state-owned companies. This type of production is engaged in when states seek to take control of productive capacity in key strategic sectors or to boost production in industries where the private sector is less likely to invest. In addition to state-owned companies, there may also be companies which are linked to the government or where the government has a stake but does not completely control the company. Despite privatization in some countries, State Owned Enterprises (SOEs) continue to have a significant role in the global economy and are increasingly engaged in international trade. Through the producer role, the state can act as a competitor to privately owned firms across many parts of the Global South, however these types of companies generally remain underexplored in their involvement with GPNs.

The fourth and last role of the state is that as a buyer within GPNs, since public procurement can involve large-scale purchases by states from private firms. Procurement is important because states need to deliver several essential social services to keep an economy running, and as such public procurement is an important aspect of economic trade worldwide and possesses an important role in GPNs. Public procurement also often favors domestic suppliers over foreign companies, making it a prominent non-tariff barrier to trade.

Some regulation regarding public procurement have been inscribed in the WTO Agreement on Public Procurement, which seeks to ensure national treatment and nondiscrimination. However, not all WTO members follow the plurilateral agreement, with only 48 WTO members bound by it (WTO, 2012). In addition to operating as a buyer through public procurement, the state can also act as a buyer through state-controlled firms. The four roles of the state within GPNs are explained in table 3 below.

Table 4 State roles within GPNs provided by Horner (2017)

Role	Relations to globalization	Explanation of measures
Facilitator	*Assisting firms in GPNs in relation to the challenges of the global economy*	*Tax incentives, subsidies, export processing zones, incentives for R&D, implementing and negotiating favourable trade policies, and interstate lobbying*
Regulator	*Instituting measures that limit and restrict the activities of firms within GPNs*	*State marketing boards, price controls, restrictions on foreign investment, trade policy (tariffs and quotas), patent laws, labour regulation, quality controls, and standards implementation*
Producer	*Creating state-owned firms, which compete for market share with other firms within GPNs*	*State-owned companies, for example, in oil and mining.*
Buyer	*Purchasing by the state of output produced by a firm*	*Public procurement, for example, of military equipment and pharmaceuticals.*

Horner (2017) expressed that considerable scope exists for deepening the research into the dynamics of the state as a buyer withing GPNs and the adherent development implications thereof. Moreover, as indicated by Vicol et al. (2019), the GPN 2.0 framework was derived from empirical analyses of the strategic coupling and value capture trajectories of firms in certain manufacturing and service sector ‘hot spots’, primarily in East and Southeast Asia, and its wider applicability for other contexts therefore remains uncertain Therefore, this study into the role and effectiveness of LCRs in the localization of a wind turbine manufacturing sector in Turkey can contribute to the development of this academic field of theory by applying the GPN framework in aa new context and deepening the research into the role of the state within GPNs.

In short, the literature on LCRs in developing countries has provided insights as to why and how LCRs are used in different developing countries, and how their effectiveness has been analyzed in previous academic studies. The literature on globalization has provided the tendencies of globalization and added insights into localizing processes, and the literature on the GPN framework has added a focus on regional development as well as insights with regards to competitive drivers and the role and dynamics of the state within GPNs. The last theoretical perspective to be elaborated upon is that of Technological Capabilities. Baker and Sovacool (2017) have combined the GPN framework with literature from the development of technological capabilities to investigate South Africa’s solar and wind energy industries, a unique combination of theoretical perspectives which has served as an inspiration for this study. For this reason, this study also explores the literature on Technological Capabilities and the role it can play in the localization of a wind turbine manufacturing sector in Turkey, which will be shortly elaborated upon in the following paragraphs.

2.4 Technological Capabilities and Application of the GPN Framework

The literature on technological capabilities and capability building is a neo-structuralist approach to development and fits within the framing of national industrialization. The need for technological learning for industrial and national development has a central role in this framing. Neo-structuralist theory emerged as a response to the neoclassical approach to development, which often neglected the need for, and production of technological activity in developing countries. The neoclassical approach assumed technology to be available to all countries and assumes there are no additional costs, risks or other constraints to using technologies. As such, it does not raise any policy issues as there can be no significant market or institutional failure (Lall, 2004). Developing countries are also taken to receive all relevant improvements from developed countries, without assimilation problems of the transferred technology and no need for adaptation or firm-specific learning or technological effort (Nelson, 1987). Thus, the general thrust of the neoclassical approach was to minimize the role of technological activity in developing countries and the need for policies to support or protect these activities.

According to Lall (1992), the OECD explains long-term differences in the performance of advanced industrial economies as resulting from the interplay of incentives and capabilities, where the capabilities describe the best that can be achieved, and incentives guide the use of these capabilities and stimulate their expansion, renewal or disappearance. In advanced economies, capabilities therefore refer mainly to the use of existing capital stock and the technical and organizational skill required for their use. Innovation capabilities stimulate the development of new sorts of capital stock and associated new forms of organization and control. Incentives originate from product markets, institutional functioning and government policies, and affect the pace of accumulation of capital and skills and more or less determine the efficiency with which capabilities are used. The interplay between incentives and capabilities happens in an institutional framework, the institutions determine the rule of the game and can intervene as they can modify behavior by changing attitudes and expectations. Thus, the starting point for many theories of technology in developing countries is that firms cannot be taken to operate on a common production function, as technological knowledge is not shared easily, and firms are not identical and do not possess the same skills or capabilities. To develop such capabilities costs time, effort and investment and eventually the differences between firms cause firm level capabilities to be differentiated among firms, although there is likely also a certain amount of synergy because firms show a common element of response to policies, markets and the institutional framework. This combination of differentiated firm level capabilities and their synergy in turn leads to differentiated national technological capabilities. Lall (1992) thus distinguishes mainly between the firm level technological capabilities and national technological capabilities. It is thus the interplay of the capabilities and incentives at the firm level that determine how well firms learn skills and master the required information to cope with industrial developments and at the national level how well countries grow dynamically in the context of rapidly changing technology. According to Lall (2004), the literature on how enterprises in developing countries use technology argues that industrial success in these countries depends on how enterprises manage the process of mastering, adapting and improving upon existing technologies. This process is difficult, and thus prone to market failures which can then have important policy implications.

In between 1980 and 2000 the so-called East Asian Tigers experienced rapid industrialization and maintained high growth rates, and policies including LCRs were extensively used by these countries as parts of their industrial policies (Lall, 2004). Parts of the manufacturing sector in Taiwan and the Republic of Korea have received relatively high levels of protection and import controls have had the central function of reducing the risk to which investors in new, especially capital-intensive industries, were exposed, which encouraged the expansion and deepening of domestic supply capabilities in these countries (Wade, 1988). The Republic of Korea developed capabilities successfully by adopting a highly interventionist strategy with a strong preference for promoting indigenous enterprises and for deepening local technological capabilities (Lall, 2004). The Korean drive for export was largely driven by local firms which were backed by policies that allowed them to develop impressive technological capabilities and a range of quantitative and tariff measures were used to provide infant industries with space to develop capabilities. Moreover, it is also interesting to note that the role of foreign multinationals has been relatively small in the sudden economic development of these countries, and foreign multinationals have a small presence in relation to the economy as a whole. As explained by Lall (2004), investments of multinationals in the manufacturing sector in these countries was small and they have had restricted access to the domestic market. The respective governments have directed these multinationals towards exports, which has provided benefits for the development of the domestic production capacity and income distribution. This shows that efforts to promote growth and restructuring of domestic production capacity and capabilities do not have to go through foreign multinationals. This is interesting in relation to the Turkish wind energy sector, as the role of foreign multinationals and domestic firms and their respective focus on the foreign or domestic markets can be researched.

Baker and Sovacool (2017), through combining the GPN framework with literature from the development of technological capabilities and the rise of cleantech, have been able to explore the relationships between national dynamics and international forces and their mutual influence on technological pathways and supply chains for renewable energy in South Africa. They discovered tensions between the economic logic of GPN (that being: the cheapest way to generate more energy is by letting foreign MNCs conduct their business unimpeded by rules such as LCRs) on the one hand, and the usefulness of developing more advanced national technological capacity for industrialization on the other hand. This combination of a GPN approach with literature from the development of national technological capabilities for the study of renewable energy development has offered Baker and Sovacool (2017), in their own words, a more nuanced and complete picture of the political economy of technological development. It has allowed for the consideration of dimensions such as the distribution of power within the networks, the significance of the development of skills and the role of trade and broader political and socio-cultural and environmental implications resulting from these trends. Thus, they have developed a theoretical framework which merges international trends such as trade, finance and technology costs with the complexity of the specific national context in South Africa, including politics. Baker and Sovacool (2017) argue that this is significant because many studies on technological development are too focused on national policy and do not consider global dynamics. Therefore, the study by Baker and Sovacool (2017) has served as an inspiration to this research because it showed the possibility for a thorough analysis of the rise of renewable energy in an emerging economy by utilizing a multi-actor approach and establishing a picture of the political economy of manufacturing capacity development including the significance of skills development and political decision making. The inclusion of a focus on technological capabilities furthermore allowed for assessing which content is manufactured locally by whom at which point in time, which then served as an indication of the capabilities that have been developed and the ones which have not been developed. (Baker & Sovacool, 2017)

The approach utilized by Baker and Sovacool (2017) also gives room for interpretation about the links between the globally and locally occurring practices, and the relationships between different levels of the geographical scale. This is interesting because the role of international and national firms, and national and local governments and their practices can all potentially be of relevance in the localization of wind turbine manufacturing and the promotion of renewable energies in the sustainable development of emerging economies. Local dynamics could play a role in the effectiveness of LCR policies. Buyer-supplier relations, the local industrial base, the practices of local actors and potential clustering could well be of relevance. In the case of clustering, the synergistic relations that local clusters can have with transnational relations, causing a lot of information to enter the cluster and diffuse within it quickly, could be important factors in the extent to which the LCR policies have influence on industrial development, as clusters with close interaction and dense linkages are often considered as the proponents of innovation. (Chandrashekar & Bala Subrahmanya, 2017) (Simmie & Sennet, 1999). According to Porter (1990), a cluster consists of industries which are linked through vertical (buyer/supplier) or horizontal (common customers, technology, channels) relationships. Simmie and Sennet (1999) argue that clusters exist along a spectrum of regionally bounded interactions which vary all the way from dense linkages (for example such as found in Silicon Valley) to co-located firms in similar industries with few local linkages or networks.

3. Background

In addition to the theoretical perspectives that form the theoretical framework, there is also background information that is required in order to conduct research into the Turkish wind energy sector and its policies, but which does not have a role in the theoretical framework. This is information regarding the technology of wind turbines, which will be elaborated upon in the following section.

3.1 Wind Energy Technology

In order to conduct research into the Turkish wind energy sector and wind energy policies, basic technical knowledge about wind turbines and the effect that wind turbine manufacturing complexity has on the localization of component manufacturing is required. The complexity of wind turbine component manufacturing is an important factor of localization, as the higher technological complexity of particular components in terms of required skills and capabilities make it more difficult to localize these components. This presumably has a distinct effect on the extent to which LCRs are effective in localizing wind turbine component manufacturing. The effect of technology complexity therefore has a relation to the domestic industrial base and the level of capabilities of domestic firms, as well as a relation to the object variable.

Wind energy can eventually be traced back to the power of the sun. The sun warms the earth, which causes hot air particles to rise and cold air particles to drop. This creates differences in air pressures which are settled by currents of air, which is called wind. Wind is however considered as a separate source of energy, and the harvesting of wind energy is a clean and durable way of energy generation because no harmful emissions occur. (Ouwehand et al., 2014)

A wind turbine has an energy payback-period of 3 to 6 months and a lifetime of 15 to 20 years. This means that the energy generated in 3-6 months is equal to the entire amount of energy required for production, assembly and disassembly of a turbine. The economic payback time is dependent on the yield, the revenue and the reimbursement for the provided energy. (Ouwehand et al., 2014)

The energy that can be harvested from wind is partially dependent on the wind speed. This wind speed knows a lot of large and small variations during a year, month, day, hour and even every second. Furthermore, wind speeds also vary with the height above the earth's surface. All of these variations need to be taken into account when harvesting wind energy.

The simplest model to estimate wind power was derived by Betz in 1962. He found a theoretical maximum for power transfer when wind is travelling through a turbine and therefore found a maximum for the amount of energy to be extracted from wind. This maximum of power that can extracted from wind is $16/27^{th}$ part, or almost 60%.

There are two principles in which energy from the wind can be harvested by wind turbines, the resistance principle and the lift principle. In the resistance principle a certain resistance is used to draw energy from the wind. However, turbines based on this principle have proven to be very inefficient and are rarely used. Turbines based on the lift principle are more common. This lift principle involves the use of wing profiles, air surrounds these wing profiles when travelling through and these wings are subsequently subjected to an upward force, called the lift force. This lift principle is the same principle that is used in airplanes and sailing boats.

There are many types of wind turbines that operate on the lift principle, and there are two main categories: turbines rotating around their horizontal axis and turbines rotating around their vertical axis. The most common type of wind turbine is a three-blade turbine based on the lift principle which rotates around its horizontal axis.

Surana et al. (2020) have identified nine key components in wind turbines: the gearbox, the bearings, the blades, the control system, the nacelle, the forging, the generator, the power converter and the tower. The blades of a turbine are attached to main axis, and the revolving motion of the blades is accelerated in the gearbox. The gearbox drives a generator which transfers mechanical energy into electrical energy. These parts are fitted within the so-called nacelle, which is assembled on top of the turbine tower and thus houses all of the generating components of a wind turbine. The nacelle also has a wind meter which measures the wind direction. When the direction of the wind changes, the revolving motors ensures that the turbine is aimed straight into the wind again.

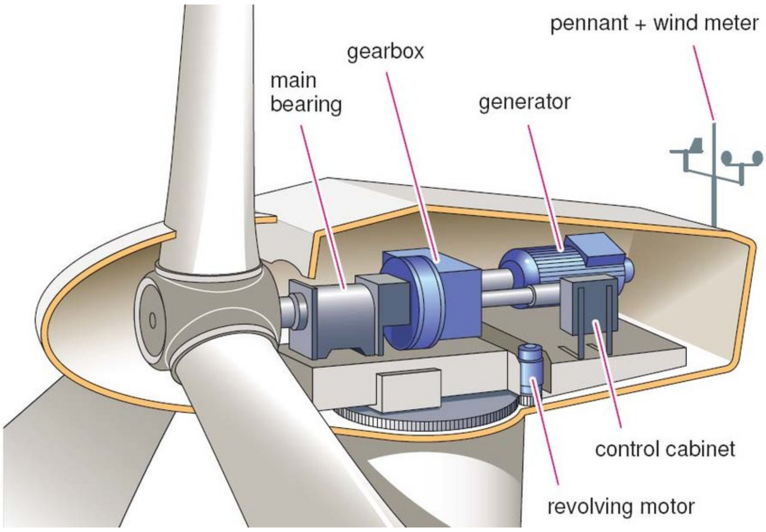

Figure 2 Cross-section of a nacelle (Al Ahmar et al., 2008)

The yield of a turbine is dependent on the circumstances in which it is placed, but in general wind speeds are higher at larger heights and the yield of a turbine is larger when the diameter of the blades increases. Therefore, the general trend in the history of wind turbines is that they keep increasing in height and rotor diameter, and developers are always pushing for the development of turbines with higher yields. In 1988 the average power of a turbine was 100 kW with a rotor diameter of 20m and a hub height of 30m. In 2012 there were already turbines with a hub height of up to 100m, a rotor diameter of up to 90m and a power of up to 3MW. Figure 3 shows the (expected) increase in size and power of wind turbines between 2000 and 2025. As can be seen, both the size of the turbines in terms of height and rotor diameter, as well as the power of the turbines has increased significantly over the years and is expected to increase even more until 2025 at least.

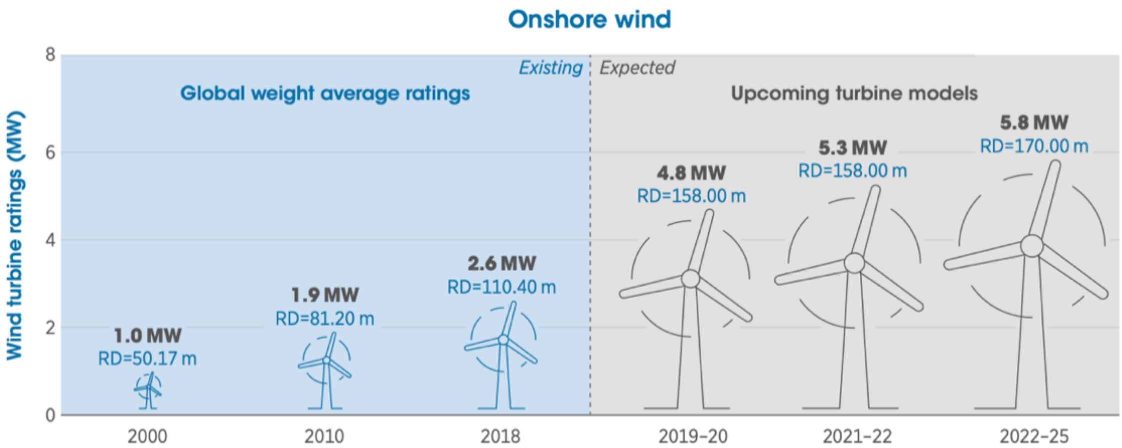

Figure 3 The (expected) increase in size and power of wind turbines between 2000 and 2025 (Ouwehand et al., 2014)*(RD = Rotor Diameter)*

The large size of the turbines is a cause of concern in terms of shipping, and with the increasing sizes of the blades and towers, shipping has become a large challenge and several supply chain solutions have appeared over the years to allow for efficient shipping of the turbines to the location of interest. Turbine manufacturers are continuously innovating in terms of shipping in order to reduce costs as much as possible.

3.2 Turkish Wind Energy Policy Development

In this subchapter, the history of wind energy policies in Turkey will be explained in order to develop an understanding of what the current policies are and when these originated. Subsequently, the specific policy incentives in Turkey and the conditions attached to these incentives will be explained.

The following explanation of the Turkish wind energy policy development includes several references to the interviews performed in the empirical case study. This is due to the fact that certain specifics of the Turkish policies were explained during these interviews, and hence are empirical findings and results of the empirical case study to which reference is made. However, in order to present a clear story and cohesive narrative, it was decided to include these empirical findings in this background chapter as it is useful to gain an understanding of the policies in the Turkish wind energy sector and the structure of the LCRs before discussing the rest of the empirical results which consider the core focus of this study.

3.2.1 Policy History

The World Bank Group published an analysis about the Turkish economy and developments in the energy sector up to 2015. In this analysis, in-depth information is provided about laws and policies pertaining to the Turkish energy sector. In the following paragraphs the most relevant laws and policies are briefly explained, as detailed in that report.

As a part of the market reform launched in 2001, the Turkish government enacted an Electricity Market Law (EML) and Gas Market Law (GML) in that year to provide for sectoral restructuring, and electricity and gas markets, electricity suppliers, bilateral contracting and an Energy Market Regulatory Authority (EMRA) were established. After the establishment of the legal framework by the EML, the large potential for wind energy in Turkey attracted interest from domestic and foreign investors. There were license applications to the EMRA for new wind projects, however there were no predetermined wind energy sites, and no information was available about the transmission system connection capacity. As a result, companies assessed project sites according to their own evaluations and connection points. However, due to the limited connection capacity and the regulation being insufficient for deciding between different applicants who applied to the same project site, the EMRA suspended licence applications from the 4th of June 2004. (World Bank, 2015)

In response, the government enacted the Law on Utilization of Renewables in Electricity generation (No. 5346), also known as the Renewable Energy Law (REL), in 2005 (Government of Turkey, 2005). The Ministry of Energy and Natural Resources (MENR) was the main body to prepare this legislation, and this is the main law related to renewable energy in Turkey. Under this law, the role of the EMRA was to take the necessary measures to encourage the role of renewable and domestic energy resources and initiate actions with relevant agencies to develop and implement renewable energy incentives. As such, the EMRA reopened the possibility of applying for license applications in 2007, after the period of suspension had lasted for three years. After the reopening in 2007, the EMRA received 751 applications in one day, corresponding to 78GW of capacity. Many of the applications were for the same zones, and the total capacity was far beyond the real capacity available for development. As a result, the EML was amended in 2008 to introduce an auctioning process. This auctioning process was to be used when there was more than one firm applying to the same project site or when the total requested capacity exceeded the capacity available at the substation. The auctioning process, executed by grid operator TEIAS, according to maximum contribution fee, began in 2010 for 13 different groups of applicants and concluded in July 2011. From the 78GW that was originally applied for, around 31GW remained after review. From this 31GW, around 1378MW consisted of single license applications, and the remaining capacity was subjected to auctions. The auctioning process started in 2010 and concluded in July 2011 and eventually, a total of 149 projects qualified with a total installed capacity of 5500MW. (World Bank, 2015)

Table 5 Institutions and their roles in the Turkish renewable energy sector (World Bank, 2015).

Organization	**Role**
Ministry of Energy and Natural Resources (MENR)	*Shapes policy in the energy sector*
Energy Market Regulatory Authority (EMRA)	*Issues licenses, sets pricing principles and regulates tariffs*
Turkish Electricity Generation Corporation (EUAS)	*Largest Power Generation Company in Turkey*
Turkish Electricity Transmission System Operator (TEIAS)	*Grid operator*
Republic of Turkey Prime Ministry Investment Support and Promotion Agency	*Consultation and attraction of foreign investors*

The REL was amended most recently in 2011, when the Renewable Energy Resources Support Mechanism (YEKDEM) was introduced. In this framework, renewable generation facilities are supported by distributing the total cost of the electricity supplied to the pool, among all the suppliers selling energy to final consumers, rather than on the direct purchaser of energy generated by each facility. Under this Renewable Energy Resources Support Mechanism, Turkey has Feed-In Tariffs for solar, biomass, geothermal, wind and hydro plants with a 10-year validity after the first operation date. The base feed in tariff for wind power plants is 7.30 US cents/kWh. One of the reasons for the tariff being set so low was to promote the development of efficient plants first. As the investment costs decline over the years, less efficient projects would also become profitable in due time. In addition to the base FIT, the YEKDEM also included an additional premium for domestically manufactured mechanical or electro-mechanical equipment used in licensed generation facilities, granted for five years after the first operation date. This is the first part of the Turkish Local Content Requirement for wind energy, and it is in line with the definition provided by Hestermeyer and Nielsen (2014) since it is a measure which conditions a benefit on the use of local goods and/or services. However, it is really more of a carrot policy than a requirement, since it's an incentive to persuade companies to use local content but does not strictly require them to do so. Nonetheless, this policy serves as serves as an incentive for the domestic manufacturing of components, as demand for domestically manufactured components is likely to increase as the result of WPP investors seeking to receive the FIT-tariff as well as the premium for domestically manufactured components. (World Bank, 2015)

The amount of the additional premium is determined by the domestically manufactured components that are used in the generation facilities, as different components are awarded a different premium, see table 5. The legislation calls for at least a 55% local content ratio in order to be granted the premium for a component. If the investor complies with the minimum threshold of 55% for a component of equipment, it is granted 55% of the incentive. For each part above the 55% local content ratio, the investor is granted an equivalently increased amount of the incentive (Invest in Turkey, 2018). The maximum premium for domestically produced equipment is 3,7 US$cents/kWh and the maximum possible total tariff for wind thereby became 11 US$cents/kWh (Government of Turkey, 2005; UNDP, 2014; World Bank, 2015).

Table 6 Premium provided for the use of domestically manufactured components in Turkish wind energy generation facilities (Government of Turkey, 2005).

Component	***Additional premium (US$cents/kWh)***
Blade	*0,8*
Generator and power electronics	*1*
Turbine tower	*0,6*
All mechanical equipment in rotor and nacelle	*1,3*

Furthermore, there are additional incentives for renewables. In the REL it is stated renewables have an 85% discount in easement, permit or license fees for the first 10 years of operation. In the Licensing

Regulation, a 90% exemption is provided from licensing fee and annual licensing fee for the first eight years of operation, and priority in system connection is ensured. All these additional incentives for renewables can be used by renewable energy generators, regardless if they are participating in YEKDEM or not. (Kuntze & Moerenhout, 2012; World Bank, 2015)

In addition to the FIT implemented under the YEKDEM, there is also an auction scheme for large-scale wind energy projects in Turkey. This auction process requires project developers to submit a bid stating their contribution fee in US$-cents/kWh. This contribution fee represents the price per unit of electricity at which the developers are able to realize the project (IRENA, 2013). The bids are then evaluated based on the basis of price and additional criteria and a 10-year power purchase agreement is signed with the winning bidder (Ozcan, 2021; World Bank, 2015). This auction scheme is called the Renewable Energy Resource Areas (YEKA) project and is explained in more detail in the Chapter 3.2.2.

Lastly, in addition to the licensed renewable energy generation, another important concept in Turkey is the unlicensed generation concept introduced in the 2007 Law for Energy Efficiency. According to this law, private people or entities are allowed to construct and operate renewable energy generation facilities with a capacity below 200kW without a license from EMRA. Later amendment of the REL increased this limit to 500kW and allowed producers to sell excess generation to regional suppliers. The latest amendment of the EML in 2013 increased the generation limit to 1MW. (World Bank, 2015)

3.2.2 Renewable Energy Resource Areas (YEKA)

As previously explained, the auction scheme for renewable energy was first introduced in Turkey in 2005. However, in 2017 the auction scheme was amended to use US$-cents/kWh as the legal tender currency for the contribution fees with the introduction of the YEKA project, a one billion US$ wind power investment project for "mega" wind energy tenders with the intention to speed up the installation process of wind turbines in Turkey while also realizing domestic production capacity for turbine components. The main objective of the YEKA project is to prioritize economic areas in terms of wind and solar energy potential and to identify technically feasible and appropriate areas without administrative problems in the establishment of solar or wind power plants. YEKA is an abbreviation for 'Renewable Energy Resource Areas', and the government aimed to determine and declare specific locations as 'YEKA' by conducting the aforementioned studies. Furthermore, potential environmental harm is taken into consideration in the selection process and the transmission infrastructure planning projections are tailored to the needs of the project. Also, the transformer capacity is reserved in areas suitable for the establishments of WPPs. The YEKA auctions consist of four stages: site selection, awarding the connection capacity utilization rights, licensing processes and purchasing the energy. The YEKA zones are subject to an auction process in which investors can submit bids with a ceiling price of 7 US$-cents in the first auction round, and updated prices in the subsequent auctions in accordance with participant numbers and bids offered in the rounds. The first YEKA bidding round was held in 2017 and the following eight consortia submitted bids to win the 1000MW contract:

1. Vestas (Denmark)
2. General Electric (GE-America) - Fina Energy
3. Goldwind (China) - Akfen Holding - Beyçelik
4. Siemens (Germany) - Türkerler - Kalyon
5. Enercon (Germany) - Polat Energy - Limak Energy
6. Nordex (Germany) – İklim Elektrik Yatırım - MKS Marmara - Zorlu Energy
7. MingYang (China) – İlk İnşaat
8. Senvion Wind Energy Solutions (Germany) - IC İçtaş Energy

Eventually, a consortium consisting of Siemens Gamesa, Kalyon Enerji and Türkerler Holding bid lowest at 0.0348US$/kWh. According to (C), there was a local content obligation of 65% in this contract. Furthermore, the winning consortium was to carry out R&D into wind turbines for 10 years, to be performed with 80% Turkish engineers and open a factory for nacelle development. This is the second part of the Turkish Local Content Requirement for wind energy, since it is a requirement which conditions a benefit on the use of local goods and/or services. Although, just like in the first part of the Local Content Requirements in Turkey, it is not strictly a requirement since companies do not have to participate in these tenders. However, since it is required to adhere to the LCR when winning the tender, it is referred to as a Turkish LCR. As a result of winning this bid, the winning consortium constructed a nacelle production factory in one of Izmir's industrial districts. (Daily Sabah, 2017; EMRA, 2020; Ozcan, 2021; Royal Danish Consulate General, 2020; Sogukpinar & Ismail, 2018)

The second tender, held in 2019, was won by Enercon and Enerjisa, who both secured 500MW of capacity out of the 1GW available for auction (Renewables Now, 2019a). Enercon secured projects in Mugla and Baliksekir for respectively 0.04US$/kWh and 0.0353 $/kWh. Enerjisa had secured projects in Ayudin and Canakkale for respectively 0.0456 US$/kWh and 0.0367 US$/kWh. According to (D), for the second YEKA tender, there was no longer the obligation to open a local factory, but there was still an obligation for using local equipment at a ratio of 55%.

There are clear benefits from the Turkish national perspective to these YEKA tenders. Firstly, they allow for large scale implementation of renewable sources in locations where not many administrative or connection-related problems should occur. Furthermore, the government has defined very specifically the contracts of these YEKA projects, allowing them to determine what kinds of factories are built and what kind of people are employed in these factories. As such, the government has had a significant degree of control in the process of promoting local industrialization in the wind energy sector. According to (A), one of the reasons why the government choose in favour of these mega tenders is that previous tenders in which there were also smaller companies involved often didn't complete the contracts because the profit margins were too low for small companies to realize the project. These mega tenders will attract only large firms which can afford to work with smaller profit margins. However, it has also been understood that the contracts auctioned in the first and second round of the YEKA tenders have not been completed yet (C). The nacelle factory is ready for operation, but due to the covid-19 pandemic the factory has not opened yet. Furthermore, the total of 2000MW has not yet been constructed and the third tendering round has also been postponed as a result of the COVID-19 pandemic. According to (G), the prices submitted in the bids were again too competitive, creating too small profit margins for the companies to complete the projects. As such, (G) argued that the companies would be better off to wait a couple of years to complete the projects, in order to allow development costs to decrease further.

In addition to the above, Ozcan (2021) performed a study which presents stakeholder views on the YEKA project. He found that stakeholders that play a role in the renewable energy investments in Turkey (relating to both Wind and Solar energy) considered the auction design useful and suited for the conditions in Turkey, as the structure of the YEKA auctions have been designed with a view to enabling the employment of qualified human capital through enhancing the domestic production capacity for wind turbines, which enables technology transfer in high value-added fields. Moreover, stakeholders believed that domestically manufactured equipment should be supported to promote the development of the energy sector and to realize competitiveness with regard to foreign firms. They also stated that products produced in the plants established as a result of YEKA auctions should be provided with export support. (Ozcan, 2021)

However, Ozcan (2021) also recognizes several shortcomings of tenders in the tendering process for licensed energy generation projects in Turkey. Such as overcompetitive bid prices, leading to insufficient project financing and returns (Tordo et al., 2013), and site selection and qualification not being performed by a central authority. Futhemore, as recommended by the World Bank (2015), it would be useful for a related public organization and the grid operator to perform studies and measurements and provide the results to the market for constructing WPPs on suitable sites.

3.2.3 Summary Turkish Wind Energy Policy Development

The Law on Utilization of Renewables in Electricity generation implemented in 2005 is the main law related to renewable energy in Turkey. Under this law, the YEKDEM and YEKA frameworks have been implemented. In the YEKDEM framework a Feed-In Tariff with a 10-year validity has been implemented. A Local Content Requirement is added as a premium on top of the base FIT if a minimum of 55% of the manufactured components used in the generation facilities are domestically produced. The height of the premium is determined by the type of component domestically manufactured, as different components are granted a different premium. The maximum premium for domestically produced equipment is 3,7 US$cents/kWh and the maximum possible total tariff for wind thereby became 11 US$cents/kWh. This framework is a direct incentive for increasing the amount of domestically generated wind energy, as the government provides a 10-year purchase guarantee with the FIT. Moreover, this is also an indirect incentive for wind turbine component manufacturers, as the demand for domestically manufactured components will increase as a result of the Local Content Requirement implemented under this framework.

The YEKA framework was first introduced in 2017 and is an investment project for mega wind energy tenders with the intention to speed up the installation process of wind turbines in Turkey and realizing domestic manufacturing capacity through additional requirements attached to the tenders. The first tender was held in 2017 for a contract worth 1000MW, this contract was won by a consortium consisting of Siemens Gamesa, Kalyon Enerji and Türkerler Holding for the contribution fee of 0.0348US$/kWh. This contract included a local content obligation of 65% and the winning consortium was to carry out R&D into wind turbines for 10 years to be performed with 80% Turkish engineers and construct a facility for nacelle development. The second tender was held in 2019 for another 1000MW, both Enercon and Enerjisa secured 500MW of the capacity available for auction. Enercon secured projects in Mugla and Baliksekir for respectively 0.04US$/kWh and 0.0353 $/kWh. Enerjisa had secured projects in Ayudin and Canakkale for respectively 0.0456 US$/kWh and 0.0367 US$/kWh. In the second tender there was the obligation of using domestically manufactured equipment at a ratio of 55%, but no obligation to construct a local manufacturing facility. The third YEKA tender has been postponed as a result of the COVID-19 pandemic and accompanying measures.

It is now clear that the Turkish LCR is two-fold, from which the first part of the LCR is placed under the YEKDEM framework and the second part is placed under the YEKA framework. Whenever reference is made in the remainder of this report to the Turkish LCR, this refers to these two policy incentives.

4. Methodology

This research study is an empirical case study in which the literature on LCRs in emerging economies, globalization GPNs and technological capability building provide direction to the empirical research. During the empirical part of the research, data has been collected from secondary and primary sources in order to be able to answer the research questions drawn up in Chapter 1. In this chapter this research design will be further explained as the operationalization of the theoretical framework, data collection and data analysis will be elaborated upon.

4.1 Operationalization of Theoretical framework

The theoretical framework has been operationalized to guide the empirical part of this research, see figure 4. As previously explained, this study has been designed as an empirical case study. This design allows the researcher to make implications about phenomena occurring at a specific location based on experience rather than literature. The object variable in this study is the effectiveness of LCR policy in the Turkish wind turbine manufacturing sector in relation to the goals it aims to achieve. This object variable is quantified through the number of companies in the wind turbine manufacturing sector, the country of origin of these companies, the complexity of the components (measured by a Product Complexity Index (PCI) which will been explained in more detail in Chapter 4.3) that these companies produce, and the number of employees employed in the sector. To that end, a comparison of these indicators before and after the LCR was implemented is made in order to determine the effectiveness of the LCR.

The object variable is explained by three explanatory variables which are drawn from the literature discussed in Chapter 2. These three explanatory variables each possess several enabling factors which are considered to be drivers for the effectiveness of LCRs. The first explanatory variable is called 'the indicator framework' as it is based on the indicator framework developed by Hansen et al. (2020). It consists of four enabling factors that contribute to LCR effectiveness: design and coherence, size and stability, restrictiveness and the domestic industrial base. This indicator framework is embedded in theory about LCRs in developing countries, technological learning and capabilities, industrial policy and development strategies in general. Operationalizing this indicator framework in an empirical setting adds structure to this research as it provides four clear enabling factors which can be examined in the empirical setting, and its operationalization can provide a contribution to the further enhancement of such frameworks.

An expansion is made upon this framework by also considering the local context in assessing the effectiveness of LCRs. To that end, the local context explanatory variable seeks to explain the effectiveness of LCRs through investigating the environmental and economic setting in which the LCRs are applied. The first enabling factor relates to the natural environment and the geographic circumstances in which the LCRs are used, and in which the Turkish wind turbine manufacturing sector is established. The second enabling factor relates to the economic context surrounding the LCRs, and in which the LCRs are used. By including considerations regarding the institutional capacity of involved government agencies, Horner's (2017) request to devote attention to assessing the viability of different roles of the state and how they manifest in the context of economic globalisation in the promotion of renewable energy measures, can also be answered.

Lastly, the literature on GPNs and the recent academic advancements in the GPN 2.0 framework resulted in the third and last explanatory variable, governance. Within this variable, three enabling factors have been identified which can contribute to the effectiveness of LCRs. As such, the role of governance is assessed on the firm level, the local level and the national state level.

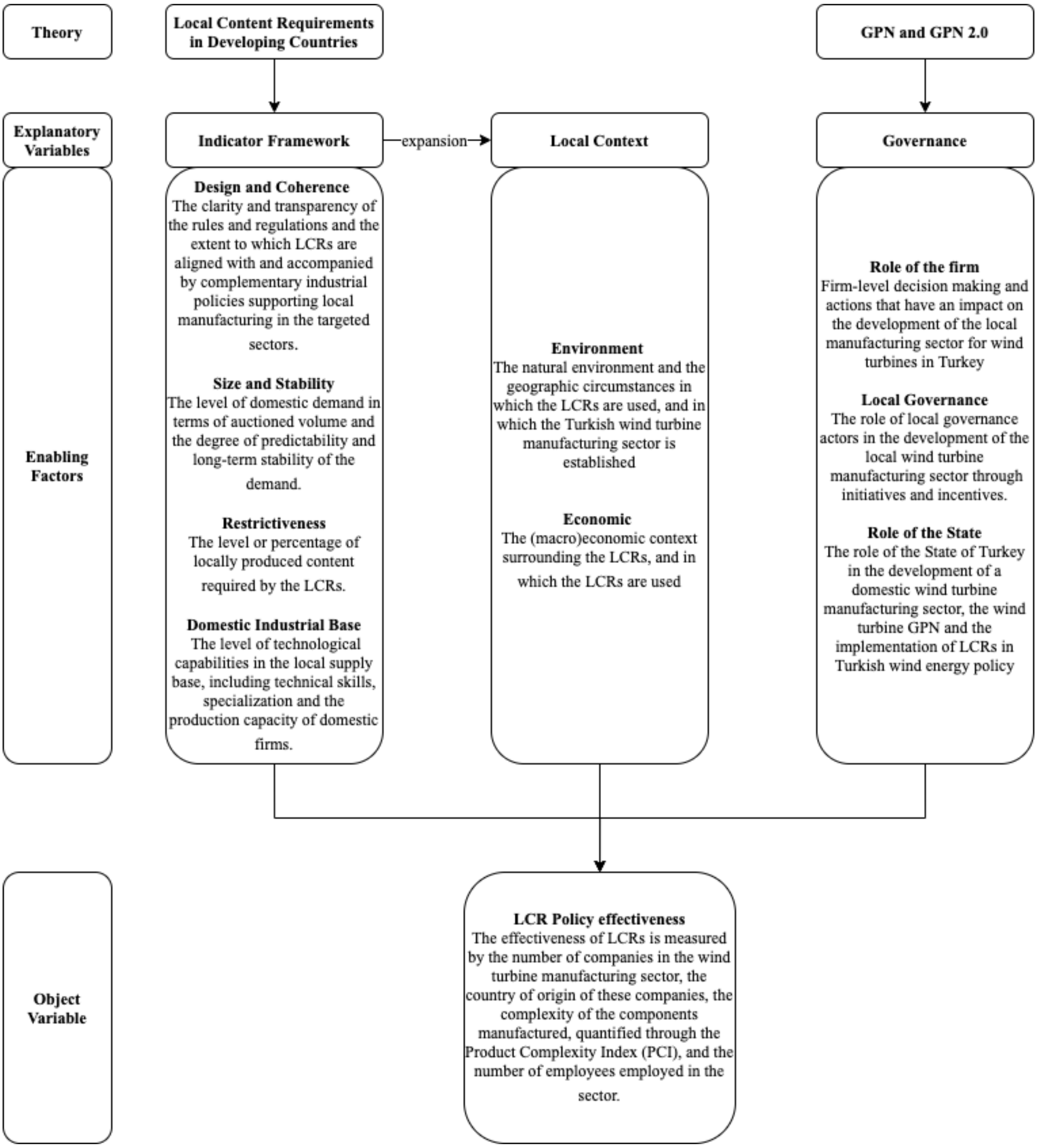

Figure 4 Operationalization of the theoretical framework

The literature on technological capabilities is not mentioned in the operationalized theoretical framework, as it has not directly led to the establishment of one of the explanatory variables. However, technological capabilities still do play a significant role in the framework, as they are for example very relevant within the enabling factor 'domestic industrial base' which is embedded in the 'indicator framework' explanatory variable. The domestic industrial base in Turkey possesses specific technological capabilities which could change over time or could stimulate (or hinder) the localization of wind turbine component manufacturing.

The main value added of the operationalization of this research framework is that it connects the theoretical insights obtained by combining different fields of literature with the empirical findings from the case study that is to be conducted. The theoretical framework has explored the literature, and by operationalizing this research framework it can be determined if certain theoretical findings can be recognized in the empirical case study. The operationalized research framework allows for the empirical assessment of the enabling factors that are considered to contribute to the effectiveness of LCRs in the localization of wind turbine manufacturing in Turkey. The empirical case study applies the indicator framework proposed by Hansen et al. (2020) and assesses the effects of the local context and the institutional capacity of involved government agencies on the effectiveness of LCRs. This operationalized research framework has thereby combined insights from literature on the use of LCRs, Globalization, GPNs and Technological Capabilities which offers a comprehensive empirical case study that allows for the drawing of conclusions that will contribute to the assessment of the role of the state, local government(s) and firms in the promotion and implementation of renewable energy measures and its contribution to the development of economies, as well as conclusions about the role of the enabling factors regarding the effectiveness of LCRs and the role of LCRs in the localization of a wind turbine manufacturing sector in Turkey. As explained by Miles, Huberman and Saldana (2014), the reason for doing fieldwork is to describe and analyze a pattern of relationships. This particular study is focused on the role of LCRs in the localization of wind turbine manufacturing in Turkey, but through studying the empirical case it might also become possible to draw conclusions, based on theory, that are useful contributions to the theoretical field. As such, eventually the conclusions that are drawn will first relate to the specific empirical case and explain the situation in the Turkish wind energy sector, but subsequently more light can be shed on general theoretical findings, or the empirical findings can be refuted by theory, which can lead to critical reflection and a new research agenda.

Lastly, it should be mentioned that although effective LCR policies should theoretically contribute to the localization of wind turbine manufacturing, there may also be other policies which contribute to this, or the effects of the entire policy scheme in which the LCRs are implemented might be difficult to disentangle from the effects of the actual LCRs. Moreover, economic opportunities in the region provided by investors or other conditions in Turkey which relate to these opportunities could play an important role. As such, there is no easy 1-to-1 relationship between the LCR and the nature and extent of wind turbine manufacturing localization, and it is difficult to disentangle the stimulating effect of the LCR from the effect of other policies or factors at play. Although the operationalized framework does try to capture all relevant factors that bear on LCR policies, and includes the environmental and economic context, it is stressed that it is by no means perfect because it cannot capture all circumstantial factors and disentangle their effects from the pure LCR effects on industry localization.

4.2 Data Collection and Analysis

In this study, both primary and secondary data collection has occurred. Primary data collection has been executed through interviews in the empirical case study, while secondary data collection has been executed by consulting academic and gray literature. The methods of data collection, sampling, interview design and data analysis and interpretation will be explained in the following paragraphs.

4.2.1 Primary data collection

Primary data collection has been executed during the empirical case study of this research to be able to find answers to the research questions and develop an understanding of the Turkish wind energy sector.

4.2.2 Data Collection from secondary sources

During the initial research stages, many types of gray literature were used to gain an understanding about the history and current state of the Turkish wind energy sector, since many of the announcements about new wind energy initiatives and developments in this sector are found in news articles or on general Turkish websites. Furthermore, different statistical sources were also consulted in order to gain an understanding about the size of the Turkish wind energy sector and the shares and roles that different companies and institutions have in this sector. Furthermore, academic literature has been consulted to establish the theoretical framework, to prepare for the empirical case study, and refute the empirical results against the academic literature.

4.2.3 Sampling and interview design

Simultaneously with the initial period of literature research, attempts were made to establish contacts with institutions and companies found to be relevant. Since travelling was prohibited as a result of the global COVID-19 pandemic, attempts were made to establish contacts through email and telephone, however these methods of establishing contacts did not yield any positive results. It was clear that alternative measures were to be utilized to obtain good, useful and informative contacts during the global COVID-19 pandemic and therefore contacts were established with a researcher from Isik University.

The contact with this researcher proved to be very valuable in establishing contacts with companies and institutions in Turkey due to the researcher's knowledge of the Turkish language, close proximity to the companies and institutions in question and utilization of contacts in her network.
The companies and institutions that were contacted in this research were partly identified through literature study, and partly based on the reachability of people operating in relevant companies or institutions in the sector.

The empirical data for his research was collected through ten semi-structured interviews with representatives with an active role in companies and institutions operating in the Turkish wind energy industry conducted between September 2020 and January 2021. Beforehand, it was determined that the interviewees should consists of at least several representatives from Transnational Corporations in the wind energy sector, also often referred to as Original Equipment Manufacturers (OEMs) in wind energy studies. But also, smaller manufacturing companies, or manufacturing companies of Turkish origin, government institutions and other relevant actors should be included in the sample. Eventually, several representatives from Transnational Corporations were interviewed and after three interviews saturation already started to appear between the interviews from these three corporations, as their findings and opinions were generally quite comparable. In addition to the TNCs, interviews were conducted with a local development agency, a freelance consultant, manufacturing companies producing towers or tower internals, a Turkish company operating in the field of electricity generation, distribution and retail and a wind energy association in the country. Eventually, certain amount of saturation among the interviews was observed. However, the interviews and the content discussed during the interviews developed over time. Findings that were discovered during interviews were, when deemed appropriate, confirmed with other interview participants. Eventually, it was concluded that after ten interviews sufficient information required to answer the research questions had been collected and that confirmation and saturation had occurred in the interviews to an extent that allowed the researcher to conclude that decent, qualitative and trustworthy information had been gathered. What also played a role here was the abundance of secondary information, gathered from gray literature, which supported or was in line with the interview findings. This provided additional confidence regarding the quality of the information gathered during the interviews and the empirical case study being on the right track. Moreover, the composition of the sample also ensured that the wind energy sector in Turkey was viewed from different angles and contributed to the quality of the primary data analysis.

In preparation of the interviews, interview guides were developed consisting of questions related to the company or organization's core business, history and role in the Turkish wind energy sector to gain an understanding of the current state of this sector and the development of this sector as a whole. The interview guides also contained questions related to the design of the LCR policies and specific incentives to promote the wind energy sector in Turkey to gain an understanding about the extent to which these incentives and policies have been successful and the reasons for their success or failure.

During the eight interviews that were conducted through videoconference, the interview guides served as a reference for the researcher to draw questions from and guide the topic of discussion during the interviews. Furthermore, detailed notes were written down during the interviews and the audio of each interview was digitally recorded. The audio files were manually transcribed. Table 6 provides an overview of the interviewed participants and the date at which they were interviewed. Each participant/interview was coded with a letter from A to J to guarantee anonymization. During this research, the interviews or statements made during the interviews are therefore often referred to with the corresponding letter, or the letter between brackets when the interview is referred to as a source. Interviews I and J did not take place via videoconferencing tools but rather a list of predefined questions was sent to the interviewees who answered those questions in their own time. As such, no transcripts have been made of these interviews and the written answers received from the interviewees were used for data analysis.

Table 7 Overview of interviews

Interview	Date of interview	Actor description	Interviewee function
A	*29-9-2020*	*A supplier for the energy sector established in Istanbul to provide Crane and Manpower for installation of Renewable (Wind turbines, Solar), Thermal power plants (Gas power) and energy constructions in general*	*Managing director*
B	*29-10-2020*	*Freelance consultant*	*Freelance consultant*
C	*06-11-2020*	*Transnational corporation in the renewable energy industry*	*Sales Manager*
D	*03-11-2020*	*Local development agency*	*Investment Promotion and support expert*
E	*12-11-2020*	*Transnational corporation in the renewable energy industry*	*General Manager*
F	*18-11-2020*	*Turkish manufacturing company producing wind turbine towers*	*CEO*
G	*2-12-2020*	*Turkish manufacturing company producing wind turbine towers*	*General Manager*
H	*9-12-2020*	*Turkish company which operates in the field of wind turbine internals*	*CEO*
I	*14-12-2020*	*Turkish company which operates in the field of electricity generation, distribution and retailing in the energy sector.*	*Unknown*
J	*21-1-2021*	*Wind energy association*	*Regulation and Policy Manager*

The questions in the interview guides were written up based on the literature available on the explanatory variables as visualized in figure 4. Moreover, because the interviews were spread over several months, new information from both the literature and the empirical environment was constantly being added, so that the content of the interviews was continuously in evolution. As such each interview provided new insights based on the evolution of the researcher's insights based on the content of the earlier interviews.

Qualitative validity of the obtained information was ensured through the combination of theoretical and empirical research in the research design. Moreover, this was ensured by crosschecking and verifying information with multiple interviewees. After data collection, member checking, a process where data is returned to interview participants, was performed to validate the accuracy of the qualitative findings from the interviews conducted through videoconference tools. No follow up interviews were been conducted.

4.2.4 Data analysis and interpretation

The first step in data analysis was the jotting down of notes during the eight interviews conducted through videoconference. Important findings and conclusions were written down on paper during the interviews for later reference or investigation. As previously explained, all interviews conducted via videoconferencing tools were audio-recorded, and transcription was performed manually. Accordingly, important quotes and sentences in the transcriptions were highlighted.

The second step in data analysis followed the recommendations by Miles, Huberman and Saldana (2014) in regard to their descriptive methods of qualitative data analysis by use of matrices. The highlighted quotes from the interviews were exported into an Excel file, with a separate Excel worksheet for every interview. The highlighted quotes were placed in the first column of this worksheet. In the second and third column, an indication was given as to whether this particular quote was most closely related to one of two themes. The first theme being “the development and current state of the Turkish wind energy sector” and the second theme “the larger theoretical constructs at hand in this research”. In the fourth column, an indication was given as to which particular (sub-) research question the quote was most closely related to or provided an answer or point of discussion. Lastly, in the fifth column a researcher interpretation was given. This matrix design allowed for the structuring of the information obtained during the interviews on the basis of the (sub-)research questions.

A second matrix design was developed in order to structure the information obtained during the interviews on the basis of the explanatory variables and the enabling factors in the operationalized theoretical framework, see figure 4. This was done so that a clear structure was in place, as the empirical information was now structured according to the explanatory variables and the enabling factors within those variables. This way of organizing ensured that the final narrative was easier to follow during the processes and writing of the data. The possible explanatory variables and enabling factors used to structure the quotes from the interviews are given in table 7.

Table 8 Explanatory variables and enabling factors used during data organization for the second matrix design

Explanatory Variables	**Enabling Factors**
Indicator framework	Design and Coherence
	Size and Stability
	Restrictiveness
	Domestic Industrial base
Local Context	Environmental
	Economic
Governance	Role of the firm
	Local Governance
	Role of the State

An example of the matrix is given in table 8, the respective explanatory variable and enabling factor were indicated in the first column, the quote itself was inserted in the second column. In the third column, a researcher interpretation of the quote was given. In the fourth and final column the overall finding of all the quotes gathered in relation to that particular explanatory variable and enabling factor was formulated.

Table 9 Second Matrix Design

Explanatory Variable	**Quote**	**Interpretation**	**Overall finding**
Enabling Factor	…	…	…

The process of designing matrices stimulated interaction with both the theoretical literature on the topics in focus in this research as well as the empirical information obtained during the interviews. As such, the designing of the matrices itself has contributed to gaining a better understanding of the empirical information obtained during the interviews and how this information is of value in the theoretical landscape. As described by Miles, Huberman and Saldana (2014), a matrix should be helpful in giving reasonable answers to the questions asked or suggesting new ways to lay out data in order to get answers. In this particular case, the first matrix design helped with the interpretation of the data and ensured that a new way of analyzing the data was ensured. This new way of data analysis resulted in the second matrix, which helped in structuring the information obtained during the interviews in such a way that relations of the empirical findings to the theoretical domain became easier to identify, which was helpful in the extraction of clear, comprehensive and insightful answers to the (sub-)research questions.

The final step of the data analysis process thus consisted of constructing a coherent narrative of the overall findings of the obtained information and the interpretation of the highlighted quotes. This narrative was structured along the lines of the explanatory variables distinguished in table 7. This narrative is provided in the results section of this report in Chapter 5 and includes the specific quotes of relevance, supplemented with theoretical information.

4.3 Complexity of Wind Turbine Component Manufacturing

The final step in the methodology of this study is the quantification of the complexity of wind turbine component manufacturing. This quantification is necessary to assess the complexity of the (potentially) localized components and to see if there is a correlation between the complexity of the components to be manufactured and the degree of localization.

Surana et al. (2020) have been able to identify nine key components of wind turbines, and have also been able to order them based on their technological manufacturing complexity by using the Product Complexity Index (PCI). The PCI is based on the hypothesis that more complex technologies with greater knowledge intensity are manufactured and exported by countries that have higher knowledge intensity, and that these countries are able to manufacture and export other high-complexity technologies. The average PCI scores for the period from 2006 to 2009 were calculated by Surana et al. (2020) for nine key components, depicted in table 9.

Table 10 Average PCI scores for key wind turbine components as calculated by Surana et al. (2020)

Component	***PCI (average 2006-2009)***
Gearbox	*1.57*
Bearing	*1.16*
Blade	*1*
Control system	*0.69*
Nacelle	*0.69*
Forging	*0.34*
Generator	*0.21*
Power Converter	*0.17*
Tower	*-0.24*

As can be seen, the gearbox is considered to be the most complex component, whereas the tower is considered to be the least complex component. In the proceedings of this research, the nine key components as shown in table 9 will be used to refer to individual components of a wind turbine. During this study, it is assumed that the product complexity for the components as provided by Surana et al. (2020) is a resemblance of reality, and will be used to draw conclusions regarding the effect of complexity on the localization of manufacturing in the empirical part of this study. The PCI is not a direct measure of (local) technological capabilities, discussed in Chapter 2.1.4, but it can provide insights into the complexity of localized products and processes and conclusions can be drawn about the technological capabilities required for their manufacture and development. However, during the empirical case study the local technological capabilities will be inquired about because conclusions related to technological capabilities should not be drawn based on the PCI alone.

In addition to the development of PCI scores, Surana et al. (2020) have researched the emergence of new component suppliers and manufacturers and changes in international supplier-OEM relationships over a 10-year period between 2006-2016 with increasing technology complexity. They have found that a domestic manufacturing supply chain initially developed in countries with large OEMs, which were the countries that also had the largest wind deployment markets in the study period of 2006-2009. The emergence of suppliers in new locations, especially in countries without an OEM, relates to the technology complexity of the components. The extent to which new countries became part of the wind

GVC and the global diversification of the GVC over time are inversely linked to the complexity of the component. For low-complexity components (towers and generators), suppliers from new locations emerged. For high-complexity components (blades and gearboxes), the emergence of new supplier countries was much lower, potentially because these higher complexity components required specialized parts suppliers with skilled manufacturing, higher absorptive capacity and tacit knowledge that may be more difficult to master for suppliers originating in developing and emerging economies. (Surana et al., 2020)

Moreover, the shipping costs for towers are high, which incentivizes manufacturers to locate closer to where the demand is located. But such incentives may also be present for labor-intensive components such as blades. Surana et al. (2020) argue that their finding on the greater emergence of low-complexity towers rather than blades in most countries indicates the importance of transport as one of many factors, along with knowledge and skills, that shape costs and decisions on the location of manufacturing. Furthermore, Surana et al. (2020) indicated that it is likely that higher-complexity components that require more skills and expertise are probably manufactured by only a few specialized suppliers in industrialized countries.

Overall, the analysis provided by Surana et al. (2020) implies that for developing countries which face institutional, financial and operational uncertainties, the emergence of suppliers manufacturing highly complex components may be a challenging endeavor without active policy interventions. Furthermore, they suggest that governments and firms would benefit from developing targeted, technology-specific approaches to participate in the wind turbine manufacturing value chain. This requires policy that not only considers the technology complexity but also the domestic capabilities of a country in relation to the requirements posed by domestic manufacturing. At the same time, they have also found evidence that a base of lower-complexity technologies could serve as a gateway to upgrade to more complex technologies over time, and that this process of catching up can be enhanced by a policy effort which targets both the emergence of new suppliers as well as the evolution of existing suppliers.

5. Results

This chapter presents the results of the empirical part of this study for each of the explanatory variables and its respective enabling factors, and subsequently quantifies the object variable LCR policy effectiveness. The empirical results regarding the explanatory variables that have been gathered during the interviews are supplemented with theoretical information in order to tell the complete story regarding the explanatory variable in question and to maintain the narrative in the report. The chapter first discusses the results related to the 'local context' explanatory variable, and then the results related to the 'indicator framework' and 'governance' explanatory variables. Lastly, the quantification of the object variable is provided in order to determine if these LCRs have actually been effective.

5.1 The Local Context

From the matrix analysis of the primary data collected for this research a number of results emerged that relate to the local context of the Turkish wind energy sector. These results have been be categorized into two enabling factors, the environmental/natural context and the economic context. In this subchapter, these empirical results related to the local context explanatory variable are explained and further substantiated with gray and academic literature in order to obtain a solid understanding of the factors at play in the local context of the Turkish wind energy sector.

5.1.1 The Environmental and Natural Context

Several quotes and findings from the interviews that emerged from the matrix analysis relating to the local context explanatory variable could be considered as factors in the environmental context or natural environment. For example, findings related to the wind energy potential in Turkey or the geography of the area. As such, the potential, the history and the current status of Turkish wind energy is explored in order to gain an understanding of the natural reasons why this area is interesting for wind turbine production and wind power utilization. In this analysis, the geography of Turkey is also considered, as the empirical findings showed that the geography of Turkey has partly played a role in the clustering effects that have occurred in the Izmir region in the Turkish wind energy sector.

Geography of Turkey

It was understood from (C) that Turkey's theoretical wind energy potential lies upwards of 50 GW, and theoretical estimates even go as far as 88GW (TUREB, 2020). This potential stems from the fact that wind speeds in Turkey are on average quite high in some parts of the country, mainly along the Western coastline and up in the northwestern part of the country. The Global Wind Atlas developed by the Danish Technical University (DTU) with the World Bank Group is able to provide insights into the average wind speeds in Turkey, see figure 5 (Balat, 2005). It can be observed that there are significant areas of land in the country where the wind speed is relatively high on average, for example along the Western coastline where the average windspeeds can exceed 7.5 m/s. The figure below presents the wind speeds at an altitude of 100m, this altitude was chosen since wind turbine hub heights often already exceed this height. Furthermore, many of the areas in which these wind turbines are placed are somewhat mountainous and therefore it is also easier to reach higher altitudes.

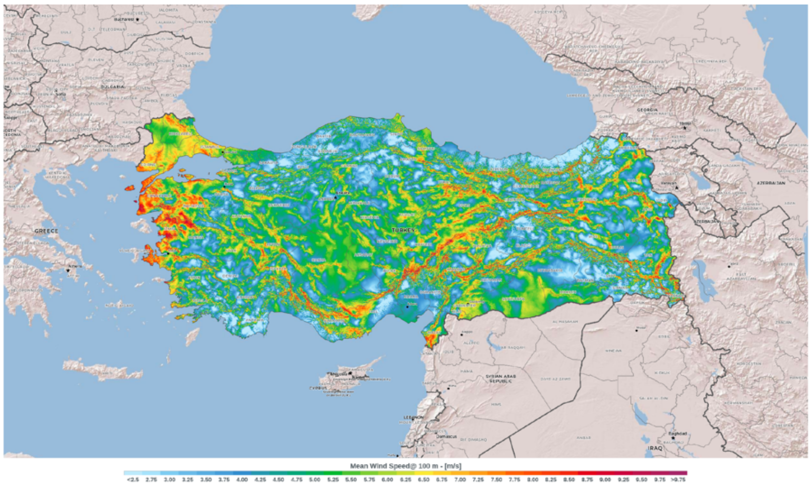

Figure 5 Distribution of mean wind speeds in Turkey.

However, according to the Global Wind Atlas developed by DTU (2019), the mean wind power density gives a more accurate indication of the available wind resource than just the wind speed. The mean wind power density is a measure of the energy available at a certain location for conversion by a wind turbine in W/m2, figure 6 presents the mean power density for Turkey as reported in 2019 at an altitude of 100m. It can be observed that the highest mean wind power density occurs in the Western part of Turkey.

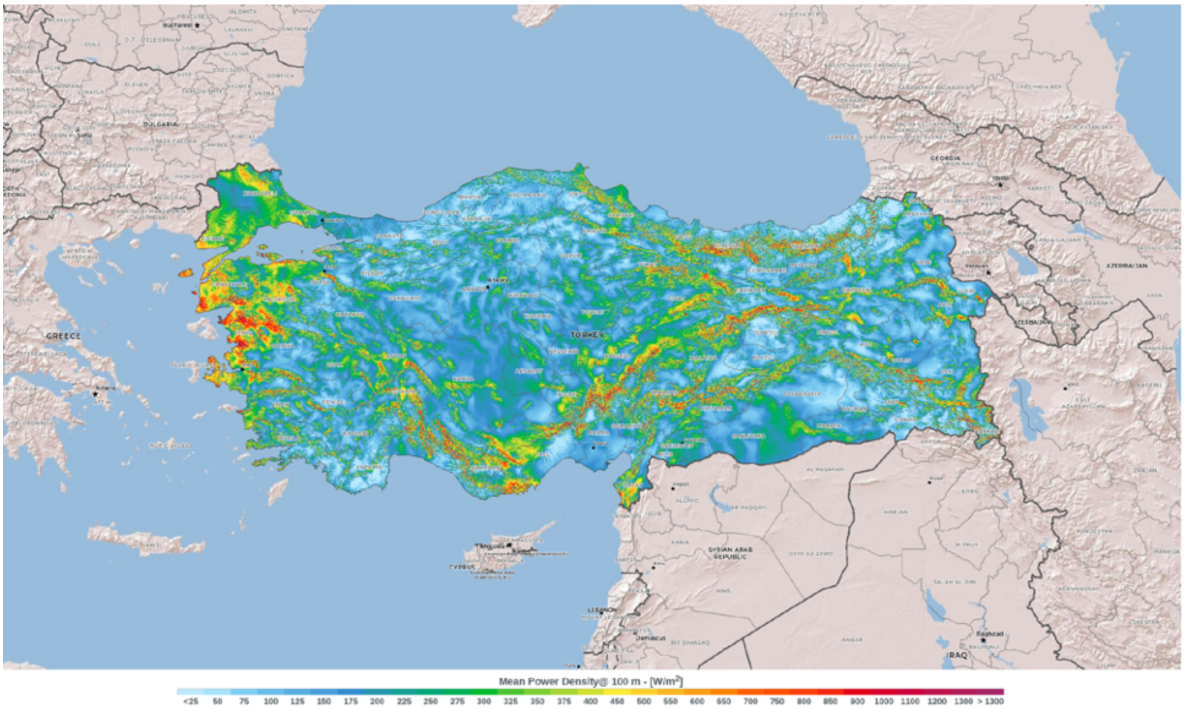

Figure 6 Distribution of mean wind power density in Turkey.

In figure 7 and 8 a more detailed graphic is provided which shows the mean power density in the Izmir and Canakkale provinces in Western Turkey.

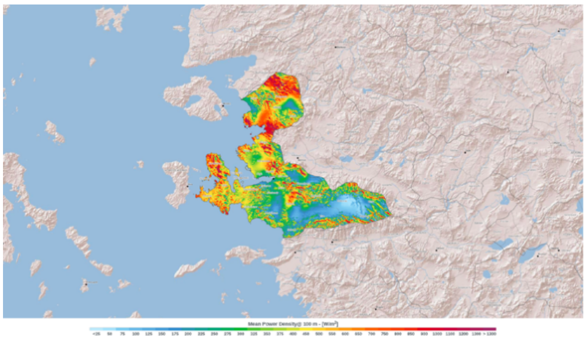

Figure 7 Distribution of mean wind power density in Izmir

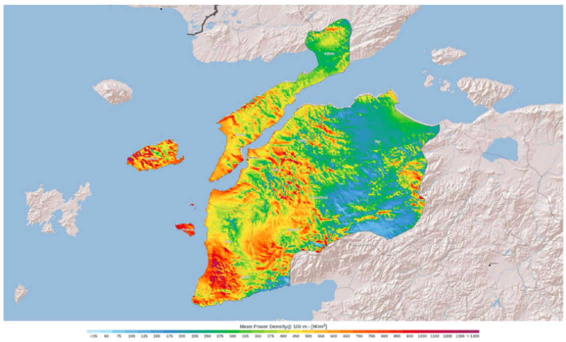

Figure 8 Distribution of mean wind power density in Canakkale

The high average wind speeds and mean power density can partly explain the concentration of wind power plants (WPPs) in the Western part of Turkey, and the proximity to the ports of Izmir and Istanbul provide an additional explanation as to why large international firms and WPPs are located in this region (DTU, 2019). As Turkey lies at the intersection of Europe, Asia, Russia, the middle East and Africa, it is the ideal location for import -and export and the close proximity of several ports is beneficial to companies which are conducting business on a global level. Additionally, for the same reasons, Izmir was already an industrial hub before the wind turbine manufacturing sector was established here, with a well-developed industrial base, as especially the manufacturing companies in the automotive and aviation sector were well developed as well as companies in the construction sector (D) (Lovatt, 2001). This ensured that there were good capabilities in Izmir to build on, and that it is relatively easy to work with skilled people in Izmir (H). This all benefitted the establishment of the wind energy sector in the region, as will be explained in more detail in Chapter 5.2.4.

The history of Wind Energy in Turkey

The first WPP in Turkey was a 1.5 to 1.7 MW power plant established in Geminyan village in 1998. It consisted of three turbines with about 500 kW of power each. The second WPP was established in Cesme-Alacati in the same year, and this WPP consisted of 12 turbines with 600kW of power each, totaling up to 7,2MW (IRENA, 2019). These early WPP's are the pioneers in Turkish wind energy development, and by the end of 1999 already 40 companies had applied to build WPPs in Turkey, equivalent to a total capacity of 1437MW.

Nowadays, there is a total capacity of 8288 MW in Turkey spread over 197 WPPs that are in operation, as opposed to a capacity of 1329 MW in 2010. In the past ten years, annual growth rates in the number of WPPs have been between 2.88% and 35.87%. The lowest rate was recorded in 2020, it was reported during interview C that this is due to the implications of the COVID-19 pandemic, as many projects have been put on hold and deadlines have been postponed to the summer of 2021. However, the strong and steady growth of the Turkish wind industry over the last 10 years can still be recognized by the generally large and steady growth rates. According to IRENA (2020), the wind energy sector in Turkey currently employs 13,300 people, and with a local content ratio of 55% in the legislation, and occasionally even higher ratios of local content in separate large-scale wind energy auctions, it is looking to significantly strengthen its local manufacturing sector for wind turbines. (Akova, 2011; Balat, 2005)

The WPPs in Turkey are spread across seven regions, with the Ege and Marmara regions being most prominent as these contain over 70% of the total number of WPPs in the country. In these regions the cities of Canakkale and Izmir are also located, these cities have a high mean wind power density as shown in figures 6 and 7 and also have some of the largest numbers of installed wind turbines in Turkey. The city of Izmir has the highest WPP count in Turkey, with 1619 WPPs in operation. However, in addition to the number of installed turbines, the city of Izmir is also a host to a large part of the wind turbine manufacturing sector, as many facilities involved with the manufacturing of components for wind turbines are located in Izmir. These manufacturing facilities will be explored in the following paragraph. (TUREB, 2020)

Manufacturing facilities in Turkey

According to (E), Enercon had a role in the establishment of the afore-mentioned first WPP in Turkey and took part with the delivery of 3 turbines. After its initial involvement, Enercon has been the market leader in terms of wind turbine market share in Turkey, however, since 2016 Nordex has overtaken Enercon and is currently the market leader with a share of 25.74% and a capacity of 2133MW (TUREB, 2020). Table 10 provides an insight into the Original Equipment Manufacturers (OEMs) that have established in Turkey and their respective capacity and market shares (TUREB, 2020).

Table 11 Turbine manufacturers capacity and market shares (TUREB, 2020)

Manufacturer	Capacity (Mw)	Market share (%)
Nordex	*2,133*	*25.74*
Enercon	*1,784.40*	*21.53*
Vestas	*1,602.20*	*19.33*
Siemens Gamesa	*1,289.70*	*15.56*
GE	*1,248. 30*	*15.06*
Suzlon	*109.20*	*1.32*
Sinovel	*108*	*1.30*
Goldwind	*10.20*	*0.12*
Senvion	*3*	*0.04*

In addition to the establishment of OEMs in Turkey, component manufacturing facilities have followed suit. WindEurope (2020) reports that there are twelve wind energy related facilities in Turkey, of which six are producing blades, four are producing towers and two are providing casting services. With twelve wind energy related facilities, Turkey is among Europe's top five countries in the manufacturing of wind turbine components (Daily Sabah, 2020). The way in which these companies have been classified is not disclosed, neither are the company names. Additionally, there are likely also numerous service companies active in the sector which are not taken into account in the WindEurope (2020) report. However, through cross checking this information with interview quotes from interviews (A), (D), (F) and (G), most of the main companies active in the wind turbine manufacturing sector in Turkey have been identified. In tables 11 and 12 basic information about the main tower and blade manufacturing companies in Turkey is provided, these companies produce for the OEMs active in the Turkish wind energy industry.

Table 12 Wind turbine tower manufacturers in Turkey

Company	Description
Alkeg Tegopi	*Alkeg Tegopi is a joint venture between Turkish energy company Alkeg and Portuguese diversified firm Tegopi. They have a 60,000 m2 manufacturing plant for wind turbine towers in Izmir with a capacity of 100 towers per year and an employment of around 1000 employees.* (Renewables Now, 2011; Tegopi, 2021)
Ates Çelik	*Ates Celik is a 100% Turkish manufacturer of wind turbine towers based in Izmir (F), they have been producing towers for wind turbines since 2012 (F) and have a capacity of 1200 tower sections per year, which is equivalent to 1GW/year (F). Steel wind tower production is their core business.*
Cimtas	*Cimtas is a Turkish provider of integrated engineering, procurement, welded fabrication,*

	assembly and installation solution in the energy business. Steel wind towers is one of their core business lines. (F)(Çimtas, 2016).
CS Wind	*CS Wind is a Korean turbine tower manufacturer which established a subsidiary in Izmir in 2018. This location acts as a bridgehead for strengthening their supply chain worldwide and to secure a production base to the European market (G)* (CS Wind, 2018).
Gesbey	*Gesbey was established in 2010 between Spanish company Gestamp Wind Steel and the Turkish Faik Celik Holding. It started mass production of turbine towers in 2011 with a capacity of 300 towers per year.* (Gesbey, 2020)
Temsan	*Temsan is a Turkish company founded in 1972 and is contractor for steel construction projects, with a lot of knowledge in the construction of steel frame composite buildings n the construction industry, such as industrial facilities, multi-story steel buildings or stadium roofs. In addition, the company has a wind tower manufacturing facility of 90.000m2 with a capacity for 60-80 towers per year, with the allocation to increase the capacity to 120-160 towers per year.* (Temsan, 2018)

As can be observed, table 11 lists six tower manufacturing facilities. Four of these manufacturing companies have been confirmed to be prominent manufacturers of wind turbine towers by (F). The companies Alkeg Tegopi and Temsan have been traced through secondary data analysis and have not been verified with interview participants. As such, it cannot be determined with complete certainty that these are the six manufacturers discussed by WindEurope (2020), but it is likely that this is the case and nonetheless the table provides an insight into which companies are producing wind turbine towers.

Table 12 lists four wind turbine blade manufacturers in Turkey. As can be observed, Enercon is also listed in this table. This is due to the fact that Enercon is not only operating as an OEM and assembling turbines but has since 2002 also operated its own wind turbine blade manufacturing facility. According to (D), other blade manufacturing companies followed the example of Enercon by coming to Turkey to produce blades.

Table 13 Wind turbine blade manufacturers in Turkey

Company	**Description**
Enercon	Enercon is a German OEM and has been producing blades in Turkey since 2002 and was the first manufacturer in Turkey (Enercon, 2016). Enercon is known for manufacturing all of its components for wind turbines in-house, however it has also started to outsource blade production to TPI Composites for several of its Turkish projects after 2018 (Wind Power Monthly, 2018).
LM Wind Power	*LM Wind Power is a GE Renewable Energy Business originating from Denmark and produces blades for GE, is located in Bergama, Izmir and employs more than 450 employees* (Coffey, 2019; evwind, 2020; LM Wind Power, 2019).
TPI Composites 1	*TPI Composites is a U.S. based company with its headquarters in Arizona* (TPI Composites, 2020). *It established its first factory in Turkey in 2012 which employs around 1300 employees* (Metyx, 2017). *TPI Composites produces wind turbine blades not only for*

	Vestas, but also for GE, Nordex, Siemens Gamesa and Enercon (Cevrioglu, 2020).
TPI Composites 2	*The second TPI Turkey factory opened for production in late 2016 as the direct result of a supply agreement with Vestas* (Metyx, 2017). *As a result, TPI Turkey now employs around 3,250 people* (Cevrioglu, 2020).

In addition to the tower and blade manufacturers in the tables above, there are many other companies which are active in the sector. Recently, a document was published by Invest in Izmir (2021), providing a comprehensive overview of all companies active in the wind energy sector in the region of Izmir. Although it does not include all of the companies active in the wind energy sector in Turkey, it does provide insights into a large portion of these companies, as there are many wind turbine manufacturing facilities in the region of Izmir and Izmir is dubbed to be a cluster for the manufacturing of wind turbines as well as the generation of wind energy due to its strategic position both in terms of geography and in the Global Production Network (C, D, H). The Izmir region sometimes even called 'the capital of wind' (J). According to (D), around 20% of the total installed wind energy capacity is located in Izmir. Moreover, according to (A), most of the wind energy production activities in Turkey are also located in Izmir and several interview participants (C), (D), (H) have spoken of Izmir as a hub for wind turbine manufacturing. This is exemplified by (C), as is quoted 'All the wind energy related facilities are now accumulated in the vicinity of Izmir, for example, our factory is in Izmir, our R&D factory is in Izmir, so everything is in Izmir, and lots of tower suppliers are also located in Izmir, so Izmir is kind of a hub now for wind energy'. The provided overview in Appendix II lists companies active in manufacturing, installation, operation, maintenance, consultancy, soft services, power generation with regards to wind energy, as well as the special investment zones in Izmir and other institutions involved in the sector. The complete overview can be consulted in Appendix II. In this document the R&D facility which has recently been constructed by Siemens Gamesa is also listed, which was the first facility in Turkey to work on the production, research and development of nacelle components (Renewables Now, 2019b).

Firms might have diverse reasons to establish themselves in Izmir. As (G) is quoted, "We are located in UK also, in Scotland, and there is targeting in Turkey, not only local market, we are targeting near Turkey, Greece, Italy, Ukraine, Croatia, Israel, and now also targeting main European countries. We can cover middle east also, Egypt, Irak, Iran." For this participants' company, it was clearly a strategic choice to establish in Izmir, to be able to target nearby countries. However, as reported by (C), sometimes large turbine manufacturers motivate their suppliers to follow them into different countries. This process of initially locating a supplier which adheres to strict quality standards and offer a competitive price, and subsequently requiring them to locate in proximity to the OEM, is a phenomenon known as 'follower sourcing'. The term follower sourcing stems from Morris et al. (2012), which explains 'the unfolding process of initial outsourcing to seek the lowest cost supplier (global sourcing), then extends in requiring the supplier to locate proximate to the factory (follower supply)'(Morris et al., 2012, p. 409), hence the combination of these two terms into the term follower sourcing. The follower sourcing phenomenon is a clear aspect of the Global Production Network in practice. As explained in Chapter 2, there is always a form of governance present in a GPN, of which this is a clear example. Furthermore, this particular phenomenon connects to the second competitive driver for global firms and their suppliers explained by Coe and Yeung (2019): Global lead firms and their suppliers must continuously develop new markets for their products and services, whether in advanced or emerging economies. Follower sourcing clearly relates to this, as the lead firm seizes the opportunity of establishing in a new market and subsequently motivates their suppliers to follow suit.

5.1.2 The Economic Context

The second enabling factor within the local context explanatory variable that was identified by means of the matrix analysis includes findings that relate to the economic context of the wind turbine manufacturing sector in Turkey. The historic developments of Turkish economic policy and the current state of the economy potentially play a role in the effectiveness of local content requirements, as in many interviews the economic context was discussed and deemed to be of importance. Therefore, a brief overview is provided of Turkey's macroeconomic policies in the 1900s and early 2000s.

From the 1930s to the 1980s, Turkey's economic policies can be characterized as interventionist and protectionist. In these years, Turkey followed a strategy of growth through inward-oriented import substitution industrialization (ISI), and in this period the government played a large role in the economy by creating public enterprises while imposing barriers to trade and financial flows. Policies were mainly designed to protect the domestic industry from foreign competition and increase government controls over the allocation of resources and production of goods. Until the 1980s, large scale private industry was supported by the government through the allocation of credit and high levels of protection from foreign competition. Although the country did become more foreign trade-oriented during the 1980s, some industries such as the automotive industry were still protected from foreign competition to a considerable extent. (Lovatt, 2001)

According to Kibrit (2004), the Turkish economy was reformed in the 1980s as a response to a strong balance-of-payments crisis accompanied by deep recession and accelerated inflation. The aim of this reform was to transition the Turkish economy from an inward-looking ISI-strategy to an outward oriented Export Led Growth (ELG) strategy. The 1980s are considered as a period of fundamental and sustained liberalization and the economy has achieved impressive transformation with a remarkable payoff (exports rose from about $US3 billion in 1980 to about $US12 billion in 1988) although a number of structural economic difficulties remained (Lovatt, 2001). Moreover, Lovatt (2001) even argues that if Turkish governments would have attempted to continue to policies of the late 1970 there was little doubt that the real output would have continued to fall, and that inflation would have accelerated even further.

In 1989, the Turkish government took serious steps to liberalize the capital account (Kibrit, 2004). After the implementation of international convertability of the Turkish Lira, the high domestic interest rates on government bonds attracted a stream of short-term capital inflow into the country. The alteration in the method for the financing of the shortage of the government sector from money printing to bond financing from 1986[1], and the attempt to stabilize the exchange rate to prevent inflationary effects from rising costs of imports made this policy combination unsustainable in a short period of time and eventually led to an exchange rate crisis in 1994. The Turkish government introduced deflationary measures to stabilize the economy after the 1994 financial crisis but the efforts in 1995, 1998 and 2000 failed to reduce the inflation rate below 25 percent per year. (Kibrit, 2004)

Güvercin (2020) argues that the gradual loss of fiscal discipline and the rise in import dependency over time after the 1980s and liberalization of the country's capital account render the Turkish economy prone to financial crisis. In the early 2000s, the economy entered a new crisis, mainly caused by unsustainable domestic debt of the public sector and unhealthy structure of the Turkish financial sector. The Turkish government established a working group to determine a way forward and in 2001 a market reform was launched as part of the government's response to the economic and financial crisis. The government took very strong measures with support of the IMF and the World Bank, most notably in the banking and energy sectors. The Turkish economy experienced high economic growth rates between 2002-2007. The independence of regulatory institutions and the development of independent central bank and regulation of financial institutions all contributed to the well performing economy in these years. As explained by Akat & Yazgan (2013), the monetary framework in this period focused on financial stability, and the policy targeted a gradual shift in the composition of aggregate demand, with a lower contribution of domestic demand and a higher contribution of external demand. However, after 2011, the inflation rate increased drastically and the share of non-tradables in the GDP increased while the share of manufacturing in the GDP decreased. The export shares of Turkey's value added increased only slightly compared to 2001, and even though the industrial base of export restructured from low technology towards medium technology, the products with low-technology content still constitute a big share of exports, while products with high-technology content still have a small share in industrial production and export. Therefore, the technological sophistication in the Turkish economy is mostly dependent on the availability of imported intermediate goods which increases with the inflow of foreign

[1] There are two ways in which a government can get money to cover a shortfall: to print more of it, or to issue bonds (loan paper) to the public. Printing money leads to inflation.

exchange and appreciation of the Turkish Lira. This could partly explain the current Turkish policies in place which aim to grow the domestic wind power and wind turbine manufacturing sectors, as this leads to a decreased energy dependency and possibly an increase in the complexity of technological content.

Güvercin (2020) argues that because Turkey did not establish robust economic and political institutions before the switch from the ISI to the ELG strategy and the economic and financial liberalization it enacted after the switch, economic structural drawbacks aggravated the process. Güvercin (2020) argues that Turkey should undertake investments to decrease the import dependency and invest in R&D and education to increase the number of qualified researchers. In that respect, it seems that Turkey has also recognized this as the focus on increasing the domestic wind turbine manufacturing capacity and wind energy generation could be indicators of Turkey investing in increasing the number of qualified engineers and the amount of R&D performed domestically.

Recently, investors' anxiety about the Turkish economy and the instability of the Turkish Lira has risen, as the Turkish Lira hit a historically low value of 8.53 against the US Dollar in November of 2020[2] (Arab News, 2020). The Lira has decreased in value for over 30% since the beginning of 2020 and it was the worst performing currency in emerging markets in 2020 (IMF, 2020). The depreciation of the Lira is explained by Turkey's structural external deficit (Akat & Yazgan, 2013; Lovatt, 2001), implicating that more currency is flowing out of the country than coming in, this is a result of unusual policy moves by the Turkish Central Bank and volatile nature of the Turkish economy. Overall, the economic picture of Turkey has become more vulnerable and uncertain, which has given rise to inflation and patchy implementation of corrective policy actions. Additionally, there are significant headwinds to be dealt with such as the implications of the COVID-19 pandemic, which has significant negative effects for the economy.

According to (F), the Turkish economy has always been fluctuating in every subject, and the difficulty is to manage these ups and downs all the time. But by having to work with such slim margins for it becomes very difficult to handle these ups and downs. Furthermore, an additional problem of the depreciation of the Turkish Lira is the poor situation of manufacturers in the Turkish industry. Due to the depreciation, these manufacturers are poor because the Turkish Lira is not worth much in comparison to the USD or Euro. Imports of materials, parts, components and machinery cost them a lot of money, but a cheap lira does boost the Turkish export market because Turkish goods are cheap for foreigners. Concerns have been expressed regarding the procurement of electric energy after the 10-year guaranteed procurement as part of the Feed-In Tariff scheme introduced in the 2005 law on the utilization of renewable energy. Companies must sell their electricity to the free market after the initial 10 years, and the free market will presumably pay in Turkish Lira instead of the hard currency agreements made under the FIT scheme. There are also concerns regarding the changes to be applied to this mechanism in 2020, as the government is currently in discussion about the way in which the mechanism should be continued, and it is likely that the switch will be made from payment in USD to Turkish Lira[3].

According to (D), the creation of local renewable energy generation capacity is not only motivated by environmental reasons, but even more so because of economic reasons, as Turkey aims to decrease its dependency on foreign energy imports as part of its macroeconomic policy. Currently, around 70% of the Turkish energy demand is met from foreign resources. This policy reasoning is likely stimulated by the afore-mentioned external deficit: if the Turkish government realizes a local manufacturing industry for wind turbines, and also achieves its targets with regards to the domestic production of electrical

[2] This is the situation in December 2020. The value of the Turkish Lira has been fluctuating heavily and because this is an ongoing study it is impossible to provide the most recent figures at all times. That is why it was chosen to use the value of November 2020, but there is the possibility that the Turkish Lira has hit lower values against the US Dollar since then.

[3] The same applies here. The text discusses the situation in December 2020, but due to the dynamic situation it is impossible to keep track of the most up to date policies. As such, the text states that it is likely that the switch will be made, as this was not yet definitive in December 2020.

energy, it is able to reduce its foreign exchange spending on foreign energy. The establishment of a manufacturing industry for the renewable energy sector should lead to a decrease in costs in the generation of renewables, since component production will become cheaper and firms in the renewable energy industry can save a lot of money on transport and logistics, furthermore the local supply of materials should contribute to this cost decrease. As such, Turkey is aiming to move towards a more stable and financially more attractive situation for the provision of domestic energy in order to meet the growing demand of the industrial sector. Moreover, by substituting their energy imports with the procurement of domestically produced renewable energy (generated with domestically produced wind turbine components), it is able to reduce the amount of foreign currency that has to be spent across borders and thereby strengthen and stabilize the position of the Turkish currency. The country currently has to spend a lot of money to import foreign energy, and to generate the funds necessary to facilitate these energy imports it needs to export a lot of goods, which presumably puts pressure on Turkey's export position.

5.1.3 Local Context Results Summary

Overall, with regards to the local context explanatory variable, it can be concluded that environmental and natural reasons have had a fair share in the establishment of a local wind turbine manufacturing industry in Turkey, with a noteworthy high density of manufacturers located in Izmir. The accumulation of wind turbine manufacturing companies and facilities in the Izmir region is recognized as the centre of wind turbine manufacturing in Turkey, and the facilities in this region provide good access to a skilled workforce, proximity to several international ports and a strategic location both in terms of geography and in the global production network of wind turbines. Nine Original Equipment Manufacturers are currently active in the Turkish wind energy industry, supported by six tower manufacturing facilities, four blade manufacturing facilities and several other companies/facilities active in the manufacturing of generators, gearboxes or nacelle components, as well as companies active in operation and maintenance or consultancy and soft services. Appendix II provides an overview of the wind energy ecosystem in Izmir.

Moreover, it has become clear that the Turkish strategy for renewable energy has mainly been motivated by economic reasons. Turkey's economic strategy has shifted from an ISI strategy to an ELG strategy in the 1980s, but since then there has been too little focus on policies for technological learning and education of qualified engineers. Moreover, the country has had fluctuating macro-economic policies which did not manage to control inflation properly, causing the country to be structurally risky for investors, and the weak balance of payments position further aggravated Turkey's high import dependency. The country's recent focus on decreasing its energy dependency by focusing on increasing the procurement of domestically generated wind energy, generated with partly domestically produced turbines, could be an indication of Turkey recognizing and trying to solve these shortfalls. However, the current economic situation and depreciation of the Turkish Lira poses a threat for the continued development of the sector, as the depreciation of the Turkish Lira is a concern for investors who are better off financially by agreements in hard currency.

5.2 The Indicator Framework

In this subchapter, the empirical results regarding the application of the indicator framework developed by Hansen et al. (2020) are discussed. This framework has been applied in the empirical case study and interview transcripts have been subjected to a matrix analysis in which the four enabling factors of LCR policy effectiveness; design and coherence, size and stability, restrictiveness and domestic industrial base, have been used to categorize quotes from the interviews.

5.2.1 Design and coherence

Regarding policy design and coherence, several findings have been extracted from the interviews which have proven to be important for the development of the Turkish wind industry sector. As explained in Chapter 2, the design and coherence indicator refers to the clarity and transparency of the rules and regulations and the extent to which LCRs are aligned with, and accompanied by, complementary industrial policies supporting local manufacturing in the targeted sectors (Hansen et al., 2020). Thus, in this subchapter not only the design and coherence of specifically the local content requirement within the Turkish REL is discussed, but also related rules and regulations that affect the outcome of the entire set of policies of which the local content requirement is a part.

First of all, the price of the FIT has to be right (A) and the premium for local content has to be aligned with this base FIT. As previously explained, the premium for local content is awarded when an investor uses a local content ratio of at least 55%. To initially attract investors, the base FIT has to be attractive so that they will eventually consider the local content premium and decide whether or not to apply for it. As explained by the interview participants, even if the base FIT of 7,3 USD/kWh is relatively low compared to tariffs in other countries, it was already very attractive for international investors. The additional premium based on local production of turbine components increases the attractiveness of investing in Turkish wind industry, as mentioned by (E), “one of the most appealing things to the investors are the additional incentives based on these blades and towers”. Furthermore, since a different premium is awarded based on the sort of component that is domestically manufactured, the price of the premium to be awarded has to be aligned with the technological complexity and investment required to manufacture that particular component (D). Moreover, financing is also deemed particularly important because viable European export credits from Export Credit Agencies can be obtained which also have good rates for investments (E). As such, the price of the incentives also has to be aligned with these export credits because the eligible amount of European export credits will decrease for investors when they conduct local sourcing and production in Turkey (E). Hence, this tradeoff between European export credits and the Turkish local content incentives has to be taken into account.

Another important aspect in the local content policies is the duration of the FIT, with a period of 10-years for the base FIT, and a duration of 5-years for the local content premium. For the YEKA auctions, the generated electricity is also procured by the government for a fixed price and a duration of 15-years. As explained, in both incentives the government procures the generated electricity for a fixed price, with a local content premium applied for five years if the participants meet the minimum target of 55% in YEKDEM and with usually very competitive prices in the YEKA projects due to the auction design. After the 10-year FIT or 15-year price and purchase guarantee in YEKA expires, the generators have to sell the energy to the free market. This purchase guarantee has been an important element of the policy because it provided wind energy companies with initial demand security (G), and as such supported the development of a wind energy sector which has resulted in companies utilizing the local content incentives. However, interview participants have also expressed concern regarding the selling of electricity after the 10-year FIT and 15-year price and purchase guarantee expiry dates (I). They will then have to sell their electricity to the free market, which trades in Turkish Lira. The Turkish Lira currently has a very low exchange rate and after these companies have been selling their electricity for a fixed price in USD for 10-years, they expect difficulties regarding the low value of the Turkish Lira.

Thirdly, interviewees expressed concerns about the continuity and sustainability of the policies in the years to come. According to (C), one of the factors hindering progress with regards to localization is the lack of industry sustainability through continuity in regulations. If this were to be ensured, it would be a good thing (C). The same type of concern has been expressed by (E) “if we don’t have any further subsidy for local production, most probably our other facility is going to disappear in one or two years and until our orders are finished”. The concern of (E) is not related to current high demand for wind turbine components, but about what will happen after 2022. According to (E) there is enough demand for components for the next two years but the demand after that period is heavily dependent on the new policy. As such, the continuity of these policies is an important factor for manufacturing firms to gain knowledge about their economic sustainability in the future and for investors to gain sufficient security. Interestingly, the expiration of the existing policies, although postponed until the summer of 2021 as a result of COVID-19, has also motivated the current production of turbines for local use. As explained by (F), the reason why companies are busy with the local market is because the local incentive mechanism is expiring. This is also what (E) referred to when discussing the current high demand for turbine components, which is caused by the approaching expiration date of the incentives.

Currently[4], the sector is waiting for the new incentive mechanism (C) for the years to come, and although (C) argued that a certain momentum in wind energy in Turkey has been created, after a certain point Turkey should catch up in terms of the competitiveness of its market against other countries where the cost of components is lower, such as China. Since local content incentives cannot go on forever (G), and the domestic industry cannot be protected continuously, at a certain point the sector has to become competitive in relation to other countries. An incentive mechanism for the suppliers instead of the investors might help to achieve this, according to (C). In the current mechanism, it is difficult to become competitive because the incentive is focused on the investors, so the suppliers do not always keep their promises, of which the lack of implementation of the YEKA tenders could be considered an example. This could be avoided by motivating the suppliers, allowing the Turkish sector to become more competitive in relation to foreign sectors by achieving more sustainable production volumes.

The last empirical finding related to the design and coherence of the policies is related specifically to the use of LCRs in policies. According to (C), instead of being a main theme, a local content requirement should be used as an additional feature and can only be practically relevant when the economy is strong. When the economy is weak, more incentives should be given in terms of financing in order to attract and facilitate investments in the country in order to go through with the local content requirements. If the local content requirement is utilized as an additionality instead of a main instrument, it is more likely that small manufacturers would also change their direction to wind energy (C). It is interesting to note that in the YEKDEM mechanism, the local content requirement is actually more of an additionality than a requirement, as explained in Chapter 3. However, in the YEKA auctions it is a requirement and due to the design of the auctions it is difficult for small manufacturers to participate, due to the low profit margins that bigger firms can afford when submitting their bids.

5.2.2 Size and stability

The size of the current Turkish wind energy sector in terms of WPPs and capacity has been discussed in Chapter 5.1.1. The Turkish government assumes 20.000MW of wind power capacity in 2023, however with the current installed capacity being 8288MW with an additional 1329MW under construction, it will be difficult to meet this target in time. However, the policy-induced demand creation for wind energy capacity attracts businesses to invest in local production in order to comply with the LCR and also provides security for future demand.

According to (C), the Turkish wind energy market can be considered an established market for wind energy. Moreover, there is more than enough space for additional companies, either foreign or domestic, to establish themselves in Turkey as the market is huge (H). However, with regards to component manufacturing, there have also been several indications by companies producing turbine components in Turkey that the market is not big enough for them, and therefore they are also exporting a lot of products or will start to focus more on exporting their products in the near future. It therefore looks like there is plenty of space for companies in the field of wind energy in general, but regarding component manufacturing this space might be more limited, especially in the more established parts of the localized GPN such as tower and blade production. This was also explained by (F), as quoted: “the Turkish market is not big enough, for us, to supply for the wind turbines in Turkey”. This is likely explained by the fact that these are international firms with plenty of experience and production capacity, this production capacity needs to be utilized in order for the firm to realize the required low costs of manufacturing, and therefore a lot of products are exported. Moreover, it has also been understood that the production chains of products for the domestic and international market are largely separated, because the domestically employed products require a 55% local content ratio but the international products do not have to meet this restriction, and thus companies often use internationally sourced goods to realize cheaper cost of material (F).

A related issue is the domestic material supply and its competitiveness compared to foreign materials. As explained by (G), there is only 1 supplier of the required steel plates for turbine towers in Turkey,

[4] This refers to November 2020

and the quality of this steel is lower than foreign steel. The interview participant could not disclose which steel supplier this was. However, after desk research, it is deemed likely that this supplier is Erdemir, because this is the only supplier supplying steel plates and is named in the Top Steel Makers List of 2019 by the World Steel Association (World Steel Association, 2019). Due to the presence of only one suitable steel manufacturer who produces the appropriate steel plates, there is a quality and a price issue related to the local sourcing and production of tower components (G). The quality is lower because the steel plates need to be welded by the tower manufacturers because the plates are not of sufficient size for immediate use in a turbine tower (G). The price issue is caused by the fact that there is only one supplier of the appropriate materials who thus has a monopoly on the supply of steel plates to tower manufacturers in turkey. As a result, the domestic supply of steel not competitive in relation to foreign steel supply, which is one reason for instability in the Turkish wind turbine production market. If the steel supply would stabilize and become competitive with foreign steel suppliers, this would be beneficial for the entire Turkish wind turbine manufacturing sector. Since currently, components for export projects are still sourced from foreign countries (F), and suppliers have to use certain loopholes in order to adhere to the 55% ratio for local projects. That would no longer be the case for steel plates if the Turkish steel supply stabilizes, saving suppliers money on the import of foreign raw materials and helping the Turkish manufacturing sector in further growth.

Furthermore, there has been criticism on the local supply of products and goods required, as explained by (I), if the investors or government establish a factory for more local production that would be beneficial because there is not yet enough local material supply. According to (I), local supply would help stabilize the market, because more local production would require more trained local engineers and technicians which is an important factor in creating a stable market, since it decreases the need for European or foreign assistance (I). According to (H), the sector is not yet stable as indicated by the growth ratios that are not stable every year. As such, most empirical findings related to the size and stability of the local manufacturing sector for wind turbines seem to indicate that although the size of the sector has grown a lot in recent years and has reached significant levels, there is still plenty of room left for growth. The local manufacturing of wind turbine towers and blades seem to be very well developed, with the major OEMs having agreements for the domestic manufacturing of blades and towers with different suppliers and realizing most of the WPPs in Turkey with partly domestically produced wind turbines. However, for components such as the nacelle, tower internal or gearboxes there is less domestic production capacity. This could be related to the technology complexity of the components, the required skills and capabilities to manufacture these components or even the demand for domestic production of these components. Moreover, the production capacity of the tower manufacturers currently exceeds local demand for wind turbine towers and as such tower manufacturers engage in export of tower components in order to meet the low production costs required to stay profitable. However, it was also indicated that the strategic location of Turkey also plays a role in their choice for exporting products (G). Lastly, it is also likely that more local production of different wind turbine components will contribute to stabilizing the market (I). When more local production is realized, costs of domestically produced materials will decrease and thus the sector will become more competitive compared to other countries, and the local content requirement could eventually be let go of.

5.2.3 Restrictiveness

According to Hansen et al. (2020), the restrictiveness of LCRs has a direct effect on the degree to which local manufacturing is established and the degree to which components with higher value added are produced locally. The tariff scheme in Turkey after the 2011 amendment of the REL provides a base tariff of 7.3 US$cents/kWh, with an additional premium for local production of components which can be received if investors meet a local content ratio of 55% (G, I)(Government of Turkey, 2005). The design of the additional premium, where the local production of lower value-added parts is rewarded with a lower premium and higher value-added and parts are rewarded with a higher premium, presumably encourages the local production of first the lower value-added parts because these are most closely related with the current capabilities in the country and subsequently the higher value-added parts for which a certain amount of knowledge transfer into the country is required. The transport of towers and blades is notoriously difficult due to their size, and therefore the local production of towers and blades is also deemed most useful in the initial stages of developing a local wind turbine manufacturing sector due to the savings that can be made in transport. The realized savings are mostly on the part of the OEM, who buy these towers. For the tower manufacturers themselves it seems to be a win-win situation, since Turkey is a strategic location to operate in different markets worldwide, and they can still achieve certain levels of production required to meet the most competitive cost of production and indulge in export (G)(F).

As was also explained by (F), the restrictiveness in terms of sourcing of materials for towers is high. For towers that are produced for domestic WPPs, materials have to be sourced domestically at a rate of 55% in order to be eligible for the local content premium. For the towers that are exported to other countries, this requirement is not present. As such, the tower manufacturers have separate supply chains for the domestic and international towers, and while the final product is exactly the same, the materials used are often sourced from different countries, as foreign materials tend to be cheaper and are therefore used in products intended for export.

In addition to the tariff premium, the percentage of local content differs between the YEKA tenders and the regular projects carried out within the framework of YEKDEM. For YEKDEM projects a local content ratio of 55% is required to receive the premium for local component production, creating demand for locally produced components. However, for the first YEKA tender a 65% local content ratio was required, as well as the establishment of a R&D facility for nacelle production and development by the winning bidder. This facility should employ 50 engineers, of whom 80% are to be of Turkish origin. In the second YEKA tender, the local content ratio was reduced to 55%, without the obligation to construct a R&D facility (D, H). According to (C), with the construction of the R&D facility as required by the first YEKA tender, almost complete localization of the major wind turbine components in Turkey has been achieved. There was already an ecosystem with the local production for blades and towers, and on top of that the winning company only had to add production of nacelle components. In addition to the above, there is also a certain extent of flexibility in the interpretation of what is considered local production. As explained by (H), some raw materials can still be sourced from abroad, but depending on the processing that is performed in Turkey the materials can still be considered local content (H).

Lastly it can be concluded that as a result of the level of restrictiveness in Turkish policies regarding LCRs, follower sourcing has occurred. The demand for local supply is created by the thresholds for local content, which encourages suppliers to establish themselves in Turkey. It has been understood that the OEMs have lists of qualified suppliers, and in order to achieve the local content ratios it is a strategic decision to motivate their suppliers to follow them into different countries in order to profit from these incentives (C).

5.2.4 Domestic Industrial base

The level of domestic industrial development and the extent of technological capabilities are important factors of influence on the effectiveness of LCRs (Hansen, 2020). Turkey is generally well known for its sophisticated and experienced automobile and construction industries, which are responsible for a significant share of the country's GDP (D). As such, a positive aspect for the development of a local wind turbine manufacturing industry in Turkey has been the presence of a knowledgeable local workforce and the domestic industrial base (C). According to (H), this is the reason that there is plenty of access to smart scientists and engineers and there is also high adaptation capacity in the region. Moreover, Turkey has learned from the initially chaotic stages in wind energy development, as the amendments made to the administrative framework over time have resulted in a more steady growth of the sector (World Bank, 2015). However, this causality also runs backwards. The use of Local Content Requirements can facilitate and stimulate the extent and complexity of localized facilities and firms, starting with the establishment of production facilities with the associated capabilities and local industrial base, but eventually upgrading to more sophisticated industries such as research and development for which innovative capabilities are also required. This is also the logic behind the use of

LCRs, as the Turkish government has the goal to establish an industry which is just as competitive as its automotive industry and is looking to expand its industrial knowledge and capabilities in the wind energy sector (J). An indication for this upgrading taking place is the construction of a local nacelle R&D facility by Siemens Gamesa, as mandated by winning the first YEKA tender. According to (C), with the construction of the R&D facility as required by the first YEKA tender, almost complete localization of the major wind turbine components in Turkey has been achieved. There was already an ecosystem, with the local production for blades and towers, and on top of that the winning company only had to add production of nacelle components. As such, the main parts of a wind turbine can now all be locally produced in Turkey. Not only the restrictiveness of the LCRs and the state of the domestic industrial base have played a role here, but also the timing of implementation of the incentives and the YEKA tendering scheme seem to have been important in achieving this. This could also be considered as a next step in localization, since with the construction of an R&D facilities, no longer are production capabilities the only capabilities present, but the research and innovative capabilities now also come into play. This is also exemplified by (F), who explains that this tower manufacturer wants to differentiate themselves among global tower suppliers because they are trying to realize a competitive advantage by innovating and proposing new solutions to OEMs. These could be indicators that Turkey is on the threshold of a new state of localization, where the regional wind turbine manufacturing cluster is becoming something more than just a pure production platform and will start to make use of a certain local knowledge base that has developed over recent years, and as a result the cluster might start to take another role in the GPN. All in all, the presence of technological capabilities combined with the willingness to innovate and adaptability of companies in the Turkish industry, combined with the design of the YEKDEM and YEKA mechanisms has led to the current state of localization (H). In this current state tower and blade manufacturers have mainly been localized, and other components have been localized to lesser extents. Also, tower manufacturers are already considered a commodity by some (C). With regards to tower manufacturers there is a combination of international and Turkish companies, and for blade manufacturers there are currently only international companies present.

Furthermore, the extent to which localization occurs also determines the extent to which the Turkish wind energy sector will be attractive for international firms and investors. As previously explained, a cluster for the manufacturing of wind turbine components has established in Izmir. Such a cluster attracts people, companies and investors which then again results in a positive effect on the local industrial development. Hence, the essence of effective LCR policy is not just to attract firms in the initial stages, but also to eventually create an attractive sector in the long-term which can measure itself against foreign competitors.

The utilization of LCRs in the development of a domestic wind turbine manufacturing industry seems to have not been hindered substantially by the present domestic industrial base. If anything, this industrial base has provided the sector with opportunities due to the easy access to skilled people, and the availability of certain capabilities within the region. The only aspect that proved to be an issue was the domestic steel supply. As previously explained by (G), the local supply of steel cannot yet compete with foreign suppliers in terms of price and quality, and it would be beneficial to have a more diverse set of domestic material suppliers in order to improve competitiveness. Moreover, the Turkish manufacturing sector should still grow in terms of production volume, as a lot of costs will decrease when that happens (I).

Lastly, the development of the wind turbine manufacturing sector has also led to engineers from the OEMs or other large firms in the renewable energy industry to spin off and establish local companies producing components and materials for the sector (D). These spinoff companies often have unique access points to the supply chain of the larger corporations. This is an important aspect for the further development of the sector. Usually, the supply chains of these companies are hard to enter, but when these spinoff companies generate unique access points, this allows them to enter the international supply chain quickly, thus creating a strong linkage between a local spinoff and the international supply chain and scope of the OEMs.

5.2.5 The Indicator Framework Results Summary

In summary, the empirical application of the indicator framework developed by Hansen et al. (2020) has provided several interesting findings related to the four indicators affecting LCR policy effectiveness.

In relation to the design and coherence of the LCR policy, it has become apparent that the price of the FIT has to be right, and the premium rewarded for the use of local content has to be aligned with the base FIT in order to attract the interest from investors. Moreover, the duration of the FIT, with a duration of 10-years for the base FIT and 5-years for the local content premium, and the 15-year price and purchase guarantee provided in the YEKA auctions have been important aspects for investors, as this provides them with demand and price security. However, there are concerns regarding the period after these respective guarantee periods, as the electricity will then need to be sold to the free market, and the current low value of the Turkish Lira is a concern for electricity generators. Also, there are concerns related to the continuity and sustainability of the policies in the years to come, as the sector is currently awaiting a new incentive mechanism and although a certain momentum has been created regarding wind energy in Turkey, the market should at some point also become competitive in relation to foreign competitors and the LCRs can also not be in place forever.

With regards to the size and stability of the wind energy market in Turkey, there are two sizes to consider. Firstly, the size of the wind energy generation capacity, which is currently 8288MW with an additional 1329MW under construction. Secondly, the size of the wind turbine component manufacturing industry, which was comprehensively detailed in Chapter 5.1.1 and which will be further analyzed in Chapter 5.4. However, it is clear that the size of both the wind energy generation capacity and wind turbine manufacturing sector are significant, and the Turkish wind energy market is therefore considered an established market. However, the stability of the market is still an issue. This issue is caused by the competitiveness of domestic materials compared to foreign materials both in terms of price and quality, and the supply capacity of domestic firms which supply the wind turbine component manufacturers.

The restrictiveness of Turkish LCR policy vary between the LCR under the YEKDEM and YEKA mechanisms. Under the YEKDEM mechanism the LCR is not so much a requirement, but more of an option for investors to claim a premium on top of the FIT, based on the locally sourced components used in the generation facility. Within the YEKA tenders, the incentives for local content are actual requirements, as the winning bidders have to comply with the rules for local content. The minimum rate of local content in the LCR under the YEKDEM mechanism is 55%, while in the YEKA tenders this was respectively 65% and 55% in the first and second tender. It has also become apparent that manufacturing companies utilize separate supply chains for products for the domestic and export market, as for export products no LCRs are present. Moreover, it has become clear that some raw materials can still be sourced from abroad but depending on the processing that is performed in Turkey on these materials, they can still sometimes be considered local content.

The domestic industrial base in Turkey has provided the wind industry sector with the right capabilities to localize tower and blade manufacturers, as indicated by localization of international blade manufacturers and the establishment of multiple tower manufacturers. The manufacturing of these components was relatively easy to conduct domestically due to Turkey's historically strong capabilities in the construction and automotive sectors. Moreover, this also provided easy access to skilled and knowledgeable people.

Moreover, there are indications that Turkey is on the threshold of a new state of localization. A state where the regional wind turbine manufacturing cluster is becoming something more than just a pure production platform and is upgrading to a more complex role within the GPN as starts to make use of a certain local knowledge base that has developed over recent years. There are however still several issues that remain, related to the quality, price and amount of supply of domestic materials compared to foreign materials. Hence it is important that the Turkish sector gains in competitiveness internationally to continue with the development of the sector and the associated domestic industries.

5.3 Governance

As explained in Chapter 2, there is always a form of governance present in Global Production Networks. One of the goals of this study was to deepen the research into the dynamics of state roles within GPNs and the development implications thereof, as called for by Horner (2017). As such, in this subchapter the empirical findings related to governance in the development of the Turkish wind turbine manufacturing sector will be explained. Here, governance refers to act of governing and the way in which this governance is enacted, where the activity of governing is the management or control of the activities of a particular country, region or organization (Cambridge Dictionary, 2021). The way in which this governance is enacted is relevant because it can have implications for the role and effect of the LCRs in Turkey's wind energy sector. As explained in Chapter 3, the aspect of governance will be assessed on three distinct levels: the firm level, the local level and the state level. This is done because these three levels of governance were recognized in the empirical results, and in each of these levels different actors operate and are responsible for the way in which governance has an influence on the role and effectiveness of the LCRs in the Turkish wind energy industry.

5.3.1 Role of the firm

The role of the firm refers to firm-level decision making and actions that have an impact on the development of the local manufacturing sector for wind turbines in Turkey. One of the most notable empirical results regarding the role of firms has been the identification of follower sourcing strategies being utilized by OEMs in order to meet the requirements of the LCRs and thereby achieve financial benefits. Follower sourcing, described as 'the unfolding process of initial outsourcing to seek the lowest cost supplier (global sourcing), then extends in requiring the supplier to locate proximate to the factory (follower supply)'(Morris et al., 2012, p. 409), has been utilized by the OEMs as they motivate suppliers and collaborators to establish themselves in Turkey, because they have lists of suppliers and collaborators that they work with and it makes it easier to meet the requirements of the local content policies (C, D). These agreements between the OEMs and their suppliers could even go as far as the OEM motivating the supplier to establish factories in Turkey to support the OEMs goals (C). This strategy of follower sourcing is a testament to the financial motives that drive firms, as they have been known for seeking the most financially attractive solutions (World Bank, 2015). However, the importance of the utilization of this strategy cannot be underestimated, as its role in the development of a wind turbine manufacturing sector able to produce every main component of a wind turbine seems to be rather significant. Many of the major OEMs have now established in Turkey, and their major suppliers such as TPI Composites and LM wind have also established in Turkey. Furthermore, international tower manufacturers have joined Turkish companies in the domestic manufacturing of wind turbine towers, and this has led to both growth and diversification in the wind turbine manufacturing sector, as a mixture of Turkish and international companies has now appeared

However, one could argue that these strategies also pose as a threat for Turkish companies seeking to enter the GPN of wind turbine components. The OEMs have agreements with their trusted suppliers, and it is therefore difficult for local firms (which have often entered the wind energy sector only recently) to get involved with the OEMs. On the other hand, the LCRs also require the OEMs to source components and materials locally, and sometimes require a local workforce. As such, this could also play into the hands of local firms as they could engage in business with the OEMs to help them meet the LCR objectives. Moreover, the spinoff effect explained in Chapter 5 also provides Turkish companies with opportunities and creates linkages between international supply chains of the OEMs and the local firms. As such, the utilization of the follower sourcing strategy has arguments both in favor and against it.

Firms have different ways in which they can affect the success of the local wind turbine manufacturing sector. Firstly, the OEMs have a role in attracting the parts of the supply chain to Turkey in order to meet the LCRs. Secondly, this could prove beneficial for local firms which aim to enter the global production network of wind turbines. Moreover, these local firms have also shown their ability to upgrade their skills and capabilities, as (F) explains 'We are trying to have a competitive advantage in this way, by proposing new solutions and being innovative'. Thus, local firms try to gain a competitive advantage through innovating and thereby contribute to the upgrading of the local manufacturing sector. This contributes to the sector becoming more sophisticated and therefore more competitive over time, which is another way in which the firms can affect the successful development of the local wind turbine manufacturing sector.

In conclusion, it could be argued that the follower sourcing strategy applied by the OEMs is the major empirical finding related to the role of the firm in the development of the Turkish wind turbine manufacturing sector. Moreover, it is clear that firms are driven by financial reasons, and thus will always look for the cheapest solution or the best ways to make profits. The innovativeness of firms contributes to the development, and especially the competitiveness of the sector, and thus firms are urged to conduct in R&D and innovation actively to allow for the sector to develop as efficiently as possible. LCRs may contribute to the development of local firms through directing the interest of OEMs to their businesses, which can allow for local firms to enter the global production network for wind turbines and create strong linkages between the local and the global.

5.3.2 Local development agency governance

The development of a wind turbine manufacturing cluster in the vicinity of Izmir has been confirmed through the interviews. This clustering effect has for a large part been facilitated through the strategies employed by a local development agency, and this has had significant impact on the development of the wind energy sector in the whole of Turkey. This is an interesting observation because it shows the relations between local and national government and there is a theoretical question here about the importance of the national state and regional institutions in promoting local manufacturing industries. As such, gaining an understanding about these developments in Turkey can contribute to the debate on the role of different governance actors in global production networks. The strategy employed by this development agency is therefore explained in the following paragraphs.

The local development agency is coordinated by the Ministry of Industry and Technology, but also has an independent management and therefore is in some ways independent from the central government, but in other ways also has some dependencies on the central government (D). It was explained by (D) that the strategy of the local development agency consisted of three steps. Initially, it created awareness in the region about the developmental ideas and plans to create interest from local and global suppliers. Subsequently, the development agency created a starting market, and thereafter it focused on attracting investors from abroad involving representatives of the agency who would speak to investors from countries with experience in the wind energy sector, such as Germany, Denmark and also China. He also stressed the importance of attracting a pioneering company in the wind energy sector to Turkey, because when such a company comes ‘the rest of the supply chain from Europe, probably not all of that, but some will come and invest in Izmir’ (D).

As apparent from its employed strategy, the development agency is very well organized and (D) explained that the development agency also had a very significant role in the implementation of favorable investment conditions for large international businesses in the Turkish wind energy sector. It was explained that ‘around’ 2012 an official letter from the local development agency was sent to the Ministry of Industry and Trade, ‘asking the Ministry to define the renewable energy sector, and especially the wind energy sector, as priority areas for investment and trade and to provide extra support for this sector in the form of financial incentives’ (D). This proposal was accepted by the Ministry and as a result, financial incentives for the local production of wind turbine towers, generators, blades and internal components were created (the feed in tariff premium scheme). Thus, it seems that this development agency has had a direct influence on the implementation or design of the YEKDEM application mechanism, which was implemented in 2011. As such, the local development agency has had a significant influence on the establishment of national wind energy policies in Turkey and thereby made a large contribution to the development of the wind energy sector in Turkey. This is in line with the findings of Gordon (2013) and van der Ven et al. (2017) which have found that local governments constitute sources of sustainable leadership, dynamism and innovation. Therefore, the relationships between local and national state governance actors, and the governance mandate of local or regional development institutions could be an interesting research topic in industrial development and policy research.

According to (D), the presence of the YEKDEM application system for wind energy attracted foreign manufacturers to come to Izmir through the inclusion of the LCR, and resulted in the situation that international companies came to the Izmir region for the production of wind turbine components. He also explained that as a result of this, several local companies were able to follow in their footsteps and enter the value chain for wind turbine component manufacturing in Turkey. Thus, the role of this local development agency has been very significant, since it has been involved in the creation and implementation of the policy mechanism to attract foreign companies and investors, and subsequently has also talked to foreign companies and investors and promoted specifically the Izmir region in order to attract these companies to the region. As such, this agency took a pro-active role in policy making and their contribution to the localization of the wind turbine manufacturing sector in the Izmir region has been tremendous.

5.3.3 Role of the state

According to Horner (2017), the national state is an important governance actor in GVC and GPN frameworks and she has distinguished a variety of state roles in GPNs. The role of the state as a buyer through procurement schemes of domestically produced renewable energy has been discussed during the interviews, and the empirical findings provide insights into how the role of the Turkish state as a buyer has contributed to the development of the Turkish wind turbine manufacturing industry.

Dicken (2011) argues that the state plays a role in two key aspects in the automobile industry. Firstly, by determining the degree of access to its domestic market, including the terms under which foreign firms are permitted to establish production plants. Secondly, by establishing the kind of support to its domestic firms and the extent to which the state discriminates against foreign firms. These two key aspects can also be recognized in the Turkish wind turbine manufacturing industry. As explained in chapter 6, the Turkish government has transitioned from an ISI strategy prior to the 1980s to an ELG strategy afterwards. Now, through protectionist policies and LCRs the government has given rise to the development of a local wind turbine manufacturing sector and increased domestic renewable energy generation capacity. This seems to entail a selective return to ISI, and the ELG strategy apparently allows for such selective returns of ISI measures. With regards to the domestic renewable energy generation capacity, the state acts as a buyer as it provides 10-year purchase guarantees for wind energy projects under the YEKDEM and YEKA mechanisms, and through these procurements aims at decreasing its energy dependency while strengthening its currency (H, J). As such, the Turkish government is running a multi-faceted policy which shows both the key aspects recognized by Dicken (2011) in the automobile industry. It clearly determines the terms under which foreign firms are permitted to establish production plants or other facilities and regulates the extent to which they have to interact with local firms to support the domestic industry. The Turkish policies are a combination of demand-pull and supply-push strategies, where the state first acts as a facilitator through attracting foreign firms in the wind turbine manufacturing industry, and subsequently operating as the main buyer for domestically generated renewable energy. Because the state operates as the main buyer, it is in clear control of both supply and demand, which it can control through regulating the amount of WPP projects and incentives.

This is interesting because while firms have an important role in navigating the wind energy landscape the government is basically in complete control over the demand and can furthermore regulate the extent to which foreign firms interact with domestic firms, and which components are manufactured at specific points in time due to the LCR components in its policies. Possibly, the state sees strategic opportunities to develop an export-oriented wind turbine manufacturing industry. As explained by (J) one of the goals for the development of the wind turbine manufacturing sector is for it to become as equally competitive as the automobile sector in Turkey. As such, it is possible that the state considers developing this sector into an export-oriented industry which is also beneficial to the value of the Turkish Lira, since this contributes to strengthening their export competitiveness under the ELG strategy. Since the wind energy sector has a lot of potential, due to the preferred geographical location and the domestic industrial base, the development of the wind turbine manufacturing sector could be a measure to help decrease the energy dependency and strengthen the balance of payments.

As is now clear, the role of the state in the establishment and operation of the Turkish wind turbine manufacturing industry is quite significant, and the strategies employed seem to indicate that the Turkish state is utilizing the strengths of its geographic location in combination with its current skills and capabilities to decrease its import dependency and thereby strengthen its balance of payments.

Lastly, in addition to the role of firms and Turkish local and state governance actors, there is also a role played by foreign parties, such as Export Credit Agencies, the European Union and other foreign parties. These parties' roles have not been extensively discussed during the interviews, however as previously explained in Chapter 7.1, it was mentioned by (E) that European Export credits, provided by European Credit Agencies (ECAs), are also attractive to Turkish firms. As such, the FIT and local content premium prices also have to compete with the export credits offered by these development banks. There are many other ways in which different types of parties can influence the way in which governance in Turkey is enacted and thereby influence the effects of the LCRs. Another such example could be the relation between Turkey and the EU, and the position and state of the negotiations regarding Turkey's Accession into the EU. Many of the decisions made by the Turkish government could be influenced by these negotiations, or their desire to access into the EU. There are many of these types of parties or influences that could be thought of, and although their role and level of influence haven't been assessed in this study, it is a factor to take into account.

5.3.4 Governance Results Summary

This chapter has discussed the empirical results related to governance on three levels, the firm level, a local level and the national state level. Regarding firm level governance, one of the most notable empirical results has been the identification of follower sourcing strategies being employed by the OEMs in order to meet the requirements of the LCRs. The role of this strategy seems to be rather significant, and many of the major OEMs in the wind energy sector have established in Turkey as well as their trusted international suppliers. As a result, the manufacturing sector in Turkey consists of a mixture of domestic and foreign firms. One could argue that the follower sourcing strategy is a threat for domestic firms, as the OEMs engage in supplier-buyer relationships with these trusted suppliers and do not engage with domestic firms. However, to meet the restrictions of the LCRs the OEMs often still engage with the domestic firms. Moreover, the spinoff effect also leads to the establishment of new domestic companies. Thus, the employment of the follower sourcing strategy has both arguments in favor and against it. Additionally, local manufacturing firms have also showed the ambition and ability to upgrade their skills and capabilities and have developed innovative capabilities as they propose new solutions to their customers in a bid to gain a competitive advantage.

The second level of governance that has appeared is that on the level of a local development agency.
A local development agency requested the Ministry of Industry and Trade to define the renewable energy sector as a priority area for investment and trade. As a result, the Ministry adopted financial incentives for the local production of wind turbine components, and thus this investment agency has had a pro-active role in policy creation and implementation. Moreover, this agency also employs a detailed strategy in which it first creates awareness in the region about the developmental ideas and plans, subsequently it creates a starting market and lastly it focuses on attracting investors and (pioneering) companies. It thus works in a very well organized and strategic manner and in that sense, it really 'governs' the way in which the sector was established and attracts interest from investors.

The third level of governance relates to the governance of the national state. The Turkish government has transitioned from an ISI strategy prior to the 1980s to an ELG strategy afterwards. Now, through protectionist policies and LCRs the government has given rise to the development of a local wind turbine manufacturing sector and increased domestic renewable energy generation capacity. Turkey first acts as a facilitator through attracting foreign firms in the wind turbine manufacturing industry, and subsequently acts as a buyer through the procurement of domestically generated wind energy, since it provides purchase guarantees for wind energy under the YEKDEM and YEKA mechanism. Through the procurement of this domestically generated energy the state aims at decreasing its energy dependency while simultaneously strengthening its currency and balance of payments. Because the state operates as the main buyer, it is in clear control of both supply and demand, which it can control through regulating the amount of WPP projects and incentives. Possibly, the state sees strategic opportunities to develop an export-oriented wind turbine manufacturing industry, as one of the goals of the sector to become as equally competitive as the automobile sector in Turkey and becoming an export-oriented sector would be beneficial to the value of the Turkish Lira as this contributes to strengthening the export competitiveness.

5.4 Effectiveness of LCRs in the localization of wind turbine manufacturing in Turkey

The three explanatory variables have now been empirically tested and several findings have come forward regarding the influence of these explanatory factors on the effectiveness of Turkish LCRs in the Turkish wind energy industry. However, in order to determine if these LCRs have actually been effective, a quantification of the object variable, LCR policy effectiveness, is required.

As explained by (J), the main goals of Turkish LCR policy are four-fold; to become as competitive as Turkey's automotive sector, to decrease foreign energy dependency, to transfer know-how into the country and to develop a labor force in the wind energy industry. Furthermore, it is now also clear that the motivation of the Turkish government to focus on the development of a domestic wind turbine manufacturing sector has mainly been for economic reasons, as the government looks to tackle its external deficit problem.

A quantification of the wind turbine manufacturing sector is performed by comparing the situation in the Turkish wind turbine manufacturing industry in 2009 and 2020. In 2009, the LCR component of the policies had not yet been implemented, and for that reason this serves as a good year for comparing the sector with the current situation. The data used for this quantification has been previously discussed in Chapter 5.1.1 to explain the current status of the wind turbine manufacturing sector in Turkey.

To begin with, table 13 lists all of the companies that are known to produce components for which the FIT premium for local production is provided. Several companies, such as Enercon and Ates Celik, appear multiple times in this table because they produce different components and thus also receive a FIT premium for each of the different components. As already explained in Chapter 5.1.1, the wind turbine manufacturing sector in Turkey in 2020 consisted of four blade manufacturing facilities, six tower manufacturing facilities, and several different companies involved in the manufacturing of generators, gearboxes and the nacelle. Table 13 combines information from the Invest in Izmir wind energy ecosystem overview provided in Appendix II with information received during the interviews and information found in gray literature.

Table 13 List of companies that produce components for which a local content premium is provided.

Company	**Component produced**	**Year of start with component production**	**PCI Score**	**FIT Premium (US$cents/kWh)**	**Country of Origin**
TPI Composites 1	Blade	2012	1	0.8	U.S.
TPI Composites 2	Blade	2016	1	0.8	U.S.
GE LM Wind Power	Blade	2017	1	0.8	Denmark
Enercon	Blade	2002	1	0.8	Germany

Ates Celik	Generator and power electronics	2010	0.21	1	Turkey
Enercon	Generator and power electronics	-	0.21	1	Germany
EMS	Generator and power electronics	2018	0.21	1	Turkey
Alkeg Tegopi	Tower	2011	-0.24	0.6	Turkey – Portugal
Ates Celik	Tower	2010	-0.24	0.6	Turkey
CS Wind	Tower	2018	-0.24	0.6	South Korea
Cimtas	Tower	2000	-0.24	0.6	Turkey
Gesbey	Tower	2010	-0.24	0.6	Turkey – Spain
Temsan	Tower	2016	-0.24	0.6	Turkey
Siemens Gamesa	Nacelle	2019	0.69	1.3	Spain
Tibet Makina	Gearbox	1970	1.57	1.3	Turkey
Dirinler Dokum	Gearbox	1974	1.57	1.3	Turkey

From the table, it can be determined that several companies started with wind turbine component production after 2010, the year the LCR component was introduced. Of the companies that were active before 2010, only Enercon is a foreign company, and the others are of Turkish origin. This is interesting because it is an indication that foreign companies mostly came to Turkey after the introduction of the LCR in 2010. It must however be noted that for the companies Tibet Makina and Dirinler Dokum, no specific date for the start of components production for the wind energy sector has been identified and thus the establishment dates of these companies have been used as a reference.

With regards to companies involved in component manufacturing, an increase in the number of companies has taken place for every component for which a FIT premium for local production is awarded. The number of blade manufacturers has increased from one to four, and the number of tower manufacturers has increased from one to six. For generator and power electronics, nacelles and gearboxes, it cannot be assumed that the figures are exhaustive since information regarding their manufacturing is relatively more difficult to find. But presumably the number of companies involved in the manufacture of generators and power electronics has increased from zero to three. For the nacelle, there is only one manufacturing facility in Turkey, which is owned by Siemens Gamesa and has opened in 2019 as part of the first YEKA tender, as discussed in Chapter 3.2.2. With regards to the manufacturing of gearboxes, two Turkish manufacturers have been identified, Tibet Makina and Dirinler Dokum. These companies have been established in the 1970's, and it is unknown when they started manufacturing for the wind energy sector, but it is known that they do deliver gearboxes to the sector nowadays. No other manufacturers of gearboxes have been identified, and thus no increase has been seen for this component. A comparison between the number of companies in 2009 and 2020 is made in figure 9.

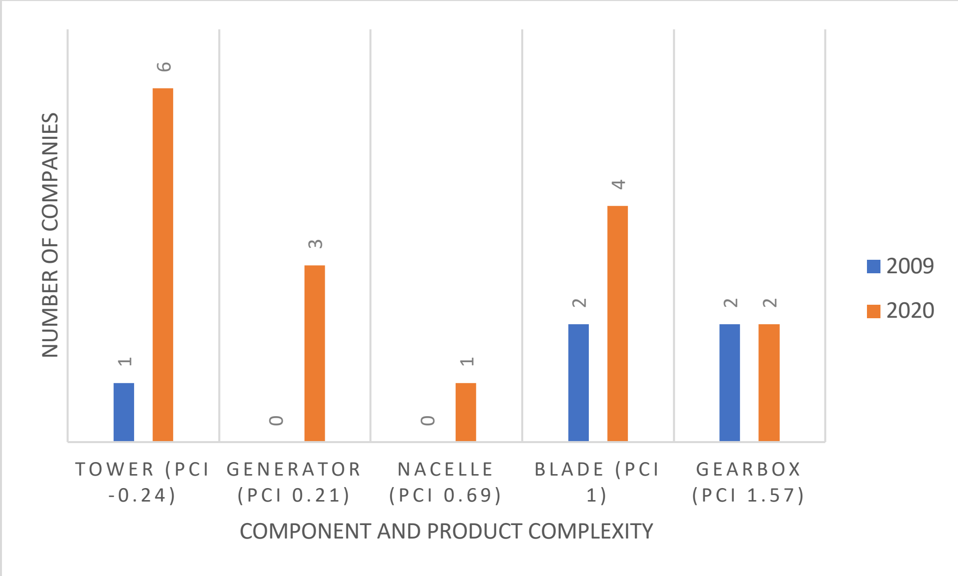

Figure 9 Wind turbine component manufacturers and the associated PCI in Turkey in 2009 vs 2020

The figure can also be used to make comparisons on the changes in the number of manufacturing companies based on product complexity, as the PCI for each component has been included in the figure. As depicted in table 9, the PCI for different components of a wind turbine ranges from -0.24 for the tower to 1.57 for the gearbox, where the complexity refers to the combination of design, processes, skills, resources and institutions required to manufacture, transport and integrate individual components into a wind turbine (Surana et al., 2020). As can be determined from figure 9, the component with the lowest PCI (Tower, PCI = -0.24) has gained the most manufacturing facilities, with an increase of five facilities. Subsequently, the second-least complex component (Generator and power electronics, PCI = 0.21) has increased the second-most in terms of manufacturing companies with an increase of three companies. The more complex components have increased by respectively one, two and zero manufacturing facilities. It seems that the components of lower complexity were interesting for manufacturing companies, most likely due to the combination of relatively low complexity and the technological capabilities that some companies already possessed. As explained by (F), Ates Celik was producing steel advertorial towers before it started with the manufacturing of wind turbine towers. As such, the company possessed the technological skills and capabilities to easily switch to the production of wind turbine towers when this opportunity presented itself. It is probably also not completely coincidental that the company started with the production of wind turbine towers after the introduction of the LCR in 2010. It is likely that many other companies currently manufacturing wind turbine towers also possessed the technological capabilities and skills required and could therefore make the switch relatively easily.

For other components, this was likely more difficult. As can be seen in table 13, no Turkish company is currently active in the manufacturing of wind turbine blades. This could be due to the missing capabilities in the Turkish domestic industrial base and hence, OEMs that have come to Turkey asked their trusted suppliers to follow them into Turkey or have outsourced blade production to other foreign companies, as most blade manufacturing companies entered the market after the introduction of the LCR in 2010.

In table 14 the PCI for the wind turbine components is compared to the awarded FIT premium. From the table it can be concluded that it is not the case that the most complex components are awarded the highest FIT premium, as for example the premium awarded for local blade production is lower than the premium awarded for local production of generator and power electronics, while Surana et al. (2020) have calculated a higher PCI for blades. However, the policy could be designed in such a way that the premium that is awarded is in alignment with the skills and capabilities of the companies active in the Turkish industrial and manufacturing sector before 2009, in order to incentivize them to enter into wind turbine component manufacturing.

Table 14 Comparison of the PCI and the awarded FIT premium

	PCI	FIT Premium (US$cents/kWh)
Tower	-0.24	0.6
Generator and power electronics	0.21	1
Mechanical equipment in rotor and Nacelle	0.69 – 1.57	1.3
Blade	1	0.8

Furthermore, a comparison of the companies in the sector in 2009 and 2020 has also been made based on the FIT premium awarded, shown in figure 10. It can be seen that the component with the lowest premium has seen the largest increase in local manufacturing facilities, but this is most likely related to skills and capabilities that were present in the Turkish sector before the introduction of the LCR than to the height of the premium.

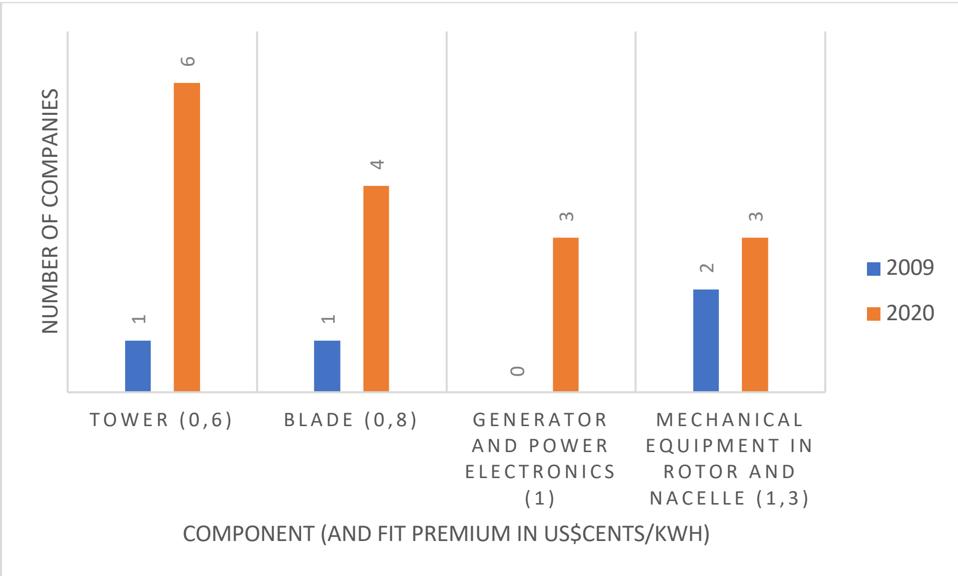

Figure 10 Wind turbine component manufacturers and the associated FIT premium in Turkey in 2009 vs 2020

Based on the figures above, it can be concluded that the number of manufacturing companies has increased for each component for which a FIT premium for local production was given. The largest increase has taken place in wind turbine tower production, followed by the production of blades, generator and power electronics and mechanical equipment in the rotor and nacelle. It is interesting to note that of the tower manufacturing companies most are of Turkish origin, while the blade manufacturing companies are all of foreign origin. Furthermore, a certain extent of technological upgrading or an increase in the technological complexity of the components locally produced seems to be taking place. The tower manufacturing companies were mostly established between 2000 and 2018, and while the first company to manufacture blades locally was established in 2002, the other three companies only arrived after 2012. And now most recently, Siemens Gamesa opened a facility for the manufacture of the nacelle, another component higher in complexity than towers.

Moreover, a certain division of labor seems to be taking place. Many tower manufacturers are Turkish, while more complex components such as blade and nacelle production are performed by foreign companies. Moreover, it is also interesting to note that Enercon, which is known to produce all their components inhouse, has opted to outsource blade production to TPI Composites in Turkey. It is also interesting that gearboxes are currently being produced mainly by Turkish companies, although it is likely that the OEMs use gearboxes from their contracted foreign suppliers and do not yet manufacture these locally, due to their high complexity.

Regarding the number of OEMs in Turkey, this has increased from 5 in 2009 to 9 in 2020. Nordex, Enercon, Vestas, GE and Suzlon were all active in 2009. While Siemens Gamesa, Sinovel, Goldwind and Senvion entered the market after 2009. What is interesting here is that the only Asian OEM to enter the market before the introduction of the LCR is Suzlon, which entered in 2009, while both Chinese OEMs Sinovel and Goldwind entered after its introduction, respectively in 2013 and 2019 (TUREB, 2020). Lastly, the number of employees in the sector also is a measure of determining whether the LCRs might have contributed to more employment in the wind turbine manufacturing sector. Although no employment figures for 2009 have been found, in 2020 the wind energy sector in Turkey reportedly employed 13,300 people in total (IRENA, 2020).

6. Conclusions and Policy Recommendations

In this chapter, the research question and sub-questions will be answered to determine if the study has realized its objectives, and policy recommendations will be provided based on these conclusions.

6.1 Research conclusions

The main objective of this study was to investigate the role played by LCRs in Turkish renewable energy policies to develop a domestic wind turbine manufacturing sector and the constellation of factors that have influenced the effectiveness of the industrial policies, including the LCRs. The research question that was established based on this objective was 'What has been the role of Local Content Requirement policies in the development of a domestic wind turbine manufacturing sector in Turkey and how can this be improved?' This question will be answered on the basis of five sub-questions.

6.1.1 The goals and objectives of LCRs in the Turkish wind energy sector

The first sub-question is 'Why are Local Content Policies utilized in Turkish wind energy policy?'. In this study, it has become clear that the Turkish government has implemented the LCRs in Turkish wind energy policies mainly as an economic strategy. The government aims to strengthen its balance of payments and stabilize the value of the Turkish Lira by decreasing the flow of currency out of the country. It is creating domestic wind energy capacity so that it can procure the domestically generated wind energy and decrease its energy dependency. However, by the implementation of the LCRs and by creating favorable investment conditions for the manufacturing of wind turbine components, the government is attracting knowledge into the country and is creating a wind energy sector which can eventually become largely independent from foreign companies. To that extent, the objective is to develop a knowledgeable labor force in the manufacturing of wind turbines in order for the sector to become competitive internationally and to not only create a production hub for national production and consumption, but also an industry focused on regional exports. This, in turn, will benefit the value of the Turkish lira in the longer term. After all, as the country has to focus on strengthening its export competitiveness in strategic sectors in which they can position themselves well, and the wind energy sector is one such sector with a lot of potential. The development of the wind energy sector can therefore help to address energy dependency and to strengthen the balance of payments. Thus, it seems that the Turkish government is utilizing green industrial policy and focusing on green industrialization mainly as a route to a better economic position. It has set goals for the development of the wind energy sector itself and has utilized LCRs to create favorable conditions, but the main reason still seems to be economically motivated.

6.1.2 The effectiveness of LCRs and assessment thereof

The second sub-question is 'What can be said about the effectiveness of these LCRs for wind turbine manufacturing localization, and how can this be assessed?'. In this study the effectiveness of the LCRs has been quantified by comparing the companies active in wind turbine component manufacturing in Turkey in 2009 with the companies in 2020. The number of OEMs in Turkey has increased from five in 2009 to nine in 2020, while the total number of turbine component manufacturers has increased from five to sixteen in the same period. The number of manufacturing companies has increased for each component for which a FIT premium for local production was given. The largest increase has taken place in wind turbine tower production, followed by the production of blades, generator and power electronics and mechanical equipment in the rotor and nacelle. It is interesting to note that of the tower manufacturing companies most are of Turkish origin, while the blade manufacturing companies are all of foreign origin. Furthermore, a certain extent of technological upgrading or an increase in the technological complexity of the components locally produced seems to be taking place. The tower manufacturing companies were mostly established between 2000 and 2018, and while the first company to manufacture blades locally was established in 2002, the other three companies only arrived after 2012. And now most recently, Siemens Gamesa opened a facility for the manufacture of the nacelle, another component higher in complexity than towers.

Hestermeyer and Nielsen (2014) have concluded that LCRs could be an efficient tool in building and sustaining a national industry, but there are also risks to the use of LCRs, and one of the main practical problems is that they may help to start up an industry but soon become a measure of government perk which sustains an increasingly inefficient industry. Thus, governments should carefully analyze the legality and economic benefits of the scheme and the difficulty to end such schemes should be considered and an exit strategy should be developed before it becomes difficult or impossible to exit an economically unviable strategy. If the situation in Turkey is compared with these outlined situations, it can be concluded that indeed, the implemented LCRs have helped to start up a domestic wind turbine manufacturing sector, but in the empirical case study many interviewees were concerned with the continuity and ultimately the exit strategy regarding the LCRs. As such, the Turkish government should be aware of the looming dangers of the policy becoming inefficient, and the introduction of new incentive mechanisms in 2021 must be properly designed to ensure continuity and to prevent the sector from becoming bogged down. Furthermore, an exit strategy will have to be designed, this has not been done to date, and should be done before exiting from an economically unviable policy will become too difficult or impossible[5].

6.1.3 Key conditions that have influenced the effectiveness of the LCRs

The third sub-question is 'What are the key conditions that have influenced the effectiveness of the LCRs?'. In this research, three explanatory factors have been identified through a combination of utilizing relevant literature and by analyzing the empirical results. These three explanatory factors partly explain or have influenced the effectiveness of the LCRs in the Turkish wind turbine manufacturing sector.

Firstly, the local context has been of influence, as the environmental and economic surroundings of the Turkish LCRs have been important in the establishment of a local wind turbine manufacturing industry in Turkey. Turkey is located in a strategic position in the Global Production Network for wind turbines, as it is located at the intersection of Europe, Africa, Asia and Russia. Moreover, Turkey itself also has preferable environmental conditions, as the western part of Turkey has good properties for wind energy generation as well as the right capabilities for hosting a wind turbine manufacturing sector. As such, the western part of Turkey, especially the Izmir region, is recognized as a cluster for wind turbine manufacturing and wind energy generation.

The Turkish strategy for renewable energy has mainly been motivated by economic reasons. Turkey's economic strategy has shifted from an ISI strategy to an ELG strategy in the 1980s, but since then there has been too little focus on policies for technological learning and education of qualified engineers. Moreover, the country has had fluctuating macro-economic policies which did not control inflation properly, causing the country to be structurally risky for investors, and the weak balance of payments position further aggravated Turkey's high import dependency. The country's recent focus on decreasing its energy dependency by focusing on increasing the procurement of domestically generated wind energy, generated with partly domestically produced turbines, could be an indication of Turkey recognizing and trying to solve these shortfalls. However, the current economic situation and depreciation of the Turkish Lira poses a threat for the continued development of the sector, as the depreciation of the Turkish Lira is a concern for investors who are better off financially by agreements in hard currency.

Secondly, the role of the design and implementation of the LCR itself is assessed by means of the operationalized indicator framework developed by Hansen et al. (2020), With regards to the design and coherence of the LCRs, it can be concluded that the prices in the FIT and the premium for local content are essential in attracting the interest of investors. Moreover, the price and purchase guarantee provided in the LCR by means of the FIT in the YEKDEM mechanism and through price and purchase guarantees in the YEKA mechanism are found to be important to investors, as this provides demand and price security. There are however concerns related to the period after these price and purchase guarantees

[5] The text discusses the situation in December 2020, the new incentive mechanisms discussed in the text might have already been announced or introduced by the time of publication of this study.

come to an end, due to the instability of the Turkish economy and the Turkish Lira. Moreover, there are concerns related to the continuity and sustainability of the policies in the years to come, as the market should at a certain point become competitive against foreign countries and the LCRs cannot be in place forever. Moreover, the lack of prospect on the new incentives as well as the lack of an exit strategy concerns interview participants.

The 2020 wind energy generation capacity of Turkey is 8288MW, with an additional 1329MW under construction. The size of the wind turbine component manufacturing industry measured in terms of the number of companies is 16, and the total wind energy sector currently employs 13,300 people (IRENA, 2020). Due to the significant size of the domestic generation and manufacturing capacity, the wind energy sector in Turkey is considered an established market. However, the stability of the sector remains an issue, which is mainly caused by the lacking competitiveness of domestic materials compared to foreign materials in terms of price, quantity and quality.

The restrictiveness of Turkish LCR policy varies between the LCR implemented under the YEKDEM and YEKA mechanisms. Under the YEKDEM mechanism the LCR is not a requirement but a carrot policy which aims to attract investors through a premium on top of the FIT. Within the YEKA tenders, the incentives for local content are actual requirements, as the winning bidders have to comply with the rules for local content. The minimum rate of local content in the LCR under the YEKDEM mechanism is 55%, while in the YEKA tenders this was respectively 65% and 55% in the first and second tender. Manufacturing companies in Turkey operate separate supply chains for products deemed for the domestic and export markets. Moreover, it has become clear that some raw materials can still be sourced from abroad but depending on the processing that is performed in Turkey on these materials, they can still sometimes be considered local content.

With regards to the domestic industrial base in Turkey, it can be concluded that this has provided the country with the right capabilities to localize tower and blade manufacturers, as indicated by the increases in the number of manufacturers for both components. The relatively solid technological capabilities present in Turkey, present through the experienced automotive and construction sectors, are beneficial to manufacturing companies. Moreover, there are indications that Turkey is on the threshold of a new state of localization, as the regional manufacturing cluster is upgrading to a more complex role within the GPN as it starts to make use of a certain established knowledge base that has developed over recent years and starts to get involved in the localization or domestic manufacturing of more complex components in addition to the already localized component manufacturers. However, for this transition to be successful the issues regarding the price, quantity and quality of domestic materials need to be solved, as the Turkish sector seeks to gain international competitiveness.

The third and final explanatory factor that has been investigated regarding its influence on the LCRs and their effectiveness is governance. Three levels of governance have been identified in the fostering of the Turkish wind turbine manufacturing sector. Governance on the firm level, governance on the level of local development agency and governance at the state level. The OEMs in Turkey utilize follower sourcing strategies by requesting their international suppliers to also establish in Turkey in order to meet the conditions of the LCRs. On the one hand, this provides benefits to the sector as it becomes more diverse and international and gains interest of international investors. On the other hand, this also introduces difficulties for domestic companies, as the OEMs usually have trustful relationships with their suppliers and do not easily engage with smaller Turkish firms. However, the nature of the LCRs also force the OEMs and other foreign companies to collaborate with the domestic Turkish firms, and the spinoff effect occurring as a result of the establishment of international companies are both positive effects for the development of the sector. Regarding governance on the local level, a local development agency has played a prominent and pro-active role in policy creation and implementation, of which the consequences for the fostering of the wind turbine manufacturing sector have been tremendous. As such, this local development agency has taken up the act of governing on the local level and this has really yielded positive results for the fostering of a domestic wind turbine manufacturing sector. Lastly, regarding governance at the state level, it can be concluded that Turkey acts as a buyer through procurement of domestically generated wind energy, by which it aims at decreasing its energy dependency while simultaneously strengthening the Turkish Lira and its balance of payments. Moreover, it is possible that the Turkish state is aiming for the wind turbine manufacturing sector to become export-oriented in an additional attempt to strengthen the export competitiveness of the country and stabilize the country's economic situation.

6.1.4 Contribution to the academic field

The fourth and final sub-question is 'How can this study contribute to the academic field of studies that focus on the effectiveness of LCRs in developing economies' green industrial policies?'. The academic contribution of this study lies in several areas. Firstly, the indicator framework developed by Hansen et al. (2020) has been applied in an empirical setting, which has provided insights into its applicability and completeness and has proven to be a valuable tool in assessing the effectiveness of LCRs. Furthermore, the study has answered to Horner's (2017) request to deepen the research into the dynamics of state roles within GPNs by considering the role of the Turkish state in the wind turbine manufacturing GPN and the development of a wind energy sector in Turkey. Furthermore, by looking at governance on the firm and local development agency level, the roles of different actors in the wind turbine manufacturing GPN have also been found to be of interest when investigating LCRs and their effectiveness.

In addition to the above, this study has used the Product Complexity Index for wind turbine components, developed by Surana et al. (2020), as a means to quantify the effectiveness of LCRs in the Turkish wind turbine manufacturing sector. This is a refreshing approach, as studies in this field generally use more descriptive information and add some information about employment and value added or the number of companies to analyze the effects of LCRs. In that respect, this study is innovative and provided a new method to analyze the effectiveness of LCRs, as it combines the number of companies with the product complexity of components to determine whether the complexity of the components plays a role in their localization. The PCI is considered to be a better indicator of technological production capabilities in the sector, more than the descriptive measures used in previous studies.

6.1.5 Conclusions

In conclusion, the main research question of this study 'What has been the role of Local Content Requirement policies in the development of a domestic wind turbine manufacturing sector in Turkey and how can this be improved?' will be answered.

The LCRs in Turkey have contributed to accelerating the establishment of a domestic wind turbine manufacturing sector in Turkey. The number of manufacturing firms for wind turbine components have increased for every component of a wind turbine. The domestic wind turbine manufacturing sector contributes to the fast growth of Turkey's wind energy generation capacity, as the Turkish government looks to decrease its energy dependency. Furthermore, the LCRs have realized to increase the number of manufacturing firms to such an extent that their products are now exported as supply exceeds domestic demand. This plays into the strategy of the Turkish government, as it is likely that they seek to establish a competitive export sector in which they can position themselves well in order to stabilize the balance of payments. To that extent, the Turkish government is pursuing green industrialization as a strategy to improve their economic situation. Due to the increased number of manufacturing firms for wind turbine components, 13,300 people are currently employed within the wind energy sector in Turkey and a knowledgeable workforce is being fostered in the field of wind energy technology. Moreover, the role of the LCRs in the YEKA mechanism has been very concrete, as this has led to the use of 65% and 55% domestic materials for the turbines to be placed as part of the contracts auctioned, and the Siemens Gamesa nacelle R&D facility has been established as a result of the LCR. In this facility 50 engineers are employed, from whom 80% of Turkish origin.

To show the impact relations of this study, figure 11 has been established. This figure shows the relations between the enabling factors, the effectiveness of LCR policy and the societal impact thereof. The core focus of this study was on the role of LCRs in the development of a domestic wind turbine manufacturing sector, but by researching this it has become apparent that there are societal impacts involved as a result of the use of LCRs. These are the aims that the Turkish government is pursuing by using this strategy, and includes improving the balance of payments, establishing an internationally competitive position with their promising wind energy industry, and reducing energy dependence. The figure below shows how these societal outcomes relate to this study.

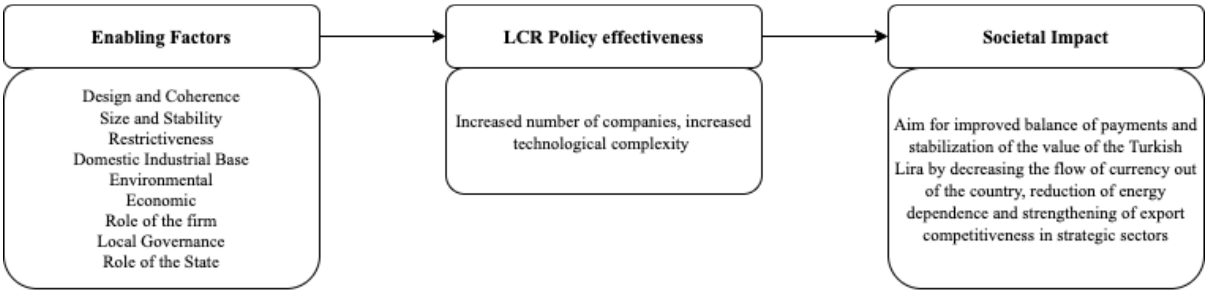

Figure 11 Impact relations between the enabling factors, LCR Policy Effectiveness and the Societal Impact..

But, despite the fact that the LCRs have helped to establish a domestic manufacturing sector for wind turbine components, there are also concerns about the continuity of the policy and the competitiveness of the sector compared to foreign countries. As such, in the use of LCRs in the Turkish wind energy sector there is still room for improvements. Considerations should be given to the development of an exit strategy, to avoid the economic impossibility of leaving the policy, and to the situation after the LCRs expire. Furthermore, better perspectives should be provided regarding the development of the policies. A more open consultation climate may well help to support companies, while this can also be important for the government to know well what the companies are struggling with, or what they are doing. In this way, the policy can be adjusted accordingly, based on a good understanding of the situation.

6.2 Policy recommendations

Several policy recommendations can be given based on this study. From the empirical case study, it has become apparent that continuity in the policies is important for investors and manufacturing companies. A recommendation for policy makers therefore is to increase the level of continuity provided by the policies, as continuity is important in the sense that a policy instrument must be in place for some time and be consistent in order to analyze the effects of its implementation. The failure to provide continuity in the policy also poses an additional risk. As explained earlier, the number of applications for WPPs increased significantly in 2020 because the incentive mechanism originally expired at the end of the year. Investors who still wanted to take advantage of the incentives quickly applied for projects, and demand for production companies increased as a result. However, these manufacturing companies have also expressed concerns about the demand after they finish producing the turbines that investors need for the projects they applied for in 2020. It is likely that the industry will grow rapidly in the coming years due to the large number of applications and the large number of turbines to be produced as a result. A possible consequence of this is that the government may not have a realistic picture of the growth of the sector, because it is now suddenly growing very rapidly in the coming years due to the lack of continuity that was initially provided and due to investors, who quickly applied for projects before the incentives expired. This could result in the government thinking that things are going very well and wanting to ease policy in a few years, but the sector may not have matured to the point of significant growth.

However, in practice this continuity can be difficult to implement, as policy makers learn over time what the results and effects of specific policies are, the contextual factors change over time and the industrial sector continuously develops. It is likely that policy makers have struggled with providing continuity in the past for these reasons. It might be necessary to adjust the policies based on these changes in the contextual factors or the development in the industrial sector, for example the height of the FIT. Adapting the policies based on changes in the developments in the sector is closely related to the second policy recommendation, which relates to more certainty about how the policy is going to evolve, so that companies can better anticipate upon these changes.

As explained, the Turkish policies including the LCRs do not offer an outlook towards the situation in the future, while most of the companies and investors realize that the current scheme cannot be in place forever. As such, a recommendation to policy makers is to be willing to keep learning, and to adjust the policies when necessary. This requires flexibility on the part of policy makers whereby the state of the sector and the effects of the policy are monitored closely. A more open consultation climate between the government and companies in the sector could help in this respect and provide the government with insights on basis of which policies can be tailored as well as provide companies with an outlook to the future situation.

The problem described above links well to the next policy recommendation, which is that policy makers should consider the development of an exit strategy to be able to leave the implemented policies. But again, the development of such an exit strategy is not an easy task. The main question here is; when is an industrial sector ripe for release and when is it no longer considered an infant industry? There are no clear rules, and it depends on the technological complexity within this sector (i.e., the extent of the capability building challenges.), and whether economies of scale play a large role in an industry. If that is the case, a certain minimum size of activity in the industry is important to realize before leaving the policies. The development of an exit strategy before implementation of the policies would be a solution to this, as governments could communicate clearly about the conditions at which the policies will be left behind before implementation of the policies, providing clarity to investors. In Turkey's case however, this is no longer possible and thus it is recommended that in the development of new incentive mechanisms for the future, such an exit strategy is at least mentioned, and that policy makers think about the conditions and criteria at which they consider the industrial sector to no longer be an infant industry. A gradual policy phaseout would also be an option to consider here.

Another policy recommendation is to foster both the emergence of new suppliers as well as the evolution of existing ones. In Turkey, the number of companies in the components with lower technological complexity increased the most, and there have been indications that several manufacturing firms have been busy with innovation and R&D as well. As such, by focusing on both the emergence of new suppliers as well as the evolution of existing ones, companies that work on the relatively simpler components will keep emerging, while other, more sophisticated companies can devote more attention on developing more complex components and concentrate more on innovation and R&D, and no longer need to spend time on manufacturing components of lower technological complexity, since there is a steady base of emerging firms which indulges in this. This can result in the sector as a whole becoming more developed. In addition, this plays into the aforementioned "spinoff effect", where employees of the OEMs go into business for themselves and become suppliers to the OEMs for specific components. Supporting these entrepreneurs also contributes to the development and upgrading of the sector.

Lastly, more attention should be devoted to the role of local development agencies. In the development of the Turkish wind turbine manufacturing sector, the role of a local development agency has been tremendous, as it was involved with the creation and implementation of the policies including LCRs. Moreover, this development agency has taken up an active role in the promotion of the sector to foreign investors and companies. The initiative shown by this development agency is a good example of how to put these kinds of incentives into practice. By involving local development agencies more actively, local and national benefits could occur, as the local differences and similarities between regions can be exploited. Local development agencies can also play a particularly interesting role at the local cluster level, e.g., through building local common facilities for technical testing, organizing training courses relating to quality improvement, disseminating information about industry trends and news, organizing trade fairs, organizing matchmaking between OEMs and potential suppliers and so on. As such, it is recommended to involve such agencies more actively.

7. Discussion

In this study, a theoretical framework was developed and applied in an empirical case study. In this framework, the object variable was the effectiveness of LCRs, which was explained by three explanatory variables that have been determined based on literature and have been recognized in the empirical case study. The explanatory variables are based on literature on the use of LCRs in developing countries and literature on Global Production Networks. Based on this literature, the framework proposed three variables: the first variable assesses a set of factors conditioning the effectiveness of LCRs using four enabling factors, the second variable takes into account the local in which LCRs are implemented, and the third variable takes into account the governance related to the implementation of LCRs at three different levels. This is an innovative approach because it has drawn explanatory factors from different areas of the literature and has combined this into one framework.

Moreover, this study has applied the indicator framework developed by Hansen et al. (2020) in an empirical setting, and has expanded upon it by including perspectives on the local context and governance. By doing so, this study has provided a more comprehensive analysis of LCRs in an empirical case study than previous literature. It has thereby also met the request by Hansen et al. (2020) to expand their framework with additional factors of importance and contributes to the development of a common framework and methods to assess the role and effectiveness of LCRs in green industrialization.

Furthermore, the Product Complexity Index has proven to be a good tool for comparing the complexity of components that manufacturing firms produce at two different points in time. It provides clear argumentation about the complexity of different components and then provides guidance for drawing conclusions based on complexity. This is a useful finding, and the PCI can be used for similar purposes in future studies. Furthermore, by using the PCI developed by Surana et al. (2020) to determine the effectiveness of LCRs, an innovative method has been developed which is able to quantify the effectiveness of LCRs to a certain extent, and which is able to include a perspective on technological capability building in the assessment of LCR policy effectiveness. In this study, no time was spent developing PCI scores, but the scores were adopted from Surana et al. (2020), in an ideal situation scores would have been developed for this study itself, which could also be a recommendation to future studies.

In addition to the above, it was also explained in Chapter 5.3.2 that Gordon (2013) and van der Ven et al. (2017) had found that local governments constitute sources of sustainable leadership, dynamism and innovation. This study endorses their findings, as a local development agency was the initiator behind the implementation of policy incentives for renewable energy and had taken up an active role in the promotion of the sector to foreign investors and companies. Also, this study shares the conclusions of Hestermeyer & Nielsen (2014), who have warned for the looming dangers of LCR policy becoming insufficient, after which it is too difficult or impossible to exit an economically unviable strategy, causing the sector to bog down.

One aspect that deserves more attention with regards to the wind energy industry in Turkey, is the implementation of a complete landscape analysis of all the companies and institutions which participate and conduct business in the field of wind energy in Turkey. It has been difficult, and has cost a lot of time, to get a clear overview of all the relevant companies and institutions in the sector. Many different sources have been consulted to get to the overview provided in this study, but still the feeling remains there are companies which are involved with wind energy in Turkey but are not named in this report. Furthermore, it was also chosen to not include service companies in this study, because it would then become too big a task and because service tasks are distributed among a large number of companies which are often difficult to reach. A complete landscape or sector analysis could provide a clear overview of all relevant actors in the sector, it could be similar to the 'Wind Energy Ecosystem overview Izmir' provided in Annex II, but then on a national level. This would provide companies and policy makers with insights as to which companies are established where and for what reasons and would ease decision making processes as well as be helpful for researchers investigating the sector. Furthermore, the availability of a better overview of the sector would allow for more or easier quantitative analyses. In general, it has been found that quantitative data was difficult to assemble, especially value-added data for different years would have been useful, as well as data about the skill levels of the people employed or R&D investment figures. This complicated the quantification of LCR policy effectiveness. If this kind of information would be more readily available, this would be interesting for researchers which focus on this sector, but also for policy makers which seek to determine the effects and effectiveness of their policies, which can help them in evaluating their policies and updating it when necessary.

With regards to data gathering, there are several points of reflection. Firstly, the study has been limited due to the measures in place in response to the COVID-19 pandemic. The researcher has not been able to visit Turkey and owing to that limitation it immediately became more difficult to establish contacts with companies and relevant institutions. As a result of not being able to travel to Turkey, the interviews were conducted through online video conferencing tools. This did not have all too seriously negative consequences for the study, but in general, physical interviews are often more natural and can also give an impression of the environment, which is currently lacking. Also, because of these limitations, there have been no company visits, and it has therefore been more difficult to determine the relationships between different companies. Moreover, although a certain extent of saturation already occurred in the interviews and a good overview of the sector was provided through the interviews, it could have been beneficial to have conducted several more interviews, especially interviews with policy makers and local SME suppliers of products and services would have been an interesting addition.

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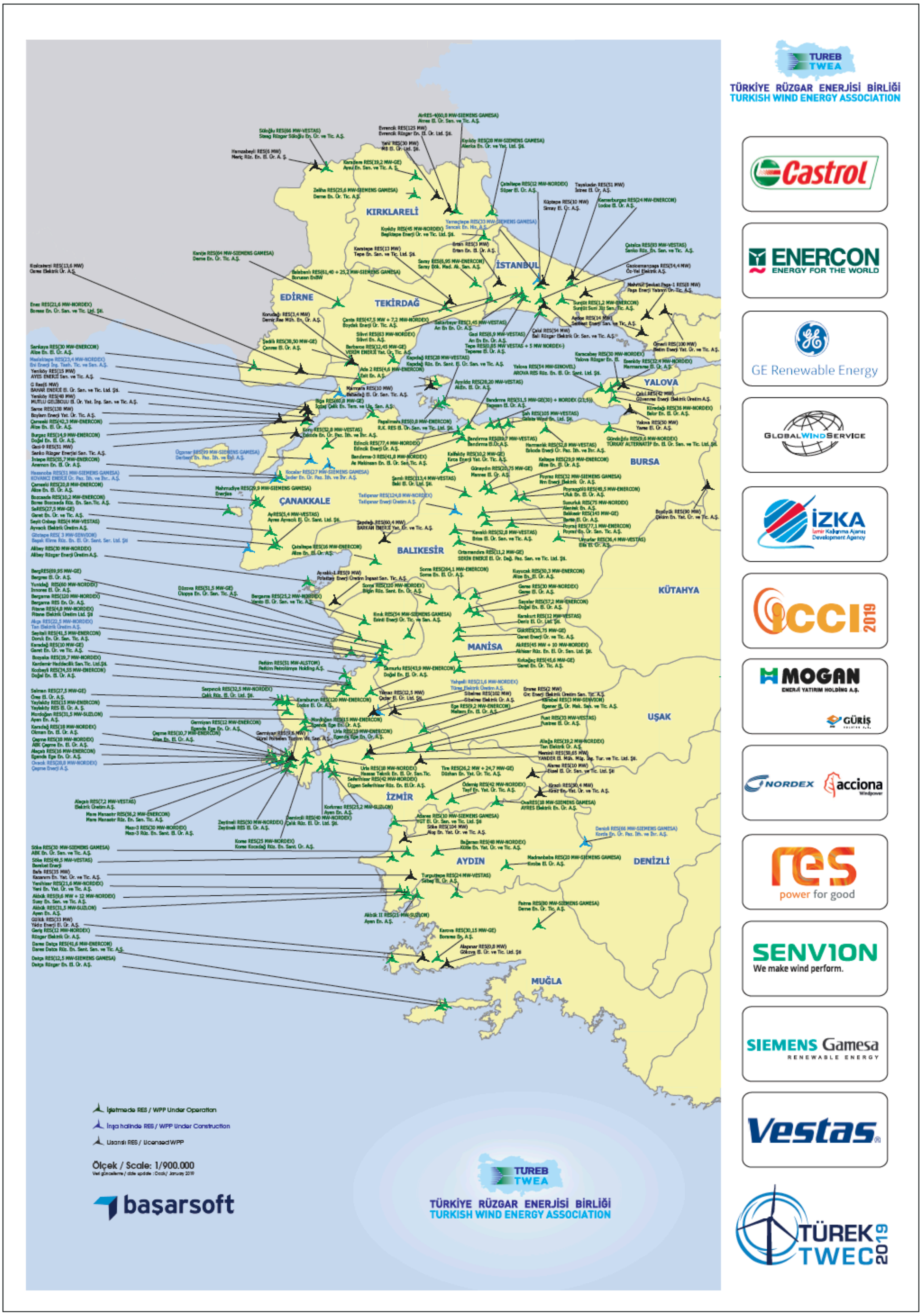
Appendices

Appendix I, Turkish Wind Power Plant Atlas 2019

Appendix Ia, Wind Power Plant Atlas of Turkey

Appendix Ib, Wind Power Plant Atlas of Western Turkey



Appendix II, Wind Energy Ecosystem overview Izmir

INVEST in İZMİR

İzmir

İZMİR WIND ENERGY CLUSTER ECOSYSTEM

MANUFACTURING

Nacelle
- SIEMENS Gamesa RENEWABLE ENERGY

Blade
- ENERCON ENERGY FOR THE WORLD
- tpi COMPOSITES
- LM WIND POWER

Tower
- ATES WIND POWER
- CS WIND
- WEC Kule

Gearbox
- tibet Makina Sanayi ve Tic.A.Ş.
- dirinler Döküm Sanayi ve Ticaret A.Ş.

Generator
- ATES WIND POWER
- ENERCON ENERGY FOR THE WORLD

R&D Center
- SIEMENS Gamesa RENEWABLE ENERGY
- tpi COMPOSITES
- nortneL

Material
- JSB
- SAERTEX
- METYX

REPUBLIC OF TURKEY MINISTRY OF INDUSTRY AND TECHNOLOGY

REPUBLIC OF TURKEY MINISTRY OF ENERGY AND NATURAL RESOURCES

EPDK REPUBLIC OF TURKEY ENERGY MARKET REGULATORY AUTHORITY

TUREB TWEA TÜRKİYE RÜZGAR ENERJİSİ BİRLİĞİ TURKISH WIND ENERGY ASSOCIATION

İZMİR DEVELOPMENT AGENCY

INVEST in İZMİR

İzmir

İZMİR WIND ENERGY CLUSTER ECOSYSTEM

MANUFACTURING

Component

dirinler Döküm Sanayi ve Ticaret A.Ş.
SAY
HAMAX EUROPE
GİMAS
HYTORC
SİSTAS
ELTAS
Gaspa
symplast
tuboplast sanayi ve ticaret a.ş
REMO
alpar
Aysar Makina Industrial Friction Materials
ÖRNEK
TRIO COMPOSITES
Kompotek
nga plast
USteel
KREA
LMC
TESUP
Sümer
REL makina

Platform

XGEN
ABP ENERGY

Fastener, Link

NORM CIVATA

Other

GÜRALP
NALBANTOĞLU Hırdavat San. Tic. Ltd. Şti.
EFES
KANAT PAINTS & COATINGS

REPUBLIC OF TURKEY MINISTRY OF INDUSTRY AND TECHNOLOGY
REPUBLIC OF TURKEY MINISTRY OF ENERGY AND NATURAL RESOURCES
EPDK REPUBLIC OF TURKEY ENERGY MARKET REGULATORY AUTHORITY
TUREB TWEA TÜRKİYE RÜZGAR ENERJİSİ BİRLİĞİ TURKISH WIND ENERGY ASSOCIATION
İZMİR DEVELOPMENT AGENCY

INVEST in İZMİR

İZMİR WIND ENERGY CLUSTER ECOSYSTEM

INSTALLATION, OPERATION AND MAINTENANCE

Maintenance

Ascent Systems

Assembly

Logistics

Safety

Crane

INVEST IN İZMİR

İzmir

İZMİR WIND ENERGY CLUSTER ECOSYSTEM

CONSULTANCY AND SOFT SERVICES

Project Development

ENISOLAR
egeres
CPC Germania – The Clean Power Company
XGEN
VRES
iTerra energy

Measuring

ENISOLAR
GENBA
egeres

Certification

MMO KALMEM
TÜRK LOYDU
TSE

Online Training

windbaba

Engineering

ARI-ES ENERJİ
DNV·GL
UL DEWI
GENSER
u-sens
VERK
Üstün Energy
SMARTCON
JbS
enercast
BES ENERJİ
RENEWATT
VENTIRA
ALFANORM

REPUBLIC OF TURKEY MINISTRY OF INDUSTRY AND TECHNOLOGY

REPUBLIC OF TURKEY MINISTRY OF ENERGY AND NATURAL RESOURCES

EPDK – REPUBLIC OF TURKEY ENERGY MARKET REGULATORY AUTHORITY

TÜREB TWEA – TÜRKİYE RÜZGAR ENERJİSİ BİRLİĞİ – TURKISH WIND ENERGY ASSOCIATION

İZMİR DEVELOPMENT AGENCY

INVEST in İZMİR

İZMİR WIND ENERGY CLUSTER ECOSYSTEM

POWER GENERATION

Independent Power Producers

Petkim · Tüpraş · Kardemir · enda Enerji Holding AŞ · ABK Çeşme RES · Kutlu Enerji

Utility

TEİAŞ · TEDAŞ · GDZ Electricity Distribution

Renewable Energy Cooperatives

İzmir Enerji Kooperatifi · SEYEKO

Republic of Turkey Ministry of Industry and Technology · Republic of Turkey Ministry of Energy and Natural Resources · EPDK Republic of Turkey Energy Market Regulatory Authority · TÜREB TWEA Türkiye Rüzgar Enerjisi Birliği Turkish Wind Energy Association · İzmir Development Agency

INVEST in İZMİR

İzmir

İZMİR WIND ENERGY CLUSTER ECOSYSTEM

SPECIAL INVESTMENT ZONES

Organized Industrial Zones

ALOSBİ
BAYOSB
BOSBİ
B.E.G.O.S.
İTOB
İASOB
KOSBİ
İZMİR PANCAR ORGANİZE SANAYİ BÖLGESİ
KINIK
MENEMEN PLASTİK İHTİSAS Organize Sanayi Bölgesi
ÖDEMİŞ OSB İZMİR
TOSBİ
TORBALI OSB

Free Zones

ESBAŞ EGE SERBEST BÖLGE KURUCU VE İŞLETİCİSİ A.Ş. AEGEAN FREE ZONE DEVELOPMENT & OPERATING CO.
İZBAŞ İZMİR SERBEST BÖLGESİ

Technology Development Zones

teknoparkizmir "tech together"
EGE Teknopark
DEPARK
izmir bilimpark

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İZMİR WIND ENERGY CLUSTER ECOSYSTEM

OTHER INSTITUTITIONS

Public Institutions

İZMİR METROPOLITAN MUNICIPALITY

KOSGEB

İZMİR DEVELOPMENT AGENCY

INVEST IN İZMİR

Start in İzmir

Chambers and Unions

EBSO

UCTEA Chamber of Electrical Engineers

UCTEA Chamber of Civil Engineers

UCTEA Chamber of Survey and Cadastre Engineers

AEGEAN EXPORTERS' ASSOCIATIONS

İESOB

UCTEA Chamber of Mechanical Engineers

UCTEA Chamber of Environmental Engineers

UCTEA Chamber of City Planners

Universities

EGE UNIVERSITY

DOKUZ EYLÜL ÜNİVERSİTESİ

İZMİR INSTITUTE OF TECHNOLOGY IZTECH

İZMİR KÂTİP ÇELEBİ UNIVERSITY

İZMİR UNIVERSITY OF ECONOMICS

YAŞAR UNIVERSITY

UNIVERSITY OF BAKIRÇAY

NGOs

ENSİA

Çevreci ENERJİ Derneği

Vocational Education

Foça Cemil Midilli Vocational and Technical High School

Events - Media

İZMİR RÜZGAR SEMPOZYUMU ve SERGİSİ

GreenTech İzmir

İzmiRüzgâr

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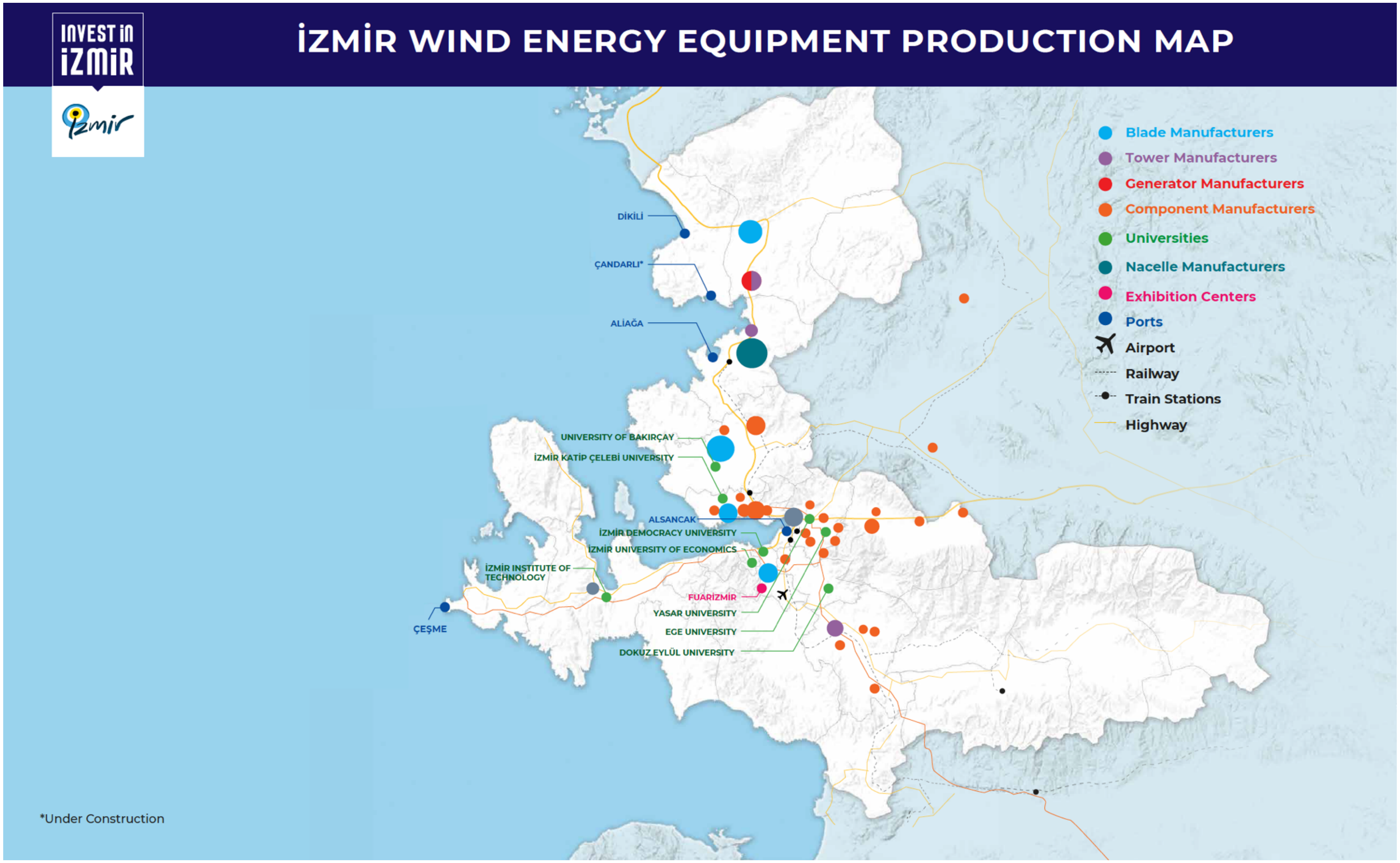
İZMİR DEVELOPMENT AGENCY


INVEST IN İZMİR
İzmir
İZMİR WIND ENERGY EQUIPMENT PRODUCTION MAP
Blade Manufacturers
Tower Manufacturers
Generator Manufacturers
Component Manufacturers
Universities
Nacelle Manufacturers
Exhibition Centers
Ports
Airport
Railway
Train Stations
Highway
DİKİLİ
ÇANDARLI*
ALİAĞA
UNIVERSITY OF BAKIRÇAY
İZMİR KATİP ÇELEBİ UNIVERSITY
ALSANCAK
İZMİR DEMOCRACY UNIVERSITY
İZMİR UNIVERSITY OF ECONOMICS
İZMİR INSTITUTE OF TECHNOLOGY
FUARİZMİR
YASAR UNIVERSITY
EGE UNIVERSITY
DOKUZ EYLÜL UNIVERSITY
ÇEŞME
*Under Construction

Appendix III, List of interview dates and times

Interview	Date of interview	Actor description	Interviewee function
A	*29-9-2020*	*A supplier for the energy sector established in Istanbul to provide Crane and Manpower for installation of Renewable (Wind turbines, Solar), Thermal power plants (Gas power) and energy constructions in general*	*Managing director*
B	*29-10-2020*	*Freelance consultant*	*Freelance consultant*
C	*06-11-2020*	*Original Equipment Manufacturer (OEM)*	*Sales Manager*
D	*03-11-2020*	*Local development agency*	*Investment Promotion and support expert*
E	*12-11-2020*	*Original Equipment Manufacturer (OEM)*	*General Manager*
F	*18-11-2020*	*Turkish manufacturing company producing wind turbine towers*	*CEO*
G	*2-12-2020*	*Turkish manufacturing company producing wind turbine towers*	*General Manager*
H	*9-12-2020*	*Turkish company which operates in the field of wind turbine internals*	*CEO*
I	*14-12-2020*	*Turkish company which operates in the field of electricity generation, distribution and retailing in the energy sector.*	*Unknown*
J	*21-01-2021*	*Wind energy association*	*Regulation and Policy Manager*

Appendix IV, Data analysis matrices

Appendix IVa, Local Context Matrix

Local Context	Quote	Interpretation	Overall finding
Environ mental/ Natural	- "Turkey is well placed" (A) - "And Turkey is a very big potential, I would say. Yeah, the studies say that around 50 GW, actually, with approximately six point five, seven meters per second wind speed. And so, we say that Turkey is a very good wind potential, wind energy potential" (C) - "Because of the port, because of the logistic issues, because of the qualified personal in Izmir also the population and the other other ingredients so they selected Izmir as a production hub. After that, some local companies followed." (D) - "Actually, around 20 percent of the total installed capacity in wind energy is located in Izmir. And also, the most promising areas, the regions are Aegean region of Turkey, so it's located near Izmir also. So, Izmir is now the production hub of the sector, we can clearly say that" (D) - "We located in UK also, in Scotland, and there is targeting in Turkey, not only local market, we are targeting near Turkey, Greece, Italy, Ukraine, Croatia, Israel, and now also targeting main European countries. We can cover middle east also, Egypt, Irak, Iran." (G) - "in Turkey, there are huge potentials." (G) - "Yes the Izmir hub is good, Izmir is close to our company, 2 hour drive, and there are 5 or 6 different plants from industrial companies nearby so it is easy to work with skilled people" (H) - "factors that have been of influence on the development of the Turkish sector are: location, loss value against currency, global warming." (I) -	- Turkey is well placed for trade between different countries and continents - Turkey has a lot of potential for wind energy - Companies have selected Izmir as a hub for the production of wind turbine components because of the port, the strategic location and for other reasons. When the big companies came, other local companies also entered the wind turbine manufacturing sector. - Turkey is also a strategic location for this company which targets European markets, but can also cover the middle east from Turkey. - In turkey there is huge potential for wind energy - In Izmir there are multiple industrial plants nearby and therefore it is easy for this company to work with skilled people. - The location of the country, the fluctuation in the value of the Turkish Lira and the concern of global warming are named as factors that have been of influence	- Turkey has a good geographical location, both in terms of wind energy potential and as a strategic location between different countries and continents. - Izmir, on the western coast of Turkey, has grown into a hub for wind turbine component manufacturing thanks to its industrial base, ports, skilled people and wind energy potential.

		on the development of the Turkish wind energy sector	
Economy	- "The dependency of energy of turkey is really high, Russia do natural gas, petroleum, lots of things. Around 70% of energy demand is met from foreign resources. So, government is trying to create local energy production capacity. They have some strategies; they have some goals. So, to support it, it is not only environmental issues, but also an economical issue, it's an economical strategy." (D) - "I see green energy, brilliant future for green energy globally and in the region. In Turkey, we have always been fluctuating in every subject, every area, so we will have up and downs, but it will grow. So, the difficulty is to manage these ups and downs in Turkey all the time. But you have to work with such slim margins, and it becomes very difficult to handle up and downs. "(F) - "But the suppliers in Turkey are very poor" (G) - "And another risk; Currency (Euro and dollar so high). The public purchase guarantee is only 10 years. Then companies have to sell to the free market with Turkish Lira. The government withdraws the purchase guarantee as of 30.06.2021." (I) - "Greatest effect currency. Because the wind sector is addicted to the Euro and Turkish lira is losing against the Euro. If more material produced in Turkey, wind sector develops that much. Because many cost will reduce if be like that." (I)	- Turkey depends for 70% on energy imports, the government is trying to reduce this number, as such the strategy for wind energy does not only have an environmental motivation but also an economical one. - This participant sees a bright future for green energy globally and in Turkey. However Turkey always fluctuates and has many ups and downs in many aspects, this has to be managed well. - Turkish materials suppliers are poorer than foreign ones, their prices are higher and the quality of materials is lower. - There is concern about the competitiveness of the wind energy sector after the 10-year purchase guarantee ends due to the exchange rate of the Turkish Lira. - The greatest effect of LCRs is the stabilization of the currency, because more content will be produced in Turkey, which will help develop the wind turbine sector and costs will reduce.	- Turkey is chasing a renewable energy strategy partly for economic reasons, as it is trying to decrease the dependency of foreign energy. Moreover, the state of the Turkish economy, especially the low current value of the Turkish Lira is one of the main concerns for investors in wind energy sector. The LCRs could help stabilizing the currency exchange rate if more domestic energy is purchased.

Appendix IVb, Indicator Framework Matrix

Indicator Framework	Quote	Interpretation	Overall finding
Policy design and coherence	- “Price has to be right, have to have big developers who is willing to go with low profit. Lower return of investment. Borders are open, everyone can enter, the one who has cheap money wins.” (A) - "What I'm trying to say in this incentive mechanism the base FIT is already seven point three dollars per megawatt hour. So it's too attractive for international investors. With the local content, you would get actually additional incentives on top of the seven point three and you can increase your FIT up to nine point four actually, with the current localization improvements in Turkey" (C) - “So I believe if I were a policymaker, I of course this incentive mechanism is in has created a momentum in wind energy in Turkey and I certainly agree with that. But on the other hand, after a point and Turkey should also catch that competitiveness against China or other countries where the cost of components are much lower.” (C) - “Once the economy is strong, you can have this local content requirements to transfer to any other technology address around the country. But on the other hand, if economy's not that strong than in order to attract investment, in order to facilitate the investments in the country. I think, somehow you should give more incentives in terms of financing, maybe lower interest rates, etcetera, if you want to go along with the local content requirements” (C) - “But I think the sustainability of this model is a question mark from my perspective, in my personal opinion actually, because the regulations, we are waiting for the regulation, the new incentive mechanism, their discussing but it hasn't been declared” (C) - “I would say it is the biggest thing hindering localization in Turkey. Maybe lack of sustainability I would say. If this is achieved by the regulations, by the continuous regulations, then it would be a good thing.” (C) - “That’s why actually incentive mechanism, instead of incentive mechanism for the investors, maybe they can introduce a mechanism where they are introducing incentives for suppliers. For example, tax	- Big companies are winning tenders because they can afford small profit margins - The FIT and local content premium are very attractive for international investors. - The Turkish wind turbine manufacturing sector should start to focus on becoming competitive compared to foreign companies. - Local content should only be done when economy is strong, because if they economy is weak it is more difficult for the companies because the suppliers are poor, and investors are not so interested. - Sustainability of the wind turbine manufacturing sector is a concern because the incentive mechanism (YEKDEM) is ending and a new one has not been presented yet. - The biggest obstacle for localization is the lack of continuity in the regulations and incentives. - An incentive mechanism for the suppliers instead of the investors would be interesting	- The LCR policy is well defined with clear percentages and expectations, but the (in)consistency of the policy on the long term is a threat. - LCRs are considered to be more effective when the economy is strong, because when the economy is poor, so are the local suppliers and this has a negative effect of the development and quality of the sector. - The LCR policy design has created a situation where the focus is on

	incentives, more tax incentives, or for example cheaper loans for them to build factory here, something like that to attract them to come to Turkey. So that they become more competitive and Turkey can become a hub for manufacturing those goods. Instead of feeding on Turkish market maybe these Turkish suppliers can also compete with others in China so that the volume can be sustainable by this way." (C) - "So of course, local content requirement is a good thing, but on the other hand they should make sure that the investments is on wind energy. Once it is ensured, then local content should be an additional requirement, I believe. By this way, small manufacturers would also change their direction to wind energy I believe." (C) - "All I'm trying to say is yes, with change of institutions, with the new bill, with the new incentive mechanism they will create a continuity, but on other hand economy should be good so that these local content requirements work well in the country, otherwise most of the investors would not go for local content, just to have cheaper financing." (C) - "As far as I know, the feed in tariff defining each component and giving a bonus to each component if they use in manufactured in Turkey" (D) - "But one of the most driving or appealing to the investor is the additional incentive based on these blades and the towers." (E) - "So if we don't have any further subsidy for the local production, most probably our other facility is going to disappear in one or two years and until our last orders are finished." (E) - "financing always is important, and when you source the components from Europe, there are some export credits which has very good rates for the investment. So when you supply locally, it means that the eligible amount of the European source cheap credit will diminish, or will decrease. But on the other hand, your revenues is increasing in Turkey" (E) - "The reason we are busy with the local market is because the local incentive mechanism is expiring" (F) - "I'm pretty sure that if there was not a local content policy, then the global tower suppliers would maybe not invest in Turkey." (F) - "Exports will start next year: Not now, but next year, we are very busy for exporting. Until now we are focusing on domestic market. For next year, local market is not so active, so we are focusing on exports." (G)	because the competitiveness will be captured in comparison to foreign companies. - Local content should not be the main part of the policy but an additional requirement, as this would offer small manufacturers a better chance to also participate in wind turbine component production when they were not doing so before. - Local content requirements should be used when a country's economy is doing good, because otherwise investors will not participate. - One of the most interesting incentives for the investors is the local content premium on top of the FIT. - Without local content requirements it is likely that this company's facility will disappear after the last order are finished and there is no longer the need to be present in Turkey. - Financing is an important part in what companies decide to do, when they decide to come to turkey to produce local components this means that the amount of eligible	the domestic market at certain times and on the export market at other times because the incentive fort he domestic market is finished soon.. - Continuity and sustainability in the LCR design is considered a crucial element. - Some believe that without LCRs, foreign investors would not have been interested in investing in the wind energy sector in Turkey. Others do not rule it out. - The purchase guarantee has been an important element of the policy. - The sector needs to

	- “As I know, local content cannot go forever. Just to ……, to protect local business and local industry, for competitiveness, for increasing this industry, be efficient. The local content couldn’t go too long time.” (G) - “Turkey is supporting a lot of renewable energy, especially wind. But not all of the scopes, for example not mechanical internals or internal business” (H) - “Government give the purchase guarantee to companies with fixed energy price. Price is 7.3 US$-cents/MWh but if use more local produced component selling price may be higher. But this guarantees valid time just 10 years. After companies must sell the produced energy to free market.” (G) - “specific factor that is beneficial for the success in Turkey is the purchase guarantee that government has given to the industry” (G) - “The concern is not having this big load at the moment, but the concern is what is going to happen in 2022-23-24, but at the moment we have enough to live for the next two years, I can say for Nordex. But the 2022-23 will heavily depend on the new policy.” (E) - “After nearly 10 years of YEKDEM practice, Turkey managed to reach significantly higher local content with its local manufacturing capabilities. YEKDEM and coupled local content bonus worked like a catalyst to increase local production for components.” (J)	European export credits will decrease. - This firm if currently busy with the local market because the YEKDEM mechanism is expiring at the end of 2020 and no new mechanism has been announced yet. - This participant is quite sure that without LCR foreign tower suppliers would not have been interested to invest in Turkey. - This company focuses on exporting a lot of products next year because the local market for wind turbines is not so active. - Local content requirements cannot be utilized forever because at one point in time they need to be removed in order to make the companies in the sector competitive against foreign firms. - The local content premium is not offered for every part of the wind turbine. - The government provides a 10-year purchase guarantee with a fixed price. - This purchase guarantee is seen as a factor that has contributed to the effectiveness of the policy	become competitive compared to international competitors.

		- The concern for companies in Turkish wind turbine manufacturing sector is not the high demand of products. But the concern about future demand, which is dependent on new policy mechanism. - Turkey has significantly increased domestic wind turbine component manufacturing thanks to the YEKDEM mechanism and the local content premium.	
Market size and stability	- "Can you confirm that most of the production activities are located in the Izmir region? Yes, and one or two tower manufacturers in Ankara region." (A) - "We are a factory delivering outside of Turkey, mainly. Turkish market is not big enough, for us, to supply for the wind turbines in Turkey." (F) - "We cannot say it is stable, we cannot say stable ratios about the improvements each year. No, we cannot say" (H) - "There's a huge market. I think this market has enough space for Turkish companies and Chinese companies. It doesn't matter" (H) - "As i said we may not talk about saturation, but the efficient fields have decreased in the last years." (I) - "There is not yet enough local supply. If investors or government establish a factory for more local production it will be better." (I) - "The market is not stable enough yet, more local production and more qualified engineers and technicians could be an important factor in creating a more stable market. This decreases the need for European/foreign assistance" (I) - "If you have many turbines installed and you are a large capacity company, you may be part of the supply chain." (I)	- Most production facilities for wind turbine components are in Izmir - The demand within Turkey itself is not large enough fort his company so they also deliver outside of Turkey. - The Turkish wind turbine market is not stable as there are not stable growth ratios every year. - There is enough room in the market for both Turkish as well as foreign companies. - The most efficient locations for wind energy generation have mostly been used but there is not yet saturation in	- The Turkish wind energy market is not stable, improvements in local supply need to be made in order to become competitive to foreign markets and create stability. - The market is big enough for foreign and domestic companies.

		the wind energy generation market - There is not enough local supply of materials and thus more local factories would be beneficial - More local production and more qualified engineers could help stabilize the market and decrease the need for foreign assistance.	- The demand within Turkey is not enough to meet the supply provided by the domestic wind turbine component manufacturers, and thus they engage in exports quite a lot. - The supply of local materials is not enough to meet the demand of the domestic wind turbine component manufacturers.
Restrictiveness	- "Because we have a list of qualified suppliers around the world. And of course, in order to achieve 65 percent local requirement in YEKA, it's the must." (C) - "So the main difference between local content and the YEKA is this is the local content is not forcing the company is having a factory, they can use local components. But in the YEKA tender, government wanted the company to have a factory and also R&D centre, specific capacity they defined" (D) - "when they announce the new incentives we will see the level probably is not as high as before, they will decrease because the manufacturing capacity is somehow created and the companies are now exporting their goods to abroad also. So it's not really necessary to give the highest support for now" (D)	- Companies work with qualified and trusted suppliers, and to be able to meet the LCRs they motivate these suppliers to establish themselves in Turkey. - In the YEKDEM mechanism the local content is a premium on the FIT but it does not require companies to build a factory. In the first round of the YEKA tender mechanism, the winning bidder was	- LCR ratio of 65% and 55% in YEKA tenders 1 and 2. - 55% local content ratio in YEKDEM projects makes firms eligible for feed in tariff premium. - Sometimes, when firms

	- “for the YEKA tender, for …. and not …., as far as I remember, they won the tender so that the percentage has changed it is now 55 percent in YEKA tender two. And there is no obligation about opening a factory, but there is an obligation about using local equipment. With the percentage of 55.” (D) - “For the first phase, they asked us to fabricate in Turkey the tower. So only fabricating was enough to have a local tower. Which means that if we import plates, which is a major input, steel plates from abroad, it was not harming the local tower definition. I think this is good. This is the mathematics and everything works very good because you still keep the competition in material and it is good to have it local. So even though you don’t have in your local content a necessity sometime, another player in Asia cannot compete with you because you buy under the same conditions the raw material and then you do it locally.” (F) - “they are asking us to have 51% minimum local rates. It means that we have to source plates locally otherwise we cannot achieve this rate.” (F) - “For the export projects, we source most of the materials globally and supply most of it from global material suppliers. For the local projects, we supply part of it from global suppliers. Because each and every time we have to achieve the 51% local input.“ (F) - “Strong local content, 51% or 55% is local sourcing.” (G) - “So, yes, all the local projects there is a regulation , like 51 percent for the local projects and must be local and with the suppliers just like us and some cover builders or some blade manufacturers the OEMs are able to reach local content ratio.” (H) - “But then also there are some several huge government tenders, we can say, public tenders. On those, the regulation, the local content requirement is quite higher than normal ones. - For example, let's say the first tender was requiring almost 65 percent local content” (H) - “For the local content, some raw materials we can source from abroad, but depending on the processing we perform on the material here in Turkey it can sometimes still be considered local content.” (H)	required to establish a R&D centre. - This participant expects that the premium for local content is not as high in a new incentive mechanism to be announced, because local manufacturing has been established and it is no longer needed to give high amounts of financial support. - In the second round of the YEKA tender the local content ratio was reduced to 55% and the requirement to build a R&D centre was removed. - For the local content requirement it is not necessary to buy everything locally. This is good because it allows companies a certain amount of flexibility which allows them to compete with foreign companies which. - Steel plates have to be sourced locally by tower manufacturers because this is a large amount of their material input and without sourcing this locally they cannot meet the LCR. - For turbine towers that are shipped abroad, there is no need to source materials locally, as such there are	apply rocessing onto foreign materials these materials can still be consiered local content, depending on the type of material and the type of processing. - Tower manufactuers have to meet 51% local content ratio in order for the OEM to be able to meet the 55% local content ratio from YEKDEM.

		separate sources and supply chains for towers that are sold domestically and internationally. - The amount of local sourcing done by tower manufacturers is 51% of 55%. - If the tower manufacturers adhere to a 51% local content ratio, the OEMs are also able to reach their LCRs. - The ratio for local content is higher in YEKA tenders than in the YEKDEM mechanism. - The first YEKA tender had a LCR of 65%. - The LCR allows for a certain amount of flexibility, as the processing steps that are applied to a material can also contribute to it being considered local content.	
Domestic industrial base	- "Construction, anker cables, etc comes from Turkish companies, because our construction companies are 2nd in the world after China." (A) - "And yes, this is this was our motivation, and we believe that this localization can be achieved. Because there is already a full field, there is already an ecosystem in Turkey, and on top of that we only add the components for nacelle." (C) - "I think positive aspects are, as you said, the local force or industrial base already developed." (C) - "The things that are hard to achieve in terms of localization will be, I believe, the volume." (C) - "Because of the port, because of the logistic issues, because of the qualified personal in Izmir also the population and the other other ingredients so they selected Izmir as a production hub. After that, some local companies followed." (D)	- Turkish construction companies are very good so they provide construction services and materials to the wind energy sector. - Companies believe that localizaiton in Turkey can be achieved because thee cosystem there is good for wind energy and wind turbine manufacturing. - A positive aspect about Turkey is the fact that the	- The domestic industrial base in Turkey was well equipped to host the wind turbine manufacturing sector. Since Turkey possessed knowledge and capabilities in the construction and automotive

	- “Manufacturing companies, as far as we know for last 20 years, we have really good manufacturing companies in defense and also aviation sector and also we have lots of OEM companies in automotive sector” (D) - “So it's really similar the producing process and also the general structure of the wind turbines. So it's really easy to transform these companies, their working areas, to the wind energy sector.” (D) - “There are some spinoff companies, which are really good for the region, for example some engineers from … they are leaving and they are opening their own companies. To sell some goods to ….. They are opening their own company. But after that, when they enter the supply chain, another company is also started working with these entrepreneurs,” (D) - “And when we go abroad and when we go with the bigger companies we also promote these companies, ‘these are our small companies but they are operating, they are selling their goods to the companies in the region’. Because its really important to involve the supply chain, the global supply chain, its really hard to enter. Probably you know that the certificated supply chain member being is really hard in the sector. Because the quality level and the expectations is really hard. So if an entrepreneur is leaving the global company and establishing their own company. And when they start to sell to this global company, they automatically enter the global supply chain. So its really good developments for the region, and we are trying to promote their successes in the news” (D) - “we just made wind tower seven years ago. And now we are proposing a new concept to the market, after seven years. This is one of the good things of local content policies.” (F) - “I would say that if there is a single source in a country, whatever it is, plain or boat, or plates or bolts whatever, it is good to keep it out of this concept. Because once there is a single source, it makes the tower more expensive” (F) - “We are trying to have a competitive advantage in this way, so by proposing new solutions and being innovative” (F) - “But, the suppliers in Turkey are very poor” (G) - “The big issue is local steel mill. There is only 1 steel mill, they cannot cover all local steel capacity that is required. So quality issue, price issue.” (G)	workforce and industrial base are already well developed. - One of the hardest things to achieve regarding localization will be the production volume. - Companies have selected Izmir as a hub for the production of wind turbine components because of the port, the strategic location and for other reasons. When the big companies came, other local companies also entered the wind turbine manufacturing sector. - Turkey has good manufacturing companies in the defense and aviation sector and a lot of OEMs in the automotive sector. - The production processes for these products are similar and therefore its easy to transform these companies into companies working on wind turbines. - Spinoff companies arise from the OEMs in Turkey. This is good because these spinoff companies have easy access to the global production network through their relationships with the OEMs. - These spinoff companies entering the global production	sectors and there were industrial ports and knowledgeable people in the region, making it a good location for the establishment of a wind turbine component manufacturing sector. - More stable supply of steel should’ve been established before implementing the LCRs, this would’ve helped the competitiveness of the sector. - Upgrading of the domestic sector has taken place as a result of the developments in the wind industry sector. - Spinoff companies

	- “So, during the local content efficient time, local supplier should be competitive, that’s what I know the meaning of local content” (G) - “Mainly the steel mill, the steel mill should be competitive.” (G) - “The bad side is more about the high price and low quality of local materials.” (G) - “Even if we don't get some huge amount of incentives, just like other scopes, we started and we continued our business in a really aggressive way, because if the government use some of our support to some scope business, then that means that industry is being established here, so that all of the players must be there.” (H) - “Turkish industry is one of the best, I guess, in this region, actually, because we have a sophisticated and experienced like the automotive industry, for example, we have and it's really strong and we have like steel and construction industry. So if you collect these figures together, then you can say that the supply chain and the production availabilities are like coming more easy to start a business.” (H) - “And there is good adaptation capacity we also say” (H) - “No in the beginning there were not enough local materials available, but now the amount of local materials is actually increasing we can say.” (H) - “Yes the Izmir hub is good, Izmir is close to our company, 2 hour drive, and there are 5 or 6 different plants from industrial companies nearby so it is easy to work with skilled people” (H) - “If more material is produced in Turkey, wind sector develops a lot. Because a lot of costs will decrease if it is so.”(I) - “Based on past industrial experience in Turkey, it was not that difficult to manufacture components of turbines or PV panels. We have tremendous industrial experience in various industries and once these industrial facilities understand the potential they can easily manufacture whatever is needed. Once they are shown the components and try manufacturing those, they have the ability to do the production efficiently.” (J)	network is good for the development of the region, and a local development agency is promoting these kind of successes in the news to promote the wind energy sector in the region to attract interest from investors. - This company only started with wind turbine tower production seven years ago and are now innovating and proposing new solutions to the market. This has been made possible through the protection offered by the LCR. - It is never good to have a single source for a certain material supply in a country, because that is more expensive. - A local tower manufacturer is trying to gain competitive advantage by proposing new solutions to the market and innovating - Turkish material suppliers are poor. - The local steel mill in Turkey, providing the steel plates for tower production, is a problem because it does not have competition and can also not cover all of the demand. This results in a quality and a	from the OEMs have easy access to the OEMs production networks and are therefore important for the development of the region.

		price issue for tower manufacturers who have to buy from this teel mill. - One of the bad things about local content requirements in turkey is the high price and low quality of local materials. - Even if there is not specific financial incentive for tower internals, this company is utilizing an aggressive strategy because the government incentives have a positive effect on the sector as a whole, and thus a company working on tower internals still benefits indirectly. Due to these incentives a local manufacturing sector is being established and therefore companies for all different parts are in demand. - Turkey has a good industrial base and this has been beneficial for the development of a local wind turbine manufacturing sector. - Turkey has good adaptation capacity, that is, the capacity to adapt to new situations and to switch focus from one sector to the other. - In the beginning the amount of local materials was not enough, but currently the	

		amount of local materials is increasing. - In Izmir there are multiple industrial plants nearby and therefore it is easy for this company to work with skilled people. - Increasing the domestic wind turbine production capacity will be beneficial because this will bring the costs down and make the sector more competitive internationally. - The industrial experience and pre-existing knowledge in Turkey has helped in a swift and easy start to the domestic manufacturing of wind turbine components.	

Appendix IVc, Governance matrix

Governance	Quote	Interpretation	Overall finding
Role of the state	- “Ren energy strategy by government, that is why people saw interest and turkey has heavy industry, a lot of sub-contractors, learning capability is high, save money on transport” (A) - “Minister of trade saw benefit, then they open doors” (A) - “In 2007, renewable energy law guarantees wind generators with 10-year agreements involving a fixed tariff. In addition, the law also reduced costs for land access, generation and licenses as well as exemption from VAT or customs taxes for wind equipment, in an effort to encourage investors to invest in wind energy.” (A) - “In 2010 the principles of “wind power plant supporting mechanism” were determined and the amended - law changed the feed-in tariffs for each source of renewable energy.” (B) - “In 2016, the ministry of Energy and Natural Resources issued a Regulation on Renewable Energy Resource Zones. This regulation introduced an investment model to support investments in renewable energy instruments and to incentivize local manufacturing of renewable generation assets. The main goals of this regulation have been to commission renewable energy resources more efficiently, to realize the renewable energy investments more rapidly, to use locally manufactured equipment and components and to contribute to research and development through technology transfer” (B) - “"As said, in 2010 the governments, the ministry made an amendment in the incentive mechanism and they introduced an incentive mechanism with the local content requirements.” (C) - “The protection of local content policies from outside of turkey. As you know China is competitors, so local content can protect, that is the main benefits.” (G)	- Interest was drawn to manufacturing wind turbine components in Turkey by the government’s renewable energy, moreover investors liked the fact that learning capability in Turkey is high and that they could save money on transport through local production. - It was only after the minister of trade saw the financial benefits of renewable energy that they opened up the sector to international investors. - In an effort to encourage investors to invest in wind energy in Turkey a purchase guarantee is provided by the government as well as several other financial incentives. - In 2010 the REL was amended to include new FIT rates - In 2016 the YEKA mechanism was introduced, a large-capacity tender for wind energy resource zones in order to speed up investments in wind energy and contribute to research and development through technology transfer. - In 2010 the REL was amended and the LCR was introduced as a premium on top of the FIT. - The main benefit of LCR policy is the protection it offers from foreign competition.	- The government’s strategy is focused on increasing the amount of domestically generated wind energy to be able to subsequently offer public procurement of this domestic wind energy in order to help stabilize the balance of payments. - Two other main goals of the LCR is to support an inward flow of knowledge and to develop a labour force in the manufacturing of wind turbines. - In 2010 the REL was amended to include a local

	- "But main goal of government decreasing foreign dependency on energy" (H) - "First, like other renewable domestic resources in terms of ability to use its own resources for the reduction of Turkey's dependence on foreign wind it is also important. The more our country uses its resources for energy, the less it will need imported fuels, primarily natural gas. In this context, the government has put in place the YEKDEM mechanism that guarantees purchases to the wind. This mechanism will expire at the end of 2020. Work on a new mechanism by the state continues. It is thought that the sector, which has reached this level with the private sector and public cooperation so far, will gain momentum once the new mechanism is announced." (J) - "The main goal of the local content policy is transferring know-how to our country and be independent and develop labor force in the wind industry." (J) - "However, Turkish Govt was targeting higher localization with the growing component manufacturing capability in Turkey for renewable equipments, therefore YEKA mechanism was introduced." (J) - "The biggest added value to the country is that it has reduced the import of other resource types for energy" (J)	- The main aim the government has with this policy is to decrease energy dependency from foreign resources. - The YEKDEM mechanism was introduced to guarantee purchases for wind energy, as such the government can decrease energy dependency. This mechanism will expire at the end of 2020 and the state of working on a new mechanism. It is thought that the sector will gain momentum when this new mechanism is announced. - The main goal of LCR is to support an inward flow of knowledge, become independent from foreign energy resources and develop a labour force in the manufacturing of wind turbines. - The government was targeting higher amounts of localization than it was achieving through YEKDEM and therefore it introduced the YEKA mechanism. - The biggest value added through LCR is the decreased energy imports and dependency	content requirement as a premium on the FIT. - In 2016 the YEKA tendering scheme was introduced to speed up the localization of wind turbine component manufacturing.
Local governance (actors)	- "So by by this way, all the manufacturers, all the wind energy, these are now accumulated in the vicinity of Izmir. It's not that good because in the end it is scattered around the country and for sites across the country that. Instead of having an sort of diversified locations where we can send our components and we can somehow get use of the lower transport costs by this way. We always need to build our factories etc in the vicinity of Izmir" (C) - "Our factory is also Izmir, our R&D center is also in Izmir, so everything is in Izmir. And lots of tower suppliers are located in Izmir. So Izmir is a kind of hub	- A lot of manufacturers of wind turbine components are located in Izmir. One negative effect of this local accumulation is that the sector is not very diversified and is not spread out over the country. If this would have been the case, the company could save money on transport for example on projects in the eastern part of the country. - Izmir is seen as a hub for wind turbine component manufacturing,	- Izmir has developed into a hub for wind turbine component manufacturing, which is also thanks to the well-organized strategy employed by a local

	now, for wind energy, which is good, of course this must have some advantages. But these advantages, as said, if we have a site somewhere on the other site of turkey, than transport cost is much higher so that's why the other parts are not that much supported. So I think it should be somehow distributed over the country, I believe. It's better for the workforce and for the employment as well. For people living there as well, for them to have the benefit of wind energy." (C) - "And about organizational structure, we are coordinated by Ministry of industry and Technology. But in Regional level we have our own, how can I say, management system. We are somehow independent from the central government, but some dependencies about budget issues and some permits, but generally the decision-making process is made by made by the boards" (D) - "First of all creating some awareness, after that creating some market, and after that we are focusing on now attracting investors from abroad, from Germany, Denmark China also, which countries focusing on renewable energy equipment manufacturing" (D) - "So it's really important for us. And that's why we are trying to attract ….. to Izmir. Because you know that this is the pioneer Company, this is the main company, when ….. come, the rest of the supply chain from Europe, probably not all of that, but some of them will come and invest in Izmir. So, we are now following these developments from Denmark, from Germany and from Spain. We are now inviting some investors and they are now starting the process" (D) - "So around 2012, also, we sent an official letter to ministry and we said that please define renewable energy sector, generators and wind energy equipments in these priority areas and give some extra support for these manufacturing companies. They accepted and added the application as a wind turbine blades, generators and	However, some believe that the companies producing turbine components should be more spread out over the country, which would spread the advantages of having such a growing wind energy sector over the whole country. - A local development agency is coordinated by the Ministry of Industry and Technology but has its own independent decision making structure on a regional level. - The strategy of the development agency consists of three steps: creating awareness, creating a market, attracting investors from countries that are experienced with wind energy. - The local development agency tries to attract the pioneering OEMs to Turkey because they believe that when these companies come to Turkey, the rest of their supply chain would follow. - In 2012, the local development agency asked the ministry to define incentives for renewable energy. This request was granted and according to this representative, the government accordingly added the premium for local content production on top of the FIT.	development agency. - This local development agency has also had a role in the introduction of the LCR in Turkish renewable energy policy.

	renewable energy equipments they defined and not all of it. For example tower, we are giving some incentives, but not as high as a generator and blades. But blade and generator is given priority by the government. So there is also some applications like these. So incentives for the manufacturing companies in Turkey." (D)		
Role of the firm	- "Investors urged big suppliers to go to other countries" (A) - "this is our strategy, this is our localization strategy, to motivate suppliers or collaborators to come with us to Turkey." (C) - "We also have some agreements with our global suppliers to come to Turkey, build a factory, even. They will also build the factory. And then, yeah of course, apart from the factory built for the nacelle assemby, we build assembly for the components. Our goal, our global suppliers will also build a factory."(C) - "…..have given the order to their supply chain "let's come with us to Izmir, we need to produce together in Izmir". So apart from local companies, the FDI is coming in Izmir" (D) - "But on the other hand it decreases the European content, and when you do such kind of investment, financing always is important, and when you source the components from Europe, there are some export credits which has very good rates for the investment. So when you supply locally, it means that the eligible amount of the European source cheap credit will diminish, or will decrease. But on the other hand, your revenues is increasing in Turkey" (E) - "with this way, we want t to differentiate among global tower suppliers because they have various big factories all over the world, and we are trying to have a competitive advantage in this way, so by proposing new solutions and being innovative" (F)	- Investors urged the suppliers with which the OEMs have agreements to follow the OEMs into Turkey, in order to meet the LCRs. - Follower sourcing is recognized as the strategy employed by this OEM. - The suppliers with which the OEMs have agreements will come to Turkey when asked by the OEM. - The FDI is also coming to Izmir because the OEMs are utilizing this follower sourcing strategy. - By coming to Turkey and complying with the LCRs, it decreases the amount of eligible European export credits for the OEMs and their suppliers, so they will always look at what is the most financially attractive option. - This tower manufacturer shows signs of upgrading of the local sector, as it is explained that they are trying to differentiate among global tower suppliers by innovating and proposing new solutions, in order to gain a competitive advantage.	- Follower sourcing has occurred in the Turkish wind turbine component manufacturing sector, as OEMs ask their trusted suppliers to establish themselves in Izmir in order to meet the LCRs. - The upgrading of local firms' skills and capabilities has been confirmed, and shows that local firms are interested in increasing the competitiveness of the sector and exploiting the sector's opportunities.

Appendix V. MSc. Theses in the Field of Technology for Global Development

2021

21.03 Edwin van Leth: Local Content Requirements as a policy instrument to foster green industrialization in developing countries: The case of the Turkish wind turbine manufacturing sector

21.02: Julie Marchand: The introduction of electric cooking in Nepal: A gender and socio-technical transition perspective

21.01 Wout van Hemmen: Change agency by grassroots entrepreneurs: an exploration of the transformative impact on sustainable development in Sub Saharan Africa

2020

20.05: Attabik Awan: Darts for the renewables' bullseye? Sustainable business models in the electricity sector of Indonesia.

20.04: Henjo Jagtenberg: The local production of cleaner cookstoves: supporting the growth of stove producers in a local market context.

20.03: Sukrit Aravind Patil: Socio-technical feasibility analysis and assessment of resource recovery through anaerobic digestion from sludge at municipal scale wastewater treatments plants in Bangalore, India.

20.02: Wahyu Ardie Nugroho: Feasibility Study of Integrated Green Refinery in Indonesia.
20.01: Edda van Teeffelen: Circular economy in the global south: A multi-level perspective case study analysis of waste-to-briquettes emerging technology in sub-Saharan Africa.

2019

19.06: Mariana Tapia Gutierrez: Electricity access provision and then what? An investigation on the effects of electricity access in rural Mexico.

19.05: Nataraj Balasubramanian: Studying sustainability transitions achieved through cross-sector collaboration in underserved contexts.

19.04: Sasinipha Chucherd: Pathways towards sustainability: An analysis of Bangkok's public transportation system through sustainability assessment and niche explorations.

19.03: Paul Bierling: The potential of hybrid floating pv-hydropower plants in Vietnam. An energy justice perspective.

19.02: Tanai Potisat: Successful governance of mini-grids: A perspective from community-based island electrification in Thailand.

19.01: Merlijn Borneman: An investigation of the sustainability trade-offs of the cocoa supply chain connecting the Netherlands with the main and most interesting cocoa supplying countries (Ghana, Côte d'Ivoire and Ecuador) between circa 1975-2015.

2018

18.07: Jeroen van Hemmen: Governing rural waste - A case study of the implementation of the eight design principles to solid waste management in Bali.

18.06: Milou Derks: Challenges for sustainable performance of government initiated rural microgrids. Analysis of incentives and policy framework for Indonesia.

18.04: Dion Visser: Sorting it out: An analysis of waste management provisions and realities on Bali.

18.05: Jaara Bijvoet: Energy access for enterprises in developing countries. Exploring the role for renewable energy technologies to address the energy issues in Kenya.

18.03: Micky van Gemert: The Influence of contextual factors on "last-mile" distribution models for solar home system distributors in East Africa.

18.02: Santiago Angel Nieto: Barriers and solutions to scale up green microfinance, Insights from a case study in Colombia.

18.01: Mercedes Fuentes Velasco: Use of Mangrove Wood as a Raw Material for Renewable Energy; Case Study on a Small Island in Indonesia.

2017

17.08: Britte Bouchaut: Rural sanitation facilities and quality of life: A mixed methods analysis of the contribution of Safe Water Gardens to the quality of life in Bintan, Indonesia.

17.07: Benedicte van Houtert: Cultural differences hampering turning e-waste to gold in Africa: Intercultural cooperation for sustainable handling of e-waste in sub Saharan Africa.

17.06: Arturo Daniel Salinas Galvan: Drivers of stove stacking in the cooking system: A case study on the adoption of advanced clean cooking stoves in Northern Vietnam.

17.05: Muhammad Husni Mubarok: Capacities and accountabilities of stakeholders in Indonesia's rural electrification program. A view from Responsible Innovation and learning approaches.

17.04: Laura Wong Sagel: Women interaction with biogas technologies in rural areas. A case study in Narino and Huila, Colombia.

17.03: Jiayi Zeng: When micro-grids meet the central grid: The emergence of grid interconnection as innovation to address the reliability issue of rural electrification.

17.02: **Ana Gabriela Dávila Gavilanes:** Feasibility analysis of electric road transportation. Introduction in Santa Cruz, Galapagos Islands.

17.01 Ellen Hoefsloot: Buying into the Kenyan solar market; Exploring user perspectives on investing in solar electricity.

2016

16.05 Mutia Prabawati: Sustainability of rural electrification projects: Case study of private sector intervention in Indonesia.

16.04 Si Liu: Jatropha biofuel development in cultivation and processing In China from 2007 to 2012: A field study.

16.03 Rodrigo González López: Identifying enabling and hindering factors to design better business models for rural electrification: Rural Uganda case study.

16.02 Hasna Afifah: Evaluation of a state-sponsored rural electrification project in Indonesia: A case study of Pengantap Hamlet, West Nusa Tenggara and lessons from process and learning-based approaches.

16.01 Joaquin Corella Puente: Augmenting the SNM framework as a practical tool for sustainable innovation in the South. Design and implementation of technologies for small-scale farmers in Northern Mexico.

<u>2015</u>

15.03 Jonathan Rodriguez Polit: Exploration of the user-value of rural electrification through Solar Home Systems in Southwestern Uganda: A case study.

15.02 Mara van Welie: NGOs' transformative approaches. Exploring how Cordaid can contribute to a fundamental change of the sanitation system in urban informal settlements in low-income countries.

15.01 Peter Kuin: No view from nowhere; studying diverging stakeholders' framework to reduce conflict over water resources in Loitokitok

<u>2014</u>

14.06 Eric Gold: Minimizing implementation failure in rural energy projects in development. A Responsible Innovation approach.

14.05 Bipashyee Ghosh: Sustainability appraisal of emerging trajectories in solar photovoltaic and urban systems in India and Thailand. A multi-criteria mapping analysis.

14.04 Ariane Biemond: African cotton production in transition; requirements for achieving a breakthrough of sustainable cultivation in the Ethiopian cotton sector.

14.03 Iliana Lykissa: A socio-technical evaluation of Solar Home Systems in Uganda: A case study with SolarNow.

14.02 Benedikt Wirmer: A functional approach to guide sustainable innovations in the sanitation chain. Malawi.

14.01 Maro Roussou: The application of participatory methods to co-develop sustainable solutions for domestic hot water and filtration of grey water. Promotion of effective participation of an indigenous school in rural Mexico.

<u>2013</u>

13.07 Joep de Boer: Building a brickmakers' cooperative in Lubuk Alung, Indonesia; an analysis of justifications and conflict situations emerging in the process of building the cooperative.

13.06 Julian Vargas Talavera: Exploring the potential of small biodigesters for electricity production in developing countries. A multi-level analysis on possible adoption in Uganda and Bolivia.

13.05 Sander Dikken: Socio-economic assessment of niche opportunities for sustainable fish- and shellfish cultivation with micro algae. Cases in the Netherlands and Tanzania.

13.04 Joosje Oosterbaan: Housing towards prosperity: an actor-network analysis of the enactment of an urban redevelopment policy and grassroots vision in the Beetham, a neighbourhood of Port of Spain, Trinidad and Tobago.

13.03 Roché Mahomedradja: The role of expectations and the societal impact regarding the use of Jatropha as a biofuel feedstock: Insights from India in pursuit of a biodiesel industry.

13.02 Kristine van Tubergen: Partnering up in Base of Pyramid projects.

13.01 Martijn Pastoors: *Jatropha*mania: A multi-perspective evaluation of Jatropha initiatives in Tanzania and Lombok, Indonesia.

<u>2012</u>

12.07 Todo Hotma Tua Simarmata: Developing transition paths toward sustainable solar PV development for rural electrification in Indonesia.

12.06 Arina Schoonbeek: Sustainable Business Models: Analyzing the Activities of Renewable Energy Organizations for Poverty Reduction in Indonesia and the Great Lakes Region in Africa.

12.05 Harini Challapally: Clean Development Mechanism's (CDM) contribution to clean energy technology development in India.

12.04 Willem Giesbers: Dutch private sector-driven development cooperation policy. An institutional analysis.

12.03 Fernando Flores Gallegos: Social capital: the linking piece for a sustainable development puzzle? Mexico.

12.02 Frans van Herwijnen: Prepaid water in Namibia: Understanding the ongoing transition.

12.01 Lisanne Saes: Prepaid water in Namibia: The impact of prepaid household water meters on the inhabitants and the municipality of Otjiwarongo.

<u>2011</u>

11.04 Rosa Kuipers: Success factors for the logistics of human nutrients in urban areas for use in agriculture. Philippines/India.

11.03 Naomi Baan Hofman: Cultivating under contract. An actor-network perspective on the socio-technical shaping of farmers' practices in north India.

11.02 Jacqueline Kooij: Micro-hydropower in Indonesia. Reflecting on learning processes.

11.01 Bart Hellings: Using carbon credits for Social Entrepreneurship: A case study at Diligent Tanzania Ltd.

2010

10.06 Otto Maria Jandl: Barriers for the employment of floating invasive weeds for biogas production in local communities in West African developing countries.

10.05 Michiel Roks: Size and sustainability: The treatment of smallholders in sustainability certification of biomass for energy purposes. Tanzania.

10.04 Ishil Kahraman: Analyzing the barriers and opportunities for the Turkish PV Market.

10.03 Sanne Heijnen: The impact of small-scale renewable energy projects in least developed countries - a baseline study. Tanzania.

10.02 Souliman Nnafie: Assessing political responsibility of transnational advocacy networks through social network analysis. An empirical study

10.01 Suyash Jolly: Upscaling of niche experiments in PV solar energy for transition to sustainability in India.